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Integration of Renewable Energy System and Efficient Demand Side Response in Smart Grids

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Abstract: *The Smart Grid, regarded as the next generation power grid, uses two-way flows of electricity and information to create a widely distributed automated energy delivery network. In this article, we survey the literature till 2011 on the enabling technologies for the Smart Grid. We explore three major systems, namely the smart infrastructure system, the smart management system, and the smart protection system. We also propose possible future directions in each system. Specifically, for the smart infrastructure system, we explore the smart energy subsystem, the smart information subsystem, and the smart communication subsystem. For the smart management system, we explore various management objectives, such as improving energy efficiency, profiling demand, maximizing utility, reducing cost, and controlling emission. We also explore various management methods to achieve these objectives. For the smart protection system, we explore various failure protection mechanisms which improve the reliability of the Smart Grid, and explore the security and privacy issues in the Smart Grid. The design of efficient Demand Response (DR) mechanisms for the residential sector entails significant challenges, due to the large number of home users and the negligible impact of each of them on the market. We propose a Multi objective model for the DSM in smart grid where a set of competing aggregators act as intermediaries between the utility operator and the home users. The operator seeks to minimize the smart grid operational cost and offers rewards to aggregators toward this goal. Profit-maximizing aggregators compete to sell DR services to the operator and provide compensation to end users in order to modify their preferable consumption pattern using optimization strategies. Finally, end-users seek to optimize the trade-off between earnings received from the aggregator and discomfort from having to modify their pattern. In this context, interruptible loads are consumers who agree to be interrupted, as required and within constraints, to maintain system security or reduce market prices, and are compensated by paying reduced tariffs. These consumers are generally large industrial customers with their own backup generation or those that can easily reschedule production. They can also be residential customers who want to save on their electricity bill, or retail electricity providers that aggregate the consumption of small customers. In accordance to contractual arrangements, the utility can directly interrupt supply to the customer, or the customer can disconnect or reduce consumption at the direct request of the utility.*

Keywords: Smart Grid, Demand Response, smart management system, DSM

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