SUSTAINABLE CONSTRUCTION – CONTRIBUTION OF THE ENGINEERING COMMUNITY TO THE ENVIRONMENTAL PROTECTION

ROLE OF ENGINEERS IN THE ENERGY EFFICIENCY OF BUILDINGS

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INTRODUCTION

- Whoo are players in the Market of EE of buildings?
- EU (Directives) 2002, 2010,

  Directive 2002/91/EC of the Energy performance of buildings
  Directive 2010/31/EC of the Energy performance of buildings (recast)

- National Governments (Law on energy efficiency, Law on Construction, Regulations)
- **Licencesed engineers**
- Finacial institutions

Ministry of Environment, Mining and Spatial Planning has adopted two regulations on energy efficiency, including:

Regulations on the conditions, content and manner of issuance of certificates of energy performance of buildings

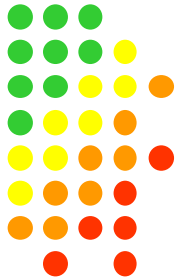
Regulations on energy efficiency in buildings

REGULATIONS ON THE CONDITIONS, CONTENT AND MANNER OF ISSUANCE OF CERTIFICATES OF ENERGY PERFORMANCE OF BUILDINGS

Responsible engineer for the energy efficiency of buildings (hereinafter referred to as responsible engineer EE) is a person who makes elaborate, performs energy audits and participate in the energy certification of buildings and which has **a license for the energy certification of buildings**

Serbian Chamber of Engineers is authorized to conduct training and professional examinations in the field of energy efficiency in buildings.

Executive Board of Serbian Chamber of Engineers determined the training program in a duration of **40 hours**. So far the program has successfully completed **over1750 candidates.**



The training program in the field of energy efficiency in buildings

TP 1 The concept of energy certificates and its role, legislation (2 hours)

TP 2 General conditions for achieving energy efficiency of building (2 hours)

TP 3 Urban parameters for achieving energy efficiency of building (1 hour)

TP 4 Architectural parameters for achieving energy efficiency of building (3 hours)

TP 5 Conditions of construction physics (3 hours)

TP 6 Construction materials and assemblies (1 hour)

TP 7 Passive and active solar systems (2 hours)

TP 8 Energy balancing of the building (2 hours)

TP 9.1 Apparatus and equipment for heating systems (2 hours)

TP 9.2 Remote heat supply and preparation of SHW (2 hours)

TP 10 Efficiency of central heating systems and regulation (2 hours)

TP 11.1 Energy inspection of heating system (1 hour)

TP 11.2 Measurement of the heat consumption for heating(1 hour)

TP 12 Methodology of annual energy calculation (2 hours)

TP 13 Electrical systems in buildings - Energy saving measures (3 hours)

TP 14.1 Examples of the preparation of energy efficiency elaborate and energy passports for existing residential building (4 hours)

TP 14.2 Measures for advancement of energy efficiency in buildings (2 hours)

TP 14.3 Measures for improving energy efficiency heating system (2 hours)

TP 14.4 Sample energy efficiency indicators calculation (3 hours)

Within the professional examination in the field of energy efficiency in buildings, the candidates after successful completion of training, made a energy efficiency elaborate and take exam.

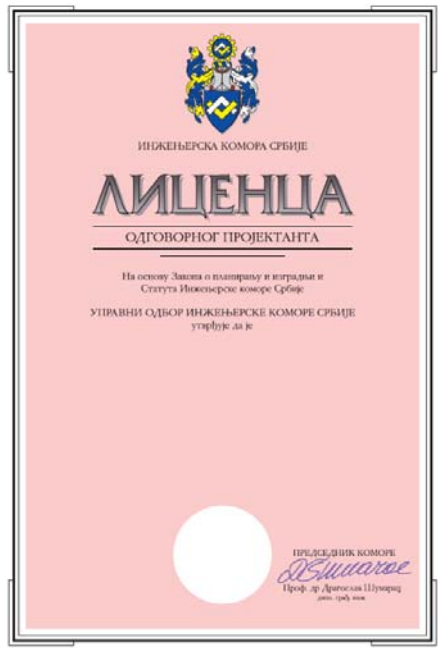
Professional exams are conducted so far in the six terms.

Over 1500 candidates passed the exam.

Licensed engineers responsible for the energy efficiency of buildings proves ability to create surveys, energy audits and participate in the energy certification of buildings.

So far, there is 1130 licensed engineers.

The license for the of energy efficiency engineer issued by The Serbian Chamber of Engineers.


ИНЖЕЊЕРСКА КОМОРА СРБИЈЕ

ЛИЦЕНЦА

ОДГОВОРНОГ ПРОЈЕКТАНТА

На основу Закона о планирању и изградњи и Статута Инжењерске коморе Србије

УПРАВНИ ОДБОР ИНЖЕЊЕРСКЕ КОМОРЕ СРБИЈЕ утврђује да је

ПРЕДСЕДНИК КОМОРЕ

Проф. др Драгослав Шумарац

Participants in the process of issuing energy passports

Ministry of Construction and Urban Planning

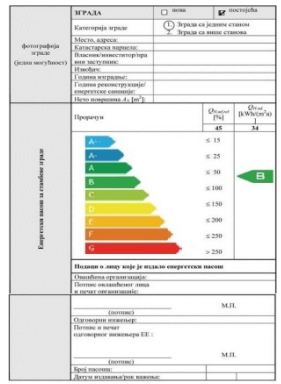
Authorizes

Authorized organization for energy certification of buildings

Conduct

- Energy audit of buildings
- Evaluation items in energy audit of the building
- Creating reports on conducted energy audit

Issuing



The eneregy passport

Chamber's licence

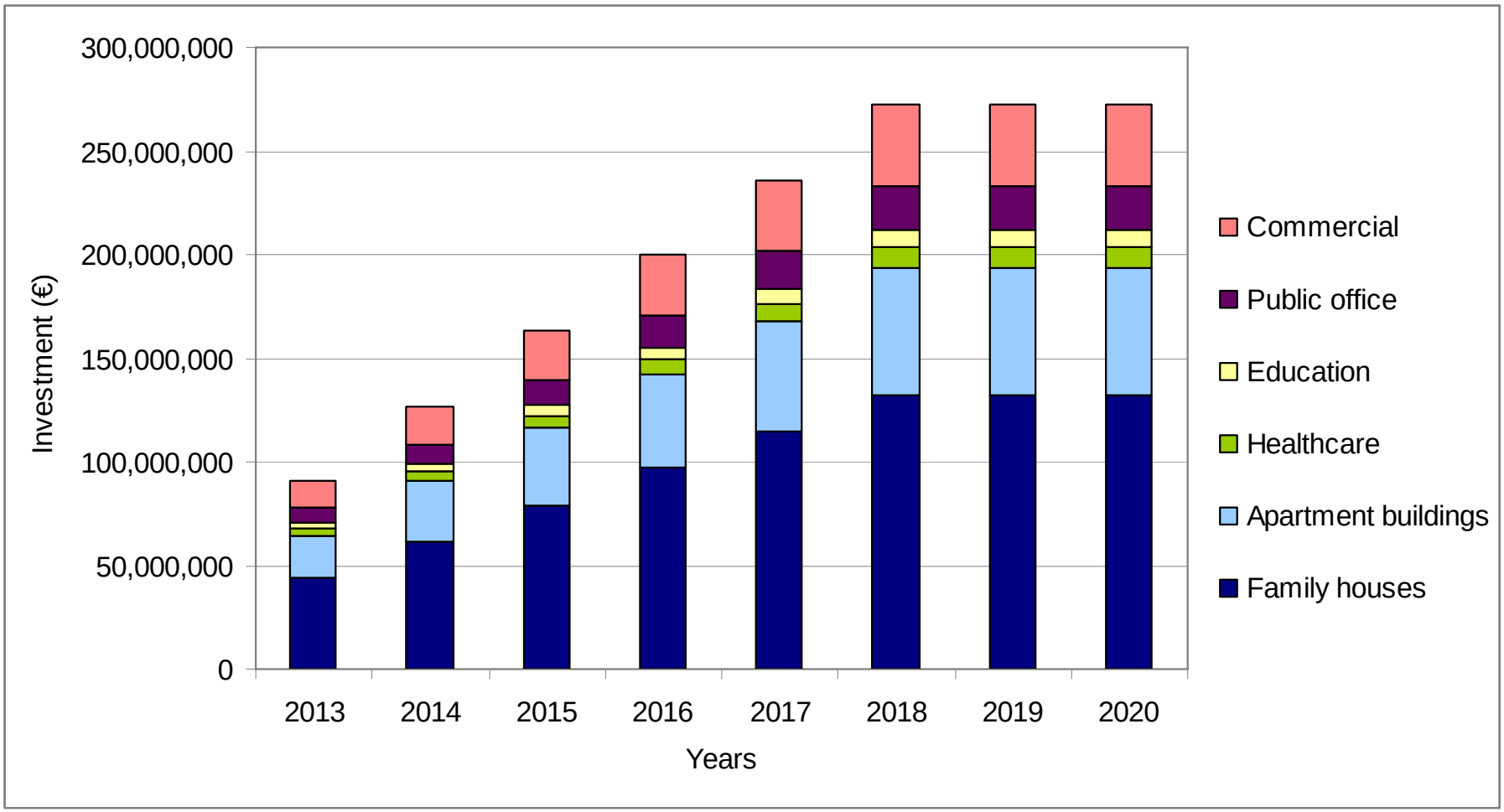
Issuing

Serbian Chamber of Engineers

Perform and participate

Energy Efficiency Engineers

ASSESSMENT OF NEEDED INVESTMENTS



CALCULATION METHODOLGY WITH AN EXAMPLE

STANDARD ISO 13790

$Q_{H,an} = Q_{H,nd} / A_f$ – specific annual energy need for heating [kWh/m^{2}a]

$$Q_{H,nd} = Q_{H,ht} - \eta_{H,gn} \cdot Q_{H,gn} = (Q_{tr} + Q_{ve}) - \eta_{H,gn} \cdot (Q_{\text{int}} + Q_{sol})$$

– annual energy need for heating [kWh/a]

$$Q_{H,ht} = (H_{tr,adj} + H_{ve,adj}) \cdot (\theta_{\text{int},set,H} - \theta_e)t$$ – total heat transfer [kWh/a]

$$H_{tr,adj} = H_D + H_g + H_U + H_A$$ – overall transmission heat transfer coefficient [W/K]

$$H_X = b_{tr,x}\left(\sum_i A_i \cdot U_i + \sum_k l_k \cdot \psi_k + \sum_j \chi_j\right)$$ – transmission heat transfer coefficient in general [W/K]

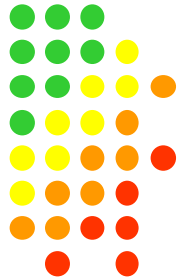
$\eta_{H,gn}$ – dimensionless gain utilization factor

$Q_{H,gn}$ – total heat gains

ENERGY EFFICIENCY OF BUILDINGS IN SERBIA

EXAMPLE

ENERGY PASSPORT FOR RESIDENTIAL BUILDINGS



Building data	
Net area within the building thermal envelope A_N [m^2]	870.3
Volume of heated part of the building V_e [m^3]	3569.56
The shape factor f_0 [m^{-1}]	0.47
Mean coefficient of heat transmission loss H'_T [W/(m^{2}K)]	0,45
The annual heat required for heating $Q_{H,nd}$ [kWh/(m^{2}a)]	41,2
Climate data	
Location	Novi Pazar
Number of heating degree days *HDD*	2628
The number of days of the heating season *HD*	180
The mean temperature of the heating period $\theta_{H,mn}$ [^{o}S]	5,4
The internal design temperature for the winter period $\theta_{H,i}$ [^{o}S]	22

ENERGY PASSPORT FOR RESIDENTIAL BUILDINGS

Data on HVAC systems in the building	
Heating system (local, central, remote)	Local
Heat source	Pellet Boiler „TRACO “ Q=100kW
Preparation systems SHW (local, central, remote)	Local
Heat source for SHW	Electricity and Solar collectors
Cooling System (local, central, remote)	Local
The energy source used for the cooling	Electricity
Ventilation (natural, mechanical, mechanical with heat recovery)	Natural and Mechanical
The source of power for ventilation	Electricity
Type and method of use of the renewable system	Solar collectors for SHW preparation
The share of renewable energy in the required heat for heating and SHW	

ENERGY EFFICIENCY OF BUILDINGS IN SERBIA

ENERGY PASSPORT FOR RESIDENTIAL BUILDINGS

Data on thermal building envelope	U [W/(m²K)]	U_{max} [W/(m²K)]	Fulfilled YES / NO
External walls	**0,21**	0,3	YES
External walls	**0,36**	0,3	NO
The inner wall toward unheated space	**0,38**	0,4	YES
The inner wall toward unheated space	**0,38**	0,4	NO
The inner wall toward unheated space	**2,41**	0,4	NO
Mezzanine structure to the unheated attic	**0,192**	0,3	YES
Pitched roof over heated space	**0,19**	0,15	NO
Mezzanine structure above the outer space	**0,25**	0,2	NO
Mezzanine structure above the outer space	**0,88**	0,2	NO
Mezzanine structure above unheated space (basement)	**0,245**	0,3	YES
Windows, balcony doors of heated room	**1**	1,5	YES
The doors to unheated rooms	**1**	-	YES

ENERGY PASSPORT FOR RESIDENTIAL BUILDINGS

Data on the heating system	
A device that is used as a source (boiler, heat substations, heat pump)	Pellet Boiler „TRACO “
Installed capacity [kW]	100
Efficiency, combustion efficiency [%]	-
Year of installation	-
Energy source	Pellet
Lower heating value [kWh/kg] [kWh/m^3]	
Emission CO_2 [kg/m^2a]	
Information about how to control	
Automatic control of the boiler / source (yes / no)	yes
Central control of the thermal performance (yes / no)	yes
Local control of the thermal performance (yes / no)	yes
Daily interruption in system operation (hours per day)	12
Weekly disrupt the system (days a week)	no
Seasonal disrupt the system (days on season)	no

ENERGY EFFICIENCY OF BUILDINGS IN SERBIA

ENERGY PASSPORT FOR RESIDENTIAL BUILDINGS

Data on heat losses	[kW]	
Transmission losses through the transparent part of the building envelope	17,48	
Transmission losses through windows and doors	9,99	
Ventilation losses through windows and doors	17,11	
The total heat loss	44,6	
Energy needs of the building	[kWh/a]	[kWh/m²a]
The annual heat required for heating, $Q_{H,nd}$	35840,8	41,2
The annual heat required to prepare SHW, Q_W	6611,7	7,6
Annual heat losses of the heating system, $Q_{H,ls}$	15488,7	17.8
The annual heat loss system for the preparation of SHW, $Q_{W,ls}$	661.2	0.8
The annual required heat, Q_H	58602.3	67.3
Annual energy delivered,	69158.4	79.5
The annual primary energy,	48156.4	55.3
Annual emissions of CO_2 [kg/a] [kg/m²a]	10663.1	12.3

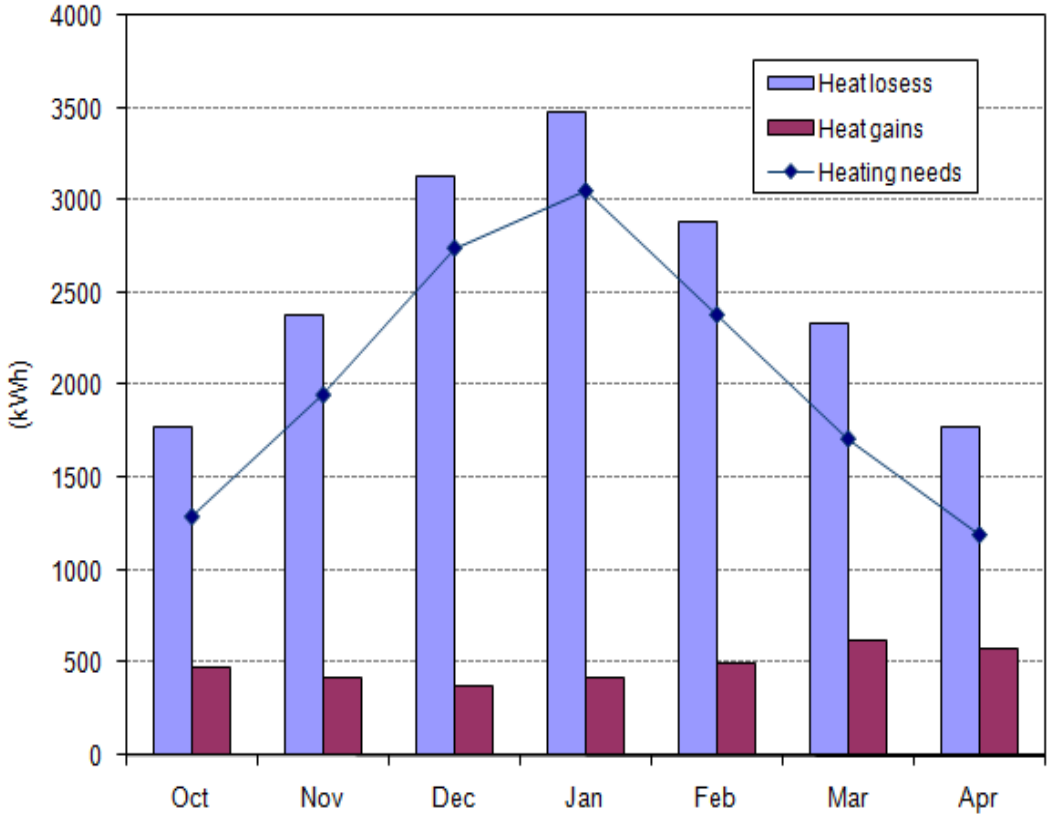
ENERGY PASSPORT FOR RESIDENTIAL BUILDINGS

Data on measured energy consumption *	[kWh/a]	[kWh/m^{2}a]
Annual measured heat for heating		
Annual measured heat to prepare SHW		
Annual measured heat		
Annual measured electricity		

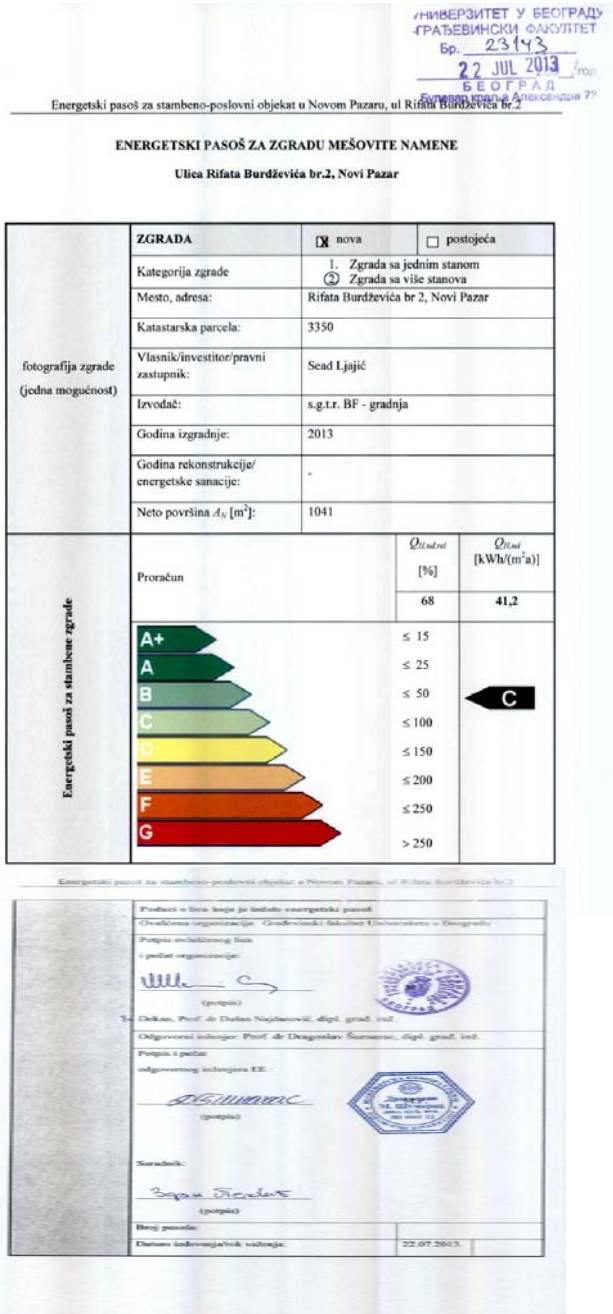
* The possibility of entering data for existing buildings when there is no data on measured energy use in the last three years

ENERGY PASSPORT FOR RESIDENTIAL BUILDINGS

Proposed measures to improve the energy efficiency of buildings
1. Increase the thermal insulation on the inner wall to the unheated space (stairs)
2. Increase the thermal insulation of the pitched roof above the heated area
3. Increase the thermal insulation of the pitched roof above the heated area
4. Increase the thermal insulation of the floor structure above the outside space (balcony)
5. Increase the thermal insulation of the floor structure beneath the outer space (balcony)


4000
3500
3000
2500
2000
1500
1000
500
0
(kWh)
Heat losess
Heat gains
Heating needs
Oct
Nov
Dec
Jan
Feb
Mar
Apr

ENERGY EFFICIENCY OF BUILDINGS IN SERBIA



УНИВЕРЗИТЕТ У БЕОГРАДУ
ГРАЂЕВИНСКИ ФАКУЛТЕТ
Бр. 23143
22 JUL 2013
БЕОГРАД
Булевар краља Александра 73

Energetski pasoš za stambeno-poslovni objekat u Novom Pazaru, ul Rifata Burdževića br.2

ENERGETSKI PASOŠ ZA ZGRADU MEŠOVITE NAMENE

Ulica Rifata Burdževića br.2, Novi Pazar

fotografija zgrade (jedna mogućnost)	**ZGRADA**	☒ nova	☐ postojeća
	Kategorija zgrade	1. Zgrada sa jednim stanom ② Zgrada sa više stanova	
	Mesto, adresa:	Rifata Burdževića br 2, Novi Pazar	
	Katastarska parcela:	3350	
	Vlasnik/investitor/pravni zastupnik:	Sead Ljajić	
	Izvođač:	s.g.t.r. BF - gradnja	
	Godina izgradnje:	2013	
	Godina rekonstrukcije/ energetske sanacije:	-	
	Neto površina A_N [m²]:	1041	

Energetski pasoš za stambene zgrade	Proračun	$Q_{H,nd,rel}$ [%]	$Q_{H,nd}$ [kWh/(m²a)]
		68	41,2
	A+	≤ 15	
	A	≤ 25	
	B	≤ 50	C
	C	≤ 100	
	D	≤ 150	
	E	≤ 200	
	F	≤ 250	
	G	> 250	

Podaci o licu koje je izradilo energetski pasoš:
Ovlašćena organizacija: Građevinski fakultet Univerziteta u Beogradu
Potpis ovlašćenog lica
i pečat organizacije:
(potpis)
Dekan, Prof. dr Dušan Najdanović, dipl. građ. inž.
Odgovorni inženjer: Prof. dr Dragoslav Šumarac, dipl. građ. inž.
Potpis i pečat
odgovornog inženjera EE:
(potpis)
Saradnik:
(potpis)
Broj pasoša:
Datum izdavanja/rok važenja: 22.07.2013.

$$Q_{H,an} = 41.2 \text{ kWh/m}^2\text{a}$$

- specific annual energy need for heating
- C category

EDUCATION, PROFESSIONAL EXAMS & LICENSING

Ministry of Construction appointed SCOE for Education.

40 hours are prescribed for AE, CE, ME, EE

Professional exam is authorized by Ministry to be leed in SCOE

1727 engineers finished Education since April 2012

1390 engineers passed Professional exam for EE

1118 engineers obtained License 381 for EE

EDUCATION, PROFESSIONAL EXAMS & LICENSING

Master of Science Course was organized at DUNP (Tempus-ENERESE)

Specialized Courses were organized at

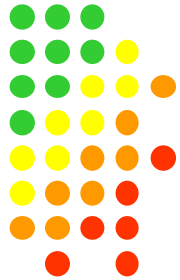
Faculty of Technical Science of Novi Sad

Architecture Faculty of Belgrade

Faculty of Civil Engineering Belgrade

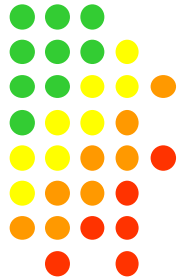
CONCLUSIONS

- Energy consumption in building sector in Serbia is ***very high***, especially regarding heat and electricity consumption in all sectors.
- Energy saving potential is substantial - around 45%
- Cost effective ERMs are mainly focused on:
  - improving thermal performance of a building's envelope;
  - lighting system;
  - heating system and automatic control.



CONCLUSIONS

- In order to achieve goals set by NEEAP, it is necessary to overcome the policy, legal, regulatory and financing barriers.
- The biggest problem is inadequate tariff system of paying the energy cost.
- The disparity in energy and fuel prices, especialy electricity, is also present in the market.
- Lack of equal financial incentives for different consumers groups also may be identified as a barrier.
- Dedicated EE financing mechanisms, adapted to the local market conditions may be the key to successful implementation and scaling up of EE investments in Serbia.



42012 - Project of Ministry of Science
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Tempus Project-ENERESE

THANK YOU FOR ATTENTION!