HIGH LOAD DEMAND PENALTY COST REDUCTION USING PHOTOVOLTAIC SYSTEMS

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DEDICATION

This project report is dedicated to my father, who taught me that the best kind of knowledge to have is that which is learned for its own sake. It is also dedicated to my mother, who taught me that even the largest task can be accomplished if it is done one step at a time

ACKNOWLEDGEMENT

In preparing this project report, I was in contact with many people, researchers, academicians, and practitioners. They have contributed towards my understanding and thoughts. In particular, I wish to express my sincere appreciation to my main thesis supervisor, Pm Dr. Mohd Junaidi Abdul Aziz for encouragement, guidance, critics and friendship. Without his continued support and interest, this thesis would not have been the same as presented here.

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ABSTRACT

Photovoltaic (PV) system is one of renewable energy source that is used widely in critical industry where power interruption is inevitable. Most of new High Voltage (HV) and Medium Voltage (MV) developed projects either in commercial and industrial sector received electricity supply from the utility but with high load declared to the utility rather than the actual usage due to the load estimation from consumer. The loads estimated by the consumer is higher than its actual demand because of the un-used and non-regular used loads such as Variable Refrigerant Flow (VRF) Air Conditioning system and Fire Protections System (FPS) which consume high power when operate. Hence, under Connected Load Charge (CLC) scheme governed by utility, the consumer will experience high penalty cost due to non-usage and non-regular loads as per declared. This project proposes a method to reduce the loads declared to the utility by using PV system as secondary electricity source serving the un-used and non-regular loads. This project will study and analyze the cash flow of the consumers under CLC scheme for over declaring the loads. Next, in order to prevent this CLC, a method to reduce the loads declared to the utility which is by using PV system as secondary electricity source serving the un-used and non-regular loads to prevent CLC will be obtain. Instead of generating electricity by the solar PV, this paper will also study the cost implication under NEM scheme since the excess electricity generated by PV which flow back to the grid will be used by neighbourhoods while the consumer will gain benefits due to this. The viability of the concept is assessed by modelling a 1.2 MW Medium Voltage commercial hostel building in east coast of Malaysia (Terengganu) using System Advisor Model (SAM) software. The idea of the concept is that by installing PV system for entire roof of this building, the power generated will compensate with priority of the non-regular and non used load which can lower the loads declare to the utility thus, replacing high demand loads in High Voltage (HV) into Low Voltage (LV) tariff which no longer subjected to CLC. The consumer then will no longer need to pay for the penalty cost instead they will reduce their monthly electricity cost under NEM scheme for the excess generated energy by the PV system especially in weekend and low demand hours that flows back into the grid. The work can be considered as significant due to the fact that the implementation of solar PV can reduce and completely remove the penalty cost incurred to the consumers and at the same time contributing to the return of investment.

ABSTRAK

Sistem Fotovoltaik (FV) merupakan salah satu tenaga boleh diperbaharui yang digunapakai secara meluas di dalam industri kritikal dimana gangguan bekalan kuasa tidak dapat dielakkan. Kebanyakan pembangunan baru berkapasiti Voltan Tinggi (VT) dan Voltan Sederhana (VS) samada di sektor industri dan komersial memperoleh bekalan elektrik daripada pembekal tetapi dengan permintaan beban yang tinggi berbanding beban sebenar disebabkan oleh jangkaan beban daripada pihak pengguna. Jangkaan beban oleh pihak pengguna adalah lebih besar berbanding beban sebenar disebabkan oleh beban yang tidak digunapakai dan juga beban yang jarang digunapakai seperti Sistem Penghawa Dingin Aliran Penyejuk Berubah (APB) dan Sistem Pemadan Kebakaran (SPK) yang memerlukan kuasa tinggi semasa beroperasi. Oleh itu, dibawah skim Cas Sambungan Beban (CSB) seliaan pihak kerajaan, pengguna akan berhadapan dengan kos denda yang tinggi oleh kerana beban yang kurang digunapkai dan tidak digunapakai sebagaimana permohonan bekalan beban. Projek ini mencadangkan cara untuk mengurangkan permintaan beban daripada pihak kerajaan dengan mengapplikasi sistem FV sebagai pembekal elektrik kedua untuk menyalurkan bekalan elektrik kepada beban kurang digunapakai dan tidak digunapakai. Projek ini akan mengkaji dan menganalisa kadar aliran kewangan pengguna dibawah skim CSB oleh kerana terlebih permintaan beban. Kemudian, bagi mengelakkan CSB, satu cara untuk mengurangkan permintaan beban daripada pihak kerajaan adalah dengan menggunapakai sistem FV sebagai pembekal elektrik kedua dengan menyalurkan bekalan kepada beban kurang gunapakai dan tidak digunapakai untuk mengelakkan CSB akan diperolehi. Selain menjana elektrik oleh solar FV, kertas kerja ini juga akan mengkaji kos terlibat dibawah skim NEM memandangkan tenaga elektrik yang terlebih oleh FV yang akan masuk ke grid akan digunapakai oleh kejiranan dan hasilnya akan dinikmati oleh pengguna. Pengzahiran projek ini ialah dengan menggunapakai 1.2 MW Voltan Sederhana bangunan asrama komersial di pantai timur semenanjung Malaysia (Terengganu) menggunakan perisisan System Advisor Model (SAM). Idea kepada konsep adalah dengan memasang sistem FV untuk keseluruhan bumbung projek ini, kuasa yang terhasil akan menyalurkan bekalan kepada keseluruhan beban dengan keutamaan kepada beban jarang gunapakai dan tidak gunapakai seterusnya mengurangkan permintaan bekalan dengan pihak kerajaan, justeru menukarkan skim bekalan beban dengan Voltan Tinggi (VT) kepada Voltan Rendah (VR) yang tidak lagi tertakluk kepada CSB. Pengguna tidak akan lagi perlu membayar kos denda malah akan menjimatkan kos elektrik bulanan dibawah skim NEM bagi tenaga yang terlebih oleh sistem FV yang disalurkan kepada grid terutamanya pada waktu hujung minggu dan waktu kurang bekerja. Kerja ini boleh dikategori sebagai ketara memandangakn penggunaan solar FV akan mengurangkan dan menghapuskan kos denda kepada pengguan dan pada waktu yang sama menghasilkan pulangan.

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PV	-	Photovoltaic
BIPV	-	Building Integrated Photovoltaic
RE	-	Renewable Energy
HV	-	High Voltage
MV	-	Medium Voltage
UBBL	-	Uniform Building by Law
JBPAM	-	Jabatan Bomba dan Penyelamat Malaysia
CLC	-	Connected Load Charge
MD	-	Maximum Demand
RMD	-	Reference Maximum Demand
AMD	-	Actual Maximum Demand
UPS	-	Uninterruptable Power Supply
kWh	-	Kilowatt hour
kWp	-	Kilowatt peak
STC	-	Standard Test Condition
SAM	-	System Advisor Model
ACAD	-	AutoCAD
TNB	-	Tenaga Nasional Berhad
SESB	-	Sabah Electricity Sdn. Bhd.
SEDA	-	Sustainable Energy Development Authority
NEM	-	Net Energy Metering
FiT	-	Feed In Tariff
DG	-	Distributed Generation
VRF	-	Variable Refrigerant Flow
AC	-	Alternating Current
DC	-	Direct Current
PVGIS	-	Photovoltaic Geographical Information System
QS	-	Quantity Surveyor

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Nowadays, electricity overloading issues become common problem between developers and TNB as primer electricity supplier. It is usually because of over sizing the equipment such as machineries with high load power and also allocation of future project which almost become an imaginary project. In declaring the loads to the TNB it is mandatory for the third party organization such as Mechanical and Electrical Consultation Firm which is responsible for Electrical works. Unfortunately, between developers and their appointed consultant, some miss-information may leads to overloading problems.

Usually, while designing Mechanical and Electrical System inside particular building, most common issues that leads to overloading is wrong estimation upon Mechanical equipments. This is due to most Mechanical equipment such as Air-Conditioning System, Machinery System and Pumping System will be known exactly during construction stage and not at designing stage. At design stage, only rough estimation can be done by certified engineer in order to declare the loads to TNB. For a designer, over declaring the loads are much better than under declaring. For example if a higher load needed than the loads declared to TNB, TNB will request for a new Sub-station which is costly, space consume and beyond contract agreed.

For instant, Figure 1.1 shows the exact load for an Air-Conditioning System that usually is lesser than the proposed size. This is because during earlier stage of designing the building, only estimation can be done by the designer because the actual loads size will be obtain once the project is on construction progress and near to installation stage since the actual loads will come from the appointed supplier. Different supplier will offer different brand hence different capacity of equipments. This stage actually consume two until three years ahead from designing stage due to project contract jurisdiction. Sometimes, sudden changes of system types also lead to the overloading issues due to on site matters.

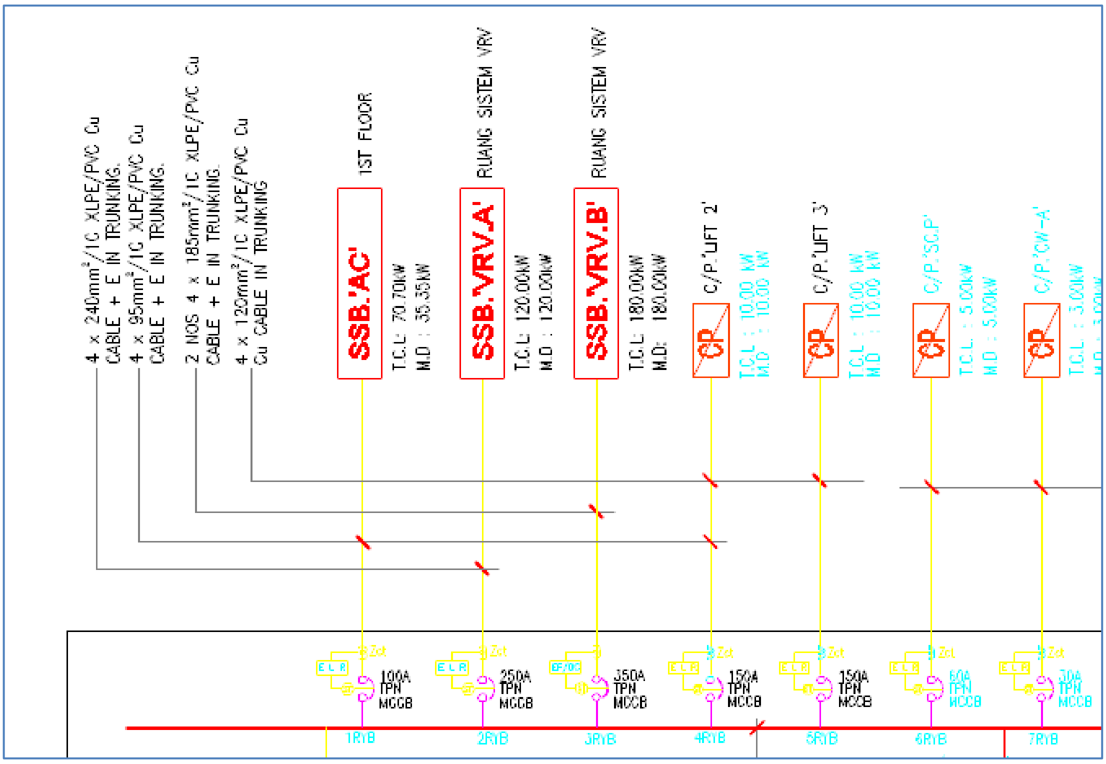

Figure 1.1 High VRF Air-Conditioning Loads

While for some loads that is compulsory but un-used is also give overloading issues. Such as Fire Fighting loads, these loads are used once emergency case such as fire occurred inside buildings. Under normal condition, these loads are left un-used and are kept on idle which is standby mode. Figure 1.2 shows the example of Fire Fighting loads for a particular building that are require under the law stated on UBBL and Guide to Fire Protection in Malaysia handbook [4].

Mechanical designer is using the handbook as a main guideline in designing their fire protection equipment as safety precautions. If the designer doesn't follow the law stated inside this book, meaning that the safety level of dedicated buildings are not comply with Jabatan Bomba dan Penyelamat Malaysia (JBPAM) and the

Certificate of Fitness (CF) will not be awarded. At the same time, once the designer already allocated these fire equipment loads into the building, the loads declare to the TNB then will become higher since most of these fire equipment loads are quite big, but will never use until emergency such as building is on fire occur. This will give waste to the loads declare, un-used but compulsory for emergency case.

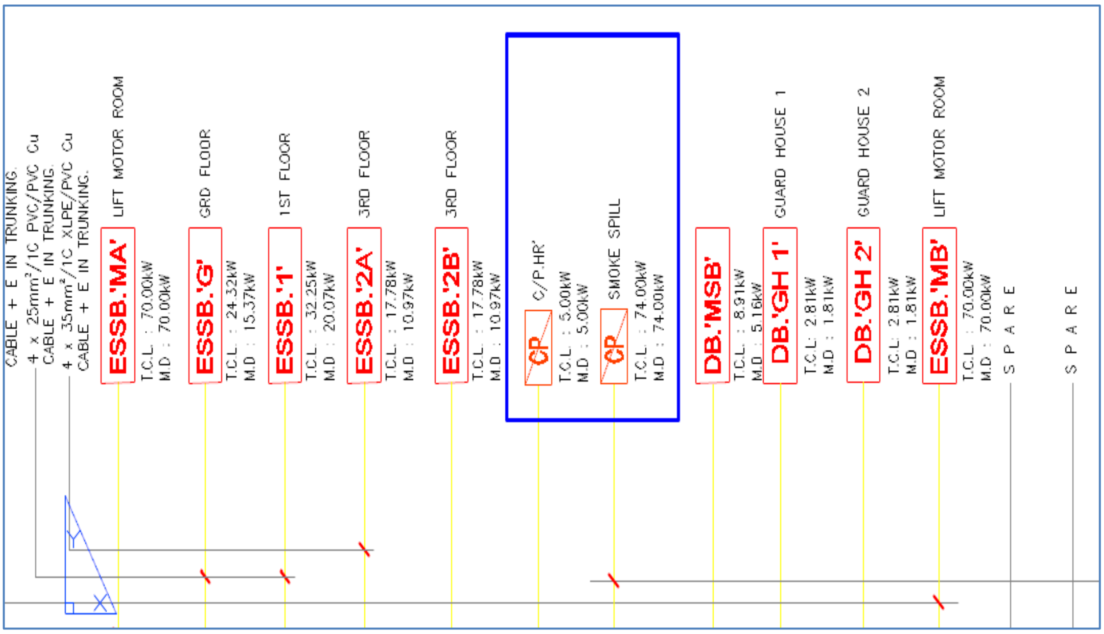

Figure 1.2 Fire Fighting Loads

These over sizing issues actually can be neglected for low voltage consumer, but will become major problems for medium and high voltage consumer since it is consider as loss to the TNB side for installing over size equipments.

Due to this overloading problems, TNB will experience lot of waste in developing their equipments such as Substation, over sizing the Transformers, Cables, Switch Gear and so on just to serve for a small amount of loads but need to provide over size and also periodically maintenance to these equipments with high cost but less outcome. Thus, in order to achieve win-win situation, TNB recently introduce a scheme which known as Connected Load Charge (CLC) in order to prevent any developers and their teams to take for granted in declaring their loads. They should know exactly the loads that will be used especially for Mechanical loads that much consume power.

Under TNB official website regarding CLC scheme, it is actually only applicable when the actual Maximum Demand (MD) recorded on any month is less than 75% of the declared maximum demand. Based on this scheme, such as the loads consume is more than 75%, CLC will not applicable since it is imposed based on the shortfall between the 75% of the declared maximum demand and maximum demand recorded in a month with rate charges of RM8.50 per kilowatt and subjected to prevailing changes from time to time [2].

Nevertheless, for the first 3 years, the CLC will be based on staggered percentage to assist consumer during the initial stage of their operation. This scheme will be prevail for all new medium voltage and high voltage consumers (consumers with supply voltage at 6.6kV and above) and are subjected to CLC for a period of 6 years from the date the supply was commissioned with CLC exemption for the first year only.

CLC is actually urging the developers and their teams to declared the load project as per needed only without taking the future project into the current develop project. It is also known as a mitigating tool to which discourage developers from over declaring their loads requirement because by over declaration the loads will lead to over plant up and waste of resources and increase in reserve margin. Also, Without CLC scheme, other consumers unconsciously will need to pay for the unnecessary higher cost of electricity due to wastage of others developers and this is unfair to those who properly declare.

Each project should be declared once and the future incoming project should be declared during its own early stage of construction without combining these all projects once by means of single submission to the TNB. While for the projects which need to have voltage upgrade, based on the CLC scheme the consumer will be levied with new CLC for a period of 5 years from the date the additional supply was commissioned without exemption for the first year. New Maximum Demand for CLC calculation is based on the total maximum demand declared (i.e current maximum demand plus additional maximum demand). In developing CLC scheme, TNB also introduce Reference Maximum Demand (RMD) in order for the consumer to not easily hit by CLC and shown by table below.

Table 1.1 Reference Maximum Demand (RMD) calculation

Year	**Reference Maximum Demand (RMD)**
1	0% x 75% x [Declared M.D (CLC exempted for the first year only)]
2	50% x 75% x [Declared M.D or Highest Recorded M.D, w/ever is higher]
3	75% x 75% x [Declared M.D or Highest Recorded M.D, w/ever is higher]
4	100% x 75% x [Declared M.D or Highest Recorded M.D, w/ever is higher]
5	100% x 75% x [Declared M.D or Highest Recorded M.D, w/ever is higher]
6	100% x 75% x [Declared M.D or Highest Recorded M.D, w/ever is higher]

From table 1 listed above, it is shown that CLC will be exempted for the first year, while for the remaining years the consumers will be encounter with CLC scheme. But, even though the CLC is initialize on the second year, based on table 1, if the RMD is less than the actual maximum demand taking monthly (AMD), so the CLC is still zero. Once the RMD is exceed than the AMD recorded, so now the CLC will be initialize by following the calculation given, and will become zero again once AMD > RMD. This condition will be continuously flow back and forth until the loads finally being re-value engineering back by the consumers in order to prevent highly cost CLC. Table 2 below shows example of CLC calculation with respect to fixed AMD amount which is 10 MW.

Table 1.2 Example of CLC calculation

Year	Maximum Demand Declared (Assume 10 MW)	Reference Maximum Demand (AMD)	Actual Maximum Demand (AMD)	CLC Penalty (RM)
1	10 MW	0% x 75% x 10 MW = 0 MW	100 KW	Not Applicable
2	10 MW	50% x 75% x 10 MW = 3, 750 KW	5, 000 KW	No Penalty (AMD > RMD)
3	10 MW	75% x 75% x 10 MW = 5, 625 KW	5, 000 KW	CLC = RM8.50 X [5, 625 – 5, 000] = RM 5, 312.00
4	10 MW	100% x 75% x 10 MW = 7, 500 KW	7, 500 KW	No Penalty (AMD > RMD)
5	10 MW	100% x 75% x 10 MW = 7, 500 KW	8, 000 KW	No Penalty (AMD > RMD)
6	10 MW	100% x 75% x 10 MW = 7, 500 KW	8, 000 KW	No Penalty (AMD > RMD)

Since the CLC tariff can be as low as zero and also can be high as per recorded and calculated demand, so a proper method should be taken by the consumers in order to prevent from CLC. Such methods can be done by developers in producing smooth and reliable electricity to their developed area are either by installing own generator set, create new own turbine complete with transformers, switchgear and other necessary equipments, installing UPS system and so on as electricity supply instead of TNB grid. But, seems most of those methods will offer high installation cost, more space area needed for developing those equipments, high periodically maintenance, complex of utilization which need highly competent person which not much people able to do, hence high cost need to pay for the competent cost, so implementation of these type of electricity supply can be put as an optional.

One of the most suitable methods that can be done by developers in developing their own secondary electricity supply to prevent highly cost CLC is by implementing PV Solar System such as shown in Figure 1.3. PV Solar System will absorb sun irradiation into its semiconductor materials and convert into electricity. Since our east cost peninsular of Malaysia consist of good sun irradiation, so by implementing this PV especially on high end buildings which need such a large amount of electricity is much better rather than using fuel-consumption equipments as a secondary electricity supply. This Solar PV will integrate with TNB Grid in serving the building loads.

Figure 1.3 Solar PV mounted on roof top building

Instead of non-fuel consumption and applying greenhouse system which emit zero pollution toward environment, PV system also require no additional space for generating electricity since it will be located on roof top of the building, either integrated with roof as in Figure 1.4 or totally roof replacing the conventional roof top. Integrating both solar PV and roof will give better view for architecture design while by replacing the conventional roof top with the all PV panels will reduce the installation cost since both will be replace by each other.

Figure 1.4 Rectangular Shape PV Panels Integrated with Conventional Roof

In designing Solar PV size to serve building loads, some parameters should be clearly clarified. Such as terms kWp that almost associates with Solar PV, this kWp actually tells that the Solar PV will produce its maximum peak power during peak period. It also tells that for a 1 kWp Solar PV which is working on its maximum capacity for 1 hour will produce 1 kWh of energy [28]. Internationally, PV system manufactured all around the world will be tested under standard regulations known as Standard Test Condition (STC). Under STC [27]:

1. Sun Light Intensity is 1000 W/m^2
2. Temperature 25˚C
3. Wind Speed of 1 m/s

As usual, all electrical equipments will operate based on their efficiency. Previously, the efficiency of Solar PV is much lower than current design. Since 1954, efficiency of solar panel will only able to convert about 6% from sun radiation. By taking STC value as a guide which is 1000 W/m^2, for a 1.6m x 1m dimension Solar PV will generate around 20W output. On 2012, an enhancement was done producing higher efficiency of Solar PV compare to previous one which is 15%. With similar size of Solar PV, efficiency then was raise up again to 19% on 2018 until current year. Even though it is seems small, but the enhancement made is much better due to constraint that need to overcome by each manufacturer [26].

Implementation of Solar PV will always associate with converter known as Inverter. Inverter is a device that converts Direct Current (DC) produce by Solar PV into Alternating Current (AC) which is used by almost home and building appliances. The rated power value for Solar PV given by the nameplate is actually a DC value, and will be convert to AC using Inverter. But, due to this conversion from DC to AC, losses will occur which reducing the nominated value given at the nameplate. This loss is actually Inverter efficiency, and always lies around 95% from rated value. Such as Solar PV rated at 100Wdc, actually will deliver around 95Wac after conversion [25] [26].

Based on demand needed by the loads, several numbers of rectangular shape PV panels each with currently dimensions around 2m x 1m (depend on wattage) generating about maximum up to 400Wdc will be arranged in parallel plus series combinations complete with high efficiency Inverter system in order to produce dedicated maximum demand. Less maintenance also require for PV system since not much electrical equipment and fuels consumption needed in developing complete PV system compare to others with complex electrical part.

Once installing the PV system as part of the roof or totally as roof top building, consumers then can also reduce their monthly electricity bill using their installed PV under Net Energy Metering (NEM) scheme as per shown in Table 1.3 and Table 1.4 below. NEM will allows electricity consumers who wish to supply their own electricity from on-site generation to pay only for the net energy they obtain from the utility. NEM is primarily used for solar photovoltaic PV systems at homes and also businesses (other distributed generation (DG) customers may have access as well) but with difference tariff. This scheme is applicable to all domestic, commercial and industrial sectors as long as they are the customers of TNB (Peninsular Malaysia) or SESB (Sabah and FT Labuan) [1].

Table 1.3 Tariff C1 for Commercial Inclusive of Government Building

Year	Tariff Category Tariff C1 – Medium Voltage General Commercial Tariff	Current Rates (1 Jan 2014)
1	For each kilowatt of maximum demand per month	30.3 RM/ kW
2	For all kWh	36.5sen/ kW
3	The minimum monthly charge is RM 600.00	

Table 1.4 Tariff B for Commercial Inclusive of Government Building

Year	Tariff Category Tariff B – Low Voltage General Commercial Tariff	Current Rates (1 Jan 2014)
1	For the first 200 kWh (1-200kWh) per month	43.5 sen/ kW
2	For the next kWh (201 kWh onwards) per month	50.9 sen/ kW
3	The minimum monthly charge is RM 7.20	

Since the output of a PV system may not perfectly match the on-site demand for electricity, a home or business with a PV system are exporting excess power to the electric grid during under load and importing power from the grid when needed. The utility bill customers only for the net electricity used during each billing period. Alternately, if a customer has produce more electricity than they have consumed, the credit for that net excess generation will be treated according to the NEM policy of the state or utility. For the consumer to apply NEM scheme, a new type electricity meter called NEM meter shown in Figure 1.5 should be replace instead of conventional TNB meter.

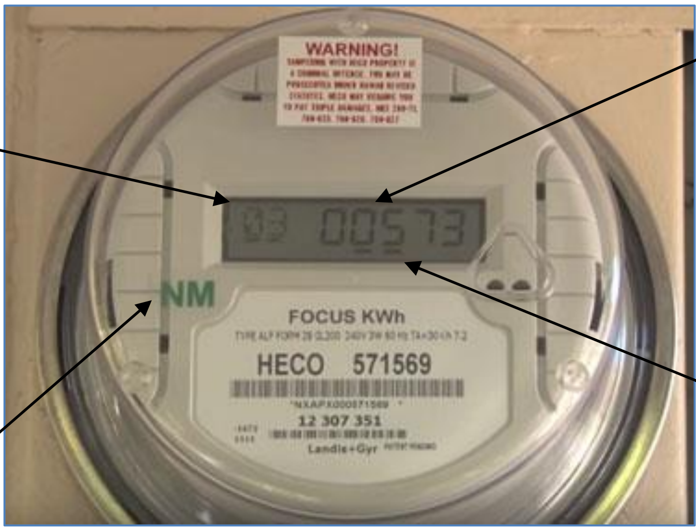

Figure 1.5 Net Energy Metering (NEM) Meter

The concept of NEM Metering is just simple. Such a particular month, meter display is 03 00573. This means that under channel 03, the building is receiving energy from grid for amount of 573 kWh. While under channel 33, such example if the meter displays 33 00300 meaning that the building is actually exporting excess energy to grid for amount of 300 kWh. Hence, net energy usage for the building will become 273 kWh and will be shown under channel 23 as 23 00273. At this time, consumer will need to pay for amount of 273 kWh energy used taken from grid. On the other case, for example if channel 03 displays 03 00300, channel 33 display 33 00573, hence channel 23 will displays as 23 00273 and the consumer will be billed for the net 273 kWh [30]. Figure 1.6 shows typical connection of NEM meter into buildings.

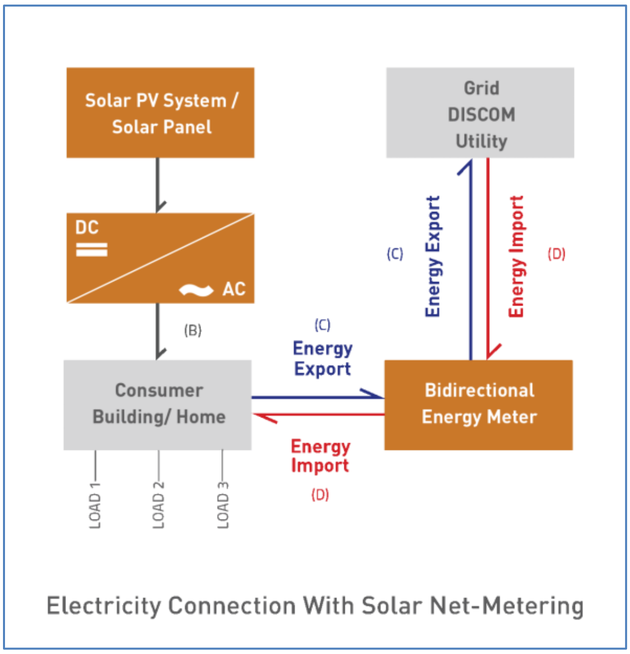

Figure 1.6 Typical Connection of NEM Meter into Building

The Ministry has introduced few solar PV initiatives to encourage Malaysia's Renewable Energy (RE) uptake. From the RE town hall held on 12th July 2018, one of the key issues highlighted by the PV industry is the need to change the concept of NEM from the existing net billing to true net energy metering. This actually will help improving the return of investment of solar PV under the NEM scheme. Effective on 1st January 2019, the Net Energy Metering (NEM) will be improved by adopting the true net energy metering concept and this will allow excess solar PV generated energy to be exported back to the grid on a "one-on-one" offset basis, meaning that every 1kWh exported to the grid will be offset against 1kWh consumed from the grid, instead of at the Displaced Cost previously.

This scheme actually replacing the older one known as Feed-In Tariff (FiT) which already superseded with this NEM scheme. Previously, FiT scheme already implemented starting on 2011 and closed registration on 2016 and replaced by NEM scheme.

The basic concept of FiT is that the Distribution Licensee (TNB/ SESB) will pays the Feed-in Approval Holder with a premium tariff for clean energy that is generated. Based to this scheme, owners can sell their clean energy to the distribution licensee for a fixed number of years with duration already dictated by the type of renewable energy used for power generation. The seller will obtain such amount of incentive with fixed payment from the electricity supplier for every kilowatt hour (kWh) of electricity generated and a guaranteed minimum payment for every kWh exported to the grid. Whilst, under NEM scheme, some different topologies are apply.

1.2 Problem Statement

It is become a rule of thumb for a developer to over declaring the amount of loads up to 70%~80% from actual loads needed. It is usually because of over sizing the equipment such as machineries with high load power and also allocation of future project which almost become an imaginary project. In declaring the loads to the TNB it is mandatory for the third party organization such as Mechanical and Electrical Consultation Firm which is responsible for Electrical works. Unfortunately, between developers and their appointed consultant, some miss-information may leads to overloading problems.

Over declaring which leads to over sizing the equipment will give high impact to the TNB in developing their equipments to serve the loads. For the low voltage consumer, TNB offer an exemption when the loads declare is high although the actual load consumed is less as long as it is under low voltage (LV) scheme. However for medium voltage (MV) and high voltage (HV) consumers are subjected to CLC [2].

A 1.2 MW 11kV (Medium Voltage) commercial building consist of various Mechanical and Electrical equipments need to be re-value engineering upon loads distribution since the actual loads usage is almost less than 75% and will be subjected to CLC scheme [2]. In developing the Mechanical and Electrical services for that particular building, almost of the equipments is actually compulsory and cannot be neglected in order to make sure the building run in satisfactory and safe manner according to those technical authorities such as JKR, BOMBA and JKKP.

For the particular research building, with demand of 1, 163.40 kW and estimated to be used for less than 75%, the minimum estimated CLC cost will is shown on Table 1.5.

1.3 Objective

The objective of this project is to study and analyze the impact of installing PV solar system as secondary energy source to the commercial building. The more specific objective of this study is:

i. To study and analyze the cash flow of the consumers under CLC scheme for over declaring the loads

ii. To design a Building Integrated Photovoltaic (BIPV) system on commercial building as secondary energy source in order to prevent CLC by TNB

iii. To evaluate and analyze the cash flow to the consumer when implementing BIPV under NEM Scheme

1.4 Scope of Project

In this paper, a new developed commercial hostel building located in Kuala Terengganu is taken as a case study. This project is under construction works and currently approaching 50% upon completion. In order to implement this solar PV into the on-progress project, there are some limitations that need to put into considerations.

Based on original contract, an aesthetic conventional roof had been selected as a main roof top. By changing the type of this aesthetic roof into solar PV panels then will actually giving some plain view for architecture aspect. Even though by installing PV system integrating with the roof top technically will give much benefit to the owner, but in terms of aesthetical value is seems to be quite low and need to be carried out for further detail discussion.

Cash flow also becomes one of the gaps in developing this project. Since there is plenty of PV panels will be installed into the roof top, making complex in maintenance hence resulting in high installation and maintenance cost.

As the project location is at Kuala Terengganu which is east coast of peninsular Malaysia, and will experience raining monsoon season during end of the years, hence the energy storage system for PV should be analyzed properly. Once the season occur, sometimes up to few months, so the PV will not going to generate electricity. This condition should be well investigated.

Also this project location just near to Kuala Terengganu Sultan Mahmud Airport, hence under regulations by Civil Aviation Authority of Malaysia for higher buildings construct near to the airport should have 'Obstacle Light' locates at the roof top of the building. This actually will give effect to the installation of solar PV into the roof building. Same goes to the TV antennas, lightning protection system and other signals receiver installed at the roof top will also give some constraint in constructing solar PV for this project.

Table 1.5 Minimum Estimated CLC

Year	**Maximum Demand Declared (kW)**	**Reference Maximum Demand (AMD)**	**Target Actual Maximum Demand (AMD)**	**CLC Penalty (RM)/ Month**
1	1, 163.4 kW	0% x 75% x 1, 163.4 kW = 0 kW	749.05 kW	Not Applicable
2	1, 163.4 kW	50% x 75% x 1, 163.4 kW = 436.28 kW	749.05 kW	No Penalty (AMD > RMD)
3	1, 163.4 kW	75% x 75% x 1, 163.4 kW = 654.41 kW	749.05 kW	No Penalty (AMD > RMD)

Year	Maximum Demand Declared (kW)	Reference Maximum Demand (AMD)	Target Actual Maximum Demand (AMD)	CLC Penalty (RM)/ Month
4	1, 163.4 kW	100% x 75% x 1, 163.4 kW = 872.55 kW	749.05 kW	CLC = RM8.50 X [872.55 – 749.05] = RM 1, 049.75
5	1, 163.4 kW	100% x 75% x 1, 163.4 kW = 872.55 kW	749.05 kW	CLC = RM8.50 X [872.55 – 749.05] = RM 1, 049.75
6	1, 163.4 kW	100% x 75% x 1, 163.4 kW = 872.55 kW	749.05 kW	CLC = RM8.50 X [872.55 – 749.05] = RM 1, 049.75
7	1, 163.4 kW	100% x 75% x 1, 163.4 kW = 872.55 kW	749.05 kW	CLC = RM8.50 X [872.55 – 749.05] = RM 1, 049.75

SAM Software parameters also give limitations to this study. Almost of data needed in SAM already entered exactly as design unless for parameter under 'Electricity Rates' which offer for only a single value of rate. Under NEM rates, it is charge based on B tariff where the first 200 kWh is charged at RM 43.5 sen/ kW and followed by next 200 kWh onwards is charged at RM 50.9 sen/ kW for Low Voltage tariff

On designing new loads distribution, several loads with less use but consume high power such as Fire Fighting equipments and VRF Air Conditioning system will assume to be omitting from receiving electricity supply from the mains grid. This omission actually is just on 'Submission Document' in declaring loads to the TNB. Practically, all loads including these Air-Conditioning and Fire Fighting loads will still obtain supply from TNB, as well as Solar PV. By omitting these two high power loads, then the tariff can be reduced from Medium Voltage to Low Voltage, hence CLC can be exempted [3].

Instead of preventing consumer from CLC, Solar PV wills also generating excess solar to the grids. The amount of excess energy will analyzed since there are no cash transactions under this scheme, but will be rolled for a period of 12 months meaning that for the next billing cost which consumes energy from grid then will be offset against amount of excess energy generated.

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