OPTIMISATION OF ENERGY MANAGEMENT IN MULTIPLE MICRO-GRIDS SYSTEM BASED ON PREDICTIVE CONTROL AND ARTIFICIAL INTELLIGENCE

Project by:
Foo Chang Jun, Nicholas
Bachelor of Engineering with Honours in Electrical Power Engineering (Year 3)

SINGAPORE INSTITUTE OF TECHNOLOGY

COLLABORATION WITH:

NUS National University of Singapore

Power Automation
A Joint Venture between SP Group and Siemens

PROJECT OBJECTIVES

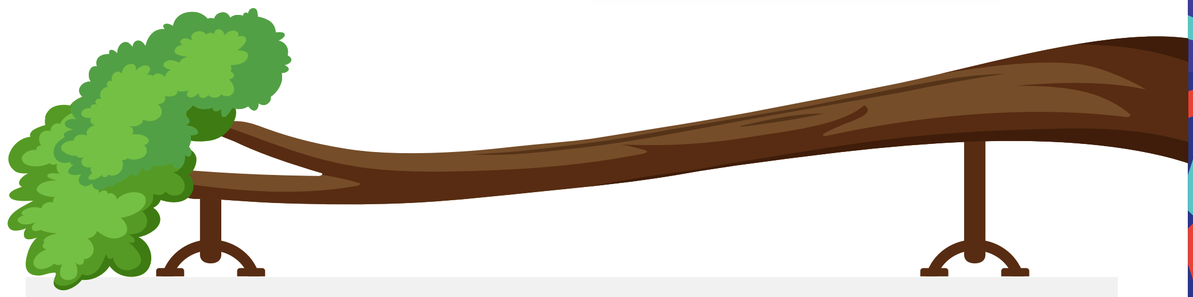
To research and develop an integrated real-time optimised energy management system based on artificial intelligence and predictive control for multiple micro-grids in a changing environment with better energy efficiency and reliability.

PROJECT SUMMARY

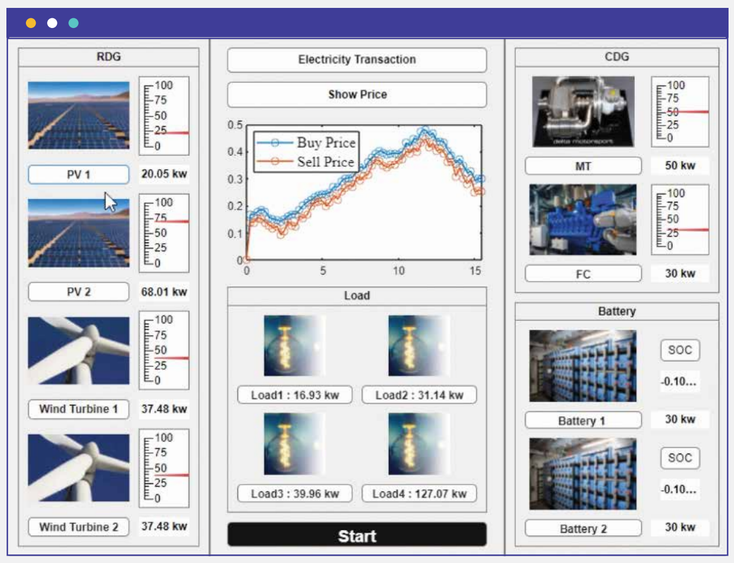
The current limitation of a single micro-grid is that it can only generate and distribute power within a localised area when it is operating as an island, independent of the electrical grid. In addition, the intermittent power generated by renewable energy sources such as solar photovoltaics (PVs) will cause variations in the output power, voltage, and frequency. Furthermore, in the event one or more energy sources fail or are unavailable, the micro-grid will not be able to meet its own load demand due to limited energy generation capability.

The EDGE funded project “Optimisation of Energy Management in Multiple Micro-grids System Based on Predictive Control and Artificial Intelligence” is a joint project between Power Automation Pte Ltd, Singapore Institute of Technology (SIT) and National University of Singapore (NUS). The project team has developed an integrated real-time optimised energy management system based on artificial intelligence and predictive control to effectively manage the exchange of energy between multiple micro-grids, which can have very different operating characteristics and dynamics. The predictive control and AI methods would automatically make the optimal decision for the energy storage system (ESS) based on real time information (such as solar PV power and electricity market) collected from the micro-grids. A communication system based on OPC UA is built for information exchange between the micro-grids and the optimisation software. Based on simulation studies, in certain scenarios, the software can help micro-grids achieve energy savings of about 10%.

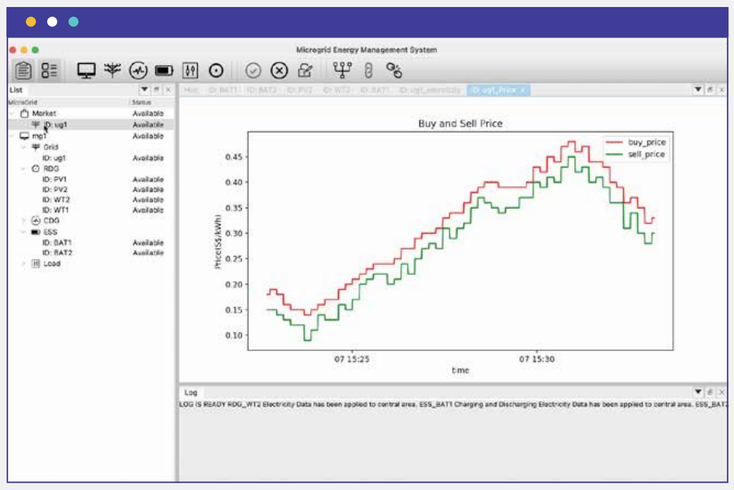
Multiple micro-grids with different operational specifications and constraints can be interconnected together to overcome the limitations of single micro-grids. Improved security of supply can be achieved by allowing the exchange of power among interconnected micro-grids. However, traditional micro-grid control systems are designed for single micro-grid operations. In addition, the control strategies are usually based on conventional model-based and multi-objective approaches, which will degrade rapidly in performance as systems become more complex with more operational uncertainties.



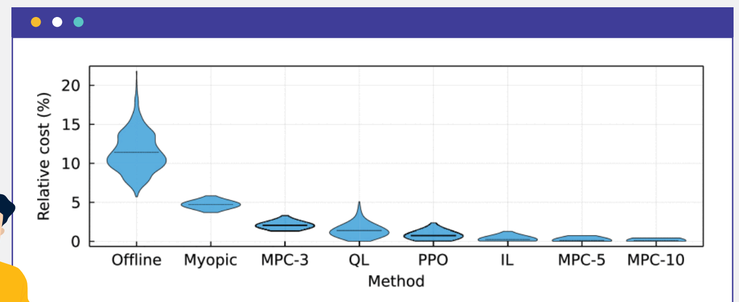
Micro-grid Simulator GUI



Optimisation Software GUI



Numerical Results of Relative Cost of Micro-grids



PROJECT OUTCOMES

1. Developed an integrated real-time optimised energy management system for micro-grid optimal power scheduling.
2. A user-friendly graphical user interface (GUI) optimisation software.
3. Software can achieve energy savings of about 10%, dependent on the specific micro-grid settings.

PART OF

YOUTH @SIEW

ORGANISED BY

ENERGY MARKET AUTHORITY
Our Clean Energy Future

POWERING LIVES