

# **Developing a Smart Home Energy Management System and Economic Feasibility Analysis of Residential Renewable Generators in Oman**

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## **Abstract**

There has been an increase in the use of Photovoltaic (PV) systems in residential buildings due to their growing accessibility and affordability, as well as the shift in consumer preferences toward more environmentally friendly and sustainable energy generation alternatives. Moreover, these systems are highly effective in reducing the increasing cost of electricity supplied from the grid. The emergence of the Internet of Things (IoT) technologies, such as smart home appliances, that can be controlled remotely or directly reveals a potential for maximizing the benefits of these renewable generators. To realize this potential, this study develops a Home Energy Management System (HEMS) that minimizes the electricity cost and maximizes customer satisfaction by scheduling the run times of appliances and the charging and discharging times of the integrated storage system. The system considers the electricity tariff rates that vary depending on energy consumption levels and the ability to import from and export to the grid. We developed a mixed integer programming formulation and a novel heuristic algorithm and implemented them in CPLEX OPL and Python, respectively. We developed a user-friendly decision support system to help the average user schedule household appliances. We also analyzed many scenarios to investigate the economic feasibility of utilizing PV panels using actual data from Oman. We determined the breakeven points for different parameters and performed sensitivity analyses.

## **Keywords:**

Smart energy , management of home energy, economic ,feasibility ,analysis

## **Biographies**

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