



# **STRATEGY FOR NATIONAL DEFINITION OF NEARLY ZERO ENERGY BUILDINGS**

Milica Jovanović Popović, Bojana Stanković, Jasna Kavran  
University of Belgrade – Faculty of Architecture

## GOALS

- reduction of energy consumption as well as substitution of fossil fuels with renewables are defined as goals in several European Directives and in national regulations of country members
- As a result of these efforts, at the moment, buildings account for 40% of the total energy consumption and about 36% of GHG emissions
- Further steps in this field concern the concept of **nearly zero energy buildings (nZEBs)**

## Legislative framework

### EU REGULATIONS

Directive **2002/91/EC** of the European Parliament and of the Council on the Energy Performance of Buildings (EPBD)

Directive **2009/28/EU** of the European parliament and of the Council on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directive 2001/77/EC and 2003/77/EC (known as **20/20/20** Directive)

Directive **2010/31/EU** of the European Parliament and of the Council on the Energy Performance of Buildings (EPBD recast)

## Directive 2010/31/EU (EPBD recast)

**Article 2** : *“nearly zero energy building means a building that has a **very high energy performance**... nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby.”*

**Article 9**: requires that *“Member States shall ensure that by 31 December **2020 all new buildings are nearly zero-energy buildings**; and after 31 December **2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings**”.*

Member States shall furthermore *“draw up **national plans** for increasing the number of nearly zero-energy buildings”* and *“following the **leading example of the public sector**, develop **policies** and take **measures** such as the setting of targets in order to **stimulate** the transformation of **buildings that are refurbished** into nearly zero-energy buildings”*.



Zero Energy school in Saint-Ouen, France  
<http://www.archdaily.com/459482/zero-energy-school-mikou-design-studio/>

Renewable Energy Directive , well known as 20-20-20 Directive,  
Also set targets by 2020 for:

- 20 % reduction in greenhouse gas emission from levels 1990,
- 20% reduction in energy consumption and,
- increase the share of renewable energy sources in energy consumption to 20%.

Also set requirements parallel to those in EPBD recast:

- by 31 December 2014 EU states shall, in their own regulations and codes, require the use of minimum levels of energy from renewable sources in new buildings but also in existing buildings that are subject to major renovation.
- the new and existing **public buildings** that are subject to major renovation, at national, regional and local level, should fulfil an **exemplary role** from **1 January 2012**.



TVZEB House in Vicenza, Italy

<http://www.archdaily.com/340669/tvzeb-zero-energy-building-traverso-vighy/>



## SERBIAN REGULATIONS

- **Law on planning and construction (2009)**

(Zakon o planirnju i izgradnji) Official gazette of Republic of Serbia 72/2009

- Article 3 (energy efficiency as a principle of spatial regulation)
- Article 4 (energy performance certificates)

- **Regulations on energy efficiency of buildings**

(Pravilnik o energetskej efikasnosti zgrada) Official gazette of Republic of Serbia 61/2011

- **Regulations on conditions, content and method of issuing EPC**

(Pravilnik o uslovima, sadržini i načinu izdavanja sertifikata o energetskim svojstvima zgrada)

Official gazette of Republic of Serbia 69/2012



- based on EPBD Directive 2002
- introduced calculation methodology for energy needed for heating (kWh/m<sup>2</sup>a), primary and final energy needed for heating, CO<sub>2</sub> emission (kg) and introduced EPC (energy performance certificate)

- **Law on rational use of energy**

(Zakon o efikasnom korišćenju energije) Official gazette of Republic of Serbia 25/2013; defines principles that are related to energy efficiency in buildings:

- Article 3 (energy certainty, sustainable energy usage, energy consumption management, economic feasibility of energy efficiency measures, minimum energy efficiency targets)
- Article 4 (application for buildings and households)
- Article 6 (implementation acts: Energy Development Strategy, Action Plan, Energy Efficiency Program)
- Article 7-9 (Action Plan)
- Article 10-12 (Energy Efficiency Program)
- Article 13 - (Energy Management System) , Article 19 (Energy Manager), Article 20 (Energy Advisor), Article 24 (Energy Audit Report) , Article 25 (Energy Audit Methodology)
- Article 43 - (Energy Audit in Buildings)
- Article 44 - (Obligations of Investors)
- Article 47 - (District heating tariff system)



- **Strategy of energy development of Serbia by 2015 with projection by 2030**

Ministry of energy, development and environmental protection of Republic of Serbia (Draft version)

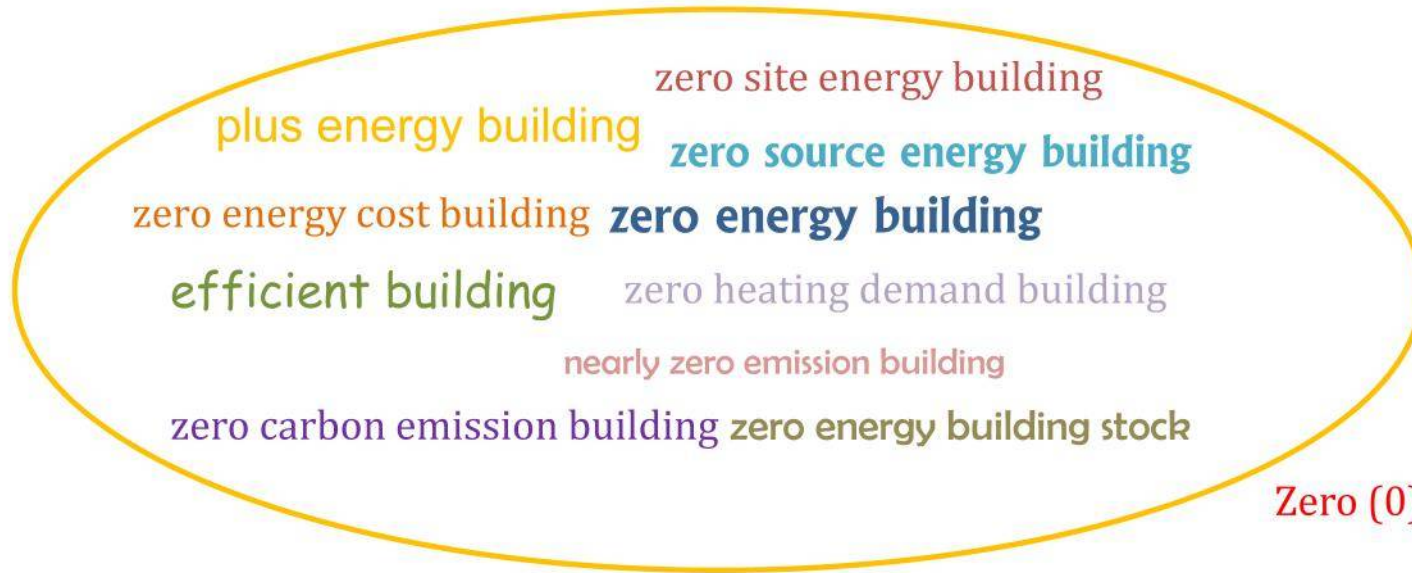
- it is planned, according to the scenario that takes into account the measures of energy efficiency, that by 2018 in housing, public and commercial sector, transportation and industry could save up to 9% final energy.
- participation of renewable energy sources in gross final energy consumption can reach 27% by 2020
- by full applications of energy efficiency measures in new buildings and in major rehabilitation of building stock, up to 16% of final energy consumption can be saved.
- **Serbia is accepting all the obligations from Energy community treaty and all Directives of the European Parliament !**

- When nearly zero energy buildings are considered, according to EPBD recast, it is requested to **make national definition, intermediate targets and action plans.**

- Therefore, Serbia is obligated to create a national definition of nZEB until 2020!



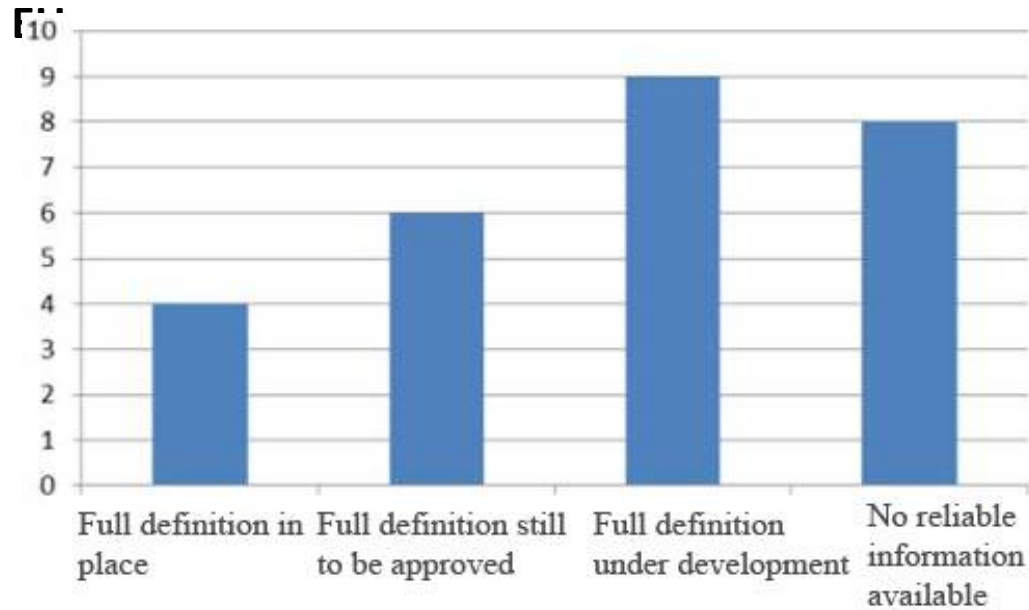
## DEFINITIONS OF NEARLY ZERO ENERGY BUILDINGS IN EU



Zero (0) common definition!



## DEFINITIONS OF NEARLY ZERO ENERGY BUILDINGS IN



Status of development of the NZEB definition in Member States, according to

**Overview of Member States information on NZEBs**

Ecofys by order of: European Commission, 2014, Groezinger, J., Boermans, T., John, A., Seehusen, J., Wehringer, F., Scherberich, M.

## DEFINITIONS OF NEARLY ZERO ENERGY BUILDINGS IN EU

National definitions of energy performance of buildings

<b>DE</b>	<ul style="list-style-type: none"> <li>• Low energy buildings (KfW40). 40% of minimum requirements (EnEV 2009)</li> <li>• NGO: Passive house, heating demand 15kWh/m<sup>2</sup>y, total primary energy requirement 120 kWh/m<sup>2</sup>a, including electrical appliances</li> </ul>
-----------	--



Housing development in Munich-Riem WA1  
[http://www.herzog-und-partner.de/english/projects/projects-riem\\_wa1.html](http://www.herzog-und-partner.de/english/projects/projects-riem_wa1.html)

Planned initiative towards “nearly zero energy buildings”

<b>DE</b>	<b>Existing requirements for housing</b>	2009: 70kWh/m <sup>2</sup> a primary energy
	<b>2010-2011</b>	
	<b>2012-2013</b>	30% reduction compared to 2009.
	<b>2014-2015</b>	
	<b>2016</b>	
	<b>2020</b>	

## DEFINITIONS OF NEARLY ZERO ENERGY BUILDINGS IN EU

### National definitions of energy performance of buildings

<b>DK</b>	<ul style="list-style-type: none"> <li>• The minimum requirement for low energy buildings class 2015 residential buildings is given by <math>30+1000/A</math> kWh/m<sup>2</sup>a (A is a heated gross floor area).</li> <li>• For other buildings the minimum requirements are given by <math>41+1000/A</math> kWh/m<sup>2</sup>a</li> <li>• The minimum requirement for non-residential buildings includes electricity for building integrated lighting.</li> <li>• A new low energy class for 2020 is on its way and is given by 20 kWh/m<sup>2</sup>a for residential and for other buildings the minimum requirements are given by 25 kWh/m<sup>2</sup>a</li> <li>• NGO: Passive house (German definition)</li> </ul>
-----------	---



Home for Life, Aarhus, Denmark  
<http://www.activehouse.info/cases/home-life>

### Planned initiative towards “nearly zero energy buildings”

<b>DK</b>	<b>Existing requirements for housing</b>	2010: 52,5-60kWh/m <sup>2</sup> a primary energy
	<b>2010-2011</b>	2010: 25% reduction compared to 2008.
	<b>2012-2013</b>	
	<b>2014-2015</b>	2015: 50% reduction compared to 2008.
	<b>2016</b>	
	<b>2020</b>	50% reduction compared to 2008.

## DEFINITIONS OF NEARLY ZERO ENERGY BUILDINGS IN EU

### National definitions of energy performance of buildings

<b>AT</b>	<ul style="list-style-type: none"> <li>• Klima: aktiv house, 70% of minimum requirements correspond to 25-45kWh/m<sup>2</sup>per year for heating</li> <li>• Klima: aktiv passive house, 20% of minimum requirements correspond to 15 kWh/m<sup>2</sup>per year for heating and 65 kWh/m<sup>2</sup>per year for primary energy</li> <li>• Low energy social buildings: Max 60 kWh/m<sup>2</sup>per year for heating (final energy consumption)</li> <li>• NGO: Passive house (German definition)</li> </ul>
-----------	--



Sunlighthouse, Austria, Juri Troy Architects  
<http://www.archdaily.com/457737/sunlighthouse-juri-troy-architects/>

### Planned initiative towards “nearly zero energy buildings”

AT	Existing requirements for housing	66.5 kWh/m <sup>2</sup> a (final energy)
	2010-2011	Proposed strategy 2010: 15% reduction compared to 2007
2012-2013		
2014-2015	Proposed strategy 2015: Passive house standard for new buildings	
2016		
2020		



## DEFINITIONS OF LOW ENERGY BUILDINGS AND NEARLY ZERO ENERGY BUILDINGS IN SERBIA

- According to the EPBD (recast) every EU member state has to make its own definition of nZEB, according to the local **economy** status.

Parameters influencing national definition creation:

- location,
- calculation methodology,
- building stock characteristics,
- technical possibilities, and
- **economy!**



## BUILDING STOCK CHARACTERISTICS

- residential buildings
- non – residential buildings

## RESIDENTIAL BUILDINGS

- National building typology elaborated in accordance with principles of TABULA project (appointed as one of two official European methodologies for energy building performance calculations)
- key findings:
  - the most of the building stock of single family houses was built in the period from 1946-1960, and of multi- family houses the period from 1960-1970,
  - therefore, approximately 50% of Serbian building stock is uninsulated, with high values of thermal losses through all the elements of envelope
  - building stock, as whole, is in poor condition, renovation measures were applied to a negligible percentage of houses

National typology of residential buildings

Тип	породично становање (до 4 стана) family housing (up to 4 apartments)			вишепородично становање (више од 4 стана по улазу) multifamily housing (more than 4 apartments per entrance)		
	1  слободностојећа Freestanding	2  у низу In a row	3  слободностојећа Freestanding	4  ламела (lamela)	5  у низу In a row	6  спиглер High-rise
А < 1919.						
Б 1919-1945						
Ц 1946-1960						
Д 1961-1970						
Е 1971-1980						
Ф 1981-1990						
Г 1991-2011						



## TOWARDS NATIONAL DEFINITION OF nZEB

- as basis, present Regulations could be used, tightening the permitted levels of needed energy for heating for 25% every year
- more rigorous solutions would include, as in other countries, all energy spent in buildings

Possible initiative towards “nearly zero energy buildings” for Serbia for new buildings (residential buildings)

2011-2012	2015-16	2017	2018	2019	2020
<ul style="list-style-type: none"><li>• Regulations on EE of buildings</li><li>• Regulations on EPC</li></ul>	25% reduction compared to 2011. 48kWh/m <sup>2</sup> a	25% reduction compared to 2015. 36kWh/m <sup>2</sup> a	25% reduction compared to 2017. 27kWh/m <sup>2</sup> a	25% reduction compared to 2018. 20kWh/m <sup>2</sup> a	25% reduction compared to 2019. 15kWh/m <sup>2</sup> a

## TOWARDS NATIONAL DEFINITION OF nZEB

- **EPISCOPE** : *Energy Performance Indicator Tracking Schemes for the Continuous Optimization of Refurbishment Processes in European Housing Stocks*. Project co-funded by the Intelligent Energy Europe programme of the EU (2013-2016) [www.episcope.eu](http://www.episcope.eu)
- Serbian contribution in the form of a Serbian chapter in EPISCOPE Synthesis Report No. 1 : **Inclusion of New Buildings in Residential Building Typologies : Steps Towards NZEBs Exemplified for Different European Countries**
- Typology extended towards new building types:

Building Size Class	SFH	TH	MFH	AB
	Single-Family House	Terraced House	Multi-Family House	Apartment Block
Picture	 <p>RS.N.SFH.08.Gen</p>		 <p>RS.N.MFH.08.Gen</p>	 <p>RS.N.AB.08.Gen</p>

- examination of possibilities for further improvement of a typical new building representative, in the context of future nZEB definition:

Energy Performance Level		Minimum Requirement	Improved Standard	Ambitious Standard / NZEB
<b>U-values</b>				
Roof	W/(m <sup>2</sup> K)	0.14	0.1	0.08
Wall	W/(m <sup>2</sup> K)	0.29	0.16	0.11
Window	W/(m <sup>2</sup> K)	1.3	0.8	0.5
Door	W/(m <sup>2</sup> K)	1.5	0.8	0.8
Floor	W/(m <sup>2</sup> K)	0.28	0.16	0.11

Variation level		Minimum Requirement	Improved Standard	Ambitious Standard / NZEB
<b>Energy standard</b>		Rulebook (2011)		
Calculation method		Serbian EPC calculation procedure (Rulebook (2011))		
Heated area (net conditioned area)	m <sup>2</sup>	1082		
Thermal transfer coefficient by transmission, related to envelope area	W/(m <sup>2</sup> K)	0.535	0.342	0.273
Relation to requirement		100%	65%	52%
Relation to reference standard / EPC rating		C	C	B
Energy need for heating	kWh/(m <sup>2</sup> a)	59.65	37.53	28.91
Delivered energy	kWh/(m <sup>2</sup> a)	69	38	30
Primary energy demand	kWh/(m <sup>2</sup> a)	76	41.7	32.15
CO <sub>2</sub> Emissions	kg/(m <sup>2</sup> a)	15.2	8.6	6.6

- ambitious improvement of current standard results in **29 kWh/m<sup>2</sup>a** of energy needed for heating!

2011-2012	2015-16	2017	2018	2019	2020
Regulations on EE of buildings	25% reduction compared to 2011	25% reduction compared to 2015	25% reduction compared to 2017	25% reduction compared to 2018	25% reduction compared to 2019
Regulations on EPC	48 kWh/m <sup>2</sup> a	36 kWh/m <sup>2</sup> a	27 kWh/m <sup>2</sup> a	20 kWh/m <sup>2</sup> a	15 kWh/m <sup>2</sup> a

## CONCLUSIONS

- there is an urgent need for a sustainable definition of nZEB for Serbia!
- further research on possibilities and restraints of local practice
- further work on policies and regulations
- it is necessary that Serbia prepares its own strategy that is sustainable and feasible!
- this strategy for nZEB definition must include:
  - location,
  - calculation methodology,
  - building stock characteristics,
  - technical possibilities,
  - especially economy as the only limiting factor!