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IMPLEMENTATION OF ENERGY RENOVATION OF BUILDINGS IN THE FIVE COUNTIES OF EASTERN CROATIA

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Abstract: This paper analyzes the final results of residential and public buildings energy renovation on the area of the Osijek-Baranja County as well as the beginning of energy renovation of residential and public buildings in the five counties of Eastern Croatia based on signed contracts for energy renovation. The structure of purpose of public buildings by cities and settlements is presented an overview of the contracted projects with the number of funds for energy renovation of multi-residential buildings is given. The conclusion emphasizes the importance of energy renovation of buildings in terms of reducing energy consumption and reducing energy imports and emphasizes that energy distributors in the five counties of Eastern Croatia need to coordinate their business procurement plans for energy delivery.

Keywords: building energy consumption, energy renovation of buildings, public buildings, region of Slavonia, residential buildings

INTRODUCTION

Buildings consume more than 42.3% of total energy consumption, and in the last 30 years (due to rising standards) this share has been increasing. Most buildings in Croatia were built by the end of the 1980's and have little or no thermal insulation; such buildings consume 5 times more energy than buildings rated with energy class B, [1] [2].

The European Parliament and the Council adopted Directive 2012/27 / EU on energy efficiency [3]. Chapter 2 (Energy Efficiency) of the section 'Renovation of buildings' (Article 4) states: 'Member States shall establish a long-term strategy to encourage investment in the reconstruction of the national housing and commercial buildings, public and private (The first version of the strategy shall be published by 30 April 2014 and subsequently updated every three years and forwarded to the Commission as part of national energy efficiency action plans). In Art.5. "Public authority buildings as a model" points out "EU Member States are obliged to rebuild 3% of the total floor area of heated and / or cooled buildings owned and used by the central government under Directive 2012/27 / EU as of 1 January 2014. "The goal is to encourage the renovation of energy-efficient publicly owned buildings to reduce the cost of maintaining them and at the same time to give an example to citizens that energy renovation results not only in energy and financial savings but also in better quality of space use. [3].

Pursuant to the said directive, the Government of the Republic of Croatia adopted: "Public Sector Buildings Energy Recovery Program 2014-2015" [4], Multifamily Buildings Energy Renovation Program

2014-2020 [5] and Public Sector Buildings Energy Recovery Program for the period 2016-2020 [6] and the Environmental and Energy Efficiency Fund and the Ministry of Construction and Physical Planning have been designated as implementing bodies.

According to data from the National Energy Management Information System (ISGE), in 2010, the Republic of Croatia recorded 13.8 million m² of usable floor space of public sector buildings; and 43.9% of the surface is in heating mode. The implementation of energy efficiency measures, ie energy renovation, plans to reduce energy consumption in public sector buildings by 30 to 60%, ie to 150 kWh/m² per year and reduce CO₂ emissions by about 20,500 tons per year [7]. In 2017, the call 'Energy renovation of buildings and use of renewable energy sources in public sector buildings' was opened, which provided HRK 380 million for the energy renovation of public sector buildings. The minimum grant awarded to finance eligible project costs was 10,806 € and a maximum of 5.4 mil. €. The grants were awarded through an open grant procedure in a permanent call modality.

ENERGY RENOVATION OF BUILDINGS IN OSIJEK-BARANJA COUNTY

— Public buildings

Public buildings include public buildings - performing activities in the field of social activities (education, education, science, culture, sports, health and social care), work of state bodies and organizations, bodies and organizations of local and regional self-government, legal entities with public authority, banks, savings banks and other financial organizations, international institutions, chambers of commerce and industry and other associations,

religious communities, passengers in public transport and users of postal and electronic communications services.

- Within the Call 4c1.2 - Pilot project "Energy renovation of buildings and use of renewable energy sources in public institutions engaged in education" - one project "Energy renovation of Primary School building" was completed in the territory of Osijek-Baranja County (OBZ). Vladimir Nazor ", Đakovo [9].

- Under Call 4c1.3. - "Energy renovation of buildings and use of renewable energy sources in public institutions engaged in education" [10] - 24 projects were implemented in the area of OBŽ; thus, the buildings of three kindergartens (Belišće, Đakovo, Našice), 11 primary school buildings (2x Čepin, Dalj, Feričanci, Koška, Ladimirevci, 2x Osijek, Semeljci, Valpovo and Vuka) and six regional school buildings (Črnkovci, Kapelna, Kotlina, Kozarac, Novi Beždan and Petlovac) and four high school buildings (Beli Manastir, Đakovo, Našice and Osijek). The annual heat demand for heating per unit area of the useful floor building area- QH_{nd} [kWh/(m²a)] - before construction works was 7,150 MWh per year in these buildings, and the projected future consumption will be 2,067 MWh per year - which makes projected savings of 71%.

- The annual primary energy consumption per useful floor area unit of the building E_{prim} [kWh/(m²a)] before reconstruction works was 10,848 MWh, and the projected future consumption will be 4,237 MWh per year (Annual primary energy per unit area of the useful floor space of an Eprim building [kWh/(m²a)] includes all energy before transformation used for heating, cooling, ventilation and domestic hot water preparation.) Fig. 1.

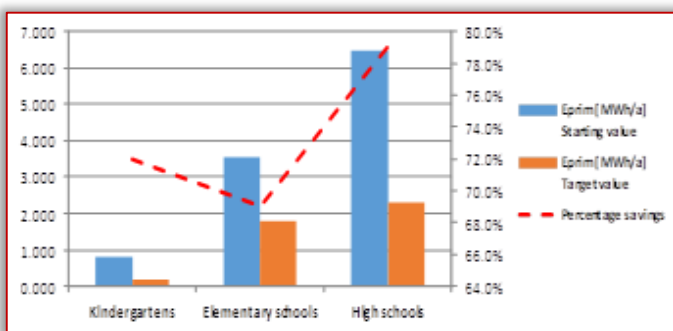


Figure 1. Required energy for heating per unit area of usable building area in energy renovated public buildings in Osijek-Baranja County [11]

- Under Call 4c1.4. (Energy Renewal and Use of Renewable Energy Sources in Public Sector Buildings) There are 11 projects in the area of OBŽ in which works have been started (in 8 settlements) or construction works have been completed (in 3 settlements). It is about energy renewal and use of renewable energy sources in buildings of voluntary

fire companies (5), buildings of sports facilities (3), community center (1), kindergarten (1) and administrative building of the local authority units (JLS) (1). The annual heat demand for heating per unit area of the useful floor area of the building - QH_{nd} [kWh/(m²a)] - before construction works amounted to 1,147 MWh per year in these facilities, and the projected future consumption will be 341 MWh per year - which makes projected savings of 70.3%

ENERGY RENEWAL CONTRACTS OF BUILDINGS IN THE AREA OF EASTERN CROATIA

—Energy renovation of apartment buildings

At the invitation of the Ministry of Construction and Physical Planning for the energy renovation of multi-residential buildings from the Slavonia region (five counties of Eastern Croatia; Fig. 2), over 100 projects (buildings) were submitted, of which 112 were accepted (from 20 settlements) for a total amount of 11.6 mil. € (Out of 648 submitted projects, 596 projects were accepted from all counties in the Republic of Croatia.) Fig. 3. The average value of the projects is 103,800 €.

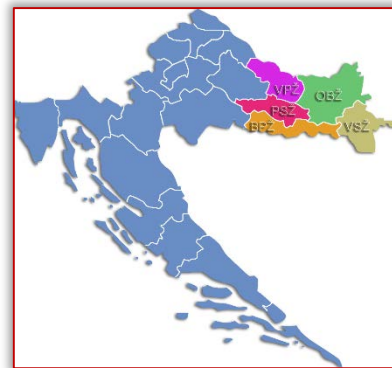


Figure 2. The five counties of Eastern Croatia

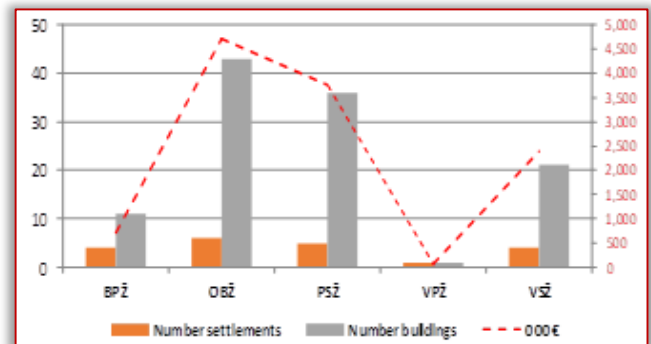


Figure 3. Number of settlements, number of buildings and amount of funds for energy renovation of multifamily buildings in the five counties of Eastern Croatia [9];

Legend: BPŽ = SlavonSKI Brod county; OBŽ = Osječko-baranjska county; PSŽ = Požeška county; VPŽ = Virovica county; VSŽ = Vukovar county;

In the case of energy renovation of multifamily buildings, construction works are undertaken to improve the thermal protection of the building envelope and to replace the exterior joinery; the projected savings for these projects are between 50%

and 70% of the heating/cooling energy per building. Table 1 shows the number of settlements and the number of apartments buildings in energy renovation by county.

Table 1. Number of settlements and number of multi-dwelling buildings under energy renovation in the five counties of Eastern Croatia, source [9]

| | BPŽ | OBŽ | PSŽ | VPŽ | VSŽ |
|----------------|-----|-----|-----|-----|-----|
| N° buildings | 4 | 6 | 5 | 1 | 4 |
| N° settlements | 11 | 44 | 35 | 1 | 21 |

—Energy renovation of public buildings

At the invitation of the Ministry of Construction and Physical Planning for the Energy Renovation of Public Buildings from the Five Counties of Eastern Croatia, over two hundred projects were submitted, of which 195 were accepted (out of 92 settlements) for a total amount of 49.6 mil. €. The average value of projects is 253,934 €, Fig. 4.

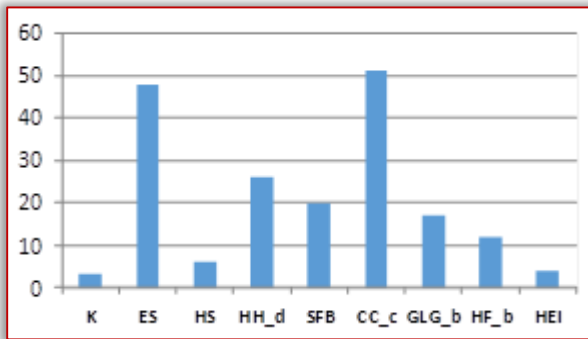


Figure 5. Number of public buildings by purpose to energy renovation on area of five counties of Eastern Croatia [9] [10];

Legend: K= kindergarten; E_s = elementary School; H_s = high school; HH_d = hospitals, health centers, dispensaries; SFB = sports facilities buildings; CC_C = community centers, culture centers, reading rooms; GLG_b = government and local government buildings; HF_b = homes of fire companies; HEI = homes for elderly and infirm

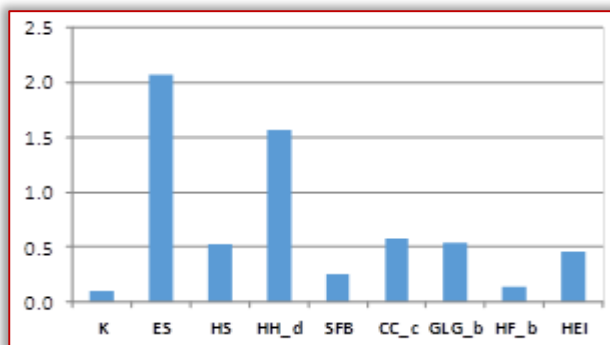


Figure 6. The value of the investment in energy renovation of public buildings by purpose in the five counties of Eastern Croatia (mil. €) [9] [10];

National currency average exchange rate for 1 € [13]

≡ Croatia = 7.4035 kuna;

- ≡ Bosnia and Herzegovina = 1.95583 convertible mark;
- ≡ Bulgaria = 1.9558 lev;
- ≡ Hungaria = 330.26 forint;
- ≡ Macedonia = 61.4893 denar;
- ≡ Romania = 4.7271 leu;
- ≡ Serbia = 117.8172 dinar;
- ≡ Turkey = 6.4594 lira

Base on the invitation from the Ministry of Construction and Physical Planning for the energy renovation the total contracted funding for energy renovation projects for apartments buildings and public buildings in the five counties of Eastern Croatia is shown in Fig. 7.

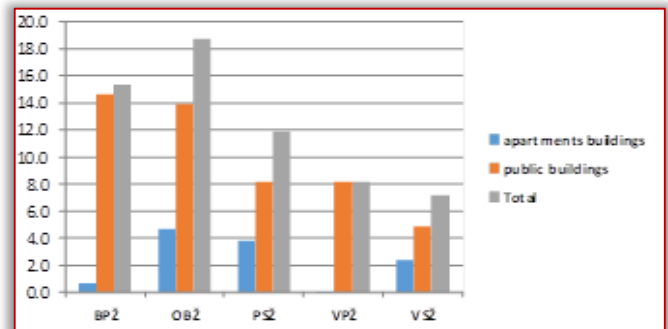


Figure 7. Total contracted funds for apartments buildings and public buildings to energy renovation projects in the five counties of Eastern Croatia (mil.€) [9] [10]

CONCLUSIONS

Following the adoption of national programs for the energy renovation of public and apartments buildings in the Republic of Croatia, grants from EU funds were secured in the preparatory phase for 3 years in the period from 2017 to 2019. Four public calls for energy renovation of public and apartments buildings were made. Within the framework of these public calls, local self-government units, counties, state bodies and public institutions (for public buildings) as building managers (for multi-residential buildings) from the five counties of Eastern Croatia applied over three hundred projects, of which 195 were accepted for public buildings in totaling € 49.6 million and 112 for apartment buildings totaling € 11.6 million. Therefore, at this stage of energy renovation of buildings in the five counties of Eastern Croatia, an energy renovation of 307 public-purpose and apartments buildings with a total value of € 61.2 million was agreed.

Most of these projects were implemented at the end of July and the rest will be completed by the end of 2019. According to projections from the contracted projects, the consumption of energy for heating/cooling will be reduced in the range from 52 to 81% for individual buildings.

The implementation of these projects is significant for several reasons:

- a) Energy consumption per unit of housing and business is reduced - which will have a positive impact on reducing the costs of family budgets and budgets of local and regional self-government units and state bodies.
- b) Imports of energy (natural gas, petroleum products, and electricity) to Croatia are decreasing - which contributes to improving the country's trade balance.
- c) CO₂ emissions are reduced - which contributes to the fulfillment of Croatia's obligations under the Kyoto Protocol, that is, to preserve the planet's climate regime.
- d) Local labor is employed in the construction sector - contributing to a reduction in unemployment and an increase in GDP in Croatia.

With regard to all of the above, we warn fuel distributors and central heating systems in the five counties of Eastern Croatia of the need for a more detailed reference to energy renovation projects for buildings to harmonize their business procurement plans for energy delivery on time [12].

Note:

This paper is based on the paper presented at IIZS 2019 – The 9th International Conference on Industrial Engineering and Environmental Protection, organized by Technical Faculty “Mihajlo Pupin” Zrenjanin, University of Novi Sad, in Zrenjanin, SERBIA, in 03–04 October, 2019.

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ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering
ISSN: 2067-3809
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