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Optimization of photovoltaics panels area at Serbian zero-net energy building

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In this study, the possibilities to decrease energy consumption of a residential building in Serbian conditions are analyzed. The building uses electricity for space heating system, heating of domestic hot water, lighting, and for other electric equipment. The electrical energy is generated by photovoltaics (PV) system and it may be consumed by the building or may be fed-in to the electricity grid. The major aim of the optimization of PV area is to determine the avoided electricity from the grid (avoided exergy), and to minimize the consumption of primary energy. The residential buildings with variable thermal insulation thickness, hot water consumption, life time, and PV's embodied energy are investigated, in order to achieve zero-net energy building or positive-net energy building. The buildings are presented by a mathematical model, in EnergyPlus environment. Open Studio plug-in in Google SketchUp was used for building virtual design, Hooke-Jeeves algorithm for optimization, and GENOPT software for software execution control. For the different areas of photovoltaics, the investigations gave the results for their optimal values. In that way, the fossil energy consumption and CO_2 emission are also minimized. © *2013 AIP Publishing LLC*. [http://dx.doi.org/10.1063/1.4817809]

I. INTRODUCTION

Nowadays, the research and development of renewable energy resources and the use of renewable energy is essential, because the renewable energy systems have a significant impact on the environment. The reserves of oil and gas, at current rates of consumption, would be adequate for another 40 and 60 yr, respectively, and the reserves for coal could be adequate for at least the next 250 yr.[1] Also, the problem is the global warming and increasing problem of greenhouse gases and air pollution. The "TRIPLE 20" goal for 2020, in the EU countries aims to reduce greenhouse gas emissions and energy consumption by 20% and simultaneously incorporate 20% renewable energy into energy consumption.

Photovoltaic (PV) energy conversion is one of the more promising renewable energy technologies which contribute significantly to a sustainable energy supply and which may help to mitigate greenhouse gas emissions.[2] PV energy conversion represents the direct conversion of sunlight into electricity. A PV generation system consists of multiple components such as PV cells, mechanical and electrical connections and mountings. Commercial PV materials commonly used for photovoltaic systems include solar cells of multi-crystalline-silicon (mc-Si), single-crystalline-silicon (sc-Si), amorphous-silicon (a-Si), cadmium-telluride (CdTe), copper-indium-diselenide (CIS) and of other thin layer materials.[3–5] The PV systems are still an expensive option for producing electricity compared to other energy sources. But many countries support this technology. Over the last five years, the global PV industry has grown more than 40% each year.[6]

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