Computational Models Development and Demand Response Application for Smart Grids

R. Pereira[1,2], J. Figueiredo[1,3], J.C. Quadrado[4]

[1] CEM/IDMEC, University of Évora, Évora, Portugal
[2] Lisbon Superior Engineering Institute, Lisbon, Portugal, rpereira@deea.isel.pt
[3] IDMEC, Instituto Superior Técnico, Technical University of Lisbon, Lisbon, Portugal
[4] Porto Superior Engineering Institute, Porto, Portugal

Abstract. This paper focuses on computational models development and its applications on demand response, within smart grid scope. A prosumer model is presented and the corresponding economic dispatch problem solution is analyzed. The prosumer solar radiation production and energy consumption are forecasted by artificial neural networks. The existing demand response models are studied and a computational tool based on fuzzy clustering algorithm is developed and the results discussed. Consumer energy management applications within the InovGrid pilot project are presented. Computation systems are developed for the acquisition, monitoring, control and supervision of consumption data provided by smart meters, allowing the incorporation of consumer actions on their electrical energy management. An energy management system with integration of smart meters for energy consumers in a smart grid is developed.

Keywords: Smart Grids, Prosumers, Demand Response, Energy Management Applications.

1 Introduction

Traditional power grid was designed to operate according to a vertical structure defined by generation, transmission and distribution, supported by several control devices which guarantee the power grid stability, reliability and efficiency [1]. Nowadays the traditional power grid is a system supported by obsolete technology [2] and at the same time it has to deal with new challenges such as increasing consumption, more inaccessible and costly fossil fuels, penetration of renewable source generation, energy markets and several power grid stakeholders. Allowing an active participation of energy consumers, reducing greenhouse gas emissions and minimizing the new implantation of traditional power plants, are other challenges that should be considered [1-3]. In order to provide an answer to these challenges, the smart grid appears as a key element for future power grid design. Mainly because smart grids allow bidirectional power flow and data communication, also because they are based on digital technology and permit to offer new services to consumers supported by smart metering, digital control technologies and by the increasing consumption awareness.