DESIGN AND OPERATION OPTIMISATION OF A MULTI-ENERGY MICRO-GRID

SINGAPORE INSTITUTE OF TECHNOLOGY

PROJECT OBJECTIVES

The project aims to (i) determine the optimal sizes of components in the Multi-Energy Micro-grid (MEMG) which is also called design optimisation; (ii) decide on the optimal schedule for a MEMG given a fixed optimal sizing; and (iii) implement both optimisation problems in Python using an Optimiser software. The Gurobi Optimiser captures the key features of the optimisation problem in a mathematical optimisation model, and generates an optimal solution based on the defined decision variables. In order to solve the optimisation problem, the user needs to define the problem including objective functions, decision variables and constraints in Python based on the format required by Gurobi. Gurobi, as a solver, will then retrieve the defined optimisation problem and solve it.

PROJECT SUMMARY

This project develops a proof-of-concept Multi-Energy Micro-grid (MEMG) using an optimal sizing and operational approach with the overall aim to reduce the operational cost for a selected site - SIT@NYP.

The adopted approach to the problem was formulated with mixed-integer linear programming (MILP). Various scenarios such as different irradiance readings on different days and different operation modes were introduced and simulated for comparison. The simulation results are then compared between two operating modes: grid-connected and stand-alone. The results are interpreted carefully to provide guidance for an actual project implementation.

Comparisons were made between two different days with two different irradiance readings.

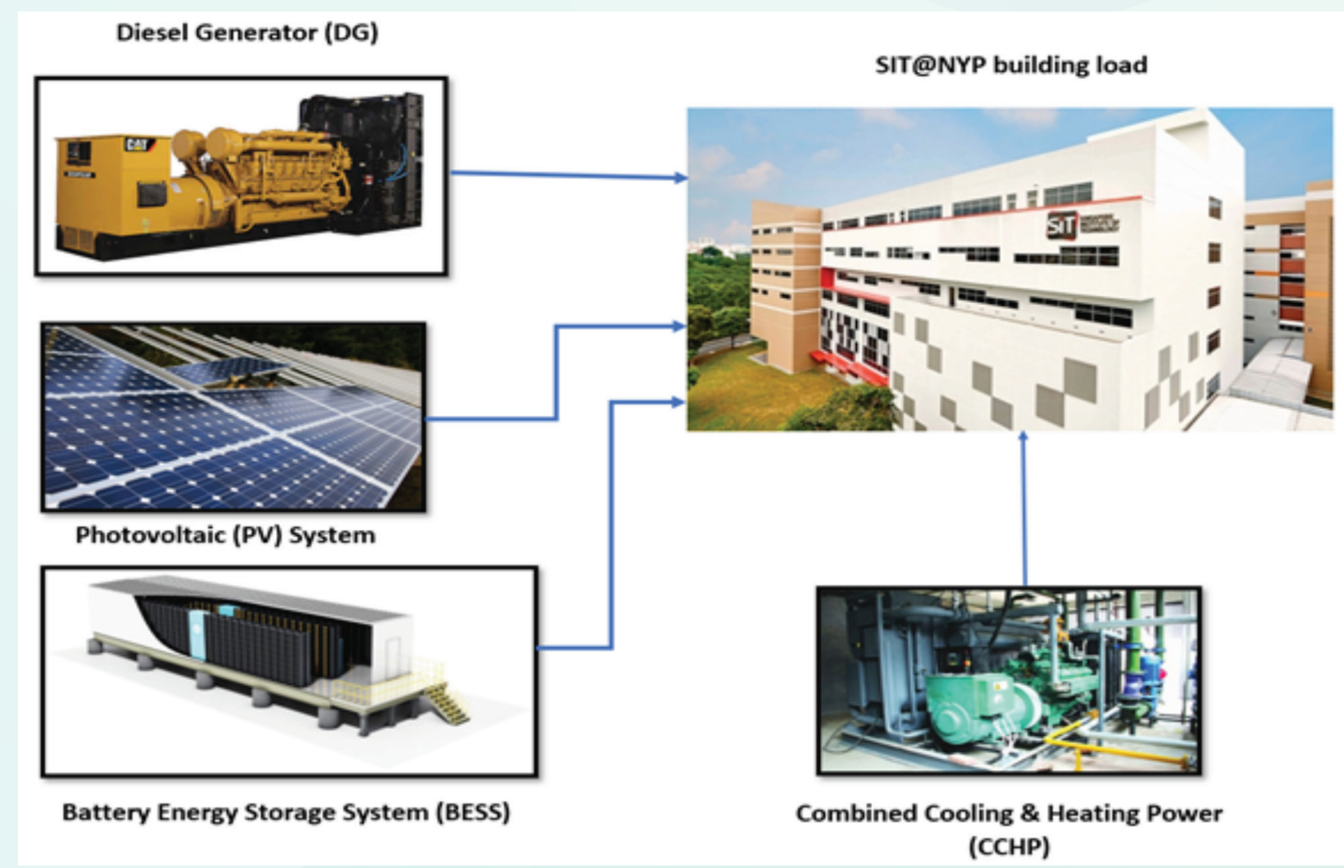
PROJECT OUTCOMES

Through this capstone project, engineers can have an optimal design and operational approach based on the designed load profile and solar irradiance to be demonstrated in a selected MEMG, prior to actual project implementation. Engineers can also introduce different scenarios and the results can be simulated and compared to provide the optimal operating recommendations to lower the operating cost of the MEMG.

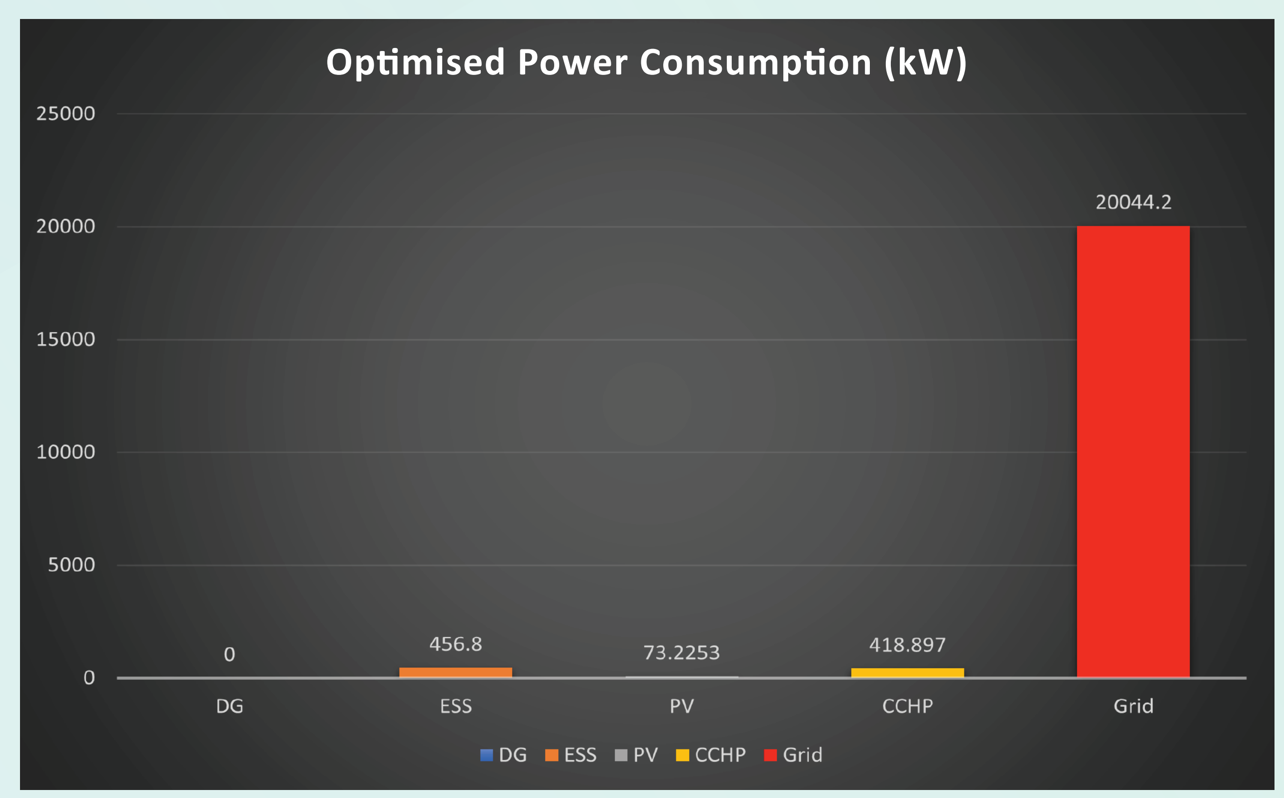
SIZE OF COMPONENTS

COMPONENT	SIZE
ESS PCS	391 kW
ESS Size	2284 kWh
PV PCS	795 kWp
PV Size	795 kWp
CCHP [28]	500 kW

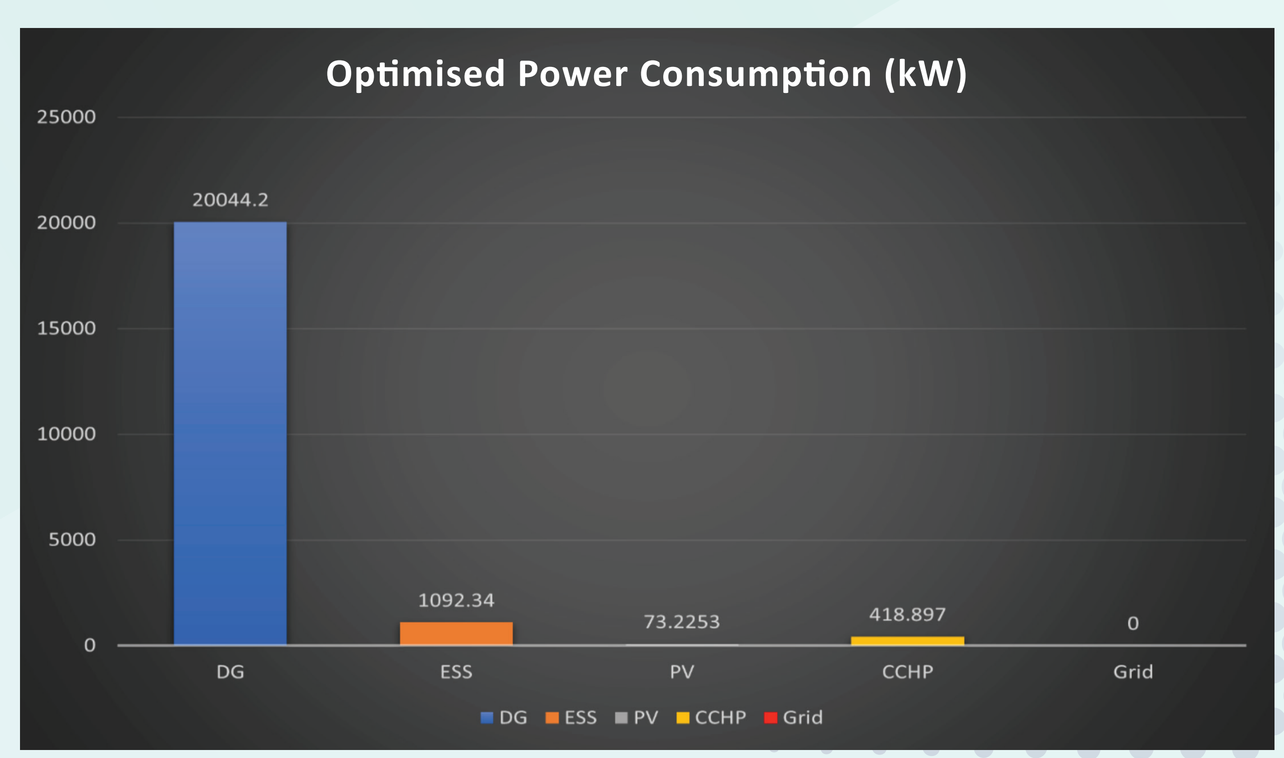
SCHEMATIC DIAGRAM OF A PROOF-OF-CONCEPT MEMG



OPTIMISED POWER CONSUMPTION SIMULATED (GRID-CONNECTED) FOR 11 AUGUST 2020



OPTIMISED POWER CONSUMPTION SIMULATED (STAND-ALONE) FOR 11 AUGUST 2020



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PROJECT BY:

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