

AGENT BASED SMART GRID MODELLING

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ABSTRACT

Though it is an era of technological advancement and autonomy, due to increase in population and the use of electrical equipment and electronic gadgets rising parallel yields problem of high energy consumption and demand. To meet this increasing energy demand several approaches have been developed. One approach to meet energy demand is to control energy usage by implementing energy efficient methods like micro grid and building management system. Another approach is green energy also known as renewable energy that is generated by natural resources like wind, rain and sunlight instead of conventional fuels. Wind and solar energy have gained much popularity.

This paper presents a smart grid simulation model based on the combination of IT-based energy management system and green energy.

1 INTRODUCTION

Smart grid is one of the energy demand efficiency methods using green energy and intelligent IT infrastructure. Unlike traditional grid systems it does not consist of centralized electricity system, each participant in energy grid acts as an agent and takes part as an active decision making agent. Smart grid has the intelligent IT systems for both end communication and digital processing from consumer to distributor and vice versa, for example a smart meter for user end and data based smart decision system for energy distributor. These elements of intelligent IT system play supportive role to achieve energy efficiency. Many researchers have been working in this area and have recently developed testbed which proves its effectiveness against traditional energy systems. However, validation of effectiveness of smart grid remains unproved due to lack of objective data availability, causing hurdles for further development of research process. Therefore this paper comes up with an idea of simulation model using agent-based simulation (ABS) technique, which can be utilized for the validation of effectiveness prior to construct the smart grid test-bed.

2 AGENT-BASED SMARTGRID SIMULATION MODEL

Traditional research is based on overall energy system neglecting micro elements of the system. Individuals like energy suppliers and consumers are the micro elements of system not considered in earlier research (P. Macro, G. Reinhard. 2013). Micro grid research deals with overall energy system (J. Oyarzaba et al. 2002) while study about smart grid deals with simple agents (S. Karnouskos, T. N. Holanda, 2009) or technical approaches (T. Godfrey et al. 2010). So, proposed simulation model does not only consider overall system but the micro aspects as well. Every individual of the system may act as an agent and take part in decision making, for demonstration of individual elements like residences, buildings, and factories agent based modeling approach aligns quite well. In this way, proposed model includes demand end of the system. While to cover up the energy generation and supply end of the system proposed model includes Discrete Event Simulation (DES) approach. Proposed simulation model also encompasses Energy Management System (EMS) approach to serve the purpose of communication between two ends.

Design of the model consists three layers, supply layer, EMS layer and Demand layer. Figure 1 depicts the conceptual structure of the model.

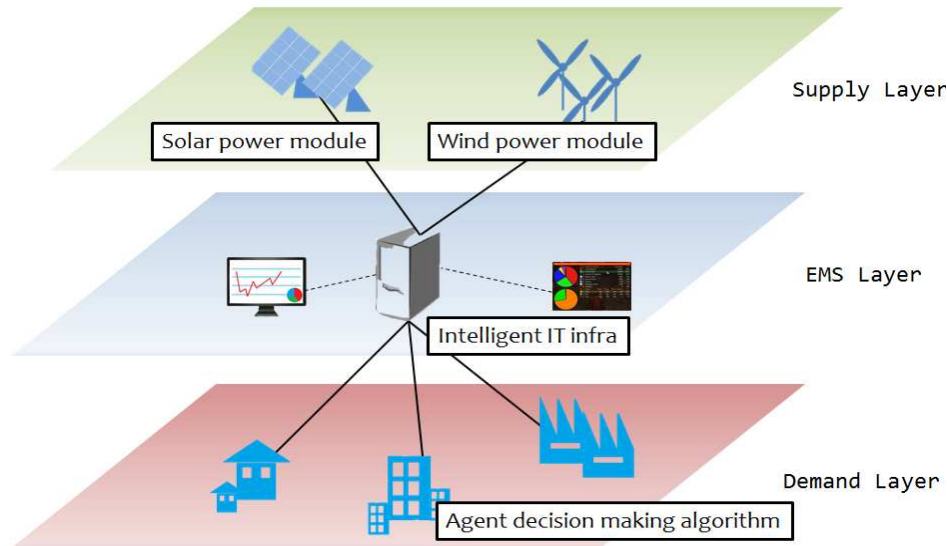


Figure 1. Smartgrid simulation model structure

- Supply layer splits in to various sub modules, each of them represents renewable energy resource. Solar and wind power modules are part of this layer.
- Demand layer contains different agents, each representing residential, commercial and industrial unit. The layer holds an agent's behavior algorithm using time-based demand transition. Additionally, this layer also comprises BDI model for a more accurate and detailed demonstration.
- EMS layer expresses an IT infrastructure in smart grid. It collects data from supply and demand layer and controls the energy flow in grid.

3 CONCLUSION AND FUTURE WORK

Increase in energy consumption and demand is being faced around the globe, even in advanced countries. Smart grid has emerged as influential technology as a solution to this problem. By using ABS based smart grid simulation model, pre-test can be carried out before constructing smart grid. The model proposes an interface that allows to change the properties of agents and system environment actively, using diverse situation. Validation of test-bed and extension of this model by using actualization agents, to be more accurate, can be the future of this research.

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