

# Abstract

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## **Micro Grid Energy Management Using Multi Agent Systems**

The traditional grid has a centralized generation, which was far away from the load due to the nature of the generation whether a hydro generation steam power plants etc., this leads to a long transmission line was needed to transmit the power from the generation point to the loads. After a period of time, the Distributed Generators (DGs) had appeared to solve this problem, these DGs can be existed near the loads. The distributed generations start to spread a lot at the grids, this leads to increase the control actions to operate these DGs leading to increasing the number of controllers. These controllers needs a communication buses in order to send and receive messages to take the appropriate action. The term smart grid is appeared to monitor and control all the components inside the grid so the grid has to be smart. The complexity of managing these distributed generations increased, therefore the term energy management starts to take place inside the grid. Finally the term micro grid has appeared after the DGs has proven its reliability so a number of DGs that can generate enough power to a number of loads without the help of the main grid is called micro grid. The micro grid is not isolated from the grid, but sometimes it can be grid connected in order to share enough power to and from the grid. The micro grid can have some power shortage at any instances, especially if the DGs are renewable energy source. The source of power cannot generate enough power at the whole year. Micro grid can have some power from the grid it also can have the power from neighboring micro grid that has extra power to share with the micro grid that has power shortage. These problems can be solved using the smart controllers employing smart devices inside the smart grid. This thesis presents a Multi Agent System (MAS) framework to monitor and control the energy management in a multiple micro grid. The micro grids consist of different energy resources such as Photovoltaic arrays (PVs), batteries as a storage units and number of loads. Each micro grid has a PV power and load power patterns that change during the 24h. These micro grids can be either isolated grid connected based on the available generation capacity and stored energy of it. The simulation of the micro grid was performed using Matlab/Simulink. The MAS was developed on Java Agent Developing Environment (JADE), which is compliant to the Foundation for Intelligent Physical Agents (FIPA) standard and an open source multi-agent platform. The integration between Matlab/Simulink and JADE was performed using MACSimJX, which enables the MATLAB/Simulink models to access JADE software. The simulations were performed on different scenarios of micro grid conditions, in order to verify the algorithms on different cases. Another algorithms are performed for a different interconnected micro grids. These micro grids can share energy with each other. The negotiation messages between the micro grids and the grid are shown with the breaker conditions of the micro grids showing a possible power flow between them.