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Eva Vaništa Lazarević, Aleksandra Đukić,
Aleksandra Krstić - Furundžić, Milena Vukmirović

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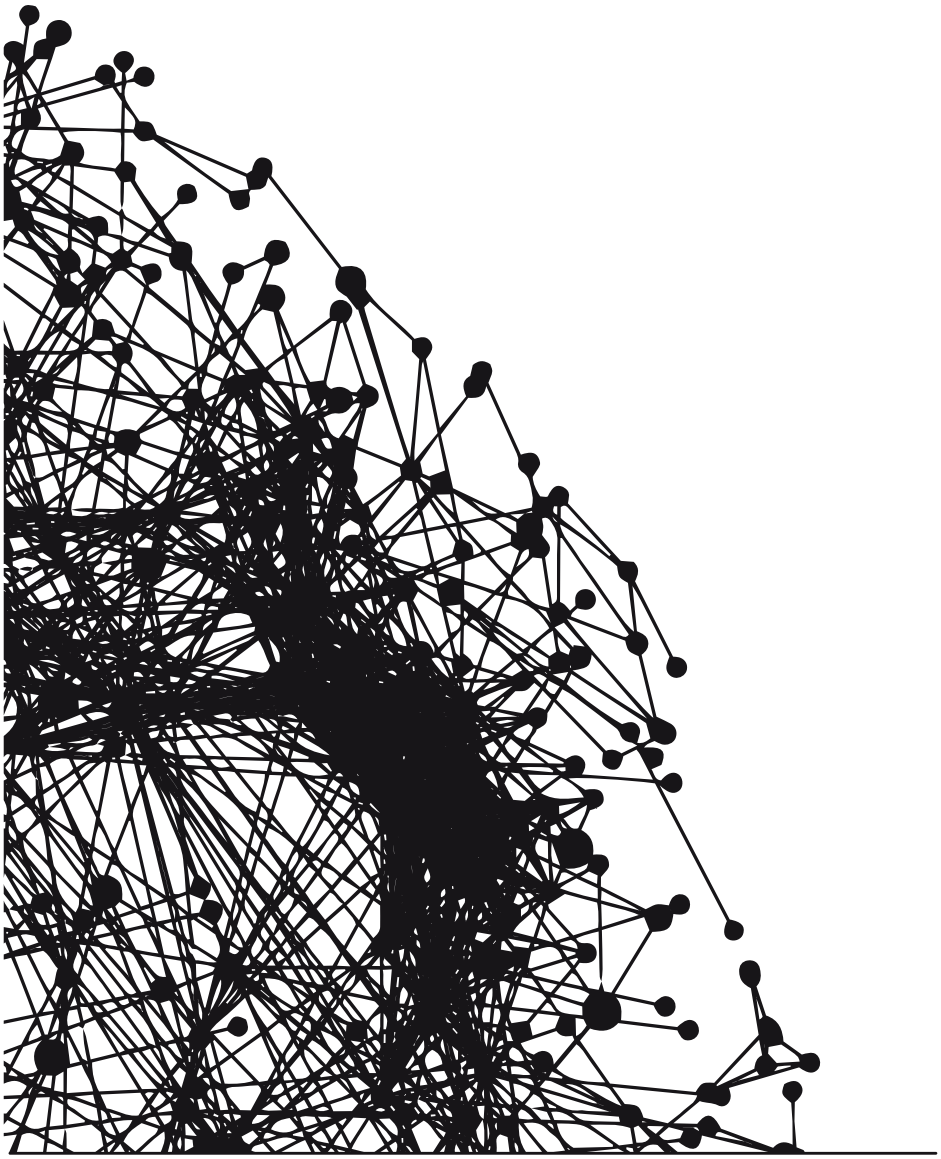

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STRATEGY FOR NATIONAL DEFINITION OF NEARLY ZERO ENERGY BUILDINGS

Milica Jovanović Popović
Full professor, Faculty of architecture University of Belgrade, King Aleksandar Boulevard 197, Belgrade, milicajp@arh.bg.ac.rs

Bojana Stanković,
PhD candidate, Faculty of architecture University of Belgrade, King Aleksandar Boulevard 197, Belgrade, stankovicarch@gmail.com

Jasna Kavran
PhD candidate, Faculty of architecture University of Belgrade, King Aleksandar Boulevard 197, Belgrade, jasna.kavran@gmail.com

ABSTARCT

Due to very intensive energy rehabilitation and retrofitting process of buildings in the past decade, EU countries reduced energy spent in buildings from 50% to less than 40% of total energy production. At the same time, at the moment, buildings account for around 36% of CO_2 emission. The recast Directive on the energy performance of buildings (EPBD 2010) stipulates that by 2020 all new buildings in European Union shell reach nearly zero- energy levels (nZEB). At the same time, public buildings should reach this goal till 2018. Introducing the new obligations for public buildings (from 2019 on) and other buildings (from 2021 on) to become nearly zero-energy buildings. This Directive does not give very precise definition of nZEB. According to this directive nZEB is:" building that has a very high energy performance... The nearly zero or very low amount of energy required should, to a very significant extent, be covered by energy from renewable sources, including renewable energy produced on-site or nearby". Accepting the differences in climate, building heritage, socio-technical levels of development, Directive does not prescribe the common methodology for implementation strategy and calculation methods, giving the opportunity to each country to define its own criteria and model. Serbia, as the candidate country, started the process of harmonization with EU regulations in the field of energy efficiency by introducing the Law on rational use of energy (2013) and in the field of buildings by introducing the Law on planning and construction (2009) and Regulations on energy performance of buildings and energy certification of buildings (2011) and in the future time has to prepare its own goals, definition of nZEB and strategies of accomplishing them. In the paper, principles for Serbian nZEB definition are elaborated taking into account national specifics:

- *existing building stock whose characteristics are elaborated in National building topology,*
- *climate diversity,*
- *economic potential,*

- *renewable energy sources.*

Keywords: Nearly zero energy buildings, national definition, energy efficiency, building stock retrofit, new buildings standard

INTRODUCTION

At the end of 20th century in most of the developed countries in Europe and in USA about 50% of total production of energy was spent in buildings, while 25% was spent in traffic and remaining 25% in industry. Accepting the fact that fossil fuel stock is limited and that greenhouse gases emission caused climate changes, developed countries set up goals for upgrading energy efficiency of buildings, introducing also the use of renewable energy sources.

Due to the extensive effort in retrofitting and rehabilitation of existing stock and new regulations for new buildings, there was a significant reduction in both: energy consumption and GHG emission. Therefore, the reduction of energy consumption as well as substitution of fossil fuels with renewables is 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 CO2 emission.

EU REGULATIONS

During the past decade the EU regulations, concerning energy efficiency, have been significantly strengthened. After the Directive from 2002, the recast of the Energy performance of buildings (EPBD, 2010/31/EU)151 and the Renewable energy Directive (RED 2009/28/EC)152 were issued defining the nZEB characteristics.

According to Article 2 of the recast Energy performance of buildings Directive "nearly zero energy building means a building that has a very high energy performance, as determined in accordance with Annex 1.The 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." In article 9 of the same Directive it is stipulated that after 31 December 2018, new buildings occupied and owned by public authorities should be nearly zero –energy buildings and by 31 December 2020, all new buildings should be nearly-zero energy buildings. Also, the members of EU should make national plans for increasing the number of nearly-zero energy buildings including:

[151] Directive 2010 2013/31/EU of the European parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast)

[152] Directive 2009/28/EU of the European parliament and of the Council of 23April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directive 2001/77/EC and 2003/77/EC

- a definition of nearly-zero energy buildings which reflects national, regional or local conditions and include
- a numerical indicator of primary energy use (in kWh/m2a), intermediate targets for improving the energy performance of new buildings by 2015,
- information on polices, financial or other measures adopted for promotion of nZEB including the use of renewable energy sources in new and existing buildings in the process of major renovation.

Although the Renewable Energy Directive (RED), well known as 20-20-20 Directive, 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%,

it also set requirements for buildings, parallel to those in EPBD recast, stipulating that:

- 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.

SERBIAN REGULATIONS

Serbia started the process of harmonization with EU regulations in the field of energy efficiency by introducing the Law on rational use of energy (2013) and in the field of buildings by introducing:

- the Law on planning and construction (2009)
- Regulations on energy performance of buildings and energy certification of buildings (2011).

During the process of defining those regulations, it was estimated that the requirements set in EPBD recast are too demanding and taking into account the situation in Serbia, post war period and economy crisis, the new regulations were based on EPBD Directive 2002. Those regulations were first regulations setting requirements for thermal protection of buildings after 1990, introducing at the same time calculation methodology for energy needed for heating (kWh/m2a), primary and final energy needed for heating, CO2 emission (kg) and introduced EPC (energy performance certificate). Although the requirements for thermal characteristics of building envelope elements were drastically raised, they are still behind the values set in most EU countries.

During 2013, Ministry of energy, development and environmental protection of Republic of Serbia prepared the Action plan, Strategy for development of energy of

republic of Serbia by 2015 with projections by 2030[153].154 It is stated that, among other obligations, Serbia is accepting all the obligations from Energy community treaty and Directive 2009/28/EU as its basis. In this document national energy sector was analysed in details and requirements and goals concerning energy are defined including energy efficiency of buildings. As one of the principles and goals for the development of Serbia, further harmonization with EU regulations was established.

When renewable energy sources are in question, 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. It is estimated that the participation of renewable energy sources in gross final energy consumption can reach 27% by 2020 and that, 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.

Definitions of low energy buildings and nearly zero energy buildings ins in EU

As there is no unique definition for highly energy efficient buildings, generally it is considered that the term indicates the buildings with higher performances than standard buildings built according to national codes and regulations. In many countries German, non-governmental definition is in use (Table 1).

When nearly zero energy buildings are considered, according to EPBD recast, it is also suggested to make national definition, intermediate targets and action plans (Table 2).

Table 1 National definitions of energy performance of buildings in European countries

GE	Low energy buildings (KfW40). 40% of minimum requirements (EnEv 2009) NGO: Passive house, heating demand 15kWh/m2y, total primary energy requirement 120 kWh/m2a, including electrical appliances
AT	Klima: aktiv house, 70% of minimum requirements correspond to 25-45kWh/m2per year for heating Klima: aktiv passive house, 20% of minimum requirements correspond to 15 kWh/m2per year for heating and 65 kWh/m2per year for primary energy Low energy social buildings: Max 60 kWh/m2per year for heating (final energy consumption) NGO: Passive house (German definition)

[153] Ministry of energy, development and environmental protection of Republic of Serbia, Strategy of energy development of Serbia by 2015 with projection by 2030, Draft version

DK	The minimum requirement for low energy buildings class 2015 residential buildings is given by 30+1000/A kWh/m2a (A is a heated gross floor area). For other buildings the minimum requirements are given by 41+1000/A kWh/m2a The minimum requirement for non-residential buildings includes electricity for building integrated lighting. A new low energy class for 2020 is on its way and is given by 20 kWh/m2a for residential and for other buildings the minimum requirements are given by 25 kWh/m2a NGO: Passive house (German definition)
IT	NGO: Casa Clima gold10 kWh/m2a
UK	1*-6*, corresponding to an energy reduction of 10%, 18%, 25%, 44% 100% and zero carbon of the minimum requirement for total heat demand (69 kWh/m2a) (4* corresponds approximately to a passive house in accordance to German definition).

Table 2 Planned initiative towards "nearly zero energy buildings"

AT	Existing requirements for housing	Proposed strategy 2010: 15% reduction compared
	2010-2011	
	2012-2013	
	2014-2015	Proposed strategy 2015:Passive
	2016	
	2020	
DK	Existing requirements for housing	2010: 52,5-60kWh/m^2a primary energy
	2010-2011	2010: 25% reduction compared to 2008.
	2012-2013	
	2014-2015	2015: 50% reduction compared to 2008.
	2016	
	2020	50% reduction compared to 2008.
DE	Existing requirements for housing	2009: 70kWh/m^2a primary energy
	2010-2011	
	2012-2013	30% reduction compared to 2009.
	2014-2015	
	2016	
	2020	
UK	Existing requirements for housing	Regulated through CO2 demands 2010 100kWh/m2a primary energy
	2010-2011	2010: 25% reduction compared to 2006.
	2012-2013	2013: 44% reduction compared to 2006.
	2014-2015	
	2016	All buildings zero carbon proposal: 10-14kg CO2/m^2a dependent on the type of dwelling appartments: 39 kWh/m^2a row house: 46 kWh/m^2a single family houses: 46 kWh/m^2a
	2020	

Definitions of low energy buildings and nearly zero energy buildings ins in Serbia

In order to make the national definition of nZEB and prepare sustainable road map for Serbia, it is necessary to identify several parameters that can be classified in following groups: location, calculation methodology, building stock characteristics, technical possibilities and economy.

Parameters deriving from the location itself are climate and renewable energy sources. Introducing the Regulations on energy efficient buildings, the old standard JUS.U.J5.600 which defined climatic zones, is not any more in effect. According to new Regulations, all calculations are taking into account the exact values for the location of the building for: HDD, insolation, external temperatures. For nZEB definition only one set of climatic data should be calculated representing the whole country. For RES, based on the present investigations, the estimation or mean values for whole country should be prepared taking into account solar, wind, geothermal and biomass energy.

Calculation methodology in Regulations on energy efficient buildings is already based on EU standards and EPBD Directive (2002). As our present regulations give the method for calculating final and primary energy and CO_2 emission, it is necessary to upgrade those standards to EPBD recast (2010) and include calculations for other types of energy spent in the buildings as obligatory. Further tightening of benchmarks and allowed levels of needed energy as well as allowed levels of CO_2 emissions are necessary in a very short period of time.

The quantity and quality of building stock has been evaluated to some extent through the National Census, but more information are available in National building typology[155] elaborated in accordance with principles of TABULA project [156] appointed as one of two official European methodologies for energy building performance calculations[157]. According to Serbian national typology, the most of the building stock of single family houses was built in the period from 1946-1960, and of multy-family houses the period from 1960-1970, before the first regulations on thermal protections appeared. It means that approximately 50% of Serbian building stock is uninsulted, with high values of thermal losses through all the elements of envelope (walls, windows, ceilings, floors...). Same investigation indicated that building stock, as whole, is in poor condition, renovation measures were applied to a negligible percentage of houses.

[155] Jovanović Popović Milica, Dušan Ignjatović et all 2013. National building typology, Belgrade, Faculty of Architecture

[156] www.building-typology.eu

[157] European Commission, "Notices from European Union institutions, bodies, offices and agencies. Guidelines accompanying Commission delegated regulation (EU) No 244/2012of 16 January 2012 supplementing Directive 2013/10/EU", Official Journal of the European Union, C115 (2012), 1-28

Technical possibilities depend on existing state of knowledge and systems applied in everyday practice. While the first is absolutely up to date and is possible to develop and implement all the new products available on the world market, the second is mostly developed in the past century and rehabilitated to a small extent.

According to the EBBD (recast) every EU member state has to make its own definition of nZEB, according to the local economy status and to make calculations that prove that initiatives are sustainable, and that industry is possible to produce new materials and elements that could lead to energy efficiency and nearly zero CO2 emission in buildings. For Serbia, the moment for introducing those standards is very difficult because of the economy crises, and it can influence the position of the benchmarks to lower standards.

If Serbia is planning to join EU in 2020, it means that all the regulations must be harmonized till that date, including present and future Directives concerning energy efficiency of buildings and GHG emission reduction to almost zero level. One of possible scenarios is presented in Table 3. It is suggested that, 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

Table 3 Possible initiative towards "nearly zero energy buildings" for Serbia for new buildings (residential buildings)

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

CONCLUSION

In the process of joining EU, Serbia must harmonize all the laws and regulations with corresponding EU regulations, including Directives on energy efficiency of buildings and CO_2 emission reduction. Since it is possible for each country to make its own road map, 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, which can be estimated as given and known factors and especially economy as the only limiting factor.

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