PROPOSAL OF BUILDING ENERGY CLASSES REGARDING TOTAL PRIMARY ENERGY CONSUMPTION

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INTRODUCTION

- According to Article 20 of the Treaty establishing the Energy Community, the Republic of Serbia has accepted the obligation to implement European Directives in the field of EE;
- Directive 2010/31/EU (hereinafter EPBD) has been implemented partially through two bylaws on BEE;
- Building energy class is determined **by final energy need for heating** purposes only;
- Articles 9-14 of EPBD state that the energy performance of buildings should be calculated taking into account all factors that play an increasingly important role (heating, air-conditioning, DHW, application of RES, passive heating and cooling elements, shading, indoor air-quality, lighting, etc).

INTRODUCTION

- The paper gives a proposal of buildings energy classes regarding total primary energy consumption;
- Classification has been done for residential buildings in Serbia.
- The approach that have been performed:
  - Selection of typical multiapprtment residential building;
  - Calculations of energy needs;
  - Determination of energy class regarding Regulations in force;
  - Selection of different technical systems in building;
  - Conducting models with different combinations of technical systems;
  - Simulation of primary energy consumption and CO2 emissions

ENERGY EFFICIENCY INDICATORS

- Energy efficiency indicators are of great importance for the objectives of **energy and environmental policy**.
- Baseline indicators for purpose of determination energy performance of buildings and determination of energy classes are following:
  - Indicator of annual heating energy consumption (kWh/m^2);
  - Indicator of annual electricity consumption (kWh/m^2);
  - Indicator of annual primary energy consumption (kWh/m^2);
  - Indicator of annual CO_2 emissions (kg/m^2).

CONVERSION FACTORS

- The calculation of primary energy consumption and specific CO_{2eq} emissions are performed using values prescribed on national level:

	Conversion factor	CO_2eq emissions
ENERGY SOURCE	f_{prim} [-]	f_{CO2eq} [kg/kWh]
Fuel oil	1.2	0.28
Gas	1.1	0.21
Coal	1.3	0.33
Wood biomass	0.1	0,34
Electricity	**3.015**	**1.099**
District heating using fossil fuels	**1.345**	-
District heating by co-generation	1.0	-

RESIDENTIAL BUILDINGS

- Energy classes for residential buildings were calculated based on simulations of energy consumption for typical residential building in Serbia of total floor area of 485 m^2.
- The building is located in Belgrade and it's energy class correspond to class "C" regarding final energy for heating ($q_{H,nd}$ = 37 kWh/m^2; $Q_{H,nd,rel}$ = 61%).
- Final energy for heating and cooling is calculated in accordance with standard SRPS EN ISO 13790, final energy for domestic hot water (DHW) in accordance with standard SRPS EN 15316-3-1, system losses in accordance with standards SRPS EN 15316 and SRPS EN 15243 and final energy for lighting in accordance with standard SRPS EN 15193.
- In order to determine the total primary energy consumption it was necessary to define structure of technical systems in building and its energy sources.

TECHNICAL SYSTEMS IN THE BUILDING

Technical system	Mark	Energy source
Heating	H1	Electricity
	H2	Fuel oil
	H3	Biomass (pellets)
	H4	Air to water heat pump
	H5	Natural gas
	H6	District heating
Domestic Hot Water (DHW)	W1	Individual electric water heaters
	W2	Central preparation of DHW (same as the source for heating)
	W3	Solar thermal panels
Cooling	C1	Split systems
	C2	Reversible heat pump
Lighting	L1	Incandescent bulbs
	L2	LED lighting
Electricity	PV	Solar photovoltaic panels

MODELS OF TECHNICAL SYSTEMS COMBINATION

Model	Heating	DHW	Cooling	Lighting
M1	H1	W1	C1	L1
M2	H2	W1	C1	L1
M3	H3	W1	C1	L1
M4	H4	W24	C2	L1
M5	H4	0.6*W3+0.4*W2,4	C2	L2
M6	H5	W1	C1	L1
M7	H5	W25	C1	L1
M8	H5	0.6W3+0.4W2,5	C2	L1
M9	H5	B3	C2	L2
M10	0.6H4+0.4H5	0.6W3+0.4*W2,4	C2	L2+PV
M11	0.6H4+0.4H5	0.6W3+0.4*W2,5	C2	L2+PV
M12	H6	0.6w3+0.4W2,6	C2	L2+PV
M13	H6	W2,6	C1	L1
M14	H4	0.6W3+0.4W2,4	C2	L2+PV
M15	H3	W23	C2	L2+PV
M16	H3	0.6W3+0.4W2,3	C2	L2+PV

THE ENERGY CLASSES

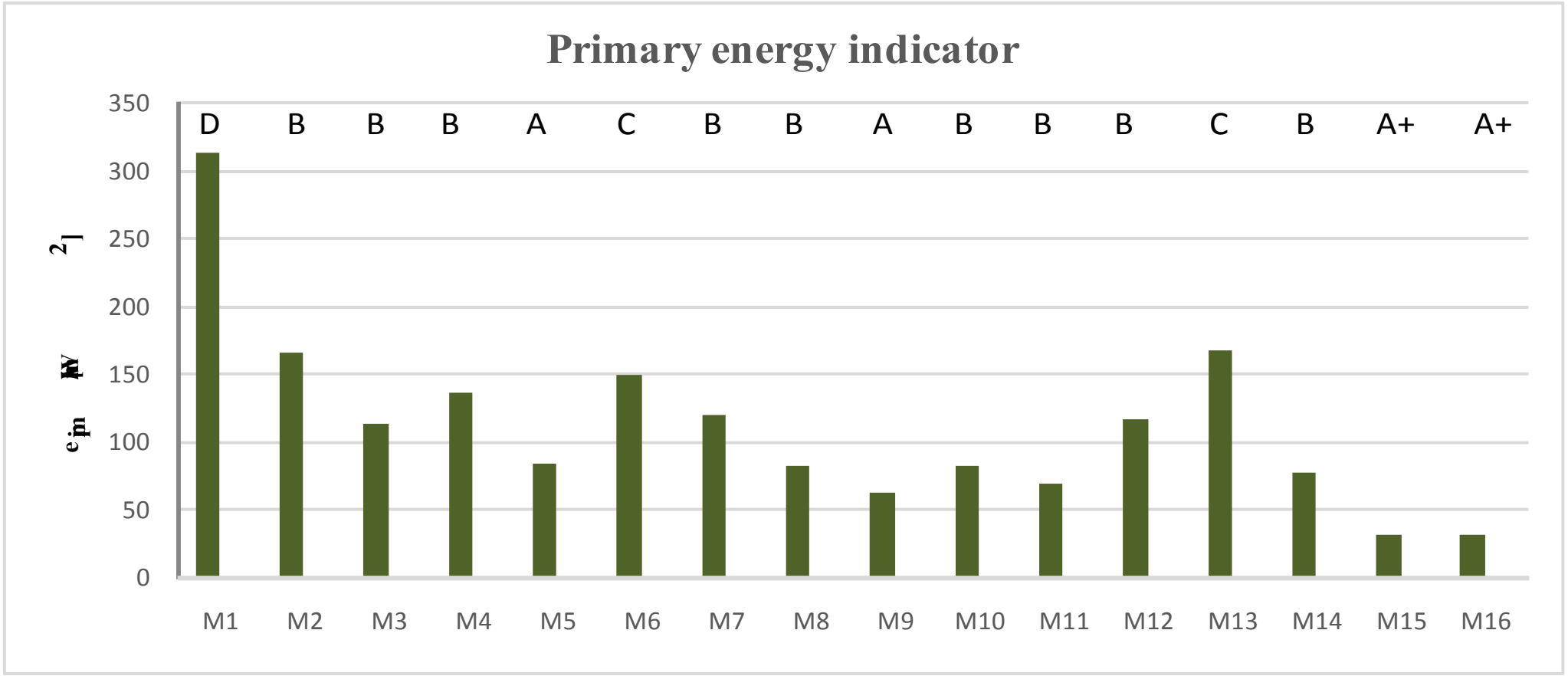
- The primary energy indicator has been calculated for each model, using conversion factors prescribed on national level.
- As a **base case**, considernig technical systems in buildings, adopted is building with district heating, local cooling and DHW preparation and incandescent/neon lighting and average energy consumption.
- The model which corresponds to energy class “C” is M13.
- In accordance with above mentioned procedure, energy classes regarding primary energy for residential buildings are obtained.
- Building energy rating scale according to primary energy indicator is based on relative values, in the same way as it is specified in national regulations regarding indicator of final energy for heating.
- The energy rating scale has 8 energy classes, from A+ to G.

THE ENERGY CLASSES

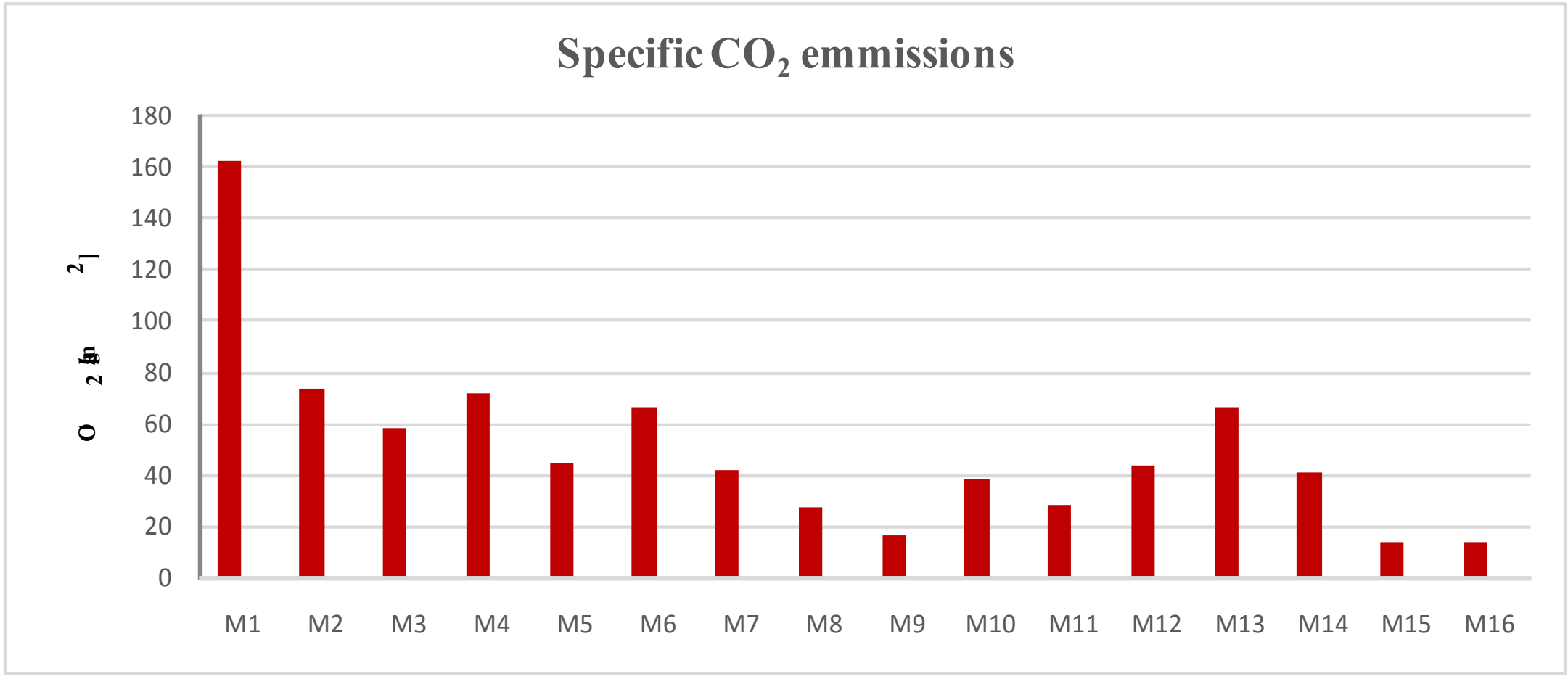
Residential buildings		New buildings	Existing buildings
Energy class	$E_{prim,rel}$	e_{prim}	e_{prim}
	[%]	[kWh/m²a]	[kWh/m²a]
A⁺	≤ 15	≤ 45	≤ 53
A	≤ 25	≤ 75	≤ 88
B	≤ 50	≤150	≤ 175
C	≤ 100	≤ 300	≤ 350
D	≤ 150	≤ 450	≤ 525
E	≤ 200	≤ 600	≤ 700
F	≤ 250	≤ 750	≤ 875
G	>250	>750	>875

THE ENERGY CLASSES

Primary energy indicator for residential building with energy classes for 16 different combinations of technical systems



SPECIFIC ANNUAL CO_{2eq} emissions for 16 models



CONCLUSION

- The research done in the paper is showing extremely big influence of building technical systems to energy consumption.
- In order to contribute national regulations upgrade in accordance with EPBD, the paper gives a proposal of buildings energy classes regarding total primary energy consumption for residential buildings.
- Also, it is shown that depending on technical systems, energy class regarding primary energy can vary from D to A+.
- The biggest potential for primary energy and CO_{2eq} reduction actually lies in the existing building stock.
- The same procedure can be done for family houses and non-residential buildings, under the similar assumptions.

CONCLUSION

- Legislative barriers are almost obsolete due to numerous changes and amendments to the laws and bylaws, followed by national action plans and strategies.
- But, when it comes national regulations on Buildings energy efficiency, upgrade in accordance with EPBD is necessary and urgent.
- Full implementation would enable expressing the total primary energy required, which is essential for the functioning of all systems in the building, also giving clear indication of energy efficiency rating.
- This approach is extremely important, because it stimulates the application of effective technical systems for heating, cooling, ventilation, domestic hot water, efficient lighting and appliances; and in addition, provides wider use of renewable energy sources.
- With the introduction of restrictions on carbon dioxide emissions, contribution to environmental protection would be significantly higher.

THANK YOU FOR ATTENTION!

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