



Clean Energy Procurement Guidebook for the Philippines

July 2019 Edition

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Section 1. About the Clean Energy Investment Accelerator

The Clean Energy Investment Accelerator (CEIA) is an innovative public-private partnership initiative that addresses barriers to scale the deployment of clean energy solutions for commercial and industrial consumers in emerging markets. CEIA is jointly led by the World Resources Institute (WRI), Allotrope Partners, and the U.S. National Renewable Energy Laboratory (NREL), and supported by the German and U.S. governments and other donors. The CEIA model is built on three essential pillars for mobilizing clean energy investment at scale:

- **Purchasers:** Commercial and industrial power purchasers create a demand signal for clean energy;
- **Policy:** Effective policies and regulations allow clean energy to scale; and
- **Pipeline:** A robust pipeline of clean energy projects attracts investment.

In the Philippines, CEIA focuses on bringing together private and public sector stakeholders in high-growth regions of the country to facilitate open dialogue and advance subnational mechanisms for mobilizing clean energy investment and deployment. This involves partnering with key local government units (LGUs), like the City of Santa Rosa, and bringing city officials and the local businesses together, in order to help **purchasers** overcome clean energy barriers, strengthen the local **policy** enabling environment, and unlock a **pipeline** of private sector clean energy projects.

This guidebook aims to serve as a resource to advance clean energy deployment in the Philippines. For private and public sector stakeholders interested in exploring renewable energy (“RE”, or “renewables”), this guide offers an **overview of the available RE procurement and financing options** in light of the evolving policies and regulations in the Philippines, as well as **case studies** highlighting how clean energy is being deployed in the Philippines and other geographic areas, and resulting in significant cost savings. The contents were directly informed by requests from businesses and municipal officials interested in specific **tools and templates** that can support early-stage efforts to consider clean energy solutions, including **checklists of key questions** to help assess a facility’s initial potential for on-site rooftop solar or potential for participating in the Green Energy Option Program, a **database of experienced RE installers** active in the Philippines, and **briefing sheets on structural considerations, cost comparisons for solar and utility rates, and insurance and warranty considerations involved in long-term contracts** for power purchase or equipment lease agreements.

This guide is intended to serve as a starting point, but the CEIA seeks to support buyers and policymakers, including those in other LGUs, interested in further exploring these issues. To join our future public-private dialogues, request more information on the contents of this guide, or learn more about the CEIA, visit our website at www.cleanenergyinvest.org, or contact CEIA Philippines Country Lead, Marlon Apanada, at amj@allotropepartners.com.

Note to Readers: Two key policies discussed in this guide - the net metering policy and the Green Energy Option Program - are currently under review. Specific elements of the design may change, which could impact renewable energy procurement choices for companies. Based on any relevant changes, the CEIA will release an updated version of this guidebook in later in 2019, which will be available on our website, <https://www.cleanenergyinvest.org/resources>.

Section 2. Corporate Renewable Energy Procurement Pathways in the Philippines

The Philippines' unsubsidized electricity rates are among the highest in Asia, and expensive, unpredictable costs of electricity have encouraged businesses and other electricity customers to explore alternative pathways to procure RE. Declining solar photovoltaic (PV) system costs, a national law promoting RE use, good renewable energy resources, and availability of experienced and competitively-priced local developers and service providers have brought the Levelized Costs of Electricity (LCOE) for solar energy and other RE resources to levels that are well below utility retail rates. The following sections outline **on-site and off-site purchasing and financing options available to customers in the Philippines** seeking to reduce their electricity costs through cleaner alternatives.

Turnkey Purchase: This is also known as “a CAPEX purchase” or “balance sheet financing.” Under a turnkey arrangement, a customer invests into and owns the solar PV system assets. Typically, turnkey purchases are either self-financed or a corporate loan from a bank may be an option if a customer has an existing credit line.

Third-Party Financed Lease, Power Purchase Agreement (PPA), or Rental: These arrangements are also known as “an OPEX contract,” “solar-as-a-service,” “solar Energy Service Company,” (ESCO) or “Build-Own-Operate.” Under a third-party financed structure, a customer does not own the solar assets directly. Instead, the solar vendor provides the financing and owns and operates the assets for the lifetime of the contract. Leasing contracts with solar vendors vary in length, but are typically 7 to 25 years. In some cases, a customer can have a “lease-to-own” option at the end of the contract, also known as a “Build-Own-Operate-Transfer” contract. In the Philippines, a PPA is the relevant option for “Contestable” customers, or those that have average monthly demand of at least 750 kW. A lease is the applicable contract for “Non-Contestable” customers with demand under 750 kW per month.

The following table compares the key characteristics of two available financing structures.

Table 1. Key Characteristics of Turnkey and Third Party Financed Structures

Characteristics	Turnkey Purchase	Third-Party Financed Lease/PPA/Rental
Financing	On company's balance sheet (cash or corporate loan/line of credit)	Financing from solar company
Operations and Maintenance (O&M)	Requires separate contract with solar company or third-party O&M provider	Cost included in lease
Equipment Warranties	Yes, possible	Yes, possible
Performance Guarantees	Yes, possible with additional cost	Cost included in lease

Insurance Included	No	Yes
Lowest per kWh Cost Over Solar System Lifetime	Yes	No
Potential for Year 1 Cash-Flow Positive	No	Yes

Implications of Net Metering and Green Energy Option on Procurement Pathways

This section describes how the net metering and Green Energy Option programs in the Philippines impact turnkey and third-party financing options. The primary options are summarized in the table below, with **green** indicating a currently available and viable option, **yellow** represents an option that requires further consideration or that may be only feasible under specific circumstances, and **red** indicates an option that is not likely feasible.

Table 2. Potential Procurement Pathways in the Philippines and Implications of Net Metering and Green Energy Option Program

	Turnkey Purchase	Third-Party Financing
On-Site with Net Metering	Net metering can result in additional cost savings for customers interested in an on-site solar PV system smaller than 100 kW.	Limited relevance in the Philippines due to rate structure and applicability of net metering revenues, which are structured as credits.
On-Site for Self-Consumption without Net Metering	Relevant for customers with a peak demand over 100 kW (works best for systems between 100 and 750 kW).	Relevant for customers who want immediate savings without upfront costs and are able to enter into long-term contracts.
Off-Site	Not relevant for off-site arrangements.	The Green Energy Option Program is opening new opportunities for large customers with a peak demand over 100 kW to purchase RE from off-site sources through PPAs with Independent Power Producers (IPPs). <small>Note: the GEOP cannot currently be used to make corporate claims of using RE as all Renewable Energy Certificates are retained by the utilities.</small>

Option 1: Turnkey Purchase On-Site with Net Metering

Relevant for customers interested in an on-site solar installation with a system size smaller than 100 kW

Net metering is a system that allows customers who generate renewable electricity on-site to export excess electricity to the grid and receive credits for it. When excess power is generated, such as when a customer's load is low (e.g. a school during weekends), it is exported to the grid and the customer receives credits from the distribution utility at a predetermined rate. The net metering (or net billing) rate is typically based on the utilities' cost of production, which is often about 40% of the total retail rate. Electricity sold back to the grid are 'banked' as credits on a customer's bill, and can be used to offset electricity purchases from the utility only for the following month. Therefore, net metering results in additional economic benefits for consumers with on-site solar PV systems who have less than seven days of full load. In markets outside the Philippines, net metering incentives are more comprehensive, and as such net metering programs have inspired large quantities of RE growth around the world.

The Philippines' net metering program has been in place since 2013, yet participation remains low. It is estimated that only just over 17 MW of solar has been adopted through this policy mechanism. The largest barrier to adoption is a complicated and lengthy project permitting process. One analysis found that 14 different permits were required from a combination of federal and local governments, power system operators, regulators, and the local utility for a single net metering project to be approved.¹ However, there are now a number of highly experienced developers active in the Philippines who can assist customers in navigating the permitting process and all associated requirements.

Another major barrier to net metering adoption is that in the Philippines, **net metering is only available to customers with a small peak demand (monthly average demand under 100 kW)** and is a good option if customers often consume electricity when RE is not being produced. Thus, there are many potential solar customers, especially large corporate energy buyers, that may be interested in net metering but that need projects larger than 100 kW to meet their demand, so they are disincentivized given the current net metering project size limitation in the Philippines.

Option 2: Turnkey Purchase On-Site for Self-Consumption

Relevant for customers with a peak demand of more than 100 kW

For customers with a monthly **electricity demand above the 100 kW** cap for the net metering program, developing renewables like on-site rooftop solar can still result in economic benefits. **RE generated could be used for self-consumption** and lower the customer's utility electricity bill. This procurement option works best for smaller renewable systems (i.e., systems between 100

¹https://d2oc0ihd6a5bt.cloudfront.net/wp-content/uploads/sites/837/2016/04/05-Getting-to-the-End-Line_final.pdf

kW and 750 kW) that will supply a portion of the customer's electricity load, and for customers with a load profile that aligns well with renewable resource availability. On-site RE systems can be procured directly through turnkey purchases where the consumer buys the system outright and owns the assets. Companies with existing lines of credit may be eligible for a loan to purchase a RE system.

Option 3: Third-Party Financed Leases or Power Purchase Agreements (PPAs) for Self-Consumption

Relevant for customers who want immediate savings without upfront costs and are able to enter into long-term contracts

Corporate renewable energy buyers that prefer not to self-finance under a turnkey model can work with solar developers to utilizing third party financing structures. Such arrangements typically include either an explicit **lease arrangement or a PPA**. Experienced developers can help customers understand the project economics of utilizing a financing mechanism that may allow customers to finance the project at minimal cost, and utilize the bill savings to pay off the system cost over a number of years.

In a third-party financed arrangement, the customer pays a predetermined amount (fixed) and/or an amount corresponding to the electricity production (variable) to the organization that owns the installation. Under a PPA, the customer pays for the RE system's electricity output using a rate that is usually lower than the utility rate. PPAs often include an annual escalator that is a percent increase set to track with either expected increases in utility tariffs, inflation, or other indices. Contestable customers, with demand of at least 750 kW per month, may enter into a PPA, while Non-Contestable customers, with demand under 750 kW per month, may enter into a lease contract. Lease contracts may be structured as flat monthly payments or set to track with energy usage (i.e., closer to a per kWh payment).

Such financing schemes aim to meet a portion of the customer's current energy needs in order to reduce operations costs and the customer's carbon footprint. These solutions allow customers to address the two leading issues associated with turnkey purchases: the upfront investment needed, and operating assets on a company's balance sheet that are not related to their core business (such as on-site RE systems). In addition, since the third-party finance provider's cashflow depends on the performance of the on-site RE system, system performance risks are not borne by the customer. However, these arrangements also involve long-term contractual obligations, which both the third-party finance provider and the customer must agree on from the outset, and comply with over the life of the contract. The Briefing Sheet in Appendix 3 at the end of this guide provides a comprehensive discussion on this type of arrangement, framing it as an agreement that involves a long-term relationship addressing associated risks.

Option 4: Off-Site Options under the Green Energy Option Program (GEOP)

Relevant for customers with a peak demand over 100 kW, or who lack the space or resource availability to pursue RE on site

Electricity customers in regulated environments are often legally bound to purchase their electricity from a single distribution utility—meaning, they are not able to choose which utility supplies their power. In these systems, utilities hold a franchise granting them a monopoly over a certain geographic area. In the Philippines, the GEOP is an innovative program that allows **large commercial and industrial customers with an average monthly peak demand over 100 kW to procure their own electricity from off-site sources** by signing PPAs with IPPs. One of the key benefits of the GEOP is that it enables businesses to pursue **sources of RE that are not available on-site**, including large off-site solar, wind, geothermal, or hydro resources.

The program generally requires utilities to deliver the power from the IPP to the customer. The utility is allowed to charge a wheeling fee, which serves as a postage stamp on every kWh of electricity distributed through their wires. The utility also acts as the power supplier of ‘last resort’ under the GEOP, meaning that if the RE secured through the PPA is unavailable, power can be provided by the utility for a fee.

Under the current version of the GEOP in the Philippines, the utility retains all Renewable Energy Certificates (RECs) generated by the IPP. RECs are used by utilities to meet RE mandates under the Philippines Renewable Portfolio Standard. However, some companies also value RECs for reporting progress toward their own energy and sustainability targets. RECs contain the legal representation of all environmental attributes associated with RE.

Therefore, it is important to note that corporate buyers that seek to claim use of renewable energy could not verifiably do so under the current GEOP given that the corporate buyer does not retain the RECs.

As a new program, some details about the GEOP remain unclear. For example, early, unofficial feedback from the Department of Energy (DoE) indicated that a PPA may need to provide 100% of a customer’s power consumption, but it is unclear over which time scale this is balanced.² Similar programs in the United States typically balance on a monthly basis, thus clarification from the DoE is being requested. Additionally, the exact formula for determining appropriate wheeling charges has yet to be published and may impact the level of cost savings available to customers.

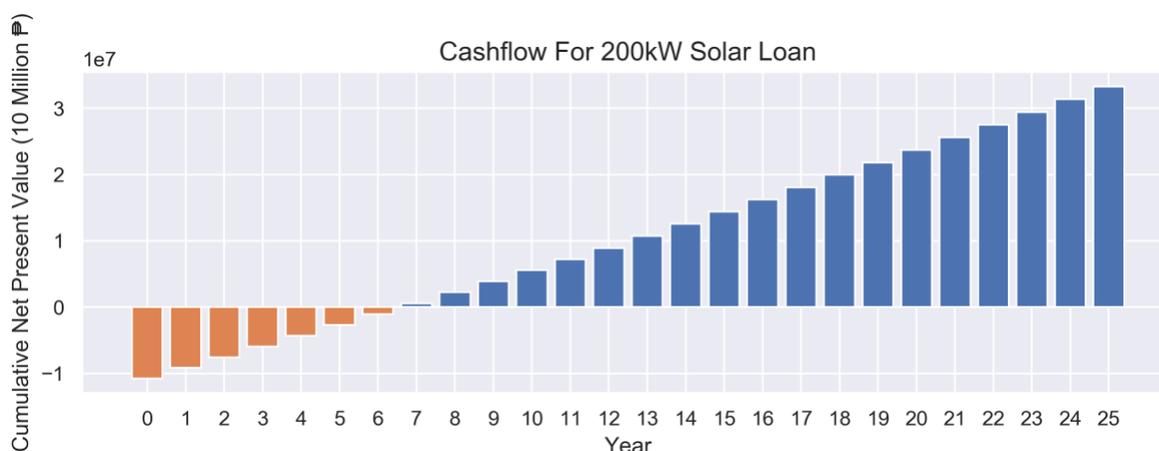
While the GEOP is a new option that is still in the process of being fully implemented, it will offer important opportunities for companies to secure their own reliable electricity through **new off-site options and new sources of RE**, at rates that could offer significant **cost savings to customers**.

² <https://www.doe.gov.ph/laws-and-issuances/departments-circular-no-dc2018-07-0019>.

Section 3. Corporate Renewable Energy Buyers Case Studies

The following business case studies highlight examples of effective deployment and cost savings associated with adopting solar for customers in the Philippines and other countries

Solar PV System for a Hospital in Mindanao: A private hospital located on a South Philippine island group is disconnected from the main electricity grid. They pay higher electricity prices and experience more interruptions than other locations in the Philippines. To counteract this, the hospital is pursuing a 200 kW solar PV system on their rooftop to offset a portion of their power consumption. This RE system will reduce the energy charges on their electricity bill. Assuming an all-in installation cost of around \$1,000 per kW, standard operation and maintenance costs, a mid-life inverter replacement, and reasonable insurance and financing rates, the system's average levelized cost of energy (LCOE) can be calculated at 3.20 ₱/kWh. Compared with retail rates of 8.50 ₱/kWh, which has had an average annual increase of 1.2% over the past two years, the system pays itself off in seven years. The chart below shows the anticipated system lifespan of 25 years and significant net cost savings of over ₱30 million. Because of the relatively short payback period, third-party financing options could also be considered.



Solar for Commercial Malls in the Philippines: In 2014, pioneering third-party financing arrangements began to emerge in the Philippines, and large-scale commercial users like malls started exploring these models. The projects, financed by energy outfits such as Solar Philippines and Cleantech Solar, provide between 0.65 and 1 MW of electricity to the building. Under this model, the rooftop solar plant is fully owned by the energy outfit and delivers the electricity at an equivalent rate lower than the local utility's rate of ₱10-10.5 per kilowatt hour. The malls that acquire electricity from their respective solar arrays benefit from 30-40% coverage of their electricity demand at a lower monthly rate than local utility rates.

Geothermal for Office Buildings in Bonifacio Global City: Five years of satisfactory energy procurement led large Filipino office developer, The Net Group, to renew its power supply agreement with AboitizPower's renewable subsidiary, AP Renewables, Inc. The office developer purchases 13.5 MW of clean, geothermal energy from the supplier to provide round-the-clock baseload power to seven of its office buildings in Bonifacio Global City. Together, the buildings

constitute three million square feet of leasable space to prominent multinational and Fortune 500 companies. The Net Group specifically pursues a holistic, green approach to its properties, subjecting each building to stringent design and operational standards. These standards can, in turn, support resident companies to implement domestic and global environmental standards.

Solar for an Airport in India: In December 2015, Bangalore’s Kempegowda International Airport announced that it would source 40% of its electricity from solar energy, offsetting approximately 17,000 tons of carbon dioxide, or the equivalent of more than 3,200 passenger vehicles each year. As of December 2018, the airport generates 3.44 MW from solar energy daily and plans to add another 8.35 MW in two phases, to total 12 MW from on-site energy generation (with plans to source an additional 8 MW off-site and reach 100% RE by 2020). Since the solar panel installation, the total clean energy savings of the Kempegowda International Airport are now over 7.5 Million kWh units. These technologies were estimated to result in significant cost savings for the airport of approximately 2.1 million RM (USD \$627,000) annually.

Solar for an Industrial in Vietnam: In July 2017, Swire Cold Storage—the third largest provider by pallet positions in the world—commissioned the construction of its first cold storage facility, located in Bac Ninh province near Hanoi. The facility is an industry-leading LEED gold-rated cold store and includes a 308 kWp rooftop solar PV system to reduce the company’s environmental footprint and contribute to its sustainability goals. Since the company’s “Sustainable Building Design Policy” was implemented in 2016, all new and renovated Swire facilities have to attain the highest or, at minimum, the second highest green building certifications.

Solar for Cities in the U.S.: To reduce electric bills and emissions and to demonstrate how local municipalities can band together around a common goal, Maryland’s Prince George’s County established the Collaboration of Municipalities Solar Energy Recovery Plan (SERP). Under the SERP, solar PV systems were installed on the roofs of government buildings across nine county municipalities. Since their installation, carbon dioxide emissions have been reduced by 209.05 tons, and the systems have resulted in cost savings of \$29,058 annually. With the cost savings and the income generated by the sale of the RECs, each jurisdiction has been able to contribute to a joint fund supporting additional solar energy programs, energy assistance for senior citizens, and a scholarship fund for students seeking to pursue green careers.

Section 4. Checklist of Key Questions When Considering On-Site Solar

Solar PV costs are falling dramatically. As utility electricity rates increase in the Philippines, commercial and industrial (C&I) facilities will increasingly have opportunities to save money by utilizing on-site solar PV power generation. The following guide provides key questions for C&I facility operators to consider when exploring solar PV options which include, but are not limited to, site ownership, physical characteristics of the site, operational practices, and access to financing. This checklist is not intended as a comprehensive resource, but as a high-level introduction to the key factors that can impact whether or not C&I businesses and facilities have the right conditions to explore cost-effective procurement of an on-site solar PV system.

If a customer decides that on-site PV is of interest, based on this checklist, the next step would be to perform a more detailed technical and engineering feasibility assessment.

Does your company own the building or have a long-term lease?

- ✓ Do you have space available on your roof for solar panels and/or sufficient land for a ground-mounted system?
- ✓ Is the roof structurally sound and will it be in place for the duration of the economic life of the solar PV system (typically, 20-25 years?)
- ✓ Is the area where the solar panels would be located free of trees, walls, buildings, or other structures that would create shade?
- ✓ Does the site's operational schedule and electricity consumption align with solar production?
- ✓ Does your company allow the use of operational budgets to lease equipment? Or does your company's budget allow for equipment to be purchased with capital budgets?
- ✓ If your company is interested in a solar lease, would it be able to sign at least a 10-year contract?

If you answer YES to all these questions, your company is well positioned to consider on-site solar.

If you answered *NO* to some of these questions, there may still be other options for RE procurement. The following sections provide a deeper look at these considerations and a more detailed explanation of the financing options for on-site solar PV electricity in the Philippines.

Ownership

✓ Direct Ownership or Facility Lease

Whether a facility operator owns or leases the building and land will influence solar PV investment decisions. Landlords sometimes are not incentivized to invest in solar PV on behalf of their tenants if there is not a profitable investment or cost-saving opportunity for the owner. Generally, a company's ownership or long-term lease of land and buildings allows for easier decision-making when committing to an on-site solar PV investment or contract.

□ Action Items:

- *If leasing the facility, determine land and building leasing agreement conditions to see if the contract term is sufficiently long to enable a payback on the solar PV system (e.g., a facility lease of at least 6 years).*
- *Explore whether the commercial landlord or industrial park would be interested in providing solar energy as a service to tenants.*

Physical Characteristics

✓ Availability of Roof or Land Space for Solar Panels

Solar PV systems require approximately 8-10 square meters of space for each kilowatt (kW) installed. Whether roof-mounted or ground-mounted, a solar PV system needs a flat or angled surface (ideally oriented in a south-facing direction for maximum sun exposure) that is free from barriers and impediments such as walls, vents, skylights, air-conditioner equipment, walkways, etc.

✓ Structural Soundness and Remaining Lifetime of Roof

Prior to installing a rooftop solar PV system, you need to determine if the building's roof is structurally capable of holding approximately 10-15 kg/sqm, which is the general range of weight bearing load for solar panels and the mounting structure. Additionally, because solar PV systems are designed for a lifetime of 20-25 years, the building owner needs to determine the remaining lifetime of the current roof. If your building currently has an old roof in need of repairs or replacement, a solar PV system should not be installed until repairs or replacement is completed. A ground-mounted solar PV system could be a good alternative if there is sufficient space on your property.

✓ Shading Barriers

To collect maximum sunlight during daylight hours, a solar PV system in the Philippines should face South as much as possible. The area where the solar PV system will be placed (rooftop or ground area) must be checked for shadows created by trees, walls, or nearby buildings. Minimal shadows throughout daylight hours - particularly between 10:00 am and 3:00 pm - is an ideal case for solar PV installations. In cases where shadows do exist in the area of the proposed solar PV system, a detailed analysis of time and direction of sunlight needs to be performed by a solar

expert to accurately estimate the impact on solar energy output.

☐ Action Items:

- *If your facility is considering a rooftop installation, conduct a structural engineering assessment of your roof space to check the quality, strength, and integrity of the roof.*
- *For both rooftop and ground-mounted systems, engineers should check for shading from trees or other structures that might impact solar energy production.*

Building Operations

✓ Operational Schedule and Electricity Consumption Patterns

Solar PV systems generate electricity every day of the year, however, production is variable based on weather and other conditions and tends to be greatest in the afternoon when the sun exposure is most direct. Your solar PV system should be designed so that as much solar electricity as possible is consumed by the building. Does your business operate on a year-round basis? Does your electricity demand remain stable from day-to-day, or does it often fluctuate? Businesses and buildings that do not operate year-round, or have long periods of very low electricity consumption, might not be suitable for an on-site solar PV system.

✓ Company's Operational Future

Solar PV systems are designed to generate electricity for 25 years or more. If your company is going to invest into solar assets or is considering a contract for solar service, the solar PV system should be used for as long as possible. As a rule of thumb, if you think your business will move locations in less than 6 years, pursuing an on-site solar PV system may not be an optimal choice.

✓ PV System Component Location and Housing

Solar panels will need to be connected to your facility's electrical Main Distribution Board (MDB). It is imperative to ensure cabling from the solar panels have access to the facility's MDB. Further, it will be necessary to have a protected indoor or outdoor area where inverters can be placed.

☐ Action Items:

- *Work with energy managers or other experts to analyze utility bills, ideally looking at average use over the past two years to understand daily, seasonal, and annual electricity consumption patterns. The tariff structure should also be examined (e.g., time of use, special utility offerings, capacity charges).*
- *Meet with your chief operations officer to discuss operational horizons, and whether the company intends to stay in its current facility for at least 6 years.*

Business and Financing

✓ **Company's Investment Policy**

As of 2018, solar PV systems for commercial and industrial energy users in the Philippines typically have a capital investment payback period of more than 6 years. If your company has guidelines that mandate new capital investments must have a *shorter* payback period than 6 years, it is advisable to consider third-party financed solar service contracts (leasing/rental) in which your company is not required to commit a capital outlay to the solar assets.

✓ **Company's Ability to Engage in Vendor Contracts for 10+ Years**

If your company prefers not to invest its own capital into solar assets solar service contracts, your company could consider a third-party financed option, often in the form of a lease or rental contract. As the electricity user, your company pays a monthly fee to use the solar PV system and the generated electricity. Typically, solar vendors require the electricity user to sign a contract for multiple years -- oftentimes a minimum of 10 years, and sometimes up to 20 years. If your company is not able to sign a long-term contract, it may be difficult to find a solar vendor that will provide the solar service lease.

□ **Action Items:**

- *Consult with your company's chief financial officer to determine whether the company has payback period requirements that would limit a turnkey capital investment.*
- *Alternatively, explore with your company's legal department whether the company can sign lease or rental contracts with a minimum suggested length of 10 years.*

Section 5. Checklist to Determine if Your Facility Should Explore Green Power Wheeling

- ✓ Is your company's average monthly electrical usage more than 100kW?
- ✓ Do you currently have a contract with a Retail Electricity Supplier (RES)?

If you answer YES to ONE these questions, your company is well positioned to consider third-party RE outsourcing.

The new Green Energy Option Program is available for customers with a peak demand of over 100kW and allows large C&I customers to procure their own electricity by signing PPAs with Independent Power Producers. The GEOP offers an opportunity for companies to secure their own green electricity at a rate below the generation charge billed by utilities. The GEOP also enables businesses to pursue sources of RE that are not available on-site, including large off-site solar, wind, geothermal, and hydro resources.

Section 6. Database of Known Experienced Installers in the Philippines

The following list of key contacts represents a collection of experienced installers who were active in the Philippines market as of February 2019. Please refer to the websites listed under each company for the latest information. This is not an exhaustive list and additional installers continue to enter the market as solar in the Philippines continues to scale. If you are aware of additional experienced installers in the Philippines, not included in the list below, please contact the CEIA team at info@cleanenergyinvest.org.

All Vision Solar Energy Systems

4th Floor Saville Bldg., 8728 Paseo de Roxas corner Sen. Gil Puyat Ave., Makati City 1209
www.all-vision.biz

CEnAG Solar

Unit 212 Valero Plaza, 124 Valero St., Brgy. Bel-Air, Makati City, Philippines 1227
www.cenag-solar.com

Edward Marcs Phils Inc.

2F Timog Bldg. 28 Eugenio Lopez Drive, South Triangle, Quezon City. 1103 Metro Manila, Philippines
www.edwardmarcsphilinc.com

Freidrich Enterprise.

#394 Paz St., Morningbreeze, Caloocan City
www.freidrichent.webnode.com

Greenheat Corp. (subsidiary of Propmech Corp.)

A. Soriano corner Arzobispo Sts. Intramuros, Manila 1002
www.greenheat.com.ph

Maschinen & Technik, Inc. (MATEC)

Tech Center, Buencamino St., Alabang, Muntinlupa City 1770
www.matec.com.ph

Meister Solar Power Solutions Corp

Stall 1 Texas St., Villasol, Malabanas, Angeles City
www.meister-solar.com

Sasonbi, Inc.

U3004 Antel Global Corporate Center, 3 Julia Vargas Avenue, Ortigas Center, Pasig City 1605
www.sasonbisolar.com

Solenergy Systems Inc.

TECO Ninoy Aquino Highway, Barangay Bundagul, Mabalacat Pampanga 2010
www.solenergy.com.ph

Transnational Uyeno Solar Corporation

The Penthouse, Net Quad Building, 4th Avenue Corner 30th Street, Bonifacio Global City, 1634 Taguig City
www.tuscsolar.com

Uni Solar Inc.

8-J Saint Peter St. P. Tuason, Cubao, Quezon City 1109
www.unisolar.com.ph

PowerSource Group

10th Floor, The Athenaeum Building, 160 L.P. Leviste Street, Salcedo Village, Makati City
www.powersourcellc.com

Energy Development Corporation (EDC)

38/F One Corporate Centre, Julia Vargas corner Meralco Avenue, Ortigas Center Pasig City 1605
www.energy.com.ph

Meralco Spectrum

3/F Business Solutions Center Manila Electric Company Compound Ortigas Avenue, Pasig City 1600
www.spectrum.net.ph

Appendix 1. Briefing Sheet on Structural Considerations for Rooftop Solar Projects

The following briefing sheet includes an overview of general structural considerations involved in rooftop solar projects, including information on mounting, structural loading, design, and roof integrity. This briefing sheet is intended to provide a preliminary introduction to relevant terms, however to move forward with a rooftop solar project, a customer should seek the professional services of a structural engineer who can assess the customer's site and provide expert advice on how these elements relate to a specific rooftop solar decision-making process.

There are a range of structural considerations that should be assessed and analyzed by experienced solar professionals when installing solar panels on rooftops. Rooftop solar PV systems are installed such that the self-weight (dead load), wind uplift, and thermal expansion of the solar panels and mounting system will not negatively affect the structural elements of the building. Additionally, the rooftop solar PV system should also be installed such that existing rooftop equipment and drainage routes are not impacted, and access is provided to all rooftop systems to allow for proper maintenance.

Before installing the system, an experienced installer will need to assess the roof of the customer and determine if the roof will need to be replaced during the life of the rooftop solar PV system. If the roof will need to be replaced, the building owners are encouraged to replace it prior to installing the PV system.

All Local Government Units (LGUs) require the application of Electrical and Building Permits for before a system can be installed. This will ensure that all installations are compliant with local building and electrical codes.

Despite permitting challenges, solar PV systems are expanding and approximately 2,200 End-Users have applied for Net-Metering for Solar across the Philippines.

Mounting System

The civil design of a roof-mounted system must carefully consider an appropriate mounting system that secures the PV array, minimizes adverse effects on the integrity of the roof, and resists uplift. In addition, a careful assessment of the added roof load must be made.

Solar panel mounting system changes the load pattern on the building roof. Where the roof was previously uniformly loaded with wind, seismic, or snow loads, these loads are now transferred to concentrated locations at the solar panel mounts. Some framing members may no longer carry any wind or seismic loads, while other framing members have those loads increased by several times. Each type building presents unique design challenges.

A qualified engineer has to conduct structural load calculations. The structural integrity of the existing roof space should be assessed by means of visual inspection and design drawing review. Visual inspection can reveal damage or degradation of existing structural members. Load assessment calculations should consider:

Net Metering

As of November 2018, the Philippines had a cumulative solar rooftop capacity of 17.18 MW from 2,186 end-users, with each system not exceeding 100 kW.

In Meralco's franchise area alone, there are 1,628 net-metered solar rooftop systems.

- Assessment of the loads acting on the PV array and roof, including wind and seismic loads. The existence of the array will cause additional vertical wind loads onto the roof.
- Assessment of the roof structure to determine its spare load capacity.
- Comparison of the roof structure capacity with the new and existing applied loads.

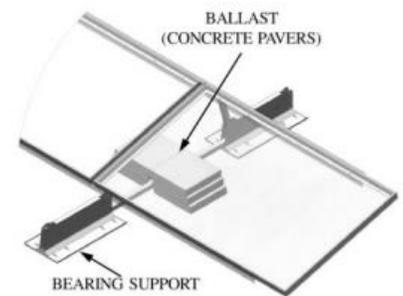
In case load assessments reveal that the roof structure cannot accommodate the added weight of the solar PV system, structural reinforcements may be incorporated into the system design.

There are two main categories of mounting solutions, BAPV (Building Attached PV) and BIPV (Building Integrated PV), where the solar modules are integrated into the building's structure (e.g. solar shingles)

There are three different BAPV methods of mounting PV systems on a roof plane structure:

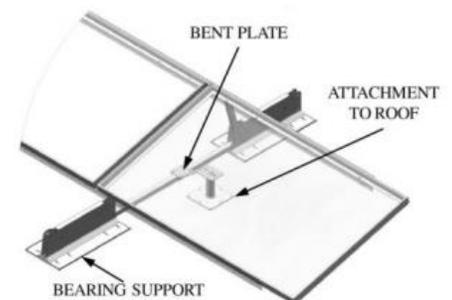
1. **Ballast-only systems** are weighed down by heavy materials such as concrete to keep them located in the same position. Ballast-only systems are not attached to the roof structure.

This type of racking system is ideal for flat rooftops such as commercial buildings, as there no penetration done on the building. The pans in contact with the roof are often covered with EPDM rubber to increase friction and protect the roof;



2. **Attached roof-bearing systems** use friction clips to secure PV modules to the beams of the framing system. Supports are attached to the building by screws, clips, or adhesives.

For flat roofs which can't support a lot of extra weight, directly attaching the system to the rooftop may be required. A structurally-attached type of system relies on penetrations in the roof surface and connections to the framing. Several options for fastening the racking system to the building are available.



3. Structurally attached on tilted roof

Residential buildings usually have sloped rooftops. There are many mounting system options for these angled roofs, with the common ones being railed, rail-less, and shared rail. All of these systems require some type of penetration or anchoring into the roof, whether that's attaching to rafters or directly to the decking.



The vast majority attach to the structural members (like rafters and trusses) of the building using a stanchion or “standoff.” The stanchions are then flashed to prevent water from leaking into the building.

Advantages of ballasted systems include:

- Avoidance of roof penetrations to the roof membrane;
- Quick and easy installation, minimizing the role of the roofing contractor;
- Allowing fire testing and optimization of wind load and roof load, not possible with often-overbuilt anchored racking systems;
- Relocating/Removal of the array on the roof will be easier for maintenance and end of system life disposal,

Advantages of attached systems include:

- Reduced dead loading to the structure;
- Increased options for array tilt (steeper tilts are possible);
- More flexibility in the avoidance of drains, vents, exhaust fans, and curbs;
- Better storm water and roof debris runoff/shedding;
- Slightly less expensive racking systems.

Structural Loading

Solar PV installations are carefully designed in a way that makes structural damage extremely unlikely. Each of the possible external forces to the system are considered separately and in combination to identify worst-case loading situation. There are guidelines on the installation, maintenance, and testing of PV systems that can help to prevent failure of the system due to extreme external forces.

The American Society of Civil Engineers (ASCE) publishes the Minimum Design Loads for Buildings and Other Structures (ASCE 7-05) to establish the design loads used in the U.S. The International Building Code (IBC) references ASCE 7-05. There may also be additional requirements based on the IBC above and beyond the general requirements. ASCE 7-05 requires equipment, such as PV arrays, to be attached to the structure. ASCE 7 is available from ASCE Publications / 800.548.2723 / pubs.asce.org

Design Considerations

Dead Load

Dead load is the weight of existing materials (roofing, sheathing) and equipment, including new solar panels. Uniform dead load for solar panels is calculated as weight of panel (plus weight of rails under panel) divided by area of panel. Typical value is 15-20 kg/m² (~3 to 4 psf). Ballasted racking systems will have dead loads greater than this by the weight of the ballast, which depends on the tilt angle and resulting wind loads. Where measures are taken to control wind loads, ballasted systems might weigh 5 to 8 pounds per square foot, but at steeper tilt angles or in areas susceptible to high winds the ballast weight required would be excessive. However, load from solar panels must consider point loads (not uniform) since the weight of the solar panels is distributed to individual base mounts.

Load Calculation Factors:

1. Number of panels in array
2. Number of connections to the roof
3. Weight of individual panels
4. Mounting System Weight
5. Total Weight of Array (1 x 3 + 4)
6. Weight at each connection (5 / 2)
7. Solar Panel Area
8. Total Array Area (1 x 7 cos(θ)) (tilt of solar panels)
9. Distribution Load (5 / 8)

Roof Deflection

Typically, an attached system will add less than 3 pounds per square foot of solar collector area, while a ballasted system will add 3 to 8 pounds per square foot depending on the tilt angle and wind loading. The weight of ballast materials varies from the edges to the middle of the racking system depending on the load to be resisted, so ballast weight is not necessarily distributed uniformly in the array. Corners and edges of structures have greater wind loads than the center of the roof, thus more ballast weight. The added weight of a ballasted system can cause deck deflection, resulting in increased ponding of water. In that case it might be necessary to improve drainage.

Wind Load

PV systems will be exposed to wind forces, and as a result will have to be designed to withstand those forces. In some cases, wind from under the modules can create very high uplift loads that must be accounted for in the design. PV systems must withstand escalated weather scenarios such as windstorms. Uplifts from strong winds create additional loads or load concentrations. Calculating wind uplift forces is similar to other load calculations but is more complicated due to fact that wind speed can vary significantly depending on where the modules and rails are located on the roof.

PV array size will partially be limited by the wind loading at the edge of the building. Edges of roof structures have greater wind loads than the center of the roof, requiring additional structural considerations closer to the roof edge. Often additional ballast material is required on these regions with a ballasted racking system.

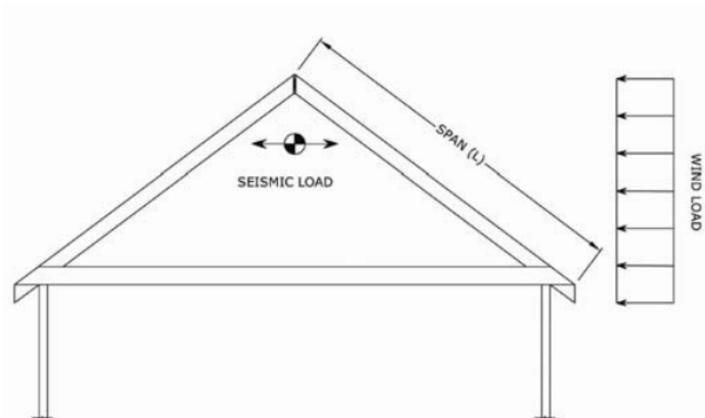
In the Philippines, the wind load for roofs shall be at least 150 kilograms per square meter (30 pounds

per square foot)³. Systems are designed in accordance with Section 207 of the National Structural Code of the Philippines Volume 1, 7th Edition (NSCP 2015), which specifies the wind loads that buildings should resist depending on the wind regions in the country.

Of the few standards related to wind loads and design of ballasted rooftop systems is Structural Engineers Association of California Report SEAOC PV2-2012 "Wind design for low-profile solar photovoltaic arrays on flat roofs", which standardizes design of ballast weight and spacing.

Seismic Load

Seismic loads must also be factored into the structural calculations. ASCE 7-05 and Section 1613 of the International Building Code cover earthquake loads and seismic design categories. The seismic requirements with a ballasted system can be found in ASCE 07-05, section 13.4.



The SEAOC recommends that in cases where the solar PV system exceeds the 10% acceptable load on the roof structure, the seismic load shall be treated as a structural load. The added weight of a rooftop solar panel installation is usually located at the highest point of the structure where even gentle lateral seismic loads imparted to a heavy rooftop solar panel installation can cause damage to an inadequately reinforced building.

SEAOC developed a document that addresses the seismic hazards associated with rooftop PV systems "Structural Seismic Requirements and Commentary for Rooftop Solar Photovoltaic Arrays" (SEAOC Report PV1-2012) reports that "for each of the three attachment methods, there are separate requirements"

ASCE standards may require attachment to the building in regions of moderate to high seismicity. However, for solar arrays that bear on low-slope roofs, "Seismic Design of Ballasted Solar Arrays on Low-Slope Roofs", Journal of Structural Engineering 10.1061/(ASCE) provides a methodology to meet the design intent of the building code without being fastened to the building structure. A ballasted system may not be used if applicable seismic standards require attachment (i.e., local jurisdictions may have prescribed requirements for attachment)⁴. Section 208 of NSCP 2015 contains the seismic provisions of the Philippines building code, and solar PV systems in the Philippines should be designed in accordance with these provisions.

Overburden Waiver

An Overburden Waiver is often required to maintain a roof warranty, and that agrees to remove part of the PV system should the roofing company need access to repair leaks or do any roof work. If

³ Republic Act No. 6541 - An Act to Ordain and Institute a National Building Code of the Philippines

⁴ NREL, 2018 "Best Practices for Operation and Maintenance of Photovoltaic and Energy Storage Systems; 3rd Edition"; 2018 National Renewable Energy Laboratory, Sandia National Laboratory, SunSpec Alliance and the SunShot National Laboratory Multiyear Partnership (SuNLaMP) PV O&M Best Practices Working Group; December 2018, <https://www.nrel.gov/docs/fy19osti/66056.pdf>, 153 pages.

required, the cost of removing and re-installing PV array area is high and it also entails lost production. The cost to remove, transport, store, and re-install the PV array can add up to 60% of the cost of a new system.

Roof Warranty Issues

Roofers often guarantee the work they do, which is often between five and 10 years for their workmanship. This will typically cover leaks, but not wear-and-tear or damage associated with the PV system. Some roofing manufacturers offer 25-year warranties, but those typically apply to commercial projects and require certain installation procedures. Installation of a PV system can increase a roof's potential for leaks and damage due to increased rooftop foot traffic and additional attachments to and through the roof membrane. Therefore, measures need to be taken in order to continue a warranty and ensure long-term performance of the roof under the PV system. The following scope of work is recommended for the roofing company having the warranty or service contract on the roof, or failing that, then another roofing company certified by the roof manufacturer:

1. Provide forms to fill out or procedures to follow and information required to officially notify roofing company and manufacturer of roof problems related to a PV system and plan for repairs.
2. Review the plan to repair to ensure that it is appropriate for the existing type of roof, compatibility of materials, stresses, expansion/contraction, membrane puncture, insulation compression, and recommended repair/replace practices. Identify the conditions required to maintain the roof warranty or recommendations for the quality of the installation, such as thickness and material properties of slip-sheets, and also including selection of cleaning agents and any other future O&M impacts.
3. Inspect the condition of the roof prior to repair work. Provide details of any repairs or reinforcement required.
4. Inspect final condition of roof upon completion and acceptance of the repairs.

To reduce the potential for leaks and to provide a more durable platform under all types of PV systems, the roof manufacturer will specify requirements and recommendations. For Ballasted Rack PV Systems this would include a sacrificial layer (membrane) of minimum thickness under the feet of the ballasted rack system; walkway system comprised of walkway pad or pavers around the blocks of PV arrays; requirements to remove PV components in order to investigate a leak or make a repair; requirements that the system be rendered safe (de-energized) for roof work, and other requirements considered necessary by the roofing company or roof material manufacturer. New flashings or other alterations to the roof must follow all technical standards and details provided by the manufacturer.⁵

⁵ NREL, 2018 "Best Practices for Operation and Maintenance of Photovoltaic and Energy Storage Systems; 3rd Edition"; 2018 National Renewable Energy Laboratory, Sandia National Laboratory, SunSpec Alliance and the SunShot National Laboratory Multiyear Partnership (SuNLaMP) PV O&M Best Practices Working Group; December 2018, <https://www.nrel.gov/docs/fy19osti/66056.pdf>, 153 pages.

Appendix 2: Comparison of Electricity Costs: Rooftop Solar and Utility Retail Rates

The Philippines' unsubsidized electricity rates are among the highest in Asia. In fact, one of the key challenges facing businesses in the Philippines are the high and unpredictable costs of electricity. However, a combination of declining solar PV system costs, a national law promoting RE use, good solar irradiance, and availability of experienced and competitively-priced local developers and service providers have brought the Levelized Cost of Electricity (LCOE) for solar energy to levels that are resoundingly lower than utility retail rates in the Philippines.

LCOE is calculated using the following formula: $LCOE = \frac{\text{Sum of costs over lifetime}}{\text{Sum of electricity produced over lifetime}}$

The sum of costs over the lifetime of the system includes both the initial Capex and all annual Operational costs, including but not limited to operations and maintenance, insurance, and inverter replacement costs. Operational costs may also include payroll for administrative and related work, rooftop lease cost (which may be zero in most arrangements), loan payments and financing-related costs paid annually, and applicable taxes that are remitted to the government. The sum of electricity includes the annual degradation of output of the solar PV system.

In order for the rooftop solar investment to be considered attractive, the solar LCOE must be competitive compared to the utility retail rate. The Figure below shows the **significant cost savings of solar** using a comparison between the typical utility retail rates and the solar LCOE in the Philippines.

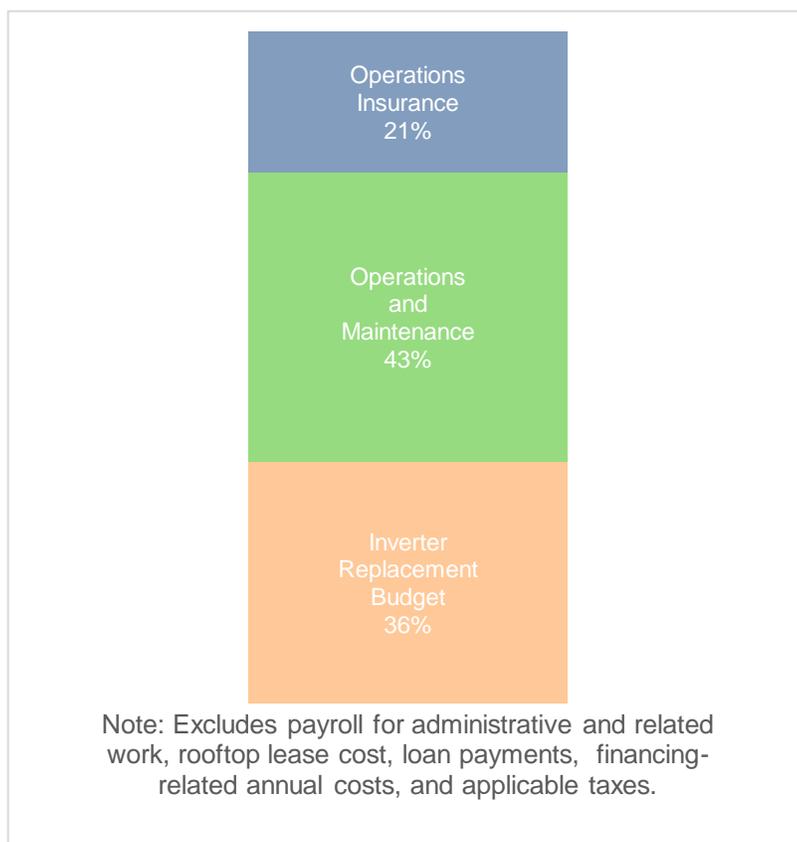


Figure 1. Breakdown of Operational Expenses

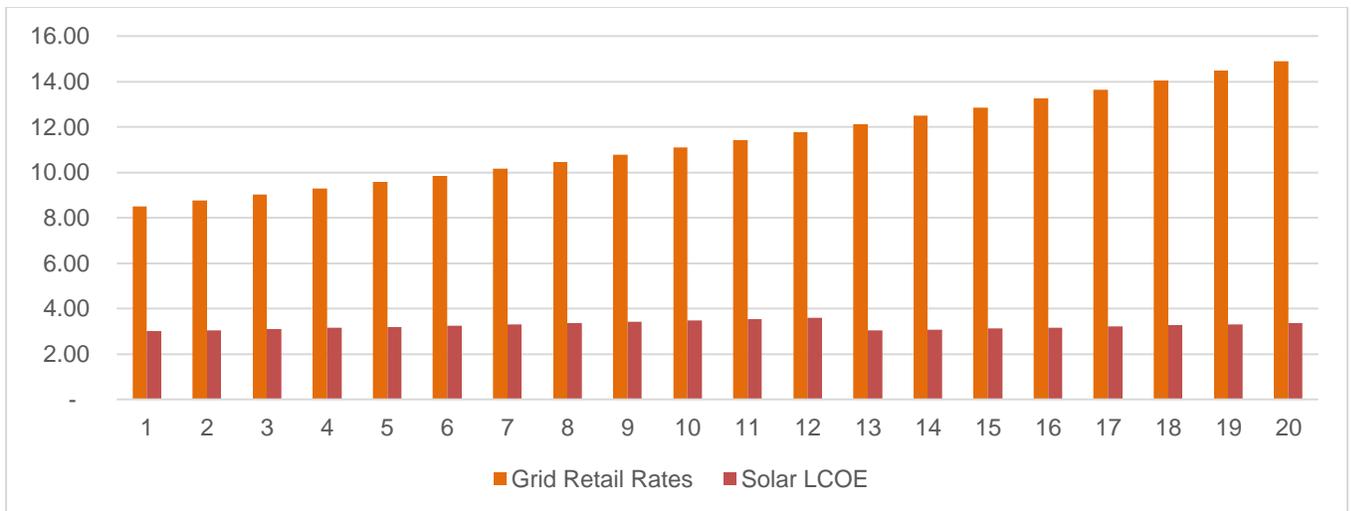


Figure 2. Comparison of Solar LCOE vs Grid Retail Rates in the Philippines

Figure 2 simplifies the movement of the utility retail rate (assuming a 3% annual increase), but the month to month and year to year movement of utility rates can also fluctuate. This is shown in Figure 3 on actual Annual Average Meralco Rates. However, observing this movement over a multi-year span shows that the growth rate is slightly above 3% for commercial users.

As Figure 4 above shows, the solar LCOE is **significantly less (2.52 times less expensive) than the utility retail rates**. For an example of a 200 kW solar rooftop investment, this results in “Net Savings” (calculated as grid or utility retail rate minus solar LCOE, multiplied by solar output in kWh) shown in Figure 2 below.

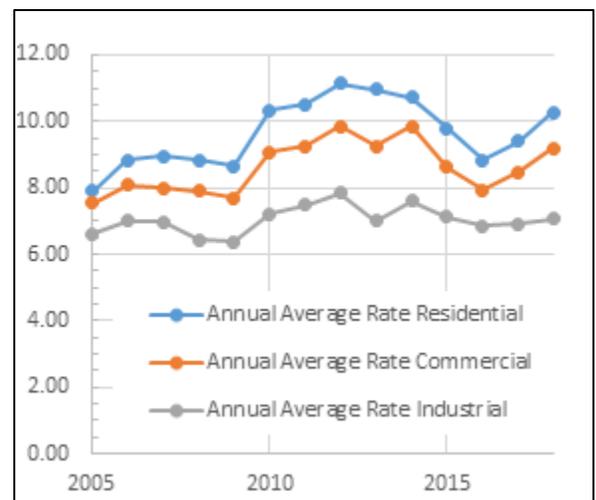


Figure 3. Average Annual Meralco Rate

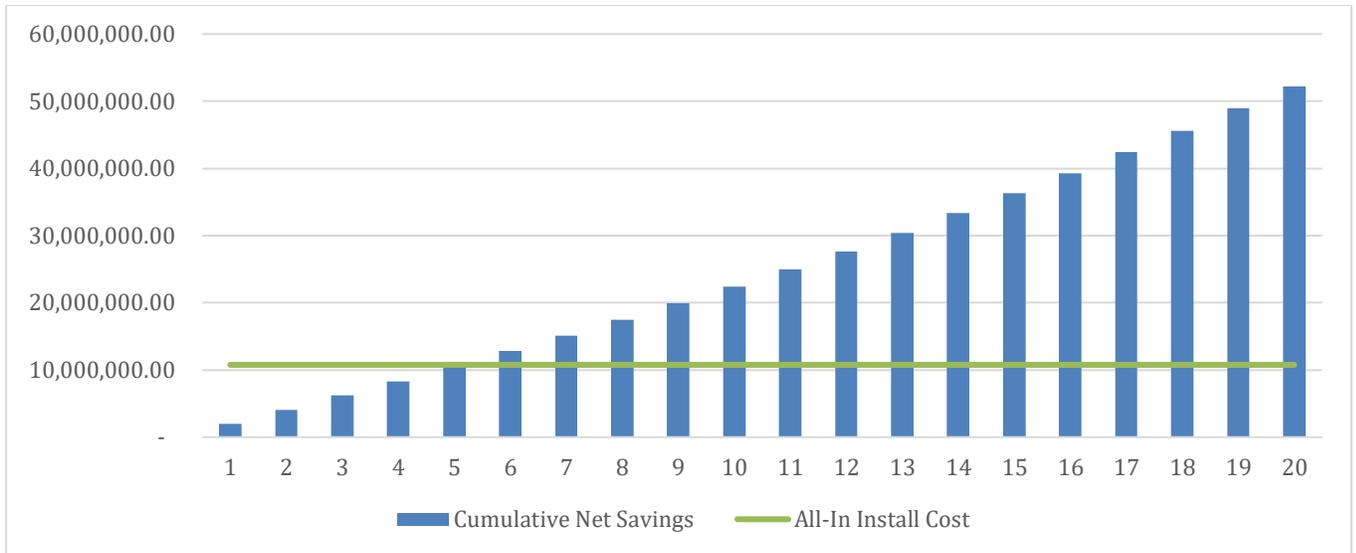


Figure 4. Cumulative Net Savings due to Solar Investment vs. All-in Install Cost

Figure 4 illustrates a Payback Period of 6 years; since the warranted production life of solar PV systems is 20 years, this means that the business in this case will get at least 14 years of “free” electricity from the system. As also seen in Figure 4, at the end of 20 years, the cumulative net savings stands at more than PHP 41 million, or **3.85 times the initial investment**.

The figures cited above show the current opportunity --- as well as the drawback --- of investing into on-site generation such as rooftop solar PV systems. While the cumulative net savings stand at almost 4 times the initial investment from 14 years of “free” electricity of the system, the initial payback period of 6 years may or may not be palatable to a business owner and their investment policies. Considering that the guaranteed life and production of the solar PV system is 20 years, obtaining a payback of 6 years can be viewed as a tremendous return. However, insights from both large and small businesses reveal a more nuanced and diverse set of viewpoints. Some businesses see a payback period of 6 years as too long and would like to see cost savings immediately, and if possible, without having to invest the upfront costs required in a turnkey purchase.

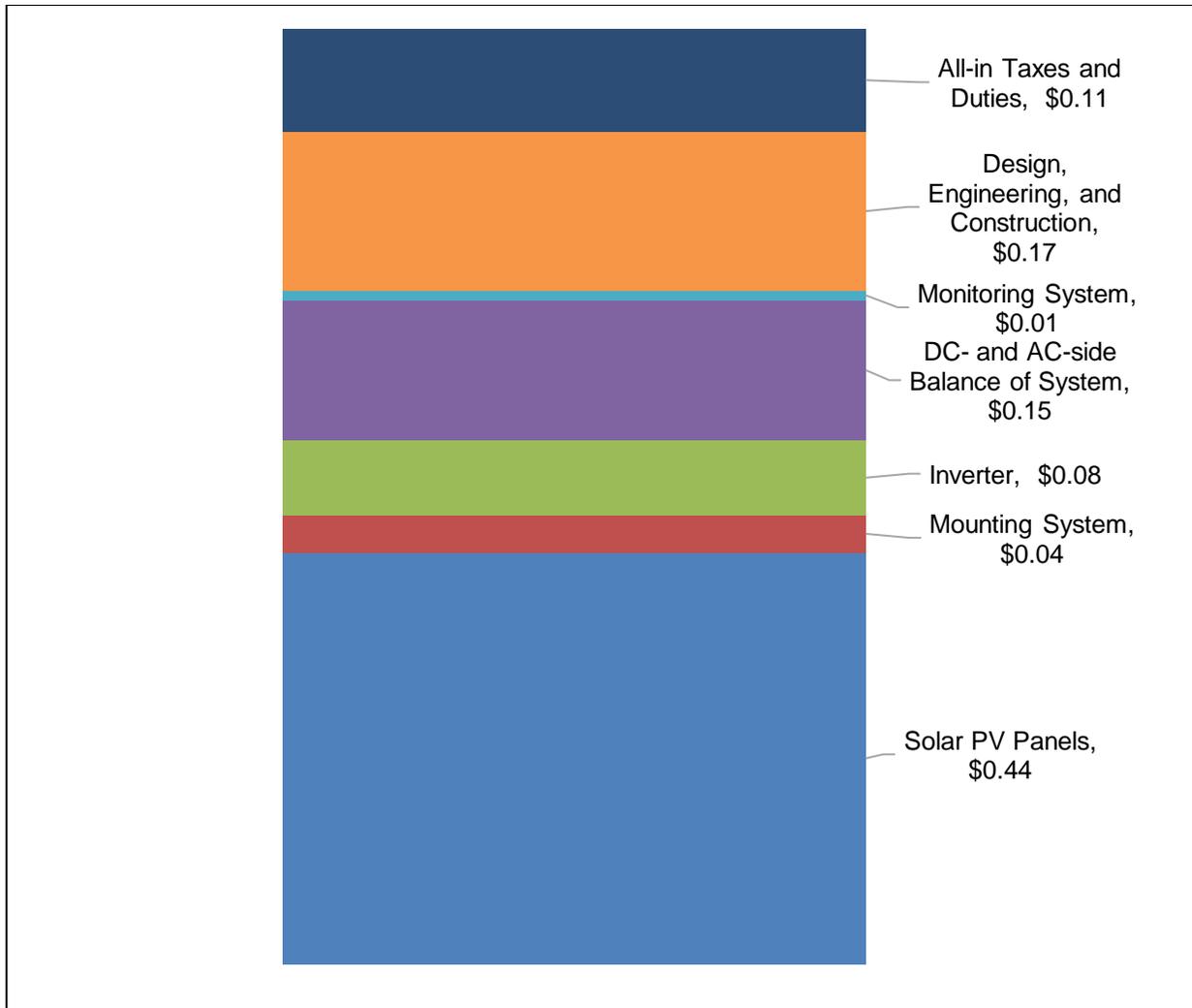


Figure 5. Average Cost Breakdown for a Commercial Scale Solar PV System in the Philippines (US Dollar per Watt-power, totaling to \$1.00)

Solutions exist for these customers where a Third-Party Financier takes on the role of providing the upfront capital investment, in exchange for long-term cash flows that can be made by providing the electricity output to the End-user. This is realized via long-term contracts that:

1. Allow the End-user to realize savings immediately, without having to provide the upfront investment;
2. Allow the Third-Party Financier to realize long-term cash flows from the rooftop solar asset on an End-user's premises; and
3. Allow an Engineering, Procurement, and Construction (EPC) Provider to offer equipment and services related to the on-site generation technology that would not have been funded without the participation of a Third-Party Financier.

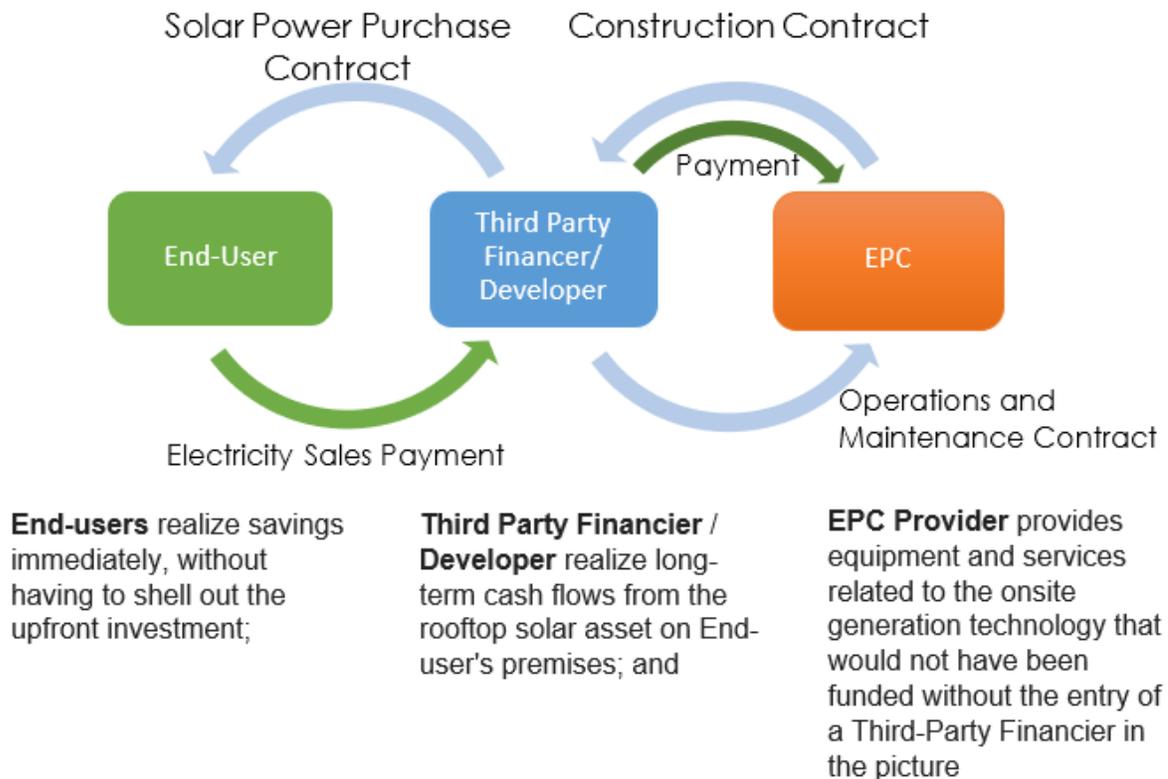


Figure 6. Third Party Finance Relationship Map

Three issues should be highlighted here:

1. **Regulatory Compliance in Nature of Contracts:** The long-term contracts must be in compliance with existing Philippine regulations in the electric power industry, including but not limited to the Revised Rules on Retail Competition and Open Access as well as the Green Energy Option Program (GEOP) under the Renewable Energy Law.
2. **Energy Production Guarantee:** The total annual energy output must be projected using industry-recognized software (such as pvwatts.nrel.gov), which shall be used as the basis for the projected schedule of annual energy production for the life of the system. It is recommended that at least 95% of the projected energy production must be guaranteed for each contract year, allowing the End-user to realize the promised savings from the RE system. In the event of a shortfall, there may be a mechanism by which the difference can be credited back to the End-user.
3. **Zero-Capex Financing Offer:** The financing solution is provided with a clear understanding that RE systems like rooftop solar PV systems, when purchased outright, entail upfront costs and operating them over several years maybe burdensome to companies that need to focus on their core businesses. Thus, the zero-Capex financing offer addresses this gap and this involves the Third-Party Financier being incentivized to ensure proper operation and maintenance of the RE system over the long-term.

Appendix 3. Briefing Sheet on Considerations, Insurance, and Warranties Involved in Long-Term Contracts or PPAs

The following briefing sheet attempts to lay out possible scenarios and outcomes involved in long-term contracts to help address end-users' questions and concerns related to insurance and warranties.

Parties Involved

Party	Objectives of Entering into a Long-Term Contract	Roles and Responsibilities
End-User Customer	<ul style="list-style-type: none"> - Achieve savings in electricity costs, increasing overall profitability - Promote environmental responsibility and sustainability to its customers and stakeholders 	<ul style="list-style-type: none"> - Offtake or purchase all of the energy output generated by on-site RE system - Provide Third-Party Financier access to the utilities and communication services/infrastructure at the project site that shall be used for the start-up, maintenance, repair, replacement (as may be needed), and operation of the on-site RE system
Third-Party Financier	<ul style="list-style-type: none"> - Realize long-term cash flows from RE system - Achieve target returns from investment considering upfront and annual expenses 	<ul style="list-style-type: none"> - Engage an EPC Provider to design and construct an on-site RE system - Finance and operate and maintain an on-site RE system - Deliver all energy output of on-site RE system to End-user - Obtain and bear all costs for necessary permits, licenses, and other approvals required by law - Maintain ownership of the on-site RE system until its ownership is transferred to End-user depending on contractual arrangements
EPC Provider	<ul style="list-style-type: none"> - Realize profit margins from the delivery of goods and services 	<ul style="list-style-type: none"> - Design and construct, and provide warranties and performance guarantees for on-site RE system - Usually contracted to maintain and troubleshoot any issues that may arise after commissioning of the system

Concepts Involved in Insurance Coverage

In order to address long-term risk exposure, two concepts are detailed below: Insurance and Warranties.

Insurable risk helps define the conditions under which the insurance industry is able, over the long run, to profitably provide insurance that clients want to buy. According to the OECD Insurance Committee, the technical conditions that make a risk insurable are: “assessability (probability and severity of losses should be quantifiable), randomness (the time at which the insured event occurs should be unpredictable when the policy is underwritten, and the occurrence itself must be independent of the will of the insured), and mutuality (numerous persons exposed to a given hazard should be able to join together to form a risk community within which the risk is shared and diversified)”. [See Gordon (2008), p. 93]

An insurance engineer and underwriter should be engaged to evaluate a facility (or the design for a yet-built system), including the O&M program, to quantify loss potential and estimate insurance coverage and costs. This review also provides a better understanding of risks that might impact the performance of a PV plant.

Concepts related to insurance include:

- Normal Loss Expected (NLE), which determines the amount of the deductible for an item that can be expected to occur, such as inverter replacement, without an insurance claim.
- Probable Maximum Loss (PML), which determines the premium paid on a portfolio over time.
- Total Insurable Value, the reported value of physical assets + annual business income, is offered as a cost benchmark (from David Walter, The Hartford Steam Boiler Inspection and Insurance Company, by working group correspondence June 7, 2016)
- Maximum Foreseeable Loss (MFS), which sets peso limits on coverage and represents the worst-case loss scenario. (NREL, 2018)

Both construction and operation insurers provide insurance for core risks:

- Loss or damage to assets
- Legal liabilities
- Loss of earnings

<i>Insurance During Construction</i>	<i>Description</i>
Erection All Risk (EAR) or Comprehensive All Risk (CAR) Insurance	EAR policies are designed to cover the risk of loss arising out of the erection and installation of machinery, plant and steel structures, including physical damage to the contract works, equipment and machinery, and liability for third-party property and/or bodily injury arising in connection with the erection work. Covered parties include the general contractor, subcontractors, and in some cases suppliers and manufacturers of equipment.
Third-Party Liability Insurance	Third-party liability coverage is an insurance policy that protects you if you're held legally responsible by another party for a physical injury or damage to their else's property.
<i>Insurance During Operations</i>	<i>Description</i>
Business Interruption Insurance	Business interruption insurance is a form of insurance coverage that replaces business income lost as a result of an event that interrupts the operations of the business, such as fire or a natural disaster. A typical Business Interruption policy can provide coverage for: Revenue, Rent, Relocation, Employee Wages, Taxes, and/ or Loan Payments.
Third-Party Liability Insurance	Third-party liability coverage is an insurance policy that protects you if you're held legally responsible by another party for a physical injury or damage to their else's property.
Loss of Profit Insurance	Same as Business Interruption Insurance
Comprehensive All Risk Insurance	Comprehensive all risks (CAR) offers comprehensive protection against physical loss or damage to the building in relation to contract works and other civil engineering works and third-party injury or damage claims. Damage to property can include improper construction of structures, damage that happens during a renovation and damage to temporary work erected on-site. Third parties, including subcontractors, may also become injured while working at the construction site.
Dismantling Guarantee	Dismantling Guarantees cover loss or damage to new or existing electrical and mechanical equipment during machine moving operations, from dismantling the plant, loading and transporting plant to site, positioning including lifting operations and thereafter during installation and assembly of the equipment. The coverage extends to loss or damage to the equipment being moved provided that the value of such equipment

The table above provides examples of different standard project risks that can be attributed to one of these core risks. The difference between them is the nature of the risks being insured: The risks arising from constructing the project and the risks arising from operating the project are quite different. For instance, installing a rooftop solar PV system has a very different risk profile compared to operating it over time once it is operational.

Insurance claims made by the asset owner or a representative of the owner such as asset manager or O&M service provider should follow instructions for making claims described in the insurance policy to the letter, keeping copies of all submittals and correspondence with the insurance company. The insurance company (claims adjuster) will need to be provided access to the site to assess damage and to collect information needed to process the claim.

Concepts Involved in Warranties

Product Warranties

A solar panel has two warranties: a performance warranty and equipment guarantee. A solar panel's performance warranty typically guarantees 90% production at 10 years and 80% at 25 years. An equipment warranty will typically range from 10-20 years without failing. A solar panel's product warranty insurance covers the integrity of the panel itself, including potential issues such as **manufacturing defects, environmental issues, premature wear and tear**. If a panel's output is lower than promised, the manufacturer will replace, repair, or reimburse the customer for the panel—depending on the warranty terms.

Defects Liability Period

A defects liability period - also known as rectification provisions - is a set period of time after a construction project has been completed during which the Contractor is responsible for repairing or rectifying defects that appear in the works. The period usually commences upon commercial operation and runs for a specified time frame.

Performance Guarantee

A performance guarantee is usually provided by the EPC contractor and/or technology supplier. Under normal market conditions, these contractors commit to or guarantee a specific level of performance by the RE project. As a minimum requirement, guarantees must cover delay (e.g. regarding the guaranteed commissioning date), certain pre-agreed minimum output levels (e.g. wind power curve or PV panel efficiency) and emissions (e.g. noise level). The guarantees should match the provisions of the power purchasing agreement or other project agreements and permits, and should be based on the contracted technical design status, operating conditions and specified fuel.

Output guarantees are usually agreed on a per unit or plant basis. In some cases, a performance bond is issued by a bank or insurance company. Liquidated damages (LDs) are financial amounts that are contractually pre-agreed by the parties to cover damages for work not being completed on time or completed with unmet output criteria. LDs aim to keep project returns consistent for the project initiator even under adverse circumstances. The contractually agreed amount of liquidated damage payments has to reflect a reasonable estimate of the potential damages that can be incurred. Liability limits must therefore coordinate with potential damages, but contractors typically limit the overall amount to between 20% and 100% of the underlying contract value.

Financiers take warranties into account in their financial prospectus only when offered by larger, more reputable, or more diversified companies with a sound credit rating.

Risk Analysis and Mitigation

Scenario	Effect to End-user	Effect to Third-Party Financier	Effect to EPC Provider
Breakdown of Equipment within first year	Fewer savings from solar; back to BAU and revert to utility for 100% of its electricity needs	Loss of revenue	Non-compliance to Defects Liability Period coverage
Breakdown of Equipment after first year	Fewer savings from solar; back to BAU and revert to utility for 100% of its electricity needs	Loss of revenue; need to repair the broken equipment immediately	No effect, as this is beyond the Defects Liability Period
Underperformance or under-delivery of electricity production during anytime of the contract period	Fewer savings from solar; back to BAU and revert to utility for its electricity needs; End-user must be careful of any minimum Fixed Payments that are written in the contract that may lead to increased payments for electricity attributable to the underperformance	Loss of revenue; need to conduct repair or address the underperformance	No effect
Non-payment of solar electricity by End-user	May trigger Third-Party Financier to impose Security Deposit and withdraw from it to cover periods of non-payment; if non-payment continues, Third-Party Financier may remotely shutdown the system leading to loss of savings from solar	Loss or delay of revenue	No effect
Insolvency of Third-Party Financier	May trigger Third-Party Financier to uninstall system or have a successor-in-interest operate the system	Stoppage of operations; may result to selling to another party to liquidate RE asset	No effect
Insolvency of End-User, abandonment of facility, or closure of operations where system is installed	Stoppage of operations	Loss of revenue	No effect
Insolvency of EPC Contractor	No effect	Negative effect in ability to service product warranties and deliver output guarantees and performance warranties	Stoppage of operations
Damage to system attributable to End-user (staff, contractors, or other parties)	May trigger Third-Party Financier to ask for payments for liquidated damages	Loss of revenue	No effect
Damage to system, partial or total, attributable to force majeure situations	Loss of savings	Loss of revenue; may trigger Third-Party Financier to invoke insurance coverage	No effect

Scenario	Risk Prevention	Risk Mitigation
Breakdown of Equipment within first year	<ul style="list-style-type: none"> • Careful EPC selection • Construction monitoring • Proper module handling • Component testing • Conduct proper system testing 	<ul style="list-style-type: none"> • Correct component selection • Defects liability period in contract • Secure Equipment Warranty
Breakdown of Equipment after first year	<ul style="list-style-type: none"> • Select credible PV technology and vendor • Install monitoring system • Periodic maintenance and equipment check-up 	<ul style="list-style-type: none"> • Install technical fault protection • Secure Equipment Warranty from technology vendor • Inventory spare parts
Underperformance or under-delivery of electricity production during anytime of the contract period	<ul style="list-style-type: none"> • Proper system sizing and design • Install Online monitoring system • Periodic Maintenance 	<ul style="list-style-type: none"> • Secure Performance Guarantee from project developer
Non-payment of solar electricity by End-user	<ul style="list-style-type: none"> • Select credit worthy End-Users 	<ul style="list-style-type: none"> • Long term lease contract should have security deposit and default provisions
Insolvency of Third-Party Financier	<ul style="list-style-type: none"> • Review track record and financial strength of parent company 	<ul style="list-style-type: none"> • Contract should be in place so that successor in-interest can provide the service and still maintain and operate the asset
Insolvency of End-User, abandonment of facility, or closure of operations where system is installed	<ul style="list-style-type: none"> • Select credit worthy End-Users 	<ul style="list-style-type: none"> • Long term lease contract should have transfer of interest stipulations
Insolvency of EPC Contractor	<ul style="list-style-type: none"> • Contract an experienced EPC 	<ul style="list-style-type: none"> • Secure product warranties that can still be serviced without the EPC • Train in-house staff to operate and maintain PV Project • Ensure that there is a master manual to operate and maintain the project upon commissioning • Engage other EPC as a fallback
Damage to system attributable to End-user (staff, contractors, or other parties)	<ul style="list-style-type: none"> • Install Hazard Warning Signs around project premises 	<ul style="list-style-type: none"> • Provide operational handbook for O&M personnel and basic safety course to staff with access to energy generation equipment
Damage to system, partial or total, attributable to force majeure situations	<ul style="list-style-type: none"> • Site Selection • Proper mechanical and technical installation 	<ul style="list-style-type: none"> • Long term lease contract should have force majeure clause

