

AN INVENTORY THEORY FRAMEWORK FOR THE ANALYSIS OF PROBABILISTIC DEMAND RESPONSE SCHEMES

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This work has two main contributions. First we conceptually describe probabilistic demand response schemes and argue that such schemes are particularly well-suited for dynamically managing demand in the residential consumption sector. However, these schemes are relatively new and there is little or no theoretical guidance for their development and evaluation. Our second contribution is therefore to describe a methodology for analyzing these schemes which incorporates the respective costs of supply generation, spinning reserve, and storage or deferment, into an operational objective function that is similar to the well-known newsvendor model, but with suitable modifications for the smart grid context. We derive sufficient conditions on the distributions of the responsive load in order to optimize this operational objective as a function of the supply generation level, and the magnitude of the response signal. These conditions are used to examine the suitability of various probabilistic demand response schemes in the single-period and multiple-period contexts.