EU PPF
PODRŠKA EU U PRIPREMI PROJEKATA
Perspektiva Srbije za održivi razvoj

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REPUBLIKA SRBIJA
MINISTARSTVO ZA EVROPSKE INTEGRACIJE

MINISTARSTVO FINANSIJA
Sektor za ugovaranje i finansiranje programa
iz sredstava Evropske unije

Projekat finansira
Evropska unija

Energy Sector – Training #17

Energy Efficiency Improvement Infrastructure Projects

Contents

1. **Training objective**
2. Key documents and the procedure for improving EE in the building sector
3. Construction and construction supervision for refurbishment of buildings
4. Management and maintenance after reconstruction
5. Summary

Training objective

After this training:

- You will understand what Energy Audits are, their importance and purpose
- You will know how to determine energy consumption and energy costs in buildings
- You will know what Energy Management System is
- You will understand the building reconstruction procedure, risks and how to prevent/mitigate them

Contents

1. Training objective
2. **Key documents and the procedure for improving EE in the building sector**
3. Construction and construction supervision for refurbishment of buildings
4. Management and maintenance after reconstruction
5. Summary

Key documents and the procedure for EE in the building sector

1. **Energy Audit (EN 16247)**
2. Procedures for estimating (measuring) and verifying energy savings
3. Modelling of energy consumption and costs
4. Energy Efficiency Survey
5. Energy certificates for buildings
6. Energy Management System

Key documents and the procedure for EE in the building sector

Energy Audit

- What are energy audits?
- Why are they done?
- What methodology is applied?
- Who carries out them?
- Typical examples of EE improvement measures in building sector
- The requirements a reconstruction project must meet for funding within PPF6
- Types of works included in PPF6 projects

Key documents and the procedure for EE in the building sector

Energy Audit

What is an Energy Audit?

- Check out, review and analysis of energy flows (energy production, transmission, consumption, losses) in a company, process or building to identify locations with significant losses or low energy efficiency.

Key documents and the procedure for EE in the building sector

Energy Audit

Why are Energy Audits done?

- Plans can be made and measures implemented based on the results of an Energy Audit to reduce energy losses and increase efficiency.

Key documents and the procedure for EE in the building sector

Energy Audit

What methodology is applied?

- Energy audits are done in accordance with European standards EN 16247:
  - Standard I – general requirements, methodology and output parameters
  - Standard II-IV – specific requirements, methodology and output parameters for energy audits of **buildings**, processes and transport
  - Standard V – qualifications and competences of energy auditors

Key documents and the procedure for EE in the building sector

Energy Audit

Who carries out Energy Audits?

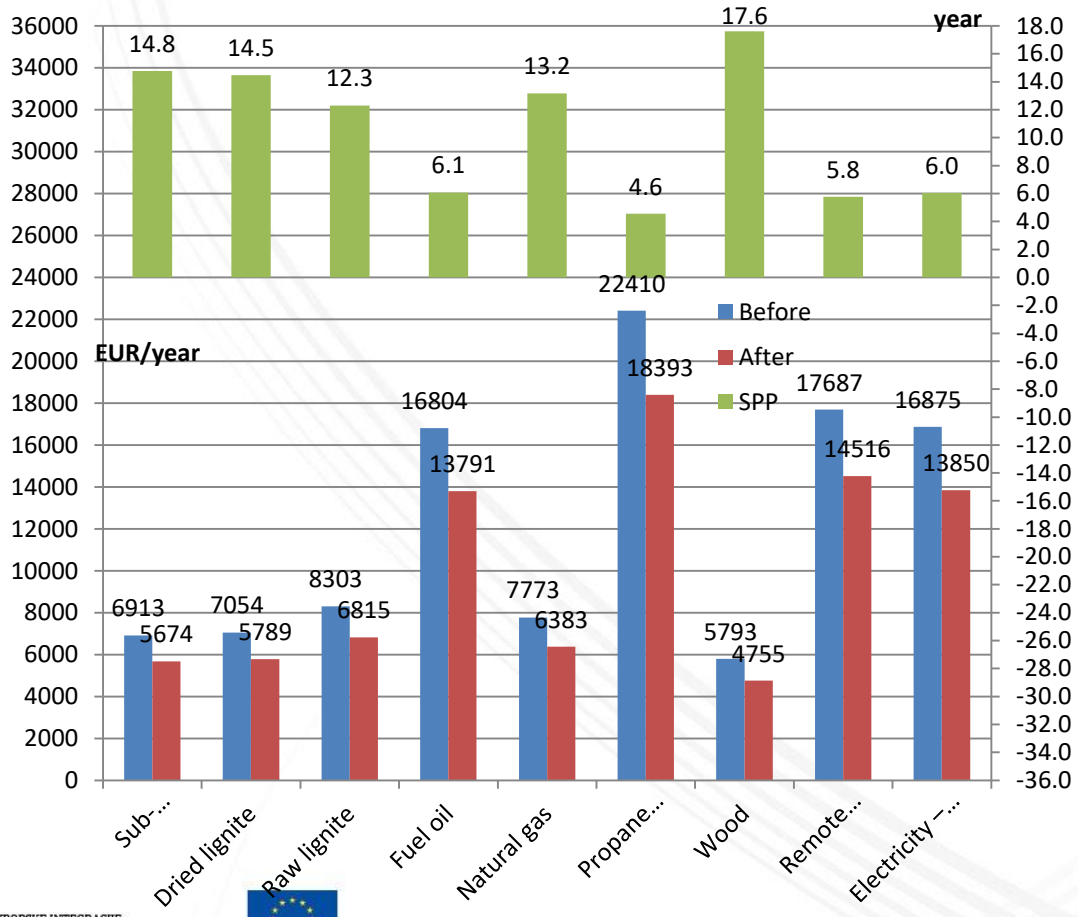
- Energy Audits and reviews are performed by a Certified Energy Advisors:
  - A natural person entered into the Certified Energy Advisors Registry – an engineer responsible for energy efficiency in buildings (license 381)
  - A company entered into the Certified Energy Advisors Registry (for entities subject to Energy Management System)

Energy audits can also be carried out by professionals not included in the Certified Energy Advisors Registry to assess the eligibility of an EE improvement project (replacement of process equipment, trucks, agricultural equipment, construction machinery, equipment and materials...) for funding by international financial institutions through domestic commercial banks or directly.

Key documents and the procedure for EE in the building sector

Energy Audit

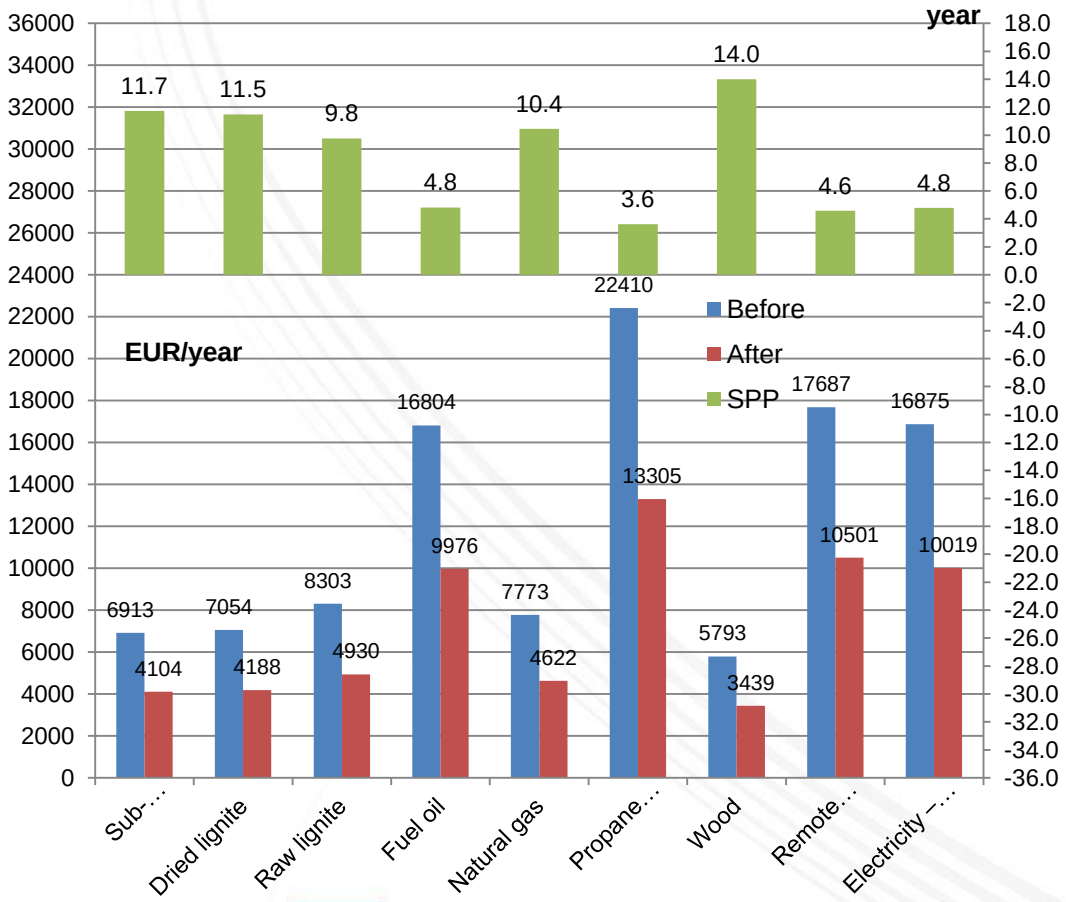
Example 1: Annual cost of heating a **public building with low EE with a heating surface of 1000 m²** before and after **joinery replacement** and the corresponding simple pay back period of investment depending on the type of fuel used for heating



Key documents and the procedure for EE in the building sector

Energy Audit

Example 2: Annual cost of heating a **public building with low EE with a heating surface of 1000 m²** before and after **insulation improvement** and the corresponding simple pay back period of investment depending on the type of fuel used for heating



Key documents and the procedure for EE in the building sector

Energy Audit

Example 3: Replacing **incandescent** light bulbs with **LED** bulbs and profit over the lifetime of the LED bulbs and the corresponding simple pay back period

	Incadescent bulb	LED bulb	unit of measure
The bulb price	0.43	5.00	
The price of electricity	0.09		EUR/kWh
Light efficiency	12	100	lm/W
Installed power	100	13	W
Working hours	1,000	1,000	h/year
Average lifetime	1,000	10,000	h
Annual energy consumption	100	13	kWh/year
Annual cost for electricity	9.00	1.17	EUR/year
Total annual operaitng cost	9.43	1.17	EUR/yeargod
Annual benefit (B)	8.26		EUR/year
Investment cost C	4.57		EUR
Discount rate	10		%
Total discount B during LED bulb lifetime	50.7		EUR
B/C	11.1		
B-C	46.2		EUR
IRR	181		%
SPP	**0.6**		**year**

Key documents and the procedure for EE in the building sector

Energy Audit

- Two tools (typology + CBA) were developed as part of the “Energy Efficiency in Public Buildings” project implemented by GIZ that can be used for the preliminary evaluation of the potential for saving energy for heating, electricity and reduction of CO_2 emissions.

- These tools are used by municipalities to create priority lists of school facilities for future energy rehabilitation.

- The tools are publicly available on the SCTM and Belgrade Faculty of Architecture WEB-based knowledge platforms
  (http://www.skgo.org/strane/291 and http://eeplatforma.arh.bg.ac.rs/)

- *NOTE: The tools were not developed in accordance with the methodology prescribed by the law and relevant by-laws, but they make an ideal tool for conducting preliminary analyses and defining priority lists for projects of public buildings – candidates for reconstruction aimed at EE improvement*

An example of a formed review of school facilities potential for future energy rehabilitation

ПРЕГЛЕД ПОТЕНЦИЈАЛА ЗА УШТЕДУ ЕНЕРГИЈЕ ЗА ГРЕЈАЊЕ И ОСВЕТЉЕЊЕ НА ШКОЛСКИМ ОБЈЕКТИМА ПРИМЕНОМ ПРЕДЛОЖЕНИХ МЕРА УНАПРЕЂЕЊА 1 И 2 У СКЛАДУ СА НАЦИОНАЛНОМ ТИПОЛОГИЈОМ ШКОЛСКИХ ЗГРАДА СРБИЈЕ

	ШКОЛА	ТИП	ПОСТОЈЕЋЕ СТАЊЕ			УНАПРЕЂЕЊЕ 1								УНАПРЕЂЕЊЕ 2							
			ЕНЕРГЕТСКИ РАЗРЕД	Qh,nd [kWh/m²]	ЕМИСИЈА CO_2 [kg]	ЕНЕРГЕТСКИ РАЗРЕД	Qh,nd [kWh/m²]	УШТЕДА ЕНЕРГИЈЕ ЗА ГРЕЈАЊЕ	СМАЊЕЊЕ ЕМИСИЈЕ CO_2	СМАЊЕЊЕ ТРОШКОВА ЗА ГРЕЈАЊЕ [ГОД]	СМАЊЕЊЕ ТРОШКОВА ЗА ОСВЕТЉЕЊЕ [ГОД]	НЕОПХОДНА ИНВЕСТИЦИЈА	ПРОСТ ПЕРИОД ПОВРАТА ИНВЕСТИЦИЈЕ [ГОД]	ЕНЕРГЕТСКИ РАЗРЕД	Qh,nd [kWh/m²]	УШТЕДА ЕНЕРГИЈЕ ЗА ГРЕЈАЊЕ	СМАЊЕЊЕ ЕМИСИЈЕ CO_2	СМАЊЕЊЕ ТРОШКОВА ЗА ГРЕЈАЊЕ [ГОД]	СМАЊЕЊЕ ТРОШКОВА ЗА ОСВЕТЉЕЊЕ [ГОД]	НЕОПХОДНА ИНВЕСТИЦИЈА	ПРОСТ ПЕРИОД ПОВРАТА ИНВЕСТИЦИЈЕ [ГОД]
1	**ОШ Димитрија Туцовића,** Доситејева 5	Ц3	G	183,44	392,09	E	122,00	34%	42%	5,171.00 €	4,158.00 €	150,262.00 €	16	C	74,12	69,01%	93%	5,678.00 €	4,322.00 €	358,861.00	36
2	**Гимназија,** Доситејева 44	Ц1	G	305,70	63,24	F	176,23	42%	51%	1,088.00 €	716.00 €	21,735.00 €	12	E	115,94	62%	96%	1,544.00 €	727.00 €	60,736.00 €	27
3	**ОШ Олга Милутивновић,** Годачица, ЧУкојевац	Б1	G	283,04	12,51	F	175,32	38%	43%	663.00 €	107.00 €	15,413.00 €	20	D	102,47	64%	92%	1,046.00 €	111.00 €	52,135.00 €	45
4	**ОШ Бранка Радичевића,** Витковац	Ц2	G	296,06	120,59	F	176,74	40%	52%	5,144.00 €	2,239.00 €	133,830.00 €	18	D	91,83	69%	72%	8,950.00 €	2,328.00 €	187,050.00 €	17
5	**ОШ Свети Сава,** Змај Јовина	Б3	G	189,42	156,68	E	130,54	31%	43%	15,985.00 €	2,248.00 €	142,876.00 €	8	C	65,72	65%	70%	35,366.00 €	2,336.00 €	334,002.00 €	9
6	ОШ Јован Дучић Рећевићи	Ц3	G	183,44	392,09	E	122,00	34%	42%	5,171.00 €	4,158.00 €	150,262.00 €	16	C	74,12	69,01%	93%	5,678.00 €	4,322.00 €	358,861.00 €	36
7	ОШ Јован Дучић Врдила	Ц2	G	296,06	120,59	F	176,74	40%	52%	5,144.00 €	2,239.00 €	133,830.00 €	18	D	91,83	70,53%	72%	8,950.00 €	2,328.00 €	187,050.00 €	17
8	ОШ Драган МаринковићАдрани	А2	G	240.4	162.252	E	149,89	38%	40,87%	2,769.00 €	762.00 €	53,000.00 €	15	D	95,83	79,44	96,33	4,270.00 €	793.00 €	160,847.00 €	31,8
9	ОШ Олга Милутивновић, Годачица,	Б3	G	189,42	156,682	E	130,54	31%	43%	15,985.00 €	2,248.00 €	142,876.00 €	8	C	65,72	65%	70,44%	35,366.00 €	2,336.00 €	334,002.00 €	8.9
10	ОШ Олга Милутивновић, Годачица, Раваница	А1	G	301,89	75,520	F	154,96	48,67%	48,45%	1,717.00 €	160.00 €	34,579.00 €	18.4	E	117,51	79,92	95,44%	2,083.00 €	179.00 €	81,222.00 €	35.9
11	ОШ Олга Милутивновић, Годачица, Лешево	А1	G	301,89	75,520	E	154,96	48,67%	48,45%	1,717.00 €	160.00 €	34,579.00 €	18.4	E	117,51	79,92	95,44%	2,083.00 €	179.00 €	81,222.00 €	35.9
12	ОШ 4.Краљевачки батаљон Краљево	Ц3	G	183,44	392,09	E	122,00	34%	42%	5,171.00 €	4,158.00 €	150,262.00 €	16	C	74,12	69,01%	93%	5,678.00 €	4,322.00 €	358,861.00 €	36
13	ОШ Доситеј Обрадовић, Врба	Ц3	G	183,44	392,09	E	122,00	34%	42%	5,171.00 €	4,158.00 €	150,262.00 €	16	C	74,12	69,01%	93%	5,678.00 €	4,322.00 €	358,861.00 €	36
14	ОШ Доситеј Обрадовић, Врба,Драгосињци	А1	G	301,89	75,520	F	154,96	48,67%	48,45%	1,717.00 €	160.00 €	34,579.00 €	18.4	E	117,51	79,92	95,44%	2,083.00 €	179.00 €	81,222.00 €	35.9
15	ОШ Доситеј Обрадовић, Врба,Ратина	Б2	F	185,29	65,140	E	120,18	35,14	45,88	7,465.00 €	949.00 €	59,254.00 €	7	C	69,55	66,22	68,66%	14,066.00 €	987,00	119,543.00 €	7.9
16	ОШ Милун Ивановић, Уиће	Б3	G	189,42	156,682	E	130.54	31%	43%	15,985.00 €	2,248.00 €	142,876.00 €	7,8	C	69,55	66,22	68,66%	14,066.00 €	987.00 €	119,543.00 €	7.9
17	ОШ Светозар Марковић, Краљево	Б3	G	189,42	156,682	E	130.54	31%	43%	15,985.00 €	2,248.00 €	142,876.00 €	7,8	C	69,55	66,22	68,66%	14,066.00 €	987.00 €	119,543.00 €	7.9
18	ОШ Милунка Савић, Витановић	Б2	F	185,29	65,140	E	120,18	35,14	45,88	7,465.00 €	949.00 €	59,254.00 €	7	C	69,55	66,22	68,66%	14,066.00 €	987.00 €	119,543.00 €	7.9
19	ОШ Ђура Јакшић, Конарево	Б2	F	185,29	65,140	E	120,18	35,14	45,88	7,465.00 €	949.00 €	59,254.00 €	7	C	69,55	66,22	68,66%	14,066.00 €	987.00 €	119,543.00 €	7.9
20	ОШ Ђура Јакшић, ИО Матаруге	Ц2	G	296,06	120,596	F	176,74	40%	52%	5,144.00 €	2,239.00 €	133,830.00 €	18,2	D	91,83	70,53%	72%	8,950.00 €	2,328.00 €	187,050.00 €	16,6
21	ОШ Ђура Јакшић, ИО Богутовац									0.00 €	0.00 €	0.00 €						0.00 €	0.00 €	0.00 €	
22	ОШ Ђура Јакшић, ИО Лопатница	А1	G	301,89	75,520	F	154,96	48,67%	48,45%	1,717.00 €	160.00 €	34,579.00 €	18.4	E	117,51	79,92	95,44%	2,083.00 €	179.00 €	81,222.00 €	35.90 €
23	ОШ Вук Караџић Краљево	А2	G	240.4	162.252	E	149,89	38%	40,87%	2,769.00 €	762.00 €	53,000.00 €	15	D	95,83	79,44	96,33	4,270.00 €	793.00 €	160,847.00 €	31,8
24	ОШ Вук Караџић Берановац	Ц2	G	296,06	120,596	F	176,74	40%	52%	5,144.00 €	2,239.00 €	133,830.00 €	18,2	D	91,83	70,53%	72%	8,950.00 €	2,328.00 €	187,050.00 €	16,6
25	ОШ Вук Караџић Каменица	Б1	G	283,04	12.515	F	175,32	38%	43%	663.00 €	107.00 €	15,413.00 €	20	D	102,47	64%	92%	1,046.00 €	111.00 €	52,135.00 €	45
26	ОШ Браћа Вилотијевић, Краљево	Ц3	G	183,44	392,09	E	122,00	34%	42%	5,171.00 €	4,158.00 €	150,262.00 €	16	C	74,12	69,01%	93%	5,678.00 €	4,322.00 €	358,861.00 €	8.9
27	ОШ Браћа Вилотијевић, ИО Грдица	А1	G	301,89	75,520	F	154,96	48,67%	48,45%	1,717.00 €	160.00 €	34,579.00 €	18.4	E	117,51	79,92	95,44%	2,083.00 €	179.00 €	81,222.00 €	35,9
28	ОШ Браћа Вилотијевић, ИО Јарчујак	Б2	F	185,29	65,140	E	120,18	35,14	45,88	7,465.00 €	949.00 €	59,254.00 €	7	C	69,55	66,22	68,66%	14,066.00 €	987.00 €	119,543.00 €	16,6
29	ОШ Браћа Вилотијевић, ИО Дракчићи	Б2	F	185,29	65,140	E	120,18	35,14	45,88	7,465.00 €	949.00 €	59,254.00 €	7	C	69,55	66,22	68,66%	14,066.00 €	987.00 €	119,543.00 €	16,6
30	ОШ Јово Курсула Краљево	Б3	G	189,42	156,682	E	130.54	31%	43%	15,985.00 €	2,248.00 €	142,876.00 €	7,8	C	65,72	68,77%	70%	35,366.00 €	2,336.00 €	334,002.00 €	8.9
31	ОШ Живан Маричић Жича	А2	G	242,79	176,609	F	178,25	26,58%	32,71	2,031.00 €	1,191.00 €	62,577.45 €	19,4	D	97,20	68,65%	94,71	2,755.00 €	1,238.00 €	199,760.00 €	50

ПРЕГЛЕД ПОТЕНЦИЈАЛА ЗА УШТЕДУ ЕНЕРГИЈЕ ЗА ГРЕЈАЊЕ И ОСВЕТЉЕЊЕ НА ШКОЛСКИМ ОБЈЕКТИМА ПРИМЕНОМ ПРЕДЛОЖЕНИХ МЕРА УНАПРЕЂЕЊА 1 И 2 У СКЛАДУ СА НАЦИОНАЛНОМ ТИПОЛОГИЈОМ ШКОЛСКИХ ЗГРАДА СРБИЈЕ																					
ШКОЛА		ТИП	ПОСТОЈЕЋЕ СТАЊЕ			УНАПРЕЂЕЊЕ 1								УНАПРЕЂЕЊЕ 2							
			ЕНЕРГЕТСКИ РАЗРЕД	Qh,nd [kWh/m²]	ЕМИСИЈА CO_2 [kg]	ЕНЕРГЕТСКИ РАЗРЕД	Qh,nd [kWh/m²]	УШТЕДА ЕНЕРГИЈЕ ЗА ГРЕЈАЊЕ	СМАЊЕЊЕ ЕМИСИЈЕ CO_2	СМАЊЕЊЕ ТРОШКОВА ЗА ГРЕЈАЊЕ [ГОД]	СМАЊЕЊЕ ТРОШКОВА ЗА ОСВЕТЉЕЊЕ [ГОД]	НЕОПХОДНА ИНВЕСТИЦИЈА	ПРОСТ ПЕРИОД ПОВРАТА ИНВЕСТИЦИЈЕ [ГОД]	ЕНЕРГЕТСКИ РАЗРЕД	Qh,nd [kWh/m²]	УШТЕДА ЕНЕРГИЈЕ ЗА ГРЕЈАЊЕ	СМАЊЕЊЕ ЕМИСИЈЕ CO_2	СМАЊЕЊЕ ТРОШКОВА ЗА ГРЕЈАЊЕ [ГОД]	СМАЊЕЊЕ ТРОШКОВА ЗА ОСВЕТЉЕЊЕ [ГОД]	НЕОПХОДНА ИНВЕСТИЦИЈА	ПРОСТ ПЕРИОД ПОВРАТА ИНВЕСТИЦИЈЕ [ГОД]
32	ОШ Чибуковачки партизани	Б3	G	189,42	156,682	E	130.54	31%	43%	15,985.00 €	2,248.00 €	142,876.00 €	7,8	C	65,72	68,77%	70%	35,366.00 €	2,336.00 €	334,002.00 €	8.9
33	ОШ Бранко Радичевић, Витковац	Б2	F	185,29	65,140	E	120,18	35,14	45,88	7,465.00 €	949.00 €	59,254.00 €	7	C	69,55	66,22	68,66%	14,066.00 €	987.00 €	119,543.00 €	16,6
34	ОШ Бранко Радичевић, Милаковац	А1	G	301,89	75,520	F	154,96	48,67%	48,45%	1,717.00 €	160.00 €	34,579.00 €	18.4	E	117,51	79,92	95,44%	2,083.00 €	179.00 €	81,222.00 €	35,9
35	ОШ Бранко Радичевић, Печеног	А1	G	301,89	75,520	F	154,96	48,67%	48,45%	1,717.00 €	160.00 €	34,579.00 €	18.4	E	117,51	79,92	95,44%	2,083.00 €	179.00 €	81,222.00 €	35,9
36	ОШ Бранко Радичевић, Закута	А1	G	301,89	75,520	F	154,96	48,67%	48,45%	1,717.00 €	160.00 €	34,579.00 €	18.4	E	117,51	79,92	95,44%	2,083.00 €	179.00 €	81,222.00 €	35,9
37	ОШ Петар Николић,Самаила	Ц2	G	296,06	120,596	F	176,74	40%	52%	5,144.00 €	2,239.00 €	133,830.00 €	18,2	D	91,83	70,53%	72%	8,950.00 €	2,328.00 €	187,050.00 €	16,6
38	ОШ Петар Николић,Мрсаћ	А1	G	301,89	75,520	F	154,96	48,67%	48,45%	1,717.00 €	160.00 €	34,579.00 €	18.4	E	117,51	79,92	95,44%	2,083.00 €	179.00 €	81,222.00 €	35.9
39	ОШ Петар Николић,Лазац	Ц2	G	296,06	120,596	F	176,74	40%	52%	5,144.00 €	2,239.00 €	133,830.00 €	18,2	D	91,83	70,53%	72%	8,950.00 €	2,328.00 €	187,050.00 €	16,6
40	ОШ Петар Николић,Буковица	Ц1	G	305,70	63,24	F	176,23	42%	51%	1,088.00 €	716.00 €	21,735.00 €	12	E	115,94	80,44%	96,67%	1,544.00 €	727.00 €	60,736.00 €	26,7
41	ОШ Драган Ђоковић Уча, Лађевци	Ц2	G	296,06	120,596	F	176,74	40%	52%	5,144.00 €	2,239.00 €	133,830.00 €	18,2	D	91,83	70,53%	72%	8,950.00 €	2,328.00 €	187,050.00 €	16,6
42	ОШ Драган Ђоковић Уча, Горњи Лађевци	Б1	G	283,04	12.515	F	175,32	38%	43%	663.00 €	107.00 €	15,413.00 €	20	D	102,47	64%	92%	1,046.00 €	111.00 €	52,135.00 €	45
43	ОШ Драган Ђоковић Уча, Обрва	А1	G	301,89	75,520	F	154,96	48,67%	48,45%	1,717.00 €	160.00 €	34,579.00 €	18.4	E	117,51	79,92	95,44%	2,083.00 €	179.00 €	81,222.00 €	35.9
44	ОШ Драган Ђоковић Уча, Тавник	А1	G	301,89	75,520	F	154,96	48,67%	48,45%	1,717.00 €	1,717.00 €	34,579.00 €	18.4	E	117,51	79,92	95,44%	2,083.00 €	179.00 €	81,222.00 €	35.9
45	ОШ Драган Ђоковић Уча, Цветке	Ц1	G	305,70	63,24	F	176,23	42%	51%	1,088.00 €	716.00 €	21,735.00 €	12	E	115,94	80,44%	96,67%	1,544.00 €	727.00 €	60,736.00 €	26,7
46	ОШ Драган Ђоковић Уча, Милочај	А1	G	301,89	75,520	F	154,96	48,67%	48,45%	1,717.00 €	1,717.00 €	34,579.00 €	18.4	E	117,51	79,92	95,44%	2,083.00 €	179.00 €	81,222.00 €	35.9
47	ОШ Јован Цвијић Сирча	Б2	F	185,29	65,140	E	120,18	35,14	45,88	7,465.00 €	949.00 €	59,254.00 €	7	C	69,55	66,22	68,66%	14,066.00 €	987.00 €	119,543.00 €	16,6

Key documents and the procedure for EE in the building sector

Energy Audit

- The technical documentation related to the Energy Efficiency Survey of public buildings subject to funding under the **PPF6 project** must be elaborated in accordance with the applicable legal regulations, including building energy certification procedure.

- The requirements that must be met by the building are as follows:
  - At least 20% final energy consumption savings calculated according to the methodology provided for in the Rulebook on Energy Efficiency of Buildings (“Official Gazette of RS”, No. 61/2011)*
  - Energy efficiency improvement by at least one class compared to the pre-renovation state, if it is cost-effective
  - Proposals for further energy savings if proven cost-effective based on technical and economic analyses
  - Thermal comfort conditions in winter time should provide at least 20 °C in workrooms
  - Building sustainability in terms of accommodation and working conditions

**Energy efficiency of public buildings with at least 20% final energy savings based on calculations for required energy demand according to the Rulebook on Energy Efficiency of Buildings (“Off. Gazette RS”, No. 61/2011), insofar as this is consistent with cost-effectiveness during lifetimes of measures or because of their special architectural or historical merit as compliance with certain minimum energy performance requirements would unacceptably alter their appearance*

Key documents and the procedure for EE in the building sector

Energy Audit

- **The types of works included in projects within PPF6 are as follows:**
  - Thermal insulation of a building's envelope and roof
  - Replacement of old windows and doors
  - Improvement of the thermal efficiency of a building including the HVAC systems, lighting and management
  - Renovation/rehabilitation of sanitary facilities (toilets, sewer and water pipes)
  - Examination of the building's structural elements and, if needed, under additional scope, structural elements rehabilitation and recovery would be conducted
  - Additional works on thermal insulation (painting, facade restoration, rain gutters, sun protection, roof repair)
  - Additional improvement of comfort in enclosed premises (replacement of leak-damaged floor coverings, interior or exterior window shutters…)
  - Construction of facilities for the disabled (access ramps, restrooms)
  - Installation of surveillance and IT equipment (CCTV cameras, modern TV installations, WiFi Internet connection)
  - Fire protection installations

Key documents and the procedure for EE in the building sector

1. Energy Audit (EN 16247)
2. **Procedures for estimating (measuring) and verifying energy savings**
3. Modelling of energy consumption and costs
4. Energy Efficiency Survey
5. Energy certificates for buildings
6. Energy Management System

Key documents and the procedure for EE in the building sector

Procedures for estimating (measuring) and verifying energy savings

What is provided for by the law and what happens in practice?

- **Practice:**
  - Use od various software (e.g. eSave)
  - Calculations made by technical consultants for specific projects/ EE improvement measures applied (Ex-ante and Ex-post project audit)
  - Use of Typology and CBA tools developed as part of the GIZ project
  - **Drawing up the Energy Audit of Buildings Report and issuing the energy passport**

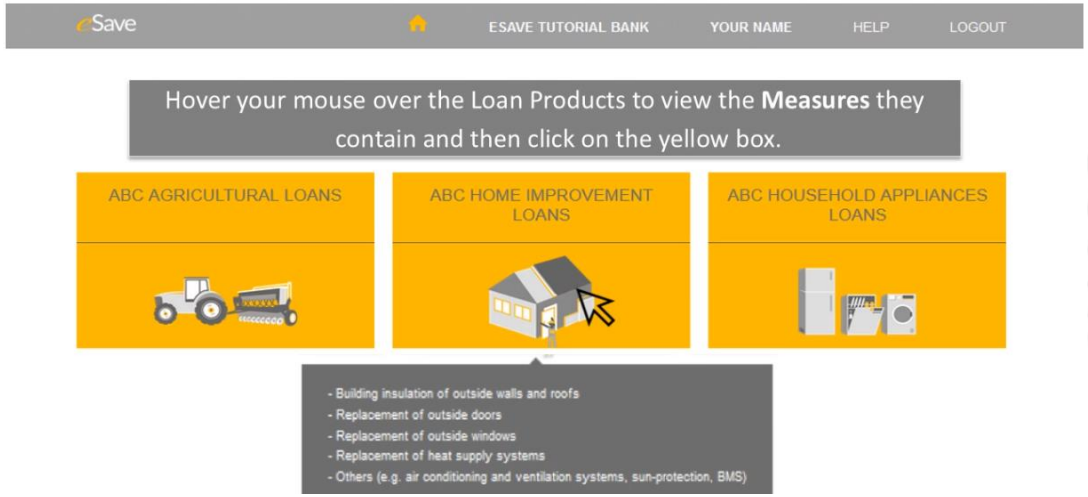
- **The Law:**
  - Energy Audit of Buildings
  - Realization
  - Certification

- **The Rulebook on the Manner and Deadlines for Submitting Data Necessary for Monitoring the Implementation of Serbian National Energy Efficiency Action Plan and Methodology for Monitoring, Validating and Evaluating the Effects of its Implementation ("Official Gazette of RS", No. 37/15)**

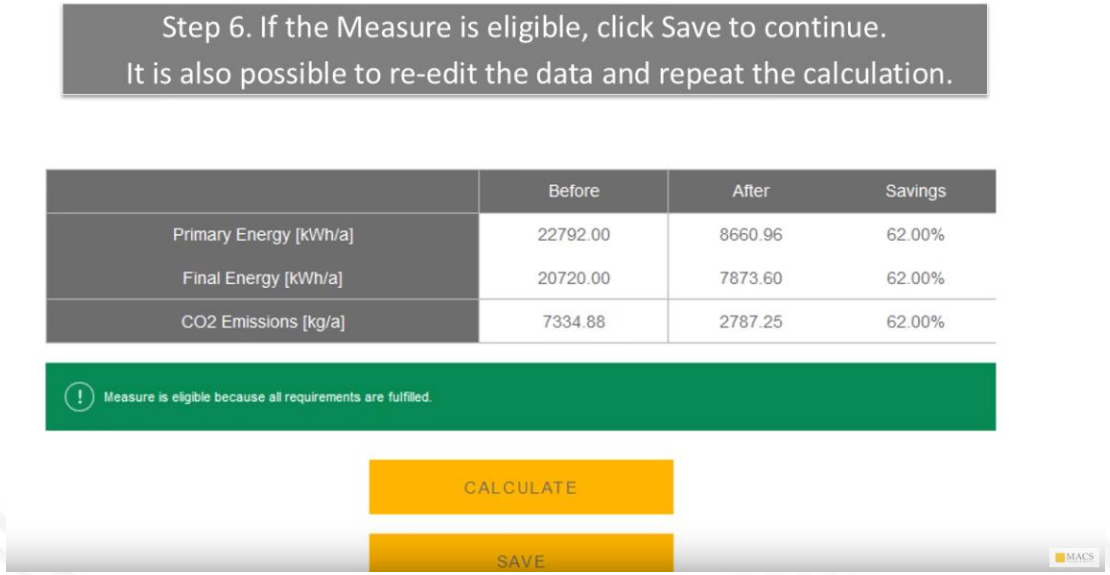
Key documents and the procedure for EE in the building sector

Procedures for estimating (measuring) and verifying energy savings

- **eSave**



...
(steps
1,2,3,4,5)



	Before	After	Savings
Primary Energy [kWh/a]	22792.00	8660.96	62.00%
Final Energy [kWh/a]	20720.00	7873.60	62.00%
CO2 Emissions [kg/a]	7334.88	2787.25	62.00%

Key documents and the procedure for EE in the building sector

Procedures for estimating (measuring) and verifying energy savings

- **An example of the calculation made by a technical consultant for the bank**

Simplified Energy Audit / Pojednostavljena energetska revizija

Measure – EE improvement of the existing production hall / *Mera – Unapređenje EE postojeće proizvodne hale*

Current energy consumption before the implementation of the EE measures *Trenutna potrošnja energije pre primene EE mera*	
Thermal characteristics of the production hall envelope (walls, roof, windows and floor) /*Termičke karakteristike omotača proizvodne hale (zidove, krov, prozore i pod) - U values (W/m²°C)*	0.58, 0.57, 1.59 and 0.53
Energy carrier for heating / Energent za grejanje	Propane butane /*TNG*
Heating system /*Sistem grejanja*	Electric heaters /*Elektro kaloriferi*
Dimensions of the heated space/*Dimenzije prostora koji se zagreva [m]*	120x60x8 m and 53x15x8.8m
Desired temperature in the object / *Željena temperatura u objektu [°C]*	22
Number of days in the year when space is heated /*Broja dana u godini kada se prostor greje [d/y]*	150
Average working hours daily/*Broj radnih sati dnevno [h/d]*	16
Lighting system /*Sistem osvetljenja*	Halogen bulbs /*Halogene sijalice*
Installed capacity of lighting system /*Instalisana snaga sistema osvetljenja (kW)*	*61*
Primary Energy Factor(PEF)/*Faktor konvezije za primarnu energiju (for propane butane)*	1.1
CO_2 emission factor / *Faktor emisije CO_2 [kg,CO_2/kWh] (for propane butane)*	0.227
Primary Energy Factor(PEF)/*Faktor konvezije za primarnu energiju (for electricity)*	2.193
CO_2 emission factor / *Faktor emisije CO_2 [kg,CO_2/kWh] (for electricity)*	0.723
Final energy consumption annually/*Potrošnja finalne energije na godišnjem nivou [kWh/y] (for heating)*	3,288,105
Final energy consumption annually/*Potrošnja finalne energije na godišnjem nivou [kWh/y] (for lighting)*	150,098
Primary energy consumption annually/*Potrošnja primarne energije na godišnjem nivou [kWh/y]*	3,946,080
CO2 emission annually/*Emisija CO2 na godišnjem nivou [kgCO_2/y]*	854,920

Assumed energy consumption after the implementation of the EE measures *Pretpostavljena potrošnja energije posle primene EE mera*	
Thermal characteristics of the production hall envelope (walls, roof, windows and floor) /*Termičke karakteristike omotača proizvodne hale (zidove, krov, prozore i pod) - U values (W/m²°C)*	0.34, 0.31, 1.1 and 0.50
Energy carrier for heating / Energent za grejanje	Natural gas /*Prirodni gas*
Heating system /*Sistem grejanja*	IC heaters /*IC grejači*
Dimensions of the heated space/*Dimenzije prostora koji se zagreva [m]*	120x60x8 m and 53x15x8.8m
Desired temperature in the object / *Željena temperatura u objektu [°C]*	22
Number of days in the year when space is heated /*Broja dana u godini kada se prostor greje [d/y]*	150
Average working hours daily/*Broj radnih sati dnevno [h/d]*	16
Lighting system /*Sistem osvetljenja*	LED bulbs / *LED sijalice*
Installed capacity of lighting system /*Instalisana snaga sistema osvetljenja (kW)*	*25*
Primary Energy Factor(PEF)/*Faktor konvezije za primarnu energiju (for natural gas)*	1.1
CO_2 emission factor / *Faktor emisije CO_2 [kg,CO_2/kWh] (for natural gas)*	0.202
Primary Energy Factor(PEF)/*Faktor konvezije za primarnu energiju (for electricity)*	2.193
CO_2 emission factor / *Faktor emisije CO_2 [kg,CO_2/kWh] (for electricity)*	0.723
Final energy consumption annually/*Potrošnja finalne energije na godišnjem nivou [kWh/y] (for heating)*	2,109,538
Final energy consumption annually/*Potrošnja finalne energije na godišnjem nivou [kWh/y] (for lighting)*	60,855
Primary energy consumption annually/*Potrošnja primarne energije na godišnjem nivou [kWh/y]*	2,453,947
CO2 emission annually/*Emisija CO2 na godišnjem nivou [kgCO_2/y]*	470,125

Impact of the EE measure on energy consumption and CO2 emission *Uticaj EE mere na potrošnju energije i emisije CO2*		
Primary energy savings / *Ušteda izražena u primarnoj energiji*	1,492,133 [kWh/y]	38 [%]
CO2 emission reduction / *Smanjenje emisije CO2*	384,796 kg,CO2/y]	45 [%]

Conclusion
Zaključak

With the primary energy savings of 37.8 % (or 1,492,133 kWh/y) and CO2 emission reduction of 45.0% (or 384,796 kg,CO_2/y) in respect to the current situation, the reconstruction of the production hall (building envelope, windows, heating system and lighting system) can be considered as an EE measure which meets the eligibility criteria of the KFW EcoLoan credit line.

Sa očekivanim uštedama u potrošnji primarne energiji od 37.8 % (odnosno 1,492,133 kWh/god)) i smanjenjem emisije CO_2 za 45.2% (odnosno 384,796 kg,CO_2/god) u odnosu na trenutno stanje, rekonstrukcija proizvodnehale (unapređenje termičkih karakterisitka omotača zgrade, zamena prozora, sistema grejanja i sistema osvetljenja) može se smatrati merom energetske efikasnosti koja je prihvatljiva sa stanovišta kriterijuma KFW EcoLoan kreditne linije.linije.

Energy consultant *Energetski konsultant*	**Nikola Nikolić, Miloš Živojinović**
Date *Datum*	**06.12.2019.**

Annexes
Annex 1 Technical Questionnaire 02
Annex 2 Offers
Annex 3 Bill of quantities
Annex 4 Photos of the existing production hall

Key documents and the procedure for EE in the building sector

Procedures for estimating (measuring) and verifying energy savings

Monitoring, validation and assessment of the effects of Serbian National Energy Efficiency Action Plan implementation

Example 1: Replacement of **lighting systems** in public sector buildings

Vlasnik projekta

Ministarstvo
Opstina

32240 Lucani

Evidencioni broj: 32240
Mesec i godina realizacije: Aug 2013
Redni Broj: 11

Oznaka mere: ОПГЗ

Naziv mere: Замена или побољшање система или уградња новог система осветљења или дела компоненти осветљења у новим или постојећим комерцијалним и зградама јавно-услужног сектора

Јединична годишња уштеда финалне енергије i-те групе замењених светиљки

$$UFES = \frac{(P_{init,i} \times n_{h_init,i} - P_{new,i} \times n_{h_new,i})}{1000}$$ [kWh/(jed×god)]

Годишња уштеда финалне енергије свих група замењених светиљки

$$FES = \sum_{i=1}^{n} \frac{(P_{init,i} \times n_{h_init,i} - P_{new,i} \times n_{h_new,i})}{1000}$$ [kWh/god]

Потребни подаци за процену уштеде:

Општина:	32240 Lucani
Назив финансијера пројекта:	
Назив и адреса објекта:	
Назив и кратак опис пројекта:	
Месец и година завршетка реализације пројек	August/13

Група светиљки

1	*Описати примењену меру ЕЕ - Описати принцип замене*	$P_{init,1}$	[W]	7,000	$UFES_1$= 2,800
		$P_{new,1}$	[W]	4,200	
		$n_{h_init,1}$	[h]	1,000	
		$n_{h_new,1}$	[h]	1,000	
		$P_{pre,1}$	[W]	125	
		$f_{pre,1}$	[-]	0.12	
		$n_{pre,1}$	[-]	50	
		$P_{prosto,1}$	[W]	75	
		$f_{prosto,1}$	[-]	0.12	
		$n_{prosto,1}$	[-]	50	
		$P_{init,2}$	[W]	0	$UFES_2$= 0
		[illegible]	[W]	0	

The questionnaire sent to the Ministry is to be filled in based on the data obtained from the lighting system main design, reconstruction or adaptation. If there is no project documentation, the existing documentation is to be used or the actual situation is to be inspected.

Key documents and the procedure for EE in the building sector

Procedures for estimating (measuring) and verifying energy savings

Monitoring, validation and assessment of the effects of Serbian National Energy Efficiency Action Plan implementation

Example 2: Thermal insulation reconstruction of certain parts of a building's structural envelope

The following is taken into account by correction coefficients a, b and c:

- *Climate zone (a)*
- *The degree of utility of the heating system and the type of energy source (b)*
- *Exploitation limit (c)*

Vlasnik projekta

Ministarstvo
Opstina

32300 Gornji Milanovac

Evidencioni broj | Mesec i godina realizacije | Redni Broj

Oznaka mere: ОПГ4 | 32300 | Jun 2015 | 11

Назив мере: **Реконструкција топлотне изолације одређених делова грађевинског омотача (нпр.: зидови, кровови, таванице, темељи) и/или замена прозора у постојећим стамбеним, комерцијалним и зградама јавно-услужног сектора**

Једначина за процену јединичне годишње уштеде финалне енергије:

$$UFES_i = \frac{(Uvalue_{init,i} - Uvalue_{new,i}) \times HDD \times 24 \times a \times (1/b) \times c}{1000} \quad [kWh/(m^2 \times god)]$$

$$FES_i = UFES_i \times A_i \quad [kWh/god]$$

$$FES = \sum_{i=1}^{K} FES_i \quad [kWh/god]$$

Потребни подаци за процену уштеде:

Општина:	32300 Gornji Milanovac
Назив финансијера пројекта:	
Назив и адреса објекта:	
Назив и кратак опис пројекта:	
Месец и година завршетка реализације пројекта:	June 2015/
Укупна инвестиција за примењену меру ЕЕ (РСД):	
Укупна инвестиција за примењену меру ЕЕ (€):	
Број степен дана (HDD) (табела 4 у Прилогу 3):	lanovac

HDD: Izaberite najbližu raspoloživu opstoinu iz liste, broj stepen dana ce se automatski upisati.

Систем грејања/ Врста горива:

Cvrsto gorivo | Tecno gorivo | Gasovito gorivo | Elektricna energija

Чврсто гориво: Pec | Kotao

Тип објекта: Грејана површина објекта:

1. Болнице и зграде сличне намене: | **2. Стамбене зграде**

3. Административне зграде, тржни центри, школе - две смене са вечерњим коришћењем

са грејањем током викенда | без грејања током викенда

4. Школа – једна смена

Key documents and the procedure for EE in the building sector

Procedures for estimating (measuring) and verifying energy savings

Monitoring, validation and assessment of the effects of Serbian National Energy Efficiency Action Plan implementation

Example 3: Replacement of **heating equipment** in buildings

Vlasnik projekta

○ Ministarstvo
● Opstina

34220 Lapovo

Ознака мере: ОПГ6 | Evidencioni broj: 34220 | Mesec i godina realizacije: Oct 2015 | Редни број: 11

Назив мере: **Замена опреме за грејање у постојећим стамбеним, комерцијалним и зградама јавно-услужног сектора**

Једначина за процену годишње уштеде финалне енергије:

$$UFES = \left(\frac{1}{\eta_{init}} - \frac{1}{\eta_{new}}\right) \cdot SHD \cdot A \quad [kWh/(jed \times god)] \qquad FES = \sum_{i=1}^{k} UFES_i \quad [kWh/go$$

Потребни подаци за процену уштеде:

Општина:	34220 Lapovo		
Назив финансијера пројекта:			
Назив и адреса објекта:			
Назив и кратак опис пројекта:			
Укупна инвестиција за примењену меру ЕЕ (РСД):			
Укупна инвестиција за примењену меру ЕЕ (€):			
Месец и година завршетка реализације пројекта:	October 2015/		
SHD	Специфична годишња потреба енергије за грејање		[kWh/(m²×god)]
A	Корисна грејана површина објекта		[m²]
Врста објекта:		SHD	Energetski razred
1. Стамбене зграде		[kWh/(m²×god)]	D
	1.а) Стамбене зграде са једним станом	171	
	1.б) Стамбене зграде са два или више станова	171	
2 Управне и пословне зграде (административне зграде)		319	
3 Зграде намењене образовању			
	3. а) школе	192	
	3. б) вртићи	198	
4. Зграде намењене здравству и социјалној заштити (Болнице)		250	
5. Зграде намењене туризму и угоститељству		245	
6. Зграде намењене спорту и рекреацији (СРЦ)		378	
7. Зграде намењене трговини и услужним делатностима		195	
Степен корисности система грејања η			Постојеће стање пре / Стање после примене мера

SHD – specific yearly heating energy demand
A – usable heated area of the facility

Key documents and the procedure for EE in the building sector

1. Energy Audit (EN 16247)
2. Procedures for estimating (measuring) and verifying energy savings
3. **Modelling of energy consumption and costs**
4. **Energy Efficiency Survey**
5. Energy certificates for buildings
6. Energy Management System

Key documents and the procedure for EE in the building sector

Modelling of energy consumption and costs / Energy Efficiency Survey

Energy consumption is modelled on the methodology provided in the **Rulebook on Energy Efficiency of Buildings ("Official Gazette of RS", No. 61/2011)**

- This Rulebook **prescribes in more detail the energy properties and the method for calculating the thermal properties of high-rise facilities**, as well as energy requirements for new and existing facilities
- This Rulebook applies to the construction of new buildings and the reconstruction, upgrading, renovation, adaptation, rehabilitation, and **energy rehabilitation of the existing buildings**
- **Energy Efficiency Survey** is a study containing calculations, text and drawings in accordance with the regulation governing the energy properties of buildings and forms an integral part of the technical documentation submitted together with the construction permit application or the application for a decision approving renovation works or facility remediation, as well as **energy rehabilitation**

Key documents and the procedure for EE in the building sector

Modelling of energy consumption and costs / Energy Efficiency Survey

Energy properties of a building are calculated for the following categories:

1. Energy required annually for heating;
2. Energy required annually for cooling;
3. Energy required annually for ventilation;
4. Energy required annually for the preparation of sanitary hot water;
5. Energy required annually for lighting;
6. Annual technical system losses;
7. Energy delivered annually;
8. Primary energy required annually;
9. Annual CO_2 emission.

Key documents and the procedure for EE in the building sector

Modelling of energy consumption and costs / Energy Efficiency Survey

Energy Efficiency Survey is done based on the following data:

1. Location climate characteristics, i.e.
   - External design temperatures in towns across the Republic of Serbia;
   - Number of degree days and mean temperature of the heating period for towns in the Republic of Serbia and
   - Mean monthly sum of radiation and mean monthly temperatures;
2. Location data, i.e. situation plan of the building containing the location of nearby facilities, showing the types of surface treatment;
3. The data on construction materials, elements and systems necessary for calculations defined by this Rulebook;
4. Data on mechanical and electrical equipment, devices and installations.

Key documents and the procedure for EE in the building sector

Modelling of energy consumption and costs / Energy Efficiency Survey

Table 6.5 – Heat gain from people and electrical appliances (SRPS EN ISO 13790):

Building type	1	2	3	4	5	6	7	8	9 Other buildings				Unit
Input data	One-apartment residential building	Multiple-apartment residential building	Office building	Educational buildings	Hospitals	Restaurants	Shopping centers	Sports centers	Meeting and presentation halls	Industrial buildings	Warehouses	Indoor pools	
Scheduled indoor temperature for winter	20	20	20	20	22	20	20	18	20	18	18	28	°C
Scheduled indoor temperature for summer	26	26	26	26	26	26	26	26	26	26	26	28	°C
Surface area per person (occupancy)	60	40	20	10	30	5	10	20	5	20	100	20	m^2/per
Heat output per person	70	70	80	70	80	100	90	100	80	100	100	60	W/per
Human heat output per surface unit	1.2	1.8	4.0	7.0	2.7	20	9.0	5.0	16	5.0	1.0	3.0	W/m^2
Daily presence (monthly average)	12	12	6	4	16	3	4	6	3	6	6	4	h
Annual electricity consumption per surface unit of heated space	20	30	20	10	30	30	30	10	20	20	6	60	kWh/m^2
Fresh air flow rate per surface unit of heated space	0.7	0.7	0.7	0.7	1.0	1.2	0.7	0.7	1.0	0.7	0.3	0.7	m^3/(h•m^2)
Fresh air flow rate per person (air portion per person)	42	28	14	7	30	6	7	14	5	14	30	14	m^3/(h•per)
Heat required to prepare SHW per surface unit of heated space	10	20	10	10	30	60	10	80	10	10	1.4	80	kWh/m^2

Key documents and the procedure for EE in the building sector

Modelling of energy consumption and costs / Energy Efficiency Survey

The total annual energy delivered is calculated as the sum of the energy required for heating and preparation of sanitary hot water, for cooling, for ventilation and air-conditioning, for lighting, and for the operation of auxiliary systems:

$$E_{del} = Q_H + Q_c + Q_{ve} + E_l + Q_{aux} \text{ [kWh/a]}$$

Key documents and the procedure for EE in the building sector

Modelling of energy consumption and costs / Energy Efficiency Survey

Table 6.12 – Conversion factors used to calculate the annual primary energy for certain types of heat source

ENERGY SOURCE	CONVERSION FACTOR*
Fuel oil	1.2
Gas	1.1
Coal	1.3
Wood biomass	0.1
Electricity	2.5
Remote heating using fossil fuels	1.8
Remote cogeneration heating	1.0

*The annual primary energy for the operation of a building is determined by multiplying the annual energy input for the building system operation with the conversion factor specified in table 6.12.

Table 6.13 – Specific CO_2 emissions for certain types of energy sources

Energy source	Per fuel unit	Per energy unit
Natural gas	1.9 kg/m^3	0.20 kg/kWh
Liquid petroleum gas	2.9 kg/kg	0.215 kg/kWh
Extra light fuel oil	2.6 kg/l	0.265 kg/kWh
Light fuel oil	3.2 kg/kg	0.28 kg/kWh
Remote heat	0.33 kg/kWh	0.33 kg/kWh**
Electricity	0.53 kg/kWh	0.53 kg/kWh
Brown coal (local)	1.5 kg/kg	0.32 kg/kWh
Brown coal (foreign)	1.88 kg/kg	0.40 kg/kWh
Lignite (local)	1.0 kg/kg	0.33 kg/kWh

**Note: The data is used when the energy source supplier fails to indicate emissions for its energy source, or energy

CO_2 emission for Belgrade power plants *according to the average annual consumption of energy sources (gas, mazut, coal, biomass, fuel oil and electricity) is 0.27 kg/kWh and 0.29 kg/kWh respectively, depending on whether the heat transfer point is a substation or an apartment.*

Key documents and the procedure for EE in the building sector

Modelling of energy consumption and costs / Energy Efficiency Survey

EE Survey contains:

1. The data based on which it was produced;
2. The technical description of technical measures and solutions applied to the project and aligned with the Rulebook, namely: (1) functional and geometric characteristics of the building, (2) the materials used, (3) systems installed, (4) types of energy sources used for heating, cooling and ventilation, (5) thermal and technical installations, (6) lighting systems, (7) the use and participation of renewable energy sources;
3. Estimates confirming that the designed construction elements and the building, or part of the building as a whole, together with the accompanying technical systems, meet the requirements of the Rulebook;
4. The annual consumption of energy necessary for the operation of technical systems in the building (final energy);
5. The annual value of total primary energy use;
6. CO_2 emissions value

Key documents and the procedure for EE in the building sector

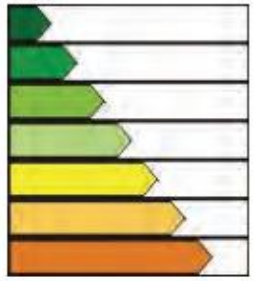
Modelling of energy consumption and costs / Energy Efficiency Survey

EE Survey sample (last page)

BILANS

TRANSMISIONI GUBICI	Qt= 70579.10 kWh
VENTILACIONI GUBICI	Qv = 28120.97 kWh
SOLARNI DOBICI	Qsol = 22561.1 kWh
DOBICI OD LJUDI	Qlj = 3995.6112 kWh
DOBICI OD EL.UREDJAJA	Qel = 15204.0 kWh
ENERGIJA POTREBNA ZA GREJANJE (razlika izmedju gubitaka i dobitaka)	Qh = 56939.41 kWh
Energija potrebna za grejanje po m2	Qh/A = 55.71 kWh/m2

Na osnovu energije potrebne za grejanje po m2, objekat spada u C energetski razred



en razred	Qh rel [%]	Qh [kWh/m2]
A+	<=15	<=9
A	<=25	<=15
B	<=50	<=30
C	**<=100**	**<=60**
D	<=150	<=90
E	<=200	<=120
F	<=250	<=150

Key documents and the procedure for EE in the building sector

Modelling of energy consumption and costs / Energy Efficiency Survey

An example of how to determine the cost of heating for a 1000 m^2 public facility with good thermal insulation characteristics (257 GJ/year – the required annual amount of thermal energy)

Energy source	Price	u.m.	Therm. power	u.m.	η	Annual quant.	u.m.	Annual cost (RSD)
Banovići coal	14,000	din/t	18.2	GJ/t	0.65	21.7	t	304,431
Vreoci coal, dried	13,500	din/t	17.2	GJ/t	0.65	23.0	t	310,625
Raw coal, lignite	8,500	din/t	9.2	GJ/t	0.65	43.0	t	365,648
Fuel oil	71	din/l	41	GJ/t	0.7	9.0	t	739,985
Natural gas	42	din/m^3	0.0333	GJ/m^3	0.95	8,131.6	m^3	343,628
Propane-butane	150,000	din/t	46	GJ/t	0.85	6.6	t	986,869
Wood	4,800	din/m^3	11	GJ/t	0.8	53.1	m^3	255,118
Central heating	10.9	din/kWh	0.0036	GJ/kWh	1	71,456.6	kWh	778,877
El. boiler	10.4	din/kWh	0.0036	GJ/kWh	1	71,456.6	kWh	743.149

2. ОБРАЧУН ЗА ИСПОРУЧЕНУ ЕЛЕКТРИЧНУ ЕНЕРГИЈУ

Р.бр.	Назив	Јед. мере	Испоручена количина	Јединична цена (EUR)	Ср.курс НБС на дан промета(РСД)	Јединична цена (РСД)	Укупно (РСД)
1	2	3	4	5	6	7=5*6	8=4*7
1	Активна електрична енергија у ВТ	kWh	2.877	0,06783	117,5235	7,971619	22.934,35
2	Активна електрична енергија у НТ	kWh	1.078	0,04301	117,5235	5,054686	5.448,95
						Укупно за испоручену електричну енергију:	**28.383,30**

3. ОБРАЧУН ЗА ПРИСТУП СИСТЕМУ ЗА ПРЕНОС/ДИСТРИБУЦИЈУ ЕЛЕКТРИЧНЕ ЕНЕРГИЈЕ Реактивна енергија за cosΦ(0.95) = 1.300

Р.бр.	Назив тарифе	Обрачунска величина	Количина за обрачун	Јединична цена (РСД)	Укупно (РСД)
1	2	3	4	5	6=4*5
1	Одобрена снага	kW	25	148,8440	3.721,10
2	Виша дневна тарифа за активну енергију	kWh	2.877	2,2330	6.424,34
3	Нижа дневна тарифа за активну енергију	kWh	1.078	0,7440	802,03
4	Реактивна енергија	kVArh	388	1,2700	492,76
5	Прекомерна реактивна енергија	kVArh	0	2,5400	0,00
6	Прекомерна снага	kW	0	595,3760	0,00
				Укупно за приступ систему за дистрибуцију електричне енергије:	**11.440,23**

4. ОБРАЧУН НАКНАДА ЗА ПОДСТИЦАЈ ПОВЛАШЋЕНИХ ПРОИЗВОЂАЧА ЕЛ. ЕНЕРГИЈЕ И УНАПРЕЂЕЊЕ ЕНЕРГЕТСКЕ ЕФИКАСНОСТИ

Р.бр.	Назив тарифе	Обрачунска величина	Количина за обрачун	Јединична цена (РСД)	Укупно (РСД)
1	2	3	4	5	6=4*5
1	Накнада за подстицај повлашћених произвођача ел.	kWh	3.955	0,093	367,82
2	Накнада за унапређење енергетске ефикасности	kWh	3.955	0,015	59,33
				Укупно накнаде за подстицај повлашћених произвођача ел. енергије и унапређење енергетске ефикасности:	**427,15**

5. РЕКАПИТУЛАЦИЈА ОБРАЧУНА

1	Испоручена електрична енергија	28.383,30
2	Приступ систему за пренос/дистрибуцију електричне енергије	11.440,23
3	Накнада за подстицај повлашћених произвођача ел.енергије	367,82
4	Накнада за унапређење енергетске ефикасности	59,33
5	Основица за обрачун акцизе (5=1+2+3+4)	40.250,68
6	Износ обрачунате акцизе (стопа 7,5%) (6=5*0.075)	3.018,80
7	Основица за ПДВ (7=5+6)	43.269,48
8	Порез на додату вредност 20% (8=7*0.20)	8.653,90
9	Такса за јавни медијски сервис	0,00
10	Укупно за обрачун (10=7+8+9)	**51.923,38**

Key documents and the procedure for EE in the building sector

1. Energy Audit (EN 16247)
2. Procedures for estimating (measuring) and verifying energy savings
3. Modelling of energy consumption and costs
4. Energy Efficiency Survey
5. **Energy certificates for buildings**
6. Energy Management System

Key documents and the procedure for EE in the building sector

Energy certificates for buildings

Energy certificates for buildings are issued according to the **Rulebook on the Conditions, Content and Manner of Issuance of Certificates of Energy Properties of Buildings** (“Official Gazette of RS”, No. 69/2012 and 44/2018).

- **Energy audit** of a building is a procedure implemented to establish the energy properties of a building and the degree in which those properties comply with the prescribed requirements.
- **Energy class of a building** is an indicator of energy properties of a building, expressed by the relative value of the annual consumption of final energy used for heating [%], and represents the percentage ratio of specific annual thermal requirements for heating QH,nd [kWh/m2a] and the maximum permitted QH,nd,max [kWh/m^2a] for a certain category of buildings. Buildings are classified into eight energy classes according to the energy scale **from “A+” to “G”**, “A+” being the most energy-friendly class, and “G” the least energy-friendly class.
- **Energy certification of a building** is a set of actions and procedures that include: the energy audit of a building, assessment of items during an energy audit of a building, drawing up an energy audit report and issuing an energy passport, and it is carried out by an authorized organization; new buildings will be issued energy certificates as part of the building’s technical acceptance procedure.
- **Energy passport** is an energy property certificate for a building that contains the calculated values of energy consumption within a certain category of buildings, energy class and recommendations for improving the energy performance of the building, and is issued by an authorized organization.
- All new buildings must have energy passports, as well as the existing buildings undergoing reconstruction, adaptation, remediation or **energy remediation**, with the exception of the buildings that are exempt from mandatory energy certification.

Key documents and the procedure for EE in the building sector

Energy certificates for buildings

Energy audit of a building includes the following:

1. An analysis of architectural and construction characteristics of the building, i.e. the analysis of thermal characteristics of the building's thermal envelope
2. An analysis of energy properties of heating systems
3. An analysis of automatic heating system control in the building
4. The measurements taken to establish the state of energy and/or energy properties, when the data cannot be obtained otherwise

Key documents and the procedure for EE in the building sector

Energy certificates for buildings

An energy audit report of a building is drawn up following an energy audit, and it contains:

1. General data about the building; location data; climate data; data on the conformity of the design of the completed facilities with the main design based on which the building was constructed;
2. Technical description of the applied technical measures and solutions according to the prescribed criteria, namely: the functional and geometric characteristics of the building, the applied building materials, elements and systems, the technical systems installed, types of energy sources for heating, cooling and ventilation, thermal and technical installations and lighting system, the use and participation of renewable energy sources;
3. The annual energy consumption necessary for the operation of technical systems in the building (**final energy**) in accordance with the regulation governing the energy performance of buildings;
4. The annual value of the use of total **primary energy** in accordance with the Rulebook on Energy Efficiency of Buildings;
5. **CO_2 emission** values calculated in accordance with the Rulebook on Energy Efficiency of Buildings;
6. **Proposed measures to improve the energy properties** of a building;
7. The signature of the EE engineer in charge who drafted the report.

Key documents and the procedure for EE in the building sector

Energy certificates for buildings

- The energy passport forms an integral part of the technical documentation submitted together with **the application fora certificate of occupancy.**
- A building will be **issued an energy passport after an energy audit of the building has been completed**, as well as the assessment and final evaluation of compliance with the prescribed requirements for the building's energy properties.
- **The authorized organization that issued the energy passport** delivers a copy of that passport to the ministry in charge of construction affairs within 15 days of the issuance thereof.
- **Until a national software** for calculating the total required energy used in a building **has been adopted**, the energy class of buildings will be calculated and expressed based on the thermal requirements for heating QH,nd [kWh/(m^{2}a)].
-

Key documents and the procedure for EE in the building sector

Energy certificates for buildings

Energy classes for healthcare and social protection buildings

		New	Existing
Energy class	$Q_{H,nd,rel}$ [%]	$Q_{H,nd}$ [kWh/(m2a)]	$Q_{H,nd}$ [kWh/m2a)]
A+	≤ 15	≤ 15	≤ 18
A	≤ 25	≤ 25	≤ 30
B	≤ 50	≤ 50	≤ 60
C	≤ 100	≤ 100	≤ 120
D	≤ 150	≤ 150	≤ 180
E	≤ 200	≤ 200	≤ 240
F	≤ 250	≤ 250	≤ 300
G	> 250	> 250	> 300

Key documents and the procedure for EE in the building sector

Energy certificates for buildings

Energy passports for residential and non-residential buildings have 5 pages, while energy passports for other buildings have 3 pages.
The following are the contents of energy passports for residential and non-residential buildings:

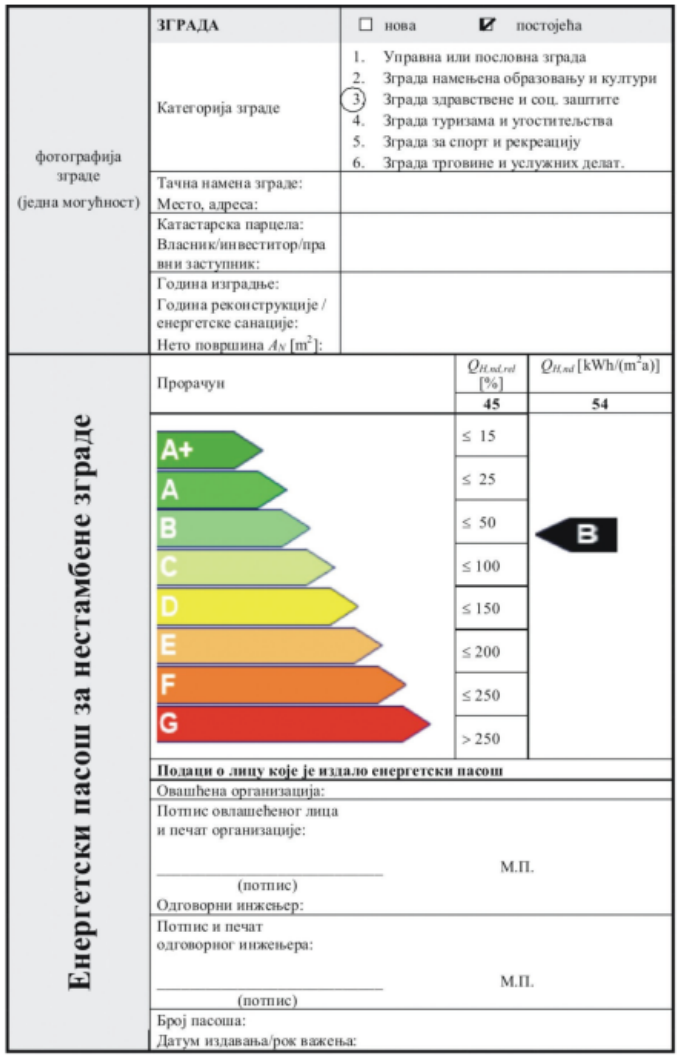
Page 1: general information about the building, energy class, signatures of persons responsible for issuing the energy passport, the number and date when it was issued and the validity period thereof;

Page 2: information about the location and climate, thermal envelope element data, and the data on thermal and technical systems (including the energy sources used);

Page 3: information on modes of use, energy requirements and CO_2 emissions (with the possibility of entering data on the measured energy consumption – for the existing buildings);

Page 4: list of recommendations for improving energy efficiency;

Page 5: list of technical terms and units used.



фотографија зграде (једна могућност)	ЗГРАДА	☐ нова ☑ постојећа
	Категорија зграде	1. Управна или пословна зграда 2. Зграда намењена образовању и култури (3) Зграда здравствене и соц. заштите 4. Зграда туризама и угоститељства 5. Зграда за спорт и рекреацију 6. Зграда трговине и услужних делат.
	Тачна намена зграде: Место, адреса:	
	Катастарска парцела: Власник/инвеститор/правни заступник:	
	Година изградње: Година реконструкције / енергетске санације: Нето површина A_N [m^2]:	

Енергетски пасош за нестамбене зграде

Прорачун	$Q_{H,nd,rel}$ [%]	$Q_{H,nd}$ [kWh/(m^{2}a)]
	45	54
A+	≤ 15	
A	≤ 25	
B	≤ 50	B
C	≤ 100	
D	≤ 150	
E	≤ 200	
F	≤ 250	
G	> 250	

Подаци о лицу које је издало енергетски пасош

Овашћена организација:

Потпис овлашћеног лица и печат организације:

М.П.

(потпис)

Одговорни инжењер:

Потпис и печат одговорног инжењера:

М.П.

(потпис)

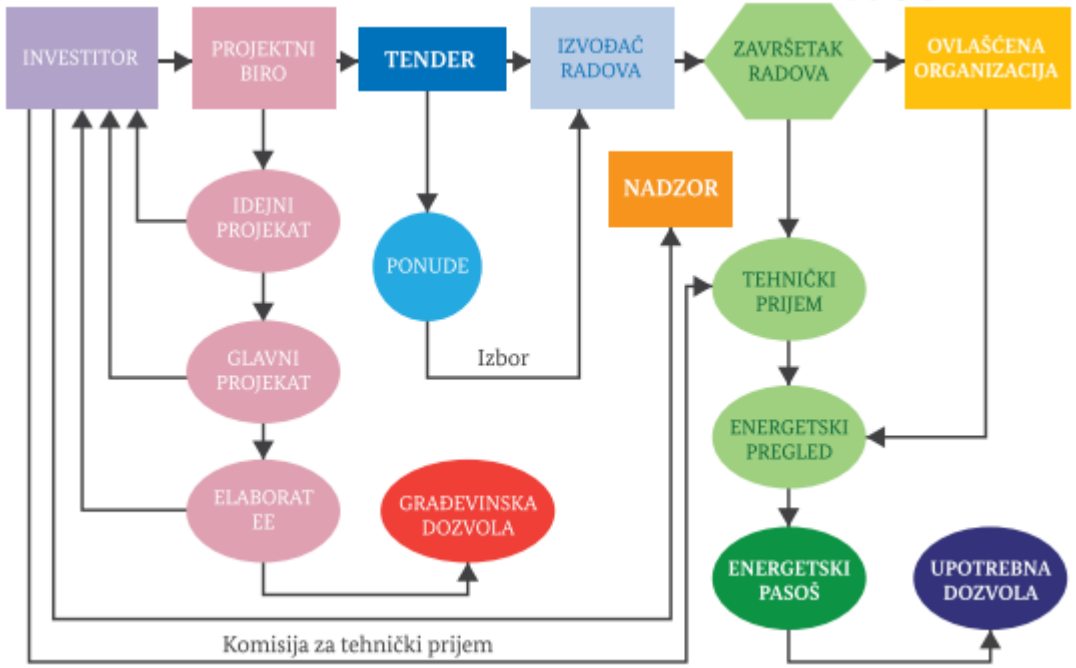
Број пасоша:

Датум издавања/рок важења:

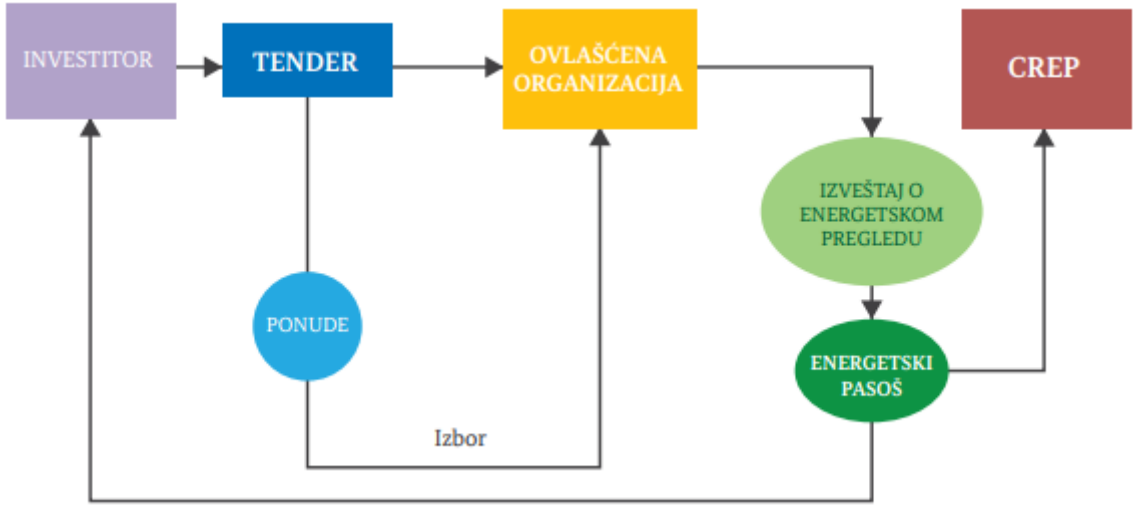
Key documents and the procedure for EE in the building sector

Energy certificates for buildings

Energy certification process for **new** buildings



Energy certification process for the **existing** buildings



Key documents and the procedure for EE in the building sector

1. Energy Audit (EN 16247)
2. Preventing risks in achieving the required energy performance
3. Procedures for estimating (measuring) and verifying energy savings
4. Modelling of energy consumption and costs
5. Energy Efficiency Survey
6. Energy certificates for buildings
7. **Energy Management System**

Key documents and the procedure for EE in the building sector

Energy Management System

SEM introduction is regulated by the Law on Efficient Use of Energy (“Official Gazette of RS”, No. 25/2013)

- **SEM** is an organized system of energy management that allows energy management system subjects to meet their statutory obligations in order to achieve the rational use of energy at the lowest possible cost.
- **SEM subjects**: The Government, Ministry, SEM obligators, energy managers, and certified energy advisors.
- **The Ministry** organizes, implements and monitors system operation and realization of SEM objectives, namely:
  - Collects annual reports from SEM obligators;
  - Maintains a database relevant for the monitoring of SEM implementation;
  - Plans and determines the theoretical and practical training schedule for energy managers and energy advisors, organizes training sessions, exams, issues licenses and keeps registers of licensed energy managers and certified energy advisors; keeps integrated records of statistical data on energy delivered to energy buyers;
  - Performs tasks in the field of energy efficiency funding and manages the Budget Fund for Improving Energy Efficiency;
  - Implements public campaigns and other educational activities to raise awareness of energy efficiency and supports other implementers of such campaigns and activities.

Key documents and the procedure for EE in the building sector

Energy Management System

- **SEM obligators are**:
  - Companies that use more energy than the amount prescribed by the Government,
  - State administration bodies and other bodies in the Republic of Serbia, autonomous province bodies, local government units with more than 20,000 inhabitants and public services using publicly owned facilities
- **SEM obligators are under the obligation to**:
  - Meet the planned energy savings targets prescribed by the Government,
  - Submit their annual reports on energy savings,
  - Appoint the necessary number of energy managers and inform the Ministry of Energy thereof,
  - Enact energy efficiency programs and plans,
  - Implement measures for the efficient use of energy,
  - Submit reports to the Ministry of Energy about meeting targets included in the EE program and plan,
  - Ensure that energy audits are carried out at least once every five years (public sector entities subject to the system at least once every 10 years) and implement other activities and measures in accordance with the law.

Key documents and the procedure for EE in the building sector

Energy Management System

SEM obligators

Category	Sector	
Industry	Industry sector and mining sector	2 500 toe/annually per location
	Sectors of transformation, transmission, distribution of energy (electrical, thermal, refineries)	
Facilities (buildings)	Commercial sector, office buildings, shopping malls and institutions that use publicly owned facilities (schools, hospitals, sports centers etc.)	1 000 toe/annually per location
LG	Any facility the energy costs of which are paid by the LG, as well as facilities used by public services (institutions and companies) established by the LG that do not exceed the marginal consumption	More than 20,000 inhabitants
State administration bodies, other bodies of the Republic of Serbia and the Autonomous Province	Any facility used by the bodies for which they pay energy costs, their individual surface area exceeding 2000 m^2	Public buildings, business premises with surface area exceeding 2000 m^2
Public services using publicly owned facilities	Institutions that consume more than 1000 toe in at least one location and companies that consume more than 2500 toe in at least one location	Institutions: 1000 toe/annually Companies: 2500 toe/annually

Key documents and the procedure for EE in the building sector

Energy Management System

- **Energy manager** is a natural person appointed by a SEM obligator particularly obliged to:
  - Collect and analyze the data on the manner in which the SEM subject uses energy;
  - Prepare EE programs and plans;
  - Propose measures that contribute to the efficient use of energy and take part in the implementation thereof;
  - Ensure that the annual report on meeting the targets contained in the EE program and plan is drawn up;
  - Implement other activities and measures provided for by the law.
- Energy manager's tasks can be performed by a person who is licensed to perform the tasks of an energy manager.
- **A certified energy advisor** carries out energy audits and energy reviews.
- A certified energy advisor is a natural or legal person, included in the registry of certified energy advisors kept by the Ministry.

Key documents and the procedure for EE in the building sector

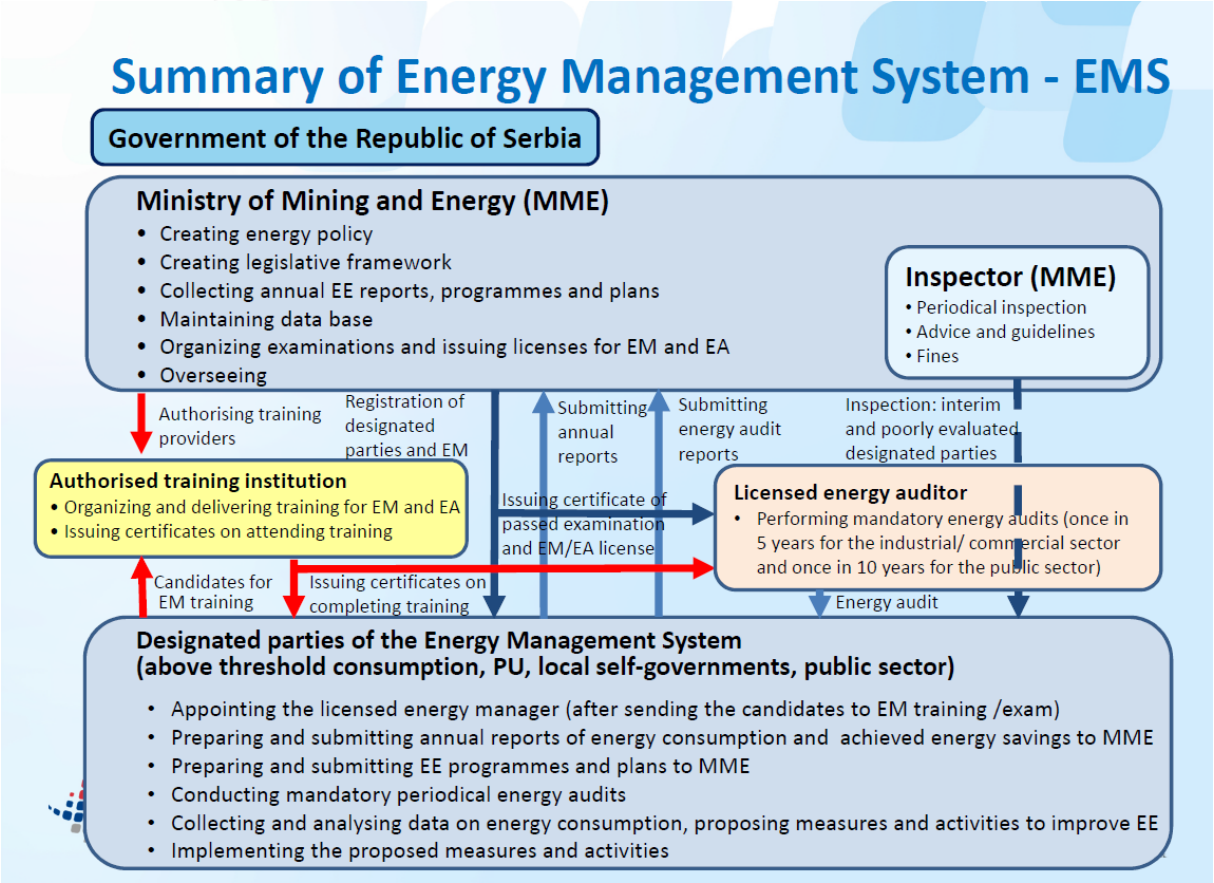
Energy Management System

- An **energy audit** report includes in particular:
  - Energy balance of the facility, production processes and services subject to audit;
  - Assessment of the current levels of energy efficiency of the facility, production processes and services subject to audit;
  - Proposal to increase the existing levels of energy efficiency of the facility, production processes and services subject to audit;
  - Assessment of the achievable energy savings and CO_2 emissions reduction for each proposed measure, as well as an estimate of the total achievable energy savings and the total CO_2 emissions reduction in case of multiple energy efficiency measures applied at the same time, including an economic and financial analysis of such measures;
  - Final expert opinion including the proposed measures for the efficient use of energy that need to be implemented;
  - Other data relevant for the assessment of energy efficiency and the proposal of measures for efficient use of energy.
- The Minister prescribes in more detail the content of the energy audit i.e. energy review report.

Key documents and the procedure for EE in the building sector

Energy Management System

SEM schematic representation

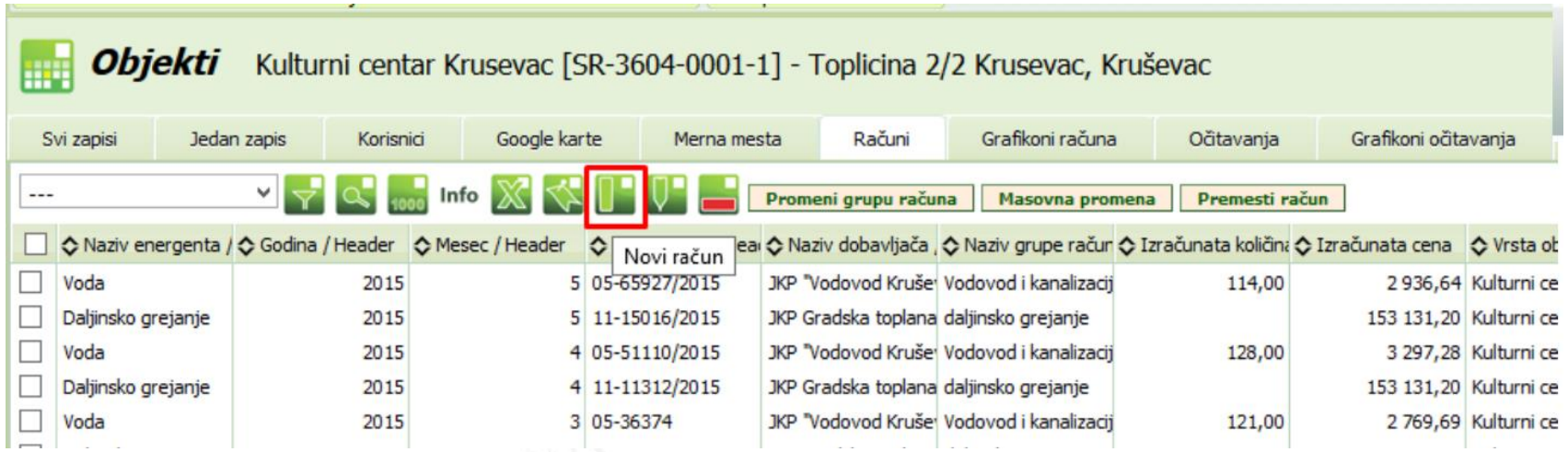


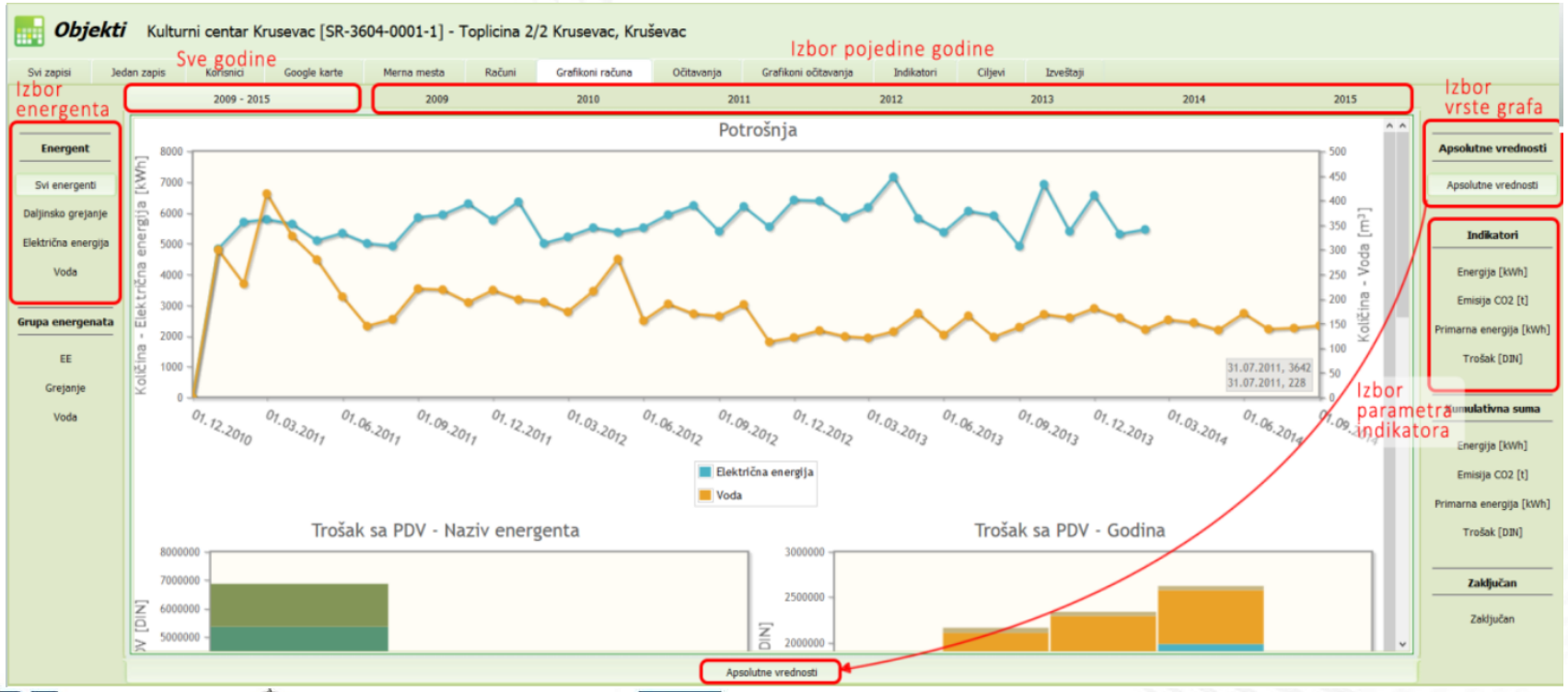
Key documents and the procedure for EE in the building sector

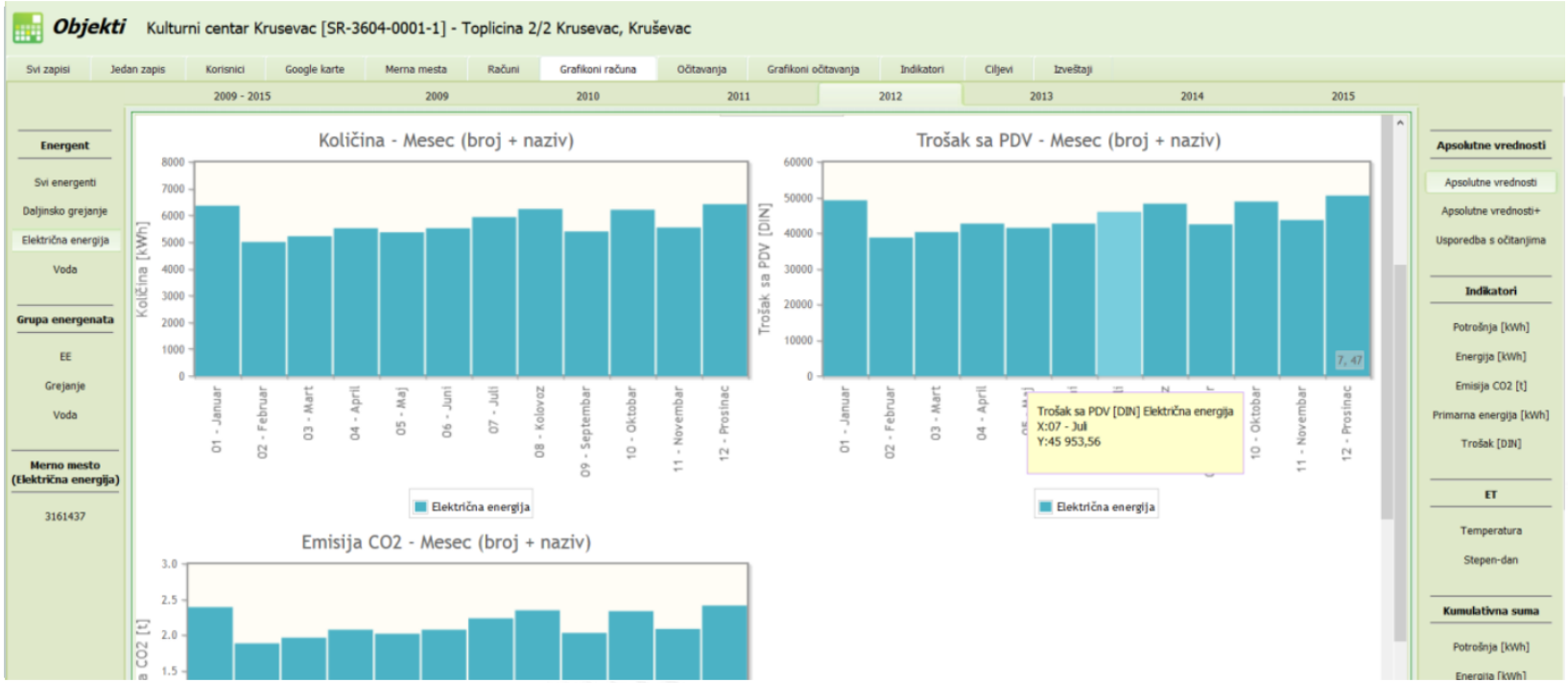
Energy Management System

- **Information System for Energy Management (ISEM)** is a web application i.e. computer software used as a basic tool for energy management system support
- The development and implementation of ISEM was made possible by the UNDP
- ISEM allows:
  - The forming of a registry of facilities whose consumption and costs of energy, energy sources and water are being constantly monitored;
  - Processing and analyzing the collected data;
  - Controlling costs and setting targets for reducing the cost of energy, energy sources and water;
  - Communication between system users and the automatic information and alert system for users;
  - Statistical control over data entry and setting up of alarms for exceeded consumption default values;
  - Simple and easy tracking of EE improvement project implementation results;
- Users of facilities (public buildings, schools, hospitals...) can enter their monthly data on consumption and bills for consumed energy, energy and water in ISEM
- Energy managers control the accuracy of the entered data
- The entered data is available and can be used directly by the Ministry of Energy as well

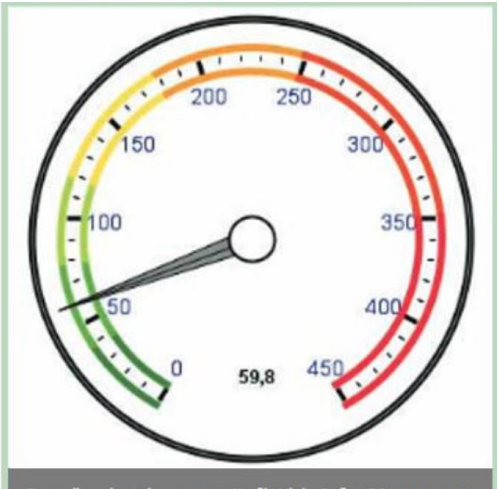
ISEM šifra / Gene	Naziv objekta / General information about the building	Adresa / General	Projekat / Genera	Poštanski broj / C	Naziv opštine / O
SR-3604-0001-1	Kulturni centar Krusevac	Toplicina 2/2 Krusev		37 000	Kruševac
SR-3604-0002-1	ZU Apoteka Krusevac, Zgrda Uprave	Luke Ivanović 34		37 000	Kruševac
SR-3604-0005-1	JP Direkcija za urbanizam i izgradnju Kruševac	Kosančićeva 5, Kruš		37 000	Kruševac
SR-3604-0006-0	Gimnazija Krusevac	Topličina 1; Kruševa		37 000	Kruševac
SR-3604-0006-1	Gimnazija skola Krusevac	Topličina 1; Kruševa		37 000	Kruševac
SR-3604-0006-2	Fiskulturna sala Gimnazija Krusevac	Kosanciceva; Krušev		37 000	Kruševac
SR-3604-0007-1	Narodni muzej Krusevac	Stevana Visokog 15,		37 000	Kruševac
SR-3604-0008-1	Istorijski arhiv Kruševac	Majke Jugovića 6 Kr		37 000	Kruševac
SR-3604-0009-1	Hemijsko tehnološka škola Kruševac	Cirila I Metodija bb,I		37 000	Kruševac


Objekti
Kulturni centar Krusevac [SR-3604-0001-1] - Toplicina 2/2 Krusevac, Kruševac
Svi zapisi
Jedan zapis
Korisnici
Google karte
Merna mesta
Računi
Grafikoni računa
Očitavanja
Grafikoni očitavanja
Info
Promeni grupu računa
Masovna promena
Premesti račun
Novi račun
Naziv energenta
Godina / Header
Mesec / Header
Naziv dobavljača
Naziv grupe račun
Izračunata količina
Izračunata cena
Vrsta ob
Voda 2015 5 05-65927/2015 JKP "Vodovod Kruše Vodovod i kanalizacij 114,00 2 936,64 Kulturni ce
Daljinsko grejanje 2015 5 11-15016/2015 JKP Gradska toplana daljinsko grejanje 153 131,20 Kulturni ce
Voda 2015 4 05-51110/2015 JKP "Vodovod Kruše Vodovod i kanalizacij 128,00 3 297,28 Kulturni ce
Daljinsko grejanje 2015 4 11-11312/2015 JKP Gradska toplana daljinsko grejanje 153 131,20 Kulturni ce
Voda 2015 3 05-36374 JKP "Vodovod Kruše Vodovod i kanalizacij 121,00 2 769,69 Kulturni ce


Objekti
Kulturni centar Krusevac [SR-3604-0001-1] - Toplicina 2/2 Krusevac, Kruševac
Sve godine
Izbor pojedine godine
Izbor energenta
Izbor vrste grafa
Izbor parametra indikatora
2009 - 2015
2009
2010
2011
2012
2013
2014
2015
Energent
Svi energenti
Daljinsko grejanje
Električna energija
Voda
Grupa energenata
EE
Grejanje
Voda
Potrošnja
Količina - Električna energija [kWh]
Količina - Voda [m³]
Električna energija
Voda
Trošak sa PDV - Naziv energenta
Trošak sa PDV - Godina
Apsolutne vrednosti
Indikatori
Energija [kWh]
Emisija CO2 [t]
Primarna energija [kWh]
Trošak [DIN]
Zaključan



Dovedena energija [kWh/m2a] u 2014



Prosečna dovedena energija [kWh/m2a] u 2014 za vrstu objekta Ostalo

Contents

1. Training objective
2. Key documents and the procedure for improving EE in the building sector
3. **Construction and construction supervision for refurbishment of buildings**
4. Management and maintenance after reconstruction
5. Summary

Construction and building reconstruction supervision

1. **The Law on Planning and Construction and other regulations relevant to the construction sector**
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Construction and building reconstruction supervision

The Law on Planning and Construction and other regulations relevant to the construction sector

- **The Law on Planning and Construction**
- **The Law on Efficient Use of Energy**
- The Law on Fire Protection
- The Energy Law
- The Law on State Survey and Cadaster
- The Law on Environmental Impact Assessment
  - The Regulation on Location Conditions
  - The Rulebook on Conducting Integrated Procedures in Electronic Form
  - The Rulebook on Facility Classification
  - The Rulebook on the Content, Method and Manner of Development and Performing Review of the Technical Documentation According to Class and Intended Use of the Facility

Construction and building reconstruction supervision

The Law on Planning and Construction and other regulations relevant to the construction sector

- The Rulebook on the Manner, Procedure and Content of Data for Determining the Fulfillment of the Conditions for Issuing License for Elaboration of Technical Documentation and Construction Licenses for Buildings for Which the Construction Permit is Issued by the Ministry or the Autonomous Province, as well as the Conditions for Revoking Such Licenses
- The Rulebook on Facilities not Subject to Certain Regulations of the Law on Planning and Construction
- The Rulebook on the Format, Content and Location of Construction Site Board
- The Rulebook on the Content and Method of Keeping the Inspection Book, the Construction Logbook and the Construction Book
- The Rulebook on the Content and Manner of Technical Inspection of Facilities, Commission Members, Content of the Commission's Proposal on Establishing the Usability of Facilities, Surveillance of Soil and Facility During Construction and Use, and Minimum Guarantee Periods for Different Types of Facilities
- The Rulebook on Content and Method of Conducting Site Supervision
- The Rulebook on General Rules of Land Lot Allocation, Regulation and Construction
- **The Rulebook on Energy Efficiency of Buildings**
- **The Rulebook on the Conditions, Content and Manner of Issuance of Certificates of Energy Properties of Buildings**

Construction and building reconstruction supervision

INTEGRATED PROCEDURE – A **“**ONE-STOP SYSTEM” FOR CONSTRUCTION INVESTORS

Integrated procedure is the exchange of documents owned by the holders of public authorizations without mediation of investors.

WHAT **IS NOT INCLUDED** IN THE INTEGRATED PROCEDURE?

- Providing information about the location;
- Issuing requirements for the design and connection to electricity distribution or transmission system, as well as to natural gas distribution or transportation system, for certain facilities, in accordance with the law governing energy.

WHAT **IS INCLUDED** IN THE INTEGRATED PROCEDURE?

- Obtaining requirements for design, and/or connection of facilities to infrastructure network;
- Issuing location requirements;
- Issuing construction permits;
- Amending location requirements and construction permits;
- Notice of works;
- Obtaining consent for the main design regarding fire protection measures;
- Notice of completed construction of foundation and facility in structural sense;
- Distributing information and documents (about construction permit, notice of commencement of works, completed construction of foundation etc.);
- Connection to infrastructure network;
- Issuing certificates of occupancy;
- Registering ownership title to the constructed facility.

Construction and building reconstruction supervision

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Construction and building reconstruction supervision

Planning documents

- **General Regulation Plan (GRP)**
  - The basic planning act for exercising rights to construction
  - Sometimes it is unnecessary, and sometimes it is not enough
- **Detailed Regulation Plan (PDR)**
- **Urban Planning Project (UP)**
- The Rulebook on General Rules of Land Lot Allocation, Regulation and Construction (PPR)
  Note: Not a planning document

Construction and building reconstruction supervision

Planning documents

- **There is a PGR**
- a) The adoption of a PDR or UP is not provided for by the PRG for the lot in question: location requirements will be issued based on PGR.
- b) The PGR provides for the adoption of a PDR for the lot in question and does not provide for a construction ban in the area:
  - a. The PGR contains a regulatory line (regulation) for the lot in question: location requirements will be issued based on the PGR and PPR;
  - b. The PGR does not contain a regulatory line (regulations) for the lot in question: no location requirements can be issued.
- c) The PGR provides for the adoption of a PDR for the lot in question and provides for a construction ban in the area:
  - a. The PDR has been adopted and does not provide for further elaboration in UP: location requirements will be issued based on the PDR;
  - b. The PDR has been adopted and it provides for further elaboration in UP: location requirements can be issued once UP has been confirmed;
  - c. The PDR has not been adopted:
    - i. If less than 12 months have passed since the decision to develop the PDR was made: no location requirements can be issued.
    - ii. If more than 12 months have passed since the decision to develop the PDR was made:
      - 1 If the PGR contains a regulatory line: location requirements will be issued based on the PPR and PGR;
      - 2 If the existing planning document does not contain a regulatory line: location requirements cannot be issued.
- d) The PGR for the lot in question provides for a mandatory UP: location requirements can be issued once the UP has been confirmed

Construction and building reconstruction supervision

Planning documents

- **There is no PGR**
  - **a.** If the adoption of an urban plan is not provided for in the area containing the given lot: location requirements will be issued based on the spatial plan (for special purpose areas or local government units), or landscaping layout for villages, if the given lot is located in an area for which a landscaping layout has been elaborated. Exceptionally, until a village landscaping layout has been adopted, location requirements can be issued based on general rules of landscaping and construction in accordance with the PPR for facilities that, according to their purpose, size and capacity, do not alter the purpose and appearance of the area and that do not have a negative impact on the surrounding area (especially for the construction of new facilities in the immediate vicinity of existing or demolished facilities and the reconstruction of existing facilities or construction of new ones on the same cadastral lot);
  - **b.** If the adoption of an urban plan is provided for by the spatial plan for the area containing the given lot, but no decision has been made on the development thereof, the location requirements will be issued based on the PPR and the spatial plan, if it contains a regulatory line (regulation).
  - **c.** No location requirements can be issued if the adoption of an urban plan is provided for by the spatial plan for the area containing the given lot, and a decision was made less than 12 months ago to develop such plan banning construction in the area.
  - **d.** If the adoption of an urban plan is provided for by the spatial plan for the area containing the given lot, and a decision has been made on the development thereof more than 12 months ago, the location requirements will be issued based on the PPR and the spatial plan, if it contains a regulatory line (regulation). If the spatial plan contains no regulatory line (regulation) for the lot in question: location requirements cannot be issued.

Construction and building reconstruction supervision

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VRSTE TEHNIČKE DOKUMENTACIJE

GP

- za potrebe izrade prethodne studije opravdanosti (član. 113. ZPI) - podleže reviziji (stručnoj kontroli) projekta (član 131. ZPI)

GENERALNI PROJEKAT ima za cilj sagledavanje resursnih i prostornih mogućnosti i ograničenja izgradnje objekata, sa zadatkom da se kroz postupke vrednovanja usvoji generalna koncepcija, makrolokacija i prostorna dispozicija objekta, utvrde osnovne funkcionalne, tehnološke i tehničke karakteristike objekta, etapnost gradnje, uslovi eksploatacije, odnos prema prostoru i životnoj sredini, kao i osnove za ekonomsku analizu. U slučaju da je u toku izrade generalnog projekta analizirano više varijantnih rešenja, vrši se izbor optimalne varijante na osnovu prirodnih, tehničkih, tehnoloških, ekonomskih, funkcionalnih, ekoloških i drugih uslova.

IDR

- za potrebe pribavljanja lokacijskih uslova (član 53a. ZPI)
- kao deo urbanističkog projekta za potrebe urbanističko-arhitektonske razrade lokacije (član 117a. ZPI)

IDEJNO REŠENJE je prikaz planirane koncepcije objekta, sa prikazom i navođenjem svih podataka neophodnih za utvrđivanje lokacijskih uslova.

IDP

- za potrebe izrade studije opravdanosti (član 114. ZPI) - podleže reviziji (stručnoj kontroli) projekta (član 131. ZPI)
- za potrebe pribavljanja Rešenja o odobrenju za izvođenje radova (član 145. ZPI)

IDEJNI PROJEKAT je skup međusobno usaglašenih projekata kojima se određuju: namena, položaj, oblik, kapacitet, tehničko-tehnološke i funkcionalne karakteristike i izgled objekta i okvirno dokazuje ispunjenost osnovnih zahteva za objekat.

PGD

- za potrebe pribavljanja građevinske dozvole (član 118a. ZPI)

PROJEKAT ZA GRAĐEVINSKU DOZVOLU je skup međusobno usaglašenih projekata kojim se definišu položaj i kapacitet objekta na lokaciji, funkcionalnost sa stanovišta tehnoloških i drugih zahteva, prostorno oblikovanje, izbor konstrukcijskog sistema, dimenzionisanje glavnih elemenata konstrukcije, načelni izbor građevinskih materijala, instalacija i opreme, čime se obezbeđuje ispunjenost lokacijskih uslova i osnovnih zahteva za objekat i dr.

PZI

- za potrebe građenja objekta i izvođenja radova

PROJEKAT ZA IZVOĐENJE je skup međusobno usaglašenih projekata neophodnih za izvođenje građevinskih, zanatskih, instalaterskih radova i drugih radova, kojim se utvrđuju građevinsko-tehničke, tehnološke i eksploatacione karakteristike objekta sa opremom i instalacijama, tehničko-tehnološka i organizaciona rešenja za izgradnju objekta, investiciona vrednost objekta, kao i uslovi održavanja objekta.
Projektom za izvođenje se razrađuju detalji i tehnološka rešenja koji su određeni projektom za građevinsku dozvolu, kao i idejnim projektom za rekonstrukciju objekta.
Izrada PZI je obavezna za građenje objekata za koje je pribavljena građevinska dozvola i za izvođenje radova na rekonstrukciji, koji se vrše na osnovu rešenja kojim se odobrava izvođenje tih radova. (član 145. ZPI), osim za objekte kategorije "A", kao i u slučajevima za koje je predviđeno pribavljanje saglasnosti na PZI u skladu sa propisima koji uređuju zaštitu od požara.

PIO

- za potrebe pribavljanja upotrebne dozvole, korišćenja i održavanja objekta

PROJEKAT IZVEDENOG OBJEKTA predstavlja skup međusobno usaglašenih projekata sa prikazom svih detalja izgrađenog objekta neophodnih za utvrđivanje njegove podobnosti za upotrebu.

Construction and building reconstruction supervision

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UTVRĐIVANJE USLOVA ZA GRAĐENJE I IZVOĐENJE RADOVA

A. Informacija o lokaciji
B. Idejno rešenje
C. Lokacijski uslovi

PRIBAVLJANJE AKTA KOJIM SE ODOBRAVA GRAĐENJE ILI IZVOĐENJE RADOVA

I Pribavljanje građevinske dozvole

A. Generalni projekat i prethodna studija opravdanosti
B. Idejni projekat i studija opravdanosti
C. Projekat za građevinsku dozvolu
D. Tehnička kontrola projekta za građevinsku dozvolu
E. Izvod iz projekta za građevinsku dozvolu
F. Imovinsko-pravni odnosi i ostvarivanje prava na izgradnju
G. Građenje na neopremljenim lokacijama: šta ako na parceli nedostaje određena infrastruktura
H. Doprinos za uređivanje građevinskog zemljišta
I. Građevinska dozvola
J. Izmena građevinske dozvole i rešenja o odobrenju

II Pribavljanje rešenja o odobrenju izvođenja radova

A. Idejni projekat za radove koji se vrše na osnovu rešenja o odobrenju
B. Rešenje o odobrenju izvođenja radova

III Posebni slučajevi

A. Objekti i radovi koji se mogu izvoditi bez akta
B. Postavljanje i uklanjanje montažnih privremenih objekata
C. Izgradnja na osnovu privremene građevinske dozvole
D. Uklanjanje objekata

IZVOĐENJE RADOVA

A. Projekat za izvođenje
B. Pribavljanje saglasnosti
C. Prijava radova
D. Izvođenje radova
E. Stručni nadzor

ZAVRŠNI KORACI

A. Priključenje objekta
B. Projekat izvedenog objekta
C. Tehnički pregled
D. Upotrebna dozvola i upis prava svojine

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Construction and building reconstruction supervision

Construction works and supervision

- Design for construction (PZI)
  - It is mandatory for the construction of facilities for which a construction permit has been obtained and for works on the reconstruction of facilities for which a decision on building approval has been obtained, except for category “A” facilities, as well as in instances where approval for main design is provided for in accordance with the regulations governing fire protection.
  - PZI is elaborated based on a construction permit project, or preliminary design for facility reconstruction, as well as regulations in the relevant fields and rules of the profession.

- After the construction permit has been obtained, only the following approvals will be necessary*:
  - Before the notice of commencement of works – approval of the Environmental Impact Assessment study, if the regulation governing environmental impact assessment provides for its elaboration, or the decision that such study is not necessary if its elaboration is not provided for.
  - Until the certificate of occupancy is obtained, or until the technical inspection of the facility – approval of the main design with regard to fire protection measures, if such obligation is provided for by the law governing fire protection.

**Obtaining approval regarding cultural property protection measures is not mandatory, but if cultural property protection measures are envisaged for the facility in accordance with the law governing the protection of immovable cultural property, the investor is to submit the main design to the competent authority no later than before the works begin, in soft copy, which is to be forwarded by the competent authority without delay to the body or organization competent for the protection of immovable cultural property.*

Construction and building reconstruction supervision

Construction works and supervision

- The notice of commencement of works is mandatory for all works for which the following is issued:
  - Construction permit;
  - Decision on building approval;
  - Temporary construction permit.

- Works will be performed based on:
  - Construction permit or decision on building approval, or temporary construction permit, or decision or permit to demolish a facility;
  - Construction permit project, or preliminary design, or facility demolition project;
  - Design for construction – mandatory for facilities constructed based on construction permits and for facility reconstruction works performed based on decisions on building approval, with the exception of category “A”.

- Expert supervision:
  - Expert supervision is provided by the investor.
  - Expert supervision is mandatory as of the beginning of construction, i.e. performance of works, until their completion, for facilities that have been issued a construction permit and for works on reconstruction that have been issued a decision on building approval.

Construction and building reconstruction supervision

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Construction and building reconstruction supervision

Technical control and usage permit

- **Facility connection**
  - The procedure for connecting the facility to utility and other infrastructure is initiated by making an application to the competent authority through CIS (Central Information System for electronic handling as part of the integrated procedure for issuing documents in order to exercise rights to facility construction and occupancy)
- The elaboration of an **as-built design** (PIO) is mandatory:
  - For all facilities constructed based on a previously issued construction permit, with the exception of category “A” facilities, for which a geodetic survey of the as-built state of the facility constructed on the lot may be submitted instead of the as-built design, on a certified cadastral-topographic map;
  - In the event of works performed based on a decision on building approval, if the investor wishes to obtain a certificate of occupancy.
- **Technical control** of the facility is mandatory in all cases when a certificate of occupancy is to be applied:
  - For all facilities constructed based on a previously issued construction permit, with the exception of category “A” facilities;
  - In the event of works performed based on a decision on building approval, if the investor wishes to obtain a certificate of occupancy.
- A **usage permit** needs to be obtained before the facility can be used, namely:
  - For facilities constructed based on a construction permit;
  - At the investor’s request, for facilities that have been issued a decision on building approval.

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Construction and building reconstruction supervision

Registration of ownership title

- **Registration of ownership title**
  - The authority that issued the certificate of occupancy submits the application for registration of ownership title.
  - The competent authority submits the following to the competent cadaster service, ex officio, through CIS, within five work days after the issued usage permit becomes valid:
    - Usage permit;
    - Geodetic Works Survey for the constructed facility and special parts of the facility;
    - Geodetic Works Survey for underground installations.
  - Once the usage permit has been delivered, the cadaster service, ex officio:
    - Makes the decision on house number (if the certificate of occupancy refers to the newly constructed facility) and the decision registering ownership title to the facility, and/or special parts of the facility, within seven days of the delivery of the certificate of occupancy;
    - Delivers to the investor and the competent administrative authority the decisions on house number and registered ownership title without delay;
    - Makes an entry into the cable duct cadaster, within 30 days of the submission of the certificate of occupancy.

Construction and building reconstruction supervision

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Construction and building reconstruction supervision

Preventing risks in achieving the required energy performance

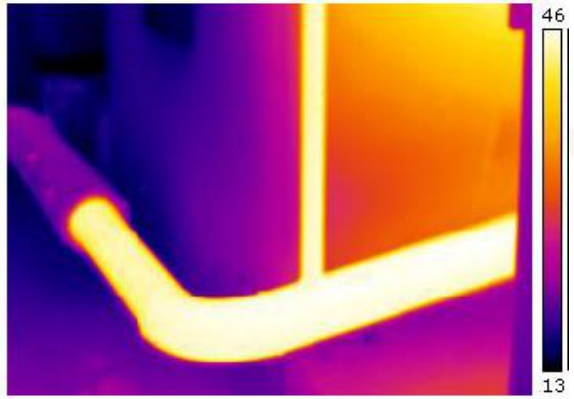
- Most frequent risks (1/2):
  - Significant delay in realization (project preparation, contracting, payments, etc.)
  - Lack of construction companies that can implement projects with a high degree of quality or their unavailability due to earlier commitments
  - Public procurement – rules of public procurement were not followed
  - Change of ownership and users
  - Costs exceeding the planned amounts
  - Incomplete bookkeeping records
  - Costs unrelated to project

Construction and building reconstruction supervision

Preventing risks in achieving the required energy performance

- Most frequent risks (2/2):

- Requirement to inform and communicate not entirely met
- Products/services not delivered/partially delivered/not used
- Objectives/project indicators not met:
  - Inappropriate thermal insulation and construction errors
  - Inappropriate joinery and installation errors
  - Inappropriate equipment and heating system devices
  - Moisture inside the structure
  - ...



Construction and building reconstruction supervision

Preventing risks in achieving the required energy performance

- Measures to prevent/mitigate risks (1/2):
  - Training key stakeholders for project management
  - Training key project users
  - Representatives of key institutions relevant to project implementation (ministries and local governments) and, if necessary, amendments of the laws and by-laws should be included in project management
  - Importance of Ex-ante and Ex-post audits
  - Adequate planning of construction market and other necessary services analyses
  - Longer deadlines for submission of bids
  - Visiting the location before submitting a bid

Construction and building reconstruction supervision

Preventing risks in achieving the required energy performance

- Measures to prevent/mitigate risks (2/2):
  - A more detailed analysis of the current state
  - Contingency cost
  - Implementation consultant
  - Project surveillance must be essential and not formal (constantly verifying if the works comply with project documentation)
  - The key decision in the contractor selection process should preferably be left to the donor in accordance with the internationally recognized procedures to avoid unjustified, but legally permissible appeals and lengthy procedures for resolving them or to make the competent state bodies make urgent decisions on them

Construction and building reconstruction supervision

The following is issued for the reconstruction of facilities for which technical documentation and funding are planned within PPF6:

<u>Construction permit</u>

Or

Building approval?

Construction and building reconstruction supervision

- **Location requirements** are **not** obtained in the following cases:
  - Performing investment maintenance works;
  - Removing obstacles for the disabled;
  - **Works that do not alter the exterior, increase the number of functional units nor the capacity of installations**;
  - Adaptation;
  - **Rehabilitation;**
  - Construction of masonry fences;
  - All other instances of works that do not make connections to the utility infrastructure, that is, works that do not change the capacity and functionality of the existing connections to the infrastructure network, except when the Law or plan document provide for an obligation to obtain the requirements.
- **The preliminary design** for works performed based on a decision on building approval is elaborated based on the previously obtained location requirements (if such works require that they be obtained), **professional rules and regulations, as well as projects or surveys of the existing state.**
- **Technical control of the preliminary design** is carried out solely for construction permit projects and not for works performed based on decisions on building approval.
-

VRSTA OBJEKTA/ RADOVA REŽIM	ČLAN 144. ZPI	ČLAN 145. ZPI	KADA GRAĐEVINSKU DOZVOLU IZDAJE LOKALNA SAMOUPRAVA				KADA GRAĐEVINSKU DOZVOLU IZDAJE MINISTARSTVO ILI AUTONOMNA POKRAJINA
KATEGORIJA	/	/	A	B	V	G	A,B,V,G
Lokacijski uslovi	×	✓[1]	✓	✓	✓	✓	✓
Idejni projekat	×	✓	×	×	×	×	✓
Reviziona komisija	×	×	×	×	×	×	✓
Rešenje o odobrenju	×	✓	×	×	×	×	×
Projekat za građevinsku dozvolu	×	×	✓	✓	✓	✓	✓
Tehnička kontrola	×	×	✓	✓	✓	✓	✓
Doprinos za uređivanje[2]	×	×	✓	✓	✓	✓	✓
Građevinska dozvola	×	×	✓	✓	✓	✓	✓
Prijava radova	×	✓	✓	✓	✓	✓	✓
Projekat za izvođenje	×	obavezno samo kod rekonstrukcije i u slučaju pribavljanja PP saglasnosti	×	✓	✓	✓	✓
Izvođač radova	×	✓	×[3]	✓	✓	✓	✓
„Velika licenca"	×	obavezno samo kod rekonstrukcije, u slučaju nadležnosti Republike	×	×	×	×	✓
Odgovorni izvođač	×	✓	×[4]	✓	✓	✓	✓
Stručni nadzor[5]	×	obavezno samo kod rekonstrukcije	×	✓	✓	✓	✓
Broj obaveznih inspekcija	0	0	2	2	2	2	2
Tehnički pregled	×	mogućnost	×[6]	✓	✓	✓	✓
Upotrebna dozvola	×	mogućnost	✓	✓	✓	✓	✓

A zgrade - nezahtevni objekti;
B zgrade - manje zahtevni objekti;
V zgrade - zahtevni objekti;
G inženjersko-građevinski objekti.

PJO – Pravilnik o objektima na koje se ne primenjuju pojedine odredbe zakona o planiranju i izgradnji

[1] Osim u slučajevima definisanim Uredbom o lokacijskim uslovima
[2] Videti ZPI za izuzetke od pravila navedenih u tabeli
[3] Videti PJO za izuzetke
[4] Videti PJO za izuzetke
[5] Videti PJO za izuzetke
[6] Obavezna je samo potvrda ovlašćenog lica da je objekat izveden u skladu sa građevinskom dozvolom i da je priključen ili podoban da bude priključen na infrastrukturnu mrežu, u skladu sa PJO

Contents

1. Training objective
2. Key documents and the procedure for improving EE in the building sector
3. Construction and construction supervision for refurbishment of buildings
4. **Management and maintenance after reconstruction**
5. Summary

Management and maintenance after reconstruction

In addition to the technical description of the equipment installed during the process of reconstructing a building with the goal of improving its EE, project documentation needs to contain the instructions for its use and maintenance in order to include these elements in the **Building Maintenance Programs**, the elaboration of which is prescribed by the law

Management and maintenance after reconstruction

Building management and maintenance is regulated by the **Law on Housing and Maintenance of Buildings ("Official Gazette of RS" No. 104/2016)**

- **Building management** means all organizational tasks and activities continuously performed by an elected or appointed person (manager or professional manager) or management body for the purpose of managing the building, which implies the responsible taking of measures to **organize the maintenance of the building**, deciding on the use of financial resources and ensuring that the building and/or parts thereof are used in accordance with its intended purpose, including other matters relevant to building management;
- **Building maintenance** means all activities ensuring the preservation of the functions and properties of the building in accordance with its purpose, and in particular with the goal of regular use and functioning thereof;

Management and maintenance after reconstruction

- Building maintenance activities include:
  - Emergency interventions,
  - Operational maintenance and
  - Investment maintenance.

- Operational and investment maintenance are performed in accordance with the building maintenance program.
- The Minister in charge of housing affairs determines in more detail the type, scope and dynamics of operational and investment maintenance, as well as the method of drawing up building maintenance programs.
- Improving the properties of a building or part of a building are activities that improve the energy or other properties of a building by upgrading or installing new parts and assemblies, and/or devices and installations.
- If the owner of the building fails to organize maintenance in accordance with this law, the competent authority of the local government unit will entrust the work of maintaining the building to an organization entrusted with carrying out tasks of public interest.

Management and maintenance after reconstruction

The Rulebook on the Type, Scope and Dynamics of Current and Investment Maintenance Activities for Buildings and the Method of Elaborating Maintenance Programs ("Official Gazette of RS" No. 54/2017)

- The manager or professional manager proposes a Maintenance Program and ensures that it is implemented in accordance with the Law on Housing and Maintenance of Buildings.
- Building maintenance programs are adopted based on **Building Condition Survey Reports**.
- Condition surveys are made according to time intervals listed in the Table (on the following slide).

Red. broj	GRAĐEVINSKI ELEMENTI, UREĐAJI, OPREMA I INSTALACIJE	Provera stanja/(u godinama)
1	KONSTRUKTIVNI GRAĐEVINSKI ELEMENTI	
1.1.	temelji/armirani beton	30-40
1.2.	noseći zidovi	25-30
1.3.	stubovi, grede i zidna platna	20-25
1.4.	međuspratne konstrukcije	20-25
1.5.	stepenište	15-20
1.6.	liftovsko okno	10-20
1.7.	**krovna konstrukcija**	**15-20**
2	DRUGI GRAĐEVINSKI ELEMENTI	
2.1.	**fasadni zidovi**	**5-7**
2.2.	unutrašnji pregradni zidovi (osim zidova u posebnim delovima)	7-10
2.3.	**krov**	**3-4**
2.4.	oluci, olučne cevi i drugi elementi za odvod vode sa krova i zaštitu zgrade od prodora vode	2-4
2.5.	druga krovna i fasadna limarija (solbanci, opšivke i dr.)	0.5-1
2.6.	dimnjačke vertikale	5-7
2.7.	ventilacioni kanali	5-7
2.8.	kanali za smeće u zgradi	5-7
2.9.	završne obrade podova, plafona i zidova u zajedničkim delovima zgrade	2-3
2.10.	**horizontalna i vertikalna hidroizolacija**	**1-2**
2.11.	**stolarija i bravarija na zajedničkim delovima zgrade (prozori, vrata i njihovi elementi)**	**2-3**
2.12.	ograde na krovu, stepeništima, terasama, lođama i zajedničkim delovima zgrade	5-7
2.13.	protivpožarno stepenište zgrade	5-7
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2.15.	septička jama	4-5
2.16.	šaht vodovodne i kanalizacione instalacije	5-7
2.17.	ulazna nadstrešnica, spoljno stepenište i natkrivka	5-10
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3.1.	lift, instalacije i uređaji unutar liftovskog okna	1
3.2.	liftovsko postojenje unutar lift kućice	1
3.3.	pumpno postrojenje za izbacivanje otpadne, podzemne i kišne vode i prepumpni uređaj	2-3
3.4.	hidroforsko ili drugo pumpno postrojenje za snabdevanje zgrade vodom ili za regulisanje pritiska vode	2-3
3.5.	uređaji i instalacije za uzbunjivanje	2-3
3.6.	oprema za video nadzor	2-3
3.7.	oprema protivprovalnog sistema	2-3
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	trotoari i platoi oko zgrade, rigole, slivnici i rešetke, ograde, žardinjere i sl.	3-5

The parts/elements of the building that significantly affect the EE, and the sustainability of the applied EE improvement measures are marked in red

Management and maintenance after reconstruction

The EE improvement measures implemented as part of building reconstruction will fail to yield the anticipated/planned long-term results if the Law on Housing and Maintenance of Buildings and the Rulebook on the Type, Scope and Dynamics of Current and Investment Maintenance Activities for Buildings and the Method of Elaborating Maintenance Programs are not applied consistently.

EU SUPPORT TO PROJECT PREPARATION

All documents, information, materials, and photos can be downloaded from EU PPF project's official web presentation at www.ppf.rs

Questions and Help

Nikola Nikolić

Lecturer, EU PPF | PPF6/EuropeAid/135637/IH/SER/RS

+381 11 4040721

info@ppf.rs

www.ppf.rs

Thank you for your attention!