

FEASIBILITY STUDY IMPLEMENTATION OF A MICRO-GRID IN THE  
HOTEL BUILDING

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Dedication to my beloved father, Mohamad Sobri Bin Ismail, my beloved mother, Wan Salasiah Bt Abdul Hamid and my fiance Suhaimi Bin Amiruddin whom support me, physically, mentally and emotionally, throughout my Master's study.

For my siblings and friends, appreciate your encouragement and help.  
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## **ABSTRACT**

Micro-grids are the most innovative area in the electric power industry today. Future micro-grids could exist as energy-balanced cells within existing power distribution grids or stand-alone power networks within small communities. This project focused on the study feasibility of having Renewable Energy (RE) resources such as Solar Photovoltaic (PV), to form a micro-grid system with environmental-friendly Distributed Energy Resources (DERs) through Combined Heat and Power (CHP) such as micro turbine operation in the hotel building. In this project, HOMER software has been used to analyze the financial analysis and performances in terms of cost of energy (COE), green house gases emission and primary energy used. Furthermore, a feasible study has been done in order to quantify the benefits of implement RE of micro-grid system in the hotel building.

## ABSTRAK

Micro-grids adalah kawasan yang paling inovatif dalam industri tenaga elektrik hari ini. Micro-grids masa depan boleh wujud sebagai sel-sel tenaga seimbang dalam grid pengagihan kuasa yang sedia ada atau yang berdiri sendiri rangkaian kuasa dalam komuniti kecil . Projek ini memberi tumpuan kepada kemungkinan kajian mempunyai Tenaga Boleh Diperbaharui ( RE) seperti Solar Photovoltaic (PV ), untuk membentuk satu sistem micro-grid dengan Sumber Tenaga mesra alam Teragih ( DERs ) melalui Gabungan Haba dan Kuasa ( CHP ) seperti operasi mikroturbin berkeupayaan dalam bangunan hotel. Dalam projek ini , perisian Homer telah digunakan untuk menganalisis analisis kewangan dan persembahan dari segi kos tenaga ( COE) , hijau pelepasan gas rumah dan tenaga utama yang digunakan . Tambahan pula, kajian kemungkinan telah dilakukan untuk menentukan nilai manfaat bagi melaksanakan RE sistem micro-grid dalam bangunan hotel.

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Project Background**

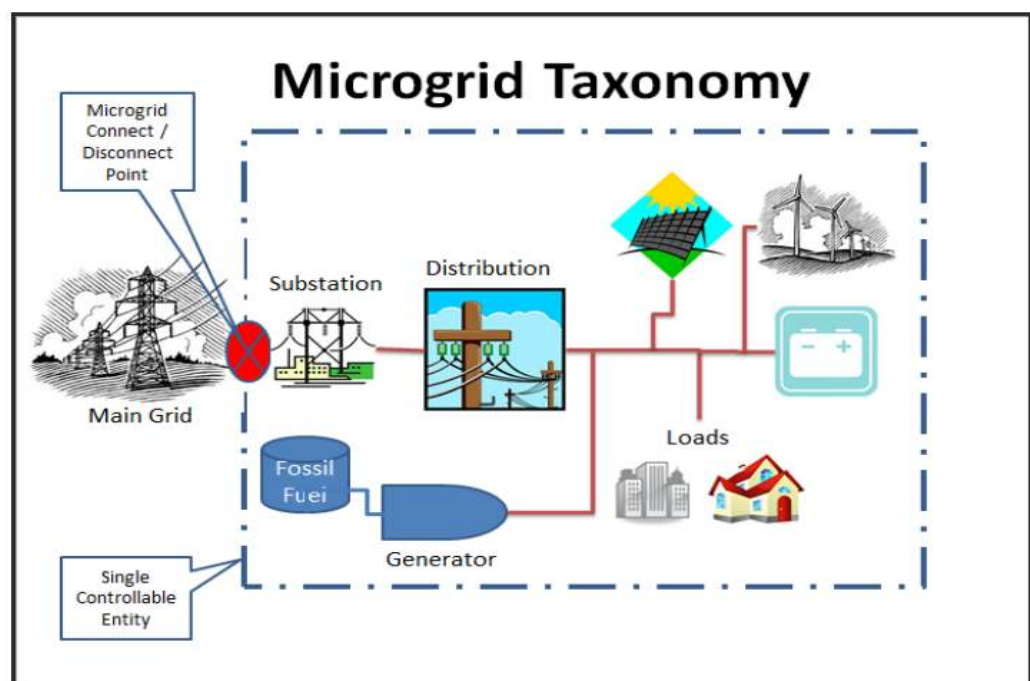
In the past, the need to generate large amounts of electrical energy and the realization that larger power plants were more efficient than smaller ones encouraged the construction of huge power plants. Example includes Itaipu Binational in Brazil, Guri in Venezuela, Sayano-Shushenk in Russia, and Churchill Falls in Canada. A more recent example is the plan for construction of the largest (18 GW) hydropower plant in China, Three Gorges Dam. However, some of these areas are affected by immense floods, massive power transmission lines and towers, air pollution, modified waterways, devastated forests, large population densities, and wars. Because of this trend in development, distances to energy sources are increasing, material capacities are reaching their limits, fossil reserves are being exhausted, and pollution is becoming widespread. New alternatives must be devised if humanity to survive today and for centuries to come [12].

The importance of smart grids has been increased due to the development of the renewable energy sector, usage of technologies for distributed generation and the concept of sustainable energy. The potential of micro-grid systems are mainly due to the reliable, secure, efficient, and environmentally friendly by using both of renewable energy sources and cogeneration technologies [1].

Micro-grid is a combination of non conventional and conventional distributed generation resources such as solar PV, wind power conversion systems, biodiesel generator sets, biomass gasifiers, micro-hydel systems, fuel cells, micro turbines which is equipped with the power electronic quality conditioning systems. The most challenging part in design and analysis of micro-grid system are due to the big scale number of design options and uncertainty parameters such as load user, size of distributed generation system and future market price of fuel. Renewable energy resources may have complexity due to their power output which is intermittent and seasonal [23].

A micro-grid is a small distributed generation interconnected system which is easily to design and operate the system. Micro-grid architecture has planning issues in terms of optimization design, sizing of Distributed Generation units in maximize the reliability, cost reduction and security system improvement [22]. Micro-grids have integrated different distributed energy sources and energy storage devices. Intelligent management methods and efficient design are required in order to meet the need of the area they are located in. The University Of Genoa Smart Poly-generation Micro-grid (SPM) developing the “2020 Energy” Project (Italian Ministry of Education, University and Research finding) at the Savona University Campus. Mostly the micro-grids in the world are characterized by distributed generation units, electrical storage devices, and a variety of thermal and electrical loads [2]. A simple diagram showing the concept of a micro-grid along with the ability to separate from the main or “Macro-grid” at a single point (i.e., go into “islanding mode”) is shown in Figure 1.1. The key parameters for micro-grid design and research [24]:

- i. Reducing T&D and power purchase cost by integrating Renewable Energy Sources
- ii. Forecasting and economic analysis in better design
- iii. Improve the quality and reliability of supply to the consumer
- iv. Multiple choices for consumers, including green power
- v. Reduction in emission intensity



**Figure 1.1:** Elementary Micro-grid Architecture

In electric grid's perspective, the key advantage of a micro-grid system, it can operate as a single collective load within the power system. Production of electricity by distributed power production using smaller generating systems, such as small-scale combined heat and power (CHP), small-scale renewable energy resources will give the result in terms of energy efficiency and environmental advantages over large central generation. Blackouts and power disturbances are either eliminated or substantially minimized when micro-grid have the ability to operate in "islanded mode". Micro-grids can offer large financial savings with

substantial room for interpretation and also can generate revenue for constituent consumers and businesses by selling the micro-grid power back to the grid/utility when not islanded [21].

## **1.2 Problem Statements**

Due to the increasing of load demands by industrialization and population which is causes the heavy load shedding during the peak hours, power failure and power disturbances since there is a shortfall of power generation from the conventional energy production. Besides that, by using the fossil fuels such as coals, diesel, in conventional energy system will give impact to the environment and health due to green gas house (GHG) emissions such as carbon dioxide. Micro-grid is one of the ways that can be implementing in order to minimize these drawbacks by using the clean, renewable energy sources such as solar, wind, and other distributed generation system which is connected to the end user load, will increase the reliability of power provided and reduce carbon emissions. Micro-grid integrate through co-generation system will increase the efficiency of energy where the waste heat produced during electricity generation has been recovered as useful heat by supplying these thermal need for heating and cooling purposes for examples to heat buildings, supply hot water, etc.

### **1.3 Problem Objectives**

There are several objectives in study of this project:

- i. To study the micro-grid system in Hotel building.
- ii. To propose Renewable Energy resources in micro-grid with co-generation systems.
- iii. To simulate and analyze the performance of system in terms of cost of energy (COE), greenhouse gases emission and fuel consumption by HOMER software. The difference between current system and proposed system has been analyzed.

### **1.4 Scope of Works**

In this project, it will focus on the study and analyze about the micro-grid system in Hotel building which is located in urban area, by taking consideration of electrification needed in the developing countries, investment and payback period for long term periods, capacity load demand need by consumers, the environment issues due to implementation of renewable energy sources, and benefits that can be achieved through this systems. The project depends on research by books, journal, magazine, paper and any article regarding micro-grids system and analysis. Based on the reading from the various source, the student need to summarize and do literature review based on the understanding through their reading.

The system will be analyze and perform under the Hybrid Optimization Model for Electric Renewable (HOMER) software and the simulation will be conducted relatively due to the feasible study through performances and financial analysis. Generally, the scope of this study will limit to make the comparative study

between the conventional power generations (current system) with micro-grid systems (proposed system) in terms of cost of energy (COE), greenhouse gases emission and fuel consumptions.

## 1.5 Organization of Report

This project has been plan properly from the starting until the end of the project. This project is to study and analyze the micro-grid integrated in Hotel building. By using HOMER software, the system has been simulating in terms of performances and financial analysis. This report consist of five main chapters; Introduction, Literature Review, Methodology, Simulation Results and Analysis, and Conclusion and Future Recommendation.

**In Chapter 1:** The author will discuss the project in collectively. This chapter will explain the important aspect of the research such as background study, objectives of the project, and scope of the projects.

**In Chapter 2:** Literature review will completely explain about the micro-grid system, co-generation system and the other important features related on these topics.

**In Chapter 3:** The author's explain the methodology in implementing and completing the project. The author will explain on the micro-grid system which is consist a small scale of Renewable Energy Resources such as solar and small scale of combined heat and power (CHP) system such as micro turbine in generate electricity and heat for the load users. The waste heat produce during electrical production has been recovered by CHP technologies for ensures the high efficiency of micro-grid system. This proposed system has been run with HOMER software. The comparison between current systems with the proposed micro-grid system has been analyzed. The result obtained from simulation has been analyzed properly.



**In Chapter 4:** The author will analyze and discuss clearly and properly about the simulation results obtained.

**In Chapter 5:** The author will conclude on the result obtained in Chapter 4 and some future recommendation has been suggested.

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