

Title: CMU-Portugal Project

Duration: 1/11 – 6/13

Sponsor: Carnegie Mellon Portugal Program

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**Description:**

In this project, we propose methods for operating smart energy consuming appliances and energy storage under uncertainty. Electric energy and ancillary service market participants face many forms of uncertainty. There is uncertainty in future market prices as well as future ancillary service needs of the electrical grid. Multiple publications resulted from this work, including the monograph *Engineering IT Enabled Sustainable Energy Systems*. A journal publication dealt with decision making by electric vehicles that can provide frequency regulation but must also fill their batteries for driving. Finally, a conference paper was published describing a method for managing stationary energy storage to both arbitrage energy prices and provide frequency regulation to the electric grid under various uncertainties.