

Guidebook on Net Metering in the Philippines

Draft Report

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List of Abbreviations

AC	-	Alternating current
CCT	-	Condominium Certificate of Title
DAS	-	Distribution Assets Study
DC	-	Direct current
DIS	-	Distribution Impact Study
DOE	-	Department of Energy
DPWH	-	Department of Public Works and Highways
DSOAR	-	Distribution Services and Open Access Rules
DU	-	Distribution utility
ECE	-	Electronics and Communications Engineer
ERC	-	Energy Regulatory Commission
FI	-	Financing institution
IEC	-	International Electrotechnical Commission
ISO	-	Organization for Standardization
kW	-	Kilowatt
kWh	-	Kilowatt-hour
LGU	-	Local government unit
ME	-	Module efficiency
MPP	-	Maximum power point
NBCDO	-	National Building Code Development Office
NEA	-	National Electrification Administration
NGCP	-	National Grid Corporation of the Philippines
NM	-	Net-metering
NPC	-	National Power Corporation
NREB	-	National Renewable Energy Board
OBO	-	Office of Building Official
pa	-	Per annum
PCAB	-	Philippine Contractors Accreditation Board
PEE	-	Professional Electrical Engineer
PIOU	-	Privately-owned investor utility
PRC	-	Professional Regulation Commission
PSSEA	-	Philippine Solar and Storage Energy Alliance
PV	-	Photovoltaic
QE	-	Qualified end-user
RA	-	Republic Act
RE	-	Renewable energy

- REE - Registered Electrical Engineer
- RES - Renewable energy system
- RME - Registered Mechanical Engineer
- ROI - Return on investment
- RPS - Renewable Portfolio Standard
- STC - Standard test conditions
- TCT - Transfer Certificate of Title
- UPS - Uninterrupted power supply

Glossary and Terms

“Certificate of Compliance” refers to a certificate issued by the Energy Regulatory Commission granting a person the authority operate facilities used in the generation of electricity.

“Contestable customer” refers to electricity end-users who are part of the “contestable market” or those who have a choice of their supplier of electricity.

“Department of Energy” (DOE) refers to the government agency created pursuant to Republic Act (RA) No. 7638 whose functions are expanded in RA No. 9136.

“Distribution Asset Study” (DAS) determines all additional distribution assets and costs required to accommodate the proposed generation source of the net-metering customer.

Distributed energy resources (DER) are small-scale power generation sources located close to where electricity and associated facilities used (e.g., a home or business) to provide an alternative to or an enhancement of the traditional electric power grid.

“Distribution Impact Study” (DIS) is conducted by the distribution utility to ensure the reliability and stability of the distribution system.

“Distribution Services and Open Access Rules (DSOAR)” refers to the Rules promulgated by the Energy Regulatory Commission under ERC Resolution No. 2, Series of 2010 including any subsequent amendments thereto, covering, among others, the terms and conditions for the connection of generating facilities to the Distribution System.

“Distribution utility” (DU) refers to any electric cooperative, private corporation, government-owned utility or existing local government unit which has an exclusive franchise to operate a Distribution System in accordance with its franchise and R.A. No. 9136, as defined in Section 4(l) of Republic Act No. 9513.

“Energy Regulatory Commission” (ERC) refers to the independent quasi-judicial regulatory agency created pursuant to RA No. 9136.

“Local Government Unit” (LGU) refers to the political subdivisions established by or in accordance with the Philippine Constitution pursuant to Executive Order (EO) No. 292 or RA No. 7160, which include the province, city, municipality and barangay.

“National Electrification Administration” (NEA) is the government agency created pursuant to RA No. 6038 and in-charge of the Philippines Rural Electrification Program.

“National Renewable Energy Board” (NREB) refers to the board created under Republic Act No. 9513 tasked under Section 10 thereof to recommend to ERC the establishment of net-metering interconnection standards, pricing methodology and other commercial arrangements necessary to ensure success of the net-metering for renewable energy program.

“Net-Metering” (NM) refers to a system, appropriate for distributed generation, in which a distribution grid user has a two-way connection to the grid and is only charged for his net electricity consumption and is credited for any overall contribution to the electricity grid.

“Net-Metering Agreement” refers to the agreement between a Qualified End-User (QE) and the DU governing the commercial and interconnection arrangements between the DU and the QE

“Net-Metering Interconnection Standards” refers to the set of requirements and procedures to ensure safe, reliable and efficient connection of QE’s RE system, and its operation thereof in parallel to the Distribution System.

“New housing development” refers to a group of individual dwelling or apartment houses that are usually built and sold or leased by management.

“On-grid system” refers to electrical systems composed of interconnected transmission lines, distribution lines, substations and related facilities for the purpose of conveyance of bulk power on the grid of the Philippines, as defined in Section 4(kk) of Republic Act No. 9513.

“Philippine Distribution Code” (PDC) refers to the set of Rules, requirements, procedures and standards governing DUs and Users of Distribution System in the operation, maintenance and development of the Distribution System. It also defines and establishes the relationship of the Distribution System with the facilities or installations of the parties connected thereto.

“Philippine Electrical Code (PEC 2017)” establishes the basic materials quality and electrical works standards for the safe use of electricity for light, heat, power, communications, signaling and for other purposes.

“Power tolerance” indicates how the power output of a solar panel might differ from its nameplate rating. They are typically expressed as a plus-or-minus percentage.

“Power rating” indicates the amount of power that the panels can produce under industry test conditions.

“Qualified end-users” (QE) refers to entities that generate electric power from an eligible on-site RE generating facility, such as, but not limited to, house or office building with photovoltaic system that can be connected to the grid, for the purpose of entering into a Net-metering agreement;

“Rapid shutdown” a system that enables facility personnel and responders to physically flip a switch to disengage the solar PV panel/array and reduce the electrical voltage in less than a minute.

“Retail electricity supplier” (RES) refers to the entities licensed by the Energy Regulatory Commission to supply electricity to the end-users in contestable market.

“Renewable Energy Certificate” (REC) refers to the certificate issued to the electric power industry participants showing the energy sourced, produced, and sold or used. RE certificates may be traded in the RE Market in complying with the RPS;

“Renewable energy resources” (RE Resources) refers to energy resources that do not have an upper limit on the total quantity to be used. Such resources are renewable on a regular basis, and whose renewal rate is relatively rapid to consider availability over an indefinite period of time. These include, among others, biomass, solar, wind, geothermal, ocean energy and hydropower conforming with internationally accepted norms and standards on dams, and other emerging renewable energy technologies;

“Renewable energy technologies” eligible RE technologies under the net-metering program include wind, solar, run-of-river hydro, biomass energy systems or such other RE systems capable of being installed with the QEs premises with or without battery

“Renewable Portfolio Standards” (RPS) refers to a market- based policy that requires electric power industry participants, including suppliers, to source a portion of their energy supply from eligible RE Resources, as defined in Section 4(ss) of Republic Act No. 9513.

Solar energy” refers to the energy derived from solar radiation that can be converted into useful thermal or electrical energy;

1. INTRODUCTION

1.1 Background

Net-metering in simple terms is a scheme that allow users to sell electricity they have generated back to the grid. The electricity generated in this manner is often from renewable energy (RE) sources with the most common being rooftop solar photovoltaics (referred to as distributed generation or distributed renewable energy). As such, net-metering has become an important and effective driver for accelerating the deployment of RE particularly in cities and municipalities. More discussions about net-metering is provided in Chapter 3.

In the Philippines, the concept of net-metering was introduced through the Renewable Energy Act of 2008 (RA 9513). The Department of Energy (DOE) is the key national government agency mandated to promote the development of indigenous and renewable energy (RE) resources.

By virtue of the Energy Regulatory Commission (ERC) Resolution 09 Series of 2013, which took effect on 24 July 2013, the Rules Enabling the Net-Metering Program for Renewable Energy set the activities into action. The Net-Metering Program is available then only for on-grid distribution systems.

A Net-Metering Reference Guide was published in 2013 by the DOE with support from the GIZ to facilitate the information dissemination of the Net-Metering Program.

Seven years have passed and there have been many developments in the implementation of the Net-Metering Program. The electricity customers' response was encouraging; there was a remarkable growth in the installation of rooftop solar PV installations in the country. However, the net-metering program, still in its infant stage of implementation, encountered challenges. The DOE, NREB and the ERC were frontrunners in finding solutions to these challenges. Several executive instruments, such as DOE department circulars and ERC Rules and resolutions, were issued.

In the recently issued DOE Department Circular No. DC 2020-1-0022 known as "Prescribing the Policies to Enhance the Net-Metering Program for Renewable Energy Systems", one of the provisions mentioned about the development of a Net-Metering Guidebook. The guidebook aims to prescribe the guidelines and procedures for net-metering arrangements from the offer to after-sales services by the net-metering installers and practitioners as well as prescribing the minimum standards for all net-metering installations, in collaborations with all concerned government agencies.

1.2 Objectives of the Guidebook on Net-Metering Program Volume

The general objective of this Guidebook is to provide the various Net-Metering Program stakeholders, particularly the electricity consumer, an easy to read, follow and understand reference in participating in the Net-Metering Program.

The specific objectives in developing this Guidebook are:


- To present the big picture of why the government is implementing a Net-Metering Program so that the various participants or stakeholders will appreciate the value of their contributions;
- To discuss in simple language the following:
 - ✓ Concept of Net-Metering
 - ✓ Participants/stakeholders in Net-Metering Program
 - ✓ Components of a Net-Metering facility
 - ✓ Steps in participating in the Net-Metering
 - ✓ Implementation arrangements between stakeholders
 - ✓ Procurement of solar PV facility and its components
- To give practical tips to net-metering program participants especially the QEs.


1.3 “Walking Through” this Guidebook

The Guidebook Volume 1 will have the following chapters:

- Chapter 1 – Introduction
- Chapter 2 – Legal framework of the Net-Metering Program
- Chapter 3 – Overview of the Net-Metering Program
- Chapter 4 – Steps in applying for the Net-Metering Program
- Chapter 5 – Procurement of solar PV system and its components
- Chapter 6 – Feedback and Grievance Redress Mechanism

There is a deliberate effort to make the Guidebook reader friendly, i.e. easy to read, to understand and to follow. Below are some tips as one reads through the Guidebook:

- Illustrations are provided when appropriate to make discussions interesting;
- Markers with  and boxed information are done for those that are reminders or advice. The reader is advised to remember to go back to them later.

- There are instances when technical terms cannot be avoided. Those enclosed in quotation marks are such terms. Descriptions are provided in the Glossary of Terms to clarify them. They are marked with  .

2. LEGAL FRAMEWORK OF THE NET-METERING PROGRAM

This chapter discusses various legislative and executive instruments that support the implementation of the Net-Metering Program in the on-grid areas of the country.

The creation of the Department of Energy (DOE) in 1992 through Republic Act (RA) 7638 declares as a policy of state, among others, to ensure a continuous, adequate and economic supply of energy through the intensive exploration, production, management and development of the country's energy resources. In consonance with this mandate, the Electric Power Industry Reform Act (EPIRA, RA 9135) was issued in 2001 to restructure the power industry and to make it more efficient and competitive. Section 37 of the EPIRA mandates the DOE to encourage private sector investments in the electricity sector and promote the development of indigenous and renewable energy (RE) resources.

The government's intent to accelerate the development and use of renewable energy was further enhanced with the enactment of the Renewable Energy Act of 2008 (RA 9513). The goal of the Act is to accelerate the exploration and development of RE, promote its efficient and cost-effective commercial application, and encourage its use as tools for balancing the goals of economic growth with protection of health and the environment. To encourage commercial development of RE projects, the RE Act specifies several market policies to enhance competitiveness. One of this policy mechanisms is the net metering.

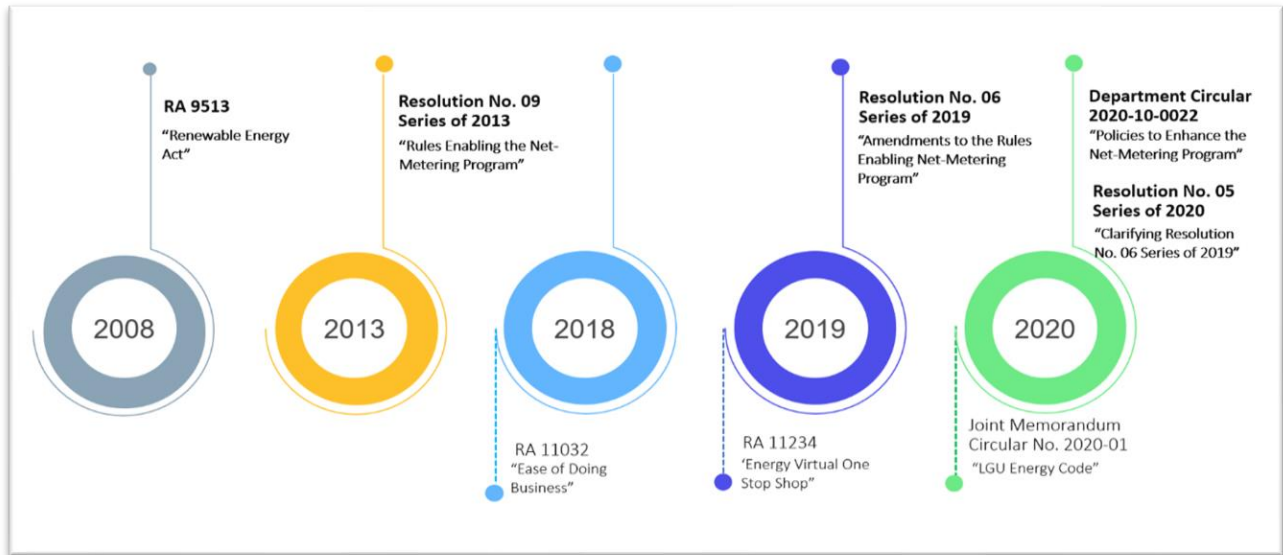


Figure 1. Laws and Issuances for the Implementation of the Net-Metering Program

The net-metering program is anchored on the following resolutions and circulars issued by both DOE and ERC. Figure 1 shows laws and issuances related to the Net-Metering Program. Those with dotted lines and located at the lower portion are laws/issuances that compliment to the implementation of the Program.

2.1 Resolution No. 09 Series of 2013 Rules Enabling the Net-Metering Program



The resolution stipulates that the rules would apply to on-grid system. All electricity end-users known as “qualified end-users” (QEs) 📖 who are of good standing are qualified to participate in the net-metering program utilizing various “renewable energy resources” 📖 such as wind, solar, biomass, biogas energy systems or other RE systems that can be installed within the QE’s premises. The DU shall install two uni-directional meters (one for import and one for export) or a bi-directional meter whichever is economical¹. A third meter close to the RE system to measure the RE generated. The DU is entitled to “renewable energy certificate” (REC) 📖 from the energy generated from RE through the program.

ERC is mandated to establish a pricing methodology applicable to net-metering. Meanwhile the DU’s monthly generation charge, which is based on blended generation costs shall be used as the preliminary reference price.

¹ A subsequent resolution prescribed the use of a bi-directional meter; refer to Section 2.3

The resolution also includes in its annexes the net-metering connection standards and net-metering agreement template. The ERC Resolution No. 09 Series of 2013 is attached as Annex 1.

2.2 Resolution No. 06 Series of 2019 Amended Net-Metering Rules

The Amended Net-Metering Rules prescribe a maximum 20-day processing timeline for the DUs to complete the whole interconnection process from receipt of the letter of interest; provided all necessary permits and licenses from various concerned agencies are secured and completed. Eligible “RE technologies”  were also modified to include wind, solar, run-of-river hydro, biomass energy systems or such other RE systems capable of being installed with the QEs premises with or without battery. In the amended rules, the ERC has considered that the conduct of “Distribution Impact Study” (DIS)  is a regular activity of the DU to ensure the reliability and stability of the distribution system, hence DIS fee and other related costs were removed to encourage participation from end-users. The pricing methodology under this resolution maintained the DUs’ blended generation cost excluding other generation adjustments, instead of the proposed retail rate. Further, the amended net-metering rules also rationalized the sharing of lifeline rate subsidy among all consumers.

The ERC Resolution No. 06 Series of 2019 is attached as Annex 2.

2.3 Resolution No. 05 Series of 2020 Amendments to the Rules Enabling Net-Metering Program

The resolution was issued to provide clarifications on some provisions mentioned in Resolution No. 09 Series of 2013 (Chapter 2.1). The following amendments were made: (i) the definition of good credit standing now refers to electricity end-users with no unsettled or outstanding obligations with the DU at the time of the application, QEs would also include new customers; (ii) all meters shall be charged to the DU except for customers who wish to install RE systems in their premises, of which the difference between the cost of the old meter and the new bi-directional meter shall be borne by the end-user; (iii) the DU shall bear the cost of an REC meter while the QE should pay the wiring cost from the facility to the REC meter; and (iv) the REC meter should be located at the connection point or near the connection point. The resolution also stipulates that in case the existing customers have two (2) uni-directional meters, the same will now be replaced by one (1) bi-directional meter.

The ERC Resolution No. 05 Series of 2020 is attached as Annex 3.

2.4 Department Circular No. 2020-10-00222 Policies on Net-Metering Program

The amended net-metering rules issued by ERC addressed most of the economic and technical barriers of the current Net-Metering Program, however the DOE deems it necessary to further enhance the current policies and commercial arrangements to increase the utilization of RE through the Net-Metering Program. The circular clarified that the QEs under the net-metering arrangement shall not be a net generator or producer at the end of each calendar. Thus, any excess or balance net-metering credits at the end of each calendar year shall be forfeited. The coverage of the program is expanded to off-grid areas; those not connected to the major national electrical transmission grids, namely Luzon, Visayas and Mindanao. The ERC in consultation with DOE, DU, the National Electrification Administration (NEA) and the National Power Corporation (NPC) may issue the necessary amendments to the net-metering interconnections standards to facilitate effective implementation of the program in off-grid areas. The NEA is stipulated to provide assistance to all electric cooperatives (ECs) in promoting the net-metering program, as well as other capacity building program such as technical assistance on Distribution Impact and Asset Studies and determination of the hosting capacity.

The Department Circular No. 2020-10-00222 is attached as Annex 4.

The net metering program is being implemented in complimentary with other laws and circulars to fast-track the approval process from other government agencies and local government units. Below are some legal instruments relevant to the program.

2.5 Joint Memorandum Circular No. 2020-01 LGU Energy Code

The DOE and the Department of Interior and Local Government (DILG) issued Joint Memorandum Circular instructing LGUs to monitor and collect the benefits of energy projects and incorporate the same in their comprehensive development. The LGUs are also mandated to streamline the processes in issuing the necessary permits on energy related projects in accordance with Section 14 of the Energy Virtual One Stop Shop (EVOSS) Act. The LGUs concerned stakeholders and constituents should be capacitated on energy safety practices, energy efficiency and conservation, energy resiliency, and energy planning.

The Joint memorandum Circular No. 2020-01 LGU Energy Code is attached as Annex 5.

2.6 RA 11032 Ease of Doing Business


The Ease of Doing Business (EODB) is an act which aims to streamline the current systems and procedures of delivering government services. A unified application form will be required for business permits and renewals to cut the red tape involved in business registration and permit renewals. A one-stop-shop will also be established to house agencies involved in starting a business. All government agencies have to comply with standard turnaround times for various transactions. All forms will be moved online, and digital copies of documents will be submitted electronically to reduce the risk of graft and corruption. Likewise, licenses and permits can now be printed at home, and this copy shall have the same authority as a hard copy. The EODB Law prescribes administrative and criminal liability to the officials and employees who may act inappropriately.

2.7 RA 11234 Energy Virtual One Stop Shop

The law establishing virtual energy one stop shop (EVOSS) aims to streamline the permitting process of power generation, transmission, and distribution projects in the Philippines. The EVOSS Act intends to eliminate the bureaucratic red tape, which often discourages foreign firms from entering the power generation industry. EVOSS is an online paperless platform where prospective energy developers can apply, monitor, and receive all the needed permits and applications, submit all documentary requirements, and even pay for fees. It will allow the single submission and synchronous processing of all required data and information, and will provide a single decision-making portal for the approval of new energy generation projects. All government agencies involved will be required to follow a strict timeframe to act on pending applications. The failure of an agency to act within the prescribed timeframe will result in the automatic approval of an application while potential administrative sanctions may be imposed against inefficient public officers to penalize the delay.

3. OVERVIEW OF THE NET-METERING PROGRAM

3.1 Concept of the Net-Metering Program

The Net-Metering Program  is a non-fiscal strategy prescribed in RA 9513 to promote the utilization of RE in the country. It is designed as an incentive scheme that aims to encourage electricity customers to participate in the generation of RE to meet part of its load demand, thereby reducing its purchased electricity from the DU. Specifically for electricity customers with rooftop solar systems, during 10Am to 3PM there may be excess electricity for its load, thus they are able to export power to the distribution system where they earn credit which will be applied to the following month.

Under the Net-Metering program, the electricity customers are allowed to install an on-site, i.e. within the electricity customer's premises, RE system not exceeding 100 kilowatts (kW) in capacity to generate electricity for their own use. The RE systems include wind, biomass, biogas energy systems or run-of-river micro-hydro or such other RE systems. The rooftop solar photovoltaic (PV) is currently the popular RE net-metering technology.

While the electricity consumers are allowed to generate electricity, it must be clear that electricity consumers will be net consumers and cannot be a net power generator. This means that their consumption is higher than their electricity generation. With this clarification, electricity consumers should not see their net-metering participation as a possible business venture by oversizing their RE or solar PV system to export more power to the grid.

"Net metering can give you a monthly paycheck"

Fact or Fiction:

FICTION.

With net metering, you can receive utility bill credits for the electricity that your solar panels produce. However, you won't receive a cash payment from your utility for your excess solar electricity, no matter how much you generate. If you do generate more electricity that you use in a year, any excess or balance net-metering credits at the end of each calendar year shall be forfeited.

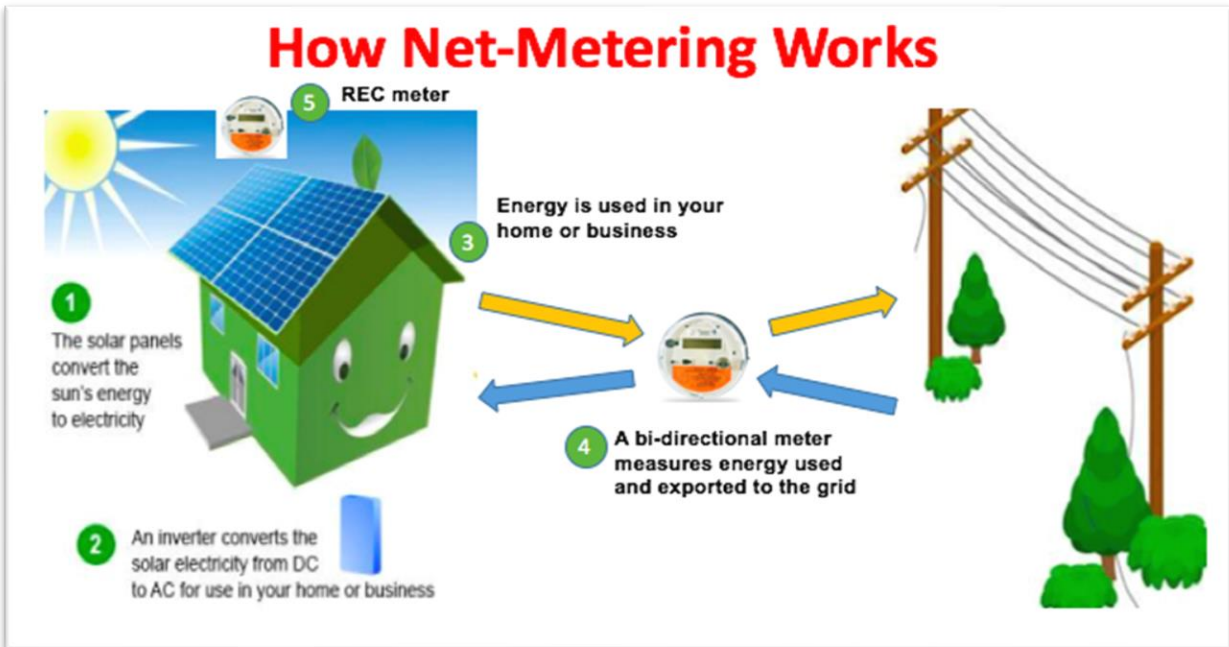


Figure 2. How Net-Metering Works

Figure 2 illustrates how the net-metering works:

- The home, school or office/commercial buildings have two sources of electricity, i.e., (i) from the solar PV or an on-site RE system and (ii) from the distribution grid;
- The electricity produced from the RE systems are direct current (DC). An inverter is a component of the solar PV system to convert DC to alternating current (AC) which will run the various loads at home or in school or office/commercial buildings;
- The flow of electricity is shown as color coded; (i) electricity from the RE system is “yellow” going to the home (for example) and during period of oversupply, it is exported to the distribution grid; (ii) electricity from the distribution grid is “blue”, goes to the home when there is not enough electricity supply from the on-site RE system;
- The flows of electricity are measured by a bi-directional meter;
- A second meter, the Renewable Energy Certificate (REC) 📖 meter, is installed to measure the gross electricity generation from the RE system. The REC meter reading is the basis for the computation of subsidies, discounts and for the Renewable Portfolio Standard (RPS) 📖 compliance.

Solar energy systems generally hit high electricity production in the afternoon; this is when many people aren't home using electricity. In contrast, solar energy systems' electricity production is low in the mornings and evenings, when home electricity use is typically higher. This is shown in

Figure 3. Net metering helps the electricity consumers to account for these ups and downs in the day-to-day electricity production and usage.

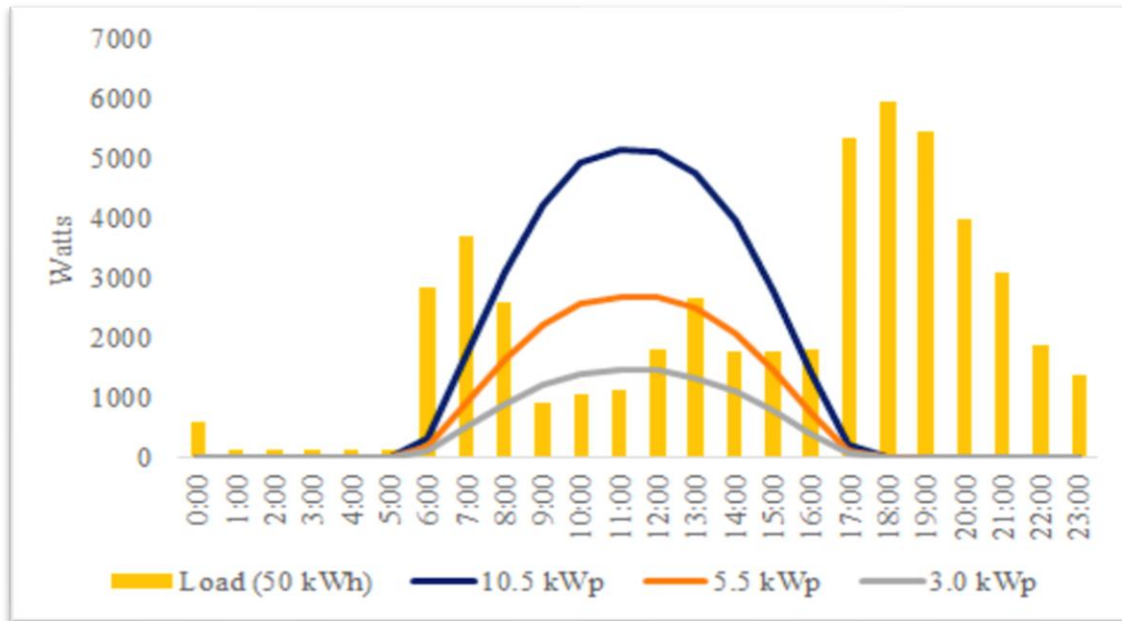


Figure 3. Typical Daily Household Energy Consumption and Solar PV Production Profile
(Source: *The Economics of Net-Metering Policy in the Philippines* by Romeo Pacudan)

The net-metering has multi-tiered benefits:

- To the “Prosumers”/QEs
 - ✓ Generate savings in electricity bills
 - ✓ Make productive use of idle roof spaces
 - ✓ Protect customer from rising electricity prices
 - ✓ Increase awareness to support green initiatives
- To the Distribution Utilities/electricity industry
 - ✓ Reduce distribution cost because electricity generation is at or near the point of consumption
 - ✓ Minimize line losses from sending voltage many miles from the nearest power plant
 - ✓ Offset expensive power generation by producing electricity during periods of high demand when power is most costly
 - ✓ Realize net benefits to the entire electric grid through reduced capital investment costs, avoided energy costs and reduced environmental compliance cost
 - ✓ Earn REC credit for RPS compliance
- To the environment
 - ✓ Reduce carbon emission
 - ✓ Help mitigate climate change

- To the economy
 - ✓ Contribute in lessening the country's dependence on costly imported fossil fuels
 - ✓ Minimize exposure to price volatility of imported fossil fuels
 - ✓ Help achieve energy security
 - ✓ Create local green jobs

3.2 The Net Metering Facility

3.2.1 Components of an RE/Solar PV System

An RE system net-metering facility, for example a solar PV system that is connected to the utility power grid, can be described also as grid-tied, on-grid, utility-interactive, grid intertie or grid back-feeding.

The major components of a solar PV Net-Metering facility, shown in Figure 2, are the following:

- Solar photovoltaic (PV) panels. the solar energy from the sun is the main fuel for producing electricity. When sunlight hits the solar PV panels, PV cells produce DC electricity.
- Inverter: converts the electricity produced from the solar PV panels from DC electricity to an AC electricity, the type of current flow used both on the grid and in your home. Some solar panel system configurations have a single inverter (often called a string inverter) for the entire system. Some have a micro-inverter connected behind each solar panel.
- Bi-directional meter: measures the inflow and outflow of electricity to and from your home; electricity produced by the rooftop solar PV is first used to power your home, and then is sent to the distribution grid in times of surplus.
- REC meter: measures the gross electricity produced by the solar PV/RE system
- Distribution electric grid: provides electricity to your home in times of under-generation and carries out excess electricity in times of over-generation. The distribution system acts as the virtual battery for the solar PV system.

Recent developments introduced the hybrid solar PV system, a combination of a grid-connected and storage-ready apparatus that provides consistent energy supply during day and night. The hybrid system stores energy for later use in one or multiple batteries but then can also pull from the grid in high energy use periods like hot summer months. Any solar plus storage system that is not meant to be entirely off-grid will be a hybrid system. The hybrid solar PV system include additional components, particularly the battery, which dramatically increases the cost. The hybrid

solar PV system may be considered if there is a special need or requirement for steady and uninterrupted power supply. This may be considered for areas which are experiencing frequent brown-outs or unsteady power supply from its DU.

3.2.2 Considerations to Participate in the RE/Solar System Net-Metering Facility

It is important for a homeowner or a school or office/commercial building administrator to understand very well if on-site RE/solar systems make sense before deciding to participate in the Net-Metering Program.

Below are some guide questions to determine whether solar PV systems will deliver desired benefits:

- *How much is the average electricity bills?*

Knowing how much you pay for the electricity bill is the first step in evaluating whether the home/school/office or commercial building is a good candidate for solar PV system. The main question is: Will the RE/solar systems save you money? Generally, the electricity bill is a dreaded monthly expense.

Some net-metering customers remark that “Installing a solar panel system that reduces your current electric bill by 40% to 50% and/or a return on investment (ROI) of about 7 years or less is a very good proposition”.

Our electricity bills have two charges; the demand charge and the energy charge. Net-metering only displaces energy charges; thus customers with pure energy-related charges will benefit from net-metering. Customers with demand-related (kW) charges may not see much reduction in its demand charges. Be that as it may, customers whose peak demand of electricity coincides with the availability of the renewable energy resource may also stand to benefit from net-metering because electricity production from renewable energy can potentially reduce the coincident peak demand for electricity.

Proper sizing of the solar PV system that will supply its current demand is a practical consideration.

- *What kind of roof do you have?*

The GI sheet roof is the commonly used roof type in the country and it is good enough for solar panel installation. Light roofing materials are not ideal for solar PV system installations because they are brittle and can be fire hazard. The support structure or frames for the roofs should be structurally sound to be able to carry the additional weight of the solar panels and mounting frames.

- *Does your roof need to be replaced?*

It is important that the roof is in good condition if you are going to install solar PV panels. Condition is different from the age of the roof, thus best for your contractor/installer determine the condition of your roof and see if it is ready for a solar system installation.

It is a good idea to replace a roof that is near the end of its life before installing solar PV systems. Solar panels when taken cared of have an expected useful life of about 25 years and you would not consider to unnecessarily have to remove them. Solar panels should be installed on roofs that are in good condition and will not need to be replaced in the near future.

- *How much sunlight does your roof receive?*

Here are some guides to determine if a home/school/office or commercial building can fully harness the sunlight:

- ✓ Roofs facing south capture more solar energy since the country is located above the equator;
- ✓ The more direct sunlight to your home receives, the optimum power the solar panels will produce
- ✓ Excessive shadings from the trees and other obstructions will reduce the amount of power that can be generated.
- ✓ There are instances when shade cannot be removed, such as when your house is surrounded by buildings which block the sunlight on your roof. If your roof receives little or minimal sunlight, then rooftop solar or a solar panel system installation may not be the best option for you.

It is still best to consult with professional and reputable solar contractors/ installers.

- *What is your local climate like?*

Solar energy can be generated in all sorts of extreme climates, from rainy areas to extremely hot locations. High efficiency solar panels convert direct and indirect sunlight into electricity, so they even work on cloudy days. A solar consultant will estimate the amount of energy a system will produce to see the potential savings before deciding to go solar. If area is prone to severe weather, it is advisable to check the durability rating of the panels that are being considered for installation.

3.3 Stakeholders in the Net Metering Program

3.3.1 Prosumers/Qualified End-users



The electricity consumers that are participants to the Net Metering Program have been referred to as prosumers and Qualified End-users (QEs).

Prosumers are members of the DU in their franchise areas that are both producers and consumers of electricity.

The Net-Metering Rules² on the other hand defined QEs as referring to entities that generate electric power from an eligible on-site RE generating facility, such as but not limited to house or office building with photovoltaic system that can be connected to the grid for the purpose of entering into a Net-Metering agreement. The Rules also provided that all end-users who are in good credit standing in the payment of their electric bills to the DU are qualified to the participate in the Net-metering program for Renewable Energy. The “good credit standing” was further clarified in ERC Resolution No. 05 Series of 2020 as end-user with no unsettled or outstanding obligations with the DU at the time of the application.

The ERC Resolution No. 06 Series of 2019 included “new customers” of the DU as qualified to participate in the Net-Metering program for RE.

The 2013 Reference Guide on Net-Metering further provided the following clarifications on who are qualified to participate in the Net-Metering Program:

- A contestable electricity customer getting power supply from a competitive Retail Electricity Supplier (RES)  is not qualified to participate;
- Only distribution end-users (or captive customers) or contestable customers  who opted to remain with their DU are qualified to participate in the Net-Metering Program;

² ERC Resolution No. 09, Series of 2013

- Electricity customers directly connected to the transmission grid are not qualified to participate. These electricity customers are not DU customers but rather are transmission load customers of the National Grid Corporation of the Philippines (NGCP).

The QEs must appreciate that their decision to participate in the Net-Metering Program of the country is not just for personal gain but rather it expands to greater benefits for the DU in their area, the environment, and the economy as discussed in Chapter 3.1.

The success of the Net-Metering Program relies on the pro-active participation of the QEs, among other factors. Below are roles and responsibilities as well as practical tips to QEs that they should know. These are also discussed in Chapter 5. Procurement of solar PV and its components.

- QEs who are planning to participate must have a good understanding of how the net-metering works before engaging service providers/contractors/installers;
- The DU is the best entity to provide basic information as well as the requirements and procedures to follow;
- Engage reputable service providers/contractors/installers with very good performance track records. Their past projects and customers must be verifiable to attest or certify of the performance of the service providers/contractors/ installers;
- Comply with all requirements of the DU and the local Office of Business Official (OBO). These requirements are prescribed to ensure the QE's best interest and safety;
- Provide the required space and associated civil works for the location of the metering facilities;
- Provide DU access to QE's premises to inspect, test and maintain and operate the protective devices and read or test the meters and other facilities; as much as possible meters should be located in areas that are accessible to DU.
- Shoulder the expenses related to the bi-directional meter (cost will be the difference of the new bi-directional meter and the old meter) and its installation. However, for new customers and QEs with existing separate meters required to replace with a bi-directional meter, the cost will be to the account of the DU;
- Provide adequate protection for the installed facility under any operating conditions whether or not the interconnected generation is in operation;
- Reference to the REC meter, QEs will bear the cost of the wiring from the REC meter to the renewable energy facility;
- Provide the DU the contact number of the person who is knowledgeable in the operation of the renewable energy system;
- Inform and seek the approval of the DU prior to the execution of any changes or modifications in the renewable energy facility or to the connection point. The QE will be liable for any costs and/or damages incurred by the DU as a result thereof;

- Grant free access to DOE, ERC and the National Renewable Energy Board (NREB) to all data generated by net-metering to enable the creation of a knowledge-based resource on net-metering. This knowledge-based resource is vital to enhance and accelerate the viability of the net-metering program and successful integration to the grid.

3.3.2 Distribution Utilities

The DUs have been mandated to enter into a net-metering agreement with the QEs subject to technical considerations and without discrimination and upon request by the distribution end-users,

Their roles and responsibilities³ in the implementation of the Net-Metering Program are further discussed below:

- Provide mechanisms for the necessary physical connection of the RE facility with a maximum capacity of 100kW and ensure compliance with Grid and Distribution Codes
- Process within 20 days from the receipt of the LOI the interconnection of the net-metering facility, provided that the QE has submitted all necessary permits and licenses from various concerned agencies.
- Conduct inspections and witness calibration and testing of the QE's lines, wires, and switches;
- Install bi-directional meter. For new customers and QEs with existing separate meters required to replace with a bi-directional meter, the cost will be to the account of the DU;
- Furnish and install REC meter in the proximity of the RE system;
- Remove the QE's generation from the distribution system at any time due to maintenance, test, repair and emergency condition or safety concerns related to the DU;
- File with the ERC applications for approval of different net-metering charges for the net-metering customers;
- Furnish the executed net-metering agreement to DOE, ERC and NREB within five (5) days from its execution;
- Remit to the ERC the QEs net-metering fee;
- Impose a net-metering charge to QEs equivalent to their existing ERC-approved Php/customer/month supply and metering rates plus the existing ERC-approved Php/kW metering rate based on the export of energy to the distribution systems as registered in the export meter;

³ References to the DUs' roles and responsibilities are the various DOE Department Circulars and ERC Resolutions discussed in Chapter 2 of this Guidebook.

- Grant free access to DOE, ERC and NREB to all data generated by net-metering to enable the creation of a knowledge-based resource on net-metering. This knowledge-based resource is vital to enhance and accelerate the viability of the net-metering program and successful integration to the grid;
- Entitled to any REC resulting from net-metering arrangements with the QE.
- Publish in DUs website (or on any official social media platform) their respective Net-Metering Programs, processes and procedures including hosting capacities on a per feeder or sector basis;
- Electric Cooperatives (ECs) will include in their orientation/briefing for new applicant member-consumers the Net-Metering Program, among others. The private investor-owned utilities (PIOU)s are likewise enjoined to do the same.

3.3.3 Local Government Units

The Local Government Units (LGUs) are enjoined to strictly comply with the provisions of RA No. 11234 and RA No. 11032 in processing permits and licenses related to applications for net-metering agreements such as, but not limited to Building Permit applications, Certification of Final Electrical Inspections (CFEI) among others. CFEI is an important permit as it is needed prior to the interconnection of the utility of the net-metering facility.

The OBO of the LGU is in-charge of the processing and issuing of the permits and licenses required. In some cases, the Engineering Unit of the LGU performs the tasks.

In processing and issuing the electrical permits and other requirements, the Electrical Division of the OBO or the Engineering Unit sees to it that the applicant complies with the standards and requirements of the electrical safety in the Philippine Electrical Code (PEC), the Electrical Engineering Law and the concerned LGU.

Chapter 4.2 discusses the processes and requirements in securing the permits and licenses required from the LGU.

3.3.4 National Government Agencies

The DOE, ERC, NREB, NEA are national government agencies (NGAs) that perform their functions which collectively are aimed at achieving the overall goal of broadening the adoption of RE in the country.

The DOE is the energy policy making body that develops/amends policies on net metering, and monitors/reviews/evaluates the implementation of the Net-Metering Program.

The ERC issues rules, resolutions and other instruments to support the policies of the DOE on net-metering.

The NREB is the policy advisory board to the DOE for energy and in this case, also for net-metering.

The NEA, being the lead overseer on the businesses and operations of the Electric Cooperatives (ECs), provides assistance to the ECs to equip them to implement their roles and responsibilities in net-metering.

3.3.5 Service Providers/Contractors/Installers

Service providers or contractors or installers are private individuals or entities who are:

- suppliers of the RE systems;
- technical consultants;
- installers of the RE system for net-metering;
- acting as representative of QEs in dealing with the DU and the LGU; or
- combination of the above or all of the above

The qualification of these service providers/contractors/installers is broad from professionals to self-taught. Their role and responsibilities in the successful implementation of net-metering is very critical, thus the following would be the minimum requirement:

- in-depth knowledge of how net-metering works and can explain in simple terms to the QEs;
- up to date with safety considerations (compliance to the different codes) in installing and operating a net-metering facility;
- knowledgeable on the prescribed processes and requirements of DU and LGU and will follow them;

In the absence of a certification or accreditation of service providers/contractors/installers, QEs are reminded to do own-qualification and performance check of candidate service providers/contractors/installers before engaging with any of them. Additional discussions on this can be found in Chapter 5.

4 STEPS IN APPLYING FOR THE NET-METERING PROGRAM

Electricity customers who are applying for the net metering program shall be guided by the following steps as illustrated in Figure 4. The steps and procedures are discussed from the point of view of the applicant or the QE. In practice, most of the steps to be performed by the QE are being done by the contractor/installer in their behalf. The QEs are enjoined to understand these steps which will be the scope of services of the contractor/installer. Figure 4 shows detailed steps in applying for net metering as well as the roles and requirements of DUs and LGUs.

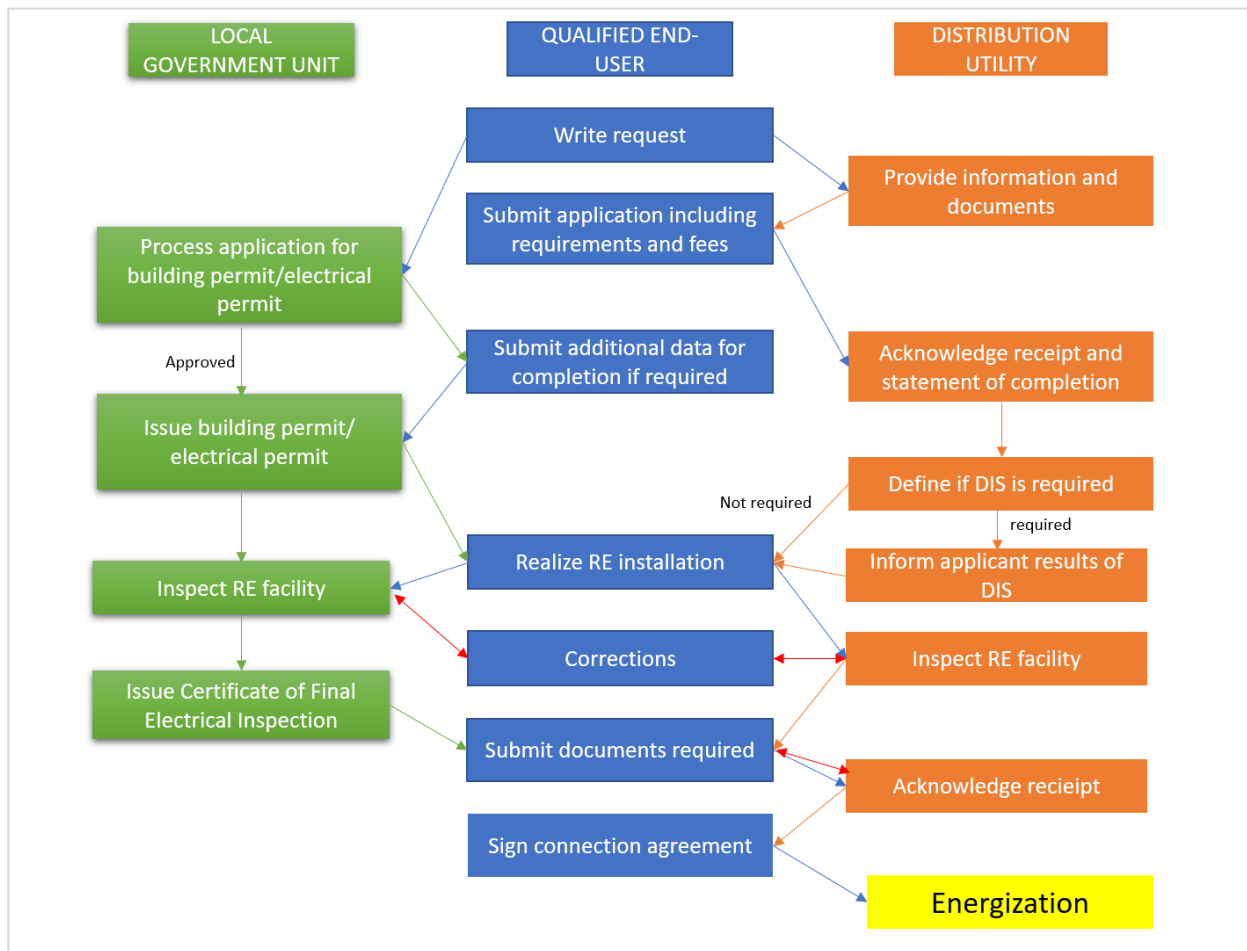
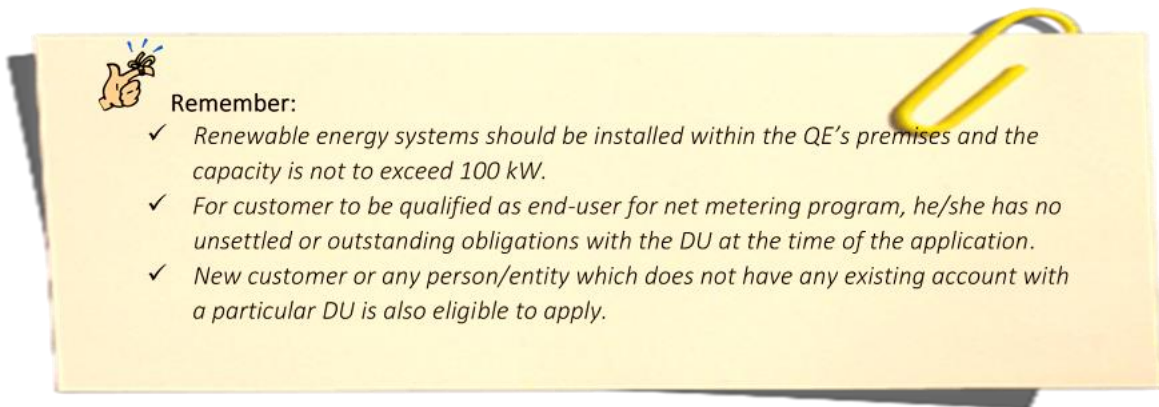


Figure 4. Steps in applying for Net-Metering

4.1 Write a request

A customer goes to the DU with a written request to participate to net-metering program; this is the Letter of Intent or Letter of Interest (LOI). The qualification of electricity customers to participate in the Net Metering Program is discussed in Chapter 3.3.1.

Before applying for net metering, make sure that there is enough space within the QE's premises where the RE systems will be installed. For rooftop solar, bear in mind that the capacity of the solar PV to be installed can be accommodated in the area of the roof and that the roofs can withstand the mounting structure of the solar PV. The required surface area for one (1) kWp by type of solar cell material is provided in Chapter 5.4.1 (Table 5).



4.2 Submit application (together with required data and fees)

4.2.1 Requirements of Distribution utility

Upon receipt of the request, the DU shall provide the customer the required documents listed below. Requirements may vary depending on the DU but deviations are not much.

- Net-metering application form- to be secured from distribution utility. The interested customer shall accomplish it accordingly.
- Identification documents - includes valid IDs and proof of valid occupancy for residential customers and secretary's certificate in case of business or commercial establishments.
- Detailed planning data - consist of information necessary for the DU to evaluate the impact of any user development on the distribution system. The detailed planning data are specified in 6.4 of the Philippine Distribution Code.
- List of certified equipment - list of equipment that will be required to run the RE facility. For example, for solar PV facility will require: solar array, mounting structure, inverter, bi-directional meters, cables, etc.
- Plant parameters form - contains technical details. Seek assistance from supplier on how to fill up this form

- Application fee amounting to Php1,500 in manager’s check payable ERC. A manager's check can be secured from a bank and will be issued to an individual who has purchased it.

Once the requirements are in order, the customer files the accomplished net-metering application form with the supporting documents. The DU will then verify the accuracy and completeness of the documents. Within ten (10) business days upon receipt of the application, the DU will issue an acknowledgement receipt with feedback on whether or not the application is complete.

4.2.2 Requirements of Local government unit

As the net-metering program involves the installation of RE systems, building permit is required. Generally, all local government units (LGUs) include the application for electrical permits to the procedure for application of a building permit. The processing of building permits falls under the overall control and supervision of the Office of the Building Official (OBO) of the LGU.

Building permit is issued by the LGU – OBO to applicant to proceed with the construction, installation, addition, alteration, renovation, conversion, repair, demolition or other work activity of a specific project/building/structure. Such building permit is issued once the accompanying principal plans and specifications and other pertinent documents are found satisfactory and substantially confirming with the Implementing Rules and Regulations of the National Building Code.

In processing the electrical permits, the Electrical Division of the OBO will see to it that the applicant complies with the standards and requirements on electrical safety in the Philippine Electrical Code (PEC), the Electrical Engineering Law, and the concerned LGU. The list of requirements of LGUs may vary. As an example, Table 1 shows the requirements for securing electrical permit for Makati and Quezon City.

Table 1. Requirements in securing electrical permit: Makati and Quezon City⁴

Makati	Quezon City
<ul style="list-style-type: none"> • Duly accomplished and signed application form (DPWH Form No. 96-001E) • Five (5) sets of complete electrical plans and specifications, duly signed and sealed by a Professional Electrical Engineer • Proof of ownership (e.g., certified true copy of CCT/TCT tax declaration, current realty tax) 	<ul style="list-style-type: none"> • Photocopy of building permit (if applicable) • Complete electrical plans signed/sealed by PEE • Filled out electrical permit application Form and CFEI Form • Photocopy of yellow card from Meralco • Photocopy of updated PRC and PTR of professionals

⁴ Information on requirements gathered from questionnaires completed by Makati and Quezon City OBO

<p>receipt, and copy of duly notarized contract of lease or deed of absolute sale for tenants or new owner</p>	<ul style="list-style-type: none"> • Photocopy of ID of applicant/owner • Photocopy of TCT of lot owner <p>If applicant will utilize old or existing building, he/she has to comply the above requirements including submission of copy of current Meralco Bill</p>
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Once all the required documents are secured, the applicant will submit the filled-out application forms together with the necessary documents to the Electrical Division of OBO. The Electrical Division will check the completeness of the submitted documents as well as review the electrical plan. When all the documents are in order, total electrical fees will be assessed. Generally, all LGUs adopt the schedule of fees set by the National Building Code of the Philippines for electrical fees as per National Building Code Development Office (NBCDO) Memorandum Circular No. 03 Series of 2016 issued on 14 March 2016 which supersedes NBCDO Memorandum Circular No. 01 Series of 2004 issued on 16 November 16 2004.

Figure 5. Schedule in computing fees for electrical permit

4. **Electrical Fees**

The following schedule shall be used for computing electrical fees in residential, institutional, commercial and industrial structures:

a. **Total Connected Load (kVA)**

		Fee	
i.	5 kVA or less.....	P 200.00	
ii.	Over 5 kVA to 50 kVA.....	P 200.00	+ P 20.00/kVA
iii.	Over 50 kVA to 300 kVA.....	1,100.00	+ 10.00/kVA
iv.	Over 300 kVA to 1,500 kVA.....	3,600.00	+ 5.00/kVA
v.	Over 1,500 kVA to 6,000 kVA.....	9,600.00	+ 2.50/kVA
vi.	Over 6,000 kVA.....	20,850.00	+ 1.25/kVA

NOTE: Total Connected Load as shown in the load schedule.

b. **Total Transformer/Uninterrupted Power Supply (UPS)/Generator Capacity (kVA)**

		Fee	
i.	5 kVA or less.....	P 40.00	
ii.	Over 5 kVA to 50 kVA.....	P 40.00	+ P 4.00/kVA
iii.	Over 50 kVA to 300 kVA.....	220.00	+ 2.00/kVA
iv.	Over 300 kVA to 1,500 kVA.....	720.00	+ 1.00/kVA
v.	Over 1,500 kVA to 6,000 kVA.....	1,920.00	+ 0.50/kVA
vi.	Over 6,000 kVA.....	4,170.00	+ 0.25/kVA

NOTE: Total Transformer/UPS/Generator Capacity shall include all transformer, UPS and generators which are owned/installed by the owner/applicant as shown in the electrical plans and specifications.

c. **Pole/Attachment Location Plan Permit**

i.	Power Supply Pole Location.....	P 30.00/pole
ii.	Guying Attachment.....	P 30.00/attachment

This applies to designs/installations within the premises.

d. **Miscellaneous Fees: Electric Meter for union separation, alteration, reconnection or relocation and issuance of Wiring Permit:**

Use or Character of Occupancy	Electric Meter	Wiring Permit Issuance
Residential	P 15.00	P 15.00
Commercial/Industrial	60.00	36.00
Institutional	30.00	12.00

e. **Formula for Computation of Fees**

The Total Electrical Fees shall be the sum of Sections 4. a. to 4. d. of this Rule.

f. **Forfeiture of Fees**

If the electrical work or installation is found not in conformity with the minimum safety requirements of the Philippine Electrical Codes and the Electrical Engineering Law (RA 7920), and the Owner fails to perform corrective actions within the reasonable time provided by the Building Official, the latter and/or their duly authorized representative shall forthwith cancel the permit and the fees thereon shall be forfeited.

In the questionnaire filled up by the Quezon City LGU, an applicant with a total connected load of 100 Amp. MCB 18 kVA has to pay Php902.40. The applicant also has to pay for building permit which is computed based on the area of the facility. For example, a facility with an area of 5,000 square meter and less has to pay Php23.00.⁵

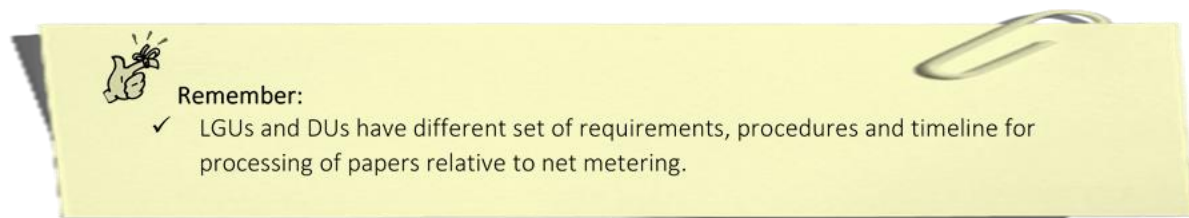
Figure 5 shows the schedule being used for computing electrical fees in residential, institutional, commercial, and industrial structures. The LGU of Makati confirmed that they are using this schedule.

If the electrical work or installation is found not in conformity with the minimum safety requirements of the Philippine Electrical Codes (PEC) and the Electrical Engineering Law (RA 7920), and the owner fails to perform correction actions within the reasonable time provided by


⁵ NBCDO Memorandum Circular No. 03, Series of 2016, Annex "A"

the Building Official, the latter and/or their duly authorized representative will cancel the permit and the fees thereon will be forfeited.


Provided that all requirements are complete and in order, it takes 4-5 days to issue the electrical permit in Makati and 5 days in Quezon City.



4.3 Technical evaluation

If application is complete, the DU shall conduct a technical evaluation. The DU will perform an initial assessment to determine if a Distribution Impact Study (DIS)  is necessary. A DIS is being conducted to assess the ability of the distribution system to safely and reliably accommodate a proposed interconnection of a new generation source and if any upgrades may be required. The applicant will not incur any additional charges for the conduct of the DIS.

For new housing developments, the DU shall conduct a DIS upon receipt of the LOI from the project developer, provided that all necessary documents and permits from different concerned agencies have been submitted. The individual homeowners of the housing developments shall undergo the same process as in any other net metering applicants. New housing development refers to a group of individual dwelling or apartment houses that are usually built and sold or leased by management.

During the conduct of the DIS, additional information may be requested from the applicant. From receipt of complete information for the DIS, the DU has sixty (60) days⁶ to complete the study. Within five (5) days⁷ from completion of the DIS, the DU forwards to the applicant the results of the study and the DU's findings on whether a subsequent stage of a Distribution Assets Study (DAS) is necessary.⁸ The DAS  determines all additional distribution assets and costs required to accommodate the proposed generation source of the net-metering customer and is usually being done for big system sizes.

⁶ Section 2.9.3.7. Distribution Services and Open Access Rules (DSOAR).

⁷ Section 2.9.3.10. DSOAR.

⁸ Section 5.6 and 5.7 Annex A-1 "Net-Metering Interconnection Standards, ERC Resolution No. 09 Series of 2013.



Remember:

- ✓ *The DU will require technical information, the applicant or QE can then seek assistance from their PV installer/supplier.*
- ✓ *The conduct of DIS will be done by the DU without additional charges to the QE.*
- ✓ *Some housing development already included solar rooftops in their housing units but application for net metering shall be done by individual homeowners.*

4.4 Installation of renewable energy system

With the conclusion of the technical evaluation phase, the DU finalizes the design of the interconnection facilities based on the results of the DIS and /or DAS, along with the corresponding project costs, if applicable. This stage includes an inspection of the Service Entrance depending on the bi-directional meter set-up.

As previously mentioned, RE systems that can be installed under the net-metering arrangement include biogas, run-of river hydro, solar, wind and biomass. As most of these systems are site-specific and would require massive infrastructure as well as larger space, solar PV becomes the most practical RE system for net metering. As such, the succeeding discussion pertaining to procurement of RE systems will focus solely on solar PV.

When determining the right size of the solar PV, the QE has to take into account the appliances that will be operating during daytime or when sunlight is available. Thus, the optimum capacity that should be installed in the QE's premises should not exceed the daytime peak demand for electricity to maximize the savings avoided costs on electricity and shorten to the extent possible the payback period of investment of solar PV facility.

It is important to check the roof, inspect the structure and position where the panels will be installed. Selecting a right solar provider is a key to ensure safe, stable and worry-free solar PV installation. Selecting a supplier who is reputable, offers after sales service support and is knowledgeable in safety standards is a must.



Please refer to Chapter 5. "Procurement of solar PV and its components" of this guidebook to get more information on selection of solar PV and components, sizing of the PV system, how to choose the right supplier/installer, and return on investment, among others.

The solar PV should be equipped with appropriate metering equipment. The DU shall furnish and install bi-directional meter at the QE's premises. The QE shall provide the required space and the associated civil works for the location of metering facilities. The metering facilities shall be installed in a clean place free of vibration and where it will be accessible and visible for reading and testing by both the DU and QE.



Remember:

- ✓ *Before installing the solar PV, it is important to determine the right size of the system and the appropriate location of the solar PV and bi-directional and REC meters.*
- ✓ *Selecting a supplier who is reputable, offers after sales service support and is knowledgeable in safety standards is a must!*

The DU shall also furnish and install a renewable energy certificate (REC)  meter in proximity to the solar PV to measure the total RE generated for compliance with the Renewable Portfolio Standards (RPS).  The meter will also be used to measure the actual consumption to determine non-exemption from paying subsidies such as lifeline subsidy rate, senior citizen subsidy rate and other relevant subsidies.

4.5 Signing of the Net-Metering Agreement


The QE and the DU will execute the net-metering agreement using the ERC approved template (Annex 6). In the event that the QE/DU makes some changes on the approved template, the ERC will review such and may approve or disapprove.

Before signing the net-metering agreement, the DU with the QE shall inspect the RE facility and check if it meets the technical requirements of the net-metering agreement and the -net metering interconnection standards. Any non-conformance has to be corrected before the net-metering agreement is signed and the RE system is connected and energized. Likewise, the LGU will inspect the facility before the issuance of certificate of final electrical inspection (CFEI). The table below shows the requirements in securing the CFEI for Makati and Quezon City. Processing of the CFEI ranges from 1 to 5 days.

Table 2. Requirements in securing Certificate of Final Electrical Inspection: Makati and Quezon City

Makati	Quezon City
<ul style="list-style-type: none"> • Certificate of completion • Photocopy of electrical permit • Approved electrical plans • Revised electrical plans • Electrical test results 	<ul style="list-style-type: none"> • Copy of Electrical Permit • Duly filled out Certificate of Final Electrical Inspection (CFEI)

In the case of Makati, the CFEI is issued with the Certificate of Use/Occupancy. The cost of CFEI is equivalent to 10% of the cost of electrical permit while the cost of Certificate of Use is computed at Php1,000 per every million of the cost of the facility.

As the QE has its own generation facility, the same will apply certificate of compliance (COC)  with ERC. The DU shall provide assistance to QE to facilitate the application and shall submit to ERC all documents related to the application including the net-metering agreement entered into within five (5) days from its execution. The executed net-metering agreement is deemed effective upon submission to ERC.

4.6 Energization

The DU has the right to witness the testing and commissioning upon completion of construction and shall have a copy of the test data. After the interconnection system is installed and ready for operation, a commissioning test will be conducted which consists of the following:

- Verification and inspections
- Reactive power test
- Protection tests
- Reconnection timing test (blocking test)
- Synchronization test

The RE facility must have the necessary equipment required to perform this test. The DU shall not be responsible for verifying any control or signal wiring not directly related to the interconnection protection.

Prior to final approval by the DU or any time thereafter, the DU reserves the right to test the relaying and control related to the protection of the DU's Distribution System.

Provided that all necessary permits and licenses from various relevant agencies are secured and completed, all DUs shall complete all the inter connection process within 20 working days from the receipt of written request from the applicant or QE.

As soon as all these procedures are undertaken, the full benefit of RE system particularly solar PV can now be realized through net metering.



Remember:

- ✓ *All DUs shall complete all the inter connection process within 20 working days from the receipt of written request from the applicant, provided that documents are complete.*

5. PROCUREMENT OF SOLAR PHOTOVOLTAIC SYSTEM AND ITS COMPONENTS

Producing electricity partly for own consumption, is available in the Philippines since 2011. This chapter provides an overview of important points to consider when planning and purchasing a small photovoltaic (PV) system intended for net-metering.

The guidebook is directed towards interested parties considering installing a grid-connected PV system up to 100 kW, under net-metering. It attempts to walk the reader through the different stages beginning from the day the idea to buy a PV system is conceived, up to the realization of the PV project. What this section intends is to assure quality and reliable installations. The system can be either a residential PV installation or a larger commercial PV system. The most common installation is rooftop solar PV as no additional space is required and anyone who has a roof suitable for solar energy can generate its own power.

Efforts are made to make the discussion simpler but there are some technical points which can be discussed by the QE with the supplier/installer.

5.1 Selection of solar modules

There are different types of modules in the market and the crystalline silicon modules (c-Si) have the largest market share. The crystalline modules are of two types: the monocrystalline and polycrystalline. The other type of solar panel is thin film which is a cheaper alternative due to less materials needed for its production.⁹

Monocrystalline solar panels are the most popular solar panels used in rooftop solar installations today because of how they look. They usually have the highest efficiency ranging from 17% to 22% which means they need lesser space to reach a given power capacity. However, they cost more than other kinds of solar panels.

The polycrystalline solar panels have lower efficiency rate than monocrystalline panels ranging from 15% to 17%. With the advancement of technology, polycrystalline panels are now much closer in efficiency to monocrystalline panels as they have been in the past. Cost of polycrystalline is cheaper but not very much.

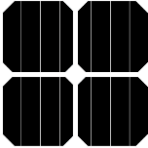


Thin film solar panels are completely different from monocrystalline and polycrystalline solar panels in terms of appearance. Thin film solar panels are lightweight and flexible, making them easy to install. They are appropriate for large-scale operations such as utility or industrial solar

⁹ Andrew Sendy. Types of solar panels: which one is the best choice? SolarReviews. January 2021.

installations because of lower efficiency ratings ranging from 10% to 13%. Thin film solar panels have the lowest cost out of the three solar panel types because of their low performance.

Table 4 shows the comparison of the three solar modules.

Table 4. Comparison of solar modules

Type of solar module	Efficiency	Pros	Cons
 Monocrystalline	17% - 22%	<ul style="list-style-type: none"> • High efficiency • Aesthetics 	<ul style="list-style-type: none"> • Higher cost
 Polycrystalline	15% - 17%	<ul style="list-style-type: none"> • Lower cost 	<ul style="list-style-type: none"> • Lower efficiency • Aesthetics
 Thin film	10% - 13%	<ul style="list-style-type: none"> • Flexible and lightweight • Aesthetics • Easy to install 	<ul style="list-style-type: none"> • Lower efficiency • Short life expectancy

Sources: <https://www.solterra.ph/topics/solar-panels/mono-vs-poly-panels/>,
<https://www.solarreviews.com/blog/pros-and-cons-of-monocrystalline-vs-polycrystalline-solar-panels#types>

5.1.2 What factors should I consider when choosing solar modules?




There are three main parameters to consider in choosing the right type of solar modules: production, durability and quality, and warranty.

Production

The amount of electricity that the solar panel can produce is dependent on a number of factors such as power rating, power tolerance, efficiency and temperature coefficient. By looking at these factors one can determine how much electricity can a solar panel produce.¹⁰

- All solar panels have nameplate “power rating”  which indicates the amount of power that the panels can produce under industry test conditions. The power examples are 100 watts, 200 watts, etc.

¹⁰ Energy Sage, LLC. Evaluating solar panel quality. July 2020. <https://news.energysage.com/how-to-choose-the-best-solar-panel-for-you/>

- “Power tolerance”  indicates how the power output of a solar panel might differ from its nameplate rating. They are typically expressed as a plus-or-minus percentage. For example, a 250-watt panel with a +/- 5% power tolerance could actually produce anywhere from 237.5 watts to 262.5 watts under ideal conditions.
- Solar panel “efficiency”  represents how effectively a solar panel can convert solar radiation (e.g. sunlight) into electricity. A higher solar panel efficiency rating means a panel will produce more kilowatt-hours of energy per watt of power capacity. The efficiency of various type of solar modules are presented in Table 4 above.
- The temperature coefficient  simply measures how much power output drops in hotter temperatures. According to specifications, mono panels perform about 0.04% better per degree Celsius than poly panels. This results to a less than 1% increase in power output for mono systems, given weather conditions in the Philippines.¹¹

Quality and Durability

The International Organization for Standardization (ISO) has created quality assurance standards for the manufacturing industry known as the ISO 9000 series. Solar panel manufacturers who are ISO 9000-compliant indicate that they meet those standards. Manufacturers who lack ISO certification do not necessarily mean that they produce inferior products but to be sure it is better to buy from a certified manufacturer.

The International Electrotechnical Commission’s (IEC) establish standards for various types of solar modules, please take note of the following:

- For crystalline silicon modules, choose the modules with standard IEC 61215 which comprises the examination of all parameters linked to ageing of PV modules and describes various qualification tests based on the artificial load of the materials (radiation, thermal and mechanical testing).
- For thin-film modules, choose the modules with standard IEC 61646, where additional test procedures are done to adapt to special properties of thin-film technologies.
- Check the safety qualification according to IEC 61730, as these are used in conjunction with above mentioned standards. Focus on fundamental construction requirements for PV modules such as the prevention of electrical shocks, fire hazards and personal injury.

¹¹ Solterra Energy Corporation. Monocrystalline vs. Polycrystalline Solar Panels. September 2019.
<https://www.solterra.ph/topics/solar-panels/mono-vs-poly-panels/>

Warranty

A strong warranty ensures that the service and support needs for the solar PV are covered in case problems occur after installation. The warranties complement well with solar panel efficiency, quality, and durability metrics.

Below are some of the industry's best practices:


- Many module manufacturers offer a product or workmanship warranty for one to three years.
- The average warranty offered for the solar panels is around 20 years. If the warranty is for a shorter period of time you can safely assume that the quality of the panels is lower.
- Most manufacturers guarantee a 25-year limited warranty on the power output, usually 90% of the minimum output power rating of the modules during the first 10 years of operation, and 80 % during the following 15 years. Sometimes, manufacturer provides a warranty stating guaranteed power output of 97% of the minimum output power rating during the first year of operation and a guaranteed maximum linear degradation of 0.7% p.a. until the 25th year.
- Reminder: Examination of European PV systems done by research and testing institutes indicate that the actual degradation is far lower than the module power guarantee offers.



Remember:

- ✓ *Check compliance of module type with IEC standards and type of warranty.*
- ✓ *Buy modules with measurement record and serial numbers as reference.*
- ✓ *Secure technical data sheet and choose modules with low tolerance ranges of nominal output or positive sorting of power output categories.*
- ✓ *If modules with high tolerance values (> 5%) are used by your installer, ask how they will be pre-sorted so connection of modules with a similar maximum power current within one string reduces losses caused by mismatch.*
- ✓ *Modules with different power output categories (e.g., 215/220/225 Wp), should be stringed with modules from the same performance class.*

5.2 Selection of inverters

The inverter  represents the connection between the PV system and the public distribution grid. It converts the direct current generated by the PV system into alternate current. Therefore, the inverters have to adapt to the grid frequency (60 Hz) and the voltage level, typically 230 V. In terms of connection to the transformers if the inverter has different line connection configuration

an additional matching transformer needs to be installed. It is important to use an inverter that can be connected to the grid without the need for a matching transformer. In addition, for net-metering installations the inverter should have an anti-islanding function. Anti-islanding senses when there is a brown-out and the inverter stops the feeding of electricity to the grid. This safety feature is necessary for the protection of utility crew who may be conducting repair works in the grid.

It's the job of the inverter in your solar energy system to convert the solar energy into something you can use. Solar panels take solar energy and make it into direct current (DC) power. The inverter's job is to convert that DC power into the alternating current (AC) electricity that can be used in your home.

Grid-tie inverter is the inverter used in net-metering. In selecting a grid-tie inverter, the following parameters¹² can be considered:

- Efficiency - select an inverter which is close to 100% efficiency, there are inverters available in the market which have efficiencies between 96 and 99%. Efficiency measures how much energy is lost when converting power from DC to AC.
- Inverter strength and resistance - Try to select inverter that can withstand high environmental temperature. If it will be installed near the sea or in coastal area, take an inverter which is coated with salt resistance material for more protection and longer life span.

Good inverters also have smart feature that can be connected to the internet so the output, system generation and other parameters can be viewed remotely. This system has special feature as it can provide signals in case of abnormal conditions like exceeding temperature threshold, etc. and can also store information. If this feature is available and the cost is reasonable, it might be good to consider this option to achieve optimal operation and understand the system's operations.

The inverter product is essential as it is most likely to be the first thing that needs replacement. Inverters have a warranty of 5 to 15 years with an average standard warranty period of 10 years.¹³

¹² How to Select a Right Grid Tie String Inverter? January 2020. www.inverter.com

¹³ Generation Solar. Inverter Warranties. September 2020. <https://www.generationsolar.com/inverters/inverter-warranties/>

Place of installation

- As much as possible, the inverter should be installed near the house meter. Shorter DC cabling cuts system loss of solar power.
- Inverters get slightly warm during their operations. To achieve higher performance, there should be adequate ventilation.
- Always comply with the external conditions demanded by the manufacturer, particularly permissible humidity and ambient temperature.



Remember:

- ✓ *Ensure adequate ventilation.*
- ✓ *Consider range of permissible ambient temperature for inverter (avoid power limitation due to high temperatures).*
- ✓ *If an inverter is mounted outdoors it has to be protected against rain and insolation.*
- ✓ *Pay attention to local high tide levels.*

5.3 Selection of mounting systems

Unlike in the past, manufacturers now offer easy to install mounting systems for flat roofs. For large roofs on industrial and commercial buildings, frames are now generally lightweight, aerodynamic, self-supporting, and without roof penetration challenges. These features are ideally suited for roofs with membrane or bitumen surfaces as they represent a slight additional load to the roof.

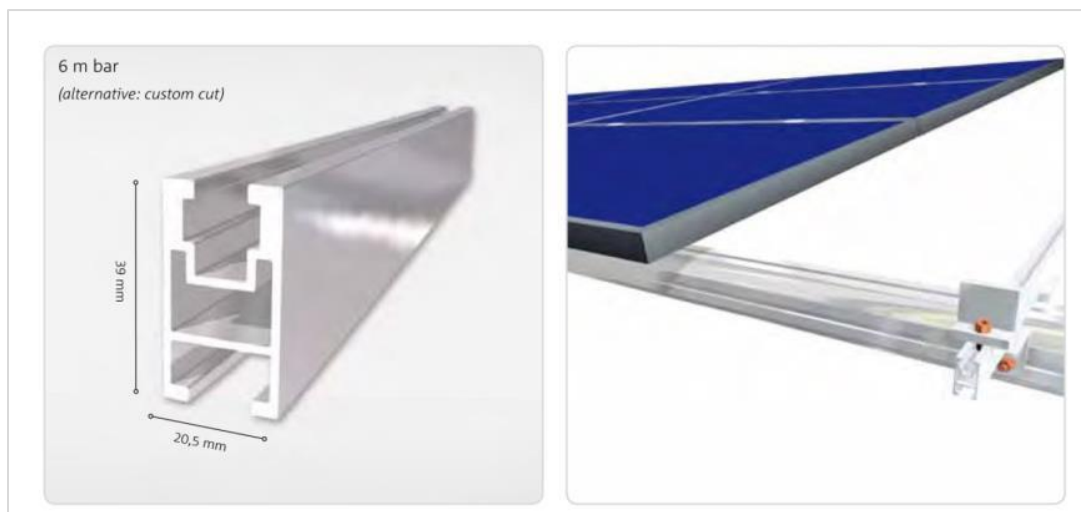
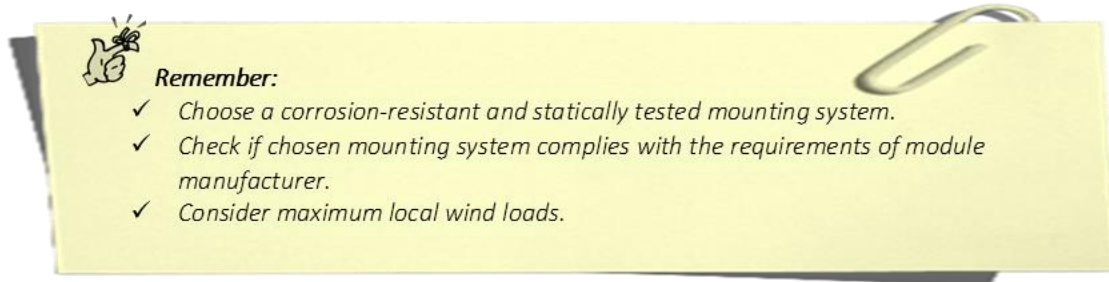


Figure 6. Mounting system of solar panels (source: 2013 Net-Metering Reference Guide)

Fixing of modules

- When fixing or clamping the solar panels on the rails of the chosen mounting system the appropriate points have to be considered.
- The weight of the modules is approximately 20 kg per module. Always check the kind of roof surface.
- In case no information is provided by the manufacturer, the module attachment should be along the longer side of the module, at around ¼ of the module length. The pre-drilled module holes are mostly in this part of the frame.
-



5.4 Sizing of the PV system

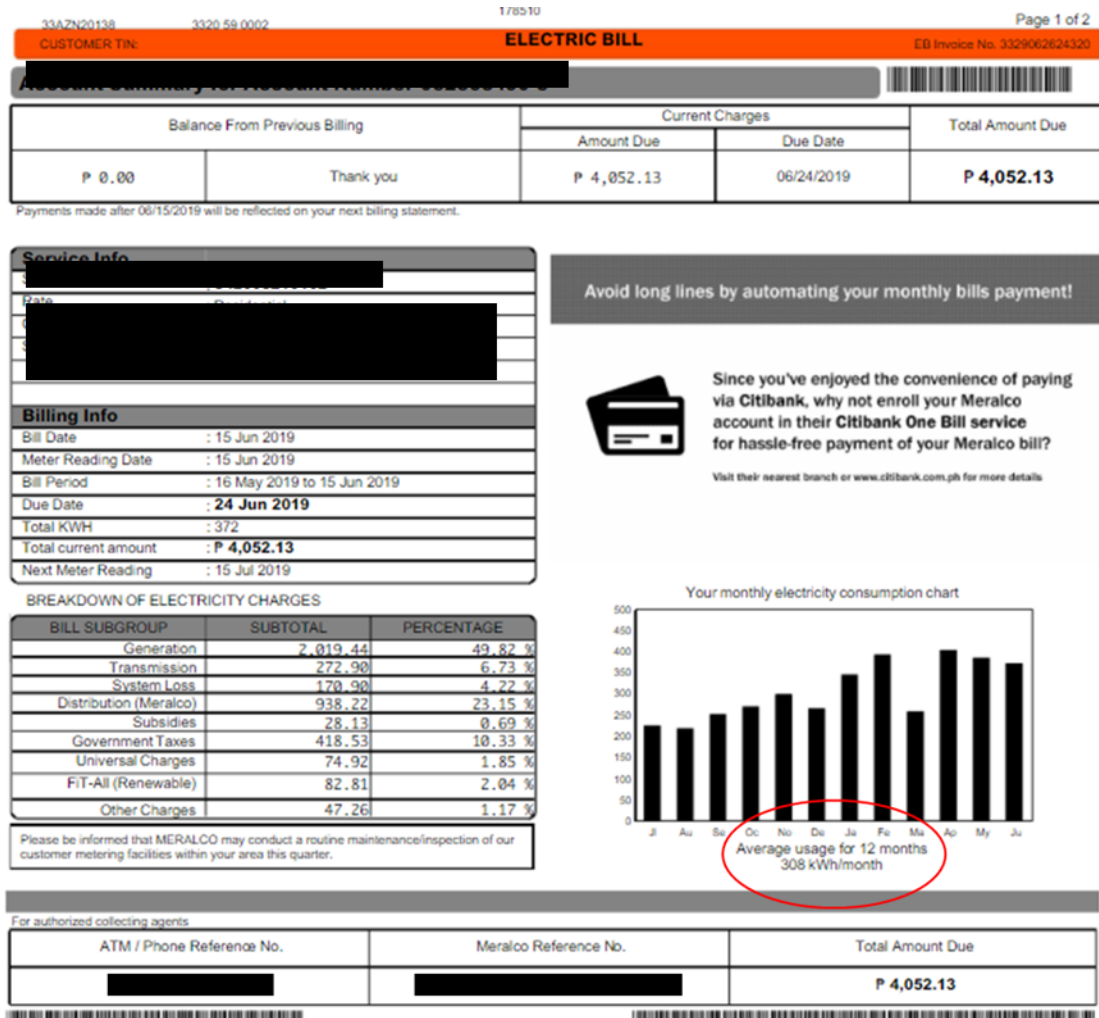
It is important to know the load demand to determine the size of the solar PV. Below are simple ways of determining your load demand and calculating the solar PV size. The above steps can only serve as an indication but the solar PV installer can come up with the right size of the system by taking into consideration various parameters such as actual loads, i.e., appliances, bulbs, etc. (in the case of the households), the actual hours of usage, time of usage, etc.

- Estimate energy use - This can be done by looking at the electricity bill from distribution utility. The electricity bill often includes one year electricity consumption including the average monthly consumption (Figure 7). From the electricity bill, compute for your daily usage, by simply dividing average monthly consumption by 30.
- Determine the peak sun-hours - "Peak sun hours" refers to the solar insolation which a particular location would receive if the sun were shining at its maximum value for a certain number of hours.¹⁴ The Philippines has peak sun-hours of 4.5 - 5 hours on an average per day.
- Calculate size of the PV system - divide the daily kWh energy requirement by peak sun-hours to get the kW output, then divide the kW output by panel's efficiency to get the size of the solar PV system. This can be calculated as:

$$\text{Daily kWh} \div \text{average sun hours} \times \text{efficiency factor} = \text{DC solar system size}$$

¹⁴ C.B.Honsberg and S.G.Bowden, "Photovoltaics Education Website," www.pveducation.org, 2019.

Figure 7. Sample of electricity bill



Using the above electric meter as an example, below is a sample calculation:

$$\text{Daily kWh} = 308 \text{ kWh/month} \div 30 \text{ days} = 10.26 \text{ kWh per day}$$

$$\text{Average sun-hours} = 4.5 \text{ hours}$$

$$\text{Efficiency factor of solar PV panel (polycrystalline)} = 16\%$$

$$\text{Size of the system} = 10.26 \text{ kWh/day} \div 4.5 \text{ hours} \times 1.16 = 2.6 \text{ kWp}$$

The size of the solar PV for net metering then should be lower than 2.6 kWp to minimize export to the grid.

If the system will be sized to 2.4 kWp, a total of 2,400 Wp of panel is required. If you choose a solar panel with rating of 400 Wp, the total number of panels that will be needed is 6 (6 x 400 Wp).

5.4.1 Smaller PV systems for residential use

The electrical power of a PV system is measured in kilowatt peak (kWp) and refers to the maximum power under standard test conditions (STC). For the installation of a 1 kWp power system, only 6 square meters of area is needed using highly efficient modules. If roof area is small, it is advisable to choose solar modules with higher efficiency. Below is the required surface area for 1 kWp per type solar cell materials.

Table 5. Roof space requirements per type of solar cell material

Solar cell material	Module efficiency	Required surface area for 1 kWp (square meter)
High performance silicon (rear contacts, HIT)	17 - 20%	5 - 6
Monocrystalline silicon	11 - 16%	6 - 9
Polycrystalline silicon	10 - 15%	7 - 10
Thin film:		9 - 17
Copper Indium Selenide	6 - 11%	
Cadmium-Telluride	6 - 11%	9 - 17
Micromorphous silicon	7 - 12%	8.5 - 15
Amorphous silicon	4 - 7%	15 - 26



Remember:

Under the net metering regime, consuming self-generated solar power makes more economic sense than selling excess power to the distribution utility. Consider what portion of your present electricity demand you would like the PV system to meet. The ideal is to plan for system lower than peak demand.

Only a portion of the household electricity demand will be covered by the PV system. It is therefore important to get a rough estimate of the overall power of the PV system obtained - based on the space allowed on your roof – and match the PV energy output with your consumption. Solar PV

allows to reduce the electricity consumption during daytime, thus it is essential to improve the demand profile by utilizing washing machines, dryers and other loads whenever the PV system delivers a lot of electricity and reaches peak capacity. Managing the load this way will reduce the peak demand for electricity. Under the net-metering regime, consuming self-generated solar power makes more economic sense than selling excess power to the distribution utility. Of course, storing energy is an option. As the prices for battery decreases in the near future, a purchase can be considered in order to use all electricity provided by the PV system.



Remember:

It will be good to check with the solar installer if the following parameters are considered:

- ✓ *Choose roof area free of shading, as shaded modules significantly reduce the PV output.*
- ✓ *If your roof is orientated towards south you will have the highest yield with a module inclination of 8°.*
- ✓ *Inclination between 0° and 20° is appropriate too.*
- ✓ *Inclining the modules provides a washing effect by rain.*
- ✓ *If it is possible for you to realize a building integrated PV system you could save money for roof tiles and other roofing material.*
- ✓ *For flat rooftops, consider sufficient distance between module rows to avoid shading.*
- ✓ *Consider what portion of your present electricity demand you would like the PV system to meet. The ideal is to plan for system lower than peak demand.*

5.4.2 Larger PV system for commercial installations

The installation of a PV system is a good investment, which can provide higher returns than a savings deposit with only an average interest rate of 0.25% - 1.25% per annum.

Larger PV systems for commercial use will make sense if loads can be arranged to coincide with high solar generated electricity. Sometimes this is realized by applying remote controlled relays or sockets to switch on additional selected loads. More recently load management components are offered that also consider weather forecasts and thereby set time frames corresponding to the projected electricity generation.

In the case that the owner of the building is the operator of the PV system, it can be considered to include the solar roof top in the property insurance. The insurance coverage should already be provided during the construction phase.

Net metering customer with large capacity system may ask the following questions to their installer:

- Is the quality of the roofing of the building suitable for the mounting of a solar system?
- Is the chosen area for the PV installation free of any shading?
- How is the relation between nominal power of the PV generator to nominal power of the inverter (described as DC/AC ratio)?
- Can loads be easily switched on and off (demand response)?
- Is the PV system divided in different arrays with intermediary spaces (for maintenance and safety reasons)?
- Has an insurance policy been concluded?



Remember:

- ✓ Check your electricity demand and consider which degree of self-consumption you would like to achieve with the PV system.
- ✓ Consider if you can re-arrange some loads to peak capacity time in order to maximize the use of the solar generated electricity.
- ✓ Check with your LGU for electrical and building permits.
- ✓ A relation between nominal power of PV generator and inverter of 1:1 is preferable (DC/AC ratio 100%) because a lower ratio would lead to losses.
- ✓ Consider an intermediary space of 1 meter and a maximum width of 40 meters as protective measure for the event of a fire in the building (thus fire fighters can maintain safety distance for fire-fighting purposes at electrical installations).
- ✓ Check with your property insurance firm about insuring the PV Installation.

5.5 Selecting a solar installer

The first question to ask is: Where will I find a good PV installation company? System installation can be found by advertisements in printed media and internet search. There are several associations like Philippine Solar and Storage Energy Alliance (PSSEA), Renewable Energy Association of the Philippines (REAP) and the Confederation of Solar Developers of the Philippines (CSDP), which can be a good source of information for possible solar installer. However, it is important that QEs must exercise due diligence in selecting the right installer.

A good solar installer must have the most of the following characteristics:

- Expertise - Currently, there is no accreditation of solar PV companies and installers yet in the Philippines. Such being the case, it might be good to check the company's work history and qualifications of its personnel. It is also worthy to look if it has a number of net metering installations.

- Licenses and Permits - Make sure that the company is registered with different government organizations like Securities and Exchange Commission (SEC) , Department of Trade and Industry (DTI) and Bureau of Internal Revenue (BIR). It is also important to look at the trade licenses, certifications, or licenses from manufacturers. Usually, the licenses and permits are posted in the company's office.
- Track record and experience - The company must have an established solar track record. It should be able to discuss about its previous clients. The more clients that the company has would mean that it has already established itself in the industry. The number of years it has been in the business can also be a gauge of its experience, installer with more than 5 years of doing net-metering installations can be a good candidate.

The end-user can also talk to previous customers to get information about after sales service, warranties and if there are any major issues with the system. It is important not to rely on online testimonials. Care must be taken to those companies that make exaggerated claims like short pay-back period or 'zero electric bills', selling electricity, etc.

Simply put, make sure that the following questions are considered when choosing the solar installer:

- Is the installer able to explain the working of the PV system in simple words and a comprehensible way?
- Does the installer cite potential benefits from net-metering that are not in accordance with the implementing rules and regulations?
- In case you have a demand charge contract with the utility, does the installer has a suggestion on the best option to size the PV system?
- Does the installer provide electrical plans and other documents required for LGU Electrical and Building Permits?
- Is the processing of permits included in the services?
- Does the offer include the delivery of all required components and services to produce electric power and feed it into the grid?
- Are grid-connection, and commissioning of the PV system included? In other words: is it a turn-key installation?
- Is the client stipulated to provide any item (e.g., scaffolding or labor)?
- Are optional and mandatory items distinguished and terms and conditions of the contract included?
- Does the installer observe current applicable standards and guidelines and know compliance standards set by the electrical and distribution codes valid in the Philippines?
- Compare the warranties being offered
- Payment conditions: are instalments included?



Remember:

- ✓ Ask your installer to conduct on-site inspection to consider existing electrical installations at the building.
- ✓ A calculation of the estimated yield should be included in the technical proposal so you can calculate the potential savings.
- ✓ Include in the contract, the installer's declaration stating compliance with current applicable standards, guidelines and rules.
- ✓ Check on insurance for the PV installation. It should provide security against storms, hail, lightning, overvoltage, theft, vandalism and other circumstances.
- ✓ Always include regular inspection of the PV system and a prompt service in case of a defect.

5.5.1 Comparing offers

It is expected that the end-user will receive several offers for the installation of solar PV facility. The following are the parameters that can be looked into when comparing offers:

- Solar and inverter
 - ✓ Type and brands (see Chapter 5.1 and 5.2)
 - ✓ Cost (Php/Wp for solar PV and Php/kW for inverter)
 - ✓ Total price of the whole system
 - ✓ Efficiency
 - ✓ Standards (for solar PV see Chapter 5.1.2)
 - ✓ Warranty - number of years
 - ✓ After sales service - (includes regular inspection of equipment, prompt service in case of defects)
- Commissioning (including tests)
- Financing options - solar company may have financing options available in case the customer does not want to pay in cash
- Credibility of the company as discussed in Chapter 5.5
- Compilation and delivery of documentation, instruction for maintenance and operation
- System design - shows how the system will look like at your premises and the amount of power that the system can generate

In case of comparable offers, a local company is preferable. Another useful aspect to consider is the possible date of installation of the PV system.



Remember:

- ✓ Demand a module layout plan with proposed location of modules and wiring.
- ✓ Demand a block diagram of whole PV system.
- ✓ Check if all necessary items are included (list shown above).
- ✓ Demand information about statically testing of offered mounting system.
- ✓ Check if offer and terms and conditions clearly state the obligations of PV system provider and client. Demand more details if this information was not provided.

5.6 Installation, Actual Operation, Operation and Maintenance, and Safety

Although the installation will be done by PV supplier/installer, there are important aspects that the end-user has to observe during and post installation.

5.6.1 Quality aspects of installation and mounting

On flat roofs, protection mats should be provided as an installation foundation, as these protect the roof membrane. Enough space should be provided in between PV arrays for accessibility in times of servicing and repair purposes. The commissioning of the PV system has to be carried out by a registered electrician. During the commissioning a protocol has to be written by the PV plant installer. This document points out important data about the PV system and records measured electrical values.

The points below are very technical but it is good to remind the supplier/installer about the following issues during installation:

- The running cables has to be short circuit proof, if possible, laying the positive and negative lines separately with a double isolation.
- The cables have to be UV resistant and properly fixed on the substructure or be conducted in adequate properly fixed on the substructure or be conducted in adequate fixings to prevent a lying on the roofing or on sharp edges.
- Some modules require the earthing of a pole (e.g., thin-film modules with string-ribbon cells: negative pole; Sun power cells: positive pole)
- For self-consumption: appropriate meters have to be installed. Under the net metering rules, bi-directional meters are installed to measure exported and imported energy and REC meters to measure the total generation from solar PV.

Similarly, remind the supplier/installer to observe the following during commissioning:

- Before switching on the PV system several values are logged: earthing resistance of the grounding system, insulating resistance of the PV system, insulating resistance of the DC main line, short circuit current for each string, open circuit voltage of the generator, open circuit voltage for each string.
- After switching on the PV installation: check the operation current of each string as well as voltage drop of diodes and fuses. Important is that the inverter feeds in and that the generator is not running in open circuit but in the operation point, generally the maximum power point (MPP).



Remember:

Check with installer/supplier the following:

- ✓ Check if cables are properly fixed. No lying on the roofing or on sharp edges.
- ✓ Include protection glass for outdoor installation.
- ✓ Ask installer to use appropriate cables and material for DC installation.
- ✓ Preferential use of solar cables (characterization: PV1-F).
- ✓ Connectors have to fit together and should not be permanently under water.
- ✓ Avoid looped circuits.
- ✓ Observe distance at about 0.5 meter between cabling and lightning protective system.

5.6.2 Quality assurance during operation time

The installer should offer a warranty on construction works for a certain period of time (at least one year). This has to be reviewed with the installer and should form part of the documentation of the PV system. The inverter should be checked on a regular basis (on vision panel or data logger) and yield values indicated on meter (every month).

5.6.3 Maintenance of the PV system

For maintenance measures by the PV system owner, regularly monitor performance to avoid disruptions. Maintenance work consists mainly on control of operational readiness of the system in order to rapidly resolve any failures.

Below are some of the things than the end-user can undertake to maintain the system:

- Maintain the system at least twice a year. This includes visual inspection and removing of leaves lying on the modules, as shading would reduce PV yield.
- Consider cleaning of the modules twice a year, particularly near to sources of high emissions like motorways, railroad tracks or pig farms. In case the monitored energy production (from inverter reading) show that it is lower than 5% or more from the baseline,

then maybe it is time to check if the panels are dirty or if there are shading. Remove shading. To clean the modules use lime-poor water, do not use harsh chemicals, abrasive scrubbers and pressure washers. .

- Twice a year check if the roof is ok. Check if all modules are properly attached and fixed.
- Check if cables been bitten by animals and if the connectors are OK
- After a lightning: check if electric-surge arresters remain intact

5.6.4 Warranty


Warranties that are being provided by installer and supplier vary. A certain supplier/installer shared the following warranties which can be used as guide when comparing offers:

Inclusions:

- Professional services (design and engineering)
- Delivery to site, installation and electrical works, including testing and commissioning
- After-sales on-call maintenance service (1 year free of charge)

Warranties:

- Solar PV Module - 25 years linear performance warranty, 10 years manufacturing warranty against defects.
- Solar Inverter – 5 years
- Rapid Shutdown Switch (Tigo TS4-A-2F brand) – 25 years
- Rapid Shutdown Switch Transmitter Communication Kit Dual Core – 10 years
- Workmanship – 1 year

For safety purposes, the Philippine Electrical Code of 2017 (PEC 2017) requires a Rapid Shutdown Switch (RSS) in Article 6.90.2.6 for rooftop PV installations. PEC 2017 stipulates that rapid shutdown needs to occur at the individual solar modules, rather than at the solar PV array as a whole. The RSS is intended to ensure the safety of firefighters when responding on fires in buildings with solar PV installations. PEC 2017 mandates that solar PV systems installed on the roof of structures or buildings required that the PV source circuits be de-energized from all sources within 10 seconds or when the utility supply has been de-energized or which the solar PV power source disconnecting means has been opened. The RSS will perform that task as the inverter can take around 45 seconds to disengage from the solar PV array and as long as 5 minutes for AC and DC capacitors inside the inverter to de-energize. 

5.6.5 Safety

A rooftop solar PV is an electrical system and therefore susceptible to electrical risk of fires and shocks. Compliance to electrical safety requirements and standards is critical to ensure safety. Solar panels that are not properly installed can cause electrical fires and electrocution as well as fluctuation in the quality of power across the circuit thereby affecting the whole community. The following are some useful tips to ensure that the PV system is safe from fire risks and shocks. The list is not exhaustive but is helpful in minimizing risks, injury and harm.

- Use credible installers. Make sure that the solar PV installers are from reputable companies that have qualified personnel doing the installation. The personnel should have undergone training/s on PV or certified electricians. The installer should preferably be licensed by the Philippine Contractors Accreditation Board (PCAB) and comply with the Philippine Electrical Code.
- Call your installer immediately if something strange is noticed with the solar system so appropriate remedy can be given. Most grid-tie systems flash red light at the inverter when something goes wrong.
- If the roof has accumulated a lot of leaves or has trees covering it, consider trimming the trees or regularly clean the panels. Buildup of leaves under the solar panel is a fire hazard and promotes water seepage through the roof during rainy season. It is important that the panels have air gaps and should not be installed over light materials like nipa or other flammable materials.
- Ensure that your solar PV system has safety features such as islanding function for inverter and rapid shutdown switch for solar PV as described above. These features are necessary for the protection of the personnel who are conducting repair works in the grid or firefighting.
- During commissioning of the solar PV system, ask the installer to give walk through on the de energization procedures or how to shut down the system in case of fire or maintenance. It is important to train more people as possible on this walk through and regularly conducts it especially, if there are new household member or staff in the case of commercial/ industrial establishments.
- If located in coastal area, consider triple railing the solar setup or enhance the anodization of the racking equipment. The system should also be designed that it can withstand severe weather conditions that it is exposed to.
- Avoid installing solar PV system near flammable gases.
- Make sure to follow the installer's instructions during maintenance. Regularly consult the manual provided by the installer as this have specific procedures for the maintenance of the system. Having your own way of maintaining the system and veering away from what

is advised may results in hazards. It is also advisable to call the solar installer and ask questions about the overall maintenance if something different is noticed on its operation.

- After a major storm or after New Year celebration, it is advisable to conduct visual check to see if there are potential of foreign object damage. A broken or shattered solar panel is a safety concern that needs to be quickly addressed.
- If your system is nearing its life span, replace it to avoid further risk of fire or electrocution. Solar PV is expected to provide 25 years of reliable power.

5.7 Return of investment

QEs are interested to know when they can recover their investment for the installation and procurement of solar PV facilities. In contrast to conventional power plants, PV systems have no fuel costs. Moreover, there are no mechanically or thermally highly stressed parts; therefore, the maintenance is limited primarily to few activities. Nevertheless, it is prudent to allocate a small budget for the eventual replacement of defective or end-of life parts.

For instance, the inverter may have to be replaced once within 20 years. It is also important to know the yearly demand for electricity, and the amount being paid for electricity.

It would be best if the quote for the PV installation would include an estimate of cost-effectiveness. This calculation is based on the expected yield, the electricity demand and the achievable degree of self-consumption as well as the excess energy that is fed into the grid.



Remember:

- ✓ Provide the installer with the current electricity and if possible, the bill for the last 6 months.
- ✓ Ask the installer if they can provide an estimate of cost-effectiveness such as ROI, payback period, etc. of the proposed system.
- ✓ Make sure that expected yield, self-consumption, and excess feed-in are according to current pricing for retail rate and generation rate.

5.7.1 Calculating ROI of solar facility for net metering

The example below shows a sample of ROI calculation of a solar roof top in the Philippines. Please check with solar installer and DU the appropriate figures. Those shaded in blue are the values that need to be replaced by actual numbers.

The example below (Note: it will be updated) is just a hypothetical calculation which shows the methodology on how the ROI of solar facility is computed under the net-metering rules in the Philippines.

Assumptions

		Unit	Value
1	Lifetime of PV	Years	20
2	Rated capacity of system (RC)	kWp	6
	Module efficiency (ME)	%	16%
	Hours/Year	hours	8,760
3	Yield (RC * ME * hours/year)	kWh/year	8,410
4	Degradation factor	%	0.50%
5	% Own consumption	%	70%
6	DU Total customer charge	Php/kWh	12.5718
7	Annual increase in DU/generation charge	%	3%
8	% Net export	%	30%
9	DU Generation charge	Php/kWh	5.4951
10	O&M/Year/kWp	Php	900
	Cost of installed PV system	Php/kWp	120,000
11	Cost of installed PV system total	Php	720,000

Year	Total solar energy produced kWh B (3*4*5)	Solar energy own Cons. kWh C B*5	DU Total customer charge Php/kWh D 6	Avoided cost Php E C*D	Solar energy export kWh F B*8	Generation charge Php/kWh G 9*7	Credit from Export Php H F*G	Savings Php I E+H	O&M Php J 2*10	Total savings Php K I-J	Investment & Cumulative Savings Php L 11-K
0										- 720,000	-720,000
1	8,410	5,887	12.5718	74,007	2,523	5.4951	13,863	87,870	5,400	82,470	-637,530
2	8,368	5,857	12.9490	75,846	2,510	5.6600	14,208	90,054	5,400	84,654	-552,876
3	8,326	5,828	13.3374	77,730	2,498	5.8298	14,561	92,292	5,400	86,892	-465,985
4	8,284	5,799	13.7375	79,662	2,485	6.0046	14,923	94,585	5,400	89,185	-376,800
5	8,243	5,770	14.1497	81,642	2,473	6.1848	15,294	96,935	5,400	91,535	-285,264
6	8,201	5,741	14.5742	83,671	2,460	6.3703	15,674	99,344	5,400	93,944	-191,320
7	8,160	5,712	15.0114	85,750	2,448	6.5614	16,063	101,813	5,400	96,413	-94,907
8	8,120	5,684	15.4617	87,881	2,436	6.7583	16,462	104,343	5,400	98,943	4,036
9	8,079	5,655	15.9256	90,064	2,424	6.9610	16,872	106,936	5,400	101,536	105,572
10	8,039	5,627	16.4033	92,303	2,412	7.1699	17,291	109,593	5,400	104,193	209,765
11	7,998	5,599	16.8954	94,596	2,400	7.3850	17,720	112,317	5,400	106,917	316,682
12	7,958	5,571	17.4023	96,947	2,388	7.6065	18,161	115,108	5,400	109,708	426,390
13	7,919	5,543	17.9244	99,356	2,376	7.8347	18,612	117,968	5,400	112,568	538,958
14	7,879	5,515	18.4621	101,825	2,364	8.0697	19,075	120,900	5,400	115,500	654,458
15	7,840	5,488	19.0160	104,355	2,352	8.3118	19,549	123,904	5,400	118,504	772,962
16	7,800	5,460	19.5865	106,949	2,340	8.5612	20,034	126,983	5,400	121,583	894,545
17	7,761	5,433	20.1740	109,606	2,328	8.8180	20,532	130,139	5,400	124,739	1,019,284
18	7,723	5,406	20.7793	112,330	2,317	9.0826	21,043	133,373	5,400	127,973	1,147,256
19	7,684	5,379	21.4026	115,121	2,305	9.3550	21,565	136,687	5,400	131,287	1,278,543
20	7,646	5,352	22.0447	117,982	2,294	9.6357	22,101	140,084	5,400	134,684	1,413,227
Total	160,438	112,306		1,887,623	48,131		353,604	2,241,227	108,000	2,133,227	

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Source: Markus Dietrich, GIZ Consultant

¹⁵ This table will be updated.

6. FEEDBACK AND GRIEVANCE REDRESS MECHANISM

The DOE subscribe to the Consumer Act of the Philippines (RA 7394) that provides for the:

- Protection of the interests of the consumer, promote his general welfare and to establish standards of conduct for business and industry;
- Protection against hazards to health and safety; and
- Protection against DECEPTIVE, UNFAIR and UNCONSCIONABLE sales acts and practices.

Aligned to these objectives, the government and the private sectors, among others, have already instituted in their operation the feedback and grievance/complaint redress mechanism for voices to be heard.

Particularly for the energy sector, the national government agencies include their local and satellite offices, DUs, LGUs and other stakeholders have created and mobilized resources that handles inquiries, feedbacks, and even grievances of their clients. The modes for communicating the inquiries, feedbacks and/or grievances are through the following, but not limited to:

- Website: there is a “Contact us” section or icon that can be readily found
- Hotlines posted in the bulletin board in their offices or their business centers
- Social media platform such as facebook

Focusing on the implementation of the net-metering program, the DOE and other offices have received complaints and grievances. This is not surprising as the program is still evolving. The benefits of streamlining of the feedback and grievance redress mechanism can be many-fold:

- Resolution of the concerns/issues of the aggrieved parties;
- Demonstration that concerned government entities and other stakeholders are advocates of consumer protection, thereby strengthening trust;
- Documentation of the experiences will aid in developing a responsive multi-stakeholder framework for feedback and grievance redress mechanism.

It is always best that the concerned parties resolve among themselves any concerns or issues that may arise in the course of the engagement. However, there may still be cases wherein the issues need to be elevated to the proper authorities. Below is a matrix showing a system on how the feedbacks/complaints can be addressed.

Table 3. Feedback and Grievance Redress Mechanism

Feedback and Grievance Redress Mechanism	
<p>How to send feedback?</p>	<p>Feedbacks and grievances may be directed to different entities depending on the type of issue.</p> <p>If concern regarding <u>electric cooperatives</u>, send complaints/feedbacks through telephone call, email or fb messenger to:</p> <p>Ernesto Silvano, Jr. Department Manager Total Electrification and Renewable Energy Development Department Email: silvanoejr@nea.gov.ph Tel. No. (02) 8927-5158 https://www.facebook.com/OfficialNEA/</p> <p><u>OR</u></p> <p>Jayson Corpuz <u>Chief Energy Regulations Officer</u> Email: jgcorpuz@erc.ph Tel. No. (02) 8631 5818 https://www.facebook.com/ERCgovPH/</p> <p>Concerns regarding <u>private distribution utilities, solar PV installers/ suppliers and local government units:</u></p> <ul style="list-style-type: none"> • DOE Luzon Field Office (Luzon area) Email: dept.ofenergylfo@yahoo.com Tel. No. (075) 656 0114 https://www.facebook.com/DOELuzonFieldOffice/ • DOE Visayas Field Office (Visayas area) Email: vfo@doe.gov.ph Tel No. (032) 253 7222 https://www.facebook.com/doevisayas/ • DOE Mindanao Field Office (Mindanao Area) Email: doe.mfo@doe.gov.ph Tel. No. (082) 224 0740 https://www.facebook.com/doemindanao/ • National Capital Region (DOE Main Office) c/o Consumer Welfare and Promotions Office (CWPO) Email: icwpo@doe.gov.ph Tel. No. (02) 84792900 https://www.facebook.com/doe.gov.ph/ • Energy Regulatory Commission Jayson Corpuz <u>Chief Energy Regulations Officer</u> Email: jgcorpuz@erc.ph Tel. No. (02) 8631 5818 https://www.facebook.com/ERCgovPH/

How to file a complaint?	<p>Feedbacks/Complaints may be filed through the following means:</p> <ul style="list-style-type: none">• Email• Phone call• Facebook messenger <p>The following information are required from the complainant:</p> <ul style="list-style-type: none">• Name• Contact number• Date of the incident• Details of the complaint• Name of person being complained (if any)
How feedbacks are processed?	<ul style="list-style-type: none">• Feedbacks/Complaints received are reviewed every week, i.e., every Monday.• A designated staff from each entity, i.e., DOE field offices and DOE main, ERC and NEA, will be assigned to handle feedbacks/complaints.• Feedbacks/Complaints will be collated and those requiring answer will be addressed by the designated staff within 3 days, i.e., until Wednesday.• Critical issues will be elevated to a senior staff.