



Faculty of Electrical and Electronic Engineering Technology



**A PERFORMANCE ANALYSIS AND FEASIBILITY STUDY FOR
SOLAR PV INSTALLATION UNDER NET ENERGY METERING
(NEM) 3.0 SCHEME**

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

NUR AMIRAH SAKINAH BINTI SALLEH

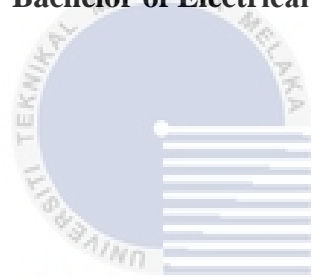
Bachelor of Electrical Engineering Technology with Honours

2021

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INSTALLATION UNDER NET ENERGY METERING (NEM) 3.0 SCHEME**

NUR AMIRAH SAKINAH BINTI SALLEH

**A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electrical Engineering Technology with Honours**



Faculty of Electrical and Electronic Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

**BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II**

Tajuk Projek : A Performance Analysis And Feasibility Study For Solar Pv
Installation Under Net Energy Metering (NEM) 3.0 Scheme

Sesi Pengajian : 2021/2022

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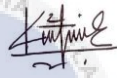
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DECLARATION

I declare that this project report entitled “A Performance Analysis And Feasibility Study For Solar Pv Installation Under Net Energy Metering (NEM) 3.0 Scheme” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

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DEDICATION

Alhamdulillah, glory be to Allah S.W.T., the Almighty. Every difficult task needs the efforts as well as the direction of seniors, particularly those who were near to our hearts.

I devote my little attempt to my dear and loving:

To my beloved parents

Mr Salleh Bin Yusoh and Mrs Julia Binti Sulaiman,

To dearest supervisor, Mr Azhar Bin Ahmad

My supportive classmate, 4 BEEY



ABSTRACT

Renewable energy is no longer an alien concept in the eyes of the world. For example Malaysia has a variety of renewable energy sources, one of which is solar energy. Solar energy is one of Malaysia's newest and fastest-growing technologies. This may give a chance for domestic students to learn more about solar technology. Various government attempts to improve the usage of solar energy, also known as Net Energy Metering, to assist individuals save money on their utility bills. This system is well suited for usage in both commercial and residential settings. However, due to the unsatisfactory financial returns, public engagement in this programme is low. People are also less knowledgeable of the advantages of embracing renewable energy sources. The project demonstrates that the government is still trying to persuade individuals to switch to solar energy. Furthermore, the goal of this study is to determine the performance of solar PV installations under NEM3.0, the most recent government programme that can produce power efficiently. In addition, this project also shows that energy generated using solar PV installations under NEM 3.0 is more economical than electricity from suppliers such as TNB. The data regarding solar energy generated was collected using the iSolarCloud application. One of the objective of this initiative is which consumers save money when extra energy is resold.

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ABSTRAK

Pada masa kini, tenaga diperbaharui bukanlah sesuatu yang asing di mata dunia. Termasuklah Malaysia yang mempunyai pelbagai jenis tenaga boleh diperbaharui dan salah satunya ialah tenaga solar. Teknologi solar adalah salah satu teknologi yang baharu dan sedang berkembang di Malaysia. Hal ini dapat memberi peluang kepada para pelajar tanah air untuk memperluaskan ilmu mereka dalam teknologi solar ini. Pelbagai inisiatif kerajaan dalam memperkasakan penggunaan tenaga solar seperti yang dikenali dengan Net Energy Metering bagi membantu rakyat menjimatkan kos sara hidup. Sistem ini sangat sesuai digunakan pada bangunan-bangunan pejabat dan kawasan perumahan. Namun, kurang penyertaan dari orang ramai akan inisiatif ini kerana pulangan kewangan yang tidak memberangsangkan. Orang ramai juga kurang informasi akan kelebihan menggunakan tenaga boleh diperbaharui. Projek ini menunjukkan bahawa kerajaan masih tidak berputus asa dalam menarik minat orang ramai untuk menggunakan tenaga solar. Selain itu, projek ini juga bertujuan untuk mengenal pasti prestasi pemasangan solar PV di bawah NEM3.0 iaitu inisiatif kerajaan yang terbaru dapat menghasilkan tenaga elektrik dengan baik. Di samping itu, dalam projek ini juga menunjukkan tenaga yang dijana menggunakan pemasangan solar PV di bawah NEM 3.0 adalah lebih menjimatkan berbanding tenaga elektrik dari pembekal seperti TNB. Aplikasi iSolarCloud telah digunakan untuk mengumpul data bagi tenaga solar yang dihasilkan. Projek ini memfokuskan penjimatan yang diperoleh oleh pengguna apabila hasil lebih tenaga dijual semula.

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LIST OF SYMBOLS

kWh	-	Kilowatt hour
MW	-	Mega watt



LIST OF ABBREVIATIONS

□□□	-	Tenaga Nasional Berhad
FIT	-	Fit In Tariff
NEM	-	Net Energy Metering
RE	-	Renewable Energy
PV	-	Photovoltaic
SEDA	-	Sustainable Energy Development Authority



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CHAPTER 1

INTRODUCTION

1.1 Background

As we know, Malaysia government established the Net Energy Metering Scheme (NEM) in November 2016, with a 500 MW quota allocation until 2020, to stimulate the usage of Malaysia's renewable energy (RE) as to replace the old scheme which is Feed-in Tariff scheme (FiT) due to (T.M.N.T Mansur et al., 2017) has been stated. The NEM enables electricity customers to create, use, and export net excess energy to the grid. The user will be compensated for net surplus energy exported to the grid based on the displaced cost per kWh unit.

However, due to the low financial return, fewer customers participated in the NEM plan than in the previous FIT program. In the beginning of 2019, NEM was improved and became fully operational on December 31, 2020, with a 500MW limit as mention by (Md Pauzi Abdullah et al,2019). Other than that, due to a strong reaction from the PV sector and in an attempt to increase solar energy consumption, the new Net Energy Metering 3.0 (NEM 3.0) initiative was announced by the Energy and Natural Resources Minister (KeTSA) in a press statement issued on December 29, 2020. Furthermore, as mentioned by (Shing Chyi Chua,2011), Malaysia's tropical environment is excellent for the growth of solar energy, with plenty of sunlight and an average irradiation of 1643 kWh/m² per year, which is one of the reasons for the PV industry's robust response.

Besides, the NEM 3.0 initiative also will provide more people the chance to save money on their power bills by installing solar PV systems on their rooftops. From 2021 2023,

the NEM 3.0 will be in force, with a total quota allocation of up to 500 MW. As SEDA have mention, NEM 3.0 is divided into three categories, namely NEM Rakyat Program, NEM GoMen Program (Government Ministries and Entities) and Nova Program (Net Offset Virtual Aggregation). Solar PV installation under NEM 3.0 were use as to analyze the performance and feasibility study.

1.2 Problem Statement

In recent years, a number of novel technologies have been introduced, including those for the production of renewable energy sources. According to the research that had been done about social acceptance of solar energy in Malaysia, majority of the survey participants were highly interested in solar energy. However, the most of them said that some obstacles, such as perceptions on the high cost of solar panels and a lack of accurate information regarding solar energy consumption, make fuel-generated power the better option. Other than that, the previous NEM scheme also does not yield a profitable financial return.

By using solar PV installation under NEM 3.0, we will generate energy to be better aware of its capabilities and performance. Therefore, by using this method to produce energy, we could reduce reliance on fossil fuel-based energy sources like natural gas, gasoline, and coal. In addition, it allowed us to generate our own clean energy while reducing emissions that may lead to depletion of the ozone layer.

1.3 Project Objective

There are a few important goals that must be met by the end of this project.

Specifically, the objectives are as follows:

- a) To analyze solar PV installation under NEM 3.0 compatible for all people.
- b) To observe generated energy using solar PV installation under NEM 3.0 is more economical compare to standard generated electricity.
- c) To identify the performance of solar PV installation under NEM 3.0 will be able to produce electricity well.

1.4 Scope of Project

The scope of this project has been defined in order to determine the features and components that will be employed in it. The goal of this project is to monitor and assess the performance and viability of solar PV installations in the NEM (3.0) scheme.

1.5 Thesis Outline

The progress of the Performance Analysis and Feasibility Study for Solar PV Installation under the Net Energy Metering (NEM) 3.0 scheme project was detailed in this thesis outline. This thesis is divided into five chapters which is an introduction to the project, a literature review, the project methodology, the project's final outcomes, and the project's conclusion.

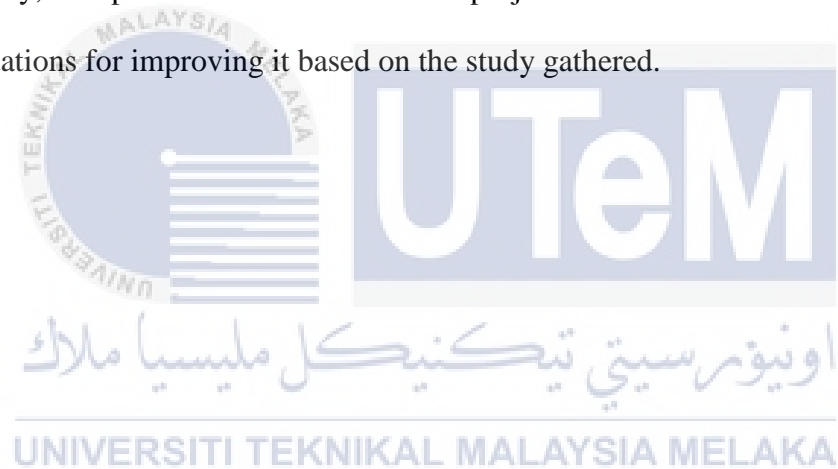
In chapter one, the project is introduced by outlining the project's background as well as the issue statement that arises. After that, describe a clear goal and the project's scope of work.

The article study that has been completed on theory and literature review that is connected to the project will be the focus of attention in chapter two.

The methods for implementing this project will be discussed in the third chapter. References and studies are used to support the selected approach, such as research. As a consequence, complete the steps that will be used to work on this project in order to get the best results. Furthermore, the analysis for my research will be well explained.

Following that, chapter four will concentrate on the project's outcome. Furthermore, the project's study findings and analyses will be summarized throughout the chapter to demonstrate the best outcome.

Finally, chapter five discussed the project's conclusion as well as future recommendations for improving it based on the study gathered.



CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A literature review is a collection of academic references, such as journal articles and theses that are related to a certain subject or study problem. In a circle within the scope and context of the project, this chapter discusses prior research that pertains to this project based on a journal, thesis, or other sort of public material. During this literature study, the researcher will learn about other people's approaches so that they can serve as guidelines for this study. It will allow the researcher to learn more and come up with fresh ideas for developing or establishing a new approach for this project.

2.2 Solar PV Installation under NEM

Solar PV installation under NEM is one of the initiatives spearheaded by Malaysia's Sustainable Energy Development Authority (SEDA) to encourage people to use renewable energy as stated by (T.M.N.T. Mansur et al, 2017). According to (Md Pauzi Abdullah et al, 2019) NEM scheme was launched in Malaysia in 2016 to replace the old Feed In Tariff (FIT) scheme. This NEM scheme differs from the previous one, in which the energy generated by the solar PV system is consumed first by the loads, with any excess energy exported and sold to the grid at a predetermined rate of RM 0.31 per kWh for residential customers (low voltage connection point) and RM 0.23 per kWh for commercial and industrial customers (medium voltage connection point). (T.M.N.T Mansur et al., 2017)

2.2.1 Evolution of Net Energy Metering

2.2.1.1 Net Energy Metering 2016 (NEM2016)

The implementation of NEM 2016 is running about two years until the end of 2018. Other than that, NEM 2016 failed to assist renewable energy in meeting its growth objective. This is owing to the fact that the NEM system attracted less customers than the previous FIT program since each imported kWh unit would only be compensated at a displacement cost of RM0.31, which is not financially appealing. As shown in Table 2.1, the rates residential consumers are charged based on Tariff A.

Table 2.1 Tariff A (domestic tariff)

Tariff Category (kWh)	Unit price (cent/kWh)
1-200	21.80
201-300	33.40
301-600	51.60
601-900	54.60
>900	57.10

(Md Pauzi Abdullah, 2019)

From Table 1, customers are charged 21.8 cents per kWh for the first 200 kWh and 33.4 cents per kWh for the next 100 kWh. If they utilize more power, the electricity charge rate rises. However, if their monthly usage surpasses 300kWh, they will be charged 51.6 cents per kWh from the 301st kWh onwards, which is significantly more than the displacement cost for NEM payment. As a result, the NEM 2016 plan may not benefit them if they consume a lot of power. To be more familiar with NEM 2016, the structure of NEM 2016 are shown as below.

Table 2.2 Structure of NEM 2016

Allowable Technology	Allowable Customer	Allowable Capacity	Net Excess Generation (NEG)
Solar 1. Rooftop of building 2. Garage, car park or similar building	Residential, commercial, industrial	Residential-12kWp (single phase) 72kWp (3 phase) Commercial and industrial- 1MWp or 75% of maximum demand or 60% of fuse rating or 60% of current transformer	Any surplus will be credited in the next billing period at displaced cost. The max roll over period is 24 months. Any excess credit after 24 months will be forfeit

(Md Pauzi Abdullah, 2019)

2.2.1.2 Net Energy Metering 2019 (NEM2019)

In the beginning of 2019, a new NEM plan (NEM 2019) was established to replace the old NEM 2016 scheme due to low financial returns. As to overcome the weaknesses of NEM 2016, some modifications have been introduced in NEM 2019 where residential, commercial, industrial, and agricultural clients are all permitted. Furthermore, the surplus generation will then be credited to Tariff A in the following billing month (domestic tariff). The rest of the system is identical to that of NEM 2016. Table 3 provides more information as below.

Table 2.3 Structure of NEM 2019

Allowable Technology	Allowable Customer	Allowable Capacity	Net Excess Generation (NEG)
Solar 1. Rooftop of building 2. Garage, car park or similar building	Residential, commercial, industrial, agriculture	Residential-12kWp (single phase) 72kWp (3 phase) Commercial and industrial- 1MWp or 75% of maximum demand or 60% of fuse rating or 60% of current transformer	Any surplus will be credited in the next billing period at retail rate. The max roll over period is 24 months. Any excess credit after 24 months will be forfeit

(Md Pauzi Abdullah, 2019)

As a good modification response, by the end of 2020, the 500MW allotment under NEM 2.0 has been completely subscribed.

2.2.1.3 Net Energy Metering 3.0 (NEM 3.0)

Due to a strong reaction from the PV sector and a desire to increase the use of solar energy, the Energy and Natural Resources Minister, via a press statement issued by KeTSA on December 29, 2020, announced the new Net Energy Metering 3.0 program (NEM 3.0) to provide more opportunities for electricity consumers to install solar PV systems on the roof of their premises to save on their electricity bills.