EVALUATION ON FEED-IN TARIFF SCHEME FOR RESIDENTIAL AREA BASED ON ARTIFICIAL NEURAL NETWORK PROJECTION

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"Specially dedicated to
My Beloved Parents, Wife and Family"

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ABSTRACT

Malaysia has introduced Feed-in Tariff (FiT) mechanism in 2011. This is accordance with Renewable Energy Act 2011 and Sustainable Energy Development Authority Act 2011. This mechanism is to promote the development and encouragement of renewable energy sector in Malaysia such as solar photovoltaic (PV), biomass, biogas, small hydro and geothermal. After 5 years of implementation in Malaysia, FiT mechanism has been know as an effective solution to make a monthly income from the energy produced from renewable sources. Hence, the residential area has started to install solar PV after the FiT was introduced. However, without taking any consideration the possibility of increament in electricity tariff, bank loan commitment, solar irradiation, increase in energy consumed and weather conditions, the existing FiT will not give an advantages to the customer. Therefore, the purpose of this project is to evaluate the FiT scheme for long term condition to residential area by using solar PV system as a renewable sources. This can be achieved by study the historical data of the electricity tariff, FiT rates, solar irradiation and energy consumption for residential house for 21 years. From the linear regression projection, it was projected that the electricity tariff will be increased around 140% from year 2015 to year 2035 for block tariff above 300kWh. In order to validate the data projection and analysis of the electricity tariff, an Artificial Neural Network (ANN) projection is also been used. The ANN analysis shown the FiT for PV system in residential area can give negative impact in long term condition.

ABSTRAK

Malaysia telah memperkenalkan Feed-in Tariff (FiT) pada tahun 2011. Ini adalah selaras dengan Akta Tenaga Boleh Baharu 2011 dan Tenaga Lestari Pembangunan Akta Lembaga 2011. Mekanisme ini adalah untuk menggalakkan pembangunan dan galakan daripada sector tenaga boleh diperbaharui di Malaysia seperti tenaga suria, biomass, biogas, hidro bersaiz sederhana dan geothermal. Selepas 5 tahun mekanisme FiT telah dikenali sebagai satu penyelesaian yang berkesan untuk menjana pendapatan bulanan daripada tenaga yang dihasilkan daripada sumber-sumber yang boleh diperbaharui. Oleh itu, penduduk dikawasan perumahan telah mula untuk memasang tenaga suria apabila FiT diperkenalkan. Walau bagainamanapun, tanpa mengambil apa-apa pertimbangan seperti kemungkinan kenaikan tariff elektrik, komitmen pinjaman bank, pancaran solar, peningkatan dalam tenaga yang digunakan dan keadaan cuaca, FiT yang sedia ada tidak akan memberi kelebihan pada pelanggan. Oleh itu, tujuan projek ini adalah untuk menilai skim FiT untuk jangka masa panjang pada kawasan perumahan dengan menggunakan system PV solar sebagai sumber yang bileh diperbaharui. Ia boleh dilaksanakan dengan kajian keatas sejarah data untuk tariff elektrik, kadar FiT, penyinaran solar dan penggunaan tenaga untuk rumah kediaman selama 21 tahun. Keputusan daripada unjuran regresi linear, ia telah meramalkan bahawa tariff elektrik akan meningkat sekitar 140% dari tahun 2015 hingga tahun 2035 bagi tariff blok diatas 300kWh. Untuk mengesahkan ramalan data dan analisis tariff elektrik, ramalan menggunakan Artificial Neural Network (ANN) telah digunakan. ANN analisis telah menunjukkan FiT untuk system PV di kawasan perumahan boleh memberikan impak negatif dalam jangka masa panjang.

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LIST OF ABBREVIATION

FiT	-	Feed in Tariff
RE	-	Renewable Energy
NREPAP	-	National Renewable Energy Policy and Action Plan
PV	-	Photovoltaic
HOMER	-	Hybrid Optimization of Multiple Energy Resources
SEDA	-	Sustainable Energy Developmet Authority
NNTOOL	-	Neural Network Fitting Tool
LR		Linear Regression
RM		Ringgit Malaysia
W/O		Without

LIST OF SYMBOLS

kWh	-	Kilo-Watt-Hour
m2	-	Square Metre
d	-	Day
%	-	Percentage

CHAPTER 1

INTRODUCTION

1.1 Project Overview

On 2nd April 2010, the feed in tariff (FiT) was introduced under National Renewable Energy Policy and Action Plan (NREPAP) which has been approved by Malaysian cabinet. This NREPAP is established to enhancing the utilisation of indigineous renewable energy (RE) resources to contribute towards national electricity supply security and sustainable socio-economic development [1].

The FiT scheme is a initiative to allow consumer to produce electricity from RE resources to be sold to power provider at fixed rates in specific duration. For example, renewable energy for biomass and biogas, the long term agreements is 16 years while for small hydro and solar PV the long term agreements is 21 years. The objectives of FiT scheme are as follows [1]:

i. To increase RE contribution in the national power generation mix

ii. To facilitate the growth of the RE industry

iii. To ensure reasonable RE generation mix

iv. To conserve the environment for future generation

Nowadays, FiT scheme in Malaysia has become common topic among the engineers, building owners, public, civilians and researchers. Lots of renewable resources can be found installed in the commercial buildings, houses and factories. In Malaysia, the FiT scheme has been introduced to the four type of renewable resources namely, biomass, biogas, small hydro and solar PV. The basis for selecting these renewable resources are based on the proven technologies under the Malaysia environment. However, the most popular renewable resources in Malaysia is solar PV. In this studies, the solar PV was selected due to it has higher solar irradiation which gives high potential in this studies.

There are two types of solar PV configuration which are grid tied PV system and stand alone PV system. Grid tied PV system is a system that connected to the utility grid. Its allows electricity generated from solar PV to be exported into national grid. While stand alone PV system is a system that also known as off grid system. This system operates independently from the electricity grid. Its normally used in rural area whereby the grids have difficult to access in.

Artificial Neural Network (ANN) projection is a computational model based on the structure and functions of biological neural networks.The structure of ANN will be affected when the information flows through the network. This is due to the changes of input and output. In general, the ANN consist of three layers that interconnected. The first layer consist of input neuron. The second layer received data from the neuron. While the third layer received output neuron from the second layer. This project aims to evaluate the FiT scheme for residential area for long term condition based on artificial neural network projection.

1.2 Problem Statement

In Malaysia, FiT has been known as an effective solution to make a monthly income. Customer can generate electricity from renewable sources that they had installed and power utility will pay in monthly basis on the total energy produced from renewable energy. However, without taking any consideration such as the possibility of increase in electricity tariff, bank loan commitment, solar irradiation, increase in energy consumption, weather conditions and system performance drop, the advantage of FiT scheme is questionable. This study will evaluate FiT scheme for residential area based on ANN projection.

1.3 Objectives

In order to achieve the aim, this paper has the following objectives:

i. To study the concept of FiT mechanism in Malaysia

ii. To predict the future electricity tariff in Malaysia based on the historical data obtained using ANN projection

iii. To perform analysis on case study for 21 years of FiT scheme for residential house with considering the possibility of increament in electricity tariff, bank loan commitment, solar irradiation, increased in energy consumption and system performance drop.

1.4 Project Report Outline

This report is produced in order to fulfill the requirement of master project. The report is organized in the following ways:

Chapter 1 describes the project introduction, problem statement and objective of the studies.

Chapter 2 reviewed and summarized the previous studies and works that has been discussed regarding the solar PV system in Malaysia, feed-in tariff (FiT) and artificial neural network (ANN).

Chapter 3 covers on the project methodology which consists of studies in historical data of electrical tariff, solar irradiation, FiT rates, data collection of selected residential house for yearly energy consumption, linear regression and ANN for projection approaches.

Chapter 4 is the project result and discussion. In this chapter, the data projection for future electricity tariff has been predicted using linear regression and validated using ANN. Besides, a 21 years case study on the implementation of FiT for selected residential house has been performed and evaluated.

Chapter 5 Concludes the overall project and suggestion for future work.

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