Review of energy consumption data from EMIS and analysis of savings potentials for public sector buildings typical of local self-government units in Serbia

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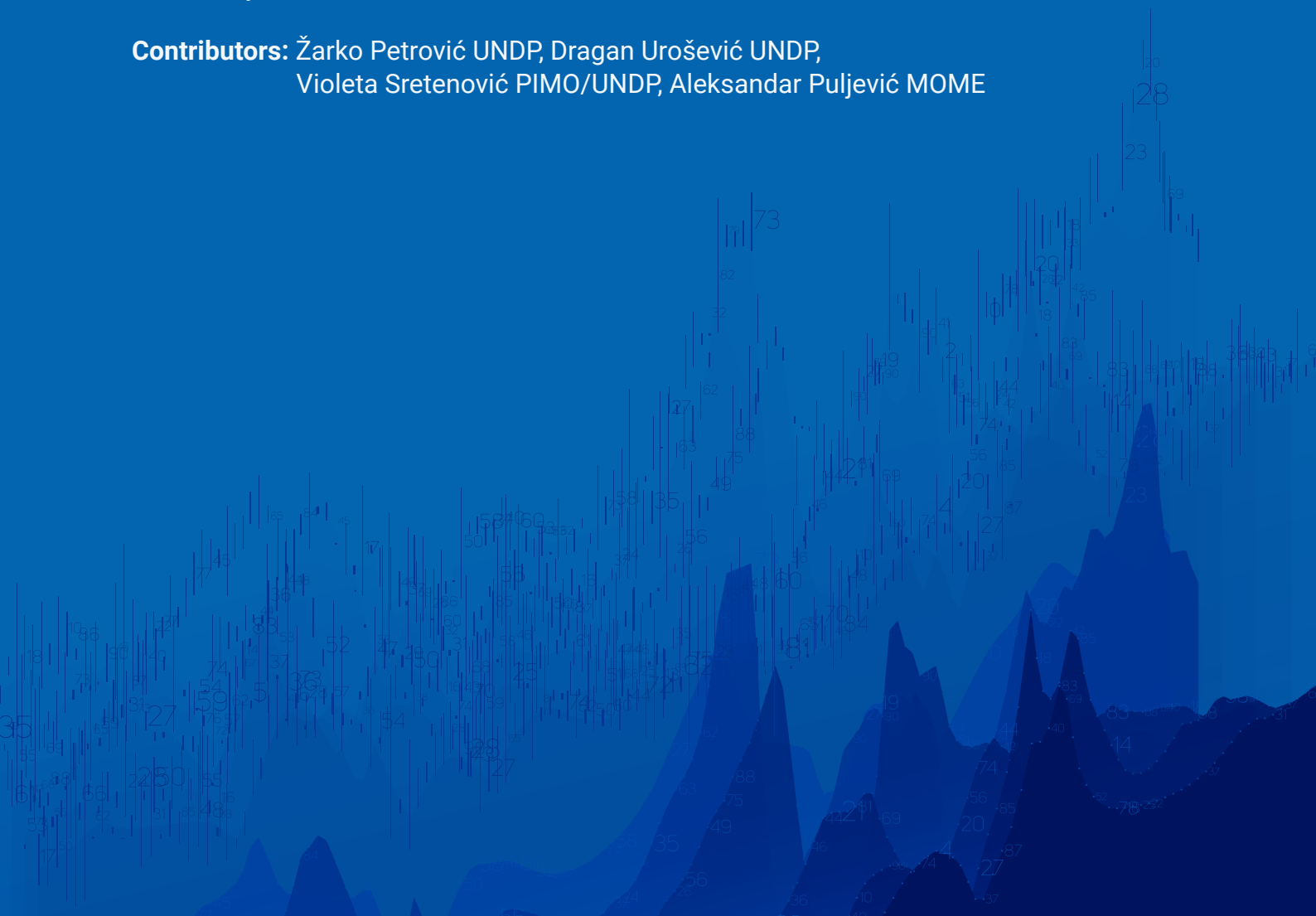
Contributors: Žarko Petrović UNDP, Dragan Urošević UNDP,
Violeta Sretenović PIMO/UNDP, Aleksandar Puljević MOME



CONTENTS

List of pictures

List of tables

List of abbreviations

UND	United Nations Development Programme
EMIS	Energy Management Information System (in Serbian: ISEM - Informacioni Sistem za Energetski Menadžment)
LSG	local self-government units
HDD	Heating degree day
NEEAP	National Energy Efficiency Action Plan
VAT	Value added tax
PIMO	Public Investment Management Office
MOME	Ministry of Mining and Energy
EPS	Expanded Polystyrene (type of insulation)
P_{br}	Gross area of the building
P_{net}	net area of the building
SPP	Simple payback period
NPV	Net present value

Executive summary

This analysis and report were prepared as part of an engagement under contract with the UNITED NATIONS DEVELOPMENT PROGRAMME (UNDP). The report shows the results of the analysis of the public buildings data sample sets that are available in the Energy Management Information System (EMIS) in Serbia as well as an analysis of the potentials for energy savings for individual buildings according to available technical documentation for buildings that were refurbished.

The purpose of the analysis and report was to determine the potentials for energy consumption and carbon emissions reductions in public buildings owned by municipalities in Serbia. The goal was also to determine the existing potential for investments and possible energy/financial savings taking into consideration the results of actual building energy refurbishment projects that have been implemented and future energy prices fluctuations.

The results of the analysis conducted can be summarized as follows.

Review of the energy consumption data sample available in EMIS

The selection of the data sample sets for analysis was conducted to be representative of local self-government units (LSG) of different sizes in Serbia, and took into consideration the number of inhabitants, the number of public buildings included, the energy source types, total energy consumption, the energy consumption profile and typology of the buildings with the goal to reach an analysis with conclusions and insights that are as objective as possible.

The analysis showed that representative LSGs can be grouped as follows:

- LSG Type 1 – 20.000 to 50.000
- LSG Type 2 – 50.000 to 100.000
- LSG Type 3 – 100.000 to 200.000
- LSG Type 4 – 200.000 to 400.000

It can be concluded that, in general, **educational institution buildings (primary schools, secondary schools and kindergartens) are responsible for the majority of costs in LSG-s** (50 to 90 % of energy and water costs) and should be the focus of programs and projects for energy efficiency improvements and energy management activities.

Taking into consideration the recent high fluctuations of energy costs across the region and entire EU, specifically the costs of natural gas and electricity but also all other energy types as well, the results of the analysis of the effect of 4 selected scenarios of price increases on the overall increase of energy costs for typical LSGs are shown to **average an increase in energy cost from 13-79%**.

Potentials for energy consumption and carbon emissions reductions in public buildings owned by municipalities in Serbia.

The analysis was conducted for a selected group of buildings that were renovated to improve energy efficiency through projects financed by the Budgetary Fund for energy efficiency and the Public Investment Management Office (PIMO). The buildings were selected to represent the major types of buildings that are usually under the jurisdiction of Municipalities. The types of building that are within this analysis include:

A -Educational institution buildings:	4 buildings;
B -Health care facilities:	1 building;
D - Cultural institution facilities:	2 buildings
F - Administrative facilities:	2 building
I - Public companies (JP) and Public utility companies (JKP) facilities:	1 building

The analysis was conducted using the data available in the Energy Management Information System - EMIS using the system generated for "Energy consumption reports". The available data was analyzed to determine the amounts of actual energy savings resulting from the implementation of energy efficiency improvement measures. For the group of buildings analyzed, the data from available technical building refurbishment documentation was used as well to confirm the scope of the implemented improvement measures and confirm the technical details about the buildings and implemented measures.

More details about the types of buildings that were the basis for the analysis can be found in Part II of this report.

The analysis of the actual energy consumption data after reconstruction that were available in EMIS confirmed that the implementation of energy renovation projects of individual buildings resulted in annual energy and CO_2 savings.

The average calculated annual energy savings potential of building renovation projects are:

- Average building **net area**: **1.838,55 m²**
- **Average electrical energy** savings per building: **36,56% or 16.023 kWh**
- **Average heating energy** savings per building: **37,73% or 100.906 kWh**
- **Average CO_2 reduction** for electricity and heating per building: **39,91 [t CO_2] or 21,71 [kg CO_2/m²]**

The average annual electrical energy savings amount to the average annual electrical consumption of 4 households or 10 people in Serbia.

The average annual heating energy savings amount to the average annual heating consumption of 11 households in Serbia.

Existing potential for investments and possible energy/financial savings

Within Part III of the report (Financial analysis – Energy savings potential of building renovation projects), a financial analysis of energy savings potentials for reconstruction of municipal buildings was conducted. The financial analysis performed included the calculation of a Simple payback period (SPP) of the implemented reconstruction projects as well as a Net present value (NPV) calculation.

The results SPP calculation

The available data from 4 typical buildings were used to calculate the general investment and savings potential. The data in table 54 shows a Summary overview of the actual energy savings and simple payback period after building renovation – for the calculation of investments and savings potential.

The range of SPP for the energy refurbishment projects is **from 13,76 to 17,07 years**.

The results of the NPV calculation

The average calculated data of energy savings potentials as well as for the average costs of building renovation projects derived from the table above, and used for the NPV calculation are:

- building net area: 1.502 m^2
- electrical energy savings: 15,57% or 3.985 kWh
- heating energy savings: 49,52% or 162.675 kWh
- CO_2 reduction for Electricity and Heating: 51,80 [t CO_2] or 34,50 [kg CO_2/m^2]
- average cost of reconstruction
  - 14.608.565 RSD (124.173 €) / building
  - 9.729 RSD (83 €) / m^2

The NPV calculation was conducted using the discount rate of 4%, and the NPV was calculated for a period of 20 years, as this aligns with the annual depreciation rate of 5% that is used according to the usual amortization life for taxation purposes of buildings as a group of fixed assets.

The results show that, with the increase of current fuel prices of 40%, the investments in building refurbishment have a positive NPV.

The total available investment potential based on 3.000 buildings is: **43.825.693.518 RSD** (**372.518.395 €**) and the total reconstructed net area would add up to **4.504.613 m²**.

The potential total annual energy savings (heating and electricity) would be **499.978.313 kWh** with a CO_2 reduction of **155.402 t CO_2**.

This potential would amount to the entire annual electricity production of the Thermal Power Plant Morava (108 MW installed capacity) in 2022.

The total investment and savings potential for these 3.000 buildings are shown in the table below.

Scen.	Fuel price increase	SPP	Total annual energy and CO_2 savings (VAT incl.)
0	0 %	15,50	2.827.728.117 RSD / 24.035.689 €
1	21 %	13,47	3.254.351.703 RSD / 27.661.989 €
2	39 %	11,98	3.658.990.212 RSD / 31.101.417 €
3	61 %	10,48	4.181.901.716 RSD / 35.546.165 €
4	79 %	9,64	4.546.002.432 RSD / 38.641.021 €
5	179 %	6,75	6.493.393.583 RSD / 55.193.845 €

It can be concluded that the future programs for energy reconstruction of public buildings in Serbia should be focused primarily on the educational institution buildings (primary schools, secondary schools and kindergartens) that are responsible for 50 to 90 % of energy and water costs in typical Local Self Government Units.

The programs of public building energy reconstruction would yield an acceptable Simple payback period of around 10 years if actual fuel prices increased by more than 60%, and this kind of price increase seems realistic and can be expected in Serbia.

A more detailed description of the main findings and conclusions of the performed analysis can be found in the last paragraph of the “Summary of the report and conclusions”.

Introduction

This report shows the results of the analysis of the public buildings data sample sets that are available in the Energy Management Information System (EMIS) in Serbia, as well as the analysis of the potential for energy savings for individual buildings, according to available technical documentation for building energy refurbishment.

The analysis is conducted to facilitate the determination of the potentials for energy consumption and carbon emissions reduction as well as the volume of possible energy/financial savings. The analysis takes into consideration energy price fluctuations for public buildings in Serbia, as well as the implementation of low-cost energy performance improvement projects and full-size buildings energy reconstruction projects.

The EMIS application that is actively being used in Serbia facilitates the energy management process for public sector buildings and provides access to data for energy planning and decision making on public investments in energy efficiency projects. To date, there are over 10,000 structures in EMIS, from which a credible sample of buildings and data could be extrapolated to perform the initial analysis of energy performance at the city level.

The selection of the data sample sets for this analysis was designed to be representative of local self-government units (LSG) in Serbia of various sizes. The typical LSG levels were selected depending on the availability and quality of the data in EMIS, the number of buildings included, the total energy consumption, diversity of energy source types and the number of inhabitants.

The focus of the study is on the building sector as it is one of the key areas where high energy cost-related savings can be achieved through the application of several financial instruments (guarantee facilities, energy performance contracts, on-tax and on-bill financing and similar approaches) that can lead to high renovation rates of both private and public buildings.

The building stock in Serbia (residential, public and commercial) is quite large and is responsible for 45 percent of final energy use. It consists of roughly 245 million square meters (m^2) of gross floor area, including an estimated 2.2 million residential buildings and 15,000 public facilities. About 15 percent of this stock was built between 1918 and 1941 or earlier, and about 32 percent was constructed between 1945 and 1970—making about half of the building stock over 50 years old. About 41 percent of the public building area (~11 million m2) are in the education sector, 14 percent (4 million m^2) in the health sector and the remaining 44 percent (~1,641, 4 million m^2) in administrative and other public buildings[1]. So, the potential for energy savings and the reduction of carbon emissions in the building sector, and especially in public buildings, in Serbia is significant.

[1] The available statistical data on the existing building stock is incomplete, particularly for the public and commercial sectors. The above figures are based on a World Bank study: Options for the Implementation of an Energy Efficiency Program in the Public Buildings Sector in Serbia (November 2013), relying on data from the Statistical Office of the Republic of Serbia (SORS), the central government and public utilities, and on Energy Savings International (ENSI) 2012, Energy Efficiency in Buildings in the Contracting Parties of the Energy Community, Study for the Energy Community, Draft Final Report 1.02.2012.

Cities in Serbia

Cities in Serbia are territorial units established by the Law on the Territorial Organization of the Republic of Serbia, which represent the economic, administrative, geographical, and cultural centers of a wider area and have more than 100,000 inhabitants.

The cities of the Republic of Serbia, according to this law, are listed by the number of inhabitants according to the 2011 census:

Table 1 List of Cities in republic of Serbia

Name of the City	Inhabitants in the wider area (2011 census)	Area (km²)
Belgrade	1,659,440	3.234
Novi Sad	341.625	699
Niš	260.237	596
Priština	198.897	572
Kragujevac	179.417	835
Leskovac	144.206	1.025
Subotica	141.554	1.007
Kruševac	128.752	854
Kraljevo	125.488	1.530
Pančevo	123.414	756
Zrenjanjn	123.362	1.327
Šabac	115.884	797
Čačak	115.337	636
Smederevo	108.209	484
Novi Pazar	100.410	742
Valjevo	90.312	905
Sombor	85.903	1.216
Vranje	83.524	860
Sremska Mitrovica	79.940	762
Loznica	79.327	612
Užice	78.040	667
Požarevac	75.334	477
Jagodina	71.852	470
Zaječar	59.461	1.069
Kikinda	59.453	782
Pirot	57.928	1.232
Vršac	52.026	800
Bor	48.615	856
Prokuplje	44.419	759

According to the amendments to the Law on Territorial Organization of the Republic of Serbia adopted in June 2018, the Republic of Serbia has 28 cities, while the capital, Belgrade, has a special status.

Part I: Review of the energy consumption data sample available in EMIS

Energy management system in Serbia

The energy management system in the Republic of Serbia is defined by the Law on Efficient Use of Energy (The Official Gazette of RS, number 25/13). The Law prescribes the subjects of the energy management system, their powers, and obligations. The subjects include the Government of the Republic of Serbia, the ministry in charge of energy, designated parties of the energy management system, energy managers and energy auditors.

The ministry in charge of energy has the key legislative, operational and oversight role in implementing the energy management system as it defines regulations related to energy efficiency and monitors and controls the system's implementation.

The designated parties of the energy management system include companies that consume more energy than the quantity prescribed by the Government and the bodies of public administration and other authorities of the Republic of Serbia, the bodies of the autonomous provinces, and the bodies of units of local self-government with populations exceeding 20,000 and other public services which use publicly owned buildings.

The basic obligation of the designated parties is to appoint the necessary number of energy managers who successfully completed the training, passed the examination and received the relevant license issued by the ministry in charge of energy and to achieve the set energy savings targets prescribed by the Government through adoption of energy efficiency programs and plans, implementation of energy efficiency measures, monitoring of the results, regular performance of energy audits and regular submission of their reports on achieving the targets to the ministry in charge of energy.

The energy managers' obligatory trainings include practical trainings, exercises in the laboratory using measuring equipment and laboratory equipment as well as computer training to acquire the ability to use the Energy Management Information System (EMIS), and other specialized software tools.

The Energy management information system – EMIS (In Serbian: Informacioni Sistem za Energetski Menadžment - ISEM) is a software application that is used as a basic support tool for the energy management system in public and commercial buildings. The EMIS has been donated to the Republic of Serbia by the UNDP – United Nations Development Programme within the Project "Introducing an energy management system in public buildings in Serbia", implemented jointly by the Ministry of Mining and Energy of the Republic of Serbia and the UNDP.

Currently EMIS holds information for more than 10.800 structures (more than 7.100 individual buildings) and this data will be used to perform the analysis within this report.

Types of buildings in the Energy Management Information System (EMIS)

The buildings in EMIS are grouped into 10 general Building types, as follows:

1. A - Educational institution buildings
2. B - Health care facilities
3. C - Collective accommodation facilities
4. D - Cultural institution facilities
5. E - Sports facilities
6. F - Administrative facilities
7. G - Public transport facilities
8. H - Catering facilities
9. I - Public companies (JP) and Public utility companies (JKP) facilities
10. Z - Other

Each group is further divided as follows:

1. Educational institution buildings

A01 - Kindergartens and nursery	A06 - Special schools	A11 - Private secondary schools
A02 – Primary schools	A07 – N/A	A12 - Private primary and secondary schools
A03 - Secondary schools	A08 - Primary and Secondary schools	A13 - United schools
A04 - Higher schools	A09 - Primary and secondary schools with a dormitory	A99 - Educational institution buildings - Other
A05 - Faculties	A10 - Private primary schools	----

2. Health care facilities

B01 - Infirmaries	B04 - Hospitals	B07 - Pharmacies
B02 - Health centers	B05 - Inpatient units	B99 – Health facilities - Other
B03 - Clinics	B06 - Clinical centers	----

3. Collective accommodation facilities

C01 - Homes for the elderly	C04 - Correctional Homes	C99 – Collective accommodation facilities - Other
C02 - Student and pupil dormitories	C05 - Correctional institutions (KPZ)	----
C03 - Homes for neglected children	C06 – Barracks	----

4. Cultural institutions facilities

D01 - Houses of culture	D04 - Museums	D99 – Cultural institution facilities - Other
D02 - Cinemas	D05 - Libraries	----
D03 - Theaters	D06 - Cultural centers	----

5. Sports facilities

E01 - Sports centers	E04 - Sports halls	E99 – Sports facilities - Other
E02 – Outdoor Pools	E05 – Stadiums	----
E03 – Indoor Pools	E06 - Ice rinks	----

6. Administrative facilities

F01 - Local offices	F04 - State administration buildings	F07 - Centers for social work
F02 - Municipal administration buildings	F05 - Courts	F08 - Administrative buildings of organizations
F03 - City administration buildings	F06 - Police	F99 – Administrative facilities - Other

7. Public transport facilities

G01 - Bus stations	G03 - Airports	----
G02 - Railway stations	G99 – Public transport facilities - Other	----

8. Catering facilities

H01 - Kitchens	H04 - Motels	H99 – Catering facilities - Other
H02 - Restaurants	H05 - Hotels	----
H03 - Resorts	H06 - Hostels	----

9. Public companies (JP) and Public utility companies (JKP) facilities

I01 - Production facilities of JP and JKP	I03 - Transformer stations of JP or JKP	----
I02 - Administrative buildings of JP and JKP	I99 – JP and PUC facilities - Other	----

10. Other

FO - Fountains	*Kapela-10842* - Chapels	*Reflektori-10881* - Reflectors
Garaze-11310 - Garages	*OOB* - Open facilities - stages	*Semafori-10822* - Traffic lights-
JC - Public taps	*11308* - Sprinklers for watering	SO - Freestanding cabinets
JR - Public lighting	*Rasveta-10821* - Lighting	Z01 - Other

This division, above, of the building type groups has been used in the analysis performed as part of this report.

Methodology of the data review

The analysis presented below has been conducted following a review and systematization of the information on energy consumption for the public building sector in Serbia that are available in the Energy Management Information System and that is being operated and administered by UNDP.

The data sets of the actual energy and water consumption and cost that were selected for this analysis, were reviewed and selected in close cooperation with UNDP staff and experts. The data sets were selected taking into consideration the availability, completeness and quality of the data in EMIS, as well as how representative they were of the selected local self-government units (LSG). The criteria to determine the representativeness of LSG included the number of inhabitants, the number of public buildings, the energy source types, total energy consumption, its energy consumption profile and groups of the buildings in order to get analysis conclusions and insights that were as objective as possible. After initial data screening, in some cases the data were verified, clarified and/or corrected to increase the accuracy and usefulness of the analysis performed and conclusions made.

These data sample sets have been selected to represent four typical LSG and are grouped as follows:

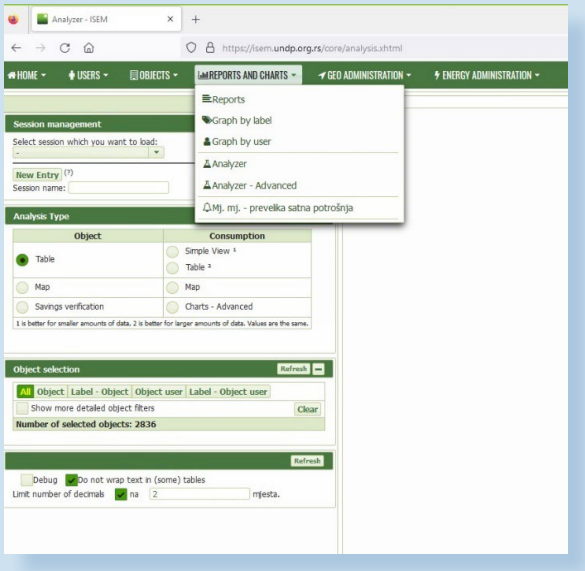
- LSG Type 1 – 20.000 to 50.000
- LSG Type 2– 50.000 to 100.000
- LSG Type 3 – 100.000 to 200.000
- LSG Type 4 – 200.000 to 400.000

The selected data sets include actual energy and water consumption and cost based on the available bills for water/electricity/fuel/heat that were collected and available in the EMIS for four consecutive years: 2018 to 2020.

Following the general data-set analysis, a sensitivity analysis was performed in order to estimate effects of the increase in energy prices on the LSG budgets due to the potential increase in prices for energy products (electricity, gas, petrol, heating oil, etc.) in future.

"EMIS Analyzer-Advanced" data export formatting and settings

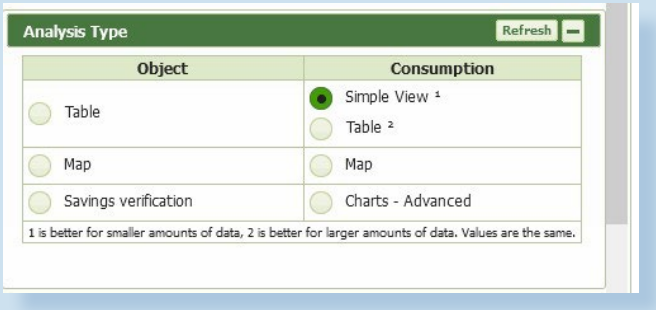
For data extraction from EMIS, the "EMIS Analyser – Advanced" functionality was used.



Picture 1. EMIS Analyzer – Advanced functionalities

The general "EMIS Analyzer – Advanced" functionality settings that were applied to extract the data are as follows:

Analysis type: In table "Consumption" ---> select "Simple View"



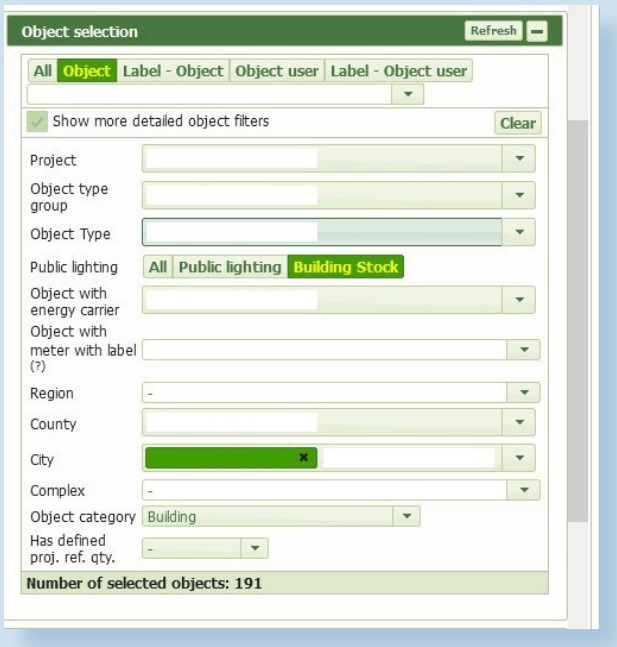
Picture 2. Analysis type settings

Object selection: Select Tab ---> “Object”

Select: “Building Stock”

Under City ---> Select targeted SLG unit: “City or Municipality”

Under Object category ---> Select: “Building”



Picture 3. Object selection settings

Consumption calculation: Calculation Method ---> “Bills - Objects”

Time interval ---> Sampling: “Year”; Interval “2018-2022”

Locked years ---> All

Under **“BILL_OBJ / Grouping”** the following types of reports for extraction were selected

Report 1 – selected “by energy carrier” --> Series

Report 2 – selected “by energy carrier” and “by object type group” --> Series

Report 3 – selected “by energy carrier” and “by object type” --> Series Time interval ---> Range: All; One value “2022”

Report 4 – selected “by object type group” and “by object type” --> Series

Picture 4. Consumption calculation settings

The total time frame that was selected for analysis is from 2018 until 2022.

The baseline energy consumption for the selected LSG was calculated as an average of the years 2018 to 2020.

The years 2021 and 2022 were not included in calculation of the baseline as these were the atypical due to COVID 19 pandemic restrictions. However, both years were included to show the most recent energy consumption. As for the year 2023, the data sets available in EMIS are still quite incomplete.

Following the setup of the settings in the EMIS Analyzer – advanced, described above, the data sets for each selected LSG were exported to XLS files, reviewed and analyzed. In the chapters below the results of the review and analysis are given, including comments regarding any observed deviations in the data.

Data review for LSG Type 1 – 20.000 to 50.000 inhabitants

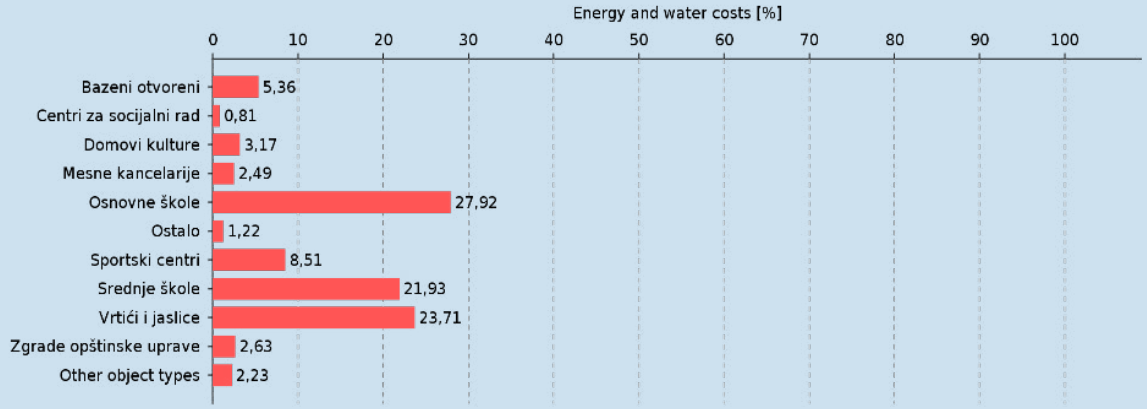
As part of the selection process of representative LSG with 20.000 to 50.000 inhabitants the available EMIS data for several candidates was analyzed. The analysis took into consideration the availability, completeness and quality of the data in EMIS, the number and types of public buildings according to its purpose (i.e. educational, social, health, etc.) and the energy source types.

The typical consumption of electricity and heat by energy source type for an LSG of this size is shown on two examples below:

Picture 5. Trends of total electricity and heat consumption for LSG Type 1

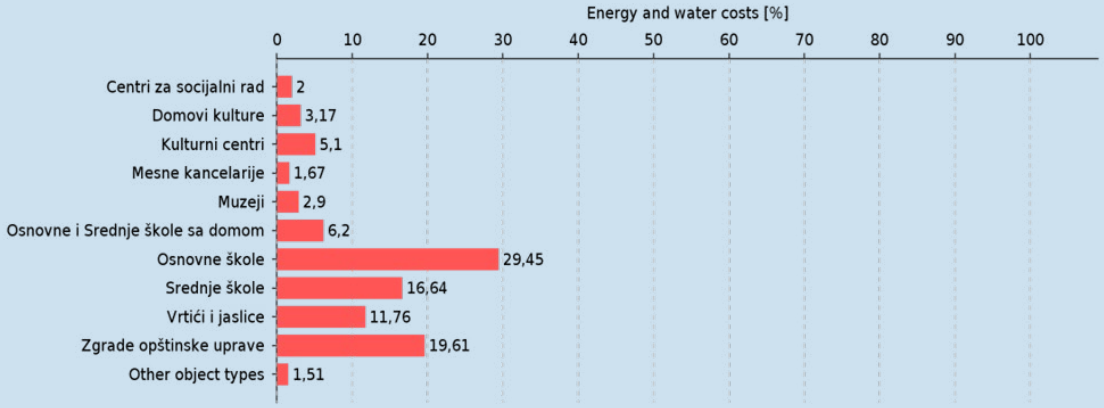
The typical types of buildings according to the purpose and their share in total cost of energy and water for the LSG of this size are shown in two examples below.

2022	Energy and water costs	
Object Type	[RSD]	[%]
Bazeni otvoreni	3.053.682	5,36
Centri za socijalni rad	461.939	0,81
Domovi kulture	1.807.163	3,17
Mesne kancelarije	1.416.312	2,49
Osnovne škole	15.897.915	27,92
Ostalo	694.919	1,22
Sportski centri	4.847.509	8,51
Srednje škole	12.488.786	21,93
Vrtići i jaslice	13.498.000	23,71
Zgrade opštinske uprave	1.499.564	2,63
Other object types	1.270.522	2,23



Picture 6. Typical types of buildings in LSG Type 1 according to the building purpose and their share in total cost of energy

2022	Energy and water costs	
Object Type	[RSD]	[%]
Centri za socijalni rad	760.884	2,00
Domovi kulture	1.206.512	3,17
Kulturni centri	1.944.887	5,10
Mesne kancelarije	634.953	1,67
Muzeji	1.104.618	2,90
Osnovne i Srednje škole sa domom	2.363.531	6,20
Osnovne škole	11.219.472	29,45
Srednje škole	6.338.365	16,64
Vrtići i jaslice	4.478.816	11,76
Zgrade opštinske uprave	7.470.677	19,61
Other object types	576.273	1,51



Picture 6. Typical types of buildings in LSG Type 1 according to the building purpose and their share in total cost of energy

An LSG of this size usually has between 80 and 150 buildings.

The energy consumption data sets for LSG Type 1 is shown below for the period from 2018 to 2022. The baseline consumption is calculated for the period from 2018 to 2020.

Table 2 Energy consumption in buildings: LSG Type 1 by energy source (carrier) - years 2018. to 2022.

Date	Year	Energy Source	Unit	Consumption	Energy [kWh]	Compared to baseline	Compared to previous year	Cost [RSD]	Cost + tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,00850	Emission CO_2[t]	Primary energy [kWh]	Number of objects	
BASELINE --> AVERAGE of 2018 to 2020															
		Electricity	kWh	1.049.414,67	1.049.414,67	-		11.718.707,68	15.072.576,70	14,36	0,12 €	1.180,48	3.238.318,25	88	
		District heating	kWh	113.663,33	113.663,33	-		47.589.955,20	52.348.950,72	460,56	3,91 €	35,52	193.402,35	8	
		Natural gas	Sm³	27.856,67	286.628,39	-		1.693.880,50	1.863.268,55	6,50	0,06 €	57,78	321.003,56	1	
		Brown coal	t	198,17	571.160,77	-		2.048.432,76	2.458.119,32	4,30	0,04 €	191,37	546.756,94	11	
		Firewood	m³	412,67	823.263,73	-		1.633.918,25	1.794.048,07	2,18	0,02 €	-	725.113,32	14	
		Wood pellet	t	23,17	114.270,85	-		475.852,89	523.438,18	4,58	0,04 €	-	117.947,40	4	
		Water	m³	20.186,95	-	-		7.638.607,26	8.401.428,63			-	-	50	
HDD -->	**2715,581**				**2.958.401,75**			**72.799.354,54**	**82.461.830,17**	**27,87**	**0,24 €**	**1.465,15**	**5.142.541,81**	**176**	
01.01.2018.	2018	Electricity	kWh	1.008.995,44	1.008.995,44	- 40.419,23		9.959.714,88	12.829.046,98	12,71	0,11 €	1108,89	3.041.919,45	68	
01.01.2018.	2018	District heating	kWh	70.630,00	70.630,00	- 43.033,33		27.173.671,56	29.891.038,72	**423,21**	**3,60 €**	20,27	110.359,38	7	#1
01.01.2018.	2018	Natural gas	Sm³	31.059,00	319.578,47	32.950,08		2.026.419,40	2.229.061,34	6,98	0,06 €	57,52	319.578,47	1	
01.01.2018.	2018	Brown coal	t	212,46	612.352,21	41.191,44		2.029.800,00	2.435.760,00	3,98	0,03 €	214,32	612.352,21	7	
01.01.2018.	2018	Firewood	m³	357,10	712.410,94	- 110.852,79		1.579.253,57	1.675.530,93	2,35	0,02 €	0	712.410,94	12	
01.01.2018.	2018	Wood pellet	t	9,25	45.622,85	- 68.648,00		205.456,44	226.002,08	4,95	0,04 €	0	45.622,85	3	
01.01.2018.	2018	Water	m³	17.743,01	-			6.662.150,94	7.327.472,81			0	-	45	
HDD -->	**2715,49**				**2.769.589,91**	**- 188.811,84**		**49.636.466,79**	**56.613.912,86**	**20,44**	**0,17 €**	**1.401,00**	**4.842.243,30**	**143**	

Observations: #1 - Very high energy price per kWh for district heating – For some buildings in EMIS the heat is charged by the building area (m²) in these cases only price for energy is entered, without consumption in kWh, thus increasing average price per kWh

01.01.2019.	2019	Electricity	kWh	1.080.870,94	1.080.870,94	31.456,27	71.875,50	11.598.686,90	14.926.026,45	13,81	0,12 €	1187,88	3.258.609,72	92	
01.01.2019.	2019	District heating	kWh	122.960,00	122.960,00	9.296,67	52.330,00	33.274.980,36	36.602.478,40	**297,68**	**2,53 €**	35,29	192.125,00	7	#2
01.01.2019.	2019	Natural gas	Sm³	26.838,00	276.146,92	- 10.481,47	- 43.431,55	1.489.730,22	1.638.703,24	5,93	0,05 €	49,71	276.146,92	1	
01.01.2019.	2019	Brown coal	t	155,41	447.930,71	- 123.230,06	- 164.421,50	1.804.924,28	2.165.909,14	4,84	0,04 €	156,78	447.930,71	11	
01.01.2019.	2019	Firewood	m³	388,03	774.113,44	- 49.150,29	61.702,50	2.088.966,43	2.346.463,07	3,03	0,03 €	0	774.113,44	15	
01.01.2019.	2019	Wood pellet	t	19,31	95.216,12	- 19.054,73	49.593,27	395.946,90	435.541,59	4,57	0,04 €	0	95.216,12	2	
01.01.2019.	2019	Water	m³	18.577,41	-			7.816.625,24	8.597.282,96			0	-	49	
HDD -->	**2652,531**				**2.797.238,13**	**- 161.163,62**	**27.648,22**	**58.469.860,33**	**66.712.404,85**	**23,85**	**0,20 €**	**1.429,66**	**5.044.141,91**	**177**	

Observations: #2 - More than 70% energy consumption increase compared to year before

01.01.2020.	2020	Electricity	kWh	1.058.377,64	1.058.377,64	8.962,97	- 22.493,30	11.528.179,68	14.814.794,13	14,00	0,12 €	1163,16	3.190.796,90	97	#3
01.01.2020.	2020	District heating	kWh	147.400,00	147.400,00	33.736,67	24.440,00	36.033.279,61	39.636.607,57	**268,91**	**2,29 €**	42,3	230.312,50	10	
01.01.2020.	2020	Natural gas	Sm³	25.673,00	264.159,77	- 22.468,62	- 11.987,15	1.300.887,09	1.430.975,80	5,42	0,05 €	47,55	264.159,77	1	#4
01.01.2020.	2020	Brown coal	t	226,63	653.199,39	82.038,62	205.268,68	2.559.476,77	3.071.372,12	4,70	0,04 €	228,62	653.199,39	12	#5
01.01.2020.	2020	Firewood	m³	492,87	983.266,81	160.003,08	209.153,37	1.961.713,44	2.157.884,79	2,19	0,02 €	0	983.266,81	16	#6
01.01.2020.	2020	Wood pellet	t	40,95	201.973,59	87.702,74	106.757,47	750.879,15	825.967,07	4,09	0,03 €	0	201.973,59	4	
01.01.2020.	2020	Water	m³	24.240,42	-			7.981.745,24	8.778.933,02			0	-	54	
HDD -->	**2778,722**				**3.308.377,20**	**349.975,45**	**511.139,07**	**62.116.160,98**	**70.716.534,50**	**21,37**	**0,18 €**	**1.481,63**	**5.523.708,96**	**194**	

Observations: #3- Increased building number (+5) & HDD-s --> decreased consumption? #4 - Increased HDD-s --> decreased consumption? #5 - Almost 50% consumption increase compared to year before --> STOCK? #6 - Almost 30% consumption increase compared to year before.[2]

[2] Regarding the increased consumption of solid energy sources (firewood, pellets, coal), usually the same facilities consume a combination of a couple or even several solid energy sources. So, from year to year the purchase of fuel differs in the combination and quantity purchased, so this influences the analysis. For example, a facility may get both coal and wood for 2018, then nothing 2019, then wood in 2020 and coal in 2021.

Table 2 Energy consumption in buildings: LSG Type 1 by energy source (carrier) - years 2018. to 2022. – continuation.

Date	Year	Energy Source	Unit	Consumption	Energy [kWh]	Compared to baseline	Compared to previous year	Cost [RSD]	Cost + tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,00850	Emission CO_2[t]	Primary energy [kWh]	Number of objects	
01.01.2021.	2021	Electricity	kWh	1.148.317,28	1.148.317,28	98.902,61	89.939,64	13.788.249,26	17.720.439,23	15,43	0,13 €	1262	3.461.946,92	96	
01.01.2021.	2021	District heating	kWh	154.120,00	154.120,00	40.456,67	6.720,00	93.877.889,27	103.265.678,20	670,03	5,70 €	44,23	240.812,50	8	
01.01.2021.	2021	Natural gas	Sm³	41.220,00	424.129,07	137.500,68	159.969,30	1.958.485,30	2.154.333,83	5,08	0,04 €	76,34	424.129,07	1	#7
01.01.2021.	2021	Brown coal	t	164,30	473.545,46	- 97.615,31	- 179.653,93	1.799.530,00	2.159.436,00	4,56	0,04 €	165,74	473.545,46	15	
01.01.2021.	2021	Firewood	m³	215,87	430.662,10	- 392.601,63	- 552.604,71	905.739,55	996.313,50	2,31	0,02 €	0	430.662,10	14	
01.01.2021.	2021	Wood pellet	t	26,15	128.977,03	14.706,18	- 72.996,56	551.129,05	606.241,96	4,70	0,04 €	0	128.977,03	5	
01.01.2021.	2021	Water	m³	19.450,85	-			8.093.907,63	8.902.025,74			0	-	51	
HDD -->	**2369,2**				**2.759.750,94**	**- 198.650,81**	**- 548.626,26**	**120.974.930,06**	**135.804.468,46**	**49,21**	**0,42 €**	**1.548,31**	**5.160.073,08**	**190**	

Observations: #7- More than 60% increased consumption compared to year before Observations: #8 - More than 360% increased consumption compared to year before

01.01.2022.	2022	Electricity	kWh	1.030.765,98	1.030.765,98	- 18.648,69	- 117.551,30	15.438.330,21	19.848.495,86	19,26	0,16 €	1.132,81	3.107.553,28	96	
01.01.2022.	2022	District heating	kWh	70.880,00	70.880,00	- 42.783,33	- 83.240,00	20.632.727,09	22.695.999,80	320,20	2,72 €	20,34	110.750,00	5	
01.01.2022.	2022	Natural gas	Sm³	150.263,72	1.546.123,53	1.259.495,14	1.121.994,46	1.963.158,61	2.159.474,48	1,40	0,01 €	278,30	1.546.123,53	1	#8
01.01.2022.	2022	Brown coal	t	143,10	412.442,82	- 158.717,95	- 61.102,64	1.885.340,00	2.262.408,00	5,49	0,05 €	144,35	412.442,82	8	
01.01.2022.	2022	Firewood	m³	133,20	265.734,00	- 557.529,73	- 164.928,10	842.509,20	926.760,12	3,49	0,03 €	0	265.734,00	2	
01.01.2022.	2022	Wood pellet	t	16,00	78.915,20	- 35.355,65	- 50.061,83	533.565,00	586.921,50	7,44	0,06 €	0	78.915,20	3	
01.01.2022.	2022	Water	m³	15.024,92	-			6.804.998,89	7.484.861,78			0	-	41	
HDD -->	**2560,4**				**3.404.861,53**	**446.459,78**	**645.110,59**	**48.100.629,00**	**55.964.921,54**	**16,44**	**0,14 €**	**1.575,80**	**5.521.518,83**	**156**	

During the analysis of the data sets for LSG Type 1, 10 observations were identified, and a deeper insight was conducted using EMIS data.

The follow up analysis was performed to clarify the identified observations and was based on the data sets from the Report 2 (based on energy consumption structured “by energy carrier” and “by object type”) and Report 3 (based on energy consumption structured “by energy carrier” and “by object type group”) extracted from EMIS Analyser. Below the data from these reports is shown.

In 2022 the representative LSG Type 1 included 99 buildings of different building types divided into 7 building type groups as follows:

- A) Educational institution buildings (50)
  - A01 - Kindergartens and nursery (6)
  - A02 - Primary schools (40)
  - A03 - Secondary schools (1)
- B) Health care facilities (2)
  - B01 – Infirmaries (2)
- C) Collective accommodation facilities (2)
  - C99 - Collective accommodation facilities – Other (2)
- D) Cultural institution facilities (6)
  - D01 - Houses of culture (3)
  - D05 – Libraries (3)
- E) Sports facilities (5)
  - E01 - Sports centers (3)
  - E02 – Outdoor Pools (2)
- F) Administrative facilities (26)
  - F01 - Local offices (19)
  - F02 - Municipal administration buildings (2)
  - F07 - Centers for social work (1)
  - F99 - Administrative facilities – Other (4)
- Other (8)
  - Z01 – Other (7)
  - Chapel (1)

The energy consumption per energy source / per building type group /per year is given below. Marked are the data that is missing or the data seems out of the usual expected range.

Table 3 Energy consumption: LSG Type 1 shown per energy source (carrier) / per building type group /per year 2018. – 2022.

Building type group: A) Educational institution buildings

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti obrazovnih institucija	Električna energija	kWh	676.567,03	676.567,03	6.643.357,43	8.563.188,59	12,66	0,11 €	743,55	2.039.714,29	53
01.01.2019.	2019	Objekti obrazovnih institucija	Električna energija	kWh	606.752,16	606.752,16	6.462.378,69	8.327.672,06	13,72	0,12 €	666,82	1.829.236,40	49
01.01.2020.	2020	Objekti obrazovnih institucija	Električna energija	kWh	509.254,19	509.254,19	5.688.594,41	7.327.335,78	14,39	0,12 €	559,67	1.535.299,53	53
01.01.2021.	2021	Objekti obrazovnih institucija	Električna energija	kWh	587.733,92	587.733,92	6.982.457,86	8.994.232,89	15,30	0,13 €	645,92	1.771.900,22	53
01.01.2022.	2022	Objekti obrazovnih institucija	Električna energija	kWh	504.424,28	504.424,28	7.502.112,93	9.665.247,97	19,16	0,16 €	554,36	1.520.738,33	48
01.01.2018.	2018	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	70.630,00	70.630,00	26.855.093,16	29.540.602,48	418,24	3,56 €	20,27	110.359,38	6
01.01.2019.	2019	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	122.960,00	122.960,00	32.956.401,96	36.252.042,16	294,83	2,51 €	35,29	192.125,00	6
01.01.2020.	2020	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	147.400,00	147.400,00	32.936.083,69	36.229.692,06	245,79	2,09 €	42,30	230.312,50	7
01.01.2021.	2021	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	154.120,00	154.120,00	93.554.808,51	102.910.289,36	667,73	5,68 €	44,23	240.812,50	7
01.01.2022.	2022	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	70.880,00	70.880,00	20.352.237,23	22.387.460,96	315,85	2,68 €	20,34	110.750,00	4
01.01.2018.	2018	Objekti obrazovnih institucija	Mrki ugalj	t	212,46	612.352,21	2.029.800,00	2.435.760,00	3,98	0,03 €	214,32	612.352,21	7
01.01.2019.	2019	Objekti obrazovnih institucija	Mrki ugalj	t	155,41	447.930,71	1.804.924,28	2.165.909,14	4,84	0,04 €	156,78	447.930,71	11
01.01.2020.	2020	Objekti obrazovnih institucija	Mrki ugalj	t	226,63	653.199,39	2.559.476,77	3.071.372,12	4,70	0,04 €	228,62	653.199,39	12
01.01.2021.	2021	Objekti obrazovnih institucija	Mrki ugalj	t	164,30	473.545,46	1.799.530,00	2.159.436,00	4,56	0,04 €	165,74	473.545,46	15
01.01.2022.	2022	Objekti obrazovnih institucija	Mrki ugalj	t	143,10	412.442,82	1.885.340,00	2.262.408,00	5,49	0,05 €	144,35	412.442,82	8
01.01.2018.	2018	Objekti obrazovnih institucija	Ogrevno drvo	m³	357,10	712.410,94	1.579.253,57	1.675.530,93	2,35	0,02 €	-	712.410,94	12
01.01.2019.	2019	Objekti obrazovnih institucija	Ogrevno drvo	m³	388,03	774.113,44	2.088.966,43	2.346.463,07	3,03	0,03 €	-	774.113,44	15
01.01.2020.	2020	Objekti obrazovnih institucija	Ogrevno drvo	m³	492,87	983.266,81	1.961.713,44	2.157.884,79	2,19	0,02 €	-	983.266,81	16
01.01.2021.	2021	Objekti obrazovnih institucija	Ogrevno drvo	m³	215,87	430.662,10	905.739,55	996.313,50	2,31	0,02 €	-	430.662,10	14
01.01.2022.	2022	Objekti obrazovnih institucija	Ogrevno drvo	m³	133,20	265.734,00	842.509,20	926.760,12	3,49	0,03 €	-	265.734,00	2
01.01.2018.	2018	Objekti obrazovnih institucija	Drvni Pelet	t	9,25	45.622,85	205.456,44	226.002,08	4,95	0,04 €	-	45.622,85	3
01.01.2019.	2019	Objekti obrazovnih institucija	Drvni Pelet	t	19,31	95.216,12	395.946,90	435.541,59	4,57	0,04 €	-	95.216,12	2
01.01.2020.	2020	Objekti obrazovnih institucija	Drvni Pelet	t	40,95	201.973,59	750.879,15	825.967,07	4,09	0,03 €	-	201.973,59	4
01.01.2021.	2021	Objekti obrazovnih institucija	Drvni Pelet	t	26,15	128.977,03	551.129,05	606.241,96	4,70	0,04 €	-	128.977,03	5
01.01.2022.	2022	Objekti obrazovnih institucija	Drvni Pelet	t	16,00	78.915,20	533.565,00	586.921,50	7,44	0,06 €	-	78.915,20	3
01.01.2018.	2018	Objekti obrazovnih institucija	Voda	m³	13.147,57	-	5.301.668,60	5.831.054,34			-	-	40
01.01.2019.	2019	Objekti obrazovnih institucija	Voda	m³	14.128,61	-	6.482.625,17	7.130.051,26			-	-	41
01.01.2020.	2020	Objekti obrazovnih institucija	Voda	m³	9.026,30	-	5.859.908,52	6.445.434,27			-	-	44
01.01.2021.	2021	Objekti obrazovnih institucija	Voda	m³	10.075,61	-	6.148.642,10	6.762.851,98			-	-	44
01.01.2022.	2022	Objekti obrazovnih institucija	Voda	m³	8.346,23	-	4.992.921,82	5.492.030,95			-	-	35

Observation: High unit costs --> See explanation below (pg. 24)

Table 3 Energy consumption: LSG Type 1 shown per energy source (carrier) / per building type group /per year 2018. – 2022. – Continuation 1/3

Building type group: B) Health care facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2022.	2022	Zdravstvene ustanove	Električna energija	kWh	79,00	79,00	16.632,83	20.675,95	261,72	2,22 €	0,09	238,17	2

Observation: High unit costs --> wrong data input

Building type group: C) Collective accommodation facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti kolektivnog smeštaja	Električna energija	kWh	40,00	40,00	34.488,48	42.924,14	1.073,10	9,12 €	0,04	120,59	2
01.01.2019.	2019	Objekti kolektivnog smeštaja	Električna energija	kWh			37.059,08	45.509,41					2
01.01.2020.	2020	Objekti kolektivnog smeštaja	Električna energija	kWh	3,00	3,00	35.385,99	43.281,52	14.427,17	122,63 €	-	9,04	2
01.01.2021.	2021	Objekti kolektivnog smeštaja	Električna energija	kWh	-	-	42.381,65	51.550,76			-	-	2
01.01.2022.	2022	Objekti kolektivnog smeštaja	Električna energija	kWh	0,15	0,15	43.148,78	52.626,69	350.844,60	2.982,18 €	-	0,45	2

Observation: **High unit costs --> wrong data input**

Building type group: D) Cultural institution facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti institucija kulture	Električna energija	kWh	99.600,00	99.600,00	868.009,77	1.119.254,10	11,24	0,10 €	109,46	300.274,08	3
01.01.2019.	2019	Objekti institucija kulture	Električna energija	kWh	95.156,54	95.156,54	905.359,30	1.166.250,16	12,26	0,10 €	104,58	286.877,95	5
01.01.2020.	2020	Objekti institucija kulture	Električna energija	kWh	106.406,97	106.406,97	1.060.676,50	1.362.657,65	12,81	0,11 €	116,94	320.795,72	5
01.01.2021.	2021	Objekti institucija kulture	Električna energija	kWh	116.235,49	116.235,49	1.328.425,05	1.707.047,88	14,69	0,12 €	127,74	350.426,75	5
01.01.2022.	2022	Objekti institucija kulture	Električna energija	kWh	105.249,55	105.249,55	1.491.765,22	1.917.703,26	18,22	0,15 €	115,67	317.306,34	5
01.01.2018.	2018	Objekti institucija kulture	Voda	m³	176,00	-	92.385,84	101.612,81			-	-	2
01.01.2019.	2019	Objekti institucija kulture	Voda	m³	831,00	-	189.349,93	208.230,47			-	-	4
01.01.2020.	2020	Objekti institucija kulture	Voda	m³	656,00	-	169.013,21	185.880,11			-	-	3
01.01.2021.	2021	Objekti institucija kulture	Voda	m³	642,00	-	165.238,20	181.722,89			-	-	4
01.01.2022.	2022	Objekti institucija kulture	Voda	m³	596,94	-	179.334,96	197.228,09			-	-	3

Table 3 Energy consumption: LSG Type 1 shown per energy source (carrier) / per building type group /per year 2018. – 2022. – Continuation 2/3

Building type group: E) Sports facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Sportski objekti	Električna energija	kWh	212.579,41	212.579,41	2.220.461,83	2.862.421,96	13,47	0,11 €	233,62	640.884,39	5
01.01.2019.	2019	Sportski objekti	Električna energija	kWh	228.036,59	228.036,59	2.596.697,52	3.345.928,02	14,67	0,12 €	250,61	687.484,72	5
01.01.2020.	2020	Sportski objekti	Električna energija	kWh	187.500,00	187.500,00	2.088.867,33	2.690.201,85	14,35	0,12 €	206,06	565.275,00	5
01.01.2021.	2021	Sportski objekti	Električna energija	kWh	195.687,00	195.687,00	2.443.503,52	3.146.842,99	16,08	0,14 €	215,06	589.957,17	5
01.01.2022.	2022	Sportski objekti	Električna energija	kWh	206.604,00	206.604,00	3.110.036,22	4.006.744,12	19,39	0,16 €	227,06	622.869,74	5
01.01.2018.	2018	Sportski objekti	Prirodni gas	Sm³	31.059,00	319.578,47	2.026.419,40	2.229.061,34	6,98	0,06 €	57,52	319.578,47	1
01.01.2019.	2019	Sportski objekti	Prirodni gas	Sm³	26.838,00	276.146,92	1.489.730,22	1.638.703,24	5,93	0,05 €	49,71	276.146,92	1
01.01.2020.	2020	Sportski objekti	Prirodni gas	Sm³	25.673,00	264.159,77	1.300.887,09	1.430.975,80	5,42	0,05 €	47,55	264.159,77	1
01.01.2021.	2021	Sportski objekti	Prirodni gas	Sm³	41.220,00	424.129,07	1.958.485,30	2.154.333,83	5,08	0,04 €	76,34	424.129,07	1
01.01.2022.	2022	Sportski objekti	Prirodni gas	Sm³	150.263,72	1.546.123,53	1.963.158,61	2.159.474,48	1,40	0,01 €	278,30	1.546.123,53	1
01.01.2018.	2018	Sportski objekti	Voda	m³	4.352,00	-	1.221.270,90	1.343.301,96			-	-	1
01.01.2019.	2019	Sportski objekti	Voda	m³	3.547,00	-	1.093.446,97	1.202.682,43			-	-	2
01.01.2020.	2020	Sportski objekti	Voda	m³	4.828,00	-	1.187.288,38	1.305.710,22			-	-	2
01.01.2021.	2021	Sportski objekti	Voda	m³	8.661,00	-	1.730.866,38	1.903.378,62			-	-	2
01.01.2022.	2022	Sportski objekti	Voda	m³	6.012,00	-	1.577.619,26	1.734.972,33			-	-	2

Building type group: F) Administrative facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Administrativni objekti	Električna energija	kWh	20.209,00	20.209,00	192.445,01	240.029,65	11,88	0,10 €	22,21	60.926,09	4
01.01.2019.	2019	Administrativni objekti	Električna energija	kWh	134.592,65	134.592,65	1.420.201,42	1.813.943,53	13,48	0,11 €	147,92	405.769,92	25
01.01.2020.	2020	Administrativni objekti	Električna energija	kWh	214.013,48	214.013,48	2.223.507,95	2.838.982,46	13,27	0,11 €	235,20	645.207,84	26
01.01.2021.	2021	Administrativni objekti	Električna energija	kWh	205.956,87	205.956,87	2.472.575,78	3.156.232,49	15,32	0,13 €	226,35	620.918,77	25
01.01.2022.	2022	Administrativni objekti	Električna energija	kWh	183.141,00	183.141,00	2.764.396,96	3.534.141,86	19,30	0,16 €	201,27	552.133,49	26

01.01.2018.	2018	Administrativni objekti	Daljinsko grejanje	kWh			318.578,40	350.436,24					1
01.01.2019.	2019	Administrativni objekti	Daljinsko grejanje	kWh			318.578,40	350.436,24					1
01.01.2020.	2020	Administrativni objekti	Daljinsko grejanje	kWh			3.097.195,92	3.406.915,51					3
01.01.2021.	2021	Administrativni objekti	Daljinsko grejanje	kWh			323.080,76	355.388,83					1
01.01.2022.	2022	Administrativni objekti	Daljinsko grejanje	kWh			280.489,86	308.538,85					1

Observation: Data about energy consumption missing --> heat consumption charged by lump sum

Table 3 Energy consumption: LSG Type 1 shown per energy source (carrier) / per building type group /per year 2018. – 2022. – Continuation 3/3

Building type group: F) Administrative facilities - continuation

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Administrativni objekti	Voda	m³	67,44	-	46.825,60	51.503,70			-	-	2
01.01.2019.	2019	Administrativni objekti	Voda	m³	70,80	-	51.203,17	56.318,80			-	-	2
01.01.2020.	2020	Administrativni objekti	Voda	m³	895,12	-	213.390,76	234.670,47			-	-	3
01.01.2021.	2021	Administrativni objekti	Voda	m³	72,24	-	49.160,96	54.072,26			-	-	1
01.01.2022.	2022	Administrativni objekti	Voda	m³	69,76	-	55.122,85	60.630,41			-	-	1

Building type group: Other

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Ostalo	Električna energija	kWh	-	-	952,37	1.228,55			-	-	1
01.01.2019.	2019	Ostalo	Električna energija	kWh	16.333,00	16.333,00	176.990,90	226.723,26	13,88	0,12 €	17,95	49.240,73	6
01.01.2020.	2020	Ostalo	Električna energija	kWh	41.200,00	41.200,00	431.147,49	552.334,87	13,41	0,11 €	45,28	124.209,76	6
01.01.2021.	2021	Ostalo	Električna energija	kWh	42.704,00	42.704,00	518.905,41	664.532,21	15,56	0,13 €	46,93	128.744,02	6
01.01.2022.	2022	Ostalo	Električna energija	kWh	31.268,00	31.268,00	510.237,28	651.356,00	20,83	0,18 €	34,36	94.266,77	8
01.01.2020.	2020	Ostalo	Voda	m³	8.835,00	-	552.144,36	607.237,95			-	-	2

Further analysis of energy consumption per object type (Report 3) disclosed the following:

The high unit cost of District heating energy (Observation #1) resulted from the fact that for some building types the energy consumption is not measured but is charged as a lump sum based on the useful area of the building (square meters).

Table 4 Details of district heating energy consumption for LSG Type 1 per Object type

Date	Year	Object Type Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Osnovne škole	Daljinsko grejanje	kWh			12.632.691,96	13.895.961,16					3
01.01.2018.	2018	Vrtići i jaslice	Daljinsko grejanje	kWh	70.630,00	70.630,00	6.233.068,80	6.856.375,68	97,07	0,83 €	20,27	110.359,38	2
01.01.2018.	2018	Centri za socijalni rad	Daljinsko grejanje	kWh			318.578,40	350.436,24					1
01.01.2018.	2018	Srednje škole	Daljinsko grejanje	kWh			7.989.332,40	8.788.265,64					1
01.01.2019.	2019	Vrtići i jaslice	Daljinsko grejanje	kWh	122.960,00	122.960,00	12.334.377,60	13.567.815,36	110,34	0,94 €	35,29	192.125,00	2
01.01.2019.	2019	Centri za socijalni rad	Daljinsko grejanje	kWh			318.578,40	350.436,24					1
01.01.2019.	2019	Osnovne škole	Daljinsko grejanje	kWh			12.632.691,96	13.895.961,16					3
01.01.2019.	2019	Srednje škole	Daljinsko grejanje	kWh			7.989.332,40	8.788.265,64					1
01.01.2020.	2020	Osnovne škole	Daljinsko grejanje	kWh			12.992.547,96	14.291.802,76					4
01.01.2020.	2020	Zgrade opštinske uprave	Daljinsko grejanje	kWh			2.722.169,52	2.994.386,47					1
01.01.2020.	2020	Centri za socijalni rad	Daljinsko grejanje	kWh			318.578,40	350.436,24					1
01.01.2020.	2020	Administrativni objekti - Ostalo	Daljinsko grejanje	kWh			56.448,00	62.092,80					1
01.01.2020.	2020	Srednje škole	Daljinsko grejanje	kWh			7.839.321,73	8.623.253,90					1
01.01.2020.	2020	Vrtići i jaslice	Daljinsko grejanje	kWh	147.400,00	147.400,00	12.104.214,00	13.314.635,40	90,33	0,77 €	42,30	230.312,50	2
01.01.2021.	2021	Centri za socijalni rad	Daljinsko grejanje	kWh			323.080,76	355.388,83					1
01.01.2021.	2021	Vrtići i jaslice	Daljinsko grejanje	kWh	154.120,00	154.120,00	72.042.151,81	79.246.366,99	514,19	4,37 €	44,23	240.812,50	2
01.01.2021.	2021	Srednje škole	Daljinsko grejanje	kWh			8.918.031,23	9.809.834,36					1
01.01.2021.	2021	Osnovne škole	Daljinsko grejanje	kWh			12.594.625,47	13.854.088,02					4
01.01.2022.	2022	Srednje škole	Daljinsko grejanje	kWh			8.399.899,62	9.239.889,58					1
01.01.2022.	2022	Osnovne škole	Daljinsko grejanje	kWh			5.132.610,06	5.645.871,07					2
01.01.2022.	2022	Vrtići i jaslice	Daljinsko grejanje	kWh	70.880,00	70.880,00	6.819.727,55	7.501.700,31	105,84	0,90 €	20,34	110.750,00	1
01.01.2022.	2022	Centri za socijalni rad	Daljinsko grejanje	kWh			280.489,86	308.538,85					1

Data review for LSG Type 2 – 50.000 to 100.000 inhabitants

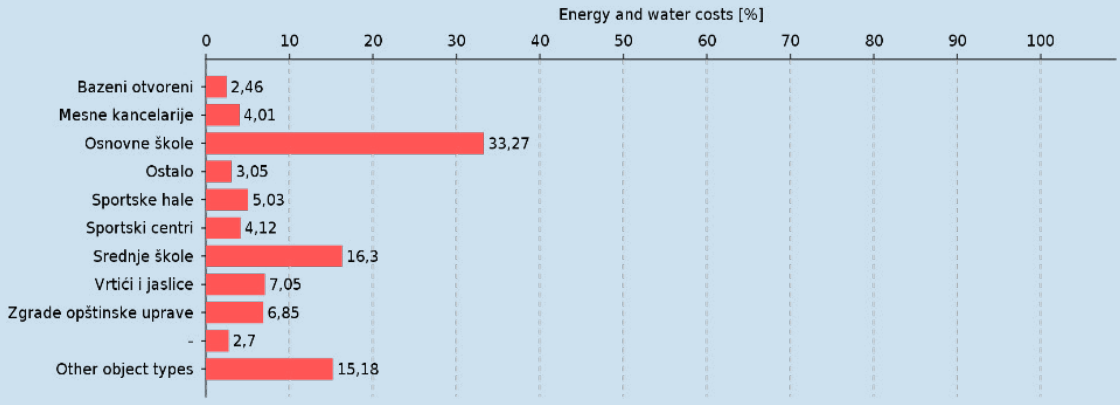
As part of the selection process for representative LSG with 50.000 to 100.000 inhabitants, the available EMIS data for several candidates was analyzed. The analysis took into consideration the availability, completeness and quality of the data in EMIS, the number and types of public buildings according to its purpose (i.e. educational, social, health, etc.) and the energy source types.

The typical consumption of electricity and heat by energy source type for the LSG of this size is shown in the two examples below:

Picture 7 Trends of total electricity and heat consumption for LSG Type 2

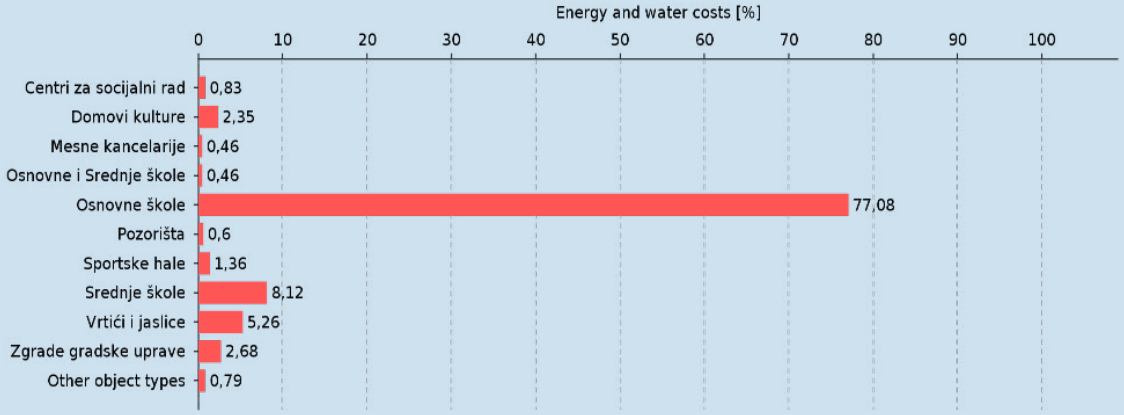
The typical types of buildings according to their purpose and share in total cost of energy and water for an LSG of this size are shown in two examples below:

2022	Energy and water costs	
Object Type	[RSD]	[%]
Bazeni otvoreni	2.275.729	2,46
Mesne kancelarije	3.707.236	4,01
Osnovne škole	30.773.507	33,27
Ostalo	2.817.182	3,05
Sportske hale	4.653.092	5,03
Sportski centri	3.813.931	4,12
Srednje škole	15.076.070	16,30
Vrtići i jaslice	6.519.863	7,05
Zgrade opštinske uprave	6.333.776	6,85
-	2.493.591	2,70
Other object types	14.040.722	15,18



Picture 8 Typical types of buildings in LSG Type 2 according to the building purpose and their share in total cost of energy

2022	Energy and water costs	
Object Type	[RSD]	[%]
Centri za socijalni rad	4.447.224	0,83
Domovi kulture	12.532.677	2,35
Mesne kancelarije	2.441.579	0,46
Osnovne i Srednje škole	2.469.278	0,46
Osnovne škole	411.338.669	77,08
Pozorišta	3.211.935	0,60
Sportske hale	7.232.787	1,36
Srednje škole	43.352.959	8,12
Vrtići i jaslice	28.092.700	5,26
Zgrade gradske uprave	14.321.461	2,68
Other object types	4.202.336	0,79



Picture 8 Typical types of buildings in LSG Type 2 according to the building purpose and their share in total cost of energy

An LSG of this size usually has between 100 and 250 buildings.

Below the display of the energy consumption data sets for LSG Type 2 is shown for the period from 2018 to 2022. The baseline consumption is calculated for the period from 2018 to 2020.

Table 5 Energy consumption in buildings: LSG Type 2 by energy source (carrier) - years 2018. to 2022.

Date	Year	Energy Source	Unit	Consumption	Energy [kWh]	Compared to baseline	Compared to previous year	Cost [RSD]	Cost + tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,00850	Emission CO_2[t]	Primary energy [kWh]	Number of objects	
BASELINE --> AVERAGE of 2018 to 2020															
		Electricity	kWh	1.432.362,25	1.432.362,25	-		21.138.098,31	27.166.325,13	18,97	0,16 €	1.574,17	4.318.285,72	93	
		District heating	kWh	926.640,33	926.640,33	-		10.925.255,60	12.015.677,24	12,97	0,11 €	265,95	1.447.875,52	4	
		Natural gas	Sm³	185.941,13	1.913.222,73	-		6.181.251,55	6.799.373,70	3,55	0,03 €	344,38	1.913.222,73	23	
		Brown coal	t	226,35	652.399,89	-		2.139.419,81	2.567.303,77	3,94	0,03 €	228,34	652.399,89	7	
		Firewood	m³	338,97	676.240,27	-		1.541.383,58	1.695.521,94	2,51	0,02 €	-	676.240,27	9	
		Wood pellet	t	63,16	311.534,19	-		1.338.855,33	1.472.740,87	4,73	0,04 €	-	311.534,19	2	
		Water	m³	14.543,38	-	-		2.338.740,83	2.588.144,01			-	-	59	
SDG -->	**2279,68**				**5.912.399,67**			**45.603.005,02**	**54.305.086,66**	**9,18**	**0,08 €**	**2.412,83**	**9.319.558,33**	**196**	
01.01.2018.	2018	Electricity	kWh	1.432.562,74	1.432.562,74	200,49		13.882.913,20	17.801.942,86	12,43	0,11 €	1.574,39	4.318.890,15	90	
01.01.2018.	2018	District heating	kWh	892.338,22	892.338,22	- 34.302,11		10.720.639,03	11.790.700,25	13,21	0,11 €	256,10	1.394.278,47	4	
01.01.2018.	2018	Natural gas	Sm³	180.984,28	1.862.219,69	- 51.003,04		6.017.150,21	6.618.865,23	3,55	0,03 €	335,20	1.862.219,69	22	
01.01.2018.	2018	Brown coal	t	360,51	1.039.067,11	386.667,22		3.458.066,11	4.149.679,33	3,99	0,03 €	363,67	1.039.067,11	10	
01.01.2018.	2018	Firewood	m³	340,68	679.654,50	3.414,23		1.768.324,84	1.945.157,32	2,86	0,02 €	-	679.654,50	11	
01.01.2018.	2018	Wood pellet	t	25,00	123.305,00	- 188.229,19		540.250,00	594.275,00	4,82	0,04 €	-	123.305,00	1	
01.01.2018.	2018	Water	m³	18.464,44	-			2.667.441,52	2.948.813,92			-	-	59	
SDG -->	**2310,81**				**6.029.147,26**	**116.747,59**		**39.054.784,91**	**45.849.433,91**	**7,60**	**0,06 €**	**2.529,36**	**9.417.414,92**	**197**	
01.01.2019.	2019	Electricity	kWh	1.469.505,36	1.469.505,36	37.143,11	36.942,62	16.309.178,82	20.977.789,59	14,28	0,12 €	1.614,99	4.430.264,77	91	
01.01.2019.	2019	District heating	kWh	959.327,78	959.327,78	32.687,45	66.989,56	11.165.525,69	12.280.291,01	12,80	0,11 €	275,33	1.498.949,65	4	#1
01.01.2019.	2019	Natural gas	Sm³	173.571,31	1.785.944,66	- 127.278,07	- 76.275,03	5.771.253,09	6.348.371,71	3,55	0,03 €	321,47	1.785.944,66	22	
01.01.2019.	2019	Brown coal	t	110,54	318.609,78	- 333.790,11	- 720.457,33	1.096.631,68	1.315.958,02	4,13	0,04 €	111,51	318.609,78	5	#2
01.01.2019.	2019	Firewood	m³	418,99	835.883,27	159.643,00	156.228,77	1.720.828,34	1.892.911,18	2,26	0,02 €	-	835.883,27	7	#3
01.01.2019.	2019	Wood pellet	t	69,30	341.801,46	30.267,27	218.496,46	1.471.554,00	1.618.709,40	4,74	0,04 €	-	341.801,46	2	#4
01.01.2019.	2019	Water	m³	12.596,81	-			2.138.135,94	2.365.973,99			-	-	57	
SDG -->	**2165,86**				**5.711.072,31**	**- 201.327,36**	**- 318.074,95**	**39.673.107,56**	**46.800.004,90**	**8,19**	**0,07 €**	**2.323,30**	**9.211.453,59**	**188**	

Observations: #1 - Increased consumption --> decreased HDD's; #2 -Reduced consumption Number of objects reduced from 10 to 5; #3 -Reduced number of objects (from 11 to 7) and increased consumption; #4 -Increased number of objects from 1 to 2

01.01.2020.	2020	Electricity	kWh	1.395.018,65	1.395.018,65	- 37.343,60	- 74.486,71	33.222.202,92	42.719.242,94	30,62	0,26 €	1.533,13	4.205.702,23	97	#5
01.01.2020.	2020	District heating	kWh	928.255,00	928.255,00	1.614,67	- 31.072,78	10.889.602,08	11.976.040,46	12,90	0,11 €	266,41	1.450.398,44	4	
01.01.2020.	2020	Natural gas	Sm³	203.267,81	2.091.503,85	178.281,12	305.559,19	6.755.351,36	7.430.884,16	3,55	0,03 €	376,47	2.091.503,85	24	
01.01.2020.	2020	Brown coal	t	208,01	599.522,79	- 52.877,10	280.913,01	1.863.561,64	2.236.273,97	3,73	0,03 €	209,83	599.522,79	7	#6
01.01.2020.	2020	Firewood	m³	257,23	513.183,04	- 163.057,23	- 322.700,23	1.134.997,57	1.248.497,33	2,43	0,02 €	-	513.183,04	9	#7
01.01.2020.	2020	Wood pellet	t	95,19	469.496,12	157.961,93	127.694,66	2.004.762,00	2.205.238,20	4,70	0,04 €	-	469.496,12	2	
01.01.2020.	2020	Water	m³	12.568,89	-			2.210.645,02	2.449.644,12			-	-	61	
SDG -->	**2362,37**				**5.996.979,45**	**84.579,78**	**285.907,14**	**58.081.122,59**	**70.265.821,18**	**11,72**	**0,10 €**	**2.385,84**	**9.329.806,47**	**204**	

Observations: #5 - The price of electricity per kWh is twice as high as in other years!; #6 - Increased number of objects from 5 to 7? increase compared to 2019.; #7 - The number of facilities increased from 7 to 9 compared to 2019, and the reduction in consumption?

Table 5 Energy consumption in buildings: LSG Type 2 by energy source (carrier) - years 2018. to 2022. – continuation

Date	Year	Energy Source	Unit	Consumption	Energy [kWh]	Compared to baseline	Compared to previous year	Cost [RSD]	Cost + tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,00850	Emission CO_2[t]	Primary energy [kWh]	Number of objects	
01.01.2021.	2021	Electricity	kWh	1.577.472,76	1.577.472,76	145.110,51	182.454,11	18.531.903,80	23.788.616,18	15,08	0,13 €	1.733,64	4.755.764,87	87	#8
01.01.2021.	2021	District heating	kWh	1.040.003,00	1.040.003,00	113.362,67	111.748,00	11.664.808,95	12.829.023,10	12,34	0,10 €	298,48	1.625.004,69	4	
01.01.2021.	2021	Natural gas	Sm³	227.058,84	2.336.299,20	423.076,47	244.795,35	7.538.931,08	8.292.824,19	3,55	0,03 €	420,53	2.336.299,20	24	
01.01.2021.	2021	Brown coal	t	215,79	621.950,60	- 30.449,29	22.427,81	1.862.292,52	2.234.751,03	3,59	0,03 €	217,68	621.950,60	10	
01.01.2021.	2021	Firewood	m³	302,24	602.976,87	- 73.263,40	89.793,83	1.385.976,08	1.524.573,69	2,53	0,02 €	-	602.976,87	8	
01.01.2021.	2021	Wood pellet	t	118,09	582.467,57	270.933,38	112.971,45	2.573.921,38	2.831.313,52	4,86	0,04 €	-	582.467,57	6	#9
01.01.2021.	2021	Wood Briquette	t	9,60	49.325,76			163.699,20	180.069,12	3,65	0,03 €	-	49.325,76	1	#10
01.01.2021.	2021	Water	m³	16.925,69	-			3.064.197,41	3.391.755,57			-	-	63	
SDG -->	**2639,37**				**6.810.495,76**	**898.096,09**	**813.516,31**	**46.785.730,42**	**55.072.926,40**	**8,09**	**0,07 €**	**2.670,33**	**10.573.789,56**	**203**	

Observations: #8 - Reduced number of facilities. Why? #9 - Increase in the number of facilities compared to 2020; #10 - New type of fuel added

01.01.2022.	2022	Electricity	kWh	1.462.177,80	1.462.177,80	29.815,55	- 115.294,96	21.954.955,60	28.206.051,57	19,29	0,16 €	1.606,93	4.408.173,64	96
01.01.2022.	2022	District heating	kWh	923.457,07	923.457,07	- 3.183,26	- 116.545,93	10.820.426,13	11.873.537,32	12,86	0,11 €	265,03	1.442.901,67	4
01.01.2022.	2022	Natural gas	Sm³	199.684,08	2.054.629,37	141.406,64	- 281.669,83	6.723.325,40	7.395.657,87	3,60	0,03 €	369,83	2.054.629,37	24
01.01.2022.	2022	Brown coal	t	163,10	470.086,82	- 182.313,07	- 151.863,78	1.790.327,00	2.148.392,40	4,57	0,04 €	164,53	470.086,82	8
01.01.2022.	2022	Firewood	m³	240,96	480.713,63	- 195.526,64	- 122.263,24	1.388.612,85	1.527.474,14	3,18	0,03 €	-	480.713,63	9
01.01.2022.	2022	Wood pellet	t	131,42	648.182,23	336.648,04	65.714,66	4.271.862,58	4.699.048,83	7,25	0,06 €	-	648.182,23	5
01.01.2022.	2022	Wood Briquette	t	36,00	184.971,60		135.645,84	722.160,00	794.376,00	4,29	0,04 €	-	184.971,60	1
01.01.2022.	2022	Water	m³	15.810,99	-			2.818.742,50	3.125.027,27			-	-	63
SDG -->	**2338,88**				**6.224.218,52**	**311.818,85**	**- 586.277,24**	**50.490.412,06**	**59.769.565,40**	**9,60**	**0,08 €**	**2.406,32**	**9.689.658,96**	**210**

During the analysis of the data sets for LSG Type 2, 10 observations were identified and deeper insight was conducted using EMIS data.

The follow up analysis was performed to clarify the identified observations and was based on the data sets from Report 2 (based on energy consumption structured “by energy carrier” and “by object type”) and Report 3 (based on energy consumption structured “by energy carrier” and “by object type group”) extracted from EMIS Analyzer. Below the data from these reports is shown.

In the year 2022 the representative LSG Type 2 included 107 buildings of different types divided into 8 building type groups as follows:

- A) Educational institution buildings (30)
  - A01 - Kindergartens and nursery (12)
  - A02 - Primary schools (16)
  - A03 - Secondary schools (2)
- C) Collective accommodation facilities (1)
  - C01 - Homes for the elderly (1)
- D) Cultural institution facilities (14)
  - D01 - Houses of culture (5)
  - D02 - Cinemas (2)
  - D05 – Libraries (5)
  - D06 - Cultural centers (1)
  - D99 - Cultural institutions facilities – Other (1)
- E) Sports facilities (9)
  - E02 – Outdoor Pools (1)
  - E04 - Sports halls (3)
  - E06 - Ice rinks (1)
  - E99 - Sports facilities – Other (4)
- F) Administrative facilities (25)
  - F01 - Local offices (16)
  - F02 - Municipal administration buildings (4)
  - F07 - Centers for social work (1)
  - F08 - Administrative buildings of organizations (1)
  - F99 - Administrative facilities – Other (3)
- H) Catering facilities (3)
  - H01 – Kitchens (1)
  - H03 – Resorts (1)
  - H99 - Catering facilities – Other (1)
- I) Public companies (JP) and Public utility companies (JKP) facilities (1)
  - I01 - Production facilities of JP and JKP (1)
- Other (24)
  - *JC* - Public taps (2)
  - *Kapela-10842* - Chapel (2)
  - *Reflektori-10881* - Reflectors (1)
  - Z01 – Other (19)

The energy consumption per energy source / per building type group /per year is given below. Marked are the data that is missing or the data seems out of the usual expected range.

Table 6 Energy consumption: LSG Type 2 shown per energy source (carrier) / per building type group / per year 2018. – 2022.

Building type group: A) Educational institution buildings

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti obrazovnih institucija	Električna energija	kWh	635.551,34	635.551,34	6.224.996,48	7.957.151,72	12,52	0,11 €	698,47	1.916.060,19	26
01.01.2019.	2019	Objekti obrazovnih institucija	Električna energija	kWh	619.233,39	619.233,39	6.913.878,89	8.831.350,68	14,26	0,12 €	680,54	1.866.864,82	26
01.01.2020.	2020	Objekti obrazovnih institucija	Električna energija	kWh	505.192,27	505.192,27	23.279.131,55	29.960.222,16	59,30	0,50 €	555,21	1.523.053,65	27
01.01.2021.	2021	Objekti obrazovnih institucija	Električna energija	kWh	627.119,64	627.119,64	7.678.405,39	9.866.127,29	15,73	0,13 €	689,20	1.890.640,30	27
01.01.2022.	2022	Objekti obrazovnih institucija	Električna energija	kWh	549.270,50	549.270,50	8.849.736,74	11.375.706,48	20,71	0,18 €	603,65	1.655.940,71	28

Table 6 Energy consumption: LSG Type 2 shown per energy source (carrier) / per building type group / per year 2018. – 2022. – Continuation 1/5

Building type group: A) Educational institution buildings – continuation

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	632.446,00	632.446,00	7.550.015,56	8.303.089,19	13,13	0,11 €	181,51	988.196,88	3
01.01.2019.	2019	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	655.120,00	655.120,00	7.593.980,97	8.351.741,77	12,75	0,11 €	188,02	1.023.625,00	3
01.01.2020.	2020	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	619.155,00	619.155,00	7.270.404,99	7.995.421,16	12,91	0,11 €	177,70	967.429,69	3
01.01.2021.	2021	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	714.703,00	714.703,00	8.039.355,70	8.841.236,53	12,37	0,11 €	205,12	1.116.723,44	3
01.01.2022.	2022	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	667.757,07	667.757,07	7.688.406,09	8.428.315,28	12,62	0,11 €	191,65	1.043.370,42	3
01.01.2018.	2018	Objekti obrazovnih institucija	Prirodni gas	Sm^3	104.494,98	1.075.190,65	3.514.962,61	3.866.458,87	3,60	0,03 €	193,53	1.075.190,65	7
01.01.2019.	2019	Objekti obrazovnih institucija	Prirodni gas	Sm^3	98.501,00	1.013.516,19	3.301.184,47	3.631.302,92	3,58	0,03 €	182,43	1.013.516,19	7
01.01.2020.	2020	Objekti obrazovnih institucija	Prirodni gas	Sm^3	115.985,85	1.193.424,79	3.868.304,49	4.255.134,94	3,57	0,03 €	214,82	1.193.424,79	7
01.01.2021.	2021	Objekti obrazovnih institucija	Prirodni gas	Sm^3	115.587,05	1.189.321,43	3.884.955,04	4.273.450,55	3,59	0,03 €	214,08	1.189.321,43	7
01.01.2022.	2022	Objekti obrazovnih institucija	Prirodni gas	Sm^3	102.906,90	1.058.850,25	3.543.788,37	3.898.167,21	3,68	0,03 €	190,59	1.058.850,25	7
01.01.2018.	2018	Objekti obrazovnih institucija	Mrki ugalj	t	347,12	1.000.469,36	3.328.165,97	3.993.799,16	3,99	0,03 €	350,16	1.000.469,36	8
01.01.2019.	2019	Objekti obrazovnih institucija	Mrki ugalj	t	105,77	304.848,84	1.041.820,93	1.250.185,11	4,10	0,03 €	106,70	304.848,84	4
01.01.2020.	2020	Objekti obrazovnih institucija	Mrki ugalj	t	195,03	562.101,90	1.720.743,72	2.064.892,46	3,67	0,03 €	196,74	562.101,90	5
01.01.2021.	2021	Objekti obrazovnih institucija	Mrki ugalj	t	204,70	589.998,71	1.740.347,22	2.088.416,66	3,54	0,03 €	206,50	589.998,71	8
01.01.2022.	2022	Objekti obrazovnih institucija	Mrki ugalj	t	154,39	444.987,82	1.673.018,69	2.007.622,43	4,51	0,04 €	155,75	444.987,82	7
01.01.2018.	2018	Objekti obrazovnih institucija	Ogrevno drvo	m^3	335,22	668.769,77	1.740.499,21	1.914.549,13	2,86	0,02 €	-	668.769,77	9
01.01.2019.	2019	Objekti obrazovnih institucija	Ogrevno drvo	m^3	416,93	831.768,79	1.710.103,86	1.881.114,25	2,26	0,02 €	-	831.768,79	6
01.01.2020.	2020	Objekti obrazovnih institucija	Ogrevno drvo	m^3	250,09	498.927,77	1.094.268,23	1.203.695,05	2,41	0,02 €	-	498.927,77	7
01.01.2021.	2021	Objekti obrazovnih institucija	Ogrevno drvo	m^3	297,48	593.475,08	1.358.828,11	1.494.710,92	2,52	0,02 €	-	593.475,08	6
01.01.2022.	2022	Objekti obrazovnih institucija	Ogrevno drvo	m^3	234,29	467.404,66	1.359.455,67	1.495.401,23	3,20	0,03 €	-	467.404,66	8
01.01.2018.	2018	Objekti obrazovnih institucija	Drvni Pelet	t	25,00	123.305,00	540.250,00	594.275,00	4,82	0,04 €	-	123.305,00	1
01.01.2019.	2019	Objekti obrazovnih institucija	Drvni Pelet	t	69,30	341.801,46	1.471.554,00	1.618.709,40	4,74	0,04 €	-	341.801,46	2
01.01.2020.	2020	Objekti obrazovnih institucija	Drvni Pelet	t	95,19	469.496,12	2.004.762,00	2.205.238,20	4,70	0,04 €	-	469.496,12	2
01.01.2021.	2021	Objekti obrazovnih institucija	Drvni Pelet	t	103,54	510.698,43	2.258.655,03	2.484.520,54	4,86	0,04 €	-	510.698,43	4
01.01.2022.	2022	Objekti obrazovnih institucija	Drvni Pelet	t	127,91	630.857,55	4.142.756,30	4.557.031,93	7,22	0,06 €	-	630.857,55	4
01.01.2021.	2021	Objekti obrazovnih institucija	Drvni Briket	t	9,60	49.325,76	163.699,20	180.069,12	3,65	0,03 €	-	49.325,76	1
01.01.2022.	2022	Objekti obrazovnih institucija	Drvni Briket	t	36,00	184.971,60	722.160,00	794.376,00	4,29	0,04 €	-	184.971,60	1
01.01.2018.	2018	Objekti obrazovnih institucija	Voda	m^3	10.744,35	-	949.060,22	1.051.693,92			-	-	23
01.01.2019.	2019	Objekti obrazovnih institucija	Voda	m^3	7.300,96	-	809.634,45	898.019,17			-	-	23
01.01.2020.	2020	Objekti obrazovnih institucija	Voda	m^3	7.289,88	-	888.442,84	985.997,33			-	-	23
01.01.2021.	2021	Objekti obrazovnih institucija	Voda	m^3	8.509,53	-	1.092.672,00	1.212.114,17			-	-	23
01.01.2022.	2022	Objekti obrazovnih institucija	Voda	m^3	7.020,81	-	941.734,90	1.047.198,13			-	-	23

Table 6 Energy consumption: LSG Type 2 shown per energy source (carrier) / per building type group / per year 2018. – 2022. – Continuation 2/5

Building type group: C) Collective accommodation facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti kolektivnog smeštaja	Električna energija	kWh	18.064,00	18.064,00	170.065,77	218.862,84	12,12	0,10 €	19,85	54.459,35	1
01.01.2019.	2019	Objekti kolektivnog smeštaja	Električna energija	kWh	2.196,35	2.196,35	34.454,74	118.515,24	53,96	0,46 €	2,41	6.621,54	1
01.01.2020.	2020	Objekti kolektivnog smeštaja	Električna energija	kWh	9.205,45	9.205,45	95.685,49	129.773,58	14,10	0,12 €	10,12	27.752,58	1
01.01.2021.	2021	Objekti kolektivnog smeštaja	Električna energija	kWh	15.972,00	15.972,00	167.822,22	215.450,15	13,49	0,11 €	17,55	48.152,39	1
01.01.2022.	2022	Objekti kolektivnog smeštaja	Električna energija	kWh	16.981,00	16.981,00	243.114,54	312.577,23	18,41	0,16 €	18,66	51.194,32	1

Observation: Only electricity consumption data is available!

Building type group: D) Cultural institution facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti instituicija kulture	Električna energija	kWh	132.146,50	132.146,50	1.226.483,58	1.575.528,20	11,92	0,10 €	145,23	398.395,26	14
01.01.2019.	2019	Objekti instituicija kulture	Električna energija	kWh	132.643,41	132.643,41	1.325.764,64	1.701.430,38	12,83	0,11 €	145,78	399.893,36	13
01.01.2020.	2020	Objekti instituicija kulture	Električna energija	kWh	107.614,75	107.614,75	1.115.839,47	1.427.126,02	13,26	0,11 €	118,27	324.436,96	13
01.01.2021.	2021	Objekti instituicija kulture	Električna energija	kWh	121.465,82	121.465,82	1.277.151,63	1.633.161,60	13,45	0,11 €	133,49	366.195,14	12
01.01.2022.	2022	Objekti instituicija kulture	Električna energija	kWh	130.826,74	130.826,74	1.732.195,18	2.220.087,37	16,97	0,14 €	143,78	394.416,47	13
01.01.2018.	2018	Objekti instituicija kulture	Prirodni gas	Sm^3	12.324,31	126.809,79	417.028,14	458.730,95	3,62	0,03 €	22,83	126.809,79	3
01.01.2019.	2019	Objekti instituicija kulture	Prirodni gas	Sm^3	11.057,31	113.773,11	374.315,76	411.740,64	3,62	0,03 €	20,48	113.773,11	3
01.01.2020.	2020	Objekti instituicija kulture	Prirodni gas	Sm^3	12.042,97	123.914,89	410.194,04	451.212,84	3,64	0,03 €	22,30	123.914,89	3
01.01.2021.	2021	Objekti instituicija kulture	Prirodni gas	Sm^3	12.358,80	127.164,61	418.551,09	460.406,20	3,62	0,03 €	22,89	127.164,61	3
01.01.2022.	2022	Objekti instituicija kulture	Prirodni gas	Sm^3	11.147,79	114.704,06	389.503,82	428.454,20	3,74	0,03 €	20,65	114.704,06	3
01.01.2018.	2018	Objekti instituicija kulture	Mrki ugalj	t	9,98	28.778,57	96.853,85	116.224,61	4,04	0,03 €	10,07	28.778,57	1
01.01.2020.	2020	Objekti instituicija kulture	Mrki ugalj	t	8,60	24.776,30	94.559,48	113.471,38	4,58	0,04 €	8,67	24.776,30	1
01.01.2021.	2021	Objekti instituicija kulture	Mrki ugalj	t	9,90	28.523,23	108.859,72	130.631,66	4,58	0,04 €	9,98	28.523,23	1
01.01.2022.	2022	Objekti instituicija kulture	Mrki ugalj	t	8,71	25.099,00	117.308,31	140.769,97	5,61	0,05 €	8,78	25.099,00	1
01.01.2018.	2018	Objekti instituicija kulture	Ogrevno drvo	m^3	4,07	8.115,68	20.746,86	22.821,54	2,81	0,02 €	-	8.115,68	1
01.01.2020.	2020	Objekti instituicija kulture	Ogrevno drvo	m^3	4,67	9.306,97	26.591,36	29.250,49	3,14	0,03 €	-	9.306,97	1
01.01.2021.	2021	Objekti instituicija kulture	Ogrevno drvo	m^3	4,67	9.306,97	26.591,36	29.250,49	3,14	0,03 €	-	9.306,97	1
01.01.2022.	2022	Objekti instituicija kulture	Ogrevno drvo	m^3	6,67	13.308,97	29.157,19	32.072,91	2,41	0,02 €	-	13.308,97	1
01.01.2018.	2018	Objekti instituicija kulture	Voda	m^3	2.881,51	-	593.875,55	653.888,52			-	-	6
01.01.2019.	2019	Objekti instituicija kulture	Voda	m^3	337,89	-	135.553,28	148.751,73			-	-	5
01.01.2020.	2020	Objekti instituicija kulture	Voda	m^3	388,44	-	148.159,38	164.051,96			-	-	7
01.01.2021.	2021	Objekti instituicija kulture	Voda	m^3	483,63	-	174.757,72	193.547,26			-	-	8
01.01.2022.	2022	Objekti instituicija kulture	Voda	m^3	358,73	-	147.687,23	163.772,36			-	-	7

Table 6 Energy consumption: LSG Type 2 shown per energy source (carrier) / per building type group / per year 2018. – 2022. – Continuation 3/5

Building type group: E) Sports facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Sportski objekti	Električna energija	kWh	222.552,00	222.552,00	2.127.064,02	2.741.393,66	12,32	0,10 €	244,58	670.949,77	6
01.01.2019.	2019	Sportski objekti	Električna energija	kWh	273.034,00	273.034,00	3.027.088,95	3.900.669,76	14,29	0,12 €	300,06	823.142,90	7
01.01.2020.	2020	Sportski objekti	Električna energija	kWh	317.399,00	317.399,00	3.601.346,97	4.639.371,20	14,62	0,12 €	348,82	956.894,51	8
01.01.2021.	2021	Sportski objekti	Električna energija	kWh	336.043,00	336.043,00	3.754.494,15	4.835.841,37	14,39	0,12 €	369,31	1.013.102,44	8
01.01.2022.	2022	Sportski objekti	Električna energija	kWh	366.416,00	366.416,00	5.217.972,79	6.723.034,89	18,35	0,16 €	402,69	1.104.670,96	9
01.01.2018.	2018	Sportski objekti	Prirodni gas	Sm^3	45.323,00	466.346,48	1.428.488,08	1.571.336,89	3,37	0,03 €	83,94	466.346,48	1
01.01.2019.	2019	Sportski objekti	Prirodni gas	Sm^3	41.013,00	421.999,16	1.305.395,54	1.435.935,10	3,40	0,03 €	75,96	421.999,16	1
01.01.2020.	2020	Sportski objekti	Prirodni gas	Sm^3	49.717,00	511.558,10	1.594.196,41	1.753.616,05	3,43	0,03 €	92,08	511.558,10	2
01.01.2021.	2021	Sportski objekti	Prirodni gas	Sm^3	62.973,00	647.954,39	1.992.612,96	2.191.874,26	3,38	0,03 €	116,63	647.954,39	2
01.01.2022.	2022	Sportski objekti	Prirodni gas	Sm^3	59.652,06	613.783,88	1.979.131,25	2.177.044,38	3,55	0,03 €	110,48	613.783,88	2
01.01.2021.	2021	Sportski objekti	Drvni Pelet	t	12,99	64.069,28	281.233,50	309.356,85	4,83	0,04 €	-	64.069,28	1
01.01.2018.	2018	Sportski objekti	Voda	m^3	1.950,38	-	427.440,11	471.378,22			-	-	3
01.01.2019.	2019	Sportski objekti	Voda	m^3	2.200,96	-	474.155,13	522.910,80			-	-	3
01.01.2020.	2020	Sportski objekti	Voda	m^3	1.409,97	-	334.775,79	369.999,20			-	-	4
01.01.2021.	2021	Sportski objekti	Voda	m^3	5.714,98	-	1.121.527,34	1.236.168,92			-	-	5
01.01.2022.	2022	Sportski objekti	Voda	m^3	3.395,58	-	710.415,92	784.940,56			-	-	5

Building type group: F) Administrative facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Administrativni objekti	Električna energija	kWh	322.481,85	322.481,85	2.955.505,52	3.796.754,18	11,77	0,10 €	354,41	972.218,29	22
01.01.2019.	2019	Administrativni objekti	Električna energija	kWh	293.580,71	293.580,71	2.946.745,44	3.778.934,53	12,87	0,11 €	322,65	885.087,13	22
01.01.2020.	2020	Administrativni objekti	Električna energija	kWh	284.871,98	284.871,98	2.962.936,39	3.792.125,73	13,31	0,11 €	313,07	858.832,05	22
01.01.2021.	2021	Administrativni objekti	Električna energija	kWh	278.385,67	278.385,67	3.175.544,24	4.064.629,75	14,60	0,12 €	305,95	839.277,13	22
01.01.2022.	2022	Administrativni objekti	Električna energija	kWh	249.334,18	249.334,18	3.479.962,89	4.457.048,66	17,88	0,15 €	274,02	751.692,69	22
01.01.2018.	2018	Administrativni objekti	Daljinsko grejanje	kWh	259.892,22	259.892,22	3.170.623,48	3.487.611,06	13,42	0,11 €	74,59	406.081,60	1
01.01.2019.	2019	Administrativni objekti	Daljinsko grejanje	kWh	304.207,78	304.207,78	3.571.544,71	3.928.549,24	12,91	0,11 €	87,31	475.324,65	1
01.01.2020.	2020	Administrativni objekti	Daljinsko grejanje	kWh	309.100,00	309.100,00	3.619.197,09	3.980.619,29	12,88	0,11 €	88,71	482.968,75	1
01.01.2021.	2021	Administrativni objekti	Daljinsko grejanje	kWh	325.300,00	325.300,00	3.625.453,25	3.987.786,57	12,26	0,10 €	93,36	508.281,25	1
01.01.2022.	2022	Administrativni objekti	Daljinsko grejanje	kWh	255.700,00	255.700,00	3.132.020,04	3.445.222,04	13,47	0,11 €	73,39	399.531,25	1

Table 6 Energy consumption: LSG Type 2 shown per energy source (carrier) / per building type group / per year 2018. – 2022. – Continuation 4/5

Building type group: F) Administrative facilities – continuation

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Administrativni objekti	Prirodni gas	Sm³	12.733,76	131.022,75	449.890,68	494.879,75	3,78	0,03 €	23,58	131.022,75	10
01.01.2019.	2019	Administrativni objekti	Prirodni gas	Sm³	16.565,00	170.443,91	572.253,69	629.479,06	3,69	0,03 €	30,68	170.443,91	10
01.01.2020.	2020	Administrativni objekti	Prirodni gas	Sm³	17.619,00	181.288,94	614.355,79	675.789,63	3,73	0,03 €	32,63	181.288,94	10
01.01.2021.	2021	Administrativni objekti	Prirodni gas	Sm³	22.384,00	230.317,93	775.712,46	853.283,71	3,70	0,03 €	41,46	230.317,93	10
01.01.2022.	2022	Administrativni objekti	Prirodni gas	Sm³	19.255,68	198.129,42	576.252,94	633.878,16	3,20	0,03 €	35,66	198.129,42	10
01.01.2018.	2018	Administrativni objekti	Voda	m³	1.687,28	-	544.894,39	601.583,04			-	-	16
01.01.2019.	2019	Administrativni objekti	Voda	m³	1.848,11	-	581.740,21	642.455,05			-	-	16
01.01.2020.	2020	Administrativni objekti	Voda	m³	2.070,76	-	641.431,55	708.557,06			-	-	17
01.01.2021.	2021	Administrativni objekti	Voda	m³	1.382,74	-	532.968,01	589.594,75			-	-	17
01.01.2022.	2022	Administrativni objekti	Voda	m³	2.118,89	-	657.870,77	727.769,09			-	-	18

Building type group: H) Catering facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Ugostiteljski objekti	Električna energija	kWh	7.823,00	7.823,00	83.912,55	107.333,69	13,72	0,12 €	8,60	23.584,78	2
01.01.2019.	2019	Ugostiteljski objekti	Električna energija	kWh	16.032,00	16.032,00	167.952,97	215.255,73	13,43	0,11 €	17,62	48.333,27	2
01.01.2020.	2020	Ugostiteljski objekti	Električna energija	kWh	10.647,00	10.647,00	123.775,40	157.895,47	14,83	0,13 €	11,70	32.098,58	2
01.01.2021.	2021	Ugostiteljski objekti	Električna energija	kWh	10.523,00	10.523,00	135.415,09	172.604,42	16,40	0,14 €	11,56	31.724,74	2
01.01.2022.	2022	Ugostiteljski objekti	Električna energija	kWh	14.497,00	14.497,00	216.837,91	277.639,86	19,15	0,16 €	15,93	43.705,56	2
01.01.2018.	2018	Ugostiteljski objekti	Mrki ugalj	t	3,41	9.819,18	33.046,29	39.655,55	4,04	0,03 €	3,44	9.819,18	1
01.01.2019.	2019	Ugostiteljski objekti	Mrki ugalj	t	4,77	13.760,94	54.810,75	65.772,91	4,78	0,04 €	4,82	13.760,94	1
01.01.2020.	2020	Ugostiteljski objekti	Mrki ugalj	t	4,39	12.644,59	48.258,44	57.910,13	4,58	0,04 €	4,43	12.644,59	1
01.01.2021.	2021	Ugostiteljski objekti	Mrki ugalj	t	1,19	3.428,66	13.085,58	15.702,70	4,58	0,04 €	1,20	3.428,66	1
01.01.2018.	2018	Ugostiteljski objekti	Ogrevno drvo	m³	1,39	2.769,05	7.078,78	7.786,65	2,81	0,02 €	-	2.769,05	1
01.01.2019.	2019	Ugostiteljski objekti	Ogrevno drvo	m³	2,06	4.114,49	10.724,48	11.796,93	2,87	0,02 €	-	4.114,49	1
01.01.2020.	2020	Ugostiteljski objekti	Ogrevno drvo	m³	2,48	4.948,30	14.137,99	15.551,79	3,14	0,03 €	-	4.948,30	1
01.01.2021.	2021	Ugostiteljski objekti	Ogrevno drvo	m³	0,10	194,81	556,61	612,28	3,14	0,03 €	-	194,81	1
01.01.2021.	2021	Ugostiteljski objekti	Drvni Pelet	t	1,56	7.699,85	34.032,85	37.436,14	4,86	0,04 €	-	7.699,85	1
01.01.2022.	2022	Ugostiteljski objekti	Drvni Pelet	t	3,51	17.324,67	129.106,28	142.016,91	8,20	0,07 €	-	17.324,67	1
01.01.2018.	2018	Ugostiteljski objekti	Voda	m³	661,00	-	86.050,69	95.647,17			-	-	2
01.01.2019.	2019	Ugostiteljski objekti	Voda	m³	646,00	-	86.669,96	96.454,19			-	-	2
01.01.2020.	2020	Ugostiteljski objekti	Voda	m³	814,00	-	99.059,28	110.164,29			-	-	2
01.01.2021.	2021	Ugostiteljski objekti	Voda	m³	633,00	-	88.436,82	98.598,72			-	-	2
01.01.2022.	2022	Ugostiteljski objekti	Voda	m³	2.670,96	-	296.536,66	327.511,98			-	-	2

Table 6 Energy consumption: LSG Type 2 shown per energy source (carrier) / per building type group / per year 2018. – 2022. – Continuation 5/5

Building type group: I) Public companies (JP) and Public utility companies (JKP) facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti JP i JKP	Električna energija	kWh	4.197,04	4.197,04	54.597,07	70.430,22	16,78	0,14 €	4,61	12.653,25	2
01.01.2019.	2019	Objekti JP i JKP	Električna energija	kWh	3.454,59	3.454,59	38.969,27	50.270,36	14,55	0,12 €	3,80	10.414,89	2
01.01.2020.	2020	Objekti JP i JKP	Električna energija	kWh	2.583,00	2.583,00	57.010,42	73.543,44	28,47	0,24 €	2,84	7.787,23	9
01.01.2021.	2021	Objekti JP i JKP	Električna energija	kWh	2.816,00	2.816,00	41.163,89	53.101,42	18,86	0,16 €	3,09	8.489,68	1
01.01.2022.	2022	Objekti JP i JKP	Električna energija	kWh	3.747,00	3.747,00	60.961,05	78.639,75	20,99	0,18 €	4,12	11.296,46	1
01.01.2018.	2018	Objekti JP i JKP	Voda	m³	36,00	-	2.706,92	3.103,55			-	-	1
01.01.2020.	2020	Objekti JP i JKP	Voda	m³	4,99	-	1.770,19	2.101,45			-	-	1
01.01.2021.	2021	Objekti JP i JKP	Voda	m³	9,64	-	2.534,04	2.992,47			-	-	1
01.01.2022.	2022	Objekti JP i JKP	Voda	m³	4,00	-	2.088,34	2.483,95			-	-	1

Observation: Only electricity and water consumption data are available

Building type group: Other

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Ostalo	Električna energija	kWh	86.689,00	86.689,00	1.003.605,65	1.287.689,84	14,85	0,13 €	95,27	261.350,00	16
01.01.2019.	2019	Ostalo	Električna energija	kWh	129.116,92	129.116,92	1.851.511,54	2.377.798,73	18,42	0,16 €	141,90	389.261,68	17
01.01.2020.	2020	Ostalo	Električna energija	kWh	157.505,21	157.505,21	1.986.477,22	2.539.185,34	16,12	0,14 €	173,10	474.846,70	15
01.01.2021.	2021	Ostalo	Električna energija	kWh	185.147,63	185.147,63	2.301.907,19	2.947.700,18	15,92	0,14 €	203,48	558.183,06	14
01.01.2022.	2022	Ostalo	Električna energija	kWh	131.105,38	131.105,38	2.154.174,50	2.761.317,33	21,06	0,18 €	144,08	395.256,48	20
01.01.2018.	2018	Ostalo	Prirodni gas	Sm^3	6.108,23	62.850,02	206.780,70	227.458,77	3,62	0,03 €	11,31	62.850,02	1
01.01.2019.	2019	Ostalo	Prirodni gas	Sm^3	6.435,00	66.212,29	218.103,62	239.913,98	3,62	0,03 €	11,92	66.212,29	1
01.01.2020.	2020	Ostalo	Prirodni gas	Sm^3	7.903,00	81.317,13	268.300,63	295.130,70	3,63	0,03 €	14,64	81.317,13	2
01.01.2021.	2021	Ostalo	Prirodni gas	Sm^3	13.755,99	141.540,85	467.099,53	513.809,48	3,63	0,03 €	25,48	141.540,85	2
01.01.2022.	2022	Ostalo	Prirodni gas	Sm^3	6.721,65	69.161,76	234.649,02	258.113,92	3,73	0,03 €	12,45	69.161,76	2
01.01.2018.	2018	Ostalo	Voda	m^3	503,92	-	63.413,64	71.519,51			-	-	8
01.01.2019.	2019	Ostalo	Voda	m^3	262,89	-	50.382,92	57.383,05			-	-	8
01.01.2020.	2020	Ostalo	Voda	m^3	590,85	-	97.006,00	108.772,83			-	-	7
01.01.2021.	2021	Ostalo	Voda	m^3	192,17	-	51.301,49	58.739,30			-	-	7
01.01.2022.	2022	Ostalo	Voda	m^3	242,02	-	62.408,69	71.351,18			-	-	7

Further analysis of energy consumption per building type (Report 3) disclosed the following:

The analysis of energy consumption per year showed that the price of electricity varied and was higher than usual. A more in-depth review showed that electricity consumption for some specific building types was most likely entered with incorrect total costs. The building types with a high unit cost of electricity are shown below.

Table 7 Details of electricity consumption with high cost per kWh for LSG Type 2 per Object type

Date	Year	Object Type Name	Energy carrier name	Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	emission[t]	Primary energy [kWh]	of objects
01.01.2018.	2018	Slobodnostojeci orman	Električna energija	kWh	21,00	21,00	10.646,72	13.255,77	631,23	5,37 €	0,02	63,31	1
01.01.2019.	2019	Slobodnostojeci orman	Električna energija	kWh	36,00	36,00	11.628,64	14.299,15	397,20	3,38 €	0,04	108,53	1
01.01.2019.	2019	Domovi za stara lica	Električna energija	kWh	2.196,35	2.196,35	34.454,74	118.515,24	53,96	0,46 €	2,41	6.621,54	1
01.01.2020.	2020	Osnovne škole	Električna energija	kWh	345.663,87	345.663,87	21.268.645,23	27.418.278,73	79,32	0,67 €	379,88	1.042.107,43	14
01.01.2021.	2021	Objekti institucija kulture - Ostalo	Električna energija	kWh	2,00	2,00	16.063,83	19.683,42	9.841,71	83,65 €	-	6,03	1
01.01.2022.	2022	Kapela	Električna energija	kWh	1.345,00	1.345,00	39.539,72	49.965,71	37,15	0,32 €	1,48	4.054,91	2

Data review for LSG Type 3 – 100.000 to 200.000 inhabitants

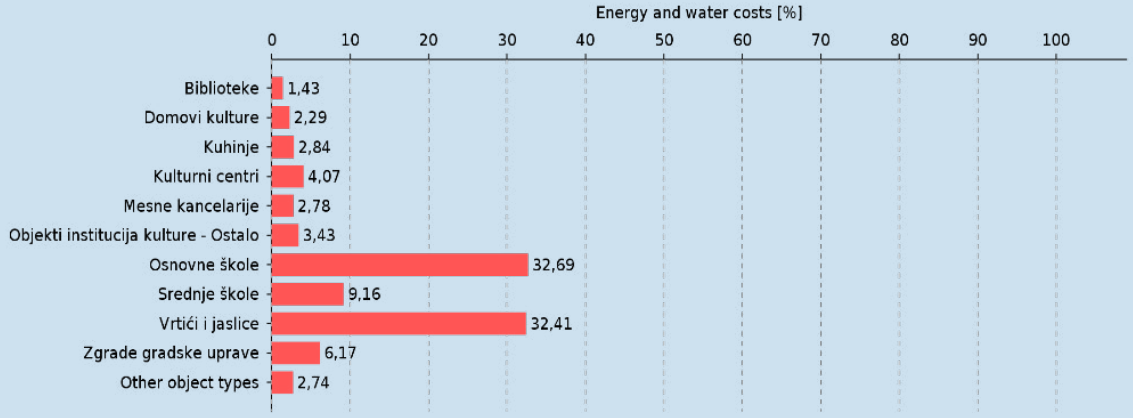
As part of the selection process for representative LSG Type 3 with 100.000 to 200.000 inhabitants, the available EMIS data for several candidates was analyzed. The analysis took into consideration the availability, completeness and quality of the data in EMIS, the number and types of public buildings according to its purpose (i.e. educational, social, health, etc.) and the energy source types.

The typical consumption of electricity and heat by energy source type for an LSG of this size is shown in the two examples below:

Picture 9 Trends of total electricity and heat consumption for LSG Type 3

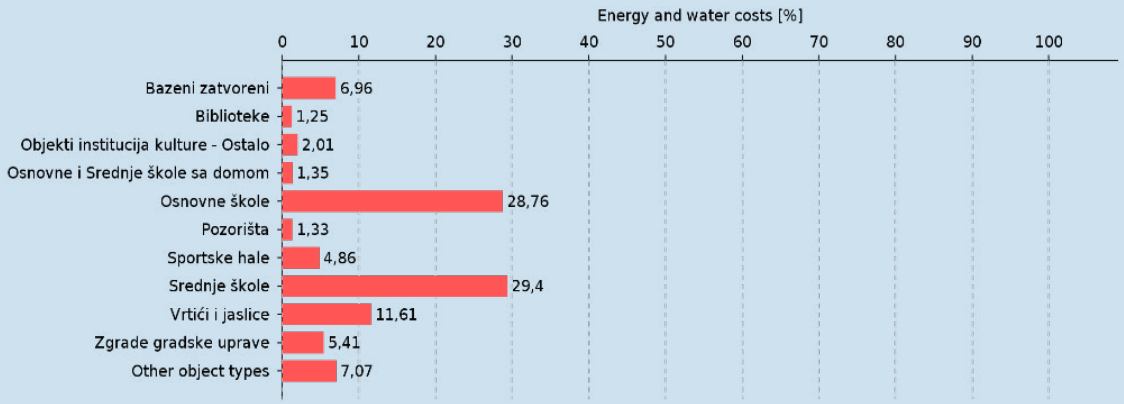
The typical types of buildings according to their purpose and share in total cost of energy and water for an LSG of this size are shown in the two examples below:

2022	Energy and water costs	
Object Type	[RSD]	[%]
Bazeni zatvoreni	27.155.623	6,96
Biblioteke	4.893.678	1,25
Objekti institucija kulture - Ostalo	7.824.378	2,01
Osnovne i Srednje škole sa domom	5.260.907	1,35
Osnovne škole	112.208.610	28,76
Pozorišta	5.186.361	1,33
Sportske hale	18.952.944	4,86
Srednje škole	114.697.425	29,40
Vrtići i jaslice	45.294.208	11,61
Zgrade gradske uprave	21.112.148	5,41
Other object types	27.581.871	7,07



Picture 10 Typical types of buildings in LSG Type 3 according to the building purpose and their share in total cost of energy

2022	Energy and water costs	
Object Type	[RSD]	[%]
Biblioteke	1.780.618	1,43
Domovi kulture	2.849.568	2,29
Kuhinje	3.541.721	2,84
Kulturni centri	5.062.334	4,07
Mesne kancelarije	3.459.271	2,78
Objekti institucija kulture - Ostalo	4.273.563	3,43
Osnovne škole	40.694.512	32,69
Srednje škole	11.406.291	9,16
Vrtići i jaslice	40.346.530	32,41
Zgrade gradske uprave	7.683.124	6,17
Other object types	3.406.188	2,74



Picture 10 Typical types of buildings in LSG Type 3 according to the building purpose and their share in total cost of energy

An LSG of this size usually has between 200 and 350 buildings.

The energy consumption data sets for LSG Type 3 is shown below for the period from 2018 to 2022. The baseline consumption is calculated for the period from 2018 to 2020.

Table 8 Energy consumption in buildings: LSG Type 3 by energy source (carrier) - years 2018. to 2022.

Date	Year	Energy Source	Unit	Consumption	Energy [kWh]	Compared to baseline	Compared to previous year	Cost [RSD]	Cost + tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,00850	Emission CO_2[t]	Primary energy [kWh]	Number of objects	
BASELINE --> AVERAGE of 2018 to 2020															
		Electricity	kWh	3.549.716,08	3.549.716,08	-		32.892.611,88	42.094.070,06	11,86	0,10 €	3.901,14	10.701.684,03	103	
		District heating	kWh	7.620.277,33	7.620.277,33	-		59.868.022,66	65.836.144,34	8,64	0,07 €	2.187,02	11.906.683,33	37	
		Natural gas	Sm³	291.625,67	3.000.653,13	-		10.863.089,67	11.949.174,26	3,98	0,03 €	540,12	3.000.653,13	12	
		Extra light fuel oil	l	36.607,67	377.688,62	-		5.219.578,01	6.263.493,61	16,58	0,14 €	105,75	377.688,62	2	
		Brown coal	t	45,77	131.908,69	-		1.831.116,67	2.197.340,00	16,66	0,14 €	46,17	131.908,69	4	
		Firewood	m³	120,98	241.351,11	-		569.266,67	626.193,33	2,59	0,02 €	-	241.351,11	4	
		Water	m³	76.582,89	-	-		5.024.392,83	5.523.008,38			-	-	66	
HDD -->	2715,581				14.921.594,96			116.268.078,38	134.489.423,99	9,01	0,08 €	6.780,20	26.359.968,91	227	
01.01.2018.	2018	Electricity	kWh	3.933.975,57	3.933.975,57	384.259,49		35.383.117,57	45.291.111,86	11,51	0,10 €	4.323,44	11.860.149,53	137	
01.01.2018.	2018	District heating	kWh	15.769.365,00	15.769.365,00	8.149.087,67		63.272.641,17	69.599.786,79	4,41	0,04 €	4.525,81	24.639.632,81	43	#1
01.01.2018.	2018	Natural gas	Sm³	285.742,00	2.940.113,73	- 60.539,40		10.169.633,31	11.186.596,64	3,80	0,03 €	529,22	2.940.113,73	15	
01.01.2018.	2018	Extra light fuel oil	l	53.506,00	552.032,10	174.343,48		7.696.080,04	9.235.296,04	16,73	0,14 €	154,57	552.032,10	2	
01.01.2018.	2018	Brown coal	t	19,00	54.761,80	- 77.146,89		237.500,00	285.000,00	5,20	0,04 €	19,17	54.761,80	4	
01.01.2018.	2018	Firewood	m³	85,80	171.171,00	- 70.180,11		381.600,00	419.760,00	2,45	0,02 €	-	171.171,00	4	
01.01.2018.	2018	Water	m³	79.148,62	-	-		5.236.262,84	5.755.860,88			-	-	73	
HDD -->	2715,49				23.421.419,20	8.499.824,24		122.376.834,93	141.773.412,21	6,05	0,05 €	9.552,21	40.217.860,97	278	

Observations: #1 - Very high consumption! 9 + objects compared to 2019 and 2020!

01.01.2019.	2019	Electricity	kWh	3.324.862,97	3.324.862,97	- 224.853,11	- 609.112,60	30.344.205,25	38.559.294,13	11,60	0,10 €	3.654,02	10.023.796,88	92	#2
01.01.2019.	2019	District heating	kWh	3.535.147,00	3.535.147,00	- 4.085.130,33	- 12.234.218,00	56.800.489,67	62.480.538,64	17,67	0,15 €	1.014,59	5.523.667,19	34	#3
01.01.2019.	2019	Natural gas	Sm³	255.002,70	2.623.824,75	- 376.828,38	- 316.288,98	10.156.035,17	11.171.638,69	4,26	0,04 €	472,29	2.623.824,75	10	
01.01.2019.	2019	Extra light fuel oil	l	34.317,00	354.055,35	- 23.633,27	- 197.976,75	5.268.024,00	6.321.628,80	17,85	0,15 €	99,14	354.055,35	2	
01.01.2019.	2019	Brown coal	t	43,94	126.643,87	- 5.264,82	71.882,07	4.537.200,00	5.444.640,00	42,99	0,37 €	44,33	126.643,87	4	
01.01.2019.	2019	Firewood	m³	140,67	280.644,36	39.293,25	109.473,36	639.426,67	703.369,33	2,51	0,02 €	-	280.644,36	4	
01.01.2019.	2019	Water	m³	82.095,42	-	-	-	5.422.046,42	5.960.096,51			-	-	66	
HDD -->	2652,531				10.245.178,30	- 4.676.416,66	- 13.176.240,90	113.167.427,18	130.641.206,10	12,75	0,11 €	5.284,37	18.932.632,40	212	

Observations: #2 - Significant reduction of object number (-45); #3 - Reduction of object number (-10). Very high consumption reduction compared to the year before.

01.01.2020.	2020	Electricity	kWh	3.390.309,70	3.390.309,70	- 159.406,38	65.446,73	32.950.512,81	42.431.804,20	12,52	0,11 €	3.725,95	10.221.105,67	80	#4
01.01.2020.	2020	District heating	kWh	3.556.320,00	3.556.320,00	- 4.063.957,33	21.173,00	59.530.937,13	65.428.107,60	18,40	0,16 €	1.020,66	5.556.750,00	34	
01.01.2020.	2020	Natural gas	Sm³	334.132,30	3.438.020,92	437.367,79	814.196,17	12.263.600,53	13.489.287,45	3,92	0,03 €	618,84	3.438.020,92	10	
01.01.2020.	2020	Extra light fuel oil	l	22.000,00	226.978,40	- 150.710,22	- 127.076,95	2.694.630,00	3.233.556,00	14,25	0,12 €	63,55	226.978,40	2	
01.01.2020.	2020	Brown coal	t	74,36	214.320,39	82.411,70	87.676,52	718.650,00	862.380,00	4,02	0,03 €	75,01	214.320,39	4	
01.01.2020.	2020	Firewood	m³	136,46	272.237,97	30.886,86	- 8.406,39	686.733,33	755.450,67	2,77	0,02 €	-	272.237,97	4	
01.01.2020.	2020	Water	m³	68.504,62	-	-	-	4.414.869,22	4.853.067,75			-	-	58	
HDD -->	2778,722				11.098.187,38	- 3.823.407,58	853.009,08	113.259.973,02	131.053.653,67	11,81	0,10 €	5.504,01	19.929.413,35	192	

Observations: #4 - Significant reduction of object number (-12)

Table 8 Energy consumption in buildings: LSG Type 3 by energy source (carrier) - years 2018. to 2022. – continuation

Date	Year	Energy Source	Unit	Consumption	Energy [kWh]	Compared to baseline	Compared to previous year	Cost [RSD]	Cost + tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,00850	Emission CO_2[t]	Primary energy [kWh]	Number of objects	
01.01.2021.	2021	Electricity	kWh	4.152.918,11	4.152.918,11	603.202,03	762.608,41	42.075.653,21	54.187.621,90	13,05	0,11 €	4.564,06	12.520.217,51	78	#5
01.01.2021.	2021	District heating	kWh	4.226.345,00	4.226.345,00	- 3.393.932,33	670.025,00	65.824.223,17	72.384.074,54	17,13	0,15 €	1.212,96	6.603.664,06	35	
01.01.2021.	2021	Natural gas	Sm³	462.114,00	4.754.875,79	1.754.222,66	1.316.854,87	15.987.639,45	17.586.087,69	3,70	0,03 €	855,88	4.754.875,79	10	#6
		Extra light fuel oil	l			- 377.688,62	- 226.978,40								
01.01.2021.	2021	Brown coal	t	26,33	75.890,17	- 56.018,52	- 138.430,22	342.423,63	410.908,36	5,41	0,05 €	26,56	75.890,17	4	
01.01.2021.	2021	Firewood	m³	100,97	201.442,47	- 39.908,64	- 70.795,50	508.398,90	559.238,79	2,78	0,02 €	-	201.442,47	4	
01.01.2021.	2021	Water	m³	83.713,35	-	-	-	7.330.960,33	8.057.389,58			-	-	57	
HDD -->	2369,2				13.411.471,54	- 1.510.123,42	2.313.284,16	132.069.298,69	153.185.320,86	11,42	0,10 €	6.659,46	24.156.090,00	188	

Observations: #5 - Consumption is increasing even though the number of buildings is lower (-2); #6 - Consumption is increasing even though the number of buildings is same, and HDD is lower

01.01.2022.	2022	Electricity	kWh	3.680.616,21	3.680.616,21	130.900,13	- 472.301,90	47.171.436,43	60.772.107,09	16,51	0,14 €	4.045,00	11.096.321,75	77	
01.01.2022.	2022	District heating	kWh	5.383.110,00	5.383.110,00	- 2.237.167,33	1.156.765,00	66.194.841,04	72.805.514,20	13,52	0,11 €	1.544,95	8.411.109,38	41	#7
01.01.2022.	2022	Natural gas	Sm³	414.812,59	4.268.172,62	1.267.519,49	- 486.703,17	17.345.206,17	19.079.699,53	4,47	0,04 €	768,27	4.268.172,62	10	
		Extra light fuel oil	l			- 377.688,62	-								
01.01.2022.	2022	Brown coal	t	49,92	143.867,97	11.959,28	67.977,80	820.307,04	984.368,44	6,84	0,06 €	50,35	143.867,97	1	
01.01.2022.	2022	Firewood	m³	114,21	227.848,05	- 13.503,06	26.405,58	657.073,32	722.780,65	3,17	0,03 €	-	227.848,05	1	
01.01.2022.	2022	Water	m³	75.244,62	-	-	-	6.897.674,61	7.584.015,66			-	-	57	
HDD -->	2560,4				13.703.614,85	- 1.217.980,11	292.143,31	139.086.538,61	161.948.485,57	11,82	0,10 €	6.408,57	24.147.319,77	187	

Observations: #7 - Increase of object number (+6)

During the analysis of the data sets for LSG Type 3, 7 observations were identified, and deeper insight was conducted using EMIS data.

The follow up analysis was performed to clarify the identified observations and was based on the data sets from Report 2 (based on energy consumption structured “by energy carrier” and “by object type”) and Report 3 (based on energy consumption structured “by energy carrier” and “by object type group”) extracted from the EMIS Analyzer. The data from these reports is shown below.

In 2022 the representative LSG Type 3 included 104 buildings of different building types divided into 7 building type groups as follows:

- A) Educational institution buildings (27)
  - A01 - Kindergartens and nursery (16)
  - A02 - Primary schools (9)
  - A03 - Secondary schools (1)
  - A08 - Primary and Secondary schools (1)
- C) Collective accommodation facilities (1)
  - C01 - Homes for the elderly (1)
- D) Cultural institution facilities (19)
  - D02 - Cinemas (1)
  - D03 – Theatres (1)
  - D04 – Museums (4)
  - D05 – Libraries (5)
  - D99 - Cultural institution facilities – Other (8)
- E) Sports facilities (7)
  - E01 - Sports centers (1)
  - E02 – Outdoor Pools (1)
  - E03 – Indoor Pools (1)
  - E04 - Sports halls (2)
  - E99 - Sports facilities – Other (2)
- F) Administrative facilities (47)
  - F01 - Local offices (40)
  - F02 - Municipal administration buildings (4)
  - F07 - Centers for social work (1)
  - F08 - Administrative buildings of organizations (2)
- H) Catering facilities (1)
  - H99 - Catering facilities – Other (1)
- Other (2)
  - Z01 – Other (2)

The energy consumption per energy source (carrier) / per building type group /per year is given below. Marked are the data that is missing or the data seems out of the usual expected range.

Table 9 Energy consumption: LSG Type 3 shown per energy source (carrier) / per building type group / per year 2018. – 2022.

Building type group: A) Educational institutions buildings

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate ->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti obrazovnih institucija	Električna energija	kWh	921.199,00	921.199,00	7.810.339,52	9.805.405,28	10,64	0,09 €	1.012,40	2.777.230,75	23
01.01.2019.	2019	Objekti obrazovnih institucija	Električna energija	kWh	877.952,45	877.952,45	7.543.011,72	9.211.894,00	10,49	0,09 €	964,87	2.646.851,06	23
01.01.2020.	2020	Objekti obrazovnih institucija	Električna energija	kWh	729.526,55	729.526,55	6.761.641,83	8.713.164,79	11,94	0,10 €	801,75	2.199.376,63	23
01.01.2021.	2021	Objekti obrazovnih institucija	Električna energija	kWh	1.020.657,00	1.020.657,00	10.267.953,00	13.235.976,28	12,97	0,11 €	1.121,70	3.077.076,72	23
01.01.2022.	2022	Objekti obrazovnih institucija	Električna energija	kWh	981.666,00	981.666,00	12.545.957,55	16.181.150,92	16,48	0,14 €	1.078,85	2.959.526,66	23
01.01.2018.	2018	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	14.347.177,00	14.347.177,00	27.332.801,62	30.066.081,79	2,10	0,02 €	4.117,64	22.417.464,06	16
01.01.2019.	2019	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	2.158.960,00	2.158.960,00	24.447.422,05	26.892.164,25	12,46	0,11 €	619,62	3.373.375,00	15
01.01.2020.	2020	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	2.277.260,00	2.277.260,00	25.877.017,36	28.408.809,26	12,47	0,11 €	653,57	3.558.218,75	17
01.01.2021.	2021	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	2.983.550,00	2.983.550,00	31.820.293,82	35.002.323,20	11,73	0,10 €	856,28	4.661.796,88	17
01.01.2022.	2022	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	2.745.030,00	2.745.030,00	31.101.281,85	34.211.410,03	12,46	0,11 €	787,82	4.289.109,38	18
01.01.2018.	2018	Objekti obrazovnih institucija	Prirodni gas	Sm³	67.435,00	693.865,69	2.262.881,20	2.489.169,32	3,59	0,03 €	124,90	693.865,69	3
01.01.2019.	2019	Objekti obrazovnih institucija	Prirodni gas	Sm³	63.655,00	654.971,76	2.090.209,58	2.299.230,54	3,51	0,03 €	117,89	654.971,76	3
01.01.2020.	2020	Objekti obrazovnih institucija	Prirodni gas	Sm³	65.975,00	678.843,17	2.171.268,59	2.388.395,45	3,52	0,03 €	122,19	678.843,17	3
01.01.2021.	2021	Objekti obrazovnih institucija	Prirodni gas	Sm³	78.261,00	805.258,73	2.542.277,28	2.796.505,01	3,47	0,03 €	144,95	805.258,73	3
01.01.2022.	2022	Objekti obrazovnih institucija	Prirodni gas	Sm³	64.614,36	664.843,02	3.950.093,34	4.345.102,68	6,54	0,06 €	119,67	664.843,02	3
01.01.2018.	2018	Objekti obrazovnih institucija	Ekstra lako lož ulje	l	43.649,00	450.335,46	6.488.994,76	7.786.793,71	17,29	0,15 €	126,09	450.335,46	1
01.01.2019.	2019	Objekti obrazovnih institucija	Ekstra lako lož ulje	l	31.045,00	320.297,47	4.797.704,00	5.757.244,80	17,97	0,15 €	89,68	320.297,47	1
01.01.2020.	2020	Objekti obrazovnih institucija	Ekstra lako lož ulje	l	18.000,00	185.709,60	2.181.150,00	2.617.380,00	14,09	0,12 €	52,00	185.709,60	1
01.01.2018.	2018	Objekti obrazovnih institucija	Mrki ugalj	t	8,00	23.057,60	100.000,00	120.000,00	5,20	0,04 €	8,07	23.057,60	3
01.01.2019.	2019	Objekti obrazovnih institucija	Mrki ugalj	t	10,00	28.822,00	125.000,00	150.000,00	5,20	0,04 €	10,09	28.822,00	3
01.01.2020.	2020	Objekti obrazovnih institucija	Mrki ugalj	t	13,00	37.468,60	158.600,00	190.320,00	5,08	0,04 €	13,11	37.468,60	3
01.01.2021.	2021	Objekti obrazovnih institucija	Mrki ugalj	t	13,04	37.583,89	163.000,00	195.600,00	5,20	0,04 €	13,15	37.583,89	3
01.01.2018.	2018	Objekti obrazovnih institucija	Ogrevno drvo	m³	68,64	136.936,80	312.000,00	343.200,00	2,51	0,02 €	-	136.936,80	3
01.01.2019.	2019	Objekti obrazovnih institucija	Ogrevno drvo	m³	91,52	182.582,40	416.000,00	457.600,00	2,51	0,02 €	-	182.582,40	3
01.01.2020.	2020	Objekti obrazovnih institucija	Ogrevno drvo	m³	71,50	142.642,50	360.000,00	396.000,00	2,78	0,02 €	-	142.642,50	3
01.01.2021.	2021	Objekti obrazovnih institucija	Ogrevno drvo	m³	62,92	125.525,40	316.800,00	348.480,00	2,78	0,02 €	-	125.525,40	3
01.01.2018.	2018	Objekti obrazovnih institucija	Voda	m³	34.463,00	-	2.122.458,61	2.333.598,05			-	-	18
01.01.2019.	2019	Objekti obrazovnih institucija	Voda	m³	22.662,91	-	1.400.778,62	1.540.229,26			-	-	17
01.01.2020.	2020	Objekti obrazovnih institucija	Voda	m³	18.493,57	-	1.144.622,51	1.258.505,70			-	-	17
01.01.2021.	2021	Objekti obrazovnih institucija	Voda	m³	19.405,03	-	1.616.977,72	1.777.984,29			-	-	17
01.01.2022.	2022	Objekti obrazovnih institucija	Voda	m³	21.899,70	-	2.008.630,72	2.208.328,27			-	-	17

Table 9 Energy consumption: LSG Type 3 shown per energy source (carrier) / per building type group / per year 2018. – 2022. – Continuation 1/4

Building type group: C) Collective accommodation facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate ->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti kolektivnog smeštaja	Električna energija	kWh	79.260,00	79.260,00	639.716,01	825.233,65	10,41	0,09 €	87,11	238.953,05	1
01.01.2019.	2019	Objekti kolektivnog smeštaja	Električna energija	kWh	84.540,00	84.540,00	888.654,77	1.146.364,65	13,56	0,12 €	92,91	254.871,19	1
01.01.2020.	2020	Objekti kolektivnog smeštaja	Električna energija	kWh	54.486,00	54.486,00	540.210,70	696.871,80	12,79	0,11 €	59,88	164.264,39	1
01.01.2021.	2021	Objekti kolektivnog smeštaja	Električna energija	kWh	82.620,00	82.620,00	994.673,16	1.283.128,38	15,53	0,13 €	90,80	249.082,78	1
01.01.2022.	2022	Objekti kolektivnog smeštaja	Električna energija	kWh	65.220,00	65.220,00	915.851,81	1.181.448,84	18,11	0,15 €	71,68	196.625,26	1
01.01.2018.	2018	Objekti kolektivnog smeštaja	Prirodni gas	Sm³	33.834,00	348.131,56	1.122.492,11	1.234.741,32	3,55	0,03 €	62,66	348.131,56	1
01.01.2019.	2019	Objekti kolektivnog smeštaja	Prirodni gas	Sm³	35.332,70	363.552,25	1.151.577,57	1.266.735,33	3,48	0,03 €	65,44	363.552,25	1
01.01.2020.	2020	Objekti kolektivnog smeštaja	Prirodni gas	Sm³	5.261,30	54.135,65	168.318,62	185.150,48	3,42	0,03 €	9,74	54.135,65	1
01.01.2021.	2021	Objekti kolektivnog smeštaja	Prirodni gas	Sm³	39.035,00	401.646,73	1.276.011,27	1.403.599,43	3,49	0,03 €	72,30	401.646,73	1
01.01.2022.	2022	Objekti kolektivnog smeštaja	Prirodni gas	Sm³	34.918,52	359.290,59	1.179.368,07	1.297.304,88	3,61	0,03 €	64,67	359.290,59	1
01.01.2018.	2018	Objekti kolektivnog smeštaja	Voda	m³	1.960,00	-	121.304,40	133.347,92			-	-	1
01.01.2019.	2019	Objekti kolektivnog smeštaja	Voda	m³	3.866,00	-	239.265,96	263.065,06			-	-	1
01.01.2020.	2020	Objekti kolektivnog smeštaja	Voda	m³	1.970,00	-	121.923,30	134.115,63			-	-	1
01.01.2021.	2021	Objekti kolektivnog smeštaja	Voda	m³	1.762,00	-	146.830,51	161.513,56			-	-	1
01.01.2022.	2022	Objekti kolektivnog smeštaja	Voda	m³	1.565,00	-	141.130,93	155.244,02			-	-	1

Building type group: D) Cultural institutions facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate -->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti institucija kulture	Električna energija	kWh	402.449,00	402.449,00	3.570.301,59	4.584.931,58	11,39	0,10 €	442,29	1.213.303,25	19
01.01.2019.	2019	Objekti institucija kulture	Električna energija	kWh	436.073,78	436.073,78	3.864.633,87	4.963.866,96	11,38	0,10 €	479,25	1.314.675,23	19
01.01.2020.	2020	Objekti institucija kulture	Električna energija	kWh	364.681,22	364.681,22	3.473.004,43	4.448.878,63	12,20	0,10 €	400,78	1.099.440,95	19
01.01.2021.	2021	Objekti institucija kulture	Električna energija	kWh	397.093,00	397.093,00	3.825.991,63	4.893.279,03	12,32	0,10 €	436,41	1.197.155,98	19
01.01.2022.	2022	Objekti institucija kulture	Električna energija	kWh	376.386,00	376.386,00	4.615.632,96	5.916.688,80	15,72	0,13 €	413,65	1.134.728,51	19
01.01.2018.	2018	Objekti institucija kulture	Daljinsko grejanje	kWh	150.881,00	150.881,00	8.197.449,21	9.017.075,62	59,76	0,51 €	43,30	235.751,56	8
01.01.2019.	2019	Objekti institucija kulture	Daljinsko grejanje	kWh	176.257,00	176.257,00	8.435.581,60	9.279.139,76	52,65	0,45 €	50,59	275.401,56	8
01.01.2020.	2020	Objekti institucija kulture	Daljinsko grejanje	kWh	172.010,00	172.010,00	8.890.623,13	9.779.685,45	56,86	0,48 €	49,37	268.765,63	8
01.01.2021.	2021	Objekti institucija kulture	Daljinsko grejanje	kWh	284.025,00	284.025,00	10.526.089,05	11.556.130,11	40,69	0,35 €	81,52	443.789,06	9
01.01.2022.	2022	Objekti institucija kulture	Daljinsko grejanje	kWh	1.600.670,00	1.600.670,00	11.335.175,33	12.459.881,92	7,78	0,07 €	459,39	2.501.046,88	9
01.01.2018.	2018	Objekti institucija kulture	Prirodni gas	Sm³	15.879,00	163.385,38	552.841,08	608.125,19	3,72	0,03 €	29,41	163.385,38	3
01.01.2019.	2019	Objekti institucija kulture	Prirodni gas	Sm³	16.170,00	166.379,60	600.594,24	660.653,66	3,97	0,03 €	29,95	166.379,60	3
01.01.2020.	2020	Objekti institucija kulture	Prirodni gas	Sm³	17.103,00	175.979,61	559.115,28	615.026,81	3,49	0,03 €	31,68	175.979,61	3
01.01.2021.	2021	Objekti institucija kulture	Prirodni gas	Sm³	20.946,00	215.521,77	687.051,17	755.756,29	3,51	0,03 €	38,79	215.521,77	3
01.01.2022.	2022	Objekti institucija kulture	Prirodni gas	Sm³	26.728,84	275.023,73	611.979,07	673.176,98	2,45	0,02 €	49,50	275.023,73	3

Table 9 Energy consumption: LSG Type 3 shown per energy source (carrier) / per building type group / per year 2018. – 2022. – Continuation 2/4

Building type group: D) Cultural institution facilities - Continuation

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate -->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti institucija kulture	Ekstra lako lož ulje	l	9.857,00	101.696,64	1.207.085,28	1.448.502,33	14,24	0,12 €	28,48	101.696,64	1
01.01.2019.	2019	Objekti institucija kulture	Ekstra lako lož ulje	l	3.272,00	33.757,88	470.320,00	564.384,00	16,72	0,14 €	9,45	33.757,88	1
01.01.2020.	2020	Objekti institucija kulture	Ekstra lako lož ulje	l	4.000,00	41.268,80	513.480,00	616.176,00	14,93	0,13 €	11,56	41.268,80	1
01.01.2018.	2018	Objekti institucija kulture	Mrki ugalj	t	11,00	31.704,20	137.500,00	165.000,00	5,20	0,04 €	11,10	31.704,20	1
01.01.2019.	2019	Objekti institucija kulture	Mrki ugalj	t	33,94	97.821,87	4.412.200,00	5.294.640,00	54,13	0,46 €	34,24	97.821,87	1
01.01.2020.	2020	Objekti institucija kulture	Mrki ugalj	t	61,36	176.851,79	560.050,00	672.060,00	3,80	0,03 €	61,90	176.851,79	1
01.01.2021.	2021	Objekti institucija kulture	Mrki ugalj	t	13,29	38.306,28	179.423,63	215.308,36	5,62	0,05 €	13,41	38.306,28	1
01.01.2022.	2022	Objekti institucija kulture	Mrki ugalj	t	49,92	143.867,97	820.307,04	984.368,44	6,84	0,06 €	50,35	143.867,97	1
01.01.2018.	2018	Objekti institucija kulture	Ogrevno drvo	m³	17,16	34.234,20	69.600,00	76.560,00	2,24	0,02 €	-	34.234,20	1
01.01.2019.	2019	Objekti institucija kulture	Ogrevno drvo	m³	49,15	98.061,96	223.426,67	245.769,33	2,51	0,02 €	-	98.061,96	1
01.01.2020.	2020	Objekti institucija kulture	Ogrevno drvo	m³	64,96	129.595,47	326.773,33	359.450,67	2,77	0,02 €	-	129.595,47	1
01.01.2021.	2021	Objekti institucija kulture	Ogrevno drvo	m³	38,05	75.917,07	191.598,90	210.758,79	2,78	0,02 €	-	75.917,07	1
01.01.2022.	2022	Objekti institucija kulture	Ogrevno drvo	m³	114,21	227.848,05	657.073,32	722.780,65	3,17	0,03 €	-	227.848,05	1
01.01.2018.	2018	Objekti institucija kulture	Voda	m³	3.501,13	-	222.980,40	245.465,07			-	-	14
01.01.2019.	2019	Objekti institucija kulture	Voda	m³	2.091,56	-	134.422,81	147.801,78			-	-	14
01.01.2020.	2020	Objekti institucija kulture	Voda	m³	1.832,38	-	116.523,88	128.168,49			-	-	12
01.01.2021.	2021	Objekti institucija kulture	Voda	m³	3.028,60	-	260.580,89	286.629,37			-	-	12
01.01.2022.	2022	Objekti institucija kulture	Voda	m³	3.406,00	-	317.768,80	349.347,36			-	-	12

Building type group: E) Sports facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate -->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Sportski objekti	Električna energija	kWh	1.247.584,00	1.247.584,00	11.277.653,75	14.543.910,34	11,66	0,10 €	1.371,09	3.761.216,24	7
01.01.2019.	2019	Sportski objekti	Električna energija	kWh	953.139,11	953.139,11	8.884.980,86	11.457.286,91	12,02	0,10 €	1.047,50	2.873.523,78	7
01.01.2020.	2020	Sportski objekti	Električna energija	kWh	1.305.149,00	1.305.149,00	13.228.946,73	17.058.907,63	13,07	0,11 €	1.434,36	3.934.763,21	6
01.01.2021.	2021	Sportski objekti	Električna energija	kWh	1.510.478,00	1.510.478,00	15.086.361,36	19.453.082,00	12,88	0,11 €	1.660,02	4.553.789,07	6
01.01.2022.	2022	Sportski objekti	Električna energija	kWh	1.502.805,00	1.502.805,00	18.863.614,81	24.325.738,94	16,19	0,14 €	1.651,58	4.530.656,51	6
01.01.2018.	2018	Sportski objekti	Daljinsko grejanje	kWh	1.034.340,00	1.034.340,00	10.065.919,34	11.072.511,27	10,70	0,09 €	296,86	1.616.156,25	2
01.01.2019.	2019	Sportski objekti	Daljinsko grejanje	kWh	924.690,00	924.690,00	9.174.552,07	10.092.007,28	10,91	0,09 €	265,39	1.444.828,13	2
01.01.2020.	2020	Sportski objekti	Daljinsko grejanje	kWh	894.510,00	894.510,00	9.089.545,38	9.998.499,92	11,18	0,10 €	256,72	1.397.671,88	2
01.01.2021.	2021	Sportski objekti	Daljinsko grejanje	kWh	918.990,00	918.990,00	8.960.555,78	9.856.611,35	10,73	0,09 €	263,75	1.435.921,88	2
01.01.2022.	2022	Sportski objekti	Daljinsko grejanje	kWh	984.480,00	984.480,00	9.710.318,68	10.681.350,55	10,85	0,09 €	282,55	1.538.250,00	2

Table 9 Energy consumption: LSG Type 3 shown per energy source (carrier) / per building type group / per year 2018. – 2022. – Continuation 3/4

Building type group: E) Sports facilities – continuation

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate ->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Sportski objekti	Prirodni gas	Sm³	146.358,00	1.505.936,01	5.458.337,56	6.004.171,32	3,99	0,03 €	271,07	1.505.936,01	2
01.01.2019.	2019	Sportski objekti	Prirodni gas	Sm³	125.687,00	1.293.243,82	5.829.289,40	6.412.218,34	4,96	0,04 €	232,78	1.293.243,82	2
01.01.2020.	2020	Sportski objekti	Prirodni gas	Sm³	224.909,00	2.314.178,66	8.679.662,58	9.546.955,70	4,13	0,04 €	416,55	2.314.178,66	2
01.01.2021.	2021	Sportski objekti	Prirodni gas	Sm³	302.511,00	3.112.656,68	10.757.095,60	11.832.502,43	3,80	0,03 €	560,28	3.112.656,68	2
01.01.2022.	2022	Sportski objekti	Prirodni gas	Sm³	269.719,13	2.775.247,99	10.945.635,67	12.040.199,24	4,34	0,04 €	499,54	2.775.247,99	2
01.01.2018.	2018	Sportski objekti	Voda	m³	29.719,00	-	1.847.761,33	2.029.996,46			-	-	6
01.01.2019.	2019	Sportski objekti	Voda	m³	44.470,00	-	2.747.555,05	3.019.249,67			-	-	5
01.01.2020.	2020	Sportski objekti	Voda	m³	40.953,00	-	2.529.834,55	2.780.297,27			-	-	5
01.01.2021.	2021	Sportski objekti	Voda	m³	52.205,00	-	4.365.169,90	4.796.081,13			-	-	5
01.01.2022.	2022	Sportski objekti	Voda	m³	44.145,00	-	3.929.987,41	4.321.178,92			-	-	5

Building type group: F) Administrative facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate ->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Administrativni objekti	Električna energija	kWh	1.064.895,19	1.064.895,19	9.940.328,53	12.767.912,17	11,99	0,10 €	1.170,32	3.210.446,03	82
01.01.2019.	2019	Administrativni objekti	Električna energija	kWh	776.250,63	776.250,63	7.131.685,38	9.164.361,55	11,81	0,10 €	853,10	2.340.240,39	37
01.01.2020.	2020	Administrativni objekti	Električna energija	kWh	759.047,93	759.047,93	7.034.291,86	9.050.290,82	11,92	0,10 €	834,19	2.288.377,69	28
01.01.2021.	2021	Administrativni objekti	Električna energija	kWh	924.353,11	924.353,11	9.519.021,80	12.253.986,88	13,26	0,11 €	1.015,86	2.786.739,75	26
01.01.2022.	2022	Administrativni objekti	Električna energija	kWh	564.545,21	564.545,21	7.495.220,56	9.642.886,91	17,08	0,15 €	620,44	1.701.990,90	25
01.01.2018.	2018	Administrativni objekti	Daljinsko grejanje	kWh	236.967,00	236.967,00	17.376.484,20	19.114.132,62	80,66	0,69 €	68,01	370.260,94	16
01.01.2019.	2019	Administrativni objekti	Daljinsko grejanje	kWh	275.240,00	275.240,00	14.492.863,27	15.942.149,59	57,92	0,49 €	78,99	430.062,50	8
01.01.2020.	2020	Administrativni objekti	Daljinsko grejanje	kWh	212.540,00	212.540,00	15.673.751,26	17.241.112,98	81,12	0,69 €	61,00	332.093,75	7
01.01.2021.	2021	Administrativni objekti	Daljinsko grejanje	kWh	39.780,00	39.780,00	14.517.284,53	15.969.009,89	401,43	3,41 €	11,42	62.156,25	7
01.01.2022.	2022	Administrativni objekti	Daljinsko grejanje	kWh	52.930,00	52.930,00	14.048.065,18	15.452.871,70	291,95	2,48 €	15,19	82.703,13	12

Observation: High district heating unit costs?

01.01.2018.	2018	Administrativni objekti	Prirodni gas	Sm³	6.021,00	61.952,48	242.971,80	267.268,98	4,31	0,04 €	11,15	61.952,48	5
01.01.2018.	2018	Administrativni objekti	Voda	m³	6.923,67	-	651.344,98	716.061,01			-	-	31
01.01.2019.	2019	Administrativni objekti	Voda	m³	5.120,95	-	503.852,35	554.025,77			-	-	26
01.01.2020.	2020	Administrativni objekti	Voda	m³	3.585,97	-	343.549,21	377.796,37			-	-	20
01.01.2021.	2021	Administrativni objekti	Voda	m³	4.699,41	-	592.950,12	652.038,88			-	-	19
01.01.2022.	2022	Administrativni objekti	Voda	m³	2.201,92	-	200.435,11	220.347,32			-	-	19

Table 9 Energy consumption: LSG Type 3 shown per energy source (carrier) / per building type group / per year 2018. – 2022. – Continuation 4/4

Building type group: H) Catering facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate ->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Ugostiteljski objekti	Električna energija	kWh	23.002,00	23.002,00	174.522,94	224.264,59	9,75	0,08 €	25,28	69.346,43	1
01.01.2019.	2019	Ugostiteljski objekti	Električna energija	kWh	28.836,00	28.836,00	198.148,80	254.846,35	8,84	0,08 €	31,69	86.934,77	1
01.01.2020.	2020	Ugostiteljski objekti	Električna energija	kWh	47.590,00	47.590,00	414.598,06	533.204,59	11,20	0,10 €	52,30	143.474,33	1
01.01.2021.	2021	Ugostiteljski objekti	Električna energija	kWh	46.864,00	46.864,00	421.196,30	541.262,19	11,55	0,10 €	51,50	141.285,59	1
01.01.2022.	2022	Ugostiteljski objekti	Električna energija	kWh	19.105,00	19.105,00	253.044,77	324.346,72	16,98	0,14 €	21,00	57.597,75	1
01.01.2018.	2018	Ugostiteljski objekti	Voda	m³	522,00	-	32.090,10	35.299,11			-	-	1
01.01.2019.	2019	Ugostiteljski objekti	Voda	m³	425,00	-	26.028,03	28.630,83			-	-	1
01.01.2020.	2020	Ugostiteljski objekti	Voda	m³	562,70	-	34.468,84	37.915,73			-	-	1
01.01.2021.	2021	Ugostiteljski objekti	Voda	m³	326,30	-	26.972,24	29.669,46			-	-	1
01.01.2022.	2022	Ugostiteljski objekti	Voda	m³	203,00	-	18.748,24	20.623,06			-	-	1

Building type group: Other

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate -->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Ostalo	Električna energija	kWh	193.901,37	193.901,37	1.931.256,58	2.490.189,98	12,84	0,11 €	213,10	584.573,86	2
01.01.2019.	2019	Ostalo	Električna energija	kWh	166.249,00	166.249,00	1.793.010,95	2.310.503,13	13,90	0,12 €	182,71	501.207,49	2
01.01.2020.	2020	Ostalo	Električna energija	kWh	129.829,00	129.829,00	1.497.819,21	1.930.485,93	14,87	0,13 €	142,68	391.408,47	2
01.01.2021.	2021	Ostalo	Električna energija	kWh	170.853,00	170.853,00	1.960.455,95	2.526.907,14	14,79	0,13 €	187,77	515.087,62	2
01.01.2022.	2022	Ostalo	Električna energija	kWh	170.889,00	170.889,00	2.482.113,96	3.199.845,97	18,72	0,16 €	187,81	515.196,16	2
01.01.2018.	2018	Ostalo	Prirodni gas	Sm^3	16.215,00	166.842,62	530.109,56	583.120,52	3,50	0,03 €	30,03	166.842,62	1
01.01.2019.	2019	Ostalo	Prirodni gas	Sm^3	14.158,00	145.677,33	484.364,38	532.800,82	3,66	0,03 €	26,22	145.677,33	1
01.01.2020.	2020	Ostalo	Prirodni gas	Sm^3	20.884,00	214.883,83	685.235,46	753.759,01	3,51	0,03 €	38,68	214.883,83	1
01.01.2021.	2021	Ostalo	Prirodni gas	Sm^3	21.361,00	219.791,87	725.204,13	797.724,54	3,63	0,03 €	39,56	219.791,87	1
01.01.2022.	2022	Ostalo	Prirodni gas	Sm^3	18.831,74	193.767,29	658.130,01	723.915,76	3,74	0,03 €	34,88	193.767,29	1
01.01.2018.	2018	Ostalo	Voda	m^3	2.059,82	-	238.323,02	262.093,26			-	-	2
01.01.2019.	2019	Ostalo	Voda	m^3	3.459,00	-	370.143,61	407.094,15			-	-	2
01.01.2020.	2020	Ostalo	Voda	m^3	1.107,00	-	123.946,93	136.268,56			-	-	2
01.01.2021.	2021	Ostalo	Voda	m^3	2.287,00	-	321.478,96	353.472,88			-	-	2
01.01.2022.	2022	Ostalo	Voda	m^3	1.824,00	-	280.973,40	308.946,71			-	-	2

Further analysis of the identified High District heating energy unit cost, using the data from Report 3, disclosed the following:

The increase of the unit cost of District heating energy resulted from the fact that for some building types the energy consumption is not measured but is charged as a lump sum based on the useful area of the building (square meters).

Table 10 Details of district heating energy consumption for LSG Type 3 per Object type where energy is charged by lump sum approach.

Date	Year	Object Type Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2019.	2019	Srednje škole	Daljinsko grejanje	kWh			230.786,16	253.864,77		- €			1
01.01.2020.	2020	Srednje škole	Daljinsko grejanje	kWh			272.610,34	299.871,38		- €			1
01.01.2021.	2021	Srednje škole	Daljinsko grejanje	kWh			278.158,60	305.974,46		- €			1
01.01.2022.	2022	Srednje škole	Daljinsko grejanje	kWh			247.210,16	271.931,18		- €			1
01.01.2018.	2018	Pozorišta	Daljinsko grejanje	kWh			3.534.050,00	3.887.455,00		- €			1
01.01.2019.	2019	Pozorišta	Daljinsko grejanje	kWh			3.556.800,00	3.912.480,00		- €			1
01.01.2020.	2020	Pozorišta	Daljinsko grejanje	kWh			3.776.375,00	4.154.012,50		- €			1
01.01.2021.	2021	Pozorišta	Daljinsko grejanje	kWh			4.017.775,00	4.419.552,50		- €			1
01.01.2022.	2022	Pozorišta	Daljinsko grejanje	kWh			3.577.950,00	3.935.745,00		- €			1
01.01.2018.	2018	Objekti institucija kulture - Ostalo	Daljinsko grejanje	kWh			628.562,43	691.418,67		- €			2
01.01.2019.	2019	Objekti institucija kulture - Ostalo	Daljinsko grejanje	kWh			632.991,69	696.290,86		- €			2
01.01.2020.	2020	Objekti institucija kulture - Ostalo	Daljinsko grejanje	kWh			670.466,54	737.513,20		- €			2
01.01.2021.	2021	Centri za socijalni rad	Daljinsko grejanje	kWh			1.658.630,29	1.824.493,32		- €			1
01.01.2022.	2022	Centri za socijalni rad	Daljinsko grejanje	kWh			1.482.373,31	1.630.610,64		- €			1

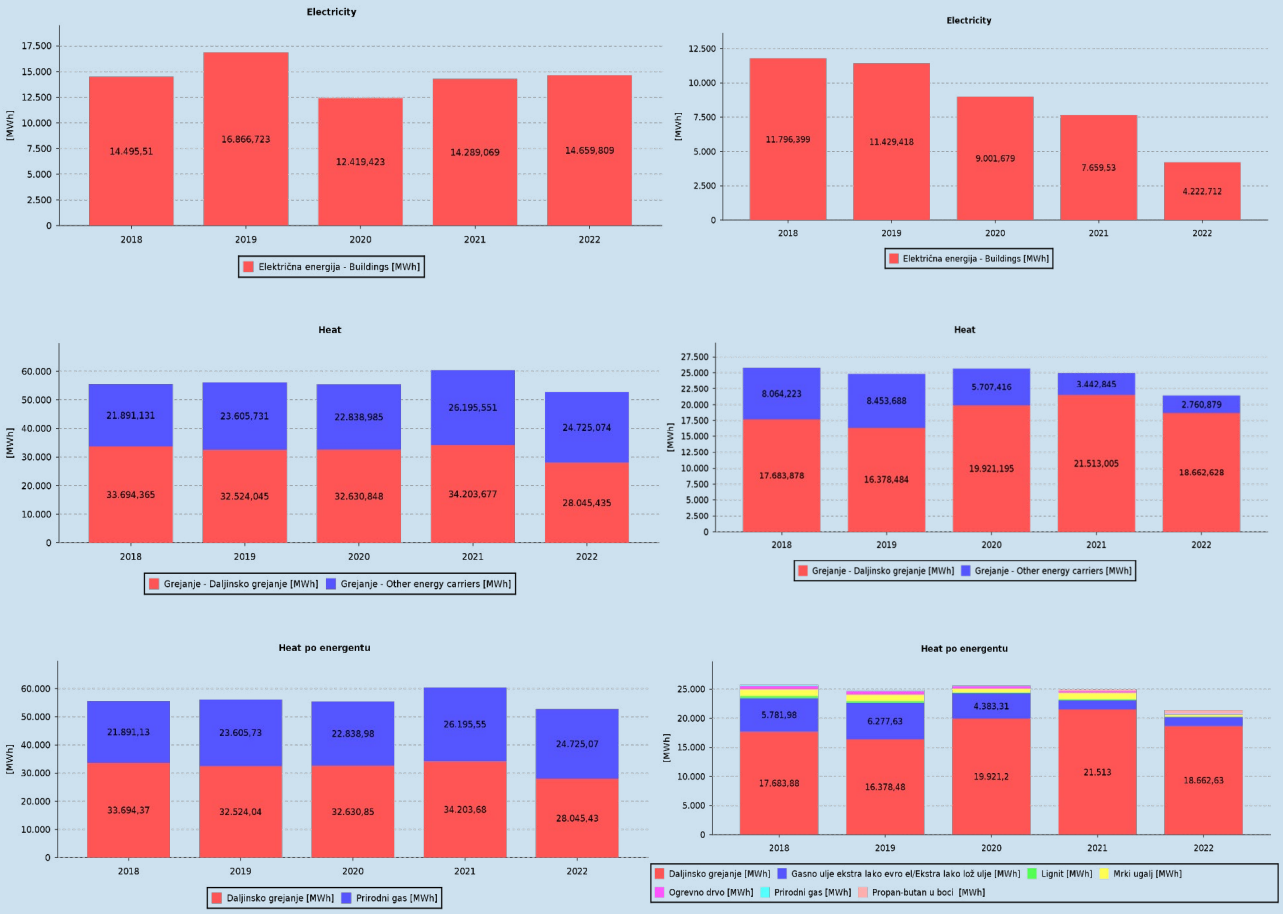
Observation: Specific increase of unit price for district hearing energy in 2021 and 2022 is result of addition of new object for which energy is charged by lump sum approach

01.01.2018.	2018	Administrativni objekti organizacija	Daljinsko grejanje	kWh			275.245,89	302.770,48		- €			2
01.01.2019.	2019	Administrativni objekti organizacija	Daljinsko grejanje	kWh			267.274,05	294.001,46		- €			2
01.01.2020.	2020	Administrativni objekti organizacija	Daljinsko grejanje	kWh			287.503,73	316.254,10		- €			2
01.01.2021.	2021	Administrativni objekti organizacija	Daljinsko grejanje	kWh			305.977,67	336.575,44		- €			2
01.01.2022.	2022	Administrativni objekti organizacija	Daljinsko grejanje	kWh			278.383,34	306.221,68		- €			2

Data review for LSG Type 4 – 200.000 to 400.000 inhabitants

As part of the selection process for representative LSG with 200.000 to 400.000 inhabitants the available EMIS data for several candidates was analyzed. The analysis took into consideration the availability, completeness and quality of the data in EMIS, the number and types of public buildings according to its purpose (i.e. educational, social, health, etc.) and the energy source types.

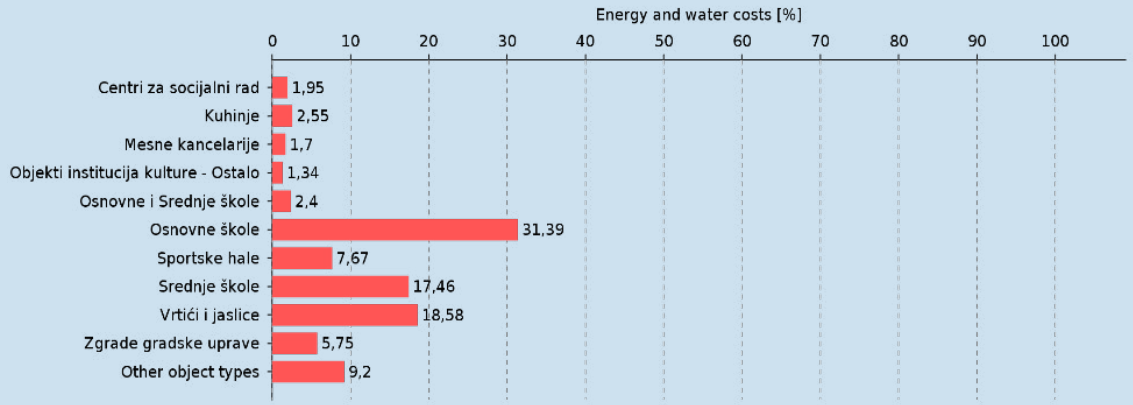
The typical consumption of electricity and heat by energy source type for an LSG of this size is shown in the two examples below:



Picture 11 Trends of total electricity and heat consumption for LSG Type 4

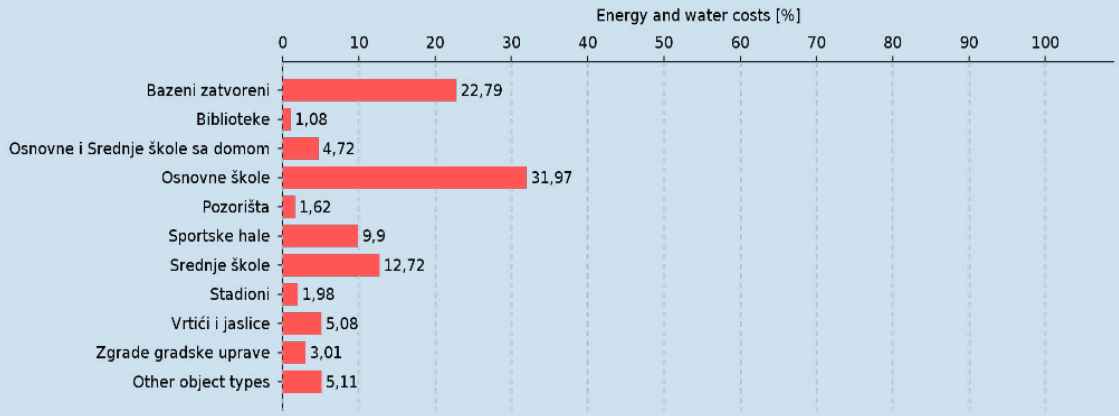
The typical types of buildings according to their purpose and share in total cost of energy and water for an LSG of this size are shown in the two examples below:

2022	Energy and water costs	
Object Type	[RSD]	[%]
Centri za socijalni rad	13.890.760	1,95
Kuhinje	18.151.338	2,55
Mesne kancelarije	12.128.323	1,70
Objekti institucija kulture - Ostalo	9.558.585	1,34
Osnovne i Srednje škole	17.066.284	2,40
Osnovne škole	223.589.625	31,39
Sportske hale	54.664.178	7,67
Srednje škole	124.385.839	17,46
Vrtići i jaslice	132.334.190	18,58
Zgrade gradske uprave	40.975.689	5,75
Other object types	65.535.431	9,20



Picture 12 Typical types of buildings in LSG Type 4 according to the building purpose and their share in total cost of energy

2022	Energy and water costs	
Object Type	[RSD]	[%]
Bazeni zatvoreni	67.104.635	22,79
Biblioteke	3.190.595	1,08
Osnovne i Srednje škole sa domom	13.892.104	4,72
Osnovne škole	94.117.844	31,97
Pozorišta	4.783.643	1,62
Sportske hale	29.145.994	9,90
Srednje škole	37.454.146	12,72
Stadioni	5.841.961	1,98
Vrtići i jaslice	14.961.903	5,08
Zgrade gradske uprave	8.855.558	3,01
Other object types	15.034.867	5,11



Picture 12 Typical types of buildings in LSG Type 4 according to the building purpose and their share in total cost of energy

An LSG of this size usually has between 250 and 550 buildings.

The energy consumption data sets for LSG Type 1 is shown below for the period from 2018 to 2022. The baseline consumption is calculated for the period from 2018 to 2020.

Table 11 Energy consumption in buildings: LSG Type 4 by energy source (carrier) - years 2018. to 2022

Date	Year	Energy Source	Unit	Consumption	Energy [kWh]	Compared to baseline	Compared to previous year	Cost [RSD]	Cost + tax [RSD]	Cost per kWh exchange rate -->	Cost per kWh [EUR] 0,00850	Emission CO_2[t]	Primary energy [kWh]	Number of objects	#1
BASELINE --> AVERAGE of 2018 to 2020															
		Electricity	kWh	14.235.507,09	14.235.507,09	-		141.515.578,53	182.366.357,06	12,81	0,11 €	15.644,82	42.917.206,78	360	
		District heating	kWh	32.497.795,89	32.497.795,89	-		264.338.661,57	290.772.527,73	8,95	0,08 €	9.326,87	50.777.806,07	144	
		Natural gas	Sm³	2.189.133,39	22.524.869,07	-		91.950.739,68	101.145.800,58	4,49	0,04 €	4.054,48	22.524.869,07	106	
		Water	m³	357.831,54	-	-		66.763.067,21	73.439.329,50			-	-	225	
HDD -->	**2242,039**				**69.258.172,05**			**564.568.046,98**	**647.724.014,87**	**9,35**	**0,08 €**	**29.026,16**	**116.219.881,93**	**835**	

Observations: #1 - Significant variation of object number by years

01.01.2018.	2018	Electricity	kWh	14.108.027,85	14.108.027,85	- 127.479,24		131.201.583,95	169.112.626,43	11,99	0,10 €	15.504,72	42.532.882,35	286	
01.01.2018.	2018	District heating	kWh	33.238.152,97	33.238.152,97	740.357,08		282.877.118,48	311.164.830,33	9,36	0,08 €	9.539,35	51.934.614,02	144	
01.01.2018.	2018	Natural gas	Sm³	2.105.776,74	21.667.179,23	- 857.689,84		87.861.559,03	96.647.714,93	4,46	0,04 €	3.900,09	21.667.179,23	97	
01.01.2018.	2018	Water	m³	397.823,71	-	-		74.585.183,25	82.043.701,57			-	-	227	
HDD -->	**2316,21**				**69.013.360,05**	**- 244.812,00**		**576.525.444,71**	**658.968.873,26**	**9,55**	**0,08 €**	**28.944,16**	**116.134.675,60**	**754**	
01.01.2019.	2019	Electricity	kWh	16.494.917,04	16.494.917,04	2.259.409,95	2.386.889,19	165.270.620,60	213.013.152,01	12,91	0,11 €	18.127,91	49.728.875,89	381	#2
01.01.2019.	2019	District heating	kWh	32.092.697,52	32.092.697,52	- 405.098,37	- 1.145.455,45	259.173.348,89	285.090.683,78	8,88	0,08 €	9.210,60	50.144.839,88	148	#3
01.01.2019.	2019	Natural gas	Sm³	2.272.487,57	23.382.533,61	857.664,54	1.715.354,38	99.271.917,98	109.199.070,88	4,67	0,04 €	4.208,86	23.382.533,61	120	#4
01.01.2019.	2019	Water	m³	405.812,37	-	-	-	77.231.188,84	84.954.307,73			-	-	225	
HDD -->	**2129,097**				**71.970.148,17**	**2.711.976,12**	**2.956.788,12**	**600.947.076,31**	**692.257.214,40**	**9,62**	**0,08 €**	**31.547,37**	**123.256.249,38**	**874**	

Observations: #2 - Increase in the number of objects (+14); #3 – Decrease of energy consumption despite increase of object number (+4); #4 - Increase in the number of objects (+23).

01.01.2020.	2020	Electricity	kWh	12.103.576,39	12.103.576,39	- 2.131.930,70	- 4.391.340,65	128.074.531,03	164.973.292,73	13,63	0,12 €	13.301,83	36.489.862,11	412	#5
01.01.2020.	2020	District heating	kWh	32.162.537,17	32.162.537,17	- 335.258,72	69.839,65	250.965.517,34	276.062.069,07	8,58	0,07 €	9.230,65	50.253.964,32	141	#6
01.01.2020.	2020	Natural gas	Sm³	2.189.135,85	22.524.894,38	25,31	- 857.639,23	88.718.742,03	97.590.615,94	4,33	0,04 €	4.054,48	22.524.894,38	102	#7
01.01.2020.	2020	Water	m³	269.858,53	-	-	-	48.472.829,53	53.319.979,20			-	-	222	
HDD -->	**2280,809**				**66.791.007,94**	**- 2.467.164,11**	**- 5.179.140,23**	**516.231.619,93**	**591.945.956,94**	**8,86**	**0,08 €**	**26.586,96**	**109.268.720,81**	**877**	

Observations: #5 - Energy consumption reduction despite increase of HDD-s and number of objects (+31); #6 – Decrease of object number (-7); #7 - Decrease of object number (-18)

01.01.2021.	2021	Electricity	kWh	13.645.831,35	13.645.831,35	- 589.675,74	1.542.254,96	164.272.375,56	211.650.039,22	15,51	0,13 €	14.996,77	41.139.452,35	391	#8
01.01.2021.	2021	District heating	kWh	33.634.974,79	33.634.974,79	1.137.178,90	1.472.437,62	256.094.222,29	281.703.644,52	8,38	0,07 €	9.653,24	52.554.648,11	137	
01.01.2021.	2021	Natural gas	Sm³	2.506.188,36	25.787.174,50	3.262.305,43	3.262.280,12	98.037.368,72	107.841.893,09	4,18	0,04 €	4.641,69	25.787.174,50	102	
01.01.2021.	2021	Water	m³	307.671,85	-	-	-	58.355.449,50	64.190.994,45			-	-	227	
HDD -->	**2561,732**				**73.067.980,64**	**3.809.808,59**	**6.276.972,70**	**576.759.416,07**	**665.386.571,28**	**9,11**	**0,08 €**	**29.291,70**	**119.481.274,96**	**857**	

Observations: #8 - Decrease of object number (-21)

01.01.2022.	2022	Electricity	kWh	13.509.797,57	13.509.797,57	- 725.709,52	- 136.033,78	192.195.012,92	247.417.275,83	18,31	0,16 €	14.847,27	40.729.337,70	394	
01.01.2022.	2022	District heating	kWh	27.551.016,29	27.551.016,29	- 4.946.779,60	- 6.083.958,50	225.379.504,85	247.917.455,34	9,00	0,08 €	7.907,14	43.048.462,95	125	#9
01.01.2022.	2022	Natural gas	Sm³	2.364.794,33	24.332.314,83	1.807.445,76	- 1.454.859,67	107.741.057,25	118.488.672,87	4,87	0,04 €	4.379,82	24.332.314,83	102	
01.01.2022.	2022	Water	m³	289.755,44	-	-	-	56.812.940,24	62.495.264,77			-	-	227	
HDD -->	**2218,241**				**65.393.128,69**	**3.865.043,36**	**- 7.674.851,95**	**582.128.515,26**	**676.318.668,81**	**10,34**	**0,09 €**	**27.134,23**	**108.110.115,48**	**848**	

Observations: #9 - Decrease of object number (-12)

During the analysis of the data sets for LSG Type 4, 9 observations were identified, and deeper insight was conducted using EMIS data.

The follow up analysis was performed to clarify the identified observations and was based on the data sets from Report 2 (based on energy consumption structured “by energy carrier” and “by object type”) and Report 3 (based on energy consumption structured “by energy carrier” and “by object type group”) extracted from EMIS Analyzer. The data from these reports is shown below.

In 2022 the representative LSG Type 4 included 300 buildings of different building types divided into 9 building type groups as follows:

- A) Educational institution buildings (133)
  - A01 - Kindergartens and nursery (67)
  - A02 - Primary schools (44)
  - A03 - Secondary schools (16)
  - A08 - Primary and Secondary schools (2)
  - A09 - Primary and secondary schools with a dormitory (1)
  - A99 - Educational institutions buildings – Other (3)
- B) Health care facilities (4)
  - B02 - Health centers (3)
  - B99 - Health facilities – Other (1)
- C) Collective accommodation facilities (2)
  - C02 - Student and pupil dormitories (1)
  - C03 - Homes for neglected children (1)
- D) Cultural institution facilities (42)
  - D03 – Theaters (3)
  - D04 – Museums (3)
  - D05 – Libraries (20)
  - D06 - Cultural centers (7)
  - D99 - Cultural institutions facilities – Other (9)
- E) Sports facilities (4)
  - E04 - Sports halls (4)
- F) Administrative facilities (81)
  - F01 - Local offices (43)
  - F02 - Municipal administration buildings (14)
  - F07 - Centers for social work (20)
  - F08 - Administrative buildings of organizations (1)
  - F99 - Administrative facilities – Other (3)
- H) Catering facilities (4)
  - H01 - Kitchens (4)
- I) Public companies (JP) and Public utility companies (JKP) facilities (23)
  - I01 - Production facilities of JP and JKP (23)
- Other (7)
  - Z01 – Other (7)

The energy consumption per energy source (carrier) / per building type group /per year is given below. Marked are the data that is missing or the data seems out of the usual expected range.

Table 12 Energy consumption: LSG Type 4 shown per energy source (carrier) / per building type group / per year 2018. – 2022.

Building type group: A) Educational institution buildings

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti obrazovnih institucija	Električna energija	kWh	8.420.276,82	8.420.276,82	79.972.392,10	103.105.485,41	12,24	0,10 €	9.253,88	25.385.450,55	129
01.01.2019.	2019	Objekti obrazovnih institucija	Električna energija	kWh	8.728.341,30	8.728.341,30	91.161.813,98	117.533.697,37	13,47	0,11 €	9.592,45	26.314.203,36	129
01.01.2020.	2020	Objekti obrazovnih institucija	Električna energija	kWh	6.969.523,16	6.969.523,16	76.539.687,87	98.637.371,52	14,15	0,12 €	7.659,51	21.011.718,44	131
01.01.2021.	2021	Objekti obrazovnih institucija	Električna energija	kWh	8.516.225,00	8.516.225,00	98.491.110,41	126.959.316,93	14,91	0,13 €	9.359,33	25.674.715,13	132
01.01.2022.	2022	Objekti obrazovnih institucija	Električna energija	kWh	8.237.068,71	8.237.068,71	119.663.958,95	154.274.993,42	18,73	0,16 €	9.052,54	24.833.114,75	130
01.01.2018.	2018	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	25.056.188,10	25.056.188,10	211.845.144,98	233.029.659,48	9,30	0,08 €	7.191,13	39.150.293,90	66
01.01.2019.	2019	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	24.029.424,12	24.029.424,12	194.794.181,82	214.273.600,01	8,92	0,08 €	6.896,44	37.545.975,18	66
01.01.2020.	2020	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	26.371.750,63	26.371.750,63	204.946.821,85	225.441.504,03	8,55	0,07 €	7.568,69	41.205.860,36	66
01.01.2021.	2021	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	27.917.189,15	27.917.189,15	212.253.093,50	233.478.402,85	8,36	0,07 €	8.012,23	43.620.608,05	66
01.01.2022.	2022	Objekti obrazovnih institucija	Daljinsko grejanje	kWh	22.825.852,87	22.825.852,87	187.182.158,15	205.900.373,97	9,02	0,08 €	6.551,02	35.665.395,11	64
01.01.2018.	2018	Objekti obrazovnih institucija	Prirodni gas	Sm³	1.697.097,97	17.462.119,83	73.089.949,92	80.398.944,91	4,60	0,04 €	3.143,18	17.462.119,83	59
01.01.2019.	2019	Objekti obrazovnih institucija	Prirodni gas	Sm³	1.733.009,08	17.831.623,67	77.131.066,45	84.844.134,20	4,76	0,04 €	3.209,69	17.831.623,67	59
01.01.2020.	2020	Objekti obrazovnih institucija	Prirodni gas	Sm³	1.525.416,06	15.695.616,05	61.164.042,03	67.280.445,94	4,29	0,04 €	2.825,21	15.695.616,05	59
01.01.2021.	2021	Objekti obrazovnih institucija	Prirodni gas	Sm³	1.775.593,63	18.269.793,08	68.339.985,67	75.173.912,74	4,11	0,03 €	3.288,56	18.269.793,08	60
01.01.2022.	2022	Objekti obrazovnih institucija	Prirodni gas	Sm³	1.609.640,86	16.562.238,67	71.610.989,06	78.744.078,69	4,75	0,04 €	2.981,20	16.562.238,67	60
01.01.2018.	2018	Objekti obrazovnih institucija	Voda	m³	267.706,26	-	49.840.411,19	54.824.452,31			-	-	122
01.01.2019.	2019	Objekti obrazovnih institucija	Voda	m³	248.398,44	-	47.297.547,79	52.027.302,57			-	-	122
01.01.2020.	2020	Objekti obrazovnih institucija	Voda	m³	217.627,67	-	39.431.786,46	43.374.965,10			-	-	122
01.01.2021.	2021	Objekti obrazovnih institucija	Voda	m³	244.543,75	-	46.335.206,59	50.968.727,25			-	-	125
01.01.2022.	2022	Objekti obrazovnih institucija	Voda	m³	233.761,17	-	45.649.918,97	50.215.941,36			-	-	127

Table 12 Energy consumption: LSG Type 4 shown per energy source (carrier) / per building type group / per year 2018. – 2022. – Continuation 1/5

Building type group: B) Health care facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Zdravstvene ustanove	Električna energija	kWh	10.330,28	10.330,28	100.355,39	128.460,96	12,44	0,11 €	11,35	31.143,72	3
01.01.2019.	2019	Zdravstvene ustanove	Električna energija	kWh	9.271,66	9.271,66	88.736,15	112.986,07	12,19	0,10 €	10,19	27.952,20	4
01.01.2020.	2020	Zdravstvene ustanove	Električna energija	kWh	394.745,58	394.745,58	3.930.526,61	5.067.695,91	12,84	0,11 €	433,83	1.190.078,97	27
01.01.2021.	2021	Zdravstvene ustanove	Električna energija	kWh	357,48	357,48	5.435,18	6.979,35	19,52	0,17 €	0,39	1.077,75	2
01.01.2022.	2022	Zdravstvene ustanove	Električna energija	kWh	6.792,50	6.792,50	67.471,51	86.012,18	12,66	0,11 €	7,46	20.478,03	1
01.01.2018.	2018	Zdravstvene ustanove	Daljinsko grejanje	kWh	120.028,47	120.028,47	902.214,44	992.435,88	8,27	0,07 €	34,45	187.544,48	3
01.01.2019.	2019	Zdravstvene ustanove	Daljinsko grejanje	kWh	980.337,56	980.337,56	7.562.249,95	8.318.474,94	8,49	0,07 €	281,36	1.531.777,44	10
01.01.2020.	2020	Zdravstvene ustanove	Daljinsko grejanje	kWh	602.607,08	602.607,08	5.167.092,85	5.683.802,13	9,43	0,08 €	172,95	941.573,56	4
01.01.2021.	2021	Zdravstvene ustanove	Daljinsko grejanje	kWh	21.590,43	21.590,43	240.106,14	264.116,75	12,23	0,10 €	6,20	33.735,05	2
01.01.2022.	2022	Zdravstvene ustanove	Daljinsko grejanje	kWh	53.942,91	53.942,91	394.434,93	433.878,42	8,04	0,07 €	15,48	84.285,80	2
01.01.2019.	2019	Zdravstvene ustanove	Prirodni gas	Sm³	51.020,00	524.965,19	2.303.484,02	2.533.832,42	4,83	0,04 €	94,49	524.965,19	20
01.01.2018.	2018	Zdravstvene ustanove	Voda	m³	6.242,00	-	1.188.539,22	1.307.393,14			-	-	6
01.01.2019.	2019	Zdravstvene ustanove	Voda	m³	4.226,20	-	804.710,74	885.181,82			-	-	3
01.01.2020.	2020	Zdravstvene ustanove	Voda	m³	612,80	-	116.683,25	128.351,57			-	-	3
01.01.2021.	2021	Zdravstvene ustanove	Voda	m³	107,00	-	20.373,87	22.411,26			-	-	2
01.01.2022.	2022	Zdravstvene ustanove	Voda	m³	2.238,89	-	449.290,72	494.219,79			-	-	3

Building type group: C) Collective accommodation facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti kolektivnog smeštaja	Električna energija	kWh	46.342,13	46.342,13	429.205,30	552.667,78	11,93	0,10 €	50,93	139.712,26	1
01.01.2019.	2019	Objekti kolektivnog smeštaja	Električna energija	kWh	44.474,00	44.474,00	439.626,05	565.586,41	12,72	0,11 €	48,88	134.080,22	1
01.01.2020.	2020	Objekti kolektivnog smeštaja	Električna energija	kWh	30.161,00	30.161,00	322.400,23	414.121,50	13,73	0,12 €	33,15	90.929,38	1
01.01.2021.	2021	Objekti kolektivnog smeštaja	Električna energija	kWh	40.267,00	40.267,00	592.361,80	761.025,16	18,90	0,16 €	44,25	121.396,95	2
01.01.2022.	2022	Objekti kolektivnog smeštaja	Električna energija	kWh	38.595,00	38.595,00	684.656,19	880.171,63	22,81	0,19 €	42,42	116.356,21	2
01.01.2018.	2018	Objekti kolektivnog smeštaja	Prirodni gas	Sm³	11.251,60	115.772,21	531.963,84	585.160,22	5,05	0,04 €	20,84	115.772,21	1
01.01.2019.	2019	Objekti kolektivnog smeštaja	Prirodni gas	Sm³	12.342,00	126.991,77	589.841,93	648.826,12	5,11	0,04 €	22,86	126.991,77	1
01.01.2020.	2020	Objekti kolektivnog smeštaja	Prirodni gas	Sm³	9.270,00	95.382,74	226.950,10	249.645,11	2,62	0,02 €	17,17	95.382,74	1
01.01.2021.	2021	Objekti kolektivnog smeštaja	Prirodni gas	Sm³	11.984,00	123.308,17	459.828,54	505.811,39	4,10	0,03 €	22,20	123.308,17	1
01.01.2022.	2022	Objekti kolektivnog smeštaja	Prirodni gas	Sm³	10.146,11	104.397,38	496.741,75	546.415,93	5,23	0,04 €	18,79	104.397,38	1

Table 12 Energy consumption: LSG Type 4 shown per energy source (carrier) / per building type group / per year 2018. – 2022. – Continuation 2/5

Building type group: C) Collective accommodation facilities – continuation

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti kolektivnog smeštaja	Voda	m³	1.098,00	-	209.070,18	229.977,20			-	-	1
01.01.2019.	2019	Objekti kolektivnog smeštaja	Voda	m³	959,00	-	182.603,19	200.863,51			-	-	1
01.01.2020.	2020	Objekti kolektivnog smeštaja	Voda	m³	676,00	-	33.536,36	36.890,00			-	-	1
01.01.2021.	2021	Objekti kolektivnog smeštaja	Voda	m³	357,00	-	67.976,37	74.774,01			-	-	1
01.01.2022.	2022	Objekti kolektivnog smeštaja	Voda	m³	692,57	-	138.969,08	152.865,99			-	-	1

Building type group: D) Cultural institution facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti institucija kulture	Električna energija	kWh	1.043.916,04	1.043.916,04	10.257.527,36	13.208.205,59	12,65	0,11 €	1.147,26	3.147.198,08	39
01.01.2019.	2019	Objekti institucija kulture	Električna energija	kWh	1.113.907,46	1.113.907,46	12.055.619,81	15.516.316,86	13,93	0,12 €	1.224,18	3.358.208,21	37
01.01.2020.	2020	Objekti institucija kulture	Električna energija	kWh	941.819,69	941.819,69	10.613.641,20	13.648.069,44	14,49	0,12 €	1.035,06	2.839.398,00	38
01.01.2021.	2021	Objekti institucija kulture	Električna energija	kWh	1.099.316,37	1.099.316,37	13.486.648,83	17.346.273,73	15,78	0,13 €	1.208,15	3.314.218,98	38
01.01.2022.	2022	Objekti institucija kulture	Električna energija	kWh	1.059.856,19	1.059.856,19	15.839.321,09	20.380.673,11	19,23	0,16 €	1.164,78	3.195.254,43	40
01.01.2018.	2018	Objekti institucija kulture	Daljinsko grejanje	kWh	1.376.830,47	1.376.830,47	12.160.286,82	13.376.315,50	9,72	0,08 €	395,15	2.151.297,61	16
01.01.2019.	2019	Objekti institucija kulture	Daljinsko grejanje	kWh	1.221.875,94	1.221.875,94	10.794.735,42	11.874.208,96	9,72	0,08 €	350,68	1.909.181,16	14
01.01.2020.	2020	Objekti institucija kulture	Daljinsko grejanje	kWh	1.335.257,38	1.335.257,38	11.338.869,02	12.472.755,92	9,34	0,08 €	383,22	2.086.339,66	15
01.01.2021.	2021	Objekti institucija kulture	Daljinsko grejanje	kWh	1.503.351,57	1.503.351,57	12.168.360,02	13.385.196,02	8,90	0,08 €	431,46	2.348.986,83	15
01.01.2022.	2022	Objekti institucija kulture	Daljinsko grejanje	kWh	1.303.057,59	1.303.057,59	11.216.963,62	12.338.659,98	9,47	0,08 €	373,98	2.036.027,48	15
01.01.2018.	2018	Objekti institucija kulture	Prirodni gas	Sm³	63.677,40	655.202,27	2.138.427,99	2.352.270,79	3,59	0,03 €	117,94	655.202,27	6
01.01.2019.	2019	Objekti institucija kulture	Prirodni gas	Sm³	66.093,49	680.062,32	2.226.297,01	2.448.926,71	3,60	0,03 €	122,41	680.062,32	6
01.01.2020.	2020	Objekti institucija kulture	Prirodni gas	Sm³	63.204,36	650.334,94	2.130.102,48	2.343.112,72	3,60	0,03 €	117,06	650.334,94	6
01.01.2021.	2021	Objekti institucija kulture	Prirodni gas	Sm³	64.950,15	668.298,11	2.177.941,88	2.396.595,06	3,59	0,03 €	120,29	668.298,11	6
01.01.2022.	2022	Objekti institucija kulture	Prirodni gas	Sm³	55.407,21	570.106,96	1.905.809,36	2.096.390,29	3,68	0,03 €	102,62	570.106,96	6
01.01.2018.	2018	Objekti institucija kulture	Voda	m³	7.485,22	-	1.425.259,87	1.567.785,86			-	-	21
01.01.2019.	2019	Objekti institucija kulture	Voda	m³	7.781,72	-	1.481.716,92	1.629.888,61			-	-	23
01.01.2020.	2020	Objekti institucija kulture	Voda	m³	4.961,00	-	944.624,91	1.039.087,40			-	-	23
01.01.2021.	2021	Objekti institucija kulture	Voda	m³	5.174,69	-	985.313,23	1.083.844,55			-	-	25
01.01.2022.	2022	Objekti institucija kulture	Voda	m³	5.607,50	-	1.117.681,46	1.229.449,60			-	-	29

Table 12 Energy consumption: LSG Type 4 shown per energy source (carrier) / per building type group / per year 2018. – 2022. – Continuation 3/5

Building type group: E) Sports facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2019.	2019	Sportski objekti	Električna energija	kWh	1.342.057,00	1.342.057,00	11.945.234,44	15.409.352,43	11,48	0,10 €	1.474,92	4.046.033,44	3
01.01.2020.	2020	Sportski objekti	Električna energija	kWh	992.897,00	992.897,00	8.732.404,93	11.264.802,36	11,35	0,10 €	1.091,19	2.993.385,88	3
01.01.2021.	2021	Sportski objekti	Električna energija	kWh	1.046.645,00	1.046.645,00	10.789.251,81	13.918.134,84	13,30	0,11 €	1.150,26	3.155.425,35	3
01.01.2022.	2022	Sportski objekti	Električna energija	kWh	1.369.201,00	1.369.201,00	16.612.166,50	21.429.694,78	15,65	0,13 €	1.504,75	4.127.867,17	3
01.01.2018.	2018	Sportski objekti	Prirodni gas	Sm³	32.300,50	332.352,76	1.060.404,32	1.166.444,76	3,51	0,03 €	59,82	332.352,76	1
01.01.2019.	2019	Sportski objekti	Prirodni gas	Sm³	28.565,00	293.916,71	957.344,82	1.053.079,30	3,58	0,03 €	52,91	293.916,71	1
01.01.2020.	2020	Sportski objekti	Prirodni gas	Sm³	403.237,00	4.149.066,79	18.746.858,07	20.621.543,87	4,97	0,04 €	746,83	4.149.066,79	4
01.01.2021.	2021	Sportski objekti	Prirodni gas	Sm³	435.117,00	4.477.092,86	19.302.613,82	21.232.875,20	4,74	0,04 €	805,88	4.477.092,86	4
01.01.2022.	2022	Sportski objekti	Prirodni gas	Sm³	448.681,86	4.616.667,12	23.654.673,99	26.020.141,39	5,64	0,05 €	831,00	4.616.667,12	4
01.01.2018.	2018	Sportski objekti	Voda	m³	26.171,00	-	4.983.220,11	5.481.542,12			-	-	3
01.01.2019.	2019	Sportski objekti	Voda	m³	33.546,00	-	6.387.493,86	7.026.243,25			-	-	3
01.01.2020.	2020	Sportski objekti	Voda	m³	24.611,00	-	4.686.180,51	5.154.798,56			-	-	4
01.01.2021.	2021	Sportski objekti	Voda	m³	29.254,20	-	5.570.291,60	6.127.320,76			-	-	4
01.01.2022.	2022	Sportski objekti	Voda	m³	19.494,80	-	3.873.577,84	4.260.935,63			-	-	4

Building type group: F) Administrative facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Administrativni objekti	Električna energija	kWh	4.204.415,63	4.204.415,63	35.956.603,02	46.338.101,49	11,02	0,09 €	4.620,65	12.675.472,23	83
01.01.2019.	2019	Administrativni objekti	Električna energija	kWh	4.314.335,67	4.314.335,67	40.662.572,90	52.381.996,32	12,14	0,10 €	4.741,45	13.006.859,18	83
01.01.2020.	2020	Administrativni objekti	Električna energija	kWh	1.577.697,34	1.577.697,34	16.536.008,89	21.247.341,84	13,47	0,11 €	1.733,89	4.756.441,94	81
01.01.2021.	2021	Administrativni objekti	Električna energija	kWh	1.692.909,18	1.692.909,18	27.784.347,85	35.746.002,34	21,12	0,18 €	1.860,51	5.103.782,59	79
01.01.2022.	2022	Administrativni objekti	Električna energija	kWh	1.496.452,74	1.496.452,74	21.718.722,97	27.665.165,17	18,49	0,16 €	1.644,60	4.511.505,72	78
01.01.2018.	2018	Administrativni objekti	Daljinsko grejanje	kWh	6.637.777,02	6.637.777,02	56.955.509,29	62.651.060,22	9,44	0,08 €	1.905,04	10.371.526,60	49
01.01.2019.	2019	Administrativni objekti	Daljinsko grejanje	kWh	5.802.487,42	5.802.487,42	45.059.658,57	49.565.624,43	8,54	0,07 €	1.665,31	9.066.386,59	48
01.01.2020.	2020	Administrativni objekti	Daljinsko grejanje	kWh	3.788.619,00	3.788.619,00	28.529.359,12	31.382.295,03	8,28	0,07 €	1.087,33	5.919.717,18	46
01.01.2021.	2021	Administrativni objekti	Daljinsko grejanje	kWh	4.143.679,51	4.143.679,51	30.558.450,46	33.614.295,50	8,11	0,07 €	1.189,24	6.474.499,23	45
01.01.2022.	2022	Administrativni objekti	Daljinsko grejanje	kWh	3.366.070,45	3.366.070,45	26.568.026,28	29.224.828,91	8,68	0,07 €	966,06	5.259.485,07	43

Table 12 Energy consumption: LSG Type 4 shown per energy source (carrier) / per building type group / per year 2018. – 2022. – Continuation 4/5

Building type group: F) Administrative facilities – continuation

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Administrativni objekti	Prirodni gas	Sm³	267.160,55	2.748.921,79	9.277.132,33	10.204.845,56	3,71	0,03 €	494,81	2.748.921,79	28
01.01.2019.	2019	Administrativni objekti	Prirodni gas	Sm³	307.419,00	3.163.157,06	12.244.070,04	13.468.477,05	4,26	0,04 €	569,37	3.163.157,06	29
01.01.2020.	2020	Administrativni objekti	Prirodni gas	Sm³	93.876,42	965.932,07	3.174.759,13	3.492.235,04	3,62	0,03 €	173,87	965.932,07	29
01.01.2021.	2021	Administrativni objekti	Prirodni gas	Sm³	99.290,58	1.021.640,46	3.446.968,22	3.791.665,04	3,71	0,03 €	183,90	1.021.640,46	28
01.01.2022.	2022	Administrativni objekti	Prirodni gas	Sm³	93.369,90	960.720,23	3.429.013,15	3.773.433,65	3,93	0,03 €	172,93	960.720,23	28
01.01.2018.	2018	Administrativni objekti	Voda	m³	84.803,35	-	16.116.515,55	17.728.167,10			-	-	63
01.01.2019.	2019	Administrativni objekti	Voda	m³	104.568,51	-	19.871.346,75	21.858.481,42			-	-	62
01.01.2020.	2020	Administrativni objekti	Voda	m³	12.003,30	-	2.284.827,29	2.513.176,73			-	-	58
01.01.2021.	2021	Administrativni objekti	Voda	m³	21.715,50	-	4.134.870,40	4.548.357,44			-	-	59
01.01.2022.	2022	Administrativni objekti	Voda	m³	24.561,49	-	4.909.939,42	5.400.933,36			-	-	60

Building type group: H) Catering facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Ugostiteljski objekti	Električna energija	kWh	229.974,00	229.974,00	2.965.923,75	3.825.737,14	16,64	0,14 €	252,74	693.325,62	4
01.01.2019.	2019	Ugostiteljski objekti	Električna energija	kWh	629.411,00	629.411,00	6.061.043,64	7.817.278,90	12,42	0,11 €	691,72	1.897.548,28	4
01.01.2020.	2020	Ugostiteljski objekti	Električna energija	kWh	725.799,00	725.799,00	6.814.654,53	8.789.203,49	12,11	0,10 €	797,65	2.188.138,83	4
01.01.2021.	2021	Ugostiteljski objekti	Električna energija	kWh	743.338,00	743.338,00	7.673.894,06	9.897.382,66	13,31	0,11 €	816,93	2.241.015,40	4
01.01.2022.	2022	Ugostiteljski objekti	Električna energija	kWh	721.824,00	721.824,00	9.516.107,78	12.272.902,86	17,00	0,14 €	793,28	2.176.155,00	4
01.01.2018.	2018	Ugostiteljski objekti	Prirodni gas	Sm³	7.542,04	77.603,07	398.920,43	438.812,47	5,65	0,05 €	13,97	77.603,07	1
01.01.2019.	2019	Ugostiteljski objekti	Prirodni gas	Sm³	36.683,00	377.446,06	2.011.311,95	2.212.443,14	5,86	0,05 €	67,94	377.446,06	2
01.01.2020.	2020	Ugostiteljski objekti	Prirodni gas	Sm³	55.769,00	573.829,55	2.183.972,75	2.402.370,02	4,19	0,04 €	103,29	573.829,55	2
01.01.2021.	2021	Ugostiteljski objekti	Prirodni gas	Sm³	78.514,00	807.861,95	2.686.497,33	2.955.147,07	3,66	0,03 €	145,42	807.861,95	2
01.01.2022.	2022	Ugostiteljski objekti	Prirodni gas	Sm³	114.520,80	1.178.350,31	4.983.812,72	5.482.193,99	4,65	0,04 €	212,10	1.178.350,31	2
01.01.2018.	2018	Ugostiteljski objekti	Voda	m³	2.479,00	-	472.026,39	519.229,03			-	-	3
01.01.2019.	2019	Ugostiteljski objekti	Voda	m³	3.807,00	-	724.890,87	797.379,96			-	-	3
01.01.2020.	2020	Ugostiteljski objekti	Voda	m³	3.288,00	-	626.068,08	688.674,89			-	-	3
01.01.2021.	2021	Ugostiteljski objekti	Voda	m³	2.731,41	-	520.087,06	572.095,77			-	-	3
01.01.2022.	2022	Ugostiteljski objekti	Voda	m³	1.815,93	-	360.219,49	396.241,44			-	-	2

Table 12 Energy consumption: LSG Type 4 shown per energy source (carrier) / per building type group / per year 2018. – 2022. – Continuation 5/5

Building type group: I) Public companies (JP) and Public utility companies (JKP) facilities

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Objekti JP i JKP	Električna energija	kWh	4.388,00	4.388,00	100.337,13	129.260,89	29,46	0,25 €	4,82	13.228,94	10
01.01.2019.	2019	Objekti JP i JKP	Električna energija	kWh	6.971,00	6.971,00	143.250,72	184.793,43	26,51	0,23 €	7,66	21.016,17	15
01.01.2020.	2020	Objekti JP i JKP	Električna energija	kWh	137.714,00	137.714,00	1.563.641,91	2.014.583,76	14,63	0,12 €	151,35	415.180,17	18
01.01.2021.	2021	Objekti JP i JKP	Električna energija	kWh	175.415,00	175.415,00	2.150.475,05	2.767.522,85	15,78	0,13 €	192,78	528.841,14	22
01.01.2022.	2022	Objekti JP i JKP	Električna energija	kWh	245.874,00	245.874,00	3.574.760,94	4.604.851,65	18,73	0,16 €	270,22	741.260,94	23

Building type group: Other

Date	Year	Object type group Name	Energy carrier name	Unit of Measure	Consumption	Energy [kWh]	Cost [RSD]	Cost + Tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,0085	CO_2 emission[t]	Primary energy [kWh]	Number of objects
01.01.2018.	2018	Ostalo	Električna energija	kWh	148.384,95	148.384,95	1.419.239,90	1.824.707,17	12,30	0,10 €	163,08	447.350,96	17
01.01.2019.	2019	Ostalo	Električna energija	kWh	306.147,94	306.147,94	2.712.722,89	3.491.144,23	11,40	0,10 €	336,46	922.974,82	105
01.01.2020.	2020	Ostalo	Električna energija	kWh	333.219,62	333.219,62	3.021.564,86	3.890.102,90	11,67	0,10 €	366,21	1.004.590,51	109
01.01.2021.	2021	Ostalo	Električna energija	kWh	331.358,32	331.358,32	3.298.850,56	4.247.401,36	12,82	0,11 €	364,16	998.979,06	109
01.01.2022.	2022	Ostalo	Električna energija	kWh	334.133,43	334.133,43	4.517.846,99	5.822.811,03	17,43	0,15 €	367,21	1.007.345,47	113
01.01.2018.	2018	Ostalo	Daljinsko grejanje	kWh	47.328,91	47.328,91	1.013.962,95	1.115.359,25	23,57	0,20 €	13,58	73.951,43	10
01.01.2019.	2019	Ostalo	Daljinsko grejanje	kWh	58.572,49	58.572,49	962.523,13	1.058.775,44	18,08	0,15 €	16,81	91.519,52	10
01.01.2020.	2020	Ostalo	Daljinsko grejanje	kWh	64.303,08	64.303,08	983.374,50	1.081.711,95	16,82	0,14 €	18,45	100.473,56	10
01.01.2021.	2021	Ostalo	Daljinsko grejanje	kWh	49.164,13	49.164,13	874.212,17	961.633,39	19,56	0,17 €	14,11	76.818,95	9
01.01.2022.	2022	Ostalo	Daljinsko grejanje	kWh	2.092,47	2.092,47	17.921,87	19.714,06	9,42	0,08 €	0,60	3.269,48	1
01.01.2018.	2018	Ostalo	Prirodni gas	Sm³	26.746,68	275.207,29	1.364.760,20	1.501.236,22	5,45	0,05 €	49,54	275.207,29	1
01.01.2019.	2019	Ostalo	Prirodni gas	Sm³	37.356,00	384.370,83	1.808.501,77	1.989.351,95	5,18	0,04 €	69,19	384.370,83	2
01.01.2020.	2020	Ostalo	Prirodni gas	Sm³	38.363,00	394.732,25	1.092.057,48	1.201.263,22	3,04	0,03 €	71,05	394.732,25	1
01.01.2021.	2021	Ostalo	Prirodni gas	Sm³	40.739,00	419.179,87	1.623.533,25	1.785.886,58	4,26	0,04 €	75,45	419.179,87	1
01.01.2022.	2022	Ostalo	Prirodni gas	Sm³	33.027,60	339.834,15	1.660.017,21	1.826.018,94	5,37	0,05 €	61,17	339.834,15	1
01.01.2018.	2018	Ostalo	Voda	m³	1.838,88	-	350.140,74	385.154,81			-	-	8
01.01.2019.	2019	Ostalo	Voda	m³	2.525,49	-	480.878,72	528.966,59			-	-	8
01.01.2020.	2020	Ostalo	Voda	m³	6.078,75	-	349.122,69	384.034,95			-	-	8
01.01.2021.	2021	Ostalo	Voda	m³	3.788,30	-	721.330,38	793.463,42			-	-	8
01.01.2022.	2022	Ostalo	Voda	m³	1.583,09	-	313.343,27	344.677,59			-	-	1

Summary of EMIS data review

Table 13 Summary of EMIS data review - consumption by energy source (carrier) per LSG Type - years 2018. to 2022.

		Energy Source	Unit	Consumption	Energy [kWh]	Cost [RSD]	Cost + tax [RSD]	Cost per kWh exchange rate --->	Cost per kWh [EUR] 0,00850	Emission CO_2[t]	Primary energy [kWh]	Number of objects	
BASELINE --> AVERAGE of 2018 to 2020													
LSG Type 1													
Average inhabitants --	**40.000**												
		Electricity	kWh	1.049.414,67	1.049.414,67	11.718.707,68	15.072.576,70	14,36	0,122 €	1.180,48	3.238.318,25	88	
		District heating	kWh	527.449,18	527.449,18	47.589.955,20	52.348.950,72	99,25	**0,844 €**	164,84	897.474,20	8	
		Natural gas	Sm³	27.856,67	286.628,39	1.693.880,50	1.863.268,55	6,50	0,055 €	57,78	321.003,56	1	
		Brown coal	t	198,17	571.160,77	2.048.432,76	2.458.119,32	4,30	0,037 €	191,37	546.756,94	11	
		Firewood	m³	412,67	823.263,73	1.633.918,25	1.794.048,07	2,18	0,019 €	-	725.113,32	14	
		Wood pellet	t	23,17	114.270,85	475.852,89	523.438,18	4,58	0,039 €	-	117.947,40	4	
		Water	m³	20.186,95	-	7.638.607,26	8.401.428,63			-	-	50	
HDD -->	**2715,580903**				**3.372.187,60**	**72.799.354,54**	**82.461.830,17**	**24,45**	**0,208 €**	**1.594,47**	**5.846.613,67**	**176**	
Average per inhabitant --->					**84,30**	**1819,98**	**2061,55**			**0,0399**	**146,17**	**4,40**	/ 1000 inhabitants

LSG Type 2													
Average inhabitants --		55.000											
		Electricity	kWh	1.432.362,25	1.432.362,25	**15.601.064,49**	**20.046.451,31**	14,00	**0,119 €**	1.574,17	4.318.285,72	93	
		District heating	kWh	926.640,33	926.640,33	10.925.255,60	12.015.677,24	12,97	0,110 €	265,95	1.447.875,52	4	
		Natural gas	Sm³	185.941,13	1.913.222,73	6.181.251,55	6.799.373,70	3,55	0,030 €	344,38	1.913.222,73	23	
		Brown coal	t	226,35	652.399,89	2.139.419,81	2.567.303,77	3,94	0,033 €	228,34	652.399,89	7	
		Firewood	m³	338,97	676.240,27	1.541.383,58	1.695.521,94	2,51	0,021 €	-	676.240,27	9	
		Wood pellet	t	63,16	311.534,19	1.338.855,33	1.472.740,87	4,73	0,040 €	-	311.534,19	2	
		Water	m³	14.543,38	-	2.338.740,83	2.588.144,01			-	-	59	
SDG -->	2279,678194				**5.912.399,67**	**40.065.971,20**	**47.185.212,84**	**7,98**	**0,068 €**	**2.412,83**	**9.319.558,33**	**196**	
Average per inhabitant --->					**107,50**	**728,47**	**857,91**			**0,0439**	**169,45**	**3,57**	/ 1000 inhabitants

LSG Type 3													
Average inhabitants --		180.000											
		Electricity	kWh	3.549.716,08	3.549.716,08	32.892.611,88	42.094.070,06	11,86	0,101 €	3.901,14	10.701.684,03	103	
		District heating	kWh	7.620.277,33	7.620.277,33	59.868.022,66	65.836.144,34	8,64	0,073 €	2.187,02	11.906.683,33	37	
		Natural gas	Sm³	291.625,67	3.000.653,13	10.863.089,67	11.949.174,26	3,98	0,034 €	540,12	3.000.653,13	12	
		Extra light fuel oil	l	36.607,67	377.688,62	5.219.578,01	6.263.493,61	16,58	0,141 €	105,75	377.688,62	2	
		Brown coal	t	45,77	131.908,69	1.831.116,67	2.197.340,00	16,66	0,142 €	46,17	131.908,69	4	
		Firewood	m³	120,98	241.351,11	569.266,67	626.193,33	2,59	0,022 €	-	241.351,11	4	
		Water	m³	76.582,89	-	5.024.392,83	5.523.008,38			-	-	66	
HDD -->	2715,580903				**14.921.594,96**	**116.268.078,38**	**134.489.423,99**	**9,01**	**0,077 €**	**6.780,20**	**26.359.968,91**	**227**	
Average per inhabitant --->					**82,90**	**645,93**	**747,16**			**0,0377**	**146,44**	**1,26**	/ 1000 inhabitants

LSG Type 4													
Average inhabitants --		340.000											
		Electricity	kWh	14.235.507,09	14.235.507,09	141.515.578,53	182.366.357,06	12,81	0,109 €	15.644,82	42.917.206,78	360	
		District heating	kWh	32.497.795,89	32.497.795,89	264.338.661,57	290.772.527,73	8,95	0,076 €	9.326,87	50.777.806,07	144	
		Natural gas	Sm³	2.189.133,39	22.524.869,07	91.950.739,68	101.145.800,58	4,49	0,038 €	4.054,48	22.524.869,07	106	
		Water	m³	357.831,54	-	66.763.067,21	73.439.329,50			-	-	225	
HDD -->	2242,038611				**69.258.172,05**	**564.568.046,98**	**647.724.014,87**	**9,35**	**0,079 €**	**29.026,16**	**116.219.881,93**	**835**	
Average per inhabitant --->					**203,70**	**1660,49**	**1905,07**			**0,0854**	**341,82**	**2,46**	/ 1000 inhabitants

Following the initial data review the inconsistent price of District heating and Electricity was identified for LSG Type 1 and LSG Type 2.

The average price was corrected as follows:

- LSG Type 1 - District heating price
  - To calculate the average price, only the data for the structures where the actual energy consumption was entered in EMIS was used.
  - By using this approach, the average district heating price was reduced from 3,91 EUR/kWh to 0,84 EUR/kWh. The changed price is marked with a bolded cell frame in the table above.
  - Using the reduced average price and actual total costs for the spent district heating energy, the total energy consumption was calculated. The calculated values are in the shaded cells in the table above.
- LSG Type 2 – Electricity price
  - The price of electricity was corrected so that the average price in the year 2020, which was 2 times higher than the other years analyzed, was reduced.
  - Through this approach, the average electricity price was reduced from 0,161 EUR/ kWh to 0,122 EUR/kWh. The changed price is marked with cell bolded cell frame in the table above.
  - Using the reduced price, the total cost of the spent energy was recalculated, and the energy consumption in EMIS was aligned with the consumption of other years. The calculated values are in the shaded cells in the table above.

The observations that can be made from the table above include:

- The number of public buildings per 1000 inhabitants varies from 1,26 to 4,40.
- The energy consumption of public buildings per inhabitant varies from 82,90 kWh/inhabitant to 203,70 kWh/inhabitant.
- The costs for energy (including tax) used in public buildings vary from 747,16 RSD/inhabitant to 2061,55 RSD/inhabitant.
- For LSG Type 1, the price of district heating energy is high even after correction for HDD that shows possible inefficiencies in the district heating network that causes the high unit price.
- For LSG Type 1, the gas price is also 2 times higher than in other LSGs, indicating a potential issue with the prices of energy sources for smaller LSGs due to smaller amounts of energy that are purchased.
- Higher prices for district heating and natural gas for LSG Type 1 caused the average cost of energy per kWh for LSG Type 1 to be significantly (almost 3x) higher than compared to other LSGs.
- For LSG Type 3, the average number of buildings per 1000 inhabitants is the lowest, indicating that possibly not all buildings are entered in EMIS. The result of this is also the lowest energy consumption per inhabitant for LSG Type 3.

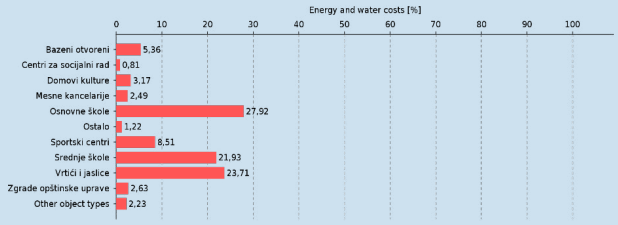
In line with the data from the Summary of the EMIS data review table, the average costs (incl. VAT) of different types of fuel have been calculated and are listed in the table below.

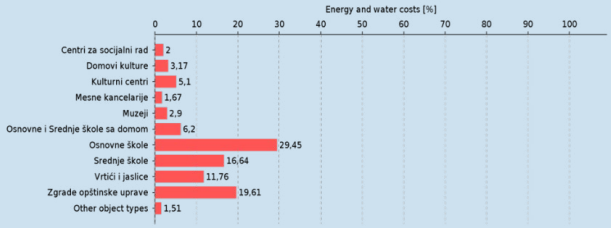
Table 14 Calculated average total energy prices per type of fuel - years 2018. to 2022.

Energy source		RSD/kWh	EUR/kWh	EUR/MWh
Electricity		13,26	0,113	112,68
District heating	*	10,18	0,087	86,57
Natural gas		4,63	0,039	39,37
Brown coal		8,30	0,071	70,54
Firewood		2,43	0,021	20,63
Wood pellet		4,65	0,040	39,56
Extra light fuel oil		16,58	0,142	141,59

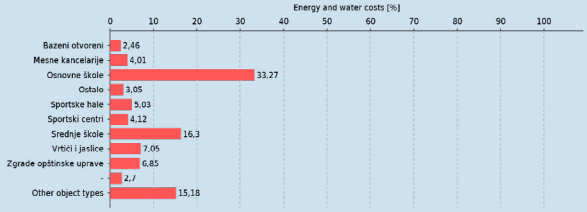
* To calculate the average price for district heating (DH), the cost for DH in LSG Type 1 was excluded due to significantly higher costs than in other LSGs. The value calculated with this approach corresponds well to received information about average prices.

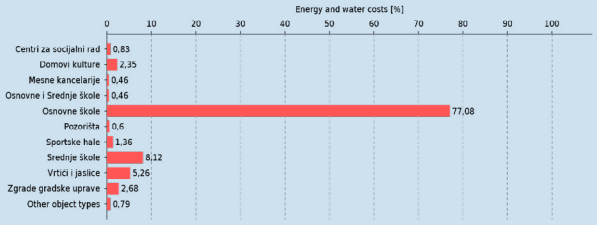
LSG Type 1



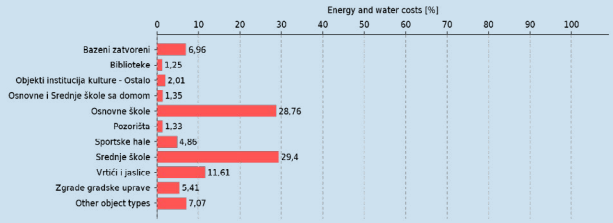


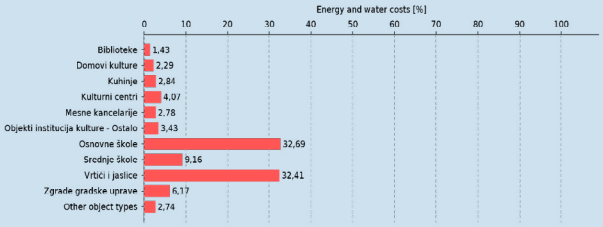
LSG Type 2



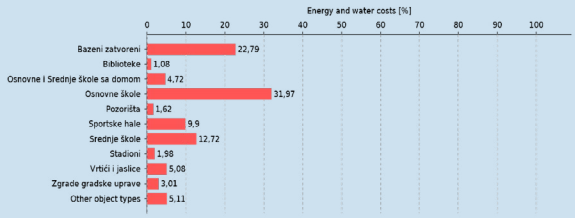


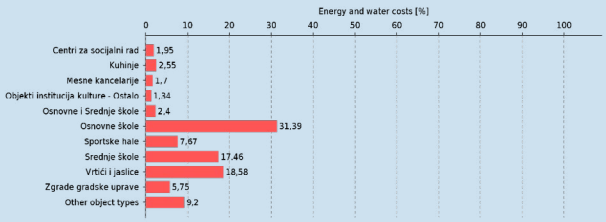
LSG Type 3





LSG Type 4





Picture 13 Comparison of typical types of buildings according to the building's purpose and their share in total cost of energy per LSG Type

The observations that can be made from the comparison above of typical types of buildings per LSG type include:

- The types of buildings that are responsible for the highest share of costs of energy are:
  - Primary schools 28% to 77 %
  - Secondary schools 8% to 29%
  - Kindergartens 5% to 32%
  - Administrative buildings 2,6% to 20%
  - Other types of buildings 0,8% to 15%
- The Educational institution buildings (primary schools, secondary schools and kindergartens) are responsible for 50 to 90 % of energy and water costs in LSGs.
- For the LSG-s analyzed the number of educational institution buildings were as follows:
  - LSG Type 1:
    - 40 Primary schools, 1 secondary school, 6 Kindergartens
      - 47 educational institution buildings out of 99 buildings in total (47,5%)
  - LSG Type 2:
    - 16 Primary schools, 2 secondary schools, 12 Kindergartens
      - 30 educational institution buildings out of 107 buildings in total (28,0%)
  - LSG Type 3:
    - 9 Primary schools, 1 secondary schools, 16 Kindergartens, 1 primary and secondary schools
      - 27 educational institution buildings out of 104 buildings in total (26,0%)
  - LSG Type 4:
    - 44 Primary schools, 16 secondary schools, 67 Kindergartens, 3 primary and secondary schools
      - 130 educational institution buildings out of 300 buildings in total (43,3%)
- LSG Type 3 has the smallest share of educational institution buildings (26%), which corresponds with the fact that the same LSG also has the smallest energy consumption per inhabitant (82,9 kWh/inhabitant) and costs for energy (including tax) per inhabitant (747,16 RSD/inhabitant).

- LSG Type 1 has the highest share of educational institution buildings (47,5%) and this fact, combined with the fact that the price of district heating and natural gas are the highest for this LSG, results in the highest costs for energy (including tax) per inhabitant (2061,55 RSD/inhabitant)

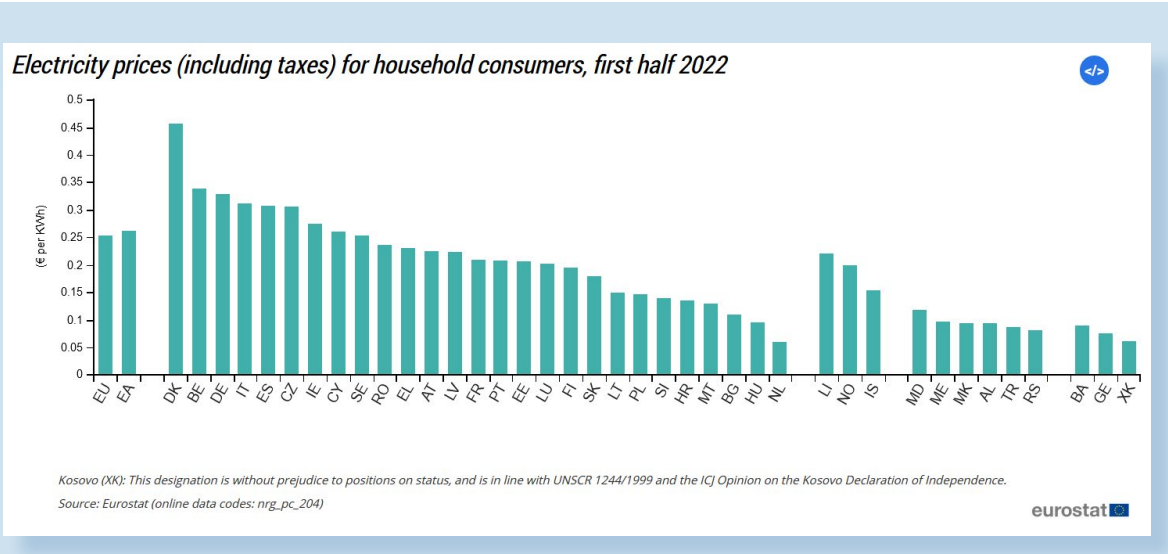
- From the above, it can be concluded that, in general, educational institution buildings are responsible for the majority of costs in LSGs and should be focus of programs and projects of energy efficiency improvements and energy management activities.

Energy cost sensitivity analysis

To analyze the influence of price increases of various fuel/energy sources on the total costs of energy for different LSG Types, several scenarios of price increases have been applied. Taking into consideration the recent high fluctuations of energy costs across the region and the entire EU, specifically the costs of natural gas and electricity but also all other energy types as well, the range of price increase for the selected scenario was set from a 25 to 100% increase.

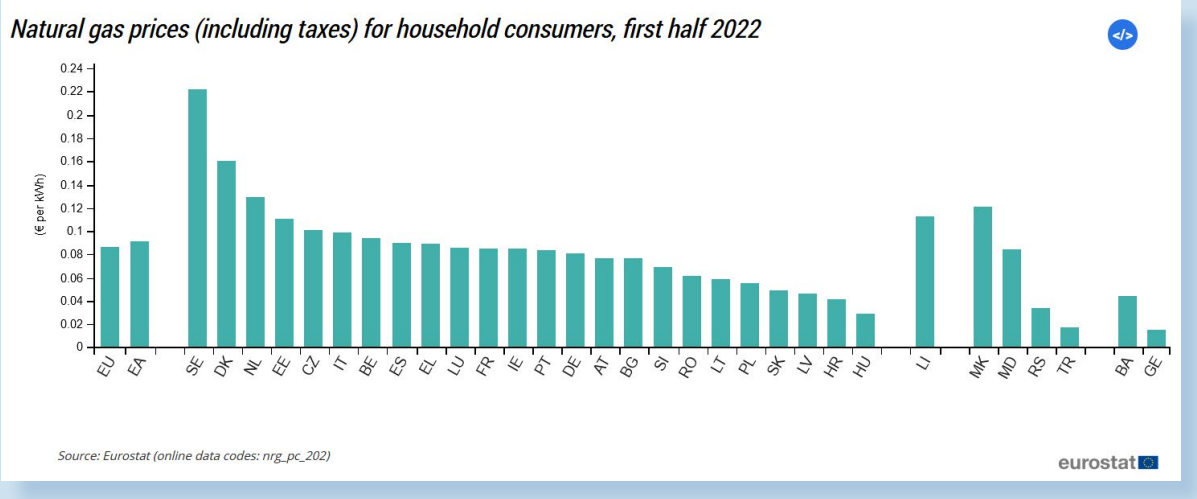
The high range of price increase was chosen to simulate the extreme changes of prices on the energy market that we have witnessed since the Russian invasion of Ukraine despite the different policies and interventions that different governments have implemented to keep the costs of energy under control. This high range of price increase will show border cases of shocks that could happen to energy budgets due to potential strong changes in energy prices.

Although the range of increase seems high, it is not unrealistic because, at the moment, energy prices in Serbia are low and a similar range of increase has already happened in some EU countries. These facts are visible from pictures below.

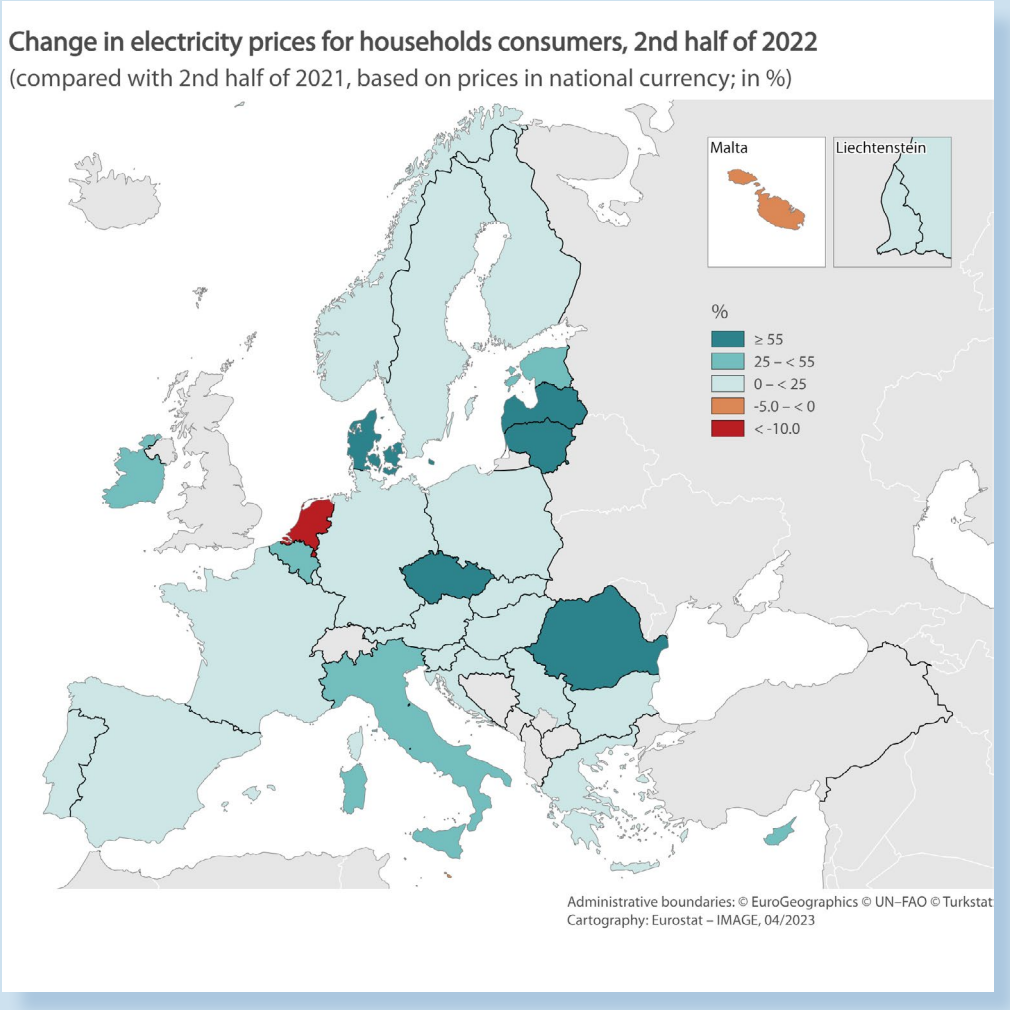


Picture 14 Electricity prices for households in first half of 2022[3]

[3] Source: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Electricity_price_statistics

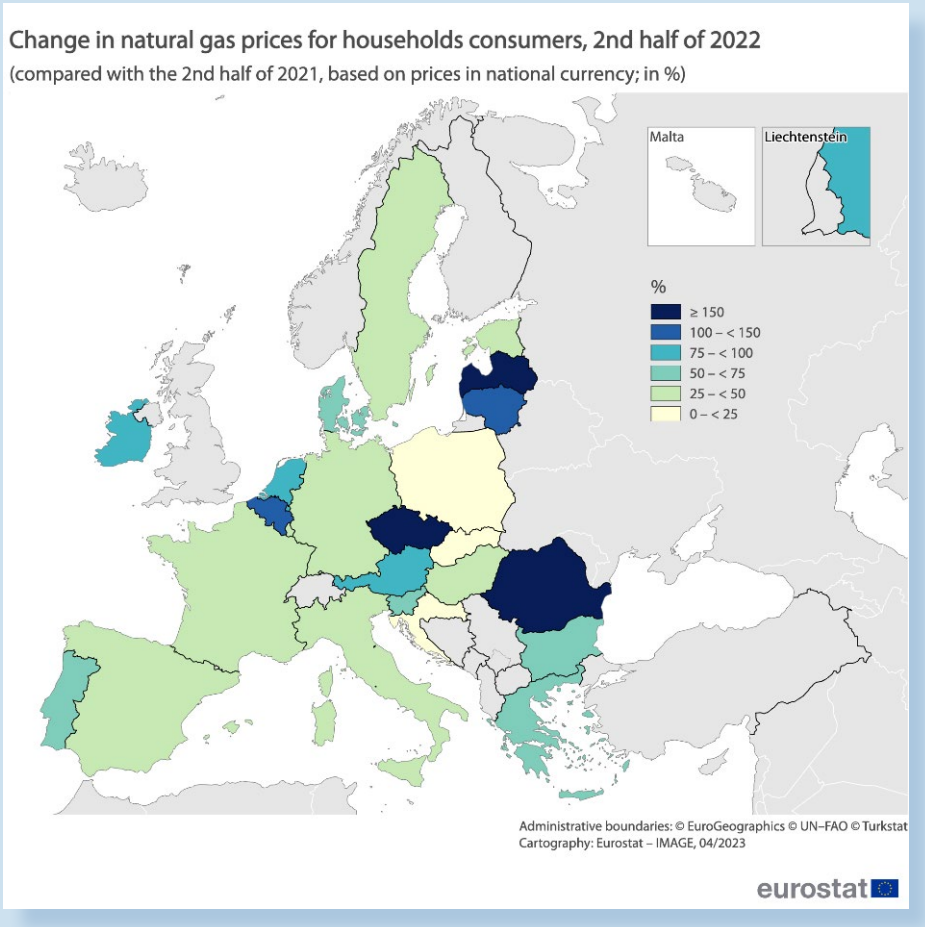


Picture 15 Natural gas prices for households in first half of 2022[4]



Picture 16 Change of electricity prices for household consumers[5]

[4] Source: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Natural_gas_price_statistics
[5] Source: https://ec.europa.eu/eurostat/web/products-eurostat-news/w/DDN-20230426-2



Picture 17 Change of natural gas prices for household consumers[6]

This analysis was conducted using a model that is available in XLS to test and compare any different scenario of price increase. The analysis was conducted using summarized EMIS data for consumption by energy source (carrier) through the years 2018 to 2022 per LSG Type, shown in Table 13 above, and the results of the analysis for 4 basic scenarios of price increase are shown below.

Scenario 1 Energy price increases:

Electricity	25%;	Brown coal	0%;	Extra light fuel oil	50%
District heating	0%;	Firewood	0%;		
Natural gas	50%;	Wood Pellet	25%;		

[6] Source: https://ec.europa.eu/eurostat/web/products-eurostat-news/w/DDN-20230426-2

Table 15 Sensitivity analysis – Scenario 1 – Summary of cost increase per LSG Type

	Energy cost increase by LSG Type for				
	Energy [kWh]	Cost + tax [RSD] Baseline	Cost + tax [RSD] After energy price change	Energy cost change	% of cost change
LSG Type 1	3.372.187,60	82.461.830,17	87.292.468,16	4.830.637,99	6%
LSG Type 2	5.912.399,67	47.185.212,84	55.964.697,73	8.779.484,89	19%
LSG Type 3	14.921.594,96	134.489.423,99	154.119.275,45	19.629.851,45	15%
LSG Type 4	69.258.172,05	647.724.014,87	743.888.504,42	96.164.489,56	15%
				Average -->	**13%**

Table 16 Sensitivity analysis – Scenario 1 – Cost increase per energy source and LSG type

						AVERAGE BASELINE COST			Sensitivity analysis					
							Cost per kWh	Cost per kWh [EUR]	Scenario:		1	<--- Select scenario		
		Energy Source	Unit	Consumption	Energy [kWh]	Cost + tax [RSD]	exchange rate --->	0,00850	% of cost change	Cost per kWh	Cost per kWh [EUR]	Cost + tax [RSD]	% of total cost change	Number of objects
BASELINE --> AVERAGE of 2018 to 2020												**AVERAGE TOAL COST CHANGE:**	**13%**	
LSG Type 1														
		Electricity	kWh	1.049.414,67	1.049.414,67	15.072.576,70	14,36	0,122 €	**25%**	17,95	0,153 €	18.840.720,87		88
		District heating	kWh	527.449,18	527.449,18	52.348.950,72	99,25	0,844 €	**0%**	99,25	0,844 €	52.348.950,72		8
		Natural gas	Sm³	27.856,67	286.628,39	1.863.268,55	6,50	0,055 €	**50%**	9,75	0,083 €	2.794.902,83		1
		Brown coal	t	198,17	571.160,77	2.458.119,32	4,30	0,037 €	**0%**	4,30	0,037 €	2.458.119,32		11
		Firewood	m³	412,67	823.263,73	1.794.048,07	2,18	0,019 €	**0%**	2,18	0,019 €	1.794.048,07		14
		Wood pellet	t	23,17	114.270,85	523.438,18	4,58	0,039 €	**25%**	5,73	0,049 €	654.297,72		4
		Water	m³	20.186,95	-	8.401.428,63						8.401.428,63		50
HDD -->	**2715,58**				**3.372.187,60**	**82.461.830,17**	**24,45**	**0,208 €**		**25,89**	**0,220 €**	**87.292.468,16**	**6%**	**176**
LSG Type 2														
		Electricity	kWh	1.432.362,25	1.432.362,25	20.046.451,31	14,00	0,119 €	**25%**	17,49	0,149 €	25.058.064,13		93
		District heating	kWh	926.640,33	926.640,33	12.015.677,24	12,97	0,110 €	**0%**	12,97	0,110 €	12.015.677,24		4
		Natural gas	Sm³	185.941,13	1.913.222,73	6.799.373,70	3,55	0,030 €	**50%**	5,33	0,045 €	10.199.060,55		23
		Brown coal	t	226,35	652.399,89	2.567.303,77	3,94	0,033 €	**0%**	3,94	0,033 €	2.567.303,77		7
		Firewood	m³	338,97	676.240,27	1.695.521,94	2,51	0,021 €	**0%**	2,51	0,021 €	1.695.521,94		9
		Wood pellet	t	63,16	311.534,19	1.472.740,87	4,73	0,040 €	**25%**	5,91	0,050 €	1.840.926,08		2
		Water	m³	14.543,38	-	2.588.144,01						2.588.144,01		59
SDG -->	**2279,68**				**5.912.399,67**	**47.185.212,84**	**7,98**	**0,068 €**		**9,47**	**0,080 €**	**55.964.697,73**	**19%**	**196**
LSG Type 3														
		Electricity	kWh	3.549.716,08	3.549.716,08	42.094.070,06	11,86	0,101 €	**25%**	14,82	0,126 €	52.617.587,58		103
		District heating	kWh	7.620.277,33	7.620.277,33	65.836.144,34	8,64	0,073 €	**0%**	8,64	0,073 €	65.836.144,34		37
		Natural gas	Sm³	291.625,67	3.000.653,13	11.949.174,26	3,98	0,034 €	**50%**	5,97	0,051 €	17.923.761,39		12
		Extra light fuel oil	l	36.607,67	377.688,62	6.263.493,61	16,58	0,141 €	**50%**	24,88	0,211 €	9.395.240,42		2
		Brown coal	t	45,77	131.908,69	2.197.340,00	16,66	0,142 €	**0%**	16,66	0,142 €	2.197.340,00		4
		Firewood	m³	120,98	241.351,11	626.193,33	2,59	0,022 €	**0%**	2,59	0,022 €	626.193,33		4
		Water	m³	76.582,89	-	5.523.008,38						5.523.008,38		66
HDD -->	**2715,58**				**14.921.594,96**	**134.489.423,99**	**9,01**	**0,077 €**		**9,01**	**0,077 €**	**154.119.275,45**	**15%**	**227**
LSG Type 4														
		Electricity	kWh	14.235.507,09	14.235.507,09	182.366.357,06	12,81	0,109 €	**25%**	16,01	0,136 €	227.957.946,32		360
		District heating	kWh	32.497.795,89	32.497.795,89	290.772.527,73	8,95	0,076 €	**0%**	8,95	0,076 €	290.772.527,73		144
		Natural gas	Sm³	2.189.133,39	22.524.869,07	101.145.800,58	4,49	0,038 €	**50%**	6,74	0,057 €	151.718.700,88		106
		Water	m³	357.831,54	-	73.439.329,50						73.439.329,50		225
HDD -->	**2242,04**				**69.258.172,05**	**647.724.014,87**	**9,35**	**0,079 €**		**9,35**	**0,079 €**	**743.888.504,42**	**15%**	**835**

Scenario 2 Energy price increases:

Electricity	50%;	Brown coal	0%;	Extra light fuel oil	75%
District heating	25%;	Firewood	25%;		
Natural gas	75%;	Wood Pellet	25%;		

Table 17 Sensitivity analysis – Scenario 2 – Summary of cost increase per LSG Type

	Energy cost increase by LSG Type for				
	Energy [kWh]	Cost + tax [RSD] Baseline	Cost + tax [RSD] After energy price change	Energy cost change	% of cost change
LSG Type 1	3.372.187,60	82.461.830,17	105.062.179,17	22.600.349,01	27%
LSG Type 2	5.912.399,67	47.185.212,84	66.103.953,78	18.918.740,94	40%
LSG Type 3	14.921.594,96	134.489.423,99	185.811.544,35	51.322.120,36	38%
LSG Type 4	69.258.172,05	647.724.014,87	887.459.675,76	239.735.660,90	37%
				Average -->	**36%**

Table 18 Sensitivity analysis – Scenario 2 – Cost increase per energy source and LSG type

						AVERAGE BASELINE COST			Sensitivity analysis					
							Cost per kWh	Cost per kWh [EUR]	Scenario:	2	<--- Select scenario			
		Energy Source	Unit	Consumption	Energy [kWh]	Cost + tax [RSD]	exchange rate --->	0,00850	% of cost change	Cost per kWh	Cost per kWh [EUR]	Cost + tax [RSD]	% of total cost change	Number of objects
BASELINE --> AVERAGE of 2018 to 2020												**AVERAGE TOAL COST CHANGE:**	**36%**	
LSG Type 1														
		Electricity	kWh	1.049.414,67	1.049.414,67	15.072.576,70	14,36	0,122 €	50%	21,54	0,183 €	22.608.865,05		88
		District heating	kWh	527.449,18	527.449,18	52.348.950,72	99,25	0,844 €	25%	124,06	1,055 €	65.436.188,40		8
		Natural gas	Sm³	27.856,67	286.628,39	1.863.268,55	6,50	0,055 €	75%	11,38	0,097 €	3.260.719,97		1
		Brown coal	t	198,17	571.160,77	2.458.119,32	4,30	0,037 €	0%	4,30	0,037 €	2.458.119,32		11
		Firewood	m³	412,67	823.263,73	1.794.048,07	2,18	0,019 €	25%	2,72	0,023 €	2.242.560,09		14
		Wood pellet	t	23,17	114.270,85	523.438,18	4,58	0,039 €	25%	5,73	0,049 €	654.297,72		4
		Water	m³	20.186,95	-	8.401.428,63						8.401.428,63		50
HDD -->	**2715,58**				**3.372.187,60**	**82.461.830,17**	**24,45**	**0,208 €**		**31,16**	**0,265 €**	**105.062.179,17**	**27%**	**176**
LSG Type 2														
		Electricity	kWh	1.432.362,25	1.432.362,25	20.046.451,31	14,00	0,119 €	50%	20,99	0,178 €	30.069.676,96		93
		District heating	kWh	926.640,33	926.640,33	12.015.677,24	12,97	0,110 €	25%	16,21	0,138 €	15.019.596,55		4
		Natural gas	Sm³	185.941,13	1.913.222,73	6.799.373,70	3,55	0,030 €	75%	6,22	0,053 €	11.898.903,98		23
		Brown coal	t	226,35	652.399,89	2.567.303,77	3,94	0,033 €	0%	3,94	0,033 €	2.567.303,77		7
		Firewood	m³	338,97	676.240,27	1.695.521,94	2,51	0,021 €	25%	3,13	0,027 €	2.119.402,43		9
		Wood pellet	t	63,16	311.534,19	1.472.740,87	4,73	0,040 €	25%	5,91	0,050 €	1.840.926,08		2
		Water	m³	14.543,38	-	2.588.144,01						2.588.144,01		59
SDG -->	**2279,68**				**5.912.399,67**	**47.185.212,84**	**7,98**	**0,068 €**		**11,18**	**0,095 €**	**66.103.953,78**	**40%**	**196**
LSG Type 3														
		Electricity	kWh	3.549.716,08	3.549.716,08	42.094.070,06	11,86	0,101 €	50%	17,79	0,151 €	63.141.105,10		103
		District heating	kWh	7.620.277,33	7.620.277,33	65.836.144,34	8,64	0,073 €	25%	10,80	0,092 €	82.295.180,43		37
		Natural gas	Sm³	291.625,67	3.000.653,13	11.949.174,26	3,98	0,034 €	75%	6,97	0,059 €	20.911.054,96		12
		Extra light fuel oil	l	36.607,67	377.688,62	6.263.493,61	16,58	0,141 €	75%	29,02	0,247 €	10.961.113,82		2
		Brown coal	t	45,77	131.908,69	2.197.340,00	16,66	0,142 €	0%	16,66	0,142 €	2.197.340,00		4
		Firewood	m³	120,98	241.351,11	626.193,33	2,59	0,022 €	25%	3,24	0,028 €	782.741,67		4
		Water	m³	76.582,89	-	5.523.008,38						5.523.008,38		66
HDD -->	**2715,58**				**14.921.594,96**	**134.489.423,99**	**9,01**	**0,077 €**		**9,01**	**0,077 €**	**185.811.544,35**	**38%**	**227**
LSG Type 4														
		Electricity	kWh	14.235.507,09	14.235.507,09	182.366.357,06	12,81	0,109 €	50%	19,22	0,163 €	273.549.535,59		360
		District heating	kWh	32.497.795,89	32.497.795,89	290.772.527,73	8,95	0,076 €	25%	11,18	0,095 €	363.465.659,66		144
		Natural gas	Sm³	2.189.133,39	22.524.869,07	101.145.800,58	4,49	0,038 €	75%	7,86	0,067 €	177.005.151,02		106
		Water	m³	357.831,54	-	73.439.329,50						73.439.329,50		225
HDD -->	**2242,04**				**69.258.172,05**	**647.724.014,87**	**9,35**	**0,079 €**		**9,35**	**0,079 €**	**887.459.675,76**	**37%**	**835**

Scenario 3 Energy price increases:

Electricity	50%;	Brown coal	25%;	Extra light fuel oil	100%
District heating	50%;	Firewood	50%;		
Natural gas	100%;	Wood Pellet	50%;		

Table 19 Sensitivity analysis – Scenario 3 – Summary of cost increase per LSG Type

	Energy cost increase by LSG Type for Energy [kWh]	Cost + tax [RSD] Baseline	Cost + tax [RSD] After energy price change	Energy cost change	% of cost change
LSG Type 1	3.372.187,60	82.461.830,17	119.809.135,38	37.347.305,22	45%
LSG Type 2	5.912.399,67	47.185.212,84	72.241.608,16	25.056.395,32	53%
LSG Type 3	14.921.594,96	134.489.423,99	207.529.630,74	73.040.206,74	54%
LSG Type 4	69.258.172,05	647.724.014,87	985.439.257,84	337.715.242,98	52%
				Average -->	**51%**

Table 20 Sensitivity analysis – Scenario 3 – Cost increase per energy source and LSG type

						AVERAGE BASELINE COST			Sensitivity analysis					
							Cost per kWh	Cost per kWh [EUR]	Scenario:	3	<--- Select scenario			
		Energy Source	Unit	Consumption	Energy [kWh]	Cost + tax [RSD]	exchange rate --->	0,00850	% of cost change	Cost per kWh	Cost per kWh [EUR]	Cost + tax [RSD]	% of total cost change	Number of objects
BASELINE --> AVERAGE of 2018 to 2020												AVERAGE TOAL COST CHANGE:	51%	
LSG Type 1														
		Electricity	kWh	1.049.414,67	1.049.414,67	15.072.576,70	14,36	0,122 €	50%	21,54	0,183 €	22.608.865,05		88
		District heating	kWh	527.449,18	527.449,18	52.348.950,72	99,25	0,844 €	50%	148,87	1,265 €	78.523.426,08		8
		Natural gas	Sm³	27.856,67	286.628,39	1.863.268,55	6,50	0,055 €	100%	13,00	0,111 €	3.726.537,11		1
		Brown coal	t	198,17	571.160,77	2.458.119,32	4,30	0,037 €	25%	5,38	0,046 €	3.072.649,14		11
		Firewood	m³	412,67	823.263,73	1.794.048,07	2,18	0,019 €	50%	3,27	0,028 €	2.691.072,11		14
		Wood pellet	t	23,17	114.270,85	523.438,18	4,58	0,039 €	50%	6,87	0,058 €	785.157,26		4
		Water	m³	20.186,95	-	8.401.428,63						8.401.428,63		50
HDD -->	2715,58				3.372.187,60	82.461.830,17	24,45	0,208 €		35,53	0,302 €	119.809.135,38	45%	176
LSG Type 2														
		Electricity	kWh	1.432.362,25	1.432.362,25	20.046.451,31	14,00	0,119 €	50%	20,99	0,178 €	30.069.676,96		93
		District heating	kWh	926.640,33	926.640,33	12.015.677,24	12,97	0,110 €	50%	19,45	0,165 €	18.023.515,86		4
		Natural gas	Sm³	185.941,13	1.913.222,73	6.799.373,70	3,55	0,030 €	100%	7,11	0,060 €	13.598.747,40		23
		Brown coal	t	226,35	652.399,89	2.567.303,77	3,94	0,033 €	25%	4,92	0,042 €	3.209.129,72		7
		Firewood	m³	338,97	676.240,27	1.695.521,94	2,51	0,021 €	50%	3,76	0,032 €	2.543.282,92		9
		Wood pellet	t	63,16	311.534,19	1.472.740,87	4,73	0,040 €	50%	7,09	0,060 €	2.209.111,30		2
		Water	m³	14.543,38	-	2.588.144,01						2.588.144,01		59
SDG -->	2279,68				5.912.399,67	47.185.212,84	7,98	0,068 €		12,22	0,104 €	72.241.608,16	53%	196
LSG Type 3														
		Electricity	kWh	3.549.716,08	3.549.716,08	42.094.070,06	11,86	0,101 €	50%	17,79	0,151 €	63.141.105,10		103
		District heating	kWh	7.620.277,33	7.620.277,33	65.836.144,34	8,64	0,073 €	50%	12,96	0,110 €	98.754.216,52		37
		Natural gas	Sm³	291.625,67	3.000.653,13	11.949.174,26	3,98	0,034 €	100%	7,96	0,068 €	23.898.348,52		12
		Extra light fuel oil	l	36.607,67	377.688,62	6.263.493,61	16,58	0,141 €	100%	33,17	0,282 €	12.526.987,23		2
		Brown coal	t	45,77	131.908,69	2.197.340,00	16,66	0,142 €	25%	20,82	0,177 €	2.746.675,00		4
		Firewood	m³	120,98	241.351,11	626.193,33	2,59	0,022 €	50%	3,89	0,033 €	939.290,00		4
		Water	m³	76.582,89	-	5.523.008,38						5.523.008,38		66
HDD -->	2715,58				14.921.594,96	134.489.423,99	9,01	0,077 €		9,01	0,077 €	207.529.630,74	54%	227
LSG Type 4														
		Electricity	kWh	14.235.507,09	14.235.507,09	182.366.357,06	12,81	0,109 €	50%	19,22	0,163 €	273.549.535,59		360
		District heating	kWh	32.497.795,89	32.497.795,89	290.772.527,73	8,95	0,076 €	50%	13,42	0,114 €	436.158.791,59		144
		Natural gas	Sm³	2.189.133,39	22.524.869,07	101.145.800,58	4,49	0,038 €	100%	8,98	0,076 €	202.291.601,17		106
		Water	m³	357.831,54	-	73.439.329,50						73.439.329,50		225
HDD -->	2242,04				69.258.172,05	647.724.014,87	9,35	0,079 €		9,35	0,079 €	985.439.257,84	52%	835

Scenario 4 Energy price increases:

Electricity	100%;	Brown coal	50%;	Extra light fuel oil	100%
District heating	75%;	Firewood	50%;		
Natural gas	100%;	Wood Pellet	75%;		

Table 21 Sensitivity analysis – Scenario 4 – Summary of cost increase per LSG Type

	Energy cost increase by LSG Type for				
	Energy [kWh]	Cost + tax [RSD] Baseline	Cost + tax [RSD] After energy price change	Energy cost change	% of cost change
LSG Type 1	3.372.187,60	82.461.830,17	141.178.050,78	58.716.220,62	71%
LSG Type 2	5.912.399,67	47.185.212,84	86.278.764,29	39.093.551,44	83%
LSG Type 3	14.921.594,96	134.489.423,99	245.585.036,85	111.095.612,86	83%
LSG Type 4	69.258.172,05	647.724.014,87	1.149.315.568,30	501.591.553,44	77%
				Average -->	**79%**

Table 22 Sensitivity analysis – Scenario 4 – Cost increase per energy source and LSG type

						AVERAGE BASELINE COST			Sensitivity analysis					
							Cost per kWh	Cost per kWh [EUR]	Scenario:		4	<--- Select scenario		
		Energy Source	Unit	Consumption	Energy [kWh]	Cost + tax [RSD]	exchange rate --->	0,00850	% of cost change	Cost per kWh	Cost per kWh [EUR]	Cost + tax [RSD]	% of total cost change	Number of objects
BASELINE --> AVERAGE of 2018 to 2020												**AVERAGE TOAL COST CHANGE:**	**79%**	
LSG Type 1														
		Electricity	kWh	1.049.414,67	1.049.414,67	15.072.576,70	14,36	0,122 €	100%	28,73	0,244 €	30.145.153,39		88
		District heating	kWh	527.449,18	527.449,18	52.348.950,72	99,25	0,844 €	75%	173,69	1,476 €	91.610.663,76		8
		Natural gas	Sm³	27.856,67	286.628,39	1.863.268,55	6,50	0,055 €	100%	13,00	0,111 €	3.726.537,11		1
		Brown coal	t	198,17	571.160,77	2.458.119,32	4,30	0,037 €	50%	6,46	0,055 €	3.687.178,97		11
		Firewood	m³	412,67	823.263,73	1.794.048,07	2,18	0,019 €	50%	3,27	0,028 €	2.691.072,11		14
		Wood pellet	t	23,17	114.270,85	523.438,18	4,58	0,039 €	75%	8,02	0,068 €	916.016,81		4
		Water	m³	20.186,95	-	8.401.428,63						8.401.428,63		50
HDD -->	**2715,58**				**3.372.187,60**	**82.461.830,17**	**24,45**	**0,208 €**		**41,87**	**0,356 €**	**141.178.050,78**	**71%**	**176**
LSG Type 2														
		Electricity	kWh	1.432.362,25	1.432.362,25	20.046.451,31	14,00	0,119 €	100%	27,99	0,238 €	40.092.902,61		93
		District heating	kWh	926.640,33	926.640,33	12.015.677,24	12,97	0,110 €	75%	22,69	0,193 €	21.027.435,17		4
		Natural gas	Sm³	185.941,13	1.913.222,73	6.799.373,70	3,55	0,030 €	100%	7,11	0,060 €	13.598.747,40		23
		Brown coal	t	226,35	652.399,89	2.567.303,77	3,94	0,033 €	50%	5,90	0,050 €	3.850.955,66		7
		Firewood	m³	338,97	676.240,27	1.695.521,94	2,51	0,021 €	50%	3,76	0,032 €	2.543.282,92		9
		Wood pellet	t	63,16	311.534,19	1.472.740,87	4,73	0,040 €	75%	8,27	0,070 €	2.577.296,52		2
		Water	m³	14.543,38	-	2.588.144,01						2.588.144,01		59
SDG -->	**2279,68**				**5.912.399,67**	**47.185.212,84**	**7,98**	**0,068 €**		**14,59**	**0,124 €**	**86.278.764,29**	**83%**	**196**
LSG Type 3														
		Electricity	kWh	3.549.716,08	3.549.716,08	42.094.070,06	11,86	0,101 €	100%	23,72	0,202 €	84.188.140,13		103
		District heating	kWh	7.620.277,33	7.620.277,33	65.836.144,34	8,64	0,073 €	75%	15,12	0,129 €	115.213.252,60		37
		Natural gas	Sm³	291.625,67	3.000.653,13	11.949.174,26	3,98	0,034 €	100%	7,96	0,068 €	23.898.348,52		12
		Extra light fuel oil	l	36.607,67	377.688,62	6.263.493,61	16,58	0,141 €	100%	33,17	0,282 €	12.526.987,23		2
		Brown coal	t	45,77	131.908,69	2.197.340,00	16,66	0,142 €	50%	24,99	0,212 €	3.296.010,00		4
		Firewood	m³	120,98	241.351,11	626.193,33	2,59	0,022 €	50%	3,89	0,033 €	939.290,00		4
		Water	m³	76.582,89	-	5.523.008,38						5.523.008,38		66
HDD -->	**2715,58**				**14.921.594,96**	**134.489.423,99**	**9,01**	**0,077 €**		**9,01**	**0,077 €**	**245.585.036,85**	**83%**	**227**
LSG Type 4														
		Electricity	kWh	14.235.507,09	14.235.507,09	182.366.357,06	12,81	0,109 €	100%	25,62	0,218 €	364.732.714,11		360
		District heating	kWh	32.497.795,89	32.497.795,89	290.772.527,73	8,95	0,076 €	75%	15,66	0,133 €	508.851.923,52		144
		Natural gas	Sm³	2.189.133,39	22.524.869,07	101.145.800,58	4,49	0,038 €	100%	8,98	0,076 €	202.291.601,17		106
		Water	m³	357.831,54	-	73.439.329,50						73.439.329,50		225
HDD -->	**2242,04**				**69.258.172,05**	**647.724.014,87**	**9,35**	**0,079 €**		**9,35**	**0,079 €**	**1.149.315.568,30**	**77%**	**835**

Part II: Review of actual energy savings after energy renovation projects of individual buildings

Over the past years many public buildings in municipalities have been renovated to improve energy efficiency and reduce energy costs. For a selected group of buildings. a real energy consumption report was prepared, using the data available in EMIS. This data was analysed to determine the amount of actual energy savings that are a result of implementing energy efficiency improvement measures.

The basis for this analysis was the EMIS data. But for the selected group of buildings, the available technical building refurbishment documentation was reviewed as well to confirm the scope of the implemented improvement measures and to confirm technical details about the buildings and measures. The energy efficiency projects that were implemented on these buildings were financed by the Budgetary Fund for energy efficiency and Public Investment Management Office (PIMO).

The buildings were selected for analysis depending on the quality of EMIS data and the availability of technical documentation. The list of buildings that were analysed is:

1. Center for social work, Leskovac
2. Health center Kanjiža/Health station Horgoš, Kanjiža
3. Primary school “Turzo Lajoš”, Senta
4. Technical school, Žagubica
5. Knjaževac gymnasium, Knjaževac
6. CZK “Masuka”, Velika Plana
7. Residential and commercial building KJP “Morava” Svilajnac
8. Senta Gymnasium, Senta
9. Home of Arts OKU “Cnesa”, Kanjiža
10. Assembly of the municipality of Medveđa

An analysis of the actual energy savings for each individual building is presented below, then followed by a summary chapter that provides an overview of the findings and conclusions.

Building 1 – Center for social work Leskovac

The Center for social work Leskovac is located at Kosta Stamenkovića street no. 6, in Leskovac. This permanent facility has an administrative-governmental function. The heating of the building is secured through connection to the district heating network. The number of floors of the building is P0+P+2. The total gross area of the building is P_{br} = 935.17 m^2 and the total net area of the building is P_{net} = 743,22 m^2.

The project of building energy refurbishment was implemented in 2018, and the measures included:

- thermal insulation of the outer envelope (facade and roof) with 5 to 10 cm of mineral wool / EPS,
- installation of thermostatic radiator valves and internal cleaning of the heating elements,
- reconstruction of the electrical installation (lights).

The building data available in EMIS were extracted in a form of a Energy consumption report. The data shown below are part of the generated report.

Table 23 Basic building data and annual consumption (EMIS) – Center for social work, Leskovac

Basic information about object

Name	Center for social work	Address	Koste Stamenkovic 6
User	Grad \ Grad Leskovac \ Centar za socijalni rad	City	Leskovac
EMIS Code	SR-4404-0156-1	Object Type	F07 - Centers for social work

Dimensions and renovation

Gross floor area [m²]	920	Year of construction completion	
Heated net floor area of the building [m²]	750	Year of last renovation	
What has been renovated			

Employees and working hours

Number of employees		Number of working hours per day		Number of working days per week	
Number of users		Number of working hours per week		Number of working days per year	
Total number of employees and users	0				

Metering points for energy carriers

Energy carrier	Number of metering points	Serial numbers
District heating	1	P121 ($)
Electricity	1	405000039060 / 6654700932191 ($)
Water	1	000638-01 ($)

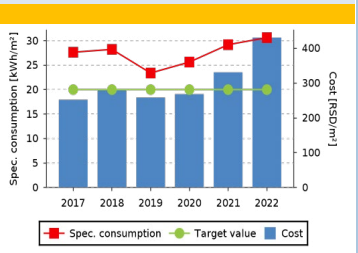
Annual consumption per group of energy carriers

Electricity

Year	Consumption [kWh]	% change in consumption compared to average before reconstruction [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
2017	25.423,00		27,63		232.063,55	252,24	27,94
2018	25.962,00		28,22		258.761,83	281,26	28,53
2019	21.516,00		23,39		237.876,60	258,56	23,65
2020	23.575,00		25,62		247.010,42	268,49	25,91
2021	26.839,00		29,17		304.637,22	331,13	29,50
2022	28.174,00		30,62		396.221,38	430,68	30,96

Renovation year

Spec. consumption - Električna Target value [kWh/m²/year]:	20



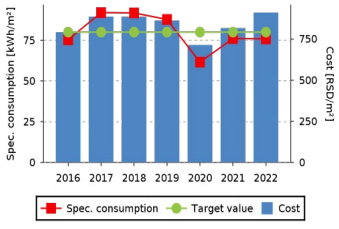
Annual consumption per group of energy carriers

Heating - District heating

Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
2016	69.290,00		75,32		729.052,52	792,45	19,89
2017	84.620,00		91,98		816.102,40	887,07	24,29
2018	84.450,00		91,79		815.137,07	886,02	24,24
2019	80.740,00		87,76		794.070,20	863,12	23,17
2020	56.650,00		61,58		657.277,55	714,43	16,26
2021	69.990,00		76,08		751.867,30	817,25	20,09
2022	69.810,00		75,88		838.278,47	911,17	20,04

Renovation year

Spec. consumption - Grejanje Target value [kWh/m²/year]:	80



The technical documentation and EMIS report data shows that the energy savings have been achieved, both for heating energy and electricity. The electricity consumption fell the most immediately after the reconstruction, but in the latter years, consumption increased. The increase is most likely due to the addition of new appliances and electricity consuming devices as the building is used for administrative and governmental functions.

For heating energy, the biggest saving was achieved in the second year after reconstruction, and then consumption increased in the following years. It is also clearly visible that the unit costs of both heating energy and electricity are rising.

A table with monthly energy consumption data normalised by heating degree days is given below.

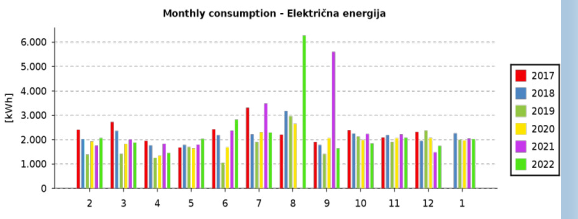
Table 24 Monthly consumption data for electricity & heating (EMIS) - Center for social work, Leskovac

Monthly consumption - data normalised by HDD

Electricity

Renovation year

	UOM	2017	2018	2019	2020	2021
1	[kWh]	0	2.263	1.999	1.974	2.049
2	[kWh]	2.408	2.025	1.389	1.937	1.758
3	[kWh]	2.728	2.359	1.419	1.827	2.007
4	[kWh]	1.957	1.768	1.253	1.348	1.830
5	[kWh]	1.679	1.785	1.701	1.650	1.797
6	[kWh]	2.426	2.186	1.054	1.691	2.368
7	[kWh]	3.314	2.221	1.907	2.307	3.484
8	[kWh]	2.206	3.177	2.964	2.651	0
9	[kWh]	1.905	1.783	1.414	2.063	5.604
10	[kWh]	2.391	2.254	2.128	1.991	2.236
11	[kWh]	2.091	2.189	1.907	2.062	2.222
12	[kWh]	2.318	1.952	2.381	2.074	1.484
	Total	25.423	25.962	21.516	23.575	26.839
	Average 2017-2018 -->		25.693	-16%	-8%	4%
				% change		

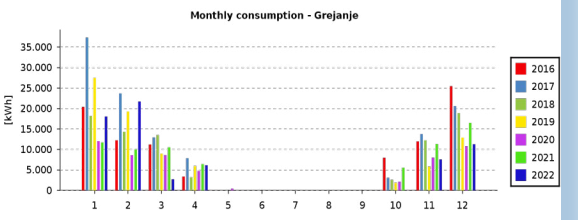


	UOM	2022
1	[kWh]	2.026
2	[kWh]	2.069
3	[kWh]	1.882
4	[kWh]	1.457
5	[kWh]	2.037
6	[kWh]	2.823
7	[kWh]	2.291
8	[kWh]	6.272
9	[kWh]	1.645
10	[kWh]	1.845
11	[kWh]	2.078
12	[kWh]	1.749
	Total	28.174
		10%
		% change

Heating - District heating

Renovation year

	UOM	2016	2017	2018	2019	2020
1	[kWh]	20.420	37.335	18.204	27.519	12.049
2	[kWh]	12.252	23.705	14.317	19.304	8.632
3	[kWh]	11.234	12.967	13.560	9.033	8.651
4	[kWh]	3.401	7.887	3.247	6.025	4.782
5	[kWh]	0	0	0	0	471
6	[kWh]	0	0	0	0	0
7	[kWh]	0	0	0	0	0
8	[kWh]	0	0	0	0	0
9	[kWh]	0	0	0	0	0
10	[kWh]	8.007	3.104	2.627	1.923	2.160
11	[kWh]	11.984	13.785	12.241	5.872	8.043
12	[kWh]	25.481	20.615	18.903	12.920	10.841
	Total	92.779	119.399	83.099	82.597	55.630
	Average 2016-2018 -->			98.426	-16%	-43%
					% change	



	UOM	2021	2022
1	[kWh]	11.754	18.063
2	[kWh]	10.031	21.722
3	[kWh]	10.547	2.739
4	[kWh]	6.450	6.166
5	[kWh]	0	0
6	[kWh]	0	0
7	[kWh]	0	0
8	[kWh]	0	0
9	[kWh]	0	0
10	[kWh]	5.583	0
11	[kWh]	11.352	7.589
12	[kWh]	16.512	11.297
	Total	72.230	67.576
		-27%	-31%
		% change	

The monthly data shows that the highest electricity savings was 16% in 2019, compared to average consumption before reconstruction and that the savings did reduce in the following years, concluding with 10% higher consumption in 2022. Due to this fact, the **average annual savings of electricity is only 3% or 667 kWh.**

For heating energy, the highest savings of 43% was achieved in 2020 and the smallest of 16% in 2019. **The average annual savings of heating energy is 29% or 28.917 kWh.**

Table 25 Summary of actual savings - Center for social work, Leskovac

Building name	Building net area	Average yearly consumption & CO_2 emmision before reconstruction - (Baseline)				Average yearly consumption & CO_2 emmision after reconstruction				Average yearly savings					
		Electricity		Heating		Electricity		Heating		Electricity			Heating		
	[m^2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[%]	[t CO_2]	[kWh]	[%]	[t CO_2]
Center for social work Leskovac	743,22	25.693	28,24	98.426	24,27	25.026	27,51	69.508	19,89	667	3%	0,73	28.917	29%	4,38

Building 2 – Health center Kanjiža/Health station Horgoš, Kanjiža

The Health center Kanjiža/Health station Horgoš is located at Bele Bartoka street no. 7 in Horgoš. It is a free-standing building built in 1968. The building uses natural gas for heating. The number of floors is P+1, the total gross area of the building is P_{br} = 753.94 m^2 and the total net area of the building is P_{net} = 644.14 m^2.

The project of building energy renovation was implemented in 2017 (2018) and included:

- thermal insulation of the outer envelope (facade and roof) with 10 cm of mineral wool,
- replacement of all windows and facade partitions,
- partial renovation of internal lighting electrical installations (replacement of worn-out lamps with new lamps with a fluorescent light source).

The building data available in EMIS were extracted in the form of an Energy consumption report. The data shown below are part of the generated report.

Table 26 Basic building data and annual consumption (EMIS) – Health station Horgoš,

Basic information about object

Name	Health center Kanjiža/Health station Horgoš	Address	Bele Bartoka 5 Horgoš
User	Opština \ Kanjiža \ Ministarstvo zdravlja/Dom zdravlja Kanjiža/Zdravstvena stanica Horgoš	City	Kanjiža
EMIS Code	SR-2403-0118-1	Object Type	B01 - Infirmaries

Dimensions and renovation

Gross floor area [m²]		Year of construction completion	
Heated net floor area of the building [m²]		Year of last renovation	
What has been renovated			

Employees and working hours

Number of employees		Number of working hours per day		Number of working days per week	
Number of users		Number of working hours per week		Number of working days per year	
Total number of employees and users	0				

Metering points for energy carriers

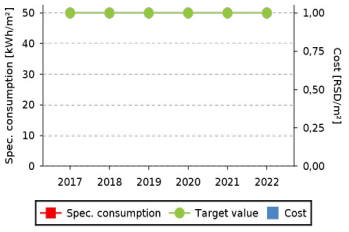
Energy carrier	Number of metering points	Serial numbers
Electricity	1	2290084004 ($)
Natural gas	1	3665238D ($)
Water	1	11001602 ($)

Annual consumption per group of energy carriers

Electricity

	Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
Renovation year	2017	28.482,00				241.647,47		31,30
	2018	20.101,00				180.819,44		22,09
	2019	22.765,00				233.198,95		25,02
	2020	22.255,00				230.289,95		24,46
	2021	22.843,00				235.674,81		25,10
	2022	20.460,00				251.151,81		22,49

Spec. consumption - Električna Target value [kWh/m²/year]:	50

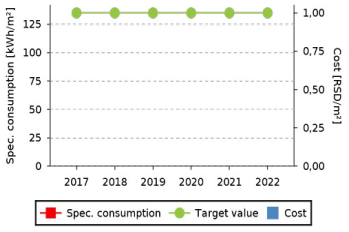


Annual consumption per group of energy carriers

Heating - Natural gas

	Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
Renovation year	2017	269.232,44				865.599,65		48,46
	2018	222.518,56				728.762,37		40,05
	2019	105.816,19				428.992,09		19,05
	2020	83.416,17				355.915,06		15,01
	2021	97.924,22				412.445,07		17,63
	2022	114.827,99				497.438,36		20,67

Spec. consumption - Grejanje Target value [kWh/m²/year]:	135



The technical documentation and EMIS report data shows that the energy savings have been achieved, both for heating energy and electricity. The EMIS report did not show specific energy consumption as no building area was entered into the system. The achieved savings are well balanced throughout the years, with the exception of first year after reconstruction when the savings of heating energy were low, most likely because reconstruction was not completed until mid-2018.

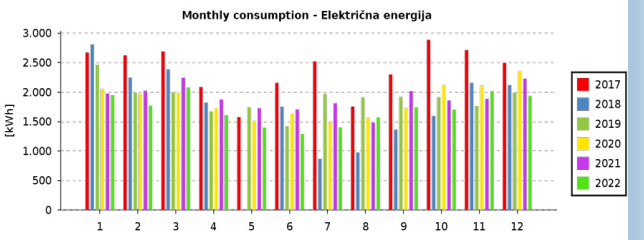
A table with monthly energy consumption data normalised by heating degree days is given below.

Table 27 Monthly consumption data for electricity & heating (EMIS) - Health station Horgoš

Monthly consumption - data normalised by HDD

Electricity

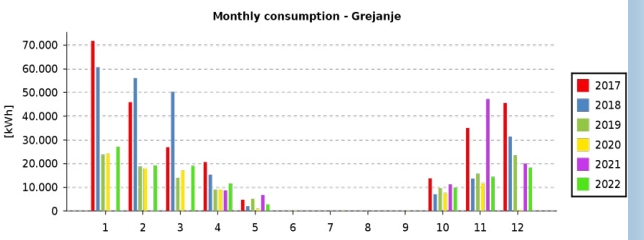
	UOM	Renovation year 2017	2018	2019	2020	2021
1	[kWh]	2.673	2.810	2.466	2.053	1.977
2	[kWh]	2.623	2.247	1.993	1.967	2.023
3	[kWh]	2.691	2.384	1.997	1.984	2.245
4	[kWh]	2.087	1.823	1.674	1.728	1.876
5	[kWh]	1.577	0	1.744	1.510	1.729
6	[kWh]	2.157	1.754	1.421	1.637	1.707
7	[kWh]	2.522	869	1.968	1.487	1.812
8	[kWh]	1.756	977	1.913	1.563	1.485
9	[kWh]	2.300	1.363	1.918	1.732	2.016
10	[kWh]	2.887	1.597	1.915	2.127	1.857
11	[kWh]	2.714	2.157	1.764	2.108	1.887
12	[kWh]	2.495	2.120	1.992	2.359	2.229
Total		28.482	20.101,00	22.765,00	22.255,00	22.843,00
Average -->		28.482	-29%	-20%	-22%	-20%
			% change			



	UOM	2022
1	[kWh]	1.948
2	[kWh]	1.770
3	[kWh]	2.077
4	[kWh]	1.605
5	[kWh]	1.399
6	[kWh]	1.289
7	[kWh]	1.401
8	[kWh]	1.571
9	[kWh]	1.743
10	[kWh]	1.704
11	[kWh]	2.019
12	[kWh]	1.934
Total		20.460,00
		-28%
		% change

Heating - Natural gas

	UOM	Renovation year 2017	2018	2019	2020	2021
1	[kWh]	71.813	60.717	23.759	24.347	0
2	[kWh]	45.950	56.108	18.781	17.986	0
3	[kWh]	26.945	50.295	14.024	17.142	0
4	[kWh]	20.674	15.360	9.081	9.093	8.711
5	[kWh]	4.744	2.047	5.153	988	6.771
6	[kWh]	0	0	163	355	148
7	[kWh]	0	0	0	0	0
8	[kWh]	0	0	0	0	0
9	[kWh]	61	0	0	200	10
10	[kWh]	13.776	7.083	9.699	7.627	11.245
11	[kWh]	35.067	13.707	15.773	11.768	47.275
12	[kWh]	45.626	31.442	23.456	500	20.044
Total		264.655	236.760	119.890	90.006	94.203
Average -->		264.655	-11%	-55%	-66%	-64%
			% change			



	UOM	2022
1	[kWh]	27.161
2	[kWh]	19.256
3	[kWh]	19.069
4	[kWh]	11.659
5	[kWh]	2.818
6	[kWh]	0
7	[kWh]	231
8	[kWh]	0
9	[kWh]	0
10	[kWh]	9.872
11	[kWh]	14.450
12	[kWh]	18.349
Total		122.866
		-54%
		% change

The monthly data shows that the highest electricity savings was 29% in 2018, compared to average consumption before reconstruction. **The average annual savings of electricity is 24% or 6.797 kWh.**

For heating energy, the highest savings was 66% in 2020 and **the average annual savings is 50% or 131.910 kWh.**

Table 28 Summary of actual savings - Health station Horgoš

Building name	Building net area	Average yearly consumption & CO_2 emmision before reconstruction - (Baseline)				Average yearly consumption & CO_2 emmision after reconstruction				Average yearly savings					
		Electricity		Heating		Electricity		Heating		Electricity			Heating		
	[m^2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[%]	[t CO_2]	[kWh]	[%]	[t CO_2]
Health station Horgoš, Kanjiža	644,14	28.482	31,30	264.655	48,46	21.685	23,83	132.745	22,48	6.797	24%	7,47	131.910	50%	25,98

Building 3 – Primary school "Turzo Lajoš", Senta

The primary school "Turzo Lajoš is located at Željeznička street no. 44 in Senta. The building uses natural gas for heating. The number of floors of the building is P+1, the total gross area of the building is P_{br} = 3.438,65 m^2 and the total net area of the building is P_{net} = 2.955,82 m^2.

The building reconstruction and energy refurbishment was implemented in 2019 and included:

- thermal insulation of the outer facade with 10 cm of mineral wool, thermal insulation of floors with 10 cm of insulation and replacement of windows,
- replacement of heating elements and installation of thermostatic radiator valves and internal cleaning of the heating elements,
- reconstruction of lights.

The building data available in EMIS were extracted in the form of an Energy consumption report. The data shown below are part of the generated report.

Table 29 Basic building data and annual consumption (EMIS) – Primary school "Turzo Lajoš", Senta

Basic information about object

Name	Primary school "Turzo Lajoš", Senta	Address	Železnička 44
User	Opština \ Senta \ OŠ "Turzo Lajoš"	City	Senta
EMIS Code	SR-2406-0011-1	Object Type	A02 - Primary schools

Dimensions and renovation

Gross floor area [m²]	3494.25	Year of construction completion	
Heated net floor area of the building [m²]		Year of last renovation	
What has been renovated			

Employees and working hours

Number of employees		Number of working hours per day		Number of working days per week	
Number of users	535	Number of working hours per week		Number of working days per year	
Total number of employees and users	535				

Metering points for energy carriers

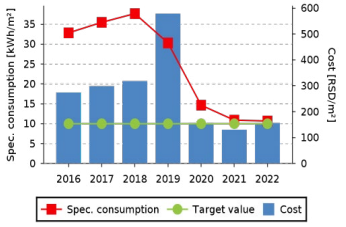
Energy carrier	Number of metering points	Serial numbers
Electricity	3	9150208878 ($), 9150212107 ($), 9150280285 ($)
Natural gas	1	01007319 ($)
Water	3	07002700 ($), 07008270 ($), 07008280 ($)

Annual consumption per group of energy carriers

Electricity

Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
2016	114.720,00		32,83		959.028,89	274,46	126,08
2017	123.930,00		35,47		1.044.942,94	299,05	136,20
2018	131.608,00		37,66		1.112.707,19	318,44	144,64
Renovation year 2019	105.844,00		30,29		2.022.059,61	578,68	116,32
2020	51.191,00		14,65		548.028,76	156,84	56,26
2021	38.083,00		10,90		455.826,53	130,45	41,85
2022	37.295,00		10,67		547.720,42	156,75	40,99

Spec. consumption - Električna Target value [kWh/m²/year]:	10

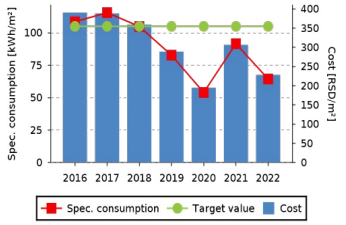


Annual consumption per group of energy carriers

Heating - Natural gas

Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
2016	379.267,28		108,54		1.364.921,63	390,62	68,27
2017	403.930,98		115,60		1.357.975,44	388,63	72,71
2018	366.539,30		104,90		1.256.228,81	359,51	65,98
Renovation year 2019	289.235,03		82,77		1.009.693,71	288,96	52,06
2020	188.697,31		54,00		680.313,37	194,70	33,97
2021	320.144,39		91,62		1.071.120,85	306,54	57,63
2022	225.107,12		64,42		797.742,86	228,30	40,52

Spec. consumption - Grejanje Target value [kWh/m²/year]:	105



The technical documentation and EMIS report data shows that the energy savings have been achieved, both for heating energy and electricity. The electricity consumption fell significantly, but the graphs show that for 2019 the costs were most likely entered 2 times into system, but this does not affect the energy saving calculations.

The biggest savings for heating energy occurred in 2020, but this is because during the first two months there was no consumption.

A table with monthly energy consumption data normalised by heating degree days is given below.

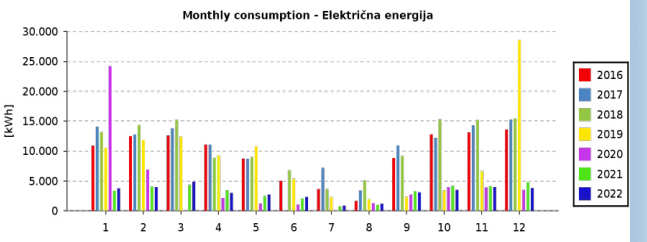
Table 30 Monthly consumption data for electricity & heating (EMIS) - Primary school "Turzo Lajoš", Senta

Monthly consumption - data normalised by HDD

Electricity

Renovation year

	UOM	2016	2017	2018	2019	2020
1	[kWh]	10.920	14.070	13.200	10.564	24.222
2	[kWh]	12.510	12.780	14.370	11.850	6.905
3	[kWh]	12.630	13.830	15.240	12.450	69
4	[kWh]	11.100	11.100	8.880	9.330	2.158
5	[kWh]	8.760	8.730	9.030	10.830	1.226
6	[kWh]	5.040	0	6.810	5.400	1.053
7	[kWh]	3.660	7.200	3.660	2.340	87
8	[kWh]	1.680	3.420	5.130	1.980	1.283
9	[kWh]	8.850	10.950	9.180	2.370	2.742
10	[kWh]	12.810	12.240	15.360	3.450	3.992
11	[kWh]	13.140	14.310	15.270	6.690	3.941
12	[kWh]	13.620	15.300	15.478	28.590	3.513
	Total	114.720	123.930	131.608	105.844	51.191
			Average 2016 - 2018--->		123.419	-59%
						% change

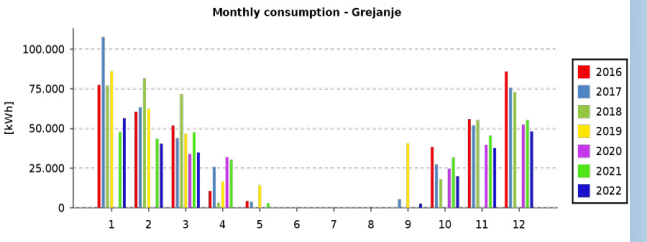


	UOM	2021	2022
1	[kWh]	3.369	3.768
2	[kWh]	4.072	3.987
3	[kWh]	4.364	4.899
4	[kWh]	3.449	3.009
5	[kWh]	2.504	2.747
6	[kWh]	2.093	2.344
7	[kWh]	764	880
8	[kWh]	1.007	1.211
9	[kWh]	3.309	3.111
10	[kWh]	4.198	3.521
11	[kWh]	4.139	3.993
12	[kWh]	4.815	3.825
	Total	38.083	37.295
		-69%	-70%
		% change	

Heating - Natural gas

Renovation year

	UOM	2016	2017	2018	2019	2020
1	[kWh]	77.517	107.702	76.985	86.232	0
2	[kWh]	60.592	63.439	81.605	62.578	0
3	[kWh]	51.904	43.954	71.799	46.748	33.969
4	[kWh]	10.653	25.770	3.297	16.647	31.935
5	[kWh]	4.307	3.829	11	14.318	0
6	[kWh]	10	0	11	0	0
7	[kWh]	10	0	0	0	0
8	[kWh]	0	0	0	0	0
9	[kWh]	125	5.439	0	40.730	0
10	[kWh]	38.377	27.318	18.097	0	24.717
11	[kWh]	55.929	52.055	55.378	0	39.782
12	[kWh]	85.911	75.637	72.920	0	52.444
	Total	385.336	405.143	380.101	267.253	182.848
			average 2016 - 2018--->		390.193	-53%
						% change



	UOM	2021	2022
1	[kWh]	47.802	56.528
2	[kWh]	43.668	40.462
3	[kWh]	47.685	34.901
4	[kWh]	30.268	0
5	[kWh]	2.939	11
6	[kWh]	0	0
7	[kWh]	0	0
8	[kWh]	0	0
9	[kWh]	0	2.637
10	[kWh]	31.649	19.927
11	[kWh]	45.451	37.755
12	[kWh]	55.315	48.193
	Total	304.777	240.414
		-22%	-38%
		% change	

The monthly data shows that the highest electricity savings was 70% in 2022, compared to average consumption before reconstruction, and **the average annual savings of 66% or 81.230 kWh.**

The highest observed savings for heating energy is 53% but this figure is not accurate as there was no consumption during the first two months. **The average annual savings is 38% or 147.514 kWh**, and that is more realistic**.**

Table 31 Summary of actual savings – Primary school "Turzo Lajoš", Senta

Building name	Building net area	Average yearly consumption & CO_2 emmision before reconstruction - (Baseline)				Average yearly consumption & CO_2 emmision after reconstruction				Average yearly savings					
		Electricity		Heating		Electricity		Heating		Electricity			Heating		
	[m²]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[%]	[t CO_2]	[kWh]	[%]	[t CO_2]
Primary school "Turzo Lajoš", Senta	2.955,82	123.419	130,81	390.193	64,76	42.190	46,37	242.680	44,04	81.230	66%	84,44	147.514	38%	20,72

Building 4 – Technical school, Žagubica

The Technical school is located at Homoljska street no. 1, in Žagubica. The main school building was built in 1979. The building had used coal for heating, but during energy reconstruction the heating fuel was changed to wood pellet. The number of floors of the building is P+1, total gross area of the building is P_{br} = 1.990,90 m^2 and total net area of the building is P_{net} = 1.630 m^2.

The project of building energy refurbishment was implemented in 2018 and included:

- thermal insulation of the outer facade (including ceiling towards the roof) with 10 cm of mineral wool and replacement of windows,
- replacement of hot water boilers with the change of fuel to wood pellet and installation of thermostatic radiator valves.
- Installation of circulation variable speed drive pump,
- PLC control system for hot water boiler and substation,
- multi zone heating control system,
- installation of DHW storage.

The building data available in EMIS were extracted in the form of an Energy consumption report. The data shown below are part of the generated report.

Table 32 Basic building data (EMIS) – Technical school, Žagubica

Basic information about object

Name	Technical school, Zagubica	Address	Homoljska bb
User	Opština \Zagubica \Tehnička škola, Žagubica	City	Zagubica
EMIS Code	SR-4208-0001-0	Object Type	A03 - Secondary schools

Dimensions and renovation

Gross floor area [m²]	1730	Year of construction completion	
Heated net floor area of the building [m²]	1630	Year of last renovation	2018

What has been renovated

- Korišćenje šumske biomase u postrojenjima za proizvodnju toplotne energije - Termička izolacija neizolovanih cevovoda i armature (toplovoda/ parovoda):izolacija od mineralne vune debljine 40mm, u opšivu od Al lima debljine 0,5mm.
- Ugradnja radijatorskih ventila sa termoregulacionim glavama
- Zamena postojećih prozora novim EE prozorima. – Termička izolacija tavanice prema negrejanom tavanu: postavljanje kamene vune u obliku mekih ploča, "Vunizol M plus", debljine 5 cm, gustine 60 kg/m³, 1890 m2 - Termička izolacija spoljnih zidova i eliminisanje toplotnih mostova: postavljanje kamene vune u obliku polutvrdih ploča, "Vunizol P plus", debljine 4 cm, gustine 75 kg/m³, 960 m2,Bojenje fasade akrilnom energetski štedljivom fasadnom bojom, visoko otpornom na toplotno zračenje prema standardu DIN EN ISO 11507 min 1000 sati, ph vrednosti min 8.0 i stepenom refleksije min 80%. 860m2 - Ugradnja radne i rezervne pumpe promenljivog protoka (frekventna regulacija) u dupleks izvedbi sa svom potrebnom armaturom.

Employees and working hours

Number of employees	27	Number of working hours per day	8	Number of working days per week	5
Number of users	219	Number of working hours per week	40	Number of working days per year	315
Total number of employees and users	246				

Metering points for energy carriers

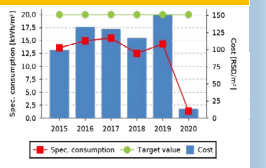
Energy carrier	Number of metering points	Serial numbers
Wood pellet	1	Drvni pelet TS Zagubica ($)
Electricity	1	2232600983010 ($)
Brown coal	1	Mrki ugalj ($)
Water	1	voda ($)

Annual consumption per group of energy carriers

Electricity

Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
2015	23.510,32		13,59		172.755,21	99,86	25,84
2016	25.869,68		14,95		230.048,03	132,98	28,43
2017	26.760,00		15,47		225.409,13	130,29	29,41
2018	21.690,00		12,54		201.931,54	116,72	23,84
2019	24.780,00		14,32		261.462,85	151,13	27,23
2020	2.340,00		1,35		24.087,07	13,92	2,57

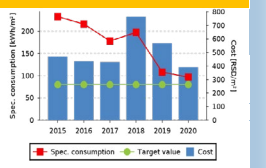
Spec. consumption - Električna Target value [kWh/m²/year]:	20



Heating - Brown coal --> Wood pellet

Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
2015	403.508,00		233,24		814.221,80	470,65	141,23
2016	374.686,00		216,58		756.063,10	437,03	131,14
2017	308.582,97		178,37		741.621,12	428,68	88,07
2018	341.801,46		197,57		1.322.790,69	764,62	0,00
2019	187.512,38		108,39		982.095,75	567,69	0,00
2020	167.694,80		96,93		676.600,00	391,10	0,00

Spec. consumption - Grejanje Target value [kWh/m²/year]:	80



The technical documentation and EMIS report data shows that only energy savings for heating was achieved, but that aligns with the implemented measures.

Heating energy costs in 2018 are significantly higher than the year before, but it is most likely because that is the year fuel sources were purchased.

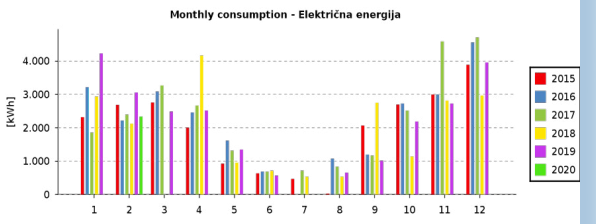
A table with monthly energy consumption data normalised by heating degree days is given below.

Table 33 Monthly consumption data for electricity & heating (EMIS) - Technical school, Žagubica

Monthly consumption - data normalised by HDD

Electricity

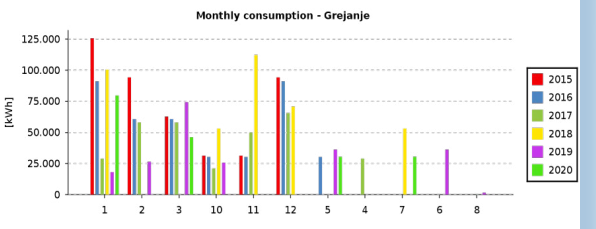
	UOM	2015	2016	2017	2018 (Renovation year)	2019
1	[kWh]	2.320	3.220	1.860	2.940	4.230
2	[kWh]	2.690	2.220	2.400	2.130	3.060
3	[kWh]	2.760	3.090	3.270	0	2.490
4	[kWh]	2.010	2.460	2.670	4.170	2.520
5	[kWh]	930	1.620	1.320	960	1.350
6	[kWh]	638	690	690	720	570
7	[kWh]	471	0	720	540	0
8	[kWh]	31	1.080	840	540	660
9	[kWh]	2.070	1.200	1.170	2.753	1.020
10	[kWh]	2.700	2.730	2.520	1.147	2.190
11	[kWh]	3.000	3.000	4.590	2.820	2.730
12	[kWh]	3.890	4.560	4.710	2.970	3.960
	Total	23.510	25.870	26.760	21.690	24.780
				average 2015 - 2016 --->	24.458	1%
						% change



	UOM	2020
1	[kWh]	0
2	[kWh]	2.340
3	[kWh]	0
4	[kWh]	0
5	[kWh]	0
6	[kWh]	0
7	[kWh]	0
8	[kWh]	0
9	[kWh]	0
10	[kWh]	0
11	[kWh]	0
12	[kWh]	0
	Total	2.340

Heating - Brown coal --> Wood pellet

	UOM	2015	2016	2017	2018 (Renovation year)	2019
1	[kWh]	125.664	91.135	29.081	100.541	18.162
2	[kWh]	94.248	60.757	58.163	0	26.522
3	[kWh]	62.832	60.757	58.163	0	74.378
4	[kWh]	0	0	29.081	0	0
5	[kWh]	0	30.378	0	0	36.324
6	[kWh]	0	0	0	0	36.324
7	[kWh]	0	0	0	53.228	0
8	[kWh]	0	0	0	0	1.718
10	[kWh]	31.416	30.378	21.229	53.228	25.773
11	[kWh]	31.416	30.378	49.983	112.370	0
12	[kWh]	94.248	91.135	65.659	70.970	0
	Total	439.824,00	394.919,00	311.360,00	390.337,00	219.202,00
				Average 2015 - 2018	384.110,00	-43%
						% change



	UOM	2020
1	[kWh]	79.758
2	[kWh]	0
3	[kWh]	46.236
4	[kWh]	0
5	[kWh]	30.549
6	[kWh]	0
7	[kWh]	30.604
8	[kWh]	0
10	[kWh]	0
11	[kWh]	0
12	[kWh]	0
	Total	187.147
		-51%
		% change

The monthly data shows that **the average annual savings of heating energy is 47% or 180.936 kWh.**

The data also show that for coal and wood intermittent data was entered, due to the related fuel purchase process.

Table 34 Summary of actual savings - Technical school, Žagubica

Building name	Building net area	Average yearly consumption & CO_2 emmision before reconstruction - (Baseline)				Average yearly consumption & CO_2 emmision after reconstruction				Average yearly savings					
		Electricity		Heating		Electricity		Heating		Electricity			Heating		
	[m²]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[%]	[t CO_2]	[kWh]	[%]	[t CO_2]
Technical school, Žagubica	1.630,00	24.458	26,88	384.110	120,15	24.780	27,23	203.175	0	- 323	-1%	-0,35	180.936	47%	120,15

Building 5 –Knjaževac gymnasium

Knjaževac gymnasium is located at Karađorđeva street no. 16, in Knjaževac. The building was built in the 1890s and reconstructed in 1960s. The building used coal for heating but during energy reconstruction the heating fuel was changed to wood. The number of floors of the building is P0+P+1, and total net area of the building is P_{net} = 2.147,01 m^2.

The project of building energy refurbishment was implemented in 2017 and included:

- thermal insulation of the attic with 15 cm of mineral wool and replacement of windows,
- installation of thermostatic radiator valves and installation of efficient pumps for distribution of heat.

The building data available in EMIS were extracted in the form of an Energy consumption report. The data shown below are part of the generated report.

Table Basic building data and annual consumption (EMIS) – Knjaževac gymnasium

Basic information about object

Name	Knjaževac gymnasium	Address	Karađorđeva 16
User	Opština \ Knjaževac \ Knjaževačka gimnazija, Knjaževac	City	Knjaževac
EMIS Code	SR-4302-0002-1	Object Type	A03 - Secondary schools

Dimensions and renovation

Gross floor area [m^2]	2147	Year of construction completion	
Heated net floor area of the building [m^2]	2147	Year of last renovation	2017
What has been renovated			
- Zamena postojećih prozora novim EE prozorima (frekventna regulacija) u dupleks izvedbi sa svom potrebnom armaturom - Termička izolacija tavanice prema negrejanom tavanu - Ugradnja radijatorskih ventila sa termoregulacionim glavama - Ugradnja radne i rezervne pumpe promenljivog protoka			

Employees and working hours

Number of employees	39	Number of working hours per day	8	Number of working days per week	5
Number of users	228	Number of working hours per week	40	Number of working days per year	315
Total number of employees and users	267				

Metering points for energy carriers

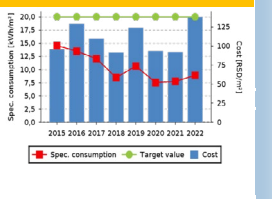
Energy carrier	Number of metering points	Serial numbers
Wood Bricquet	1	Drvni briket Gimnazija Knjazevac ($)
Electricity	6	22-180 0054493-2 ($), 22-180 0054507-6 ($), 22-180 0054515-7 ($), 4313868511 ($), 4313868520 ($), 4313868538 ($)
Lignite	1	Lignit - Knjaževačka gimnazija ($)
Brown coal	1	Mrki ugalj - Knjaževačka gimnazija ($)
Firewood	1	Ogrevno drvo - Knjaževačka gimnazija ($)
Water	1	135092 ($)

Annual consumption per group of energy carriers

Electricity

Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
2015	31.255,00		14,56		204.911,39	95,44	34,35
2016	28.944,00		13,48		276.994,12	129,01	31,81
Renovation year 2017	25.955,00		12,09		235.997,13	109,92	28,52
2018	18.252,00		8,50		196.824,88	91,67	20,06
2019	22.917,00		10,67		266.423,44	124,09	25,19
2020	16.198,70		7,54		200.767,08	93,51	17,80
2021	16.679,30		7,77		198.168,26	92,30	18,33
2022	19.103,00		8,90		296.783,83	138,23	20,99

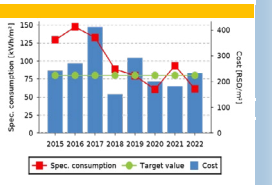
Spec. consumption - Električna Target value [kWh/m²/year]: 20



Heating - Coal ---> Wood briquet / Firewood

Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
2015	277.267,08		129,14		518.363,81	241,44	36,36
2016	316.339,84		147,34		580.846,61	270,54	29,37
Renovation year 2017	284.230,55		132,38		884.933,06	412,17	99,94
2018	190.347,78		88,66		325.301,95	151,51	19,43
2019	170.914,46		79,61		625.950,00	291,55	59,82
2020	130.387,56		60,73		432.720,00	201,55	39,64
2021	200.857,66		93,55		391.695,00	182,44	10,39
2022	131.464,35		61,23		499.287,50	232,55	46,01

Spec. consumption - Grejanje Target value [kWh/m²/year]: 80



The technical documentation and EMIS report data show that the energy savings has been achieved, both for heating energy and electricity. The electricity consumption fell due to installation of more efficient pumps in the heating station.

For the heating energy the balanced energy saving was achieved throughout the years.

A table with monthly energy consumption data normalised by heating degree days is given below.

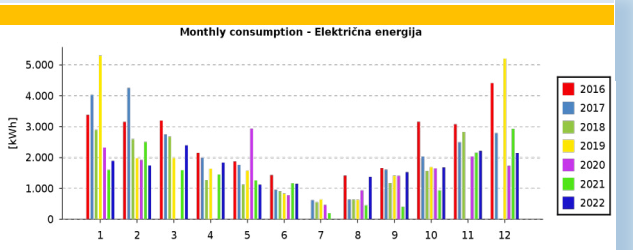
Table 35 Monthly consumption data for electricity & heating (EMIS) - Knjaževac gymnasium

Monthly consumption - data normalised by HDD

Electricity

Renovation year

	UOM	2016	2017	2018	2019	2020
1	[kWh]	3.386	4.031	2.896	5.303	2.324
2	[kWh]	3.158	4.257	2.602	1.979	1.923
3	[kWh]	3.199	2.750	2.678	1.984	0
4	[kWh]	2.153	1.998	1.273	1.641	0
5	[kWh]	1.877	1.763	1.123	1.577	2.938
6	[kWh]	1.436	956	908	834	781
7	[kWh]	0	624	557	645	466
8	[kWh]	1.419	640	638	635	939
9	[kWh]	1.660	1.609	1.177	1.417	1.409
10	[kWh]	3.161	2.035	1.569	1.692	1.649
11	[kWh]	3.082	2.498	2.831	0	2.036
12	[kWh]	4.413	2.794	0	5.210	1.734
	Total	28.944	25.955	18.252	22.917	16.199
	Average 2016 - 2017 --->		27.450	-34%	-17%	-41%
				% change		

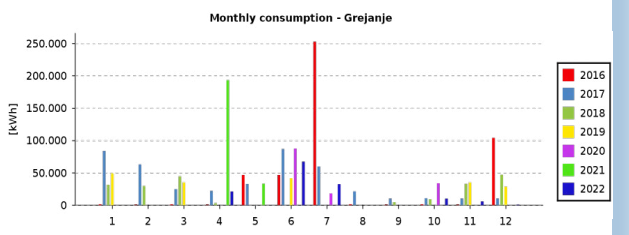


	UOM	2021	2022
1	[kWh]	1.601	1.894
2	[kWh]	2.508	1.743
3	[kWh]	1.592	2.397
4	[kWh]	1.453	1.837
5	[kWh]	1.261	1.124
6	[kWh]	1.170	1.152
7	[kWh]	200	0
8	[kWh]	455	1.376
9	[kWh]	408	1.530
10	[kWh]	940	1.683
11	[kWh]	2.159	2.219
12	[kWh]	2.932	2.148
	Total	16.679	19.103
		-39%	-30%
		% change	

Heating - Coal ---> Wood briquet / Firewood

Renovation year

	UOM	2016	2017	2018	2019	2020
1	[kWh]	1.698	84.208	31.831	49.522	0
2	[kWh]	1.588	63.360	29.983	0	0
3	[kWh]	1.698	25.034	45.005	35.604	0
4	[kWh]	1.643	22.443	3.555	0	0
5	[kWh]	46.985	33.092	0	0	0
6	[kWh]	46.930	87.156	0	42.077	87.847
7	[kWh]	253.148	60.066	0	0	18.435
8	[kWh]	1.698	21.633	0	0	0
9	[kWh]	1.643	10.653	4.945	0	0
10	[kWh]	1.698	11.008	9.490	0	34.145
11	[kWh]	1.643	10.653	33.414	35.604	0
12	[kWh]	104.329	10.684	47.354	29.130	0
	Total	464.703	439.989	205.576	191.937	140.427
	Average 2016 - 2017 --->		452.346	-55%	-58%	-69%
				% change		



	UOM	2021	2022
1	[kWh]	0	0
2	[kWh]	0	0
3	[kWh]	0	0
4	[kWh]	193.766	21.426
5	[kWh]	33.605	0
6	[kWh]	0	67.646
7	[kWh]	0	32.752
8	[kWh]	0	0
9	[kWh]	0	0
10	[kWh]	0	10.420
11	[kWh]	0	6.108
12	[kWh]	0	1.263
	Total	227.371	139.615
		-50%	-69%
		% change	

The monthly data shows that **the average annual savings of electricity is 32% or 8.820 kWh**, and for heating energy **the average is 60% or 271.361 kWh.** For heating as well, there is intermittent data entering into EMIS due to the related fuel purchase process.

Table 36 Summary of actual savings - Knjaževac gymnasium

Building name	Building net area	Average yearly consumption & CO_2 emmision before reconstruction - (Baseline)				Average yearly consumption & CO_2 emmision after reconstruction				Average yearly savings					
		Electricity		Heating		Electricity		Heating		Electricity			Heating		
	[m^2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[%]	[t CO_2]	[kWh]	[%]	[t CO_2]
Knjaževac gymnasium, Knjaževac	2.147,01	27.450	31,56	452.346	55,22	18.630	20,47	180.985	35,06	8.820	32%	11,09	271.361	60%	20,17

Building 6 – CZK "Masuka", Velika Plana

The Culture center "Masuka" is located at Branka Radičevića street no. 1 in Velika Plana. The facility is public, intended for cultural and artistic activities and entertainment. It was built in the 1950s. The building is connected to the District heating network. The number of floors of the building is P0+P+1, the total gross area of the building is P_{br} = 1.918 m^2 and the total net area of the building is P_{net} = 1.585 m^2.

The project of building energy refurbishment was implemented in 2018 and included:

- thermal insulation of the outer facade and roof with 10 cm of mineral wool and replacement of windows,
- reconstruction of the heating substation and installation of thermostatic radiator valves and internal cleaning of the heating elements,
- installation of a circulation variable speed drive pump,
- PLC control system for the hot water boiler and substation,
- Multi-zone heating control system,
- installation of calorimeters.

The building data available in the EMIS were extracted in the form of an Energy consumption report. The data shown below are part of the generated report.

Table 37 Basic building data and annual consumption (EMIS) – CZK "Masuka", Velika Plana

Basic information about object

Name	CZK "Masuka", Velika Plana	Address	Branka Radičevića 1
User	Opština \ Velika Plana \ CZK "Masuka"	City	Velika Plana
EMIS Code	SR-4703-0026-1	Object Type	D06 - Cultural centers

Dimensions and renovation

Gross floor area [m²]	1575	Year of construction completion	
Heated net floor area of the building [m²]	1361	Year of last renovation	2018

What has been renovated

Ugradnja radne i rezervne pumpe promenjljivog protoka (frekventna regulacija) u dupleks izvedbi sa svom potrebnom armaturom - Termička izolacija spoljnih zidova i eliminisanje toplotnih mostova: (mineralna kamena vuna debljine D=10 cm),1300 m2 - Ugradnja nove toplotne podstanice za prelazak na daljinsko grejanje - Zamena postojećih prozora novim PE. prozorima

Employees and working hours

Number of employees	18	Number of working hours per day	8	Number of working days per week	5
Number of users	23	Number of working hours per week	40	Number of working days per year	
Total number of employees and users	41				

Metering points for energy carriers

Energy carrier	Number of metering points	Serial numbers
District heating	2	1054 ($), 1055 ($)
Electricity	2	15309849, 4314046167 ($), 15348089, 4314046175 ($)
Water	1	94 ($)

Annual consumption per group of energy carriers

Electricity

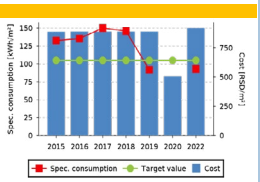
Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
2015	22.073,00		14,01		236.155,60	149,94	24,26
2016	19.452,00		12,35		239.726,79	152,21	21,38
2017	21.195,00		13,46		223.980,14	142,21	23,29
Renovation year 2018	25.264,00		16,04		266.615,40	169,28	27,77
2019	26.229,00		16,65		320.410,29	203,44	28,83
2020	14.771,00		9,38		185.352,23	117,68	16,23
2022	23.056,00		14,64		361.928,47	229,80	25,34

Spec. consumption - Električna Target value [kWh/m²/year]:	20

Heating - District heating

Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
2015	208.870,00		132,62		1.399.507,96	888,58	59,95
2016	213.470,00		135,54		1.401.672,96	889,95	61,27
2017	236.500,00		150,16		1.401.672,96	889,95	67,88
Renovation year 2018	229.960,95		146,01		1.401.672,96	889,95	66,00
2019	144.469,66		91,73		1.401.672,96	889,95	41,46
2020					795.792,00	505,26	
2022	146.640,00		93,10		1.448.887,28	919,93	42,09

Spec. consumption - Grejanje Target value [kWh/m²/year]:	105



The technical documentation and EMIS report data show that the energy savings has been achieved, both for heating energy and electricity. But there are some issues with the entering of the data in EMIS here as well.

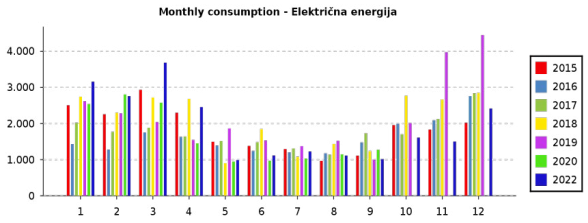
A table with monthly energy consumption data normalised by heating degree days is given below.

Table 38 Monthly consumption data for electricity & heating (EMIS) - CZK "Masuka", Velika Plana

Monthly consumption - data normalised by HDD

Electricity

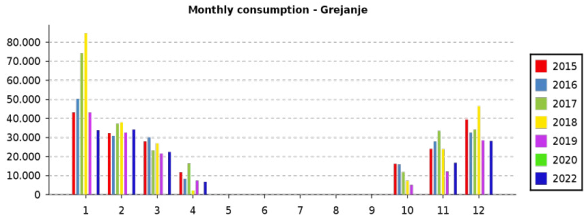
	UOM	2015	2016	2017	Renovation year 2018	2019
1	[kWh]	2.507	1.434	2.024	2.743	2.615
2	[kWh]	2.258	1.281	1.773	2.303	2.285
3	[kWh]	2.933	1.753	1.885	2.721	2.042
4	[kWh]	2.301	1.632	1.644	2.681	1.548
5	[kWh]	1.497	1.392	1.518	906	1.865
6	[kWh]	1.382	1.245	1.487	1.851	1.534
7	[kWh]	1.295	1.205	1.313	1.087	1.375
8	[kWh]	969	1.179	1.142	1.438	1.524
9	[kWh]	1.114	1.481	1.736	1.243	1.007
10	[kWh]	1.958	1.998	1.705	2.771	2.015
11	[kWh]	1.834	2.093	2.128	2.669	3.974
12	[kWh]	2.025	2.759	2.840	2.851	4.446
Total		22.073	19.452	21.195	25.264	26.229
				Average 2015 - 2018 --->	21.996	19%
						% change



	UOM	2020	2022
1	[kWh]	2.542	3.158
2	[kWh]	2.806	2.758
3	[kWh]	2.578	3.683
4	[kWh]	1.455	2.456
5	[kWh]	952	991
6	[kWh]	974	1.118
7	[kWh]	1.036	1.228
8	[kWh]	1.150	1.115
9	[kWh]	1.278	1.017
10	[kWh]	0	1.612
11	[kWh]	0	1.503
12	[kWh]	0	2.417
Total		14.771	23.056
		-33%	5%
		% change	

Heating - Districti heating

	UOM	2015	2016	2017	Renovation year 2018	2019
1	[kWh]	43.216	50.306	74.254	84.715	43.149
2	[kWh]	32.326	30.860	37.264	37.962	32.562
3	[kWh]	28.001	30.116	23.297	26.973	21.611
4	[kWh]	11.806	8.372	16.416	2.229	7.447
5	[kWh]	0	0	0	0	0
6	[kWh]	0	0	0	0	0
7	[kWh]	0	0	0	0	0
8	[kWh]	0	0	0	0	0
9	[kWh]	0	0	0	0	0
10	[kWh]	16.233	15.981	11.936	7.433	5.194
11	[kWh]	24.060	27.965	33.496	23.956	12.193
12	[kWh]	39.443	32.579	34.160	46.463	28.526
Total		195.085	196.179	230.824	229.731	150.682
				Average 2015 - 2018 --->	212.955	-29%
						% change



	UOM	2020	2022
1	[kWh]	0	33.863
2	[kWh]	0	34.183
3	[kWh]	0	22.436
4	[kWh]	0	6.771
5	[kWh]	0	0
6	[kWh]	0	0
7	[kWh]	0	0
8	[kWh]	0	0
9	[kWh]	0	0
10	[kWh]	0	0
11	[kWh]	0	16.762
12	[kWh]	0	28.227
Total		0	142.241
			-33%
			% change

The electricity consumption monthly data shows that in 2019 there was increase in consumption. For 2020 the data set is incomplete (missing last three months), for 2021 the full set of data is missing, and only for 2022 is the data available. For 2022 only 5% of savings was achieved, and when calculated the **average annual savings of electricity is only 3% or 644 kWh.**

For heating energy, the data are also incomplete. The data is missing for 2020 and 2021. When calculated for 2019 and 2022 **the average savings is 31% or 66.493 kWh.**

Table 39 Summary of actual savings - CZK "Masuka", Velika Plana

Building name	Building net area	Average yearly consumption & CO_2 emmision before reconstruction - (Baseline)				Average yearly consumption & CO_2 emmision after reconstruction				Average yearly savings					
		Electricity		Heating		Electricity		Heating		Electricity			Heating		
	[m²]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[%]	[t CO_2]	[kWh]	[%]	[t CO_2]
CZK "Masuka", Velika Plana	1.585,00	21.996	24,18	212.955	63,78	21.352	23,47	146.462	41,78	644	3%	0,71	66.493	31%	22,00

Building 7 – Residential and commercial building KJP "Morava" Svilajnac

The residential and commercial building KJP "Morava" is located at Svetog Save street no. 84 in Svilajnac. The facility is the administrative building of a communal public company and was built in 1984. The building uses electricity for heating (electrical hot water boilers). The number of floors of the building is P+1, the total net area of the building is P_{net} = 563.92 m^2.

The project of building energy refurbishment was implemented in 2017 and included:

- thermal insulation of the outer facade with 8cm EPS and replacement of windows,
- thermal insulation of the roof, the ceiling adjacent to an unheated attic, the floor (ceiling) over the unheated basement and interior (partition) walls,
- installation of a circulation variable speed drive pump,
- installation of thermostatic radiator valves and calorimeters.

The building data available in EMIS were extracted in the form of an Energy consumption report. The data shown below are part of the generated report.

Table 40 Basic building data and annual consumption (EMIS) – KJP "Morava" Svilajnac

Basic information about object

Name	Residential and commercial building KJP "Morava" Svilajnac	Address	Svetog Save 84
User	Opština \ Svilajnac \ Stambeno poslovna zgrada KJP "Morava" Svilajnac	City	Svilajnac
EMIS Code	SR-3510-0032-1	Object Type	102 - Administrative buildings of JP and JKP

Dimensions and renovation

Gross floor area [m²]	620	Year of construction completion	1998
Heated net floor area of the building [m²]	564	Year of last renovation	2017
What has been renovated			
- Ugradnja radne i rezervne pumpe promenljivog protoka (frekventna regulacija) u dupleks izvedbi sa svom potrebnom armaturom:- Ugradnja radijatorskih ventila sa termoregulacionim glavama:- Termička izolacija kosog krova: (kamena vuna debljine 10 cm) .351,8 m2 -Zamena postojećih prozora novim EE prozorima - Termička izolacija spoljnih zidova i eliminisanje toplotnih mostova			

Employees and working hours

Number of employees	27	Number of working hours per day	8	Number of working days per week	5
Number of users	30	Number of working hours per week	40	Number of working days per year	260
Total number of employees and users	57				

Metering points for energy carriers

Energy carrier	Number of metering points	Serial numbers
Electricity	1	0414824606 ($)

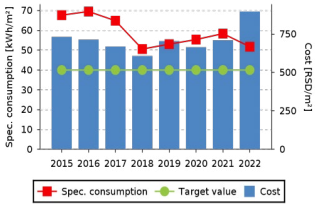
Annual consumption per group of energy carriers

Electricity

Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
2015	41.970,00		67,69		453.913,45	732,12	46,13
2016	43.110,00		69,53		442.743,96	714,10	47,38
2017	40.230,00		64,89		414.775,27	668,99	44,21
2018	31.365,00		50,59		376.783,12	607,71	34,47
2019	32.895,00		53,06		436.763,67	704,46	36,15
2020	34.335,00		55,38		412.308,18	665,01	37,73
2021	36.195,00		58,38		440.315,57	710,19	39,78
2022	32.100,00		51,77		556.133,16	896,99	35,28

Renovation year

Spec. consumption - Električna Target value [kWh/m²/year]:	40



The technical documentation and EMIS report data shows that the building uses only electricity as an energy source and that that savings after reconstruction has been achieved. For 2020, there is an increase in electricity cost, despite a reduction in consumption.

A table with monthly energy consumption data normalised by heating degree days is given below.

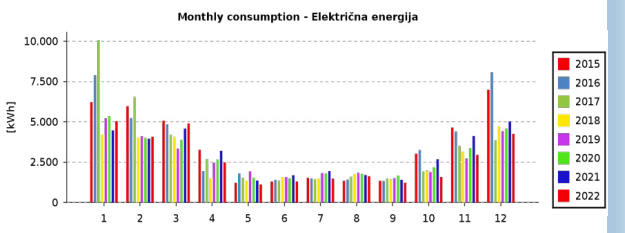
Table 41 Monthly consumption data for electricity & heating (EMIS) - KJP "Morava" Svilajnac

Monthly consumption - data normalised by HDD

Electricity

Renovation year

	UOM	2015	2016	2017	2018	2019
1	[kWh]	6.225	7.890	10.050	4.215	5.220
2	[kWh]	5.970	5.235	6.540	4.035	4.110
3	[kWh]	5.070	4.845	4.215	4.065	3.345
4	[kWh]	3.270	1.950	2.685	1.500	2.475
5	[kWh]	1.230	1.800	1.545	1.365	1.935
6	[kWh]	1.305	1.410	1.350	1.590	1.575
7	[kWh]	1.530	1.485	1.455	1.500	1.830
8	[kWh]	1.350	1.425	1.605	1.770	1.845
9	[kWh]	1.350	1.335	1.500	1.440	1.515
10	[kWh]	3.030	3.255	1.935	1.995	1.890
11	[kWh]	4.650	4.410	3.510	3.165	2.730
12	[kWh]	6.990	8.070	3.840	4.725	4.425
	Total	41.970	43.110	40.230	31.365	32.895
		Average 2015 -2017 --->		41.770	-25%	-21%
					% change	



	UOM	2020	2021	2022
1	[kWh]	5.355	4.470	5.040
2	[kWh]	4.005	3.960	4.080
3	[kWh]	3.885	4.590	4.905
4	[kWh]	2.670	3.210	2.490
5	[kWh]	1.530	1.365	1.125
6	[kWh]	1.485	1.695	1.305
7	[kWh]	1.800	1.950	1.485
8	[kWh]	1.785	1.710	1.635
9	[kWh]	1.680	1.410	1.230
10	[kWh]	2.190	2.685	1.590
11	[kWh]	3.375	4.125	2.955
12	[kWh]	4.575	5.025	4.260
	Total	34.335	36.195	32.100
		-18%	-13%	-23%
		% change		

The monthly data shows that the highest electricity saving was 25% in 2018, compared to the average consumption before reconstruction. **The average annual savings of electricity is 20% or 8.392 kWh.**

Table 42 Summary of actual savings - KJP "Morava" Svilajnac

Building name	Building net area	Average yearly consumption & CO_2 emmision before reconstruction - (Baseline)				Average yearly consumption & CO_2 emmision after reconstruction				Average yearly savings					
		Electricity		Heating		Electricity		Heating		Electricity			Heating		
	[m²]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[%]	[t CO_2]	[kWh]	[%]	[t CO_2]
KJP "Morava" Svilajnac	563,92	N/A		41.770	45,91	N/A		33.378	36,68	N/A			8.392	20%	9,22

Building 8 – Senta gymnasium, Senta

Senta gymnasium is located at Glavni trg 12 in Senta. The building is connected to the District heating network. The number of floors of the building is P0+P+2+Pot, the total gross area of the building is P_{br} = 6.007,20 m² and the total net area of the building is P_{net} = 5.138,34 m².

The project of building adaptation and refurbishment of the building was implemented in 2017 and 2018 and included:

- thermal insulation of the outer envelope. The street facade insulated with 1 cm of thin-layer thermal insulation and the rest with 10 cm of mineral wool, and replacement of windows,
- replacement of heating elements (radiators).

The building data available in EMIS were extracted in the form of an Energy consumption report. The data shown below are part of the generated report.

Table 43 Basic building data and annual consumption (EMIS) – Senta gymnasium

Basic information about object

Name	Gymnasium Senta	Address	Glavni trg 12
User	Opština \Senta \Senćanska gimnazija, Senta	City	Senta
EMIS Code	SR-2406-0001-1	Object Type	A03 - Secondary schools

Dimensions and renovation

Gross floor area [m²]	7098	Year of construction completion	
Heated net floor area of the building [m²]		Year of last renovation	
What has been renovated			

Employees and working hours

Number of employees	62	Number of working hours per day		Number of working days per week	
Number of users	379	Number of working hours per week		Number of working days per year	
Total number of employees and users	441				

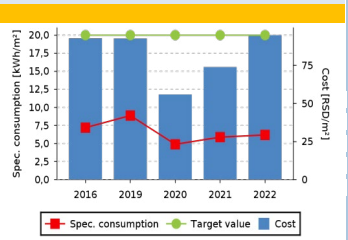
Metering points for energy carriers

Energy carrier	Number of metering points	Serial numbers
District heating	1	04022067 ($)
Electricity	2	4113276580 ($), 9150251650 ($)
Water	2	07004240 ($), 07007540 ($)

Annual consumption per group of energy carriers

Electricity

Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
2016	51.050,00		7,19		658.698,04	92,80	56,10
2019	62.966,00		8,87		657.880,14	92,69	69,20
2020	34.700,00		4,89		396.903,70	55,92	38,14
2021	41.764,00		5,88		524.893,81	73,95	45,90
2022	43.926,00		6,19		673.392,98	94,87	48,27
				Spec. consumption - Električna Target value [kWh/m²/year]:			20

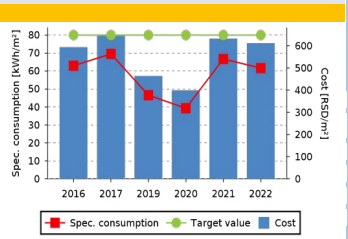


Annual consumption per group of energy carriers

Heating - District heating

Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
2016	446.737,00		62,94		4.219.361,06	594,44	128,21
2017	493.468,00		69,52		4.606.293,74	648,96	141,63
2019	330.448,00		46,56		3.295.634,66	464,30	94,84
2020	278.871,00		39,29		2.833.911,43	399,25	80,04
2021	473.464,00		66,70		4.492.855,98	632,97	135,88
2022	437.340,00		61,61		4.345.695,45	612,24	125,52
				Spec. consumption - Grejanje Target value [kWh/m²/year]:			80

Renovation year



The technical documentation and EMIS report data shows that the energy savings have been achieved. Although no documentation was received, the available data for electricity consumption indicate that the electrical system (lights) was most likely reconstructed in 2019. It is also evident that the price of electricity has been constantly rising.

For heating, consumption fell in the two years following the reconstruction, but then it has increased to almost the same level as before reconstruction. This increase could have resulted from a change in the way the building is used, or it indicates significant deterioration of the energy management processes in the building. The data needed to come to an accurate conclusion is not available.

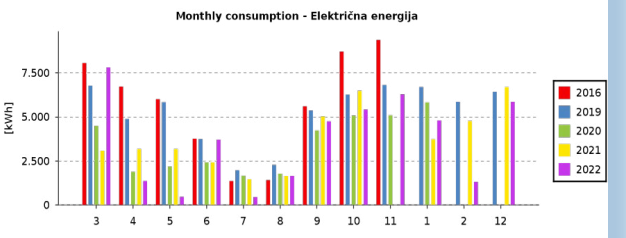
A table with monthly energy consumption data normalised by heating degree days is given below.

Table 44 Monthly consumption data for electricity & heating (EMIS) – Senta gymnasium

Monthly consumption - data normalised by HDD

Electricity

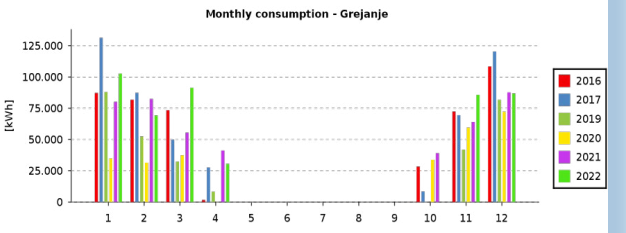
	UOM	2016	2019	2020	2021	2022
1	[kWh]	0	6.702	5.828	3.745	4.804
2	[kWh]	0	5.861	0	4.783	1.318
3	[kWh]	8.063	6.777	4.499	3.082	7.815
4	[kWh]	6.727	4.887	1.888	3.187	1.365
5	[kWh]	6.011	5.840	2.194	3.185	471
6	[kWh]	3.765	3.750	2.424	2.425	3.715
7	[kWh]	1.365	1.977	1.665	1.468	456
8	[kWh]	1.421	2.282	1.781	1.652	1.655
9	[kWh]	5.608	5.373	4.237	5.040	4.754
10	[kWh]	8.715	6.270	5.083	6.499	5.423
11	[kWh]	9.375	6.818	5.101	0	6.289
12	[kWh]	0	6.429	0	6.698	5.861
Total		51.050	62.966	34.700	41.764	43.926
Average 2016 - 2019 --->			57.008	-39%	-27%	-23%
				% change		



Heating - District heating

Renovation year

	UOM	2016	2017	2019	2020	2021
1	[kWh]	87.332	131.373	88.048	35.003	80.239
2	[kWh]	81.843	87.388	52.613	31.615	82.526
3	[kWh]	73.488	50.004	32.460	37.571	55.581
4	[kWh]	1.807	27.731	8.427	0	41.296
5	[kWh]	0	0	0	0	0
6	[kWh]	0	0	0	0	0
7	[kWh]	0	0	0	0	0
8	[kWh]	0	0	0	0	0
9	[kWh]	0	0	0	0	0
10	[kWh]	28.506	8.557	0	33.962	39.220
11	[kWh]	72.468	69.521	41.997	59.736	64.110
12	[kWh]	108.440	120.375	81.790	72.340	87.766
Total		453.885	494.948	305.334	270.226	450.738
Average 2016 - 2017 --->			474.417	-36%	-43%	-5%
				% change		



	UOM	2022
1	[kWh]	102.828
2	[kWh]	69.425
3	[kWh]	91.386
4	[kWh]	30.722
5	[kWh]	0
6	[kWh]	0
7	[kWh]	0
8	[kWh]	0
9	[kWh]	0
10	[kWh]	0
11	[kWh]	85.803
12	[kWh]	86.915
Total		467.079
		-2%
		% change

The monthly data shows that the savings of electricity are evenly distributed throughout the years and that **the average annual savings of electricity is 30% or 16.878 kWh.**

For heating energy, the highest savings was 43% in 2020. In 2021 and 2022, savings were only at 2% and 5%, respectively. Due to the significantly reduced savings in 2021 and 2022 **the average annual heating energy savings is 28% or 132.317 kWh.**

Table 45 Summary of actual savings – Senta gymnasium

Building name	Building net area	Average yearly consumption & CO_2 emmision before reconstruction - (Baseline)				Average yearly consumption & CO_2 emmision after reconstruction				Average yearly savings					
		Electricity		Heating		Electricity		Heating		Electricity			Heating		
	[m²]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[%]	[t CO_2]	[kWh]	[%]	[t CO_2]
Senta Gymnasium, Senta	5.138,34	57.008	56,10	474.417	134,92	40.130	50,38	342.099	109,07	16.878	30%	5,72	132.317	28%	25,85

Building 9 – Home of Arts OKU "Cnesa", Kanjiža

The Home of Arts OKU "Cnesa" is located at Trg glavni br.9 in Kanjiža. The building was built in 1987. The building uses natural gas for heating fuel. The total gross area of the building is P_{br} = 1.855m^2 and the total net area of the building is P_{net} = 1.585 m^2.

The project of building energy refurbishment of building was implemented in 2019 and included:

- thermal insulation of the outer facade with 10 cm of mineral wool and replacement of windows,
- replacement of the old hot-water boiler with two condensation boilers and installation of thermostatic radiator valves.

The building data available in EMIS were extracted in the form of an Energy consumption report. The data shown below are part of the generated report.

Table 46 Basic building data and annual consumption (EMIS) – Home of Arts OKU "Cnesa"

Basic information about object

Name	Home of Arts OKU "Cnesa"	Address	Trg glavni br.9
User	Opština \ Kanjiža \ Obrazovno-kulturna ustanova "Cnesa", Kanjiža	City	Kanjiža
EMIS Code	SR-2403-0015-1	Object Type	D99 - Cultural institutions facilities - Other

Dimensions and renovation

Gross floor area [m^2]	1855	Year of construction completion	1987
Heated net floor area of the building [m^2]		Year of last renovation	2001
What has been renovated			
Objektu bioskopa dogradjena je pozorišna bina sa kancelarijama i magacinima			

Employees and working hours

Number of employees	17	Number of working hours per day	16	Number of working days per week	6
Number of users	320	Number of working hours per week	96	Number of working days per year	313
Total number of employees and users	337				

Metering points for energy carriers

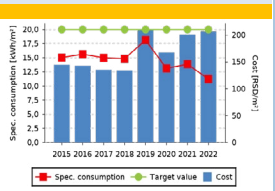
Energy carrier	Number of metering points	Serial numbers
Electricity	3	2310254072 ($), 2310254439 ($), 2310284788 ($)
Natural gas	2	3662940 ($), 3663881D ($)
Water	5	11001003 ($), 11001004 ($), 11001005 ($), 11001006 ($), 11001010 ($)

Annual consumption per group of energy carriers

Electricity

Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m^2/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m^2]	CO emission [t CO]
2015	27.885,00		15,03		268.244,32	144,61	30,65
2016	29.010,00		15,64		265.007,04	142,86	31,88
2017	27.810,00		14,99		251.022,34	135,32	30,56
2018	27.540,00		14,85		249.155,38	134,32	30,27
Renovation year 2019	33.618,00		18,12		390.039,85	210,26	36,95
2020	24.321,00		13,11		310.797,89	167,55	26,73
2021	25.708,00		13,86		373.124,07	201,15	28,25
2022	20.825,00		11,23		383.122,85	206,54	22,89

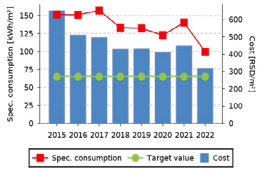
Spec. consumption - Električna Target value [kWh/m^2/year]:	20



Heating - Natural gas

Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m^2/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m^2]	CO emission [t CO]
2015	281.031,81		151,50		1.210.872,19	652,76	50,59
2016	280.272,97		151,09		950.437,15	512,37	50,45
2017	291.447,26		157,11		923.908,54	498,06	52,46
2018	247.151,39		133,24		798.049,59	430,22	44,49
Renovation year 2019	245.391,90		132,29		800.820,04	431,71	44,17
2020	227.930,79		122,87		763.064,63	411,36	41,03
2021	260.383,56		140,37		834.813,87	450,03	46,87
2022	185.003,41		99,73		589.698,87	317,90	33,30

Spec. consumption - Grejanje Target value [kWh/m^2/year]:	65



The technical documentation and EMIS report data show that the energy savings have been achieved. For electricity consumption in 2019 there is an increase of consumption that is most likely the result of the reconstruction works that were implemented at that time, and the reduction in the following years were most likely the result of improved thermal insulation and reduction of usage of additional heaters in the buildings.

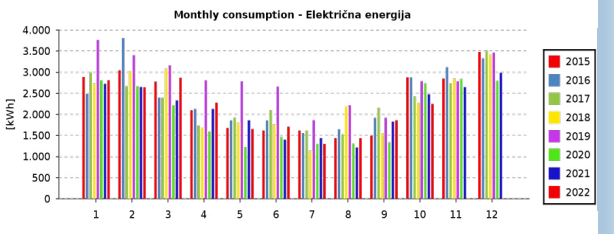
A table with monthly energy consumption data normalised by heating degree days is given below.

Table 47 Monthly consumption data for electricity & heating (EMIS) – Home of Arts OKU "Cnesa"

Monthly consumption - data normalised by HDD

Electricity

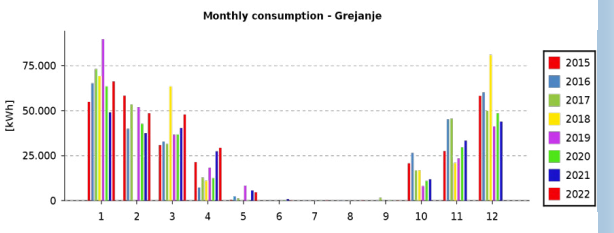
	UOM	2015	2016	2017	2018	Renovation year 2019
1	[kWh]	2.889	2.490	3.000	2.730	3.765
2	[kWh]	3.047	3.810	2.670	3.030	3.404
3	[kWh]	2.779	2.400	2.400	3.090	3.162
4	[kWh]	2.100	2.130	1.740	1.680	2.810
5	[kWh]	1.680	1.860	1.920	1.800	2.782
6	[kWh]	1.620	1.860	2.100	1.770	2.657
7	[kWh]	1.620	1.560	1.620	1.140	1.865
8	[kWh]	1.440	1.650	1.530	2.190	2.218
9	[kWh]	1.500	1.920	2.160	1.560	1.920
10	[kWh]	2.880	2.880	2.430	2.280	2.789
11	[kWh]	2.850	3.120	2.730	2.850	2.780
12	[kWh]	3.480	3.330	3.510	3.420	3.466
Total		27.885	29.010	27.810	27.540	33.618
Average 2015 - 2019 --->						29.172,6



	UOM	2020	2021	2022
1	[kWh]	2.809	2.726	2.811
2	[kWh]	2.669	2.651	2.645
3	[kWh]	2.218	2.334	2.869
4	[kWh]	1.598	2.131	2.280
5	[kWh]	1.230	1.861	1.656
6	[kWh]	1.467	1.402	1.711
7	[kWh]	1.303	1.441	1.303
8	[kWh]	1.309	1.218	1.438
9	[kWh]	1.342	1.831	1.862
10	[kWh]	2.739	2.477	2.250
11	[kWh]	2.843	2.648	0
12	[kWh]	2.794	2.988	0
Total		24.321	25.708	20.825
		-17%	-12%	-29%
		% change		

Heating - Natural gas

	UOM	2015	2016	2017	2018	Renovation year 2019
1	[kWh]	54.898	65.252	73.158	69.246	89.696
2	[kWh]	58.345	39.972	53.445	0	51.948
3	[kWh]	30.921	32.848	31.567	63.520	36.676
4	[kWh]	21.455	7.320	12.876	11.145	18.361
5	[kWh]	519	2.423	1.345	0	8.394
6	[kWh]	20	247	0	0	0
7	[kWh]	0	237	0	0	0
8	[kWh]	0	278	0	0	0
9	[kWh]	60	227	1.669	0	0
10	[kWh]	20.802	26.610	16.841	16.980	8.161
11	[kWh]	27.614	45.281	45.647	21.042	23.514
12	[kWh]	58.248	60.138	49.945	81.037	41.281
Total		272.882	280.834	286.493	262.969	278.029
Average 2015 - 2019 --->						276.241



	UOM	2020	2021	2022
1	[kWh]	63.527	49.056	66.267
2	[kWh]	42.722	37.545	48.597
3	[kWh]	36.793	40.385	47.903
4	[kWh]	12.601	27.488	29.407
5	[kWh]	222	5.711	4.712
6	[kWh]	244	921	253
7	[kWh]	189	109	286
8	[kWh]	56	0	286
9	[kWh]	255	20	242
10	[kWh]	11.047	11.928	0
11	[kWh]	29.676	33.377	0
12	[kWh]	48.606	43.949	0
Total		245.937	250.489	197.954
		-11%	-9%	-28%
		% change		

The monthly data shows that **the average annual savings of electricity is 19% or 5.555 kWh.**

For heating energy, **the calculated average annual savings is 16% or 44.781 kWh** but the actual energy savings is a bit smaller because, for the last three months of 2022, the data of energy consumption is missing.

Table 48 Summary of actual savings – Home of Arts OKU "Cnesa"

Building name	Building net area	Average yearly consumption & CO_2 emmision before reconstruction - (Baseline)				Average yearly consumption & CO_2 emmision after reconstruction				Average yearly savings					
		Electricity		Heating		Electricity		Heating		Electricity			Heating		
	[m²]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[%]	[t CO_2]	[kWh]	[%]	[t CO_2]
Home of Arts OKU "Cnesa", Kanjiža	1.585,00	29.173	32,06	276.241	48,43	23.618	25,96	231.460	40,40	5.555	19%	6,11	44.781	16%	8,03

Building 10 – Assembly of the municipality of Medveđa

The Assembly of the municipality of Medveđa is located at Jablanička street no. 48 in Medveđa. The building was built in the 1950s. The building uses wood as heating fuel. The number of floors of the building is P+1, the total gross area of the building is P_{br} = 1.841,90 m² and the total net area of the building is P_{net} = 1.393,03 m².

The project of building energy refurbishment was implemented in 2017 and included:

- thermal insulation of the outer facade with 10 cm and the ceiling towards the roof with 12 cm of mineral wool and replacement of windows,
- reconstruction of the existing heating boiler room, replacement of the existing boiler with a new boiler that uses wood pellets, replacement of heating elements (radiators) and installation of thermostatic radiator valves,
- adding additional floor area (rooms) to the building.

The building data available in EMIS were extracted in the form of an Energy consumption report. The data shown below are part of the generated report.

Table 49 Basic building data and annual consumption (EMIS) – Medveđa municipality Assembly

Basic information about object

Name	Assembly of the municipality of Medveđa	Address	Jablanička 48
User	Opština \ Medveđa \ Skupstina opstine Medvedja	City	Medveđa
EMIS Code	SR-4405-0023-1	Object Type	Zgrade opštinske uprave

Dimensions and renovation

Gross floor area [m²]	919	Year of construction completion	
Heated net floor area of the building [m²]	918	Year of last renovation	2018
What has been renovated			
- Korišćenje šumske biomase u postrojenjima za proizvodnju toplotne energije: toplovodni kotao na pelet 300 kW		- Zamena postojećih prozora novim EE prozorima	

Employees and working hours

Number of employees	81	Number of working hours per day	8	Number of working days per week	5
Number of users	70	Number of working hours per week	40	Number of working days per year	
Total number of employees and users	151				

Metering points for energy carriers

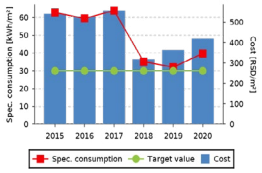
Energy carrier	Number of metering points	Serial numbers
Wood pellet	1	drvni pelet ($)
Electricity	1	6655500128179 ($)
Firewood	1	ogrevno drvo ($)
Water	1	voda ($)

Annual consumption per group of energy carriers

Electricity

Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
2015	57.775,00		62,87		497.917,32	541,80	63,49
2016	54.754,00		59,58		486.425,72	529,30	60,17
Renovation year 2017	58.776,00		63,96		512.519,32	557,69	64,59
2018	32.392,00		35,25		292.517,54	318,30	35,60
2019	29.548,00		32,15		333.860,43	363,29	32,47
2020	36.548,00		39,77		386.383,56	420,44	40,17

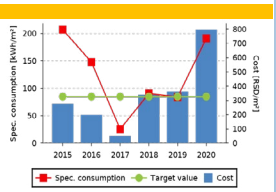
Spec. consumption - Električna Target value [kWh/m²/year]: 30



Heating - Firewood --> Wood pellet

Year	Consumption [kWh]	% change in consumption compared to the previous year [%]	Spec. consumption [kWh/m²/year]	Spec. Consumption and Targeted Value Reached Yes/No	Cost [RSD]	Spec. cost [RSD/m²]	CO emission [t CO]
2015	190.401,63		207,18		255.025,46	277,50	0,00
2016	135.852,72		147,83		181.962,21	198,00	0,00
Renovation year 2017	23.621,60		25,70		46.793,18	50,92	0,00
2018	83.127,93		90,45		312.210,82	339,73	0,00
2019	77.419,49		84,24		333.626,80	363,03	0,00
2020	175.710,64		191,20		732.614,64	797,19	0,00

Spec. consumption - Grejanje Target value [kWh/m²/year]: 85



The technical documentation and EMIS report data shows that the energy savings have been achieved. For electricity it is clear that the savings were achieved immediately after reconstruction and are uniform throughout the years.

For heating energy, savings have fluctuated, and in 2020 it even increased to an amount similar to the one before reconstruction, but we have to take into consideration that hat the net floor area of the building was increased during the reconstruction, and this increases the energy needs of the building.

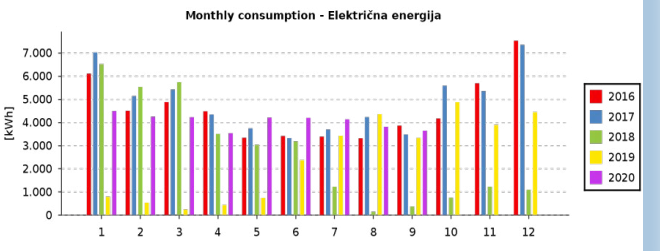
A table with monthly energy consumption data normalised by heating degree days is given below.

Table 50 Monthly consumption data for electricity & heating (EMIS) – Medveđa municipality Assembly

Monthly consumption - data normalised by HDD

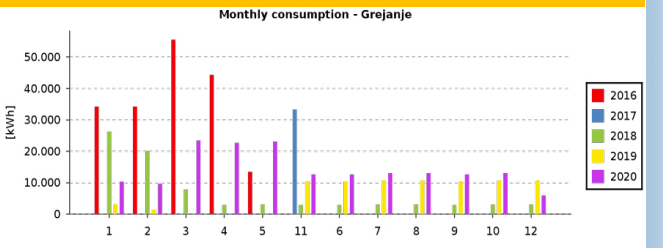
Electricity

	UOM	2016	Renovation year 2017	2018	2019	2020
1	[kWh]	6.115	7.030	6.527	803	4.498
2	[kWh]	4.509	5.147	5.540	539	4.257
3	[kWh]	4.885	5.429	5.746	252	4.232
4	[kWh]	4.486	4.348	3.509	445	3.541
5	[kWh]	3.346	3.752	3.042	745	4.215
6	[kWh]	3.421	3.330	3.190	2.382	4.202
7	[kWh]	3.394	3.701	1.228	3.432	4.139
8	[kWh]	3.321	4.237	150	4.365	3.816
9	[kWh]	3.868	3.486	379	3.341	3.648
10	[kWh]	4.177	5.594	756	4.882	0
11	[kWh]	5.698	5.364	1.229	3.907	0
12	[kWh]	7.534	7.358	1.096	4.455	0
Total		54.754	58.776	32.392	29.548	36.548
Average 2016 - 2017 -->			56.765	-43%	-48%	-36%
				% change		



Heating - Firewood --> Wood pellet

	UOM	2016	Renovation year 2017	2018	2019	2020
1	[kWh]	34.265	0	26.326	3.205	10.366
2	[kWh]	34.265	0	20.217	1.447	9.697
3	[kWh]	55.542	0	7.911	0	23.459
4	[kWh]	44.340	0	2.983	0	22.702
5	[kWh]	13.495	0	3.082	0	23.124
6	[kWh]	0	0	2.983	10.451	12.670
7	[kWh]	0	0	3.082	10.799	13.092
8	[kWh]	0	0	3.082	10.799	13.092
9	[kWh]	0	0	2.983	10.451	12.670
10	[kWh]	0	0	3.082	10.799	13.092
11	[kWh]	0	33.330	2.983	10.451	12.670
12	[kWh]	0	0	3.082	10.799	5.913
Total		181.907	33.330	81.798	79.200	172.548
Average 2016 - 2017 -->			107.619	-24%	-26%	60%
				% change		



The monthly data shows that **the average annual savings of electricity is 42% or 23.936 kWh.**

For heating energy, the energy savings have fluctuated, and for 2019 and 2020 there are inconsistencies in the available data. For 2019 the data for 3 months are missing, and for the same period of 2020 the energy consumption data is significantly higher, indicating that there could be an error in entering the data and that the data from 2019 were entered in 2020 instead. Also, for 2020 the energy consumption in all months is significantly higher than in 2019, indicating a change of the way the building is used. All this led to the **calculated average annual increase of heating energy of 3% or -3.564 kWh.**

Table 51 Summary of actual savings – Medveđa municipality Assembly

Building name	Building net area	Average yearly consumption & CO_2 emmision before reconstruction - (Baseline)				Average yearly consumption & CO_2 emmision after reconstruction				Average yearly savings					
		Electricity		Heating		Electricity		Heating		Electricity			Heating		
	[m²]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[%]	[t CO_2]	[kWh]	[%]	[t CO_2]
Medveđa municipality Assembly	1.393,03	56.765	62,75	107.619	0	32.829	36,08	111.182	0	23.936	42%	26,67	- 3.564	-3%	0,00

Summary of actual energy savings review

Table 52 Summary overview of actual energy savings

	Building name	Building net area	Average yearly consumption & CO_2 emmision before reconstruction - (Baseline)				Average yearly consumption & CO_2 emmision after reconstruction				Average yearly savings						Type of heating		CO_2 - reduction Electricity + Heating	
			Electricity		Heating		Electricity		Heating		Electricity			Heating			Before	After	CO_2	CO_2
		[m²]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[%]	[t CO_2]	[kWh]	[%]	[t CO_2]			[t CO_2]	[kg CO_2/m²]
1	Center for social work Leskovac	743.22	25,693	28.24	98,426	24.27	25,026	27.51	69,508	19.89	667	3%	0.73	28,917	29%	4.38	District heating	District heating	5.11	6.87
2	Health station Horgoš, Kanjiža	644.14	28,482	31.30	264,655	48.46	21,685	23.83	132,745	22.48	6,797	24%	7.47	131,910	50%	25.98	Natural gas	Natural gas	33.45	51.92
3	Primary school "Turzo Lajoš", Senta	2,955.82	123,419	130.81	390,193	64.76	42,190	46.37	242,680	44.04	81,230	66%	84.44	147,514	38%	20.72	Natural gas	Natural gas	105.16	35.58
4	Technical school, Žagubica	1,630.00	24,458	26.88	384,110	120.15	24,780	27.23	203,175	0	- 323	-1%	-0.35	180,936	47%	120.15	Brown coal	Wood pellet	119.80	73.49
5	Knjaževac gymnasium, Knjaževac	2,147.01	27,450	31.56	452,346	55.22	18,630	20.47	180,985	35.06	8,820	32%	11.09	271,361	60%	20.17	Brown coal	Wood briquette / firewood	31.25	14.56
6	CZK "Masuka", Velika Plana	1,585.00	21,996	24.18	212,955	63.78	21,352	23.47	146,462	41.78	644	3%	0.71	66,493	31%	22.00	District heating	District heating	22.71	14.33
7	KJP "Morava" Svilajnac	563.92	N/A		41,770	45.91	N/A		33,378	36.68	N/A			8,392	20%	9.22	Electricity	Electricity	9.22	16.36
8	Senta Gymnasium, Senta	5,138.34	57,008	56,10	474,417	134.92	40,130	50.38	342,099	109.07	16,878	30%	5.72	132,317	28%	25.85	Natural gas	Natural gas	31.57	6.14
9	Home of Arts OKU "Cnesa", Kanjiža	1,585.00	29,173	32.06	276,241	48.43	23,618	25.96	231,460	40.40	5,555	19%	6.11	44,781	16%	8.03	Natural gas	Natural gas	14.14	8.92
10	Medveđa municipality Assembly	1,393.03	56,765	62.75	107,619	0	32,829	36.08	111,182	0	23,936	42%	26.67	- 3,564	-3%	0.00	Firewood	Wood pellet	26.67	19.15
	Average values	**1,838.55**	**43,827**	**45.97**	**270,273**	**60.59**	**27,804**	**31.25**	**169,367**	**34.94**	**16,023**	**36.56%**	**15.84**	**100,906**	**37.33%**	**25.65**			**39.91**	**21.71**

In the 10 above buildings above, all major types of buildings that are usually under the jurisdiction of Municipalities are represented. The types of buildings that are represented are:

A -Educational institution buildings: 4 buildings;
B -Health care facilities: 1 building;
D - Cultural institution facilities: 2 buildings
F - Administrative facilities: 2 building
I - Public companies (JP) and Public utility company (JKP) facilities: 1 building

The selection of buildings above provides a strong representation of the typical buildings in the jurisdiction of municipalities.

From the summary table above, the following average values can be seen:

- the average building **net area** of **1838,55 m²**
- the average **electrical energy** savings after the reconstruction of **36,56% or 16.023 kWh**
- the average **heating energy** savings after the reconstruction of **37,33% or 100.906 kWh**
- the average **CO_2 reduction** for Electricity and Heating **39,91 [t CO_2] or 21,71 [kg CO_2/m²]**

Part III: Financial analysis – Energy savings potential of building renovation projects

With the goal of performing a financial analysis of energy saving potentials for the reconstruction of municipal buildings for the buildings analyzed in part II of this report, data about the actual costs of implementing those reconstruction projects were gathered.

The data for 6 out of 10 buildings was received, and this data will be used in further analysis.

The data for the following buildings where energy reconstruction projects were implemented was received:

1. Health station Horgoš, Kanjiža
2. Technical school, Žagubica
3. Knjaževac gymnasium, Knjaževac
4. CZK "Masuka", Velika Plana
5. KJP "Morava" Svilajnac
6. Medveđa municipality Assembly

To calculate the energy costs, the following average fuel prices (incl. VAT) per type of energy source will be used (source: Table 14 Calculated average total energy prices per type of fuel - years 2018. to 2022.)

Energy source	RSD/kWh	EUR/kWh	EUR/MWh
Electricity	13,26	0,113	112,68
District heating	10,18	0,087	86,57
Natural gas	4,63	0,039	39,37
Brown coal	8,30	0,071	70,54
Firewood	2,43	0,021	20,63
Wood pellet	4,65	0,040	39,56
Extra light fuel oil	16,58	0,142	141,59

The calculated reduction of greenhouse gas emissions (CO_2) that result from the implemented reconstruction projects will be regarded as potential income for the buildings where the savings were achieved. The potential annual CO_2 earnings will be calculated by multiplying the annual emission reduction by the expected prices per ton CO_2 equivalent.

The expected range of carbon price was taken from the report "A carbon pricing design for the Energy Community - Final Report"[7]. The expected values for Serbia are the following: 0 EUR per ton of CO_2 equivalent until 2025, 6.625 EUR until 2030, 16 EUR until 2035, 39.75 EUR until 2035, and 80 EUR beyond 2040. These values will be used to calculate the Net present value (NPV), and to calculate the Simple payback period. The average value of Carbon price, calculated from the above values, is 31.594 EUR per ton of CO_2 equivalent.

Simple payback period of the analyzed implemented building renovation projects

1. Health station Horgoš, Kanjiža — P_{net} = 644,14 m²

Building Type: B – Health care facilities

Reconstruction costs (inc. VAT): **12.871.717 RSD (109.410 EUR)**

Reconstruction included:

- thermal insulation of the outer envelope (facade and roof) with 10 cm of mineral wool,
- replacement of all windows and facade partitions,
- partial renovation of internal lighting electrical installations (replacement of worn-out lamps with new lamps with a fluorescent light source).

Fuel type: Electricity / Natural gas

Achieved annual savings:

- Electricity: 6.797 kWh --> 90.109 RSD (766 EUR)
- Heating energy 131.910 kWh --> 610.978 RSD (5.193 EUR)
- **Total energy** **138.707 kWh --> 701.088 RSD (5.959 EUR)**
- **CO_2** **33,45 [t CO_2] --> 124.316 RSD (1.057 EUR)**
- **TOTAL energy + CO_2** **--> 825.403 RSD (7.016 EUR)**

Simple payback period

- **SPP = 15,59 years**

2. Technical school, Žagubica — P_{net} = 1.630,00 m²

Building Type: A -Educational institution buildings

Reconstruction costs (inc. VAT): **21.905.999 RSD (186.201 EUR)**

Reconstruction included:

- thermal insulation of the outer facade (including ceiling towards roof) with 10 cm of mineral wool and replacement of windows,

[7] https://www.energy-community.org/dam/jcr:82a4fc8b-c0b7-44e8-b699-0fd06ca9c74d/Kantor_carbon_012021.pdf

- replacement of hot water boilers with change of fuel to wood pellet and installation of thermostatic radiator valves,
- installation of a circulation variable speed drive pump,
- PLC control system for hot water boiler and substation,
- Multi-zone heating control system.
- installation of DHW storage.

Fuel type: Electricity / Wood pellet

Achieved annual savings:

- Electricity: -323 kWh --> - 4.275 RSD (- 36 EUR)
- Heating energy 180.936 kWh --> 842.079 RSD (7.158 EUR)
- **Total energy** **180.613 kWh --> 837.804 RSD (7.121 EUR)**
- **CO_2** **119,80 [t CO_2] --> 445.274 RSD (3.785 EUR)**
- **TOTAL energy + CO_2** **--> 1.283.078 RSD (10.906 EUR)**

Simple payback period

- **SPP = 17,07 years**

3. Knjaževac gymnasium, Knjaževac P_{net} = 2.147,01 m^2

Building Type: A -Educational institution buildings

Reconstruction costs (inc. VAT): **12.265.524 RSD (104.257 EUR)**

Reconstruction included:

- thermal insulation of attic with 15 cm of mineral wool and replacement of windows,
- installation of thermostatic radiator valves and installation of efficient pumps for distribution of heat.

Fuel type: Electricity / Wood briquette - firewood

Achieved annual savings:

- Electricity: 8.820 kWh --> 116.919 RSD (994 EUR)
- Heating energy 271.361 kWh --> 658.593 RSD (5.598EUR)
- **Total energy** **280.180 kWh --> 775.511 RSD (6.592 EUR)**
- **CO_2** **31,25 [t CO_2] --> 116.158 RSD (987 EUR)**
- **TOTAL energy + CO_2** **--> 891.670 RSD (7.579 EUR)**

Simple payback period

- **SPP = 13,76 years**

4. CZK "Masuka", Velika Plana P_{net} = 1.585,00 m²

Building Type: D - Cultural institution facilities

Reconstruction costs (inc. VAT): **11.391.017 RSD (96.824 EUR)**

Reconstruction included:

- thermal insulation of the outer facade and roof with 10 cm of mineral wool and replacement of windows,
- reconstruction of heating substation and installation of thermostatic radiator valves and internal cleaning of the heating elements,
- installation of circulation variable speed drive pump,
- PLC control system for hot water boiler and substation,
- Multi-zone heating control system,
- installation of calorimeters.

Fuel type: Electricity / District heating

Achieved annual savings:

- Electricity: 644 kWh --> 8.537 RSD (73 EUR)
- Heating energy 66.493 kWh --> 677.211 RSD (5.756 EUR)
- **Total energy** **67.137 kWh --> 685.749 RSD (5.829 EUR)**
- **CO_2** **22,71 [t CO_2] --> 84.405 RSD (717 EUR)**
- **TOTAL energy + CO_2** **--> 770.153 RSD (6.546 EUR)**

Simple payback period

- **SPP = 14,79 years**

5. KJP "Morava" Svilajnac P_{net} = 563,92 m²

Building Type: I - Public companies (JP) and Public utility companies (JKP) facilities

Reconstruction costs (inc. VAT): **4.049.973 RSD (34.425 EUR)**

Reconstruction included:

- thermal insulation of the outer facade with 8cm EPS and replacement of windows,
- thermal insulation of roof, ceiling adjacent to an unheated attic, floor (ceiling) over unheated basement and interior (partition) walls,
- installation of circulation variable speed drive pump,
- installation of thermostatic radiator valves and calorimeters.

Fuel type: Electricity / Electricity

Achieved annual savings:

- Electricity: N/A
- Heating energy 8.392 kWh --> 111.251 RSD (946 EUR)
- **Total energy** **8.392 kWh --> 111.251 RSD (946 EUR)**
- **CO_2** **9,22 [t CO_2] --> 34.287 RSD (291 EUR)**
- **TOTAL energy + CO_2** **--> 145.539 RSD (1.237 EUR)**

Simple payback period

- **SPP = 27,83 years**

6. Medveđa municipality Assembly P_{net} = 1.393,03 m^2

Building Type: F - Administrative facilities

Reconstruction costs (inc. VAT): **9.812.526 RSD (83.406 EUR)**

Reconstruction included:

- thermal insulation of the outer facade with 10 cm and ceiling towards the roof with 12 cm of mineral wool and replacement of windows,
- reconstruction of existing heating boiler room, replacement of existing boiler with new boiler that uses wood pellets, replacement of heating elements (radiators) and installation of thermostatic radiator valves,
- adding additional floor area (rooms) to the building.

Fuel type: Electricity / Wood pellet

Achieved annual savings:

- Electricity: 23.936 kWh --> 317.311 RSD (2.697 EUR)
- Heating energy - 3.564 kWh --> - 16.585 RSD (- 141 EUR)
- **Total energy** **20.372 kWh --> 300.726 RSD (2.556 EUR)**
- **CO_2** **26,67 [t CO_2] --> 99.130 RSD (843 EUR)**
- **TOTAL energy + CO_2** **--> 399.856 RSD (3.399 EUR)**

Simple payback period

- **SPP = 24,54 years**

Table 53 Summary overview of actual energy savings and simple payback period after building renovation.

	Building name	Building net area	Costs of reconstruction (incl VAT)		Average reconstruction costs		Average yearly savings										Total energy savings			CO_2 - reduction Electricity + Heating	CO_2 - reduction Monetary value		SPP	Type of heating	
			ex. rate --->	0,00850			Electricity					Heating								CO_2	CO_2	CO_2	CO_2		Before	After
		[m²]	[RSD]	[EUR]	[RSD]	[EUR/m²]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	RSD	EUR	[t CO_2]	[kg CO_2/m²]	RSD	EUR	YEAR		
1	Health station Horgoš, Kanjiža	644	12.871.718	109.410	19.983	170	6.797	24%	90.109	766	7,47	131.910	50%	610.978	5.193	25,98	138.707	701.088	5.959	33,45	51,92	124.316	1.057	15,59	Natural gas	Natural gas
2	Technical school, Žagubica	1.630	21.905.999	186.201	13.439	114	- 323	-1%	- 4.275	- 36	-0,35	180.936	47%	842.079	7.158	120,15	180.613	837.804	7.121	119,80	73,49	445.274	3.785	17,07	Brown coal	Wood pellet
3	gymnasium, Knjaževac	2.147	12.265.524	104.257	5.713	49	8.820	32%	116.919	994	11,09	271.361	60%	658.593	5.598	20,17	280.180	775.511	6.592	31,25	14,56	116.158	987	13,76	Brown coal	Wood briquette / firewood
4	CZK "Masuka", Velika Plana	1.585	11.391.017	96.824	7.187	61	644	3%	8.537	73	0,71	66.493	31%	677.211	5.756	22,00	67.137	685.749	5.829	22,71	14,33	84.405	717	14,79	District heating	District heating
5	KJP "Morava" Svilajnac	564	4.049.973	34.425	7.182	61			N/A			8.392	20%	111.251	946	9,22	8.392	111.251	946	9,22	16,36	34.287	291	27,83	Electricity	Electricity
6	Medveđa municipality	1.393	9.812.526	83.406	7.044	60	23.936	42%	317.311	2.697	26,67	- 3.564	-3%	- 16.585	- 141	0,00	20.372	300.726	2.556	26,67	19,15	99.130	843	24,54	Firewood	Wood pellet
	Average values	**1.327**	**12.049.459**	**102.420**	**9.079**	**77**	**7.975**	**20%**	**105.720**	**899**	**9,12**	**109.255**	**34%**	**480.588**	**4.085**	**32,92**	**115.900**	**568.688**	**4.834**	**42,04**	**31,67**	**156.243**	**1.328**	**16,62**		

The table above indicates that the highest calculated simple payback period (SPP) is **27,83 years for building no 5.** KJP "Morava" Svilajnac and **24,54 years for building no 6.** Medveđa municipality Assembly. Building no 5. uses only electricity as an energy source, and the reconstruction that was implemented included only thermal insulation of the outer facade with 8cm EPS and the replacement of windows. As the usage of electricity for heating is not frequent, this building will not be included to calculate average values to determine the general investment and savings potential in the next step. For building no 6. the implemented reconstruction included construction of an additional floor area (rooms) to the building and that resulted in the increased total heated area of the building as well as an increase in the energy usage of the building. For this reason, that building will also be excluded from the calculation of general investment and savings potential in the next steps.

The following data will be used for to calculate the general investment and savings potentials:

Table 54 Summary overview of actual energy savings and simple payback period after building renovation – to calculate the investments and savings potentials.

	Building name	Building net area	Costs of reconstruction (incl VAT)		Average reconstruction		Average yearly savings										Total yearly energy savings			CO_2 - reduction Electricity + Heating		CO_2 - reduction Monetary value		SPP	Type of heating	
			ex. rate --->	0.00850			Electricity					Heating								CO_2	CO_2	CO_2	CO_2		Before	After
		[m²]	[RSD]	[EUR]	[RSD]	[EUR/m²]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	RSD	EUR	[t CO_2]	[kg CO_2/m²]	RSD	EUR	YEAR		
1	Health station Horgoš, Kanjiža	644	12,871,718	109,410	19,983	170	6,797	24%	90,109	766	7.47	131,910	50%	610,978	5,193	25.98	138,707	701,088	5,959	33.45	51.92	124,316	1,057	15.59	Natural gas	Natural gas
2	Technical school, Žagubica	1,630	21,905,999	186,201	13,439	114	323	-1%	4,275	36	-0.35	180,936	47%	842,079	7,158	120.15	180,613	837,804	7,121	119.80	73.49	445,274	3,785	17.07	Brown coal	Wood pellet
3	Knjaževac gymnasium,	2,147	12,265,524	104,257	5,713	49	8,820	32%	116,919	994	11.09	271,361	60%	658,593	5,598	20.17	280,180	775,511	6,592	31.25	14.56	116,158	987	13.76	Brown coal	Wood briquette /
4	CZK "Masuka", Velika Plana	1,585	11,391,017	96,824	7,187	61	644	3%	8,537	73	0.71	66,493	31%	677,211	5,756	22.00	67,137	685,749	5,829	22.71	14.33	84,405	717	14.79	District heating	District heating
	Average values	**1,502**	**14,608,565**	**124,173**	**9,729**	**83**	**3,985**	**15.57%**	**52,823**	**449**	**4.73**	**162,675**	**49.52%**	**697,215**	**5,926**	**47.07**	**166,659**	**750,038**	**6,375**	**51.80**	**34.50**	**192,538**	**1,637**	**15.50**		

Calculation of renovation projects Net present value (NPV) and sensitivity analysis

To calculate the Net present value (NPV) of potential investments in building refurbishment, the discount rate of 4% as recommended by the Ministry of Finance of the Republic of Serbia[8] will be used.

The NPV will be calculated for a period of 20 years, as this is aligned with the annual depreciation rate of 5% that is used according to the usual amortization life for taxation purposes of buildings as a group of fixed assets.

[8] https://www.mfin.gov.rs/upload/media/wdcb1S_6015df14df90d.pdf

The sensitivity analysis will be conducted in accordance with the previously defined scenarios for energy cost sensitivity analysis, performed under part I of this report. The predefined scenarios are given in the table below.

Table 55 Scenarios of fuel price increase used for energy cost sensitivity analysis

PREDEFINED FUEL PRICE INCRESE SCENARIOS						
	0	1	2	3	4	5
Electricity	0%	25%	50%	50%	100%	200%
District heating	0%	0%	25%	50%	75%	150%
Natural gas	0%	50%	75%	100%	100%	250%
Brown coal	0%	0%	0%	25%	50%	150%
Firewood	0%	0%	25%	50%	50%	100%
Wood pellet	0%	25%	25%	50%	75%	150%
Extra light fuel oil	0%	50%	75%	100%	100%	250%
Average % of increase	**0%**	**21%**	**39%**	**61%**	**79%**	**179%**

To calculate the total potential of investments in building refurbishment and the potential for energy savings, data were gathered about the potential number of existing buildings under jurisdiction of municipalities. The numbers are as follows: 4229 schools, 1773 Infirmaries, 158 Health centers, and 174 Municipal buildings. In total, the assessed number of municipal buildings is **6.334.**

If a refurbishment rate of 50% is targeted for the period of the next 10 years, the potential number of buildings that could be refurbished is **roughly 3.000**. This number will be used to calculate the potential investment amount and savings.

The calculated reduction of greenhouse gas emissions (CO_2) that that result from the implemented reconstruction projects will be regarded as potential income for buildings where the savings were achieved. The potential annual CO_2 earnings will be calculated by multiplying the annual emission reduction by the expected prices per ton CO_2 equivalent.

The expected range of carbon price was taken from the report "A carbon pricing design for the Energy Community - Final Report"[9]. The expected values for Serbia are the following: 0 EUR per ton of CO_2 equivalent until 2025, 6.625 EUR until 2030, 16 EUR until 2035, 39.75 EUR until 2035, and 80 EUR beyond 2040. These values will be used to calculate the Net present value (NPV).

The results of the NPV analysis and the calculated potential for investment and savings, as well as the results of the sensitivity analysis of the increase in fuel prices are shown in tables below.

[9] https://www.energy-community.org/dam/jcr:82a4fc8b-c0b7-44e8-b699-0fd06ca9c74d/Kantor_carbon_012021.pdf

Table 56 NPV calculation - Sensitivity analysis Baseline scenario (0) – No fuel price increase

	Building name	Building net area	Costs of reconstruction (incl VAT)		Average reconstruction		Average yearly savings										Total yearly energy savings			CO₂ - reduction Electricity + Heating		CO₂ - reduction Monetary value		SPP	Type of heating	
			ex. rate -->	0,00850			Electricity					Heating								CO₂	CO₂	CO₂	CO₂		Before	After
		[m²]	[RSD]	[EUR]	[RSD]	[EUR/m²]	[kWh]	[%]	RSD	EUR	[t CO₂]	[kWh]	[%]	RSD	EUR	[t CO₂]	[kWh]	RSD	EUR	[t CO₂]	[kg CO₂/m²]	RSD	EUR	YEAR		
1	Health station Horgoš, Kanjiža	644	12.871.718	109.410	19.983	170	6.797	24%	90.109	766	7,47	131.910	50%	610.978	5.193	25,98	138.707	701.088	5.959	33,45	51,92	124.316	1.057	15,59	Natural gas	Natural gas
2	Technical school, Žagubica	1.630	21.905.999	186.201	13.439	114	323	-1%	4.275	36	-0,35	180.936	47%	842.079	7.158	120,15	180.613	837.804	7.121	119,80	73,49	445.274	3.785	17,07	Brown coal	Wood pellet
3	gymnasium, Knjaževac	2.147	12.265.524	104.257	5.713	49	8.820	32%	116.919	994	11,09	271.361	60%	658.593	5.598	20,17	280.180	775.511	6.592	31,25	14,56	116.158	987	13,76	Brown coal	briquette / firewood
4	CZK "Masuka", Velika Plana	1.585	11.391.017	96.824	7.187	61	644	3%	8.537	73	0,71	66.493	31%	677.211	5.756	22,00	67.137	685.749	5.829	22,71	14,33	84.405	717	14,79	District heating	District heating
	Average values	**1.502**	**14.608.565**	**124.173**	**9.729**	**83**	**3.985**	**14%**	**52.823**	**449**	**4,73**	**162.675**	**47%**	**697.215**	**5.926**	**47,07**	**166.659**	**750.038**	**6.375**	**51,80**	**34,50**	**192.538**	**1.637**	**15,50**		

Sensitivity analysis

Scenario: 0 <--- Select scenario

Average energy prices incl. VAT				
Energy source	% of cost change	RSD/kWh	EUR/kWh	EUR/MWh
Electricity	0%	13,26	0,113	112,68
District heating	0%	10,18	0,087	86,57
Natural gas	0%	4,63	0,039	39,37
Brown coal	0%	8,30	0,071	70,54
Firewood	0%	2,43	0,021	20,63
Wood pellet	0%	4,65	0,040	39,56
Extra light fuel oil	0%	16,58	0,141	140,96

NPV calculation (20 year period)

	Discount rate	4%		Price of CO_2
	Investment	- 14.608.565	- 124.173 €	
2024	Year 1	750.038	6.375 €	- € 2024
2025	Year 2	790.412	6.719 €	6,625 € 2025
	Year 3	790.412	6.719 €	6,625 €
	Year 4	790.412	6.719 €	6,625 €
	Year 5	790.412	6.719 €	6,625 €
	Year 6	790.412	6.719 €	6,625 €
2030	Year 7	847.545	7.204 €	16,00 € 2030
	Year 8	847.545	7.204 €	16,00 €
	Year 9	847.545	7.204 €	16,00 €
	Year 10	847.545	7.204 €	16,00 €
	Year 11	847.545	7.204 €	16,00 €
2035	Year 12	992.282	8.434 €	39,75 € 2035
	Year 13	992.282	8.434 €	39,75 €
	Year 14	992.282	8.434 €	39,75 €
	Year 15	992.282	8.434 €	39,75 €
	Year 16	992.282	8.434 €	39,75 €
2040	Year 17	1.237.573	10.519 €	80,00 € 2040
	Year 18	1.237.573	10.519 €	80,00 €
	Year 19	1.237.573	10.519 €	80,00 €
2043	Year 20	1.237.573	10.519 €	80,00 € 2043
				31,594 AVERAGE
	NPV	**- 2.254.035**	**- 19.159 €**	

Investment and savings potential

3.000 <--- potential number of buildings that could be refurbished in next 10 years

	Total net area buildings	Potential investment for reconstruction (incl VAT)		Average reconstruction costs		Potential average yearly savings										Potential total savings energy savings			CO₂ - reduction Electricity + Heating		CO₂ - reduction Monetary value		SPP
		ex. rate -->	0,00850			Electricity					Heating								CO₂	CO₂	CO₂	CO₂	
	[m²]	[RSD]	[EUR]	[RSD]	[EUR/m²]	[kWh]	[%]	RSD	EUR	[t CO₂]	[kWh]	[%]	RSD	EUR	[t CO₂]	[kWh]	RSD	EUR	[t CO₂]	[kg CO₂/m²]	RSD	EUR	YEAR
	4.504.613	**43.825.693.518**	**372.518.395**	**9.729**	**83**	**11.953.650**	**14%**	**158.467.508**	**1.346.974**	**14.184**	**488.024.663**	**47%**	**2.091.646.016**	**17.778.991**	**141.218**	**499.978.313**	**2.250.113.525**	**19.125.965**	**155.402**	**34,50**	**577.614.593**	**4.909.724**	**15,50**

The NPV (20 years) of the average building renovation project in case of the baseline scenario (current energy price) is negative (**-2.254.035 RSD / -19.159 €**).

The investment potential calculated on the base of 3000 buildings is **43.825.693.518 RSD** (**372.518.395 €**). This investment would result in **499.978.313 kWh** of saved energy, which is equivalent to **2.250.113.525 RSD** (**19.125.965 €**) and a reduction of **155.402 t CO_2** emissions, which is equivalent to **577.614.593 RSD** (**4.909.724 €**). The average simple payback period is **15,50 years**.

Table 57 NPV calculation - Sensitivity analysis Scenario 1 – Average fuel price increase of 21%

	Building name	Building net area	Costs of reconstruction (incl VAT)		Average reconstruction		Average yearly savings										Total yearly energy savings			CO₂ - reduction Electricity + Heating		CO₂ - reduction Monetary value		SPP	Type of heating	
			ex. rate -->	0,00850			Electricity					Heating								CO₂	CO₂	CO₂	CO₂		Before	After
		[m²]	[RSD]	[EUR]	[RSD]	[EUR/m²]	[kWh]	[%]	RSD	EUR	[t CO₂]	[kWh]	[%]	RSD	EUR	[t CO₂]	[kWh]	RSD	EUR	[t CO₂]	[kg CO₂/m²]	RSD	EUR	YEAR		
1	Health station Horgoš, Kanjiža	644	12.871.718	109.410	19.983	170	6.797	24%	112.637	957	7,47	131.910	50%	916.467	7.790	25,98	138.707	1.029.104	8.747	33,45	51,92	124.316	1.057	11,16	Natural gas	Natural gas
2	Technical school, Žagubica	1.630	21.905.999	186.201	13.439	114	323	-1%	5.344	45	-0,35	180.936	47%	1.052.599	8.947	120,15	180.613	1.047.255	8.902	119,80	73,49	445.274	3.785	14,68	Brown coal	Wood pellet
3	gymnasium, Knjaževac	2.147	12.265.524	104.257	5.713	49	8.820	32%	146.148	1.242	11,09	271.361	60%	658.593	5.598	20,17	280.180	804.741	6.840	31,25	14,56	116.158	987	13,32	Brown coal	briquette / firewood
4	CZK "Masuka", Velika Plana	1.585	11.391.017	96.824	7.187	61	644	3%	10.672	91	0,71	66.493	31%	677.211	5.756	22,00	67.137	687.883	5.847	22,71	14,33	84.405	717	14,75	District heating	District heating
	Average values	**1.502**	**14.608.565**	**124.173**	**9.729**	**83**	**3.985**	**14%**	**66.028**	**561**	**4,73**	**162.675**	**47%**	**826.218**	**7.023**	**47,07**	**166.659**	**892.246**	**7.584**	**51,80**	**34,50**	**192.538**	**1.637**	**13,47**		

Sensitivity analysis

Scenario: 1 <--- Select scenario

Average energy prices incl. VAT				
Energy source	% of cost change	RSD/kWh	EUR/kWh	EUR/MWh
Electricity	25%	16,57	0,141	140,85
District heating	0%	10,18	0,087	86,57
Natural gas	50%	6,95	0,059	59,06
Brown coal	0%	8,30	0,071	70,54
Firewood	0%	2,43	0,021	20,63
Wood pellet	25%	5,82	0,049	49,45
Extra light fuel oil	50%	24,88	0,211	211,44

NPV calculation (20 year period)

	Discount rate	4%		Price of CO_2
	Investment	- 14.608.565	- 124.173 €	
2024	Year 1	892.246	7.584 €	- € 2024
2025	Year 2	932.620	7.927 €	6,625 € 2025
	Year 3	932.620	7.927 €	6,625 €
	Year 4	932.620	7.927 €	6,625 €
	Year 5	932.620	7.927 €	6,625 €
	Year 6	932.620	7.927 €	6,625 €
2030	Year 7	989.753	8.413 €	16,00 € 2030
	Year 8	989.753	8.413 €	16,00 €
	Year 9	989.753	8.413 €	16,00 €
	Year 10	989.753	8.413 €	16,00 €
	Year 11	989.753	8.413 €	16,00 €
2035	Year 12	1.134.490	9.643 €	39,75 € 2035
	Year 13	1.134.490	9.643 €	39,75 €
	Year 14	1.134.490	9.643 €	39,75 €
	Year 15	1.134.490	9.643 €	39,75 €
	Year 16	1.134.490	9.643 €	39,75 €
2040	Year 17	1.379.781	11.728 €	80,00 € 2040
	Year 18	1.379.781	11.728 €	80,00 €
	Year 19	1.379.781	11.728 €	80,00 €
2043	Year 20	1.379.781	11.728 €	80,00 € 2043
				31,594 AVERAGE
	NPV	**- 321.384**	**- 2.732 €**	

Investment and savings potential

3.000 <--- potential number of buildings that could be refurbished in next 10 years

	Total net area buildings	Potential investment for reconstruction (incl VAT)		Average reconstruction costs		Potential average yearly savings										Potential total savings energy savings			CO₂ - reduction Electricity + Heating		CO₂ - reduction Monetary value		SPP
		ex. rate -->	0,00850			Electricity					Heating								CO₂	CO₂	CO₂	CO₂	
	[m²]	[RSD]	[EUR]	[RSD]	[EUR/m²]	[kWh]	[%]	RSD	EUR	[t CO₂]	[kWh]	[%]	RSD	EUR	[t CO₂]	[kWh]	RSD	EUR	[t CO₂]	[kg CO₂/m²]	RSD	EUR	YEAR
	4.504.613	**43.825.693.518**	**372.518.395**	**9.729**	**83**	**11.953.650**	**14%**	**198.084.385**	**1.683.717**	**14.184**	**488.024.663**	**47%**	**2.478.652.725**	**21.068.548**	**141.218**	**499.978.313**	**2.676.737.110**	**22.752.265**	**155.402**	**34,50**	**577.614.593**	**4.909.724**	**13,47**

The NPV of the average building renovation project in the case of Scenario 1 (average fuel price increase of 21%) is also negative (**-321.384 RSD / -2.732 €**).

The investment potential remains the same (**43.825.693.518 RSD / 372.518.395 €**), as well as the reduction of CO_2 (**155.402 t CO_2**) with a monetary equivalent of **577.614.593 RSD** (**4.909.724 €**). The potential energy saving is also the same (**499.978.313 kWh**), but the monetary equivalent is **2.676.737.110 RSD** (**22.752.265€**), giving an average simple payback period of **13,47 years**.

Table 58 NPV calculation - Sensitivity analysis
Scenario 2 – Average fuel price increase of 39%

	Building name	Building net area	Costs of reconstruction (incl VAT)		Average reconstruction		Average yearly savings										Total yearly energy savings			CO_2 - reduction Electricity + Heating		CO_2 - reduction Monetary value		SPP	Type of heating	
			ex. rate -->	0,00850			Electricity					Heating								CO_2	CO_2	CO_2	CO_2		Before	After
		[m²]	[RSD]	[EUR]	[RSD]	[EUR/m²]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	RSD	EUR	[t CO_2]	[kg CO_2/m²]	RSD	EUR	YEAR		
1	Health station Horgoš, Kanjiža	644	12.871.718	109.410	19.983	170	6.797	24%	135.164	1.149	7,47	131.910	50%	1.069.212	9.088	25,98	138.707	1.204.376	10.237	33,45	51,92	124.316	1.057	9,69	Natural gas	Natural gas
2	Technical school, Zagubica	1.630	21.905.999	186.201	13.439	114	323	1%	6.413	55	-0,35	180.936	47%	1.052.599	8.947	120,15	180.613	1.046.186	8.893	119,80	73,49	445.274	3.785	14,69	Brown coal	Wood pellet briquette / firewood
3	gymnasium, Knjaževac	2.147	12.265.524	104.257	5.713	49	8.820	32%	175.378	1.491	11,09	271.361	60%	823.241	6.998	20,17	280.180	998.619	8.488	31,25	14,56	116.158	987	11,00	Brown coal	Firewood
4	CZK "Masuka", Velika Plana	1.585	11.391.017	96.824	7.187	61	644	3%	12.806	109	0,71	66.493	31%	846.514	7.195	22,00	67.137	859.320	7.304	22,71	14,33	84.405	717	12,07	District heating	District heating
	Average values	**1.502**	**14.608.565**	**124.173**	**9.729**	**83**	**3.985**	**14%**	**79.234**	**673**	**4,73**	**162.675**	**47%**	**947.891**	**8.057**	**47,07**	**166.659**	**1.027.125**	**8.731**	**51,80**	**34,50**	**192.538**	**1.637**	**11,98**		

Sensitivity analysis

Scenario: 2 <--- Select scenario

Average energy prices incl. VAT			
Energy source	% of cost change	RSD/kWh	EUR/kWh	EUR/MWh
Electricity	50%	19,89	0,169	169,02
District heating	25%	12,73	0,108	108,21
Natural gas	75%	8,11	0,069	68,90
Brown coal	0%	8,30	0,071	70,54
Firewood	25%	3,03	0,026	25,79
Wood pellet	25%	5,82	0,049	49,45
Extra light fuel oil	75%	29,02	0,247	246,68

NPV calculation (20 year period)

		Discount rate	4%		Price of CO_2	
	Investment	-	14.608.565	- 124.173 €		
2024	Year 1		1.027.125	8.731 €	- €	2024
2025	Year 2		1.067.499	9.074 €	6,625 €	2025
	Year 3		1.067.499	9.074 €	6,625 €	
	Year 4		1.067.499	9.074 €	6,625 €	
	Year 5		1.067.499	9.074 €	6,625 €	
	Year 6		1.067.499	9.074 €	6,625 €	
2030	Year 7		1.124.632	9.559 €	16,00 €	2030
	Year 8		1.124.632	9.559 €	16,00 €	
	Year 9		1.124.632	9.559 €	16,00 €	
	Year 10		1.124.632	9.559 €	16,00 €	
	Year 11		1.124.632	9.559 €	16,00 €	
2035	Year 12		1.269.369	10.790 €	39,75 €	2035
	Year 13		1.269.369	10.790 €	39,75 €	
	Year 14		1.269.369	10.790 €	39,75 €	
	Year 15		1.269.369	10.790 €	39,75 €	
	Year 16		1.269.369	10.790 €	39,75 €	
2040	Year 17		1.514.660	12.875 €	80,00 €	2040
	Year 18		1.514.660	12.875 €	80,00 €	
	Year 19		1.514.660	12.875 €	80,00 €	
2043	Year 20		1.514.660	12.875 €	80,00 €	2043
					31,594	AVERAGE
	NPV		**1.511.673**	**12.849 €**		

Investment and savings potential

3.000 **<--- potential number of buildings that could be refurbished in next 10 years**

Total net area buildings	Potential investment for reconstruction (incl VAT)		Average reconstruction costs		Potential average yearly savings										Potential total savings energy savings			CO_2 - reduction Electricity + Heating		CO_2 - reduction Monetary value		SPP
	ex. rate -->	0,00850			Electricity					Heating								CO_2	CO_2	CO_2	CO_2	
[m²]	[RSD]	[EUR]	[RSD]	[EUR/m²]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	RSD	EUR	[t CO_2]	[kg CO_2/m²]	RSD	EUR	YEAR
4.504.613	**43.825.693.518**	**372.518.395**	**9.729**	**83**	**11.953.650**	**14%**	**237.701.262**	**2.020.461**	**14.184**	**488.024.663**	**47%**	**2.843.674.357**	**24.171.232**	**141.218**	**499.978.313**	**3.081.375.619**	**26.191.693**	**155.402**	**34,50**	**577.614.593**	**4.909.724**	**11,98**

The NPV of the average building renovation project in the case of Scenario 2 (average fuel price increase of 39%) **is positive** (**1.511.673 RSD / 12.849 €**).

The investment potential is the same (**43.825.693.518 RSD / 372.518.395 €**), as well as the reduction of CO_2 (**155.402 t CO_2**) with a monetary equivalent of **577.614.593 RSD** (**4.909.724 €**).

The potential energy saving remains **499.978.313 kWh,** but the monetary equivalent is now **3.081.375.619 RSD** (**26.191.693 €**) giving an average simple payback period of **11,98years**.

From this it can be concluded that the increase of actual prices to roughly 40% would bring the projects into the marginally acceptable level for investing.

Table 59 NPV calculation - Sensitivity analysis
Scenario 3 – Average fuel price increase of 61%

	Building name	Building net area	Costs of reconstruction (incl VAT)		Average reconstruction		Average yearly savings										Total yearly energy savings			CO_2 - reduction Electricity + Heating		CO_2 - reduction Monetary value		SPP	Type of heating	
			ex. rate -->	0,00850			Electricity					Heating								CO_2	CO_2	CO_2	CO_2		Before	After
		[m²]	[RSD]	[EUR]	[RSD]	[EUR/m²]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	RSD	EUR	[t CO_2]	[kg CO_2/m²]	RSD	EUR	YEAR		
1	Health station Horgoš, Kanjiža	644	12.871.718	109.410	19.983	170	6.797	24%	135.164	1.149	7,47	131.910	50%	1.221.956	10.387	25,98	138.707	1.357.120	11.536	33,45	51,92	124.316	1.057	8,69	Natural gas	Natural gas
2	Technical school, Zagubica	1.630	21.905.999	186.201	13.439	114	323	-1%	6.413	55	-0,35	180.936	47%	1.263.119	10.737	120,15	180.613	1.256.706	10.682	119,80	73,49	445.274	3.785	12,87	Brown coal	Wood pellet
3	gymnasium, Knjaževac	2.147	12.265.524	104.257	5.713	49	8.820	32%	175.378	1.491	11,09	271.361	60%	987.889	8.397	20,17	280.180	1.163.267	9.888	31,25	14,56	116.158	987	9,59	Brown coal	briquette / firewood
4	CZK "Masuka", Velika Plana	1.585	11.391.017	96.824	7.187	61	644	3%	12.806	109	0,71	66.493	31%	1.015.817	8.634	22,00	67.137	1.028.623	8.743	22,71	14,33	84.405	717	10,23	District heating	District heating
	Average values	**1.502**	**14.608.565**	**124.173**	**9.729**	**83**	**3.985**	**14%**	**79.234**	**673**	**4,73**	**162.675**	**47%**	**1.122.195**	**9.539**	**47,07**	**166.659**	**1.201.429**	**10.212**	**51,80**	**34,50**	**192.538**	**1.637**	**10,48**		

Sensitivity analysis

Scenario: **3** <--- Select scenario

Average energy prices incl. VAT			
Energy source	% of cost change	RSD/kWh	EUR/kWh	EUR/MWh
Electricity	50%	19,89	0,169	169,02
District heating	50%	15,28	0,130	129,85
Natural gas	100%	9,26	0,079	78,74
Brown coal	25%	10,37	0,088	88,18
Firewood	50%	3,64	0,031	30,94
Wood pellet	50%	6,98	0,059	59,34
Extra light fuel oil	100%	33,17	0,282	281,92

NPV calculation (20 year period)

	Discount rate	4%		Price of CO_2	
	Investment	- 14.608.565	- 124.173 €		
2024	Year 1	1.201.429	10.212 €	- €	2024
2025	Year 2	1.241.803	10.555 €	6,625 €	2025
	Year 3	1.241.803	10.555 €	6,625 €	
	Year 4	1.241.803	10.555 €	6,625 €	
	Year 5	1.241.803	10.555 €	6,625 €	
	Year 6	1.241.803	10.555 €	6,625 €	
2030	Year 7	1.298.936	11.041 €	16,00 €	2030
	Year 8	1.298.936	11.041 €	16,00 €	
	Year 9	1.298.936	11.041 €	16,00 €	
	Year 10	1.298.936	11.041 €	16,00 €	
	Year 11	1.298.936	11.041 €	16,00 €	
2035	Year 12	1.443.673	12.271 €	39,75 €	2035
	Year 13	1.443.673	12.271 €	39,75 €	
	Year 14	1.443.673	12.271 €	39,75 €	
	Year 15	1.443.673	12.271 €	39,75 €	
	Year 16	1.443.673	12.271 €	39,75 €	
2040	Year 17	1.688.964	14.356 €	80,00 €	2040
	Year 18	1.688.964	14.356 €	80,00 €	
	Year 19	1.688.964	14.356 €	80,00 €	
2043	Year 20	1.688.964	14.356 €	80,00 €	2043
				31,594	AVERAGE
	NPV	**3.880.519**	**32.984 €**		

Investment and savings potential

3.000 **<--- potential number of buildings that could be refurbished in next 10 years**

Total net area buildings	Potential investment for reconstruction (incl VAT)		Average reconstruction costs		Potential average yearly savings										Potential total savings energy savings			CO_2 - reduction Electricity + Heating		CO_2 - reduction Monetary value		SPP
	ex. rate -->	0,00850			Electricity					Heating								CO_2	CO_2	CO_2	CO_2	
[m²]	[RSD]	[EUR]	[RSD]	[EUR/m²]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	RSD	EUR	[t CO_2]	[kg CO_2/m²]	RSD	EUR	YEAR
4.504.613	**43.825.693.518**	**372.518.395**	**9.729**	**83**	**11.953.650**	**14%**	**237.701.262**	**2.020.461**	**14.184**	**488.024.663**	**47%**	**3.366.585.861**	**28.615.980**	**141.218**	**499.978.313**	**3.604.287.123**	**30.636.441**	**155.402**	**34,50**	**577.614.593**	**4.909.724**	**10,48**

The NPV of the average building renovation project in the case of Scenario 3 (average fuel price increase of 61%) **is positive (3.880.519 RSD / 32.984 €)**.

The investment potential is the same (**43.825.693.518 RSD / 372.518.395 €**), as well as the reduction of CO_2 (**155.402 t CO_2**) with a monetary equivalent of **577.614.593 RSD** (**4.909.724 €**).

The potential energy saving remains **499.978.313 kWh**, with a monetary equivalent of **3.604.287.123 RSD (30.636.441 €)** giving an average simple payback period of **10,48 years**.

Table 60 NPV calculation - Sensitivity analysis
Scenario 4 – Average fuel price increase of 79%

	Building name	Building net area	Costs of reconstruction (incl VAT)		Average reconstruction		Average yearly savings										Total yearly energy savings			CO_2 - reduction Electricity + Heating		CO_2 - reduction Monetary value		SPP	Type of heating	
			ex. rate -->	0,00850			Electricity					Heating								CO_2	CO_2	CO_2	CO_2		Before	After
		[m²]	[RSD]	[EUR]	[RSD]	[EUR/m²]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	RSD	EUR	[t CO_2]	[kg CO_2/m²]	RSD	EUR	YEAR		
1	Health station Horgoš, Kanjiža	644	12.871.718	109.410	19.983	170	6.797	24%	180.219	1.532	7,47	131.910	50%	1.221.956	10.387	25,98	138.707	1.402.175	11.918	33,45	51,92	124.316	1.057	8,43	Natural gas	Natural gas
2	Technical school, Zagubica	1.630	21.905.999	186.201	13.439	114	323	-1%	8.551	73	-0,35	180.936	47%	1.473.639	12.526	120,15	180.613	1.465.088	12.453	119,80	73,49	445.274	3.785	11,47	Brown coal	Wood pellet
3	gymnasium, Knjaževac	2.147	12.265.524	104.257	5.713	49	8.820	32%	233.837	1.988	11,09	271.361	60%	987.889	8.397	20,17	280.180	1.221.726	10.385	31,25	14,56	116.158	987	9,17	Brown coal	briquette / firewood
4	CZK "Masuka", Velika Plana	1.585	11.391.017	96.824	7.187	61	644	3%	17.075	145	0,71	66.493	31%	1.185.120	10.074	22,00	67.137	1.202.194	10.219	22,71	14,33	84.405	717	8,85	District heating	District heating
	Average values	**1.502**	**14.608.565**	**124.173**	**9.729**	**83**	**3.985**	**14%**	**105.645**	**898**	**4,73**	**162.675**	**47%**	**1.217.151**	**10.346**	**47,07**	**166.659**	**1.322.796**	**11.244**	**51,80**	**34,50**	**192.538**	**1.637**	**9,64**		

Sensitivity analysis

Scenario: **4** <--- Select scenario

Average energy prices incl. VAT			
Energy source	% of cost change	RSD/kWh	EUR/kWh	EUR/MWh
Electricity	100%	26,51	0,225	225,37
District heating	75%	17,82	0,151	151,50
Natural gas	100%	9,26	0,079	78,74
Brown coal	50%	12,45	0,106	105,81
Firewood	50%	3,64	0,031	30,94
Wood pellet	75%	8,14	0,069	69,23
Extra light fuel oil	100%	33,17	0,282	281,92

NPV calculation (20 year period)

	Discount rate	4%		Price of CO_2	
	Investment	- 14.608.565	- 124.173 €		
2024	Year 1	1.322.796	11.244 €	- €	2024
2025	Year 2	1.363.170	11.587 €	6,625 €	2025
	Year 3	1.363.170	11.587 €	6,625 €	
	Year 4	1.363.170	11.587 €	6,625 €	
	Year 5	1.363.170	11.587 €	6,625 €	
	Year 6	1.363.170	11.587 €	6,625 €	
2030	Year 7	1.420.303	12.073 €	16,00 €	2030
	Year 8	1.420.303	12.073 €	16,00 €	
	Year 9	1.420.303	12.073 €	16,00 €	
	Year 10	1.420.303	12.073 €	16,00 €	
	Year 11	1.420.303	12.073 €	16,00 €	
2035	Year 12	1.565.040	13.303 €	39,75 €	2035
	Year 13	1.565.040	13.303 €	39,75 €	
	Year 14	1.565.040	13.303 €	39,75 €	
	Year 15	1.565.040	13.303 €	39,75 €	
	Year 16	1.565.040	13.303 €	39,75 €	
2040	Year 17	1.810.331	15.388 €	80,00 €	2040
	Year 18	1.810.331	15.388 €	80,00 €	
	Year 19	1.810.331	15.388 €	80,00 €	
2043	Year 20	1.810.331	15.388 €	80,00 €	2043
				31,594	AVERAGE
	NPV	**5.529.935**	**47.004 €**		

Investment and savings potential

3.000 **<--- potential number of buildings that could be refurbished in next 10 years**

Total net area buildings	Potential investment for reconstruction (incl VAT)		Average reconstruction costs		Potential average yearly savings										Potential total savings energy savings			CO_2 - reduction Electricity + Heating		CO_2 - reduction Monetary value		SPP
	ex. rate -->	0,00850			Electricity					Heating								CO_2	CO_2	CO_2	CO_2	
[m²]	[RSD]	[EUR]	[RSD]	[EUR/m²]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	RSD	EUR	[t CO_2]	[kg CO_2/m²]	RSD	EUR	YEAR
4.504.613	**43.825.693.518**	**372.518.395**	**9.729**	**83**	**11.953.650**	**14%**	**316.935.016**	**2.693.948**	**14.184**	**488.024.663**	**47%**	**3.651.452.822**	**31.037.349**	**141.218**	**499.978.313**	**3.968.387.839**	**33.731.297**	**155.402**	**34,50**	**577.614.593**	**4.909.724**	**9,64**

The NPV of the average building renovation project in the case of Scenario 4 (average fuel price increase of 79%) **is positive (5.529.935 RSD / 47.004 €)**.

The investment potential is the same (**43.825.693.518 RSD** / **372.518.395 €**), as well as the reduction of CO_2 (**155.402 t CO_2**) with a monetary equivalent of **577.614.593 RSD** (**4.909.724 €**).

The potential energy saving remains **499.978.313 kWh** with a monetary equivalent of **3.968.387.839 RSD** (**33.731.297 €**) giving an average simple payback period of **9,64 years**.

Table 61 NPV calculation - Sensitivity analysis
Scenario 5 – Average fuel price increase of 179%

	Building name	Building net area	Costs of reconstruction (incl VAT)		Average reconstruction		Average yearly savings										Total yearly energy savings			CO_2 - reduction Electricity + Heating		CO_2 - reduction Monetary value		SPP	Type of heating	
			ex. rate --->	0,00850			Electricity					Heating								CO_2	CO_2	CO_2	CO_2		Before	After
		[m²]	[RSD]	[EUR]	[RSD]	[EUR/m²]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	RSD	EUR	[t CO_2]	[kg CO_2/m²]	RSD	EUR	YEAR		
1	Health station Horgoš, Kanjiža	644	12.871.718	109.410	19.983	170	6.797	24%	270.328	2.298	7,47	131.910	50%	2.138.424	18.177	25,98	138.707	2.408.752	20.474	33,45	51,92	124.316	1.057	5,08	Natural gas	Natural gas
2	Technical school, Žagubica	1.630	21.905.999	186.201	13.439	114	323	-1%	12.826	109	-0,35	180.936	47%	2.105.198	17.894	120,15	180.613	2.092.372	17.785	119,80	73,49	445.274	3.785	8,63	Brown coal	Wood pellet
3	gymnasium, Knjaževac	2.147	12.265.524	104.257	5.713	49	8.820	32%	350.756	2.981	11,09	271.361	60%	1.317.185	11.196	20,17	280.180	1.667.941	14.177	31,25	14,56	116.158	987	6,87	Brown coal	briquette / firewood
4	CZK "Masuka", Velika Plana	1.585	11.391.017	96.824	7.187	61	644	3%	25.612	218	0,71	66.493	31%	1.693.028	14.391	22,00	67.137	1.718.640	14.608	22,71	14,33	84.405	717	6,32	District heating	District heating
	Average values	**1.502**	**14.608.565**	**124.173**	**9.729**	**83**	**3.985**	**14%**	**158.468**	**1.347**	**4,73**	**162.675**	**47%**	**1.813.459**	**15.414**	**47,07**	**166.659**	**1.971.926**	**16.761**	**51,80**	**34,50**	**192.538**	**1.637**	**6,75**		

Sensitivity analysis

Scenario: 5 <--- Select scenario

Average energy prices incl. VAT			
Energy source	% of cost change	RSD/kWh	EUR/kWh EUR/MWh
Electricity	200%	39,77	0,338 338,05
District heating	150%	25,46	0,216 216,42
Natural gas	250%	16,21	0,138 137,80
Brown coal	150%	20,75	0,176 176,35
Firewood	100%	4,85	0,041 41,26
Wood pellet	150%	11,64	0,099 98,90
Extra light fuel oil	250%	58,04	0,493 493,37

NPV calculation (20 year period)

	Discount rate	4%		Price of CO_2	
	Investment	- 14.608.565 €	- 124.173 €		
2024	Year 1	1.971.926	16.761 €	- €	2024
2025	Year 2	2.012.300	17.105 €	6,625 €	2025
	Year 3	2.012.300	17.105 €	6,625 €	
	Year 4	2.012.300	17.105 €	6,625 €	
	Year 5	2.012.300	17.105 €	6,625 €	
	Year 6	2.012.300	17.105 €	6,625 €	
2030	Year 7	2.069.433	17.590 €	16,00 €	2030
	Year 8	2.069.433	17.590 €	16,00 €	
	Year 9	2.069.433	17.590 €	16,00 €	
	Year 10	2.069.433	17.590 €	16,00 €	
	Year 11	2.069.433	17.590 €	16,00 €	
2035	Year 12	2.214.170	18.820 €	39,75 €	2035
	Year 13	2.214.170	18.820 €	39,75 €	
	Year 14	2.214.170	18.820 €	39,75 €	
	Year 15	2.214.170	18.820 €	39,75 €	
	Year 16	2.214.170	18.820 €	39,75 €	
2040	Year 17	2.459.461	20.905 €	80,00 €	2040
	Year 18	2.459.461	20.905 €	80,00 €	
	Year 19	2.459.461	20.905 €	80,00 €	
2043	Year 20	2.459.461	20.905 €	80,00 €	2043
				31.594	AVERAGE
	NPV	14.351.828	121.991 €		

Investment and savings potential

3.000 **<--- potential number of buildings that could be refurbished in next 10 years**

	Total net area buildings	Potential investment for reconstruction (incl VAT)		Average reconstruction costs		Potential average yearly savings										Potential total savings energy savings			CO_2 - reduction Electricity + Heating		CO_2 - reduction Monetary value		SPP
		ex. rate --->	0,00850			Electricity					Heating								CO_2	CO_2	CO_2	CO_2	
	[m²]	[RSD]	[EUR]	[RSD]	[EUR/m²]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	RSD	EUR	[t CO_2]	[kg CO_2/m²]	RSD	EUR	YEAR
	4.504.613	**43.825.693.518**	**372.518.395**	**9.729**	**83**	**11.953.650**	**14%**	**475.402.525**	**4.040.921**	**14.184**	**488.024.663**	**47%**	**5.440.376.465**	**46.243.200**	**141.218**	**499.978.313**	**5.915.778.990**	**50.284.121**	**155.402**	**34,50**	**577.614.593**	**4.909.724**	**6,75**

The NPV of the average building renovation project in the case of a more extreme scenario 5 (fuel price increase of 179%) **is positive (14.351.828 RSD / 121.991 €)**. This increase of price could be realistic taking into consideration the current low prices in Serbia and the future expected increase of fossil fuel prices.

The investment potential remains the same (**43.825.693.518 RSD** / **372.518.395 €**), as well as the reduction of CO_2 (**155.402 t CO_2**) with a monetary equivalent of **577.614.593 RSD** (**4.909.724 €**).

The potential energy saving remains **499.978.313 kWh**, with a monetary equivalent of **5.915.778.990 RSD** (**50.284.121 €**) giving an average simple payback period of only **6,75 years**.

Summary of NPV calculation and sensitivity analysis

Within the NPV calculation the potential increase of the monetary savings into the future due to the increase of fuel prices was not included. The reason was to keep the calculation as conservative as possible as the increase of potential monetary savings could be diminished because of a reduction in the efficiency of the heating system and outer building envelope over time, and the rate of savings increase could not be estimated with strong accuracy.

The average cost of reconstruction calculated on the basis of the actual data of the implemented building renovation projects is 14.608.565 RSD (124.173 €) per building or 9.729 RSD (83 €) per square meter. The average building net area is 1.502 m^2, the average achieved total energy saving (heating and electricity) is 166.659 kWh and an average CO_2 reduction of 51,80 t CO_2.

The NPV calculation and sensitivity analysis provided the following results.

Table 62 SPP and NPV calculation – summary of the results with sensitivity analysis

Scen.	Fuel price increase	SPP	NPV (20-year period, 4% discount rate)	Total annual energy and CO_2 savings (VAT incl.)
0	0 %	15,50	-2.254.035 RSD / -19.159 €	942.576 RSD / 8.012 €
1	21 %	13,47	-321.384 RSD / -2.732 €	1.084.784 RSD / 9.221 €
2	39 %	11,98	1.511.673 RSD / 12.849 €	1.219.663 RSD / 10.367 €
3	61 %	10,48	3.880.519 RSD / 32.984 €	1.393.967 RSD / 11.849 €
4	79 %	9,64	5.529.935 RSD / 47.004 €	1.515.334 RSD / 12.880 €
5	179 %	6,75	14.351.828 RSD / 121.991 €	2.164.465 RSD / 18.398 €

The results show that with an increase of current fuel prices of 40%, the investments in building refurbishment have a positive NPV.

Following the calculation of the total potential for investments in building refurbishment, for the period of the next 10 years, the number of buildings was approximated using the available data on the number the buildings under jurisdiction of municipalities. The total assessed number of municipal buildings was 6334 and, taking into consideration a possible targeted refurbishment rate of 50%, the selected potential number of buildings that could be refurbished is **3.000**.

The total available investment potential for these 3.000 buildings is **43.825.693.518 RSD** (**372.518.395 €**), The total reconstructed net area would add up to **4.504.613 m2**, the potential total annual energy saving (heating and electricity) would be **499.978.313 kWh** and a CO_2 reduction of **155.402 t CO_2**. The total investment and savings potential for these 3000 buildings are shown in the table below.

Table 63 Summary of monetary savings potential - with sensitivity analysis

Scen.	Fuel price increase	SPP	Total annual energy and CO_2 savings (VAT incl.)
0	0 %	15,50	2.827.728.117 RSD / 24.035.689 €
1	21 %	13,47	3.254.351.703 RSD / 27.661.989 €
2	39 %	11,98	3.658.990.212 RSD / 31.101.417 €
3	61 %	10,48	4.181.901.716 RSD / 35.546.165 €
4	79 %	9,64	4.546.002.432 RSD / 38.641.021 €
5	179 %	6,75	6.493.393.583 RSD / 55.193.845 €

Summary of the report and conclusions

The analysis presented in this report was conducted in three parts
Part I: Review of the energy consumption data sample available in EMIS;
Part II: Review of actual energy savings after energy renovation projects of individual buildings and
Part III: Financial analysis – Energy savings potential of building renovation projects.

The first step of analysis accomplished in Part I of the report was based on the data available from the Energy Management Information System (EMIS), that contains data for more than 10.800 structures (more than 7.100 individual buildings). The total time frame that was selected for analysis is from 2018 until 2022. The selected data sets include actual energy and water consumption and cost, based on the available bills for water/electricity/fuel/heat that were collected and available in the EMIS for the four consecutive years: 2018 to 2020.

The selection of the data sample sets for analysis was conducted to be representative of local self-government units (LSG) of different sizes in Serbia, and have taken into consideration the number of inhabitants, the number of public buildings included, the energy source types, total energy consumption, the energy consumption profile and the typology of the buildings in order to get analysis conclusions and insights that are as objective as possible.

The analysis showed that representative LSGs can be grouped as follows:

- LSG Type 1 – 20.000 to 50.000
- LSG Type 2 – 50.000 to 100.000
- LSG Type 3 – 100.000 to 200.000
- LSG Type 4 – 200.000 to 400.000

After initial data screening and in some cases data verification, clarification and/or correction to increase the accuracy and usefulness of the analysis, a credible sample of buildings and data were extrapolated and an initial analysis of energy performance on the level of a city was conducted. The baseline energy consumption for a selected LSG was calculated as an average for the years 2018 to 2020. The years 2021 and 2022 were not included in the calculation of baseline as these were the atypical due to COVID 19 pandemic restrictions. However, both years were included to show the most recent energy consumption. As for 2023, the data sets available in EMIS are still quite incomplete.

Results of Part I: Review of the energy consumption data sample available in EMIS

Table 13 Summary of EMIS data review - consumption by energy source (carrier) per LSG Type - years 2018. to 2022. (from pg. 58)

								Cost per kWh	Cost per kWh [EUR]				
		Energy Source	Unit	Consumption	Energy [kWh]	Cost [RSD]	Cost + tax [RSD]	exchange rate --->	0,00850	Emission CO_2[t]	Primary energy [kWh]	Number of objects	
BASELINE --> AVERAGE of 2018 to 2020													
LSG Type 1													
Average inhabitants --	40.000												
		Electricity	kWh	1.049.414,67	1.049.414,67	11.718.707,68	15.072.576,70	14,36	0,122 €	1.180,48	3.238.318,25	88	
		District heating	kWh	527.449,18	527.449,18	47.589.955,20	52.348.950,72	99,25	0,844 €	164,84	897.474,20	8	
		Natural gas	Sm³	27.856,67	286.628,39	1.693.880,50	1.863.268,55	6,50	0,055 €	57,78	321.003,56	1	
		Brown coal	t	198,17	571.160,77	2.048.432,76	2.458.119,32	4,30	0,037 €	191,37	546.756,94	11	
		Firewood	m³	412,67	823.263,73	1.633.918,25	1.794.048,07	2,18	0,019 €	-	725.113,32	14	
		Wood pellet	t	23,17	114.270,85	475.852,89	523.438,18	4,58	0,039 €	-	117.947,40	4	
		Water	m³	20.186,95	-	7.638.607,26	8.401.428,63			-	-	50	
HDD -->	2715,580903				3.372.187,60	72.799.354,54	82.461.830,17	24,45	0,208 €	1.594,47	5.846.613,67	176	
Average per inhabitant --->					84,30	1819,98	2061,55			0,0399	146,17	4,40	/ 1000 inhabitants
LSG Type 2													
Average inhabitants --	55.000												
		Electricity	kWh	1.432.362,25	1.432.362,25	15.601.064,49	20.046.451,31	14,00	0,119 €	1.574,17	4.318.285,72	93	
		District heating	kWh	926.640,33	926.640,33	10.925.255,60	12.015.677,24	12,97	0,110 €	265,95	1.447.875,52	4	
		Natural gas	Sm³	185.941,13	1.913.222,73	6.181.251,55	6.799.373,70	3,55	0,030 €	344,38	1.913.222,73	23	
		Brown coal	t	226,35	652.399,89	2.139.419,81	2.567.303,77	3,94	0,033 €	228,34	652.399,89	7	
		Firewood	m³	338,97	676.240,27	1.541.383,58	1.695.521,94	2,51	0,021 €	-	676.240,27	9	
		Wood pellet	t	63,16	311.534,19	1.338.855,33	1.472.740,87	4,73	0,040 €	-	311.534,19	2	
		Water	m³	14.543,38	-	2.338.740,83	2.588.144,01			-	-	59	
SDG -->	2279,678194				5.912.399,67	40.065.971,20	47.185.212,84	7,98	0,068 €	2.412,83	9.319.558,33	196	
Average per inhabitant --->					107,50	728,47	857,91			0,0439	169,45	3,57	/ 1000 inhabitants
LSG Type 3													
Average inhabitants --	180.000												
		Electricity	kWh	3.549.716,08	3.549.716,08	32.892.611,88	42.094.070,06	11,86	0,101 €	3.901,14	10.701.684,03	103	
		District heating	kWh	7.620.277,33	7.620.277,33	59.868.022,66	65.836.144,34	8,64	0,073 €	2.187,02	11.906.683,33	37	
		Natural gas	Sm³	291.625,67	3.000.653,13	10.863.089,67	11.949.174,26	3,98	0,034 €	540,12	3.000.653,13	12	
		Extra light fuel oil	l	36.607,67	377.688,62	5.219.578,01	6.263.493,61	16,58	0,141 €	105,75	377.688,62	2	
		Brown coal	t	45,77	131.908,69	1.831.116,67	2.197.340,00	16,66	0,142 €	46,17	131.908,69	4	
		Firewood	m³	120,98	241.351,11	569.266,67	626.193,33	2,59	0,022 €	-	241.351,11	4	
		Water	m³	76.582,89	-	5.024.392,83	5.523.008,38			-	-	66	
HDD -->	2715,580903				14.921.594,96	116.268.078,38	134.489.423,99	9,01	0,077 €	6.780,20	26.359.968,91	227	
Average per inhabitant --->					82,90	645,93	747,16			0,0377	146,44	1,26	/ 1000 inhabitants
LSG Type 4													
Average inhabitants --	340.000												
		Electricity	kWh	14.235.507,09	14.235.507,09	141.515.578,53	182.366.357,06	12,81	0,109 €	15.644,82	42.917.206,78	360	
		District heating	kWh	32.497.795,89	32.497.795,89	264.338.661,57	290.772.527,73	8,95	0,076 €	9.326,87	50.777.806,07	144	
		Natural gas	Sm³	2.189.133,39	22.524.869,07	91.950.739,68	101.145.800,58	4,49	0,038 €	4.054,48	22.524.869,07	106	
		Water	m³	357.831,54	-	66.763.067,21	73.439.329,50			-	-	225	
HDD -->	2242,038611				69.258.172,05	564.568.046,98	647.724.014,87	9,35	0,079 €	29.026,16	116.219.881,93	835	
Average per inhabitant --->					203,70	1660,49	1905,07			0,0854	341,82	2,46	/ 1000 inhabitants

The following observations of the analyzed EMIS data for a typical LSG can be made from the above table:

- The number of buildings per 1000 inhabitants varies from 1,26 to 4,40.
- The energy consumption per inhabitant varies from 82,90 kWh/inhabitant to 203,70 kWh/inhabitant.
- The costs for energy (including tax) vary from 747,16 RSD/inhabitants to 2.061,55 RSD/inhabitants.
- For LSG Type 1 the price of district heating energy is high even after correction that shows the possible inefficiencies in the district heating network that causes a high unit price.
    - The correction of the district heating price was conducted following an in-depth analysis that showed that there is inconsistency related to the district heating price that is because for some of the buildings the district heating energy is still not metered, but rather charged as a lump sum and is calculated based on the useful area of the building (square meters) leading to very high energy prices in some cases.
- For LSG Type 1, the gas price is also 2 times higher than in other LSGs showing potential issues with the price of energy sources for smaller LSGs due to smaller amounts of energy being purchased.
- Higher prices for district heating and natural gas for LSG Type 1 resulted in the fact that the average cost of energy per kWh for LSG Type 1 is significantly (almost 3x) higher when compared to other LSGs.
- For LSG Type 3, the average number of buildings per 1000 inhabitants is the lowest, indicating that possibly not all buildings are entered into EMIS. The result of this is also the lowest energy consumption per inhabitant for LSG Type 3.

The analysis of fuel consumption showed that in cases when buildings are using solid fuel as an energy source (such as firewood, pellets, coal and similar), in some cases, a mix of fuel is being used at the same building with no regular metering of actual fuel consumption, but rather the consumption is assessed. This leads to a lower level of accuracy related to actual fuel consumption. In addition, from year to year the purchase of fuel varies in the combination and quantity purchased. For example, a facility can get both coal and wood for one year in a larger volume and then nothing the following year, and then only wood in the next year and finally coal the following year. All this influences the accuracy and potential conclusions of the energy analysis.

In some cases, high unit costs of energy were observed in the in-depth analysis of the EMIS data and usually provided the insight that the high unit costs are the result of incorrect data input in EMIS! With this in mind, it is recommended to automatize the data acquisition by EMIS either by connection to energy distributor billing databases or by gathering the data by remote meter reading.

In some cases, there was also significant variation in the building numbers per year for the same LSG, showing inconsistency in the data-gathering process for buildings and leading to lower quality of the data for the analysis. The recommendation is to verify that the data are entered consistently and consecutively for the buildings that are in EMIS, which would have led to much better and more accurate results in the analysis.

This point towards the fact that, in order to secure the strong quality of the data needed for a proper energy analysis, it is critical to have well-trained and motivated energy managers as well as established processes and procedures for data gathering and verification. This forms the basis for systematic energy management.

An analysis of the typical types of buildings per LSG type was also performed. Based on EMIS data, the following observations can be made:

- The types of buildings that are responsible for the highest share of costs of energy are:
    - Primary schools 28% to 77 %
    - Secondary schools 8% to 29%
    - Kindergartens 5% to 32%
    - Administrative buildings 2,6% to 20%
    - Other types of buildings 0,8% to 15%
- Educational institution buildings (primary schools, secondary schools and kindergartens) are responsible for 50 to 90 % of energy and water costs in LSGs.
- For the analyzed LSGs, the number of educational institution buildings were as follows:
    - LSG Type 1:
        - 40 Primary schools, 1 secondary school, 6 Kindergartens
            - 47 educational institution buildings out of 99 buildings in total (47,5%)
    - LSG Type 2:
        - 16 Primary schools, 2 secondary schools, 12 Kindergartens
            - 30 educational institution buildings out of 107 buildings in total (28,0%)
    - LSG Type 3:
        - 9 Primary schools, 1 secondary schools, 16 Kindergartens, 1 primary and secondary schools
            - 27 educational institution buildings out of 104 buildings in total (26,0%)

- LSG Type 4:
  - 44 Primary schools, 16 secondary schools, 67 Kindergartens, 3 primary and secondary schools (
    - 130 educational institution buildings out of 300 buildings in total (43,3%)

- LSG Type 3 has the smallest share of educational institution buildings (26%) which corresponds with the fact that this LSG also has the smallest energy consumption per inhabitant (82,9 kWh/inhabitant) and costs for energy (including tax) per inhabitant (747,16 RSD/inhabitant).

- LSG Type 1 has the highest share of educational institution buildings (47,5%) and this, combined with the fact that the price of district heating and natural gas are the highest for this LSG, results in the highest costs for energy (including tax) per inhabitant (2.061,55 RSD/inhabitant)

From above it can be concluded that, in general, educational institution buildings are responsible for the majority of costs in LSGs and should be the focus of programs and projects of energy efficiency improvements and energy management activities.

The results of the analyzed data sample from EMIS were used to determine the average actual energy costs (incl. VAT) for different types of fuel that were used to perform a sensitivity analysis of the effects of the potential increase of the fuel prices on LSG budget costs for energy.

The calculated average actual energy prices are listed in the table below.

Table 14 Calculated average total energy prices per type of fuel - years 2018. to 2022. (from pg. 59)

Energy source		RSD/kWh	EUR/kWh	EUR/MWh
Electricity		13,26	0,113	112,68
District heating	*	10,18	0,087	86,57
Natural gas		4,63	0,039	39,37
Brown coal		8,30	0,071	70,54
Firewood		2,43	0,021	20,63
Wood pellet		4,65	0,040	39,56
Extra light fuel oil		16,58	0,142	141,59

* - To calculate the average price for district heating (DH) the cost for DH in LSG Type 1 was excluded due to significantly higher costs than in other LSGs. The value calculated with this approach corresponds well to received information about average prices.

Taking into consideration the recent high fluctuations of energy costs across the region and the entire EU, specifically the costs of natural gas and electricity but also all other energy types as well, the range of price increase for the selected scenario was set from 25 to 100% of increase.

The analysis was conducted using an XLS based model to summarize EMIS data for consumption by the energy source (carrier) from 2018 to 2022 per LSG Type (shown in Table 13. Above).

The selected energy price increase scenarios were:

ENERGY PRICE INCREASE SCENARIOS				
	1	2	3	4
Electricity	25%	50%	50%	100%
District heating	0%	25%	50%	75%
Natural gas	50%	75%	100%	100%
Brown coal	0%	0%	25%	50%
Firewood	0%	25%	50%	50%
Wood pellet	25%	25%	50%	75%
Extra light fuel oil	50%	75%	100%	100%

The results of the analysis of the effect of 4 selected scenarios of price increases on the overall increase of energy costs for a typical LSGs are shown below.

Table 15 Sensitivity analysis – Scenario 1 –
Summary of cost increase per LSG Type (from pg. 64)

	Energy cost increase by LSG Type for				
	Energy [kWh]	Cost + tax [RSD] Baseline	Cost + tax [RSD] After energy price change	Energy cost change	% of cost change
LSG Type 1	3.372.187,60	82.461.830,17	87.292.468,16	4.830.637,99	6%
LSG Type 2	5.912.399,67	47.185.212,84	55.964.697,73	8.779.484,89	19%
LSG Type 3	14.921.594,96	134.489.423,99	154.119.275,45	19.629.851,45	15%
LSG Type 4	69.258.172,05	647.724.014,87	743.888.504,42	96.164.489,56	15%
				Average -->	**13%**

Table 17 Sensitivity analysis – Scenario 2 –
Summary of cost increase per LSG Type (from pg. 65)

	Energy cost increase by LSG Type for				
	Energy [kWh]	Cost + tax [RSD] Baseline	Cost + tax [RSD] After energy price change	Energy cost change	% of cost change
LSG Type 1	3.372.187,60	82.461.830,17	105.062.179,17	22.600.349,01	27%
LSG Type 2	5.912.399,67	47.185.212,84	66.103.953,78	18.918.740,94	40%
LSG Type 3	14.921.594,96	134.489.423,99	185.811.544,35	51.322.120,36	38%
LSG Type 4	69.258.172,05	647.724.014,87	887.459.675,76	239.735.660,90	37%
				Average -->	**36%**

Table 19 Sensitivity analysis – Scenario 3 –
Summary of cost increase per LSG Type (from pg. 66)

	Energy cost increase by LSG Type for				
	Energy [kWh]	Cost + tax [RSD] Baseline	Cost + tax [RSD] After energy price change	Energy cost change	% of cost change
LSG Type 1	3.372.187,60	82.461.830,17	119.809.135,38	37.347.305,22	45%
LSG Type 2	5.912.399,67	47.185.212,84	72.241.608,16	25.056.395,32	53%
LSG Type 3	14.921.594,96	134.489.423,99	207.529.630,74	73.040.206,74	54%
LSG Type 4	69.258.172,05	647.724.014,87	985.439.257,84	337.715.242,98	52%
				Average -->	**51%**

Table 21 Sensitivity analysis – Scenario 4 –
Summary of cost increase per LSG Type (from pg. 67)

	Energy cost increase by LSG Type for				
	Energy [kWh]	Cost + tax [RSD] Baseline	Cost + tax [RSD] After energy price change	Energy cost change	% of cost change
LSG Type 1	3.372.187,60	82.461.830,17	141.178.050,78	58.716.220,62	71%
LSG Type 2	5.912.399,67	47.185.212,84	86.278.764,29	39.093.551,44	83%
LSG Type 3	14.921.594,96	134.489.423,99	245.585.036,85	111.095.612,86	83%
LSG Type 4	69.258.172,05	647.724.014,87	1.149.315.568,30	501.591.553,44	77%
				Average -->	**79%**

Results of Part II: Review of actual energy savings after energy renovation projects of individual buildings

Part II of the analysis was conducted for selected group of buildings that were renovated to improve energy efficiency. The energy efficiency projects that were implemented were financed by the Budgetary Fund for energy efficiency and Public Investment Management Office (PIMO).

The analysis was done using the data available in EMIS (from the Energy consumption reports that were prepared) and this data was analyzed to determine the amounts of actual energy savings that are results of implementation of energy efficiency improvement measures. For the analyzed group of buildings, the data from available technical building refurbishment documentation was also used to confirm the scope of the implemented improvement measures and to confirm the technical details about the buildings and the implemented measures.

The buildings were selected for analysis depending on the quality of EMIS data and the availability of technical documentation. The list of buildings that were analysed is:

1. Center for social work, Leskovac
2. Health center Kanjiža/Health station Horgoš, Kanjiža
3. Primary school “Turzo Lajoš”, SentaBuilding
4. Technical school, Žagubica
5. Knjaževac gymnasium, Knjaževac
6. CZK “Masuka”, Velika Plana
7. Residential and commercial building KJP “Morava” Svilajnac
8. Senta Gymnasium, Senta
9. Home of Arts OKU “Cnesa”, Kanjiža
10. Assembly of the municipality of Medveđa

In the 10 buildings above, all major types of buildings that are usually under the jurisdiction of Municipalities are represented and they provide a strong representation of the typical buildings under the jurisdiction of municipalities.

The types of building that are represented are:

A -Educational institution buildings:	4 buildings;
B -Health care facilities:	1 building;
D - Cultural institution facilities:	2 buildings
F - Administrative facilities:	2 building
I - Public companies (JP) and Public utility company (JKP) facilities:	1 building

The results of the analyzed data are shown in the table below.

Table 52 Summary overview of actual energy savings (from pg. 89)

	Building name	Building net area	Average yearly consumption & CO_2 emmision before reconstruction - (Baseline)				Average yearly consumption & CO_2 emmision after reconstruction				Average yearly savings						Type of heating		CO_2 - reduction Electricity + Heating	
			Electricity		Heating		Electricity		Heating		Electricity			Heating			Before	After	CO_2	CO_2
		[m²]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[t CO_2]	[kWh]	[%]	[t CO_2]	[kWh]	[%]	[t CO_2]			[t CO_2]	[kg CO_2/m²]
1	Center for social work Leskovac	743.22	25,693	28.24	98,426	24.27	25,026	27.51	69,508	19.89	667	3%	0.73	28,917	29%	4.38	District heating	District heating	5.11	6.87
2	Health station Horgoš, Kanjiža	644.14	28,482	31.30	264,655	48.46	21,685	23.83	132,745	22.48	6,797	24%	7.47	131,910	50%	25.98	Natural gas	Natural gas	33.45	51.92
3	Primary school "Turzo Lajoš", Senta	2,955.82	123,419	130.81	390,193	64.76	42,190	46.37	242,680	44.04	81,230	66%	84.44	147,514	38%	20.72	Natural gas	Natural gas	105.16	35.58
4	Technical school, Žagubica	1,630.00	24,458	26.88	384,110	120.15	24,780	27.23	203,175	0	- 323	-1%	-0.35	180,936	47%	120.15	Brown coal	Wood pellet	119.80	73.49
5	Knjaževac gymnasium, Knjaževac	2,147.01	27,450	31.56	452,346	55.22	18,630	20.47	180,985	35.06	8,820	32%	11.09	271,361	60%	20.17	Brown coal	Wood briquette / firewood	31.25	14.56
6	CZK "Masuka", Velika Plana	1,585.00	21,996	24.18	212,955	63.78	21,352	23.47	146,462	41.78	644	3%	0.71	66,493	31%	22.00	District heating	District heating	22.71	14.33
7	KJP "Morava" Svilajnac	563.92	N/A		41,770	45.91	N/A		33,378	36.68	N/A			8,392	20%	9.22	Electricity	Electricity	9.22	16.36
8	Senta Gymnasium, Senta	5,138.34	57,008	56,10	474,417	134.92	40,130	50.38	342,099	109.07	16,878	30%	5.72	132,317	28%	25.85	Natural gas	Natural gas	31.57	6.14
9	Home of Arts OKU "Cnesa", Kanjiža	1,585.00	29,173	32.06	276,241	48.43	23,618	25.96	231,460	40.40	5,555	19%	6.11	44,781	16%	8.03	Natural gas	Natural gas	14.14	8.92
10	Medveđa municipality Assembly	1,393.03	56,765	62.75	107,619	0	32,829	36.08	111,182	0	23,936	42%	26.67	- 3,564	-3%	0.00	Firewood	Wood pellet	26.67	19.15
	Average values	**1,838.55**	**43,827**	**45.97**	**270,273**	**60.59**	**27,804**	**31.25**	**169,367**	**34.94**	**16,023**	**36.56%**	**15.84**	**100,906**	**37.33%**	**25.65**			**39.91**	**21.71**

The analysis of the actual energy consumption data after reconstruction that were available in EMIS confirmed that the implementation of energy renovation projects of individual buildings resulted in energy and CO_2 savings.

The average calculated energy savings potential of building renovation projects are:

- building **net area**: **1.838,55 m²**
- **electrical energy** savings: **36,56% or 16.023 kWh**
- **heating energy** savings: **37,33% or 100.906 kWh**
- **CO_2 reduction** for Electricity and Heating: **39,91 [t CO_2] or 21,71 [kg CO_2/m²]**

Within Part III of the report (Financial analysis – Energy savings potential of building renovation projects), a financial analysis of energy savings potentials for the reconstruction of municipal buildings was conducted. The financial analysis performed included a calculation of the Simple payback period (SPP) of the implemented reconstruction projects as well as the Net present value (NPV).

Data about the actual costs of the implemented reconstruction projects and the following data were used for the SPP and NPV calculations:

- average fuel prices (incl. VAT) per type of energy source - Table 14 Calculated average total energy prices per type of fuel - years 2018 to 2022 (from pg.59).
- Income that can be generated from sales of greenhouse gas emissions (CO_2) that result from the implemented reconstruction projects.
    - The expected range of the carbon price for Serbia, used for calculation, are: 0 EUR per ton of CO_2 equivalent until 2025, 6.625 EUR until 2030, 16 EUR until 2035, 39.75 EUR until 2035, and 80 EUR beyond 2040. (the average value of Carbon price 31.594 EUR per ton of CO_2 equivalent).

The results of the calculation of SPP are shown in the table below.

Table 53 Summary overview of actual energy savings and simple payback period after building renovation (from pg. 95)

	Building name	Building net area	Costs of reconstruction (incl VAT)		Average reconstruction costs		Average yearly savings										Total energy savings			CO_2 - reduction Electricity + Heating	CO_2 - reduction Monetary value			SPP	Type of heating	
			ex. rate --->	0,00850			Electricity					Heating														
		[m²]	[RSD]	[EUR]	[RSD]	[EUR/m²]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	RSD	EUR	[t CO_2]	[kg CO_2/m²]	RSD	EUR	YEAR	Before	After
1	Health station Horgoš, Kanjiža	644	12.871.718	109.410	19.983	170	6.797	24%	90.109	766	7,47	131.910	50%	610.978	5.193	25,98	138.707	701.088	5.959	33,45	51,92	124.316	1.057	15,59	Natural gas	Natural gas
2	Technical school, Žagubica	1.630	21.905.999	186.201	13.439	114	- 323	-1%	- 4.275	- 36	-0,35	180.936	47%	842.079	7.158	120,15	180.613	837.804	7.121	119,80	73,49	445.274	3.785	17,07	Brown coal	Wood pellet
3	gymnasium, Knjaževac	2.147	12.265.524	104.257	5.713	49	8.820	32%	116.919	994	11,09	271.361	60%	658.593	5.598	20,17	280.180	775.511	6.592	31,25	14,56	116.158	987	13,76	Brown coal	Wood briquette / firewood
4	CZK "Masuka", Velika Plana	1.585	11.391.017	96.824	7.187	61	644	3%	8.537	73	0,71	66.493	31%	677.211	5.756	22,00	67.137	685.749	5.829	22,71	14,33	84.405	717	14,79	District heating	District heating
5	KJP "Morava" Svilajnac	564	4.049.973	34.425	7.182	61			N/A			8.392	20%	111.251	946	9,22	8.392	111.251	946	9,22	16,36	34.287	291	27,83	Electricity	Electricity
6	Medveđa municipality	1.393	9.812.526	83.406	7.044	60	23.936	42%	317.311	2.697	26,67	- 3.564	-3%	- 16.585	- 141	0,00	20.372	300.726	2.556	26,67	19,15	99.130	843	24,54	Firewood	Wood pellet
	Average values	**1.327**	**12.049.459**	**102.420**	**9.079**	**77**	**7.975**	**20%**	**105.720**	**899**	**9,12**	**109.255**	**34%**	**480.588**	**4.085**	**32,92**	**115.900**	**568.688**	**4.834**	**42,04**	**31,67**	**156.243**	**1.328**	**16,62**		

The results of this analysis show that the highest calculated simple payback period (SPP) of **27,83 years for building no 5.** KJP "Morava" Svilajnac and **24,54 years for building no 6.** Medveđa municipality assembly can be excluded as non-typical. Building no 5. used only electricity as an energy source, and the reconstruction that was implemented only included the thermal insulation of the outer facade with 8cm EPS, the replacement of windows, and the usage of electricity for heating that is frequently present in public buildings. Also, for building no 6. the implemented reconstruction included construction of an additional floor area (rooms) to the building that resulted in an increased total heated area of the building as well as an increase of the energy usage of the building. For this reason, this building was also excluded from the calculation of general investment and savings potential in the next steps.

Data from the other 4 typical buildings were used to calculate the general investment and savings potential. The data are shown in the table below.

Table 54 Summary overview of actual energy savings and simple payback period after building renovation – for calculation of investments and savings potential. (from pg. 95)

	Building name	Building net area	Costs of reconstruction (incl VAT)		Average reconstruction		Average yearly savings										Total yearly energy savings			CO_2 - reduction Electricity + Heating		CO_2 - reduction Monetary value		SPP	Type of heating	
			ex. rate --->	0.00850			Electricity					Heating														
		[m²]	[RSD]	[EUR]	[RSD]	[EUR/m²]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	[%]	RSD	EUR	[t CO_2]	[kWh]	RSD	EUR	[t CO_2]	[kg CO_2/m²]	RSD	EUR	YEAR	Before	After
1	Health station Horgoš, Kanjiža	644	12,871,718	109,410	19,983	170	6,797	24%	90,109	766	7.47	131,910	50%	610,978	5,193	25.98	138,707	701,088	5,959	33.45	51.92	124,316	1,057	15.59	Natural gas	Natural gas
2	Technical school, Žagubica	1,630	21,905,999	186,201	13,439	114	- 323	-1%	- 4,275	- 36	-0.35	180,936	47%	842,079	7,158	120.15	180,613	837,804	7,121	119.80	73.49	445,274	3,785	17.07	Brown coal	Wood pellet
3	Knjaževac gymnasium,	2,147	12,265,524	104,257	5,713	49	8,820	32%	116,919	994	11.09	271,361	60%	658,593	5,598	20.17	280,180	775,511	6,592	31.25	14.56	116,158	987	13.76	Brown coal	Wood briquette /
4	CZK "Masuka", Velika Plana	1,585	11,391,017	96,824	7,187	61	644	3%	8,537	73	0.71	66,493	31%	677,211	5,756	22.00	67,137	685,749	5,829	22.71	14.33	84,405	717	14.79	District heating	District heating
	Average values	**1,502**	**14,608,565**	**124,173**	**9,729**	**83**	**3,985**	**15.57%**	**52,823**	**449**	**4.73**	**162,675**	**49.52%**	**697,215**	**5,926**	**47.07**	**166,659**	**750,038**	**6,375**	**51.80**	**34.50**	**192,538**	**1,637**	**15.50**		

The average calculated data of energy savings potentials of building renovation projects derived from the table above, and used for NPV calculation are:

- building net area: 1.502 m²
- electrical energy savings: 15,57% or 3.985 kWh
- heating energy savings: 49,52% or 162.675 kWh
- CO_2 reduction for Electricity and Heating: 51,80 [t CO_2] or 34,50 [kg CO_2/m²]
- average cost of reconstruction
  - 14.608.565 RSD (124.173 €) / building
  - 9.729 RSD (83 €) / m²

The set of data above was used to calculate NPV values, and the calculation was conducted using the discount rate of 4%. The NPV was calculated for the period of 20 years, as this is aligned with the annual depreciation rate of 5% that is used according to the usual amortization life for taxation purposes of buildings as a group of fixed assets.

To conclude the calculation, a sensitivity analysis was conducted in accordance with the previously defined scenarios for the energy cost sensitivity analysis performed under part I, and an additional, more extreme, price increase scenario was added. The predefined scenarios are given in the table below.

Table 55 Scenarios of fuel price increase used for energy costs sensitivity analysis (from pg. 96)

PREDEFINED FUEL PRICE INCRESE SCENARIOS						
	0	1	2	3	4	5
Electricity	0%	25%	50%	50%	100%	200%
District heating	0%	0%	25%	50%	75%	150%
Natural gas	0%	50%	75%	100%	100%	250%
Brown coal	0%	0%	0%	25%	50%	150%
Firewood	0%	0%	25%	50%	50%	100%
Wood pellet	0%	25%	25%	50%	75%	150%
Extra light fuel oil	0%	50%	75%	100%	100%	250%
Average % of increase	**0%**	**21%**	**39%**	**61%**	**79%**	**179%**

To calculate the total potential for investments in building refurbishment, for the period of the next 10 years, the number of buildings was approximated using the available data on the number of buildings under the jurisdiction of municipalities. The total assessed number of municipal buildings was 6334 and taking into consideration a possible targeted refurbishment rate of 50% the selected potential number of buildings that could be refurbished is **3.000**.

Results of Part III: Financial analysis – Energy savings potential of building renovation projects

The potential increase of the monetary savings in future due to the increase of fuel prices was not included during the NPV calculation. The reason was to keep the calculation as conservative as possible because the increase of potential monetary savings could be diminished due to reduction of the efficiency of the heating system and outer building envelope over time, and the rate of savings increase could not be estimated with strong accuracy.

The NPV calculation and sensitivity analysis provided the following results.

Table 62 SPP and NPV calculation – summary of the results with sensitivity analysis (from pg. 103)

Scen.	Fuel price increase	SPP	NPV (20-year period, 4% discount rate)	Total annual energy and CO_2 savings (VAT incl.)
0	0 %	15,50	-2.254.035 RSD / -19.159 €	942.576 RSD / 8.012 €
1	21 %	13,47	-321.384 RSD / -2.732 €	1.084.784 RSD / 9.221 €
2	39 %	11,98	1.511.673 RSD / 12.849 €	1.219.663 RSD / 10.367 €
3	61 %	10,48	3.880.519 RSD / 32.984 €	1.393.967 RSD / 11.849 €
4	79 %	9,64	5.529.935 RSD / 47.004 €	1.515.334 RSD / 12.880 €
5	179 %	6,75	14.351.828 RSD / 121.991 €	2.164.465 RSD / 18.398 €

The results show that with an increase of current fuel prices by 40% the investments in building refurbishment have a positive NPV.

The total available investment potential for 3.000 buildings is **43.825.693.518 RSD** (**372.518.395 €**) and the total reconstructed net area would add up to **4.504.613 m²**.

The potential total annual energy savings (heating and electricity) would be **499.978.313 kWh** and a CO_2 reduction of **155.402 t CO_2**.

The total investment and savings potential for these 3000 buildings are shown in the table below.

Table 63 Summary of monetary savings potential – with sensitivity analysis (from pg. 103)

Scen.	Fuel price increase	SPP	Total annual energy and CO_2 savings (VAT incl.)
0	0 %	15,50	2.827.728.117 RSD / 24.035.689 €
1	21 %	13,47	3.254.351.703 RSD / 27.661.989 €
2	39 %	11,98	3.658.990.212 RSD / 31.101.417 €
3	61 %	10,48	4.181.901.716 RSD / 35.546.165 €
4	79 %	9,64	4.546.002.432 RSD / 38.641.021 €
5	179 %	6,75	6.493.393.583 RSD / 55.193.845 €

From the above it can be concluded that future programs for energy reconstruction of public buildings should be focused primarily on the educational institution buildings (primary schools, secondary schools and kindergartens) that are responsible for 50 to 90 % of energy and water costs in the typical LSGs.

Public building energy reconstruction programs would also yield acceptable SPP with the expected increase of energy prices of 61% that is quite realistic for Serbia, and with the expected future introduction of carbon prices in future.

Following support files/documents are available with this report:

PART I

- LSG1_R1_Consumption in buildings_by energy carrier.xlsx
- LSG1_R2_Consumption in buildings_by energy carrier & object type group.xlsx
- LSG1_R3_Consumption in buildings_by energy carrier & object type.xlsx
- LSG1_R4_Consumption in buildings_by object type group & object type_2022.xlsx
- LSG2_R1_Consumption in buildings_by energy carrier.xlsx
- LSG2_R2_Consumption in buildings_by energy carrier & object type group.xlsx
- LSG2_R3_Consumption in buildings_by energy carrier & object type.xlsx
- LSG2_R4_Consumption in buildings_by object type group & object type_2022.xlsx
- LSG3_R1_Consumption in buildings_by energy carrier.xlsx
- LSG3_R2_Consumption in buildings_by energy carrier & object type group.xlsx
- LSG3_R3_Consumption in buildings_by energy carrier & object type.xlsx
- LSG3_R4_Consumption in buildings_by object type group & object type_2022.xlsx
- LSG4_R1_Consumption in buildings_by energy carrier.xlsx
- LSG4_R2_Consumption in buildings_by energy carrier & object type group.xlsx
- LSG4_R3_Consumption in buildings_by energy carrier & object type.xlsx
- LSG4_R4_Consumption in buildings_by object type group & object type_2022.xlsx
- Summary of EMIS data review_consumption in buildings_by energy carrier & LSG_(R1).xlsx
- Sensitivity analysis_Energy price_LSG.xlsx

PART II & III

- EE investments & savings_SPP_NPV +sensitivity analysis_CO2.xlsx