**EEE4022S 2023 Project Topic ID : SC-06**

**Title**

Intelligent Energy Management Scheme of a Hybrid Microgrid using Machine Learning Techniques

**Student**

Julian Banks (BNKJUL001)

**Supervisor**

A/Prof. Sunetra Chowdhury, Electrical Engineering Department, University of Cape Town

**Project Description**

This project deals with the design of an intelligent energy management scheme for a hybrid microgrid using machine learning techniques. The microgrid must not have more than 1MW generation. The microgrid should be able to operate in both islanded and grid-tied modes. It should be able to provide uninterrupted and quality power to its own loads and must also be able to exchange power with the utility if there is excess generation. The EMS should be designed to match the generation and load demand on the microgrid under both islanded and grid-tied operation. It should also be able to control charging and discharging of the battery or to execute load shedding during a drastic generation shortfall. The aim of the scheme will be to maintain power quality at the load terminals under all operating conditions.

Deliverables include:

i) Review of hybrid microgrid energy management and intelligent energy management algorithms.

ii) Design and simulation of test microgrid, loads and the intelligent energy management scheme. All design steps should be clearly shown.

iii) Testing and validation of the performance of the scheme for various modes of operation and loading/resource availability conditions.

iv) Interpretation of results and conclusions.

Research steps will include the followings:

i) Collecting data for developing the load profile.

ii) Selecting the simulation software.

iii) Collecting/preparing data to simulate a realistic battery-powered uninterrupted power supply.

iv) Simulating an integrated system model with the battery, controller, and loads.

iv) Testing the system and controller for various load profiles and operational scenarios.

v) Cost analysis of the overall system.

vi) Interpretation of results and conclusions.

**Ethics in Research**

**Third-party Data Collection**

In order to develop and test the energy management system, following data for a UCT premise/building will be requested from UCT Properties and Services:

a) Energy consumption (kWh) per month for a year except 2020

b) Daily load profile (weekday, weekend day, summer day and winter day as available)

c) GPS coordinate of the building (to develop the energy management system of the PV component as needed for the microgrid, considering geographic location)

d) Rooftop area of the building and whether flat roof or sloping roof (to develop the energy management system of the PV component as needed for the microgrid, considering rooftop area and roof type)

Along with access to the data mentioned above, written permission will also be requested for using the data in this research and in resulting publications.

UCT Properties and Services will be duly acknowledge and all data will be kept strictly anonymous and confidential in the thesis and publications.

**Machine Learning Application – Minimum Risk**

This research aims to develop and test an intelligent energy management scheme for a hybrid microgrid using machine learning. The research will be fully in the simulation space and so will be the outcome. No practical set up for real-time application will be developed. Hence as per risk levels of AI applications, the outcome will not involve social scoring (Level 1), it will not involve safety and health AI/bots (Level 2), it will not involve developing chatbots or similar which can bias natural persons (Level 3) and it will not involve gaming (Level 4). If this outcome is to be translated into a practical application, that will be a separate research project in itself with its own ethics clearance requirements. Hence, in summary, this project does not exceed “minimum risk” and should be exempted from a full ethics submission,