

ENERGY OPTIMIZATION OF SERBIAN BUILDINGS WITH PV PANELS AND DIFFERENT HEATING SYSTEMS

ENERGETSKA OPTIMIZACIJA SRPSKIH KUĆA SA FOTONAPONSKIM PANELIMA I RAZLIČITIM GREJNIM SISTEMIMA

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Today, renewable energy plays an elementary role in resolving environmental pollution and global warming problems. Solar energy has become a promising alternative source due to its advantages: abundance, pollution free, and renewability. In this paper, possibilities to decrease energy consumption of residential buildings are analyzed. The buildings with electrical energy generated by PV system and different space heating systems (electric heating, district heating) are investigated. The major aims are to determine the area of the PV array installed on the roof and to minimize the energy consumption. Then, it is possible to achieve the zero-net energy building (ZNEB) or positive-net energy building (PNEB). The buildings were simulated in EnergyPlus environment. Open Studio plug-in in Google SketchUp was used for buildings design, Hooke-Jeeves algorithm for optimization, and GENOPT software for software execution control during optimization.

Keywords: ZNEB; Photovoltaic; Heating system, Optimization; Simulation

Obnovljivi izvori energije danas imaju elementarnu ulogu u rešavanju problema zagadjenja zivotne sredine i u globalnog zagrevanja. Solarna energija je postala vodeći izvor obnovljive energije, zbog svojih prednosti: neiscrpnog izvora, osobine da ne zagadjuje životnu sredinu i obnovljivosti. U ovom radu analizirane su mogućnosti za smanjenje potrošnje energije kod porodičnih zgrada. Istraživana je zgrada sa PV sistemom za generisanje električne energije i sa različitim sistemima grejanja (električno grejanje, daljinsko grejanje). Glavni cilj istraživanja je da se odredi potrebna veličina PV panela, instaliranih na krovu zgrade, i da se minimizira potrošnja energije. Na taj način, moguće je dostići koncept neto-nulte energetske zgrade (zero net-energy building - ZNEB) ili neto-pozitivne energetske zgrade (positive net-energy building - PNEB). Zgrade su simulirane u okruženju softvera EnergyPlus. Open Studio plug-in u Google SketchUp-u je korišćen za dizajniranje zgrade, Hooke-Jeeves algoritam za optimizaciju, a GENOPT softver za izvršnu kontrolu softvera pri optimizaciji.

Ključne reči: Neto-nulta energetska zgrada (ZNEB); fotonaponski (PV) paneli; grejni sistem; optimizacija; simulacija;

1. INTRODUCTION

The research and development of renewable energy resources and use have significant impact on the environment nowadays. The reasons for that are lower world reserves of oil, gas and coal, and, also, the increasing problems of global warming, greenhouse gases and air pollution [1].

An attractive option for clean and renewable electricity generation is solar photovoltaic (PV) technology. This technology represents the direct conversion of solar radiation into electricity. The PV systems are still an expensive option for producing electricity compared to other energy systems, but, many countries support this technology.

In Serbia, the building sector consumes more than 50% of the used energy. Around 24% of the total building floor area is heated by electricity [2]. An intention of our country to become a member of EU obliges us to reduce the energy consumption by 20% and to obtain 20% of total energy from renewable energy by 2020 [3]. To achieve these goals, some advanced energy concepts for built environment should be applied

