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ENERGY BALANCES OF PUBLIC BUILDINGS IN THE CITY OF NOVI SAD

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Abstract: The aim of the study was to analyze the cost of energy services to the buildings of public use in the City of Novi Sad. The analysis considered the average amount of used energy, energy costs and CO₂ emissions, as well as the average value of energy indicators (specific annual consumption of electricity, specific annual heat consumption, specific annual water consumption). This detailed representation of the size of energy indicators should represent a benchmark for future energy projects which need to be performed in order to achieve energy savings of at least 1% per annum. Also, this paper presents a preliminary design of a new energy-efficient facility self-heating eco-house, the future building of the Energy Agency of Novi Sad.

Keywords: Energy efficiency, energy balance, renewable energy sources

1. INTRODUCTION

Houses of our ancestors were energy sustainable, as made from natural materials, wood, mud, cane, land and similar materials. But, after the Second World War in the former Republic of Yugoslavia was not taken into account the quality and comfort of the then housing, but the quality, also to be as soon as possible address the issue of the large influx of rural population to the cities.

The largest number of residential buildings in the Republic of Serbia today is in energy class G, which means that for heating consume more than 175 kWh/m² per year. [1] Here we should also add the fact that because of the age of buildings and installations on them from year to year increase maintenance costs. The average energy required to heat buildings in Serbia is about 2.5 times higher than in EU countries. In Serbia, 70% of the buildings has no insulation, which is one reason why they spend about 40% of energy. For investment in high-quality insulation is necessary today an investment of 18 €/m². One of the main reasons for implementing energy efficiency in buildings is the protection of the environment, or. reduction of CO₂ and other harmful gases into the atmosphere [2-4]. For example, the application of measures of economic efficiency of CO₂ and other harmful gases in Germany was reduced by 27%, and today the Federal Republic of Germany 1/3 of its energy gets from renewable energy sources.

The European Commission has proposed a five-point action plan for European energy security and solidarity through [5]:

- ≡ construction of infrastructure and the diversification of energy supplies;
- ≡ international energy relations;
- ≡ creation of oil and gas reserves and the mechanisms of response to emergencies;
- ≡ energy efficiency; and,
- ≡ best use of domestic resources within the EU.

Efficient use of energy achieve the following aims [6]:

- ≡ increase the security of supply of energy and its efficient use;
- ≡ increasing the competitiveness of the economy;
- ≡ reducing the negative impact of the energy sector on the environment;
- ≡ encouraging responsible behavior towards energy policy based on the implementation of efficient energy use and energy efficiency measures in the sectors of production, transmission, distribution and consumption of energy.



2. ENERGY AGENCY CITY OF NOVI SAD

Energy Agency of the City of Novi Sad was established in 2005; its founder is the Assembly of Novi Sad. The Agency is a legal entity and was established in order to carry out development, technical and regulatory affairs in the field of energy within the jurisdiction of the City, as well as activities in the field of energy by the Republic or the Community of Vojvodina delegated to the City.

The role of the Agency consists of continuous and quality performance of development, technical and regulatory affairs in the energy sector of the City and the implementation of the priority objectives of the energy policy of the city, such as:

- ≡ ensuring optimal and secure energy supply and energy in the City,
- ≡ create strategies and plans for sustainable energy development of the City,
- ≡ reduce energy consumption, reaching and maintaining to a certain quality of municipal services and comfort in public buildings,
- ≡ reduction of energy consumption in the private and commercial sectors, and that this is not at risk of quality housing, and the performance of commercial activities,
- ≡ reduce energy consumption, and energy costs in public utility companies, along with reaching and maintaining adequate quality of municipal services,
- ≡ use of renewable energy with the maximum use of resources in the City,
- ≡ creating conditions to as many users as they become available and accessible different fuels (gas, heat, electricity, renewable energy sources)
- ≡ reducing negative impacts on the environment from the use of that energy, and due to other activities,
- ≡ education of the population about the rational use of energy, examples of energy efficient appliances and renewable forms of energy.

After 31 December 2020, all new buildings in the EU will have to spend energy in the amount of "close to zero" and energy could significantly should be covered from renewable sources. Today, across Europe are build buildings that produce up to 5 times more energy than they consume. One such project of highly efficient buildings (future building of the Energy Agency of the City of Novi Sad) was done by academician Veljko Milkovic [7]. Property area basically is 600 m². It is the office building Self-Heating Eco House, which is characterized by: sustainable construction, eco-innovation, high energy efficiency, passive solar architecture, vertical greening, etc. figure 1. At the facility reflective surface to 2.5 times increases light and heat in the building. From the renewable energy sources are represented solar energy (panels and collectors), heat pump and biomass boiler.



Figure 1. The appearance of the future building of the Energy Agency of the City of Novi Sad

3. MATERIAL AND METHODS

The aim of this work was to be done the energy balance of 207 objects (tab.1) public spending in the City of Novi Sad in 2014. The analyzed objects of public spending in the City of Novi Sad are the responsibility of different actors and different levels of administration. The analysis also considered the average amount of energy used, energy costs and CO₂ emissions, as well as the average value of energy indicators (specific annual consumption of electricity, specific annual heat consumption, specific annual water consumption).

4. RESULTS AND DISCUSSION

In table 2 are shown the amount of used energy, energy costs and CO₂ emissions observed at public facilities in 2014. On observed facilities totaled 22,551,932 kWh of electricity, 23,506,254 kWh of heat energy and 24,766,469 m³ of natural gas, table 2. Total costs for energy products amounted to





526,527,591 dinars, ie. for electricity 158,682,691 dinars, for heat energy 233,103,435 dinars and for natural gas 134,741,465 dinars, table 2. For the total spent energy into the atmosphere is emitted 43,001,252 kg CO₂, i.e. for electricity is emitted 24,378,552 kg CO₂, for heat energy 9,391,582 kg CO₂ and for spent natural gas 9,231,118 kg CO₂, table 2.

Table 1. The analyzed objects of public spending in 2014.

Groups of public buildings by function	The types of public facilities	Number of objects
Facilities of educational institutions	Kindergartens	75
	Elementary schools	39
	High Schools	16
Health centers	Health clinics	29
	Pharmacy	19
	Health institutions	6
Facilities of social protection	Nursing center	2
	Others	1
Facilities of Cultural Institutions	Community centers	2
	Theatres	2
	Museums	1
	Others	6
Administrative buildings	Administration buildings municipal / city / state	2
	Public buildings and public utility companies	7

Table 2. Spent amount of energy, energy costs and emissions of CO₂

Energent	Consumption of energy	Costs for energy	Emission CO ₂
Electricity	22,551,932 kWh	158,682,691 din	24,378,552 kg
Heat energy	23,506,254 kWh	233,103,435 din	9,391,582 kg
Natural Gas	24,766,469 m ³	134,741,465 din	9,231,118 kg
T O T A L =		526,527,591 din	43,001,252 kg

Table 3. Average values of energy indicators and specific costs in the energy balance

Analysed facilities	Energy indicators for 2014					
	Specific annual electricity consumption		Specific annual heat consumption		Specific annual water consumption	
	Per unit area of the object (kWh/m ² per year)	According to user (the actual number of regular users) (kWh/user per year)	Per unit of heating surface of the object (kWh/m ² per year)	According to user (the actual number of regular users) (kWh/user per year)	Per unit area of the object (m ³ /m ² per year)	According to user (the actual number of regular users) (m ³ /user per year)
Utility companies	81	787	85	8,360	17.76	46.18
Cultural institutions	58	2,303	103	5,976	44.97	756.24
Elementary schools	29	193	133	862	0.90	7.54
High schools	66	354	146	506	0.70	3.16
Health institutions	78	1,148	289	4,376	1.18	23.75
Institutions of social protection	123	914	289	2,075	3.72	29.23
Health clinics	59	1,276	236	5,319	1.29	30.22
Pharmacy	108	1,839	122	2,447	1.46	28.55
Preschool institutions	50	510	138	2,148	1.63	10.79
Administrative buildings	32	814	65	1,633	0.16	3.21
AVERAGE CONSUMPTION	68.40	1,013.80	160.60	3,370.20	7.38	93.89

In table 3 are shown the average values of energy indicators (specific annual consumption of electricity, specific annual consumption of heat energy, specific annual water consumption) for 2014. Thus, the specific annual electricity consumption was lowest in administrative buildings 32 kWh/m² yr., and highest in social care institutions 123 kWh/m² per year, table 3. Lowest specific annual heat consumption was in the administrative buildings of 65 kWh/m² per year, and the highest in health





institutions and institutions of social protection 289 kWh/m² per year, tab.3. The lowest specific annual water consumption was in the administrative buildings of 0.16 m³/m² per year, and the highest in cultural institutions 44.97 m³/m² per year, table 3.

The results presented in table 3 indicate that there is scope for improving energy efficiency in certain public buildings in the city of Novi Sad. One of the models of energy efficiency improvements could certainly be a model public-private partnership called. ESCO model investment.

5.CONCLUSIONS

In recent years, a household is a term that energy efficiency is the newest renewable energy source. Legal regulation in the Republic of Serbia has prescribed that from 2012 all new buildings must have energy passports, and improving energy efficiency is considered to be the public interest. The spearheads of application flows of energy efficiency should be a local government, which should become producers and not just consumers of energy. In the case of public buildings in the city of Novi Sad were identified the biggest consumers of energy, which will be the highest investments in the energy efficiency of buildings.

Note

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