

Central Energy Management for Optimizing Utility Grid Power Exchange with a Network of Smart Homes

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Abstract : Smart homes are small energy systems which may be equipped with renewable energy sources, storage devices, and loads. Energy management strategy plays a main role in the efficient operation of smart homes. Effective energy scheduling of the renewable energy sources and storage devices guarantees efficient energy management in households while reducing the energy imports from the grid. Nevertheless, despite such strategies, independently day ahead energy schedules for multiple households can cause undesired effects such as high power exchange with the grid at certain times of the day. Therefore, the interactions between multiple smart home day ahead energy projections is a challenging issue in a smart grid system and if not managed appropriately, the imported energy from the power network can impose additional burden on the distribution grid. In this paper, a central energy management strategy for a network consisting of multiple households each equipped with renewable energy sources, storage devices, and Plug-in Electric Vehicles (PEV) is proposed. The decision-making strategy alongside the smart home energy management system, minimizes the energy purchase cost of the end users, while at the same time reducing the stress on the utility grid. In this approach, the smart home energy management system determines different operating scenarios based on the forecasted household daily load and the components connected to the household with the objective of minimizing the end user overall cost. Then, selected projections for each household that are within the same cost range are sent to the central decision-making system. The central controller then organizes the schedules to reduce the overall peak to average ratio of the total imported energy from the grid. To validate this approach simulations are carried out for a network of five smart homes with different load requirements and the results confirm that by applying the proposed central energy management strategy, the overall power demand from the grid can be significantly flattened. This is an effective approach to alleviate the stress on the network by distributing its energy to a network of multiple households over a 24- hour period.

Keywords : energy management, renewable energy sources, smart grid, smart home

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