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Exploring the Energy Saving Benefits of Solar Power and Hot Water Systems: A Case Study of a Hospital in Central Taiwan

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Abstract : introduction: Hospital buildings require considerable energy, including air conditioning, lighting, elevators, heating, and medical equipment. Energy consumption in hospitals is expected to increase significantly due to innovative equipment and continuous development plans. Consequently, the environment and climate will be adversely affected. Hospitals should therefore consider transforming from their traditional role of saving lives to being at the forefront of global efforts to reduce carbon dioxide emissions. As healthcare providers, it is our responsibility to provide a high-quality environment while using as little energy as possible. Purpose / Methods: Compare the energy-saving benefits of solar photovoltaic systems and solar hot water systems. The proportion of electricity consumption effectively reduced after the installation of solar photovoltaic systems. To comprehensively assess the potential benefits of utilizing solar energy for both photovoltaic (PV) and solar thermal applications in hospitals, a solar PV system was installed covering a total area of 28.95 square meters in 2021. Approval was obtained from the Taiwan Power Company to integrate the system into the hospital's electrical infrastructure for self-use. To measure the performance of the system, a dedicated meter was installed to track monthly power generation, which was then converted into area output using an electric energy conversion factor. This research aims to compare the energy efficiency of solar PV systems and solar thermal systems. Results: Using the conversion formula between electrical and thermal energy, we can compare the energy output of solar heating systems and solar photovoltaic systems. The comparative study draws upon data from February 2021 to February 2023, wherein the solar heating system generated an average of 2.54 kWh of energy per panel per day, while the solar photovoltaic system produced 1.17 kWh of energy per panel per day, resulting in a difference of approximately 2.17 times between the two systems. Conclusions: After conducting statistical analysis and comparisons, it was found that solar thermal heating systems offer higher energy and greater benefits than solar photovoltaic systems. Furthermore, an examination of literature data and simulations of the energy and economic benefits of solar thermal water systems and solar-assisted heat pump systems revealed that solar thermal water systems have higher energy density values, shorter recovery periods, and lower power consumption than solar-assisted heat pump systems. Through monitoring and empirical research in this study, it has been concluded that a heat pump-assisted solar thermal water system represents a relatively superior energy-saving and carbon-reducing solution for medical institutions. Not only can this system help reduce overall electricity consumption and the use of fossil fuels, but it can also provide more effective heating solutions.

Keywords : sustainable development, energy conservation, carbon reduction, renewable energy, heat pump system
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