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## ENERGY OPTIMIZATION OF SERBIAN BUILDINGS WITH PV PANELS AND GAS HEATING SYSTEM

**Abstract:** For clean and renewable electricity generation, solar photovoltaic (PV) technology is the best option. Solar energy has become a promising alternative source due to its advantages: abundance, pollution free, and renewability. On the other hand, gas heating system is an low-temperature and low-energetic system. In this paper, the possibilities to decrease energy consumption of Serbian residential buildings are analyzed. The building with gas space heating and electrical energy generated by PV system is investigated. The major aim is to determine the area of the PV array in order to minimize the consumption of primary energy. The residential buildings with variable thermal insulation thickness, variable domestic hot water consumption and variable types of PV panels are investigated in order to achieve positive-net energy building (PNEB). The buildings are 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. The obtained results gave the optimal size of PV array.

**Keywords:** PNEB; Photovoltaic; Gas heating system, Optimization; Simulation;

### 1. INTRODUCTION

Nowadays, building sector consumes about 40 % of the consumed energy. In Serbia, building sector consumes more than 50 % of the consumed energy [1]. Also, the world's reserves of oil, gas and coal are lower, and problems of global warming, greenhouse gases and air pollution are increasing. Because of that, research and development of renewable energy resources and use have significant impact on the environment [2]. An attractive option for clean and renewable electricity generation is solar photovoltaic (PV) technology, which represents the direct conversion of solar radiation into electricity. On the other hand, gas heating system is a low-temperature heating system. So, the building with two of these systems can be zero-net energy building (ZNEB) or positive-net energy building (PNEB).

In the recent years, many of scientists defined ZNEB and PNEB [3]. By definition, ZNEB produces all energy it consumes during year, and the yearly electrical energy supplied

to the electricity grid balances that received from the electricity grid. The PNEB produces more energy than it consumes during year, and the yearly electrical energy supplied to the electricity grid is higher than that received from the electricity grid [4].

From solar energy, the building produces electrical energy by the PV array on its roof.

This article reports investigations of the possibilities to decrease energy consumption of Serbian residential buildings with PV array and gas heating systems, through the variation of thermal insulation thickness and electricity consumption in building.

The major objective of this investigation is to determine the size of PV panels on the roof in order to minimize the consumption of primary energy.

The investigated buildings were located in Kragujevac, Serbia. In these buildings, electricity was used to satisfy energy needs for lighting, appliances, and DHW heating. In these simulations, the heating devices would operate from 15 October to 14 April next year.









