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Modeling and energy dispatching for a small-scale hybrid photovoltaic-battery grid (PBG) system using model predictive control (MPC)

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Rapid development of global economy has remarkably increased energy requirements. The realization that fossil fuel resources required for the generation of energy are depleting and that climate change is related to carbon emissions to the atmosphere has increased interest in energy saving and environmental protection. The first strategy to reduce dependence on fossil resources is based on reducing power consumption by applying energy savings programs focused on energy demand reduction and energy efficiency in industrial and domestic applications. In this study, the problems of modeling and energy dispatching for a small-scale hybrid photovoltaic-battery-grid (PBG) system using model predictive control (MPC) has been investigated. Artificial neural network (ANN) based global solar radiation forecast is used to plan in advance for periods of low sunshine. Electrical appliances of the house are divided into critical loads (hot water cylinder, lighting, power sockets and cooking range) and non-critical loads (dish washer, washing machine and dryer) and the MPC is able to shift non-critical loads operation to the period when excess PV energy is available by utilizing the solar radiation forecast. Excess PV energy is utilized within the house to further increase hot water temperature in the hot water cylinder rather than exporting all available excess PV energy to the grid. Optimization is used to maximize PV array utilization with in the residential house and reduce grid imports. Performance of the overall model predictive control based hybrid energy system is verified by simulation results.

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