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Hybrid Renewable Energy System Development Towards Autonomous Operation: The Deployment Potential in Greece

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Abstract : A notable amount of electrical energy demand in many countries worldwide is used to cover public energy demand for road, square and other public spaces' lighting. Renewable energy can contribute in a significant way to the electrical energy demand coverage for public lighting. This paper focuses on the sizing and design of a hybrid energy system (HES) exploiting the solar-wind energy potential to meet the electrical energy needs of lighting roads, squares and other public spaces. Moreover, the proposed HES provides coverage of the electrical energy demand for a Wi-Fi hotspot and a charging hotspot for the end-users. Alongside the sizing of the energy production system of the proposed HES, in order to ensure a reliable supply without interruptions, a storage system is added and sized. Multiple scenarios of energy consumption are assumed and applied in order to optimize the sizing of the energy production system and the energy storage system. A database with meteorological prediction data for 51 areas in Greece is developed in order to assess the possible deployment of the proposed HES. Since there are detailed meteorological prediction data for all 51 areas under investigation, the use of these data is evaluated, comparing them to real meteorological data. The meteorological prediction data are exploited to form three hourly production profiles for each area for every month of the year; minimum, average and maximum energy production. The energy production profiles are combined with the energy consumption scenarios and the sizing results of the energy production system and the energy storage system are extracted and presented for every area. Finally, the economic performance of the proposed HES in terms of Levelized cost of energy is estimated by calculating and assessing construction, operation and maintenance costs.

Keywords : energy production system sizing, Greece's deployment potential, meteorological prediction data, wind-solar hybrid energy system, levelized cost of energy
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