Unleashing the Potential of Rooftop Solar PV in Oriental Mindoro, Philippines

GGGI

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This policy advisory report was prepared by the Global Green Growth Institute (GGGI) to respond to the request from the Provincial Government of Oriental Mindoro. The report is a summary of the findings of the preliminary assessment conducted for the promotion of Rooftop Solar PV in Oriental Mindoro, Philippines.

The report was prepared under the overall guidance from Juhern Kim (Country Representative, Philippines), with technical inputs and authorship from Edith Batac (former Senior Officer), Jonathan Catalla (Renewable Energy Officer), Muharrem Askin (Energy Specialist), and Andrew Lee (former Private Sector Advisor). Pepe Nebril (Senior Officer) led major strategic communications with all relevant stakeholders in the Province of Oriental Mindoro. Reby Orbista (Finance and Administration Associate) provided a coordination support. Jaepyo Chun (Monitoring and Evaluation Officer) and Serena Spurgeon are also acknowledged, for their editorial and communications support.

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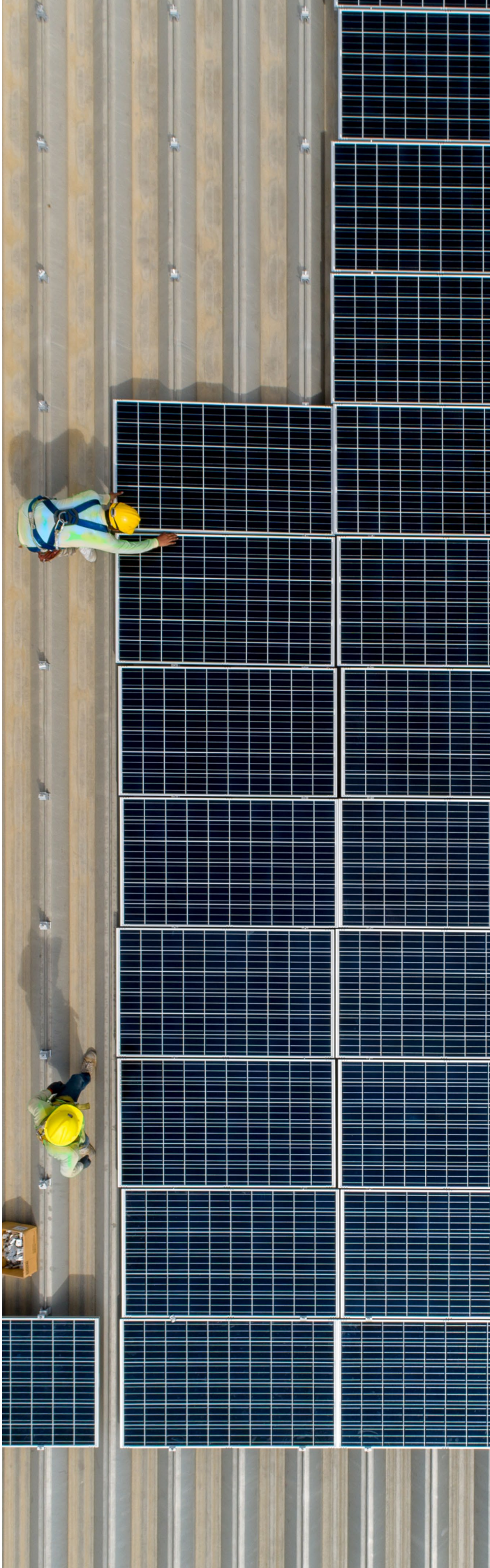
EXECUTIVE SUMMARY

Diesel-fired power plants account for almost 60% of the energy supply in Oriental Mindoro, while the remaining generation comes from hydro and wind energy technologies. With a projected annual growth of 7% until 2028, energy demand primarily comes from residential consumers (57.44%), followed by commercial customers (22.11%), industrial users (8.9%), and public buildings (8.14%). Based on data as of June 2020, power prices in Oriental Mindoro rank highest among all provinces in the MIMAROPA Region, considering that power generation rates in the province are already subsidized by 48% through the universal charge billed to all energy consumers. Improvements are also sought by the public from power distribution utility Oriental Mindoro Electric Cooperative Inc. (ORMECO) in terms of service reliability to minimize length and frequency of power interruptions in its service area.

A strategy being seriously considered by Provincial Government of Oriental Mindoro (PGOM) to increase and diversify local energy supply sources is the introduction of rooftop solar PV in public buildings. In response to PGOM's request for technical assistance, the Global Green Growth Institute (GGGI) conducted an assessment and found that mainstreaming rooftop solar PV into the province's power systems has a significant potential to create public value, such as: a) reduction in greenhouse gas (GHG) emission; b) creation of green jobs required for construction/installation and maintenance; c) improvements in service reliability with the additional supply from the installation; d) savings in power costs if supported by the net-metering scheme; and e) contribution to improving the ease of doing business in the province, thereby attracting more investments.

Supported by government leadership, local policy, and technical capacity of relevant infrastructure



services, an environment conducive to investment for renewable energy development can unleash Oriental Mindoro's solar energy potential which will "***promote the well-being of an empowered citizenry prospering under a climate-resilient green growth economy through a proactive, accountable, and participatory governance.***"[1]

The enabling environment through national agenda, regulatory framework, and stakeholder support provides a promising foundation for PGOM's policy direction on rooftop solar PV projects. The ambitious renewable energy targets and revitalized commitment to the Paris Climate Agreement by the national government, as well as the Renewable Energy Law and its implementing instruments provide the essential anchors to legitimize the policy direction contemplated by PGOM. The decreasing cost of rooftop solar PV systems, diverse financing options, and ongoing developments in upgrading the national grid infrastructure further strengthen the business case for rooftop solar PV installations. In order to fully leverage these enabling factors in delivering public value, this assessment provides the following immediate recommendations.

- **Institutionalize a clean energy agenda through the enactment of a provincial ordinance** that provides the local policy framework to accelerate development of renewable energy, with an emphasis on solar PV installations due to their relative feasibility among other renewable technologies in off-grid areas.
- **Communicate with all stakeholders, including the local energy distribution utilities, electric cooperatives, generation companies, consumer groups, civil society organizations,** among others**,** to strengthen the shared aspiration toward access to reliable, affordable, and clean energy, through information, education, and information campaigns, and public consultations.
- **Improve the operational capacity of local energy utility ORMECO to accommodate the net-metering scheme and more diverse energy supply source from renewables,** through the capacity development platforms available in National Electrification Administration (NEA) and peer-to-peer learning sessions with other electric cooperatives.
- **Pursue public-private partnership with funding support from local and international financing facilities.** The rooftop solar PV project may be implemented through Build-Operate-Transfer or other appropriate PPP contracts as allowed by the Department of Energy (DOE),[2][3] aside from grant capital deployment. Financing facilities for rooftop solar PV are made available by local banks such as the Development Bank of the Philippines (DBP) and the Land Bank of the Philippines (LBP), and major private banks in the Philippines. International funding sources from the donor communities are also an option to explore, particularly to fill the gap of current lack of local capacity to originate and structure bankable projects.

1 Provincial Government of Oriental Mindoro Vision and Mission. https://ormindoro.gov.ph/about/. Accessed on 28 April 2021

2 Executive Order No. 462 s. 1997, and superseded by RA 9513.

3 DOE. "Renewable Energy Development", a presentation PDF. Slide 3. https://www.doe.gov.ph/sites/default/files/pdf/announcements/epower_03_01_renewable_energy_sector_development.pdf

1. INTRODUCTION

This policy advisory report was prepared by the Global Green Growth Institute (GGGI) in response to the request from the Provincial Government of Oriental Mindoro (PGOM) for technical assistance in creating a policy and regulatory environment to facilitate investments in renewable energy, particularly rooftop solar deployment.

This is in line with the priority of PGOM to address the cause of persistent power problems in the province, characterized by frequent rotational interruptions due to supply shortage and obsolete facilities, and increasing electrification tariffs due to heavy dependence on imported diesel. Through the introduction of rooftop solar photovoltaic technology (solar PV) in buildings owned and operated by the local government, PGOM intends to demonstrate the benefits of solar power and encourage the private sector to invest in clean, indigenous, and renewable energy.

In its Philippines Country Planning Framework 2021-2025[1], GGGI puts forward solar PV, among other programmatic solutions, to support the country's transition toward climate-resilient and inclusive green growth. As a neutral, independent, and trusted advisor to the Republic of the Philippines, GGGI directly engaged with the PGOM, the Department of Energy (DOE), the Oriental Mindoro Electric Cooperative Inc. (ORMECO), and other relevant stakeholders to respond to the strategic need from the government. This report is a result of a series of consultations and analyses.

The policy advisory report firstly reviews the current power sector situation in Oriental Mindoro and focuses on three strategic pillars that are key to ensuring effective implementation of public sector projects – public value creation, enabling environment, and operational capacity[2]. Following the assessment are recommendations to strengthen each of the pillars as applied in the case of the

1 Global Green Growth Institute. Country Planning Framework 2021-2025.

2 Moore, M. Moore, M. Managing for Value: Organizational Strategy in For-Profit, Nonprofit, and Governmental Organizations. Nonprofit and Voluntary Sector Quarterly 2000; 29; 183-204. https://scholar.harvard.edu/markmoore/publications/managing-value-organizational-strategy-profit-non-profit-and-governmental

rooftop solar PV that PGOM envisions to initiate in public buildings that were identified by the PGOM – such as provincial and municipal offices, hospitals, public markets, and gymnasiums.

In this prefeasibility assessment, the Provincial Capitol Complex Main Building, located in Barangay Camilmil, Calapan City, is selected as a case study to further analyze the potential for solar PV project development. The succeeding discussions lead to developing a policy assessment and conclude with strategic recommendations to the PGOM toward an enabling environment and mechanisms to encourage the promotion, fund sourcing, installation, and operations of solar PV systems in government buildings in the province.

2. POWER SECTOR ANALYSIS IN ORIENTAL MINDORO

2.1. Power Supply

Oriental Mindoro is among the provinces under the Small Power Utilities Group (SPUG) located in remote areas not connected to the main grid or the transmission system operated by the National Grid Corporation of the Philippines (NGCP). The Oriental Mindoro Electric Cooperative Inc. (ORMECO) distributes electricity for the 14 municipalities and one city in the province. Established in the 1970s, ORMECO directly contracts with power generation facilities owned and operated by mostly private entities, with an exception of one government-owned asset leased to a private sector operator. Based on ORMECO's report[3], all municipalities have reached 100% electrification, except for the municipality of Mansalay, where only 71.59% of the total households are energized.

While endowed with significant renewable energy potential, Oriental Mindoro remains highly dependent on diesel-based power generation like any other isolated island grids in the Philippines. In 2018, only 2.9% of the 1,456 GWH total power produced in SPUG areas was supplied by renewable energy sources, while 97.1% was from oil-based power plants.[4] Based on ORMECO's total contracted capacity of 86.5 MW in 2020, diesel is the dominant fuel source accounting for almost 60% or 51.4 MW, followed by renewable energy sources, namely hydro at 22% or 19.1 MW and wind at 18.5% or 16 MW[5] as shown in Figure 1.

The Department of Energy (DOE) awarded several renewable energy projects to private sector developers, which are currently under the development (pre-commissioning) stage. These are the 85 MW wind power project in Bulalacao, the 10 MW hydroelectric project in San Teodoro and Puerto Galera, and committed projects including the 13 MW geothermal energy project in Naujan[6] and the 8 MW biomass project in Pinamalayan.[7]

3 Oriental Mindoro Electric Cooperative Inc. President and General Manager's Report 2019. Calapan City, 2020

4 Department of Energy. Philippine Energy Plan 2018-2040.

5 ORMECO Inc. Power Suppliers Portfolio as of December 2020. ORMECO Corporate Planning Department. Calapan City, 2020.

6 10MW Montelago Geothermal Power Project in Naujan was granted with Certificate of Confirmation of Commerciality by the DOE and listed as a committed project as of May 2021.

7 List of Awarded Renewable Energy Project as of 31December 2020. Department of Energy. Taguig City, 2020. This biomass project is listed as committed as of May 2021.

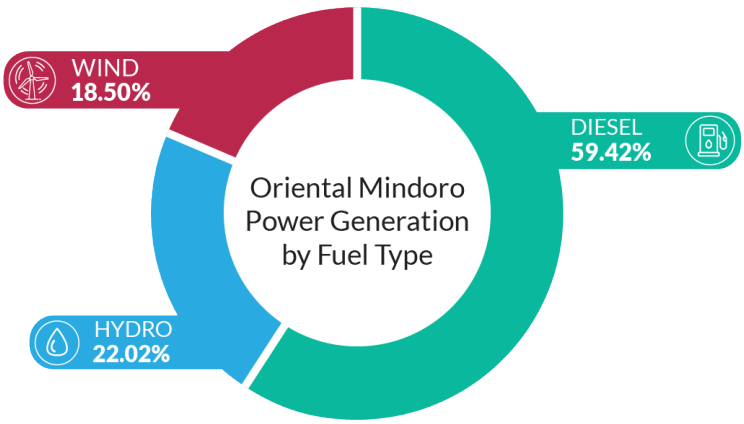


Figure 1. *Diesel is the dominant fuel source for power generation in Oriental Mindoro, followed by hydro, and wind energy.*

	(1) System Loss	(2) SAIFI (incidents)	(3) SAIDI (minutes)
NEA Standard for Off-Grid	12%	30	3,375
Top Score	1.83%	0.51	7.70
MIMAROPA Average Score	10.30%	22.52	1,294.91
ORMECO Score	9.99%	16.39	788.36

Table 1. *2019 NEA Report on Technical Standards on Power Reliability shows ORMECO meeting performance standards, ranking higher than regional average, but significantly lagging behind top performers among electric cooperatives across the Philippines.*

(1) System Loss measures the efficiency of the distribution system (2) System Average Interruption Frequency Index (SAIFI) - standard power interruption per customer per year (3) System Average Interruption Duration Index (SAIDI) - the standard duration of power interruption per customer per year.

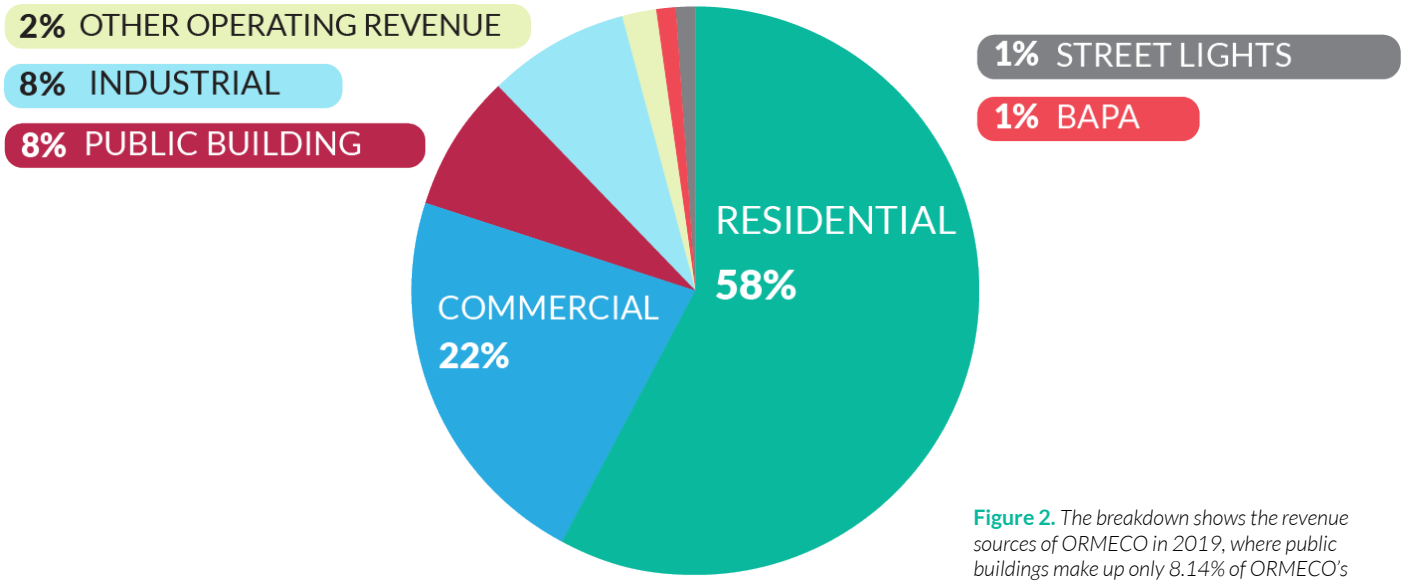


Figure 2. *The breakdown shows the revenue sources of ORMECO in 2019, where public buildings make up only 8.14% of ORMECO's revenues.*

2.2. Power Demand

Oriental Mindoro's power demand was registered at 56.5 MW in 2019. Similar to other SPUG and small island/isolate grid areas, energy demand in the province does not come from a large industrial base since a majority of ORMECO's customers are residential and small commercial establishments.[8] ORMECO reported that sales from residential customers account for 57.44% (PHP1.4B) of its revenue sources, followed by commercial customers at 22.11% (PHP537M), industrial users at 8.29% (PHP201M), and public buildings at 8.14% (PHP198M).[9] Figure 2 shows the breakdown of revenue sources of ORMECO in 2019.

Meanwhile, ORMECO forecasts an average of 7% annual growth rate in electricity demand in the next eight years, attributed to rapid urbanization and industrialization in the province and various investments in the recreation, tourism, commercial, and agriculture industries, as well as the construction

8 ORMECO Power Supply Procurement Plan 2019-2028. Department of Energy. Taguig City, June 2021.

9 Oriental Mindoro Electric Cooperative Inc. President and General Manager's Report 2019. Calapan City, 2020

	*Average System Rate	*Average Power Rate
Oriental Mindoro	PHP12.51/kWh	PHP8.48/kWh
MIMAROPA	PHP10.11/kWh	PHP6.00/kWh
Lowest Rate in MIMAROPA	PHP8.71/kWh	PHP4.31/kWh

Table 2. *Oriental Mindoro's power rates rank high compared with MIMAROPA levels, based on average system rate and average power rate.* *Average rate for all customer types (residential, commercial, industrial, public buildings, and streetlights

of new public buildings.[10] Based on ORMECO's projections, new generating capacity is required to meet an estimate of 58 MW additional demand by 2028, beyond the scope of its current contracted supply and the installed capacity of existing generation facilities.[11]

2.3. Service Reliability

Power service in Oriental Mindoro is within the acceptable technical parameters according to the National Electrification Administration (NEA) in its quarterly compliance report in 2019. Moreover, power service in Oriental Mindoro is marginally more reliable relative to the average performance of all electric cooperatives in the MIMAROPA region. Service levels in Oriental Mindoro, however, require significant improvement if compared with the top-performing cooperatives across the entire country as shown in Table 1.[12]

2.4. Distribution Utilities Upgrades and Grid Connection Plans

Massive works were implemented to restore the distribution facilities operated by ORMECO after consecutive typhoons in the province in previous years. Following these activities, ORMECO has been focusing on rehabilitation of the distribution networks, including meter replacements, upgrade of distribution lines, transformer load management and upgrades, and power substation upgrades.[13]

In May 2018, the 69 kV Calapan-Puerto Galera transmission line was brought online by the National Power Corporation (NPC) to enhance power dispatch reliability in the province. The 41 km line was rehabilitated to decongest ORMECO's 13.8 kV distribution line, aligned with NPC's mandate to provide associated power delivery services in areas not connected to the national grid.[14] Additional projects by NPC in the province include the rehabilitation of the Calapan-Bansud 69 kV transmission line and the installation of a 69 kV line along Bansud to Mansalay and Mansalay to San Jose.[15]

NGCP is undertaking special projects to link isolated island grids to the national grid, including the Batangas-Mindoro Interconnection Project.[16] The interconnection of the Mindoro Island to the main grid will enable access to bulk generation sources in Luzon and the export of excess power generation from renewables.[17] NGCP reported that an investigation on the transmission line route and identification of possible cable terminal stations

10 ORMECO Power Supply Procurement Plan 2019-2028. Department of Energy. Taguig City, June 2021.

11 Ibid.

12 Compliance Report on the Performance of Electric Cooperatives for 4Q-2019. National Electrification Administration. Quezon City, 2019.

13 Ibid.

14 "Napocor complete rehab, energizes Calapan-Puerto Galera line in Mindoro. National Power Corporation. 12 May 2018. https://www.napocor.gov.ph/index.php/news-article/35-press-release/291-press-release-12-may-2018.

15 Ibid.

16 Based on NGCP's Transmission Development Plan 2020-2040, the Batangas-Mindoro Interconnection Project aims to accommodate growing demand in Luzon through additional transmission capacity linking isolated islands to the national grid. In Mindoro Islands, the transmission system is composed of 69 kV lines connected to the power plants and load stations under NPC-SPUG. Combined peak demand already surpassed the combined total load of ORMECO and Occidental Mindoro Electric Cooperative, Inc. The 500 kV NGCP substation in Pinamukan Batangas will serve as the interconnection substation of Mindoro island to the main grid, with Calapan as the interconnection point.

17 National Grid Corporation of the Philippines. Transmission Development Plan 2020-2040. Quezon City, 2020.

in Batangas and Mindoro had been conducted.[18] Based on the DOE Transmission Masterplan, the interconnection infrastructure is targeted for completion by December 2024.[19]

2.5 True Cost of Power

Cost of electricity generation is heavily subsidized in SPUG areas through the Universal Charge for Missionary Electrification (UCME) administered by the NPC. UCME is a subsidy mechanism established in 2001 through the Republic Act 9136 or the Electric Power Industry Reform Act (EPIRA), funneled to off-grid areas, and funded by payments from power consumers reflected as "universal charge" in the monthly electricity bills. Existing subsidized approved generation rate (SAGR) granted by the Energy Regulatory Commission (ERC) for generating facilities in the Mindoro Islands is PHP5.6404/kWh.[20] The generation charge reflected in ORMECO's February 2021 power rate is PHP6.0173/kWh[21] This means that the true cost of power generation in Oriental Mindoro during the stated billing period is PHP11.66 per kWh, where the subsidy is equivalent to 48% of the total generation cost per kWh.

Oriental Mindoro power rates are higher than the average levels in the region. By June 2020, the province's average systems rate and the average power rate are higher by 23.71% and 41.37% respectively, compared with the average prices in MIMAROPA.[22] During this period, Oriental Mindoro ranks highest among other provinces MIMAROPA in terms of electricity prices based on the average systems rate and average power rate as shown in Table 2.

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18 Ibid.

19 2019 Power Situation Report. Department of Energy. Taguig City, July 2020. https://www.doe.gov.ph/sites/default/files/pdf/electric_power/2019-power-situation-report.pdf

20 Small Power Utilities Group Existing Effective Rates as of February 2021. National Power Corporation. https://www.napocor.gov.ph/index.php/npc-spug-electricity-rates

21 ORMECO Approved Unbundled Rate Schedule for February and March 2021. http://www.ormeco-inc.com/index.php

22 MIMAROPA Electric Cooperatives Fact Sheet. Philippine Rural Electric Cooperatives Association, Inc., Quezon City, 2020.

3. ENABLING ENVIRONMENT

The legal and political environment is highly enabling for solar PV and other renewable energy technologies, as well as implementing energy efficiency and conservation measures. An enabling environment provides the necessary sources of legitimacy and support for government institutions to create value for their stakeholders.[23] Being Party to the United Nations Framework Convention on Climate Change (UNFCCC), the Government of the Philippines submitted on 15 April 2021 its Nationally Determined Contribution (NDC) to commit to a projected GHG emission reduction and avoidance of 75%[24] of the 3,340.3 MtCO2e business-as-usual cumulative emission in the agriculture, wastes, industry, transport, and energy sectors from 2020 to 2030.[25] This commitment sets a revitalized momentum for the pursuit of sustainable development objectives, among which are energy security and low-carbon economic growth.

3.1 Policy Framework for Solar PV

Enabling policies, including national laws and institutional arrangements, are available to support investments in solar PV systems in areas connected to the main grid as well as in off-grid areas. The Philippine NDC document makes reference to the Philippine Energy Plan (PEP) 2018-2040 as among the policy instruments from which the GHG emission reduction commitments are based. The PEP 2018-2040 outlines the government's energy priorities, with an emphasis on advancing use of renewable energy, including mainstreaming solar PV through private sector investments.

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23 Moore, M.

24 2.71% unconditional (using nationally-mobilized resources); 72.29% conditional (requiring support/means of implementation under the Paris Agreement.

25 Republic of the Philippines. Nationally Determined Contribution Communicated to the UNFCC on 15 April 2021.

Republic Act 9513 / Renewable Energy Act of 2008 (RE Law)

Republic Act 9513 is a landmark legislation promoting development, utilization, and commercialization of renewable energy resources in the Philippines. The RE Law provides the legal framework, implementing mechanisms, rules and regulations, as well as fiscal incentives to facilitate private sector investments in renewable energy. In the case of solar energy, installed capacities have expanded significantly to 984 MW as December 2019 from only 1 MW in 2008 following enactment of the RE Law.[26] Rooftop solar PVs account for 4.289% at 44.13MW of the current total solar energy installed capacity in the Philippines[27]. Moreover, solar energy projects already under construction or which have secured a Certificate of Confirmation of Commerciality and Financial Closing account to 408.6 MW or 48.4% of all renewables in the pipeline.[28]

Two policy mechanisms of the RE Law are especially relevant in mainstreaming rooftop solar PV projects, namely: (1) the Renewable Portfolio Standard, and (2) Net-metering.

Renewable Portfolio Standard (RPS)

This policy instrument mandates electric power industry participants such as generators, distribution utilities, or suppliers to source or produce a specified minimum fraction of their electricity from eligible RE resources. The RPS also considers the stable and reliable operations of the transmission/distribution facilities in calculating the minimum RPS requirement in a specific area. The current RPS rules in the off-grid areas mandate that the actual RE generation after the baseline year of 2018 shall not be lower than 1% by 2020, the year when RPS is fully implemented. Furthermore, RPS in off-grid areas is envisioned to help with contributing to the rationalization of the UCME and improving self-sufficiency in power generation of electric cooperatives and distribution utilities through the integration of renewables in their supply mix.[29]

At present, ORMECO is meeting the RPS requirements based on its supply contracts with five renewable energy projects operating in the province. These include ORMECO-owned and operated two-phase Linao-Cawayan Mini-Hydro Power Plants in Municipality of Baco with a combined installed capacity of 5.10 MW; the 6 MW Inabasahan Hydroelectric Power Project operated by Ormin Power Inc. located in the Municipality of San Teodoro; the 8 MW Catuiran Hydroelectric Power Plant operated by Catuiran Hydropower Corporation located in the Municipality of Naujan, and finally, the 16 MW wind farm operated by Philippine Hybrid Energy Systems, Inc. in Puerto Galera.

Distributed Generation and Net Metering Scheme

"Distributed Generation" refers to a system of small generation entities supplying directly to the distribution grid, any one of which shall not exceed 100 kW in capacity.[30] On the other hand, ***"Net Metering"*** refers to a mechanism in which customers of distribution utilities are allowed to install renewable energy facilities for their own use, such as rooftop solar PV, and export excess electricity to the distribution utility using a two-way connection to the distribution facilities. The consumer is given credit for the exported electricity, equivalent to the distribution utility's blended generation cost, and such credit is deducted from the customer's electric bill.[31] The purpose of the net metering program is to implement and encourage end-users to participate in renewable electricity generation.

Net-metering is not yet being implemented in off-

26 Department of Energy. Philippine Energy Plan 2018-2040. https://www.doe.gov.ph/sites/default/files/pdf/pep/pep-2018-2040_20210323.pdf, pp 114-115.

27 Department of Energy, "Existing Power Plants". https://www.doe.gov.ph/list-existing-power-plants

28 Department of Energy

29 Ibid.

30 Republic Act 9513 or the Renewable Energy Act of 2008. Section 4(j). https://www.officialgazette.gov.ph/2008/12/16/republic-act-no-9513/

31 Department of Energy, National Renewable Energy Board, and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.
Net Metering Reference Guide: How to avail solar rooftops and other renewables below 100 kW in the Philippines.

Stakeholder	Role in the Project	Impact of Project	Level of Power	Level of Support	Incentive for Cooperation/Support
PGOM	▪ Policymaker ▪ Project proponent ▪ RE Champion	▪ Additional power supply ▪ Lower power cost ▪ Precedent to scaling up solar PV investments	High	High	▪ Achievement of development plans ▪ Popular support
Municipal Governments of Oriental Mindoro	▪ Potential customers and project proponent of solar PV installations ▪ Some policymaking authority to cascade provincial ordinance to municipality	▪ Additional power supply ▪ Lower power cost	Medium	High	▪ Achievement of development plans ▪ Popular support
ORMECO	▪ Distributes electricity sourced from independent power producers	▪ Decrease in sales/revenue due to net-metering ▪ Additional expenses given ERC order for distribution utilities to shoulder cost of net-metering ▪ Potential negative impact on contractual obligations with IPP on minimum offtake ▪ Technical constraints of distribution facilities to accommodate intermittent energy and implement net-metering	Medium	Low	▪ Additional revenue stream to sustain the cooperative
Independent Power Producers (IPP)	▪ Generates electricity ▪ Supplies power via contract with ORMECO	▪ Decrease in sales/revenue due to distributed generation	Medium	Low	▪ Additional revenue stream to sustain business ▪ Stake in renewable projects
DOE	▪ Policymaker ▪ Regulator ▪ Proponent for support mechanisms	▪ Support NREP 2020-2040	High	High	▪ Leverage strong LGU support to achieve NREP targets
NEA	▪ Policymaker, regulator for electric cooperatives	▪ Support to NEA goals of total electrification in rural areas	High	High	▪ Leverage strong LGU support to achieve NEA targets

Table 3. *The Stakeholder Analysis provides an overview on the stakeholders, whose level of power and support are key determinants of the existing enabling environment for the policy or project.*

grid areas or in locations with isolated grid systems. However, under the proposed NREP 2020-2040, roll-out of net metering in off-grid areas is among the policies the DOE will prioritize as a driver for the continued utilization of renewable energy toward the Clean Energy Scenario by 2040. Department Circular No. DC 2020-10-0022 or the «***Prescribing the Policies to Enhance the Net-Metering Program for Renewable Energy Systems***» was issued by the DOE to encourage and further promote electricity End-Users' participation in the Net-Metering Programin off-grid or isolated grid systems.

Republic Act 11285 (Energy Efficiency and Conservation Act)

Republic Act 11285 or the ***Energy Efficiency and Conservation Act*** (EEC Act) institutionalizes energy efficiency and conservation to improve energy supply, minimize impact of fluctuating prices of imported fossil fuels on the local market, and reduce carbon emissions. The law ***"provides for the establishment of a framework for introducing and institutionalizing fundamental policies on energy efficiency and conservation, including the promotion of efficient and judicious utilization of energy, increase in the utilization of energy efficiency and renewable energy technologies, and the delineation of responsibilities among various government agencies and private entities***."

Among the provisions of RA 11285 is the creation of an Energy Efficiency and Conservation Office in the local government level, which may be part of the respective planning and development departments of these jurisdictions.

In November 2019, the DOE issued Department Circular DC 2019-11-0014, which sets the implementing rules and regulations (IRR) of the EEC Act[32]. Meanwhile, in December 2020, the DOE released Department Circular DC 2020-12-0026[33] or the Adoption of the Guidelines on Energy Conserving Design of Buildings.

A rooftop solar PV program in the provincial scale should include considerations related to RA 11285 and its IRR, as well as the DOE guidelines on design of buildings.

Program Support Strategies

The following are some of the program support strategies outlined in the NREP 2020-2040 toward achieving the country's renewable energy targets by 2040.

National Renewable Energy Plan (NREP) **–** The NREP outlines the policy framework for implementing the RE Law. It sets the interim targets and strategy to almost triple the RE-based capacity of the country by 2030 compared to its 2010 level. In the proposed NREP 2020-2040 draft, the national government targets to achieve 35% share of renewable energy in the energy mix by 2030 and 50% by 2040. The framework also consists of sectoral sub-programs for renewable resources including geothermal, hydropower, biomass, wind, solar and ocean. The program covers the sectoral policy roadmaps for each of the identified technologies. Solar energy sector roadmap sets an ambitious target of additional 10,601 MW of solar power capacity, a significant increase from the country's 2020 total solar energy installed capacity of 984 MW. However, the targets are contingent on the combination of policies and mechanisms to create private sector interest and technological advancements on photovoltaic systems for cost reduction.

Local Renewable Energy Plan (LREP) **–**DOE enjoins the local government units (LGUs) to facilitate development of renewables within their jurisdictions to complement its interventions related to policy, capacity-building, and regulatory requirements in order to achieve the NREP targets. LGUs are encouraged to formulate local energy policies as part of their development plans and local

32 https://www.doe.gov.ph/sites/default/files/pdf/issuances/dc2020-10-0022.PDF

33 DOE, *Webpage for DC 2020-12-0026, "Adoption of the Guidelines on Energy Conserving Design of Building", https://www.doe.gov.ph/laws-and-issuances/department-circular-no-dc2020-12-0026*

ordinances, as well as institutionalize regulatory reforms to streamline permitting processes for energy projects. The collaboration between the national government and the LGUs is underpinned by the following: Republic Act 7160 or the Local Government Code of 1991, which mandates LGUs to be self-reliant in the delivery of basic services; Joint Memorandum 2020-01 between the DOE and the Department of Interior and Local Government (DILG) issued in April 2020, which establishes the guidelines for facilitating implementation of energy projects, including renewable energy.

Competitive Renewable Energy Zones (CREZ) – DOE and NGCP launched the CREZ to facilitate planning in support of large-scale transmission expansions/ upgrades to accelerate development of renewable energy. Twenty-five CREZ with high-quality solar and wind resources were identified across the country, with an estimated 16 GW of optimized solar PV projects by 2040.[34] The most economic RE resources are identified according to CREZ, where transmission plans will be prioritized and barriers to entry will be addressed, including permitting, right-of-way acquisition, and other regulatory requirements. The CREZ process was developed to also support distributed RE systems, such as solar PV in off-grid areas. Two CREZ areas were identified in the Mindoro Islands: Central Oriental Mindoro with a solar potential of 130 MW and the southern part of the Mindoro Island with a 213 MW solar potential.[35]

3.2 Stakeholders

Stakeholders, including citizens, elected officials, interest groups, private sector organizations, and other groups that can influence policy or project outcomes, are part of the enabling environment. Table 3 outlines the key stakeholders who have power and influence with regard the plan of the Provincial Government to install rooftop solar PV systems in public buildings.

Provincial Government of Oriental Mindoro (PGOM) – the provincial LGU of Oriental Mindoro has a central role in the project as local policymaker, reform champion, and project proponent. It has the authority to set a clean energy agenda to support the province's development aspirations, underpinned by its mission and vision statements that emphasize climate-resilience and green growth. In this regard, PGOM has high power and support to the solar PV project, if successful in helping address power supply issues in the province, can muster support from the public.

Municipal Governments of Oriental Mindoro – PGOM envisions that solar PV systems will be installed in all public buildings in the province, including those that are owned and operated by municipal LGUs. Oriental Mindoro's Municipal LGUs, which cover 14 municipalities and one city, have expressed strong support for this endeavor and are willing to provide counterpart funding in retrofitting their facilities so they may properly accommodate solar installations. As project proponents with some policymaking authority relative to the project and given their endorsement to solar PV installations, Municipal LGUs have medium power and high support for the project. Success of the project will translate into support from their constituents.

Oriental Mindoro Electric Cooperative, Inc. (ORMECO) – ORMECO is a non-stock, non-profit rural electric cooperative with the function of electricity distribution in the province. ORMECO supports renewable energy utilization as stated in its mission statement.[36] ORMECO directly contracts with independent power consumers for power supply, including diesel, hydro, and wind. As public buildings comprise 10% of its consumer base, ORMECO may extend limited support given potential negative impact of the solar PV and net-metering on its revenue and on its contractual obligations with independent power producer related to minimum offtake. Moreover, ORMECO

34 Department of Energy. Draft National Renewable Energy Plan 2020-2040. Taguig City, 2021.

35 National Renewable Energy Laboratory, Department of Energy (Philippines), National Grid Corporation of the Philippines, United States Agency for International Development. Ready for Renewables: Grid Planning and Competitive Renewable Energy Zones (CREZ) in the Philippines. Taguig City, September 2020.

36 ORMECO Corporate Website, http://www.ormeco-inc.com

will shoulder costs associated with the Renewable Energy Certificate (REC) meter and will need to comply with systems parameters in accommodating net-metered solar PV installations.[37] Power is rated medium due to ORMECO's role in the project to provide the infrastructure connecting the solar PV system to the distribution facilities. ORMECO may cooperate if provided with appropriate incentives to maintain viability of its business and the stability of its facilities.

Independent Power Producers (IPP) – About 60% of Oriental Mindoro's power supply is provided by modular diesel-fired power plants and bunker C-type power plants operated by private investors. As with ORMECO, IPPs support to the solar PV project may be low due potential negative impact of the project on their revenue given reduction in demand from the distribution utility from consumers with solar PV installations and dispatch prioritization of solar power from excess supply from the installations over fossil-fuel based energy sources. These stakeholders may be encouraged to collaborate to develop Oriental Mindoro's renewable energy potential through investment participation in the solar PV project. Among the five diesel IPPs, two have expressed interest in diversifying their portfolio to include renewable energy.[38,39]

Department of Energy (DOE) – the DOE is the national government agency mainly in charge of policy and regulatory functions of the energy sector in the Philippines. DOE has set ambitious renewable energy targets and requires the cooperation of LGUs to facilitate renewable energy development. The role of the DOE on this project is high given its capacity to support resource mobilization in the form of donor funding and capacity building to facilitate the solar PV project in Oriental Mindoro. Support from the DOE is also high as the project aligns with its policy priorities as reflected in the proposed 2020-2040 NREP.

National Electrification Administration (NEA) – NEA overseas the rural electrification in the country and is mandated to have regulatory functions over electric cooperatives. As an attached agency to the DOE, NEA sets up and enforces governance and performance standards for electric cooperatives and also provides institutional, technical, and financial assistance to the electric cooperatives.[40] NEA has been highly supportive of renewable energy development in its areas of jurisdiction and has endorsed solar PV projects in off-grid areas.[41]

37 Energy Regulatory Commission. *"ERC clarifies provision in amended metering rules."* https://www.erc.gov.ph/ContentPage/62004

38 Cabuag, VG. "DMCI power to expand to renewable energy." 15 November 2015. https://businessmirror.com.ph/2015/11/19/dmci-power-to-expand-to-renewable-energy/

39 Global Business Power Corporate Website. https://gbp.com.ph/company-profile/

40 DOE Department Circular No. 2013-07-0015 Prescribing the Implementing Rules and Regulations of Republic Act 10531 or the National Electrification Administration Reform Act fo 2013. https://www.nea.gov.ph/ao39/about-us/charter/ra-10531

41 National Electrification Administration. "*Solar Energy Tapped to Meet Romblon's Power Demand.*" 28 March 2020. https://www.nea.gov.ph/ao39/535-solar-energy-tapped-to-meet-romblon-s-power-demand

4. PROPOSED ROOFTOP SOLAR PV SYSTEMS IN PUBLIC BUILDINGS

The aim of the desktop analysis is to demonstrate an inexpensive and quick process to assess public buildings for suitability to net-metered, grid-tied rooftop solar PV. The outputs of the assessment are (1) the potential annual energy production of the proposed rooftop solar PV facility and (2) the potential electricity bill savings for a period of twenty-five years.

The following sections provide an assessment of two options for the rooftop solar PV installations as applied to the Main Building of the Provincial Capitol Complex. The first option is a 100 kW net-metered rooftop solar PV system linked to the distribution facilities of ORMECO, and a 300 kW own-use rooftop solar PV installation.

2019	kWH Consumed	Gross Amount	PhP/kWh	ORMECO Generation Rate[42]
	A	B	C = B ÷ A	D = C * 0.63
January	19,476.5	₱ 176,635.67	₱ 9.0692	₱ 5.7136
February	20,483.9	₱ 178,959.69	₱ 8.7366	₱ 5.5041
March	21,239.5	₱ 183,837.42	₱ 8.6554	₱ 5.4529
April	22,834.5	₱ 201,235.30	₱ 8.8128	₱ 5.5520
May	22,162.9	₱ 197,025.14	₱ 8.8899	₱ 5.6006
June	24,429.6	₱ 217,589.23	₱ 8.9068	₱ 5.6113
July	25,688.8	₱ 236,705.73	₱ 9.2144	₱ 5.8051
August	19,392.5	₱ 175,406.81	₱ 9.0451	₱ 5.6984
September	19,056.7	₱ 175,267.19	₱ 9.1971	₱ 5.7942
October	16,958.9	₱ 147,339.11	₱ 8.6880	₱ 5.4734
November	21,491.3	₱ 179,971.50	₱ 8.3742	₱ 5.2757
December	21,239.5	₱ 174,207.47	₱ 8.2021	₱ 5.1673
TOTAL	**254,454.6**	**₱ 2,334,180.26**	**NA**	**NA**
MONTHLY AVERAGE	**21,204.6**	**₱ 194,515.0**	**₱ 8.8160**	**₱ 5.5541**

Table 4. *Oriental Mindoro Provincial Capitol Main Building Consumer's History from ORMECO for 2019 show that consumption is highest during the summer months.*

42 This is calculated as 63% of the Gross Rate based on average historical data. When available, the actual generation charge should be used.

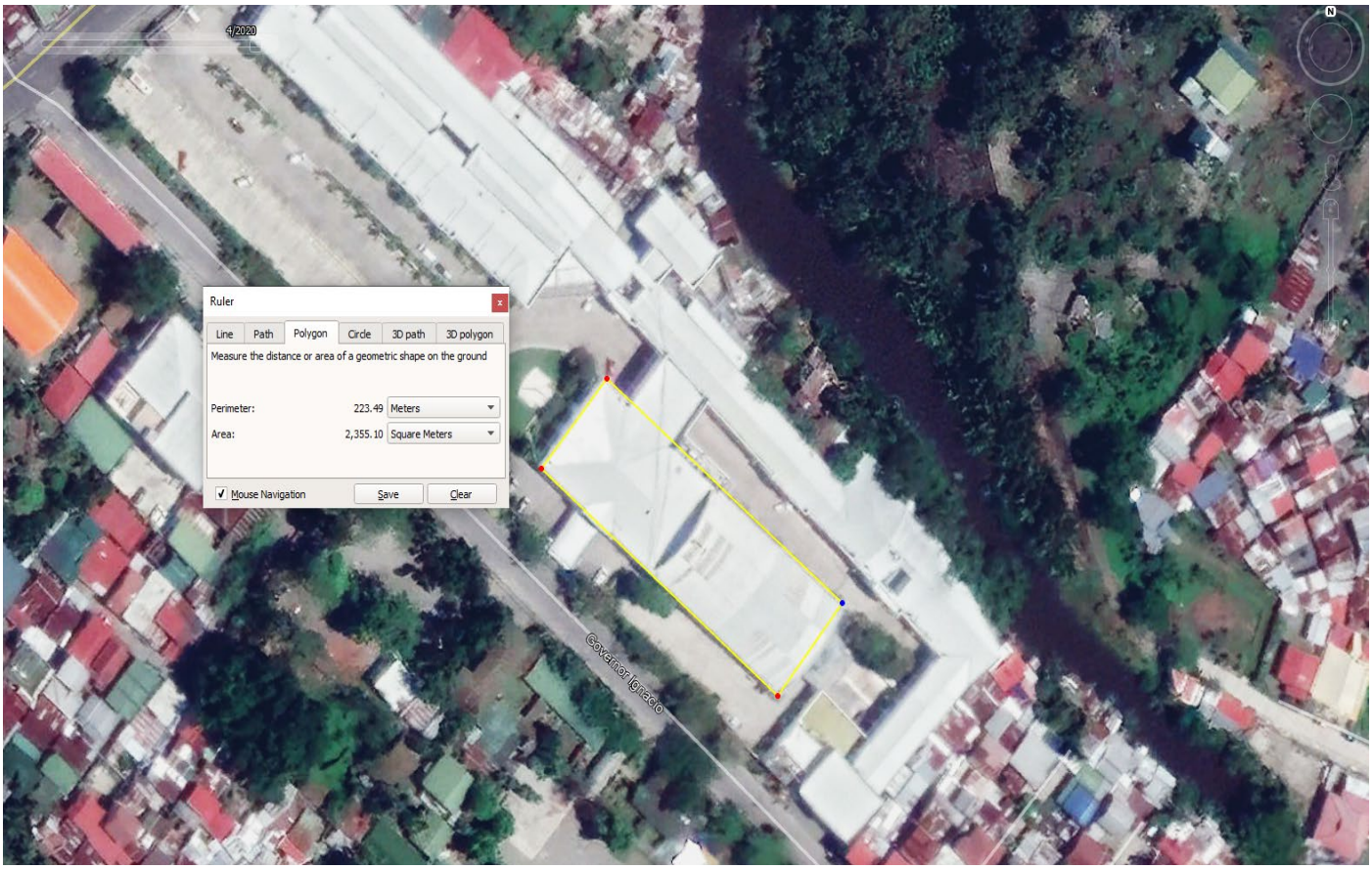


Figure 3. *Google Earth screenshot of the Oriental Mindoro Provincial Capitol Complex to get an approximate rooftop area of the Main Building*

Profile of the Main Building of the Provincial Capitol Complex

The Main Building is a two-level office and administrative building that serves as the official seat of the provincial government. It is built on estimated 2,130 square meters of land while the Capitol Complex itself is a 1.7-hectare public property within the commercial and residential center of Calapan. In 2019, the building consumed a total of 254,455kWh and incurred an electricity bill of PHP 2,344,181.[43] The 2019 monthly consumption and annual electricity spending will be used as reference for the purpose of the desktop assessment. Table 4 shows the monthly consumption and corresponding gross electricity cost incurred by the building in 2019.

Rooftop Configuration[44]

Several factors dictate the optimum design of fixed-mounted solar panels on rooftops. In ideal conditions in the Northern Hemisphere, the final design will only include south-facing segments of the roof to maximize the solar potential for the duration of the day. Considerations such as the proximity to ORMECO feeder lines, the tilt angle of the roof, structural design of the trusses, the wiring of the solar panels and the inverters, access for maintenance and cleaning, and ventilation will also determine the final useable area for the solar panels.

Whenever possible, prospective planners should conduct actual measurements of the rooftop facility being considered. As-built plans of the building are a good secondary source of data to secure the

43 ORMECO electricity consumers history of the Main Building

44 Most observations in this section were derived from aerial photographs of the Main Building, since as-built drawings and actual measurements of the rooftop are not available.

Figure 4. *The customized rooftop area layout for 100-kW solar PV system of PGOM Main Building using the PVWatts Calculator*

best estimations of the area that will be available for installation. Lacking this information, planners may also use aerial photographs from online maps such as Google Earth. For this study, the rooftop area of the Main Building was measured using Google Earth's Ruler tool. Figure 3 below shows the screenshot of the main building from Google Earth. The Ruler tool gives out a rooftop area of 2,335.10 square meters. The map also shows that the alignment of the building is positioned approximately 40 degrees from an east-west orientation.

Based on the map, there are no nearby structures that can cause any shading obstructions to the area of interest. Actual site observations of the Main Building confirm this. In cases where such obstructions exist, the proper estimation adjustments must be taken into consideration. For the purposes of this desktop assessment, a maximum useable area of 2,000 square meters will be used.

4.1 Option A: 100 kW Net-Metered Rooftop Solar PV

As discussed in the preceding sections, net-metering is scheme promoted by the national government to encourage consumers to install renewable energy-based power generating facilities and partially supply their own electricity needs. Net-metering is used mostly with rooftop solar PV installations.

This desktop assessment will use this upper limit value of 100 kW net-metering cap set by the RE Law in the input parameters, and in consideration of the useable rooftop space of the Main Building of 2,000 square meters. Using the System Customization applet of the PVWatts calculator, the proposed rooftop area can be drawn as an overlay on top of the aerial photograph of the Main Building. Figure 4 shows the potential rooftop area for a 100-kW net-metering system for the Main Building.

Net metering requires that the facility is capped to a maximum of 100 kilowatts and connected to ORMECO's distribution grid. All electricity generated by the facility will be fed directly to the building for its immediate consumption. Any excess generation will be exported and, with the help of a bi-directional smart meter, PGOM will be credited the equivalent amount for the exported electricity in the bill of the succeeding month. In addition, a net-metered facility is grid-tied as required by law to ensure that the facility does not inadvertently leak energy that may

Figure 5. *The customized rooftop area layout for 300-kW solar PV system of PGOM Main Building using the PVWatts Calculator. Further detailed designs will be needed for both layouts during the full feasibility studies. These will involve structural analysis.*

endanger field personnel during repair operations.[45]

As the 100 kW net-metered rooftop solar PV is connected to the distribution facilities of the electric cooperative, the system cannot operate and generate electricity should there be rotational power outages in the vicinity of the net-metered facility.

4.2 Option B: 300 kW Own-Use Rooftop Solar PV

The DOE also allows private and public entities to install their own-use solar facilities with capacities above 100 kilowatts. These facilities need to be located within or contiguous with the end-user's premises and operated solely for the supply of all or a portion of their electricity requirements. In other words, any electricity generated shall be for the sole consumption of the end-user and the export to the distribution facilities of any excess energy is not allowed.

While this type of facility does not require an operating contract from the DOE, the end-user needs to obtain a Certificate of Registration from the agency, as detailed in its circular DC 2019-10-0013 or the ***Omnibus Guidelines Governing the Award and Administration of Renewable Energy Contracts and Registration of Renewable Energy Developers***[46].

The rooftop area of the Main Building of the Provincial Capitol Complex will be able to accommodate a solar PV installation with the said capacity. Figure 5 shows the potential rooftop area for a 300-kW own-use system for the Main Building. The locations of the rooftops indicated relative to path of the sun and their orientations need to be considered during the actual assessment.

An own-use rooftop solar PV is not capped at 100 kilowatts and is not grid-tied, provided it is equipped with an islanding mode to isolate it from the main

45 MERALCO website. "Solar and Net Metering". https://residential.meralco.com.ph/products-services-and-programs/solar-net-metering

46 https://www.doe.gov.ph/laws-and-issuances/department-circular-no-dc-2019-10-0013

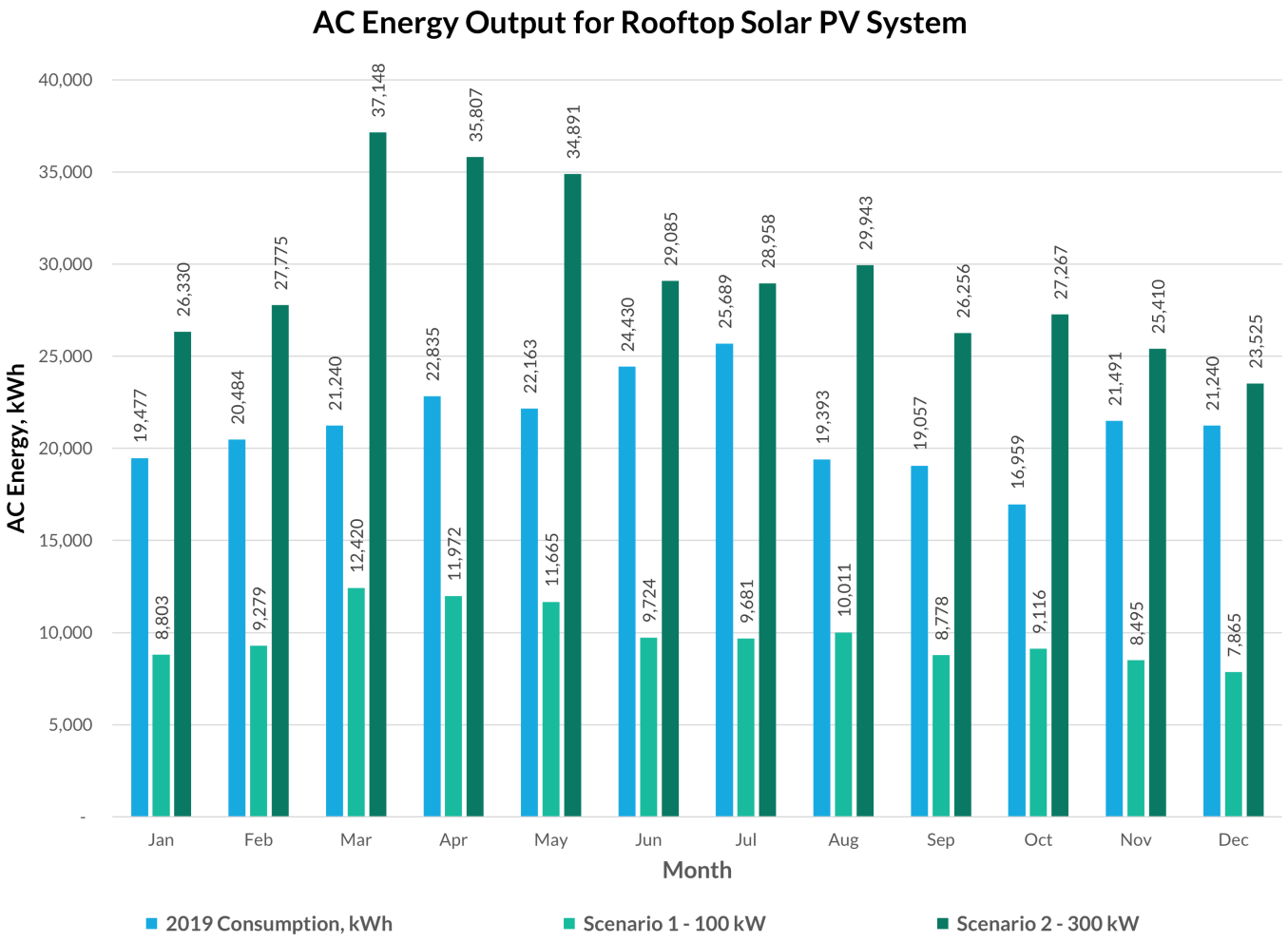


Figure 6 *For Option 1, the projected generation of the 100-kW system is 50% of the actual 2019 electricity consumption of the capitol Main Building, translating to cost savings. For Option 2, the projected generation of the 300-kW system is in 39 % excess (on the average) of the actual 2019 electricity consumption of the Main Building, translating to energy for use by neighboring buildings in the Capitol Complex.*

grid. It should be contiguously located within the premises of the end-user, such as adjacent buildings within the Capitol Complex. The restriction is that any excess generation from the facility cannot be exported to other entities outside the pre-determined location of the end-user, based on the current DOE guidelines.[47]

4.3 Power Yield and Return on Investment Assessment

Publicly available online tools and software have enabled this inexpensive desktop study. The US National Renewable Energy Laboratory (NREL) maintains the PVWatts Calculator[48]. This internet browser-based tool estimates the energy production and cost of energy of grid-connected photovoltaic (PV) energy systems throughout the world. The user inputs specific technical information about the proposed facility and the tool gives out an estimated monthly energy production for the first year of operation, as well as the cost of this generated energy.

In addition, the DOE promotes the use of a Microsoft

47 https://www.doe.gov.ph/sites/default/files/pdf/netmeter/manual-for-interconnection-of-rooftop-pv-v5.pdf

48 NREL, PVWatts https://pvwatts.nrel.gov/index.php

Input Parameter	Assumption	Remarks
DC System Size	Scenario 1 – 100 kW Scenario 2 – 300 kW	
Module Type	Standard	This is the most acceptable type of solar PV module with affordability and module efficiency considered
Array Type	Fixed (open rack)	The most stable type recommended to be used is fixed-type for rooftop solar PV installations.
System Losses	14%	This is the system losses value given by default by the PVWatts calculator based on standard losses of typical PV systems.
Tilt	15°	For uniformity, this tilt angle is being assumed unless the actual measured tilt angel of the roofing structure is obtained.
Azimuth	220°	A 180° azimuth is equivalent to a building that is oriented at the east-west line; since the Main Building is around 40° tilted from this, an azimuth of 220° is used.
Rate Type	Commercial	In the PVWatts calculator, the two choices are residential and commercial; for public buildings, commercial is the appropriate value.
Rate ($/kWh)	0.1837	The annual average rate from *Table 4* if ₱ 8.8160 converts to US$0.1837 at an exchange rate of US$1 = ₱ 48.00.

Table 5 *shows the summary of input assumptions for PVWatts system info parameters in the NREL calculator for the Main Building. These input assumptions will be different for each of the 23 public buildings.*

Excel[49],[50], template to calculate the return on investment of a proposed solar facility. The user inputs the same technical information in addition to financial assumptions such as the construction costs, initial electricity rates (with escalation), operation and maintenance costs, and others. The tool then gives out an annual tabulation of the projected savings from the use of the facility as well as the ROI information of the project.

This desktop assessment uses these online tools for illustration purposes only. Detailed measurements of the rooftop system and actual technical data and financial assumptions may vary from those that were used here.

49 DOE, MS Excel file: "solar-roof-top-roi-calculation-template.xls" https://www.doe.gov.ph/sites/default/files/pdf/netmeter/solar-roof-top-roi-calculation-template.xlsx

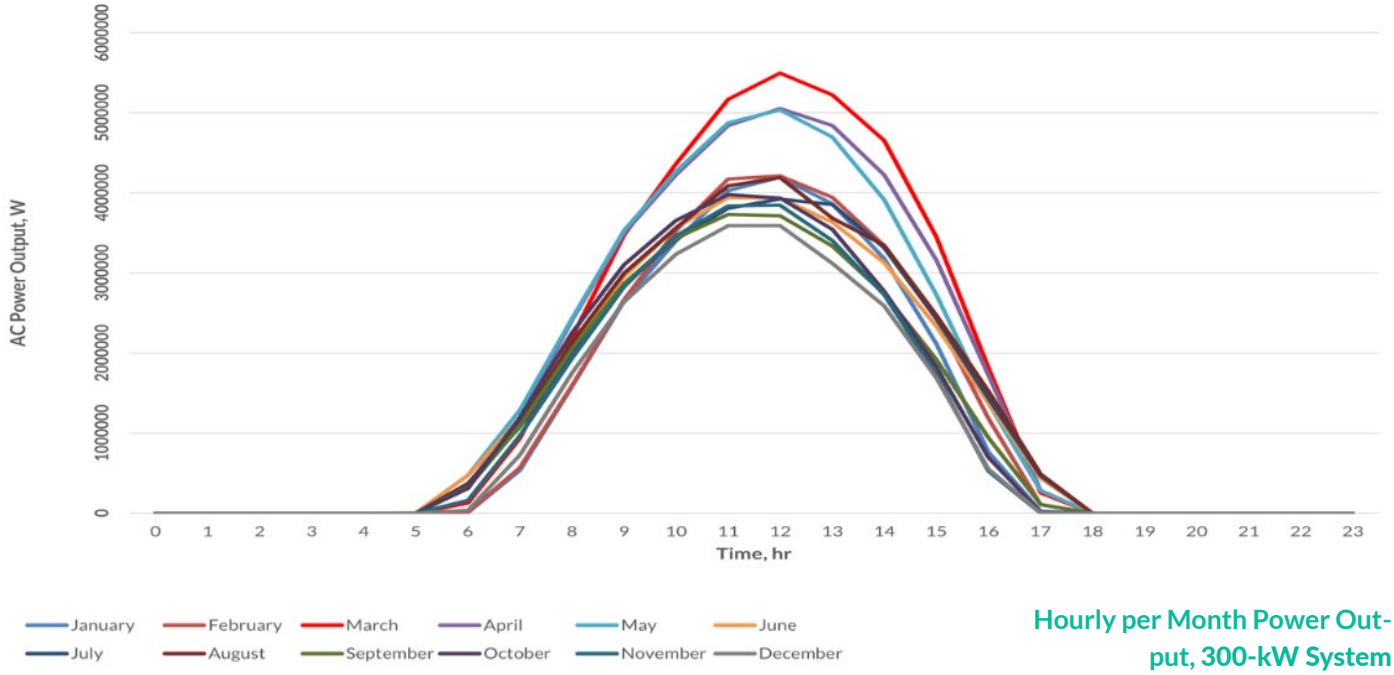
50 DOE, MS Excel file: "solar-roof-top-roi-calculation-template.xls" https://www.doe.gov.ph/sites/default/files/pdf/netmeter/solar-roof-top-roi-calculation-template.xlsx

Input Assumptions to PVWatts Calculator System Info Parameters

The PVWatts Calculator formulated by the United States National Renewable Energy Laboratory (NREL) gives an estimate of the energy production of a solar PV system in the conceptual stage of this type of project. Depending on the assumptions used, the results can aid planners in deciding whether to pursue the project further by conducting a more thorough feasibility study. Table 5 shows the system design inputs for the two solar PV systems options to the PVWatts calculator formulated by NREL.

Annual Energy Production for the First Year (PVWatts Calculator)

Shown in below is the comparative energy production of the proposed 100-kW facility and 300-kW for the first year of operation. The monthly variation is



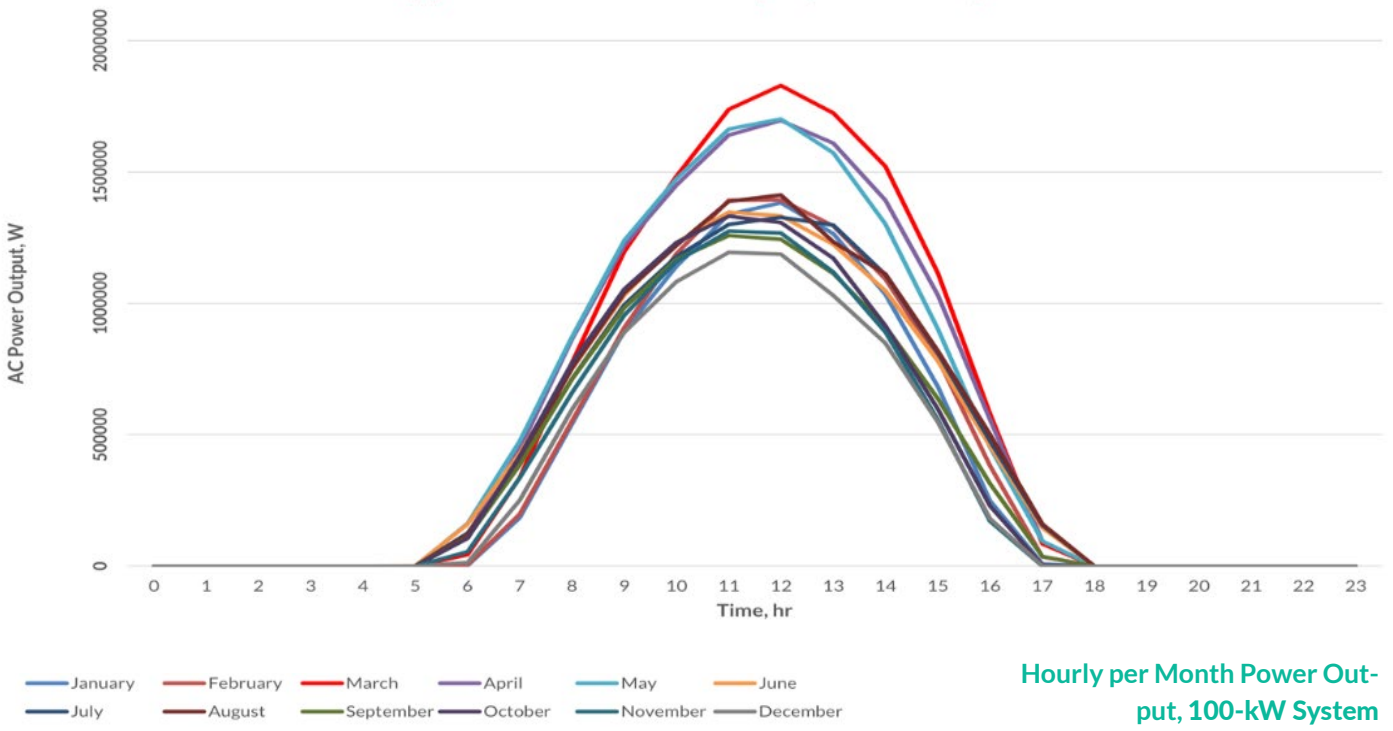


Figure 7. *The Hourly Power Output Per Month of the Proposed Facility for the 100-kW scenario.*

due to the normal irradiation changes related to the weather over the region during the course of the year.

On an hourly basis, the power output of the proposed facilities is shown in Figure 7. The hourly production is stable for most of the year except for

Month	2019 Consumption, kWh	Proposed Facility's Energy Production, kWh	Percentage of 2019 Consumption, kWh	2019 Monthly Rate, ₱/kWh	Electricity Bill Savings, ₱
	A	B	C = B ÷ A	D	E = B * D
January	19,477	8,803	45%	9.0692	79,835.89
February	20,484	9,279	48%	8.7366	81,066.93
March	21,240	12,420	64%	8.6554	107,500.68
April	22,835	11,972	61%	8.8128	105,506.54
May	22,163	11,665	60%	8.8899	103,700.25
June	24,430	9,724	50%	8.9068	86,609.59
July	25,689	9,681	50%	9.2144	89,204.17
August	19,393	10,011	51%	9.0451	90,550.35
September	19,057	8,778	45%	9.1971	80,732.52
October	16,959	9,116	47%	8.6880	79,199.91
November	21,491	8,495	44%	8.3742	71,138.46
December	21,240	7,865	40%	8.2021	64,509.13
TOTAL	**254,455**	**117,809**	**N. A.**	**N. A.**	**1,039,554.42**
MONTHLY AVERAGE	**21,205**	**9,817**	**50%**	**8.8160**	**86,629.5354**

Table 6. *Using 2019 consumption and electricity rate figures, a projected PHP 1.040 million savings may be realized. The assumptions made for the preceding calculations should be replaced by more recent and actual figures. In particular, the nameplate performance of the brands of solar modules and their rated efficiencies will play into the outputs of the PVWatts Calculator. After the conceptual stage, such greater attention to the assumptions is needed to come up with a better assessment of the project.*

the three months between March and April, where production is noticeably higher. The proposed facility will generate power between 5:00am and 6:00pm with the highest generation during March, April, and May.

Table 6 below summarizes the monthly AC energy output of the proposed facility being considered for the first year, using 2019 consumption and electricity rates as a basis of calculation.

It is noted that a potential PHP 1.040 million savings from prevailing electricity expenses is being projected, since the electricity generation from the rooftop solar PV facility averages at 50 % of the 2019 consumption of the Main Building.

For a 300-kW facility, the electricity generation is around 39% on the average in excess of the 2019 consumption of the Main Building on the assumption that the solar facility will operate from 8:00am to 5:00pm. Additional connections and retrofits need to be installed to feed this excess electricity to the adjacent buildings.

Twenty-Five Year Annual Energy Production

As an additional output, the DOE ROI Calculator computes for the annual energy production of the rooftop solar PV facility. Figure 8 below shows the yearly projected total annual energy production (AEP) of the proposed net metering facility.

The proposed 100-kW rooftop solar PV system is projected to generate 118 MWh of net electricity in the first year of operation whereas this figure drops to 104 MWh in the 25th year. This is due to the natural degradation of the components of a rooftop solar PV system, including the solar modules, the inverters, and the connecting wires, which gives rise to a progressive loss of efficiency. With a degradation value assumed as 0.5% a year in electricity generation, the system will yield an average of 110 MWh per year for the forecasted operational period.

The input parameter of 0.5% for the degradation factor is reflected in the projected annual energy production of the proposed system for this analysis.

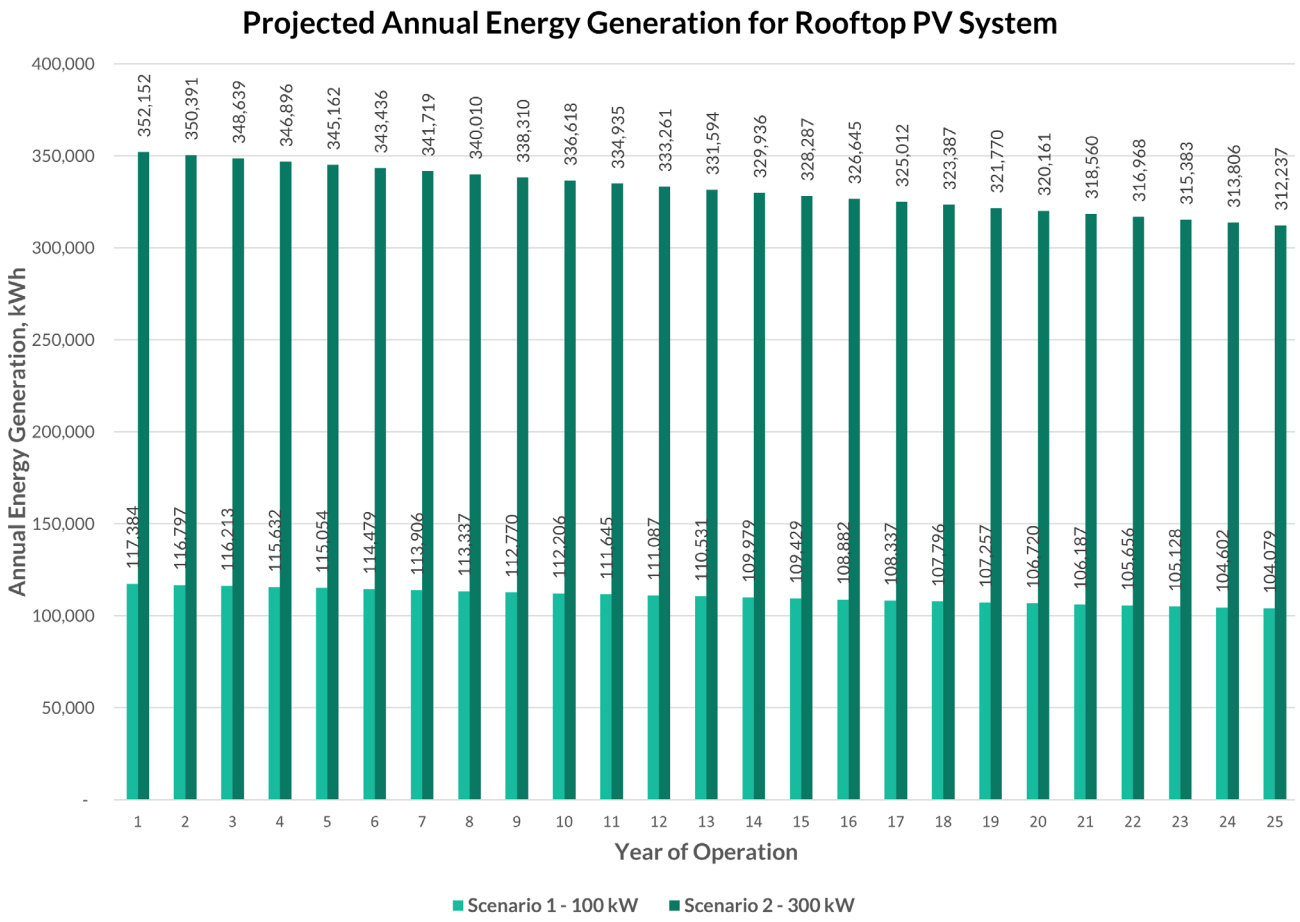


Figure 8. *Twenty-Five Year Annual Energy Generation of the proposed rooftop solar PV . The annual energy generation during the 25-year lifetime of the rooftop solar PV system shows a degradation.*

Input Parameter	Assumptions	Remarks
Lifetime of PV	25 years	This is the warranty for modern PV modules
Rated Capacity of PV System (RC)	Scenario 1 – 100 kW Scenario 2 – 300 kW	Feasibility of these rated capacities are subject to rooftop structural stability study
Capacity Factor	13%	This is the capacity factor being assumed by the PVWatts calculator in its internal formulas; for consistency, this is also going to be used for the ROI calculator
Degradation Factor	0.5%	Based on the most recent global studies, this value is the standard that is used for preliminary assessments such as this
% Own Consumption	100%	All of the electricity generated is considered to be consumed by the Main Building
DU Total Customer Charge	PHP 8.8160	This is taken from the average monthly electricity rates from Table 4
Annual Increase in DU/ Generation Charge	3%	This assumption is taken from the DOE's sample calculations[51]
DU Generation Charge	PHP 5.5541	This is assumed to be 63% of the average monthly electricity rates from Table 4
Operations and Maintenance/Year/ kWp	PHP12,000	This assumption is taken from the DOE's sample calculations
Cost of Installed PV System per kW	PHP 79,000	This assumption is from the most recent global market data and adjusting for the Philippines[52]

Table 7 *outlines the summary of input assumptions for DOE ROI Calculator Input Parameters for the two rooftop solar PV system options.*

51 DOE Net Metering Page. "4. How to buy a solar roof top from your installer." https://www.doe.gov.ph/4-how-buy-solar-roof-top-your-installer
52 International Renewable Energy Agency. Power Generation Costs 2019. Abu Dhabi, 2020.

Key Performance Indicators	Option 1: 100kW, Net Metering	Option 2: 300kW, Own Use
Total Solar Energy Produced[53]	2,765,092 kWh	8,295,275 kWh
Total Cost	₱ 10,920,000	₱ 32,760,000
Total Savings	₱ 32,279,818	₱ 96,839,455
Break Even	8 years	8 years
Internal Rate of Return, %	12%	12%

Table 8. *Both scenarios for a rooftop solar PV facility over the Capitol Main Building will recover their investments in eight years at an internal rate of return of 12%.*

53 Feasibility of these rated capacities are subject to rooftop structural stability study

This provides valuable information in forecasting the energy supply for the facility and in managing energy demand by the Main Building. However, due to limited data, this assessment assumes that energy demand of the Main Building remains will remain constant for the 25-year period.

Input Assumptions to DOE Return on Investment (ROI) Calculator Parameters

The DOE ROI Calculator requires system information and financial assumptions to run its calculations. Table 8 shows a summary of these assumptions and their respective justifications.

Return on Investment Results

A return on investment (ROI) assessment of a project looks at the ratio between its projected net income (or net savings) and the investment. It involves the computation of the internal rate of return (IRR), which is the percentage rate that an investment earns or its profitability for the period that it is invested. In project investment analysis, the IRR is used to assess the viability of a project.

The DOE ROI Calculator hardcodes the formulas used in ROI analysis into an Excel file, providing an easy way for planners to come up with the project's IRR and break-even year (the year when all original investments are recovered, and the project starts saving) without calculating these values manually. This Calculator is therefore useful to assess the financial viability of a project at the conceptual stage. The DOE ROI Calculator is a project pre-assessment tool and is not meant to be the final project investment analysis for any rooftop solar PV project. Other investment expenses need to be considered, and the assumptions need to be fine-tuned to come up with a more realistic analysis.

Table 9 below summarizes the results given out by the DOE ROI calculator. Notably, the facility will break even within eight years and has an IRR of 12%. This value can be interpreted as saying that 12% of the original investment is being recovered for every year that the project results to savings on electricity costs.

Because the input parameters for this ROI Calculator include the estimated per-kilowatt installation and maintenance costs, the result gives out an estimated total cost of PHP 10.9 million for the project as well as the total savings of PHP 32.3 million. Since this tool calculates the rate of savings on an annual basis, the upfront installation costs are considered on the first year, and the maintenance costs and annual savings are considered every year for the 25-year lifetime of the project.

4.4 ENERGY EFFICIENCY AND CONSERVATION

Along with renewable energy, and in line with the passage of RA 11285 and the Joint Circular No. 2020-01 from the DOE and the Department of the Interior and Local Government, entitled ***"Guidelines for LGUs to Facilitate the Implementation of Energy***

Projects"[54]**,** PGOM can initiate energy efficiency and conservation (EE&C) projects through the following:

- promoting, facilitating, and implementing renewable energy and energy efficiency and conservation projects in accordance with applicable laws and regulations;
- incorporating RE and EE&C programs, policies, and projects into the Provincial Development and Physical Framework Plan as well as the comprehensive development plans of the municipalities and Calapan City;
- streamlining processes in issuing necessary permits on RE and EE&C-related projects;
- establishing a program and set timelines for the full compliance of applicable provisions of RA 11285 and its IRR, in particular those that mandate the establishment of an EE&C Office

PGOM is instrumental in encouraging the respective municipalities and Calapan City to initiate the promulgation of their corresponding ordinances.

In addition, the DOE has issued Department Circular 2020-12-0026 ***"Adoption of the Guidelines on Energy Conserving Design of Buildings").*** This policy sets standards and guidelines that new buildings need to comply with, as well as for retrofitting existing buildings (including all government buildings).[55] Incorporating a retrofitting program for public buildings identified for installation of rooftop solar PV systems will ensure that the cooling and lighting equipment of these buildings will comply with this policy.

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54 https://www.doe.gov.ph/laws-and-issuances/dilg-doe-joint-memorandum-circular-no-2020-01

55 https://www.doe.gov.ph/guidelines-energy-conserving-design-buildings-and-utility-systems

5. CREATING PUBLIC VALUE

Solar PV is a clean, renewable, and affordable source of energy. Public value is defined as the value created by government through its services, regulatory actions, and policy issuances.[56] As reflected in its mission statement, PGOM's value proposition to its stakeholders is *"to promote the well-being of an empowered citizenry prospering under a climate-resilient green growth economy through a proactive, accountable, and participatory governance."*[57]

Demonstrating the benefit of renewable energy sources through rooftop solar PV in public buildings is a value creation that can help improve not only the power situation in the province, but also enhance the business environment, create green jobs, improve air quality, and mitigate climate change. Table 10 outlines the estimated value creation assuming either 100 kW net-metered rooftop solar PV system or 300 kW own-use rooftop solar PV system is installed in the Main Building of the PGOM Capitol Complex.

56 Moore, M.
57 Provincial Government of Oriental Mindoro Vision and Mission. https://ormindoro.gov.ph/about/. Accessed on 28 April 2021

5.1 Improved Power Supply

The two options for the rooftop solar PV installation in the Main Building will encourage demand-side participation in electricity production since the end-user is empowered to generate electricity within its premises. This self-generated energy supplements the electricity supplied by the electric cooperative. This is aligned with the strategy by the DOE to promote demand-side participation of energy production

VALUE CREATION	100 kW Net-Metered Rooftop Solar PV	300 kW Own-Use Rooftop Solar PV
Improved Service Reliability	100 kW solar PV can provide an annual average of 110.6 MWh, equivalent to 50% of energy requirement by the main building;	300 kW solar PV can provide an annual average of 331.8 MWh,
Electricity bill savings	Annual average savings of around PHP1,039,600 or 50% of the electricity bill of the Provincial Capitol Main Building and greater savings for public buildings with less electricity demand	Annual average savings of around PHP1,683,200 or 75% of the electricity bill of the Provincial Capitol Main Building and greater savings for public buildings with less electricity demand
Potential Emission Reduction	1,153 tonnes CO2 through 25 years	3,461 tonnes CO2 through 25 years
Green Jobs	Jobs related to installation and maintenance of rooftop solar PV systems	
Economic Growth	Reliable, affordable, and clean energy supply improves business environment and attracts private sector investments	

Table 9. *Value created by the solar PV system in public buildings include additional energy supply, lower cost of power, emission reduction, green jobs generation, and positive economic impact.*

to improve energy supply security. [58] A large-scale implementation of rooftop solar PV on public buildings in Oriental Mindoro may lead to less demand from this market segment and free up supply to other customers being serviced by ORMECO.

5.2 Electricity Bill Savings

Power generated by both options will result in savings in the electricity bills for the Main Building. For the 100 kW net-metered system, the projected amount of savings is PHP 1.040 million for the first year. This further projects to an average annual generation of 111 megawatt-hours for the 25-year lifetime of the project and a total savings of PHP35.279 million.

For a rooftop solar PV facility of 300-kW capacity, the savings projections is PHP1.683 million for the first year, on the assumption that all electricity during daytime can be supplied by such facility. This further projects to an average annual generation of 332 megawatt-hours for the 25-year lifetime of the project and a total savings of PHP 105.839 million.

5.3. Emission Reduction

Power generation from solar PV has no environmental impact since sunlight is a renewable source that does not have carbon dioxide emissions. In the case of the Provincial Capitol Complex Main Building, the 100 kW and 300 kW rooftop solar installations will lead to a total of 1,154 tonnes of CO_2 and 3,416 tonnes of CO_2 emissions reduction respectively throughout the project lifetime.[59] Carbon emission reduction potential of this initiative by PGOM can be fully maximized if all the pre-identified 23 public buildings will be installed with rooftop solar PV systems.

Furthermore, based on the estimates of the DOE, Central Oriental Mindoro has a solar potential of 130 MW, while the southern part of the entire Mindoro Island has a 213 MW solar potential.[60] Development and operationalization of Oriental Mindoro's solar potential will lead to immense contribution by the province in terms of carbon dioxide emission reduction.

5.4. Green Jobs

Solar PV projects create 5.76-6.21 jobs per MW average capacity during the manufacturing, construction, and installation stage, and 1.20-4.80 jobs per MW average capacity during the operations and maintenance stage.[61] Job creation in the solar energy sector is significantly higher than in coal fired power facilities, where only 0.27 jobs per MW are created during the manufacturing, construction, and installation stage and 0.74 jobs per MW are created during the operations and maintenance stage. Furthermore, based on industry estimates, a 100-MW solar project can create approximately 5,000 full-time jobs in three years.[62] Each direct job created generates seven indirect jobs in the industry.[63] These additional jobs will also generate more revenues from tax payments, which the local government can use to fund public services.

For a proposed rooftop solar PV facility on a public building such as the Main Building at the Oriental Mindoro Capitol Complex, the project has the potential of generating jobs in the following areas:

- Installation and construction – will involve skilled installers and electricians for the construction of the solar panels, the interconnections, and the inverters
- Operations and maintenance– will involve supervision and monitoring of the daily

58 https://www.doe.gov.ph/announcements/call-comments-draft-department-circular-entitled-prescribing-policies-enhance-and

59 Based on an assumption of the emission of 0.418 kg of CO2 per kilowatt-hour. US Energy Information Agency, "How much carbon dioxide is produced per kilowatt-hour of electricity?" https://www.eia.gov/tools/faqs/faq.php?id=74&t=11

60 National Renewable Energy Laboratory, Department of Energy (Philippines), National Grid Corporation of the Philippines, United States Agency for International Development. Ready for Renewables: Grid Planning and Competitive Renewable Energy Zones (CREZ) in the Philippines. Taguig City, September 2020.

61 *"Investment in renewable energy generates jobs. Supply of skilled workforce needs to catch up."* International Labour Organization and the European Union. Geneva 2008.

62 It's More Sun in the Philippines: Facts and Figures on Solar Energy in the Philippines Project Development Programme (PDP) Southeast Asia. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Manila, 2013.

63 Ibid.

electricity production of the solar PV facility; will also involve coordination with ORMECO for any grid interconnection issues
- Billing and accounting - will involve setting up a system to monetize the savings enabled by the PV facility and coordinating with ORMECO for the monthly accounting of these savings in relation to the electricity bill
- Repair and maintenance – will involve both basic and more complex repair tasks to ensure the efficient operation of the facility
- Physical cleaning – will involve periodic cleaning and inspection of the solar panels to maintain the power output of the solar facility and flag early damage to the components

5.5. Economic Growth

The Cities and Municipalities Competitiveness Index 2020[64] of the National Competitiveness Council names the provincial capital Calapan City and the municipalities of Pinamalayan, Puerto Galera, Gloria, and Socorro as top performance in terms of economic dynamism, government efficiency, infrastructure, and resiliency. In these areas, local government units in Oriental Mindoro have significant improvement in creating a stable business environment, generate employment, provide reliable government services, and demonstrate capacity to facilitate economic activities despite shocks, such as natural disasters.[65] To sustain these gains, Oriental Mindoro should have a strong power system to serve as the backbone of further economic development and industrialization.

Based on a large number of studies, improving access, reliability, and price of electricity have a strong correlation to economic growth. A good example of these literature is the annual ***Doing Business in the Philippines*** survey by the World Bank Group, which includes "Getting Electricity" as one of the variables of a business environment conducive to various types of investments. Indicators used to measure this include reliability of supply, as reflected by the SAIFI and SAIDI, and the price of electricity, among others.[66]

Diverse and local sources of energy improve supply security and reliability of services.[67] Solar PV systems can help augment the province's diesel-dependent power supply, shortage of which is the usual reason for frequent power outages. The declining cost of solar PV systems and the short period of time required for installation make solar energy a viable solution to meet Oriental Mindoro's current and future demand.

Finally, creating an enabling environment for renewables, in terms of local government policy and technical capacity of relevant infrastructure services such as the distribution facilities, will attract private sector investors to develop the abundant renewable energy potential of the province. Such development will maximize the potential of the province as an agro-industrial powerhouse with reliable, affordable, and clean energy supply. PGOM's vision for the province to be a "food base exporting high-value products, the preferred agri-ecotourism destination in MIMAROPA by 2025" can be facilitated by the value created from solar PV systems.

64 National Competitiveness Council. Cities and Municipalities Competitiveness Index 2020 January 2021. https://cmci.dti.gov.ph/rankings.php

65 Ibid.

66 World Bank Group. Doing Business in the Philippines. Makati City, 2020.

67 Xiangou Li. Diversification and Localization of Energy Systems for Sustainable Development and Energy Security. Energy Policy 33(17):2237-2243. February 2005

6. OPERATIONAL CAPACITY

Effective delivery of the Solar PV systems requires operational capacities of stakeholders in charge of project implementation. Operational capacity is indicated by the organization's financial resources, structure, systems and processes, and manpower. The operational capacities of PGOM and the municipal LGUs (policy capacity) and ORMECO (technical capacity), as implementing stakeholders, are the key operational prerequisites in scaling up solar PV systems in Oriental Mindoro.

6.1 Policy Capacity

Policy capacity refers to the "***ability of governments to make intelligent choices, scan environmental and strategic directions, weigh and assess implications of policy alternatives, and make appropriate use of knowledge in policymaking.***"[68] Furthermore, the ability by governments to mobilize support from various stakeholders is a function of policy capacity.

In scaling up solar PV installations in Oriental Mindoro, with provincial government buildings as pilot cases, PGOM and the municipal LGU need to demonstrate their policy capacity to undertake the process that involves the following steps: 1) identify and evaluate policy alternatives; 2) establish a transparent and collaborative venue for stakeholder consultations on policy alternatives; 3) make informed choices based on robust data and decision criteria; 4) institutionalize the preferred policy option through local ordinance and development plans; 5) establish the corresponding organizational structure, support mechanisms, as well as financial resources to implement the policy choice, monitor policy outcomes; 6) and take necessary actions to monitor and evaluate policy outcomes as well as effect improvements.

68 X. Wu, M. Ramesh & M. Howlett (2015) Policy capacity: A conceptual framework for understanding policy competences and capabilities, Policy and Society, 34:3-4, 165-171, DOI: 10.1016/j.polsoc.2015.09.001

PGOM and the municipal LGUs should also have the capacity to align its policy objectives with the interests of the project stakeholders, specifically ORMECO and the independent power producers (IPPs), in consideration of potential negative impact of the project on their businesses. PGOM and the municipal LGUs should also have the capacity to promote Oriental Mindoro as a viable location for renewable energy investments through administrative and regulatory processes to bridge financing and commercial gaps on solar PV investments and to improve ease of doing business in the province. Finally, PGOM should also build its capacity as it engages its staff in the bidding, construction, and operations and maintenance processes of the rooftop solar PV facilities.

6.2 Technical Capacity

As the organization primarily managing the distribution of electricity in Oriental Mindoro, ORMECO requires the technical capacity to integrate in its system the supply additions from diverse energy resources, including decentralized and intermittent renewables such as solar PV installations. Moreover, ORMECO needs to be ready to comply with applicable policies and support mechanisms, such as net metering, given the national government's aggressive renewable energy development targets. ORMECO recognizes the need for technical capacity upgrade, as reflected in the Power Procurement Supply Plan (PPSP) it submitted to NEA in 2019. In its PPSP, ORMECO took note of the recommendation, based on its distribution impact study, to enhance its distribution system to meet the technical requirements to accommodate additional power supply.

7. FINANCING OPTIONS

Global solar photovoltaic costs have declined significantly in the last two decades. Solar PV module prices have gone down from US$4.88/W in 2000 to US$0.38/W in 2019[69]. Total installation costs per kilowatt have declined between 64% and 86% from 2010 to 2019. [70] For prevailing Philippine market figures, this amounts to PHP 79,200 per kW in 2020.[71] The DOE, citing independent market research reports, estimates that the solar power generation in the Philippines will reach around 8,700 MW by 2030.[72] In addition, these are upfront costs and such installations do not need any fuel or feed-stock to operate. In this regard, rooftop solar installations are affordable power source, especially if the alternative fuel is imported diesel.

Within on-grid areas in the Philippines, private sector involvement in rooftop solar PV has been on a steady rise. As of 2020, 44.51 MW worth of rooftop solar facilities are in operation[73]. Several of these projects have even been able to avail of the feed-in tariff program of DOE since 2014. In off-grid areas, however, rooftop solar PV penetration has been less successful because of the barriers related to (1) private investment risk and (2) institutional and technical capacity of the local government and the distribution utilities respectively [74].

At this time, large Philippine banks tend to focus on utility-scale RE projects that are not necessarily limited to ground-mounted solar[75]. However, loans and lending mechanisms to net-metering rooftop solar PV projects such as the Financing Utilities for Sustainable Energy Development (FUSED)[76] program from the Development Bank of the Philippines and the Go Green Inclusive Financing for SMEs and LGUs Program (GO GREEN)[77] of the Land Bank of the Philippines are starting to become viable options.[78] Table 12 provides a summary of the terms of these financing facilities.

International financing, such as the Green Climate Fund (GCF), is another option that PGOM can explore to finance its rooftop solar PV Program. The GCF was established within the framework of the UN Framework Convention on Climate Change (UNFCCC) to provide developing countries with access to financing mechanisms to support climate adaptation and mitigation.

The GCF recognizes the need to simplify and streamline the approval of certain small-scale projects, particularly from direct access entities in developing countries. The Simplified Approval Process Pilot Scheme (SAP) [79], which is now operating, is meant to address this. The other possible way is to bundle this sort of project opportunities in other provinces and make a national level proposal to the financiers like the GCF.

In either cases, any GCF projects should be developed via Direct Access

69 Our World in Data, "Solar PV Module Prices". https://ourworldindata.org/grapher/solar-pv-prices
70 International Renewable Energy Agency. Power Generation Costs 2019. Abu Dhabi, 2020.
71 Ibid.
72 Philippine Daily Inquirer, "What's in Vogue? Solar Rooftops". https://business.inquirer.net/248692/whats-vogue-solar-rooftops
73 Department of Energy, "Existing Power Plants". https://www.doe.gov.ph/list-existing-power-plants
74 Ibid.
75 IRENA, "Renewable Readiness Assessment: Philippines", p. 30-31. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Mar/IRENA_RRA_Philippines_2017.pdf
76 Development Bank of the Philippines, https://www.dbp.ph/developmental-banking/infrastructure-and-logistics/financing-utilities-for-sustainable-energy-development-fused/
77 Land Bank of the Philippines, https://www.landbank.com/loans/business-loan/powerwaterutilities/go-green-inclusive-financing-program
78 DOE, https://www.doe.gov.ph/sites/default/files/pdf/e_ipo/04_veif_2019_financing_program_energy_projects_dbp.pdf
79 GCF, "Brief: The GCF Simplified Approval Process." https://www.greenclimate.fund/sites/default/files/document/gcf-brief-simplified-approval-process_0.pdf

Financing Facility	FUSED (Financing Utilities for Sustainable Energy Development)[80]	Green Financing Program[81]	Go Green Inclusive Financing for SMEs and LGUs Program[82]
Institution	**Development Bank of the Philippines**	**Development Bank of the Philippines**	**Landbank of the Philippines**
Eligible Borrowers	• Private Corporations • Electric Cooperatives • Local Government Units • Government Owned and Controlled Corporations • Private Financial Institutions	• Private Corporations/Enterprises • Local Government Units (LGUs) • Government Owned and Controlled Corporations (GOCCs) • Government Agencies (where allowed) • Water Districts/Private Service Providers • Cooperatives/Associations • Participating Financial Institutions (PFIs)/Microfinance Institutions (MFIs)	• Local Government Units (LGUs) • Enterprises duly registered as either: o Single Proprietorship o Partnership o Corporation o Cooperative • State Universities and Colleges, Local Universities and Colleges • Private Universities and Colleges classified as SME • Government Owned and Controlled Corporations
Eligible Projects	• Development and construction of energy generation or mini-grid rural electrification projects thru conventional (coal, diesel, bunker, etc.) and renewable energy resources (hydro, wind, solar, biomass, geothermal and other emerging technology) to address power supply system constraint. • Power distribution and transmission projects that will improve power supply system safety, reliability, efficiency such as reduction of system losses and power service quality for existing customers through rehabilitation and upgrading of distribution system. • Purchase of necessary equipment (hardware and software), service vehicles, tools, and other non-network projects (e.g. office building, warehouse) to improve efficiency and service delivery. • Any project which improves the reliability and efficiency of rural power supply and increase access to electricity services.	• Air Pollution Prevention and Control • Water Pollution Prevention and Control • Solid and Hazardous Waste Management • Resource Conservation, Resource Efficiency and Cleaner Production • Climate Change Adaptation and Mitigation (CCA/M) and Disaster Risk Reduction (DRR) • Other environmental/green projects/initiatives	• Solar Energy Systems • Other Eligible Projects o Environment-friendly energy systems (e.g. high-efficiency and energy conversion equipment, heat insulation system)

80 DBP, "Financing Utilities for Sustainable Energy Development," https://www.dbp.ph/wp-content/uploads/2018/10/fused.pdf
81 DBP, "Green Financing Program brochure," https://www.dbp.ph/wp-content/uploads/2021/01/Green-Financing.pdf
82 Landbank of the Philippines, "Go Green Inclusive Financing for SMEs and LGUs Program (GO GREEN)". https://www.landbank.com/loans/business-loan/powerwaterutilities/go-green-inclusive-financing-program

Financing Facility	FUSED (Financing Utilities for Sustainable Energy Development)[80]	Green Financing Program[81]	Go Green Inclusive Financing for SMEs and LGUs Program[82]
Institution	**Development Bank of the Philippines**	**Development Bank of the Philippines**	**Landbank of the Philippines**
Eligible Expenditures	• Capital Investment • Institutional development • Working capital requirement (i.e. prompt payment rebate, operations and maintenance) • Interest during construction • Plant acquisition and/or refinancing of existing loan • Consultancy services • Project preparation activities for renewable energy projects (i.e. feasibility study, detailed engineering design)	• Capital Investment o Installation, construction, maintenance, rehabilitation, expansion, improvement, or upgrading of physical assets and facilities o Acquisition of equipment • Initial working capital o Prototype design, testing, and production o Marketing and promotion activities (e.g. participation in Green Trade Shows and Exhibitions) o Financing production of booked sales orders/purchase order financing • Consulting Services such as cost of ecodesing, preparation of feasibility study, and detailed engineering design • Transaction costs for CDM or other carbon crediting mechanism • Refinancing of eligible existing operational projects, provided that it is in addition to a new loan proposal for an eligible project	
Equity Participation	• Private corporations – minimum of 20% based on total project cost • Electric Cooperatives, Local Government Units and Government Owned and Controlled Corporations – minimum of 10% based on total project cost	• Private corporations – minimum of 20% based on total project cost • Electric Cooperatives, Local Government Units and Government Owned and Controlled Corporations – minimum of 10% based on total project cost	• 90% : 10% Project Cost Sharing
Loan Term	• The term of the loan shall be based on the project cash flows or depending on the source of fund. The mode of repayment shall be monthly or quarterly depending on the cash flow of the project and/or the business	• Up to maximum of fifteen (15) years inclusive of up to five (5) years grace period based on project cash flows	
Interest Rate	• Prevailing market rate, fixed or variable.	• Prevailing market rate, fixed or variable.	
Loan Amount	• Private corporations, enterprises, cooperatives, associations – up to 80% of total project cost • LGUs/GOCCs/GA – up to 90% of total project cost	• Private corporations, enterprises, cooperatives, associations – up to 80% of total project cost • LGUs/GOCCs/GA – up to 90% of total project cost	• 90% of Project cost

Table 10. *DBP and Land Bank Financing Options*

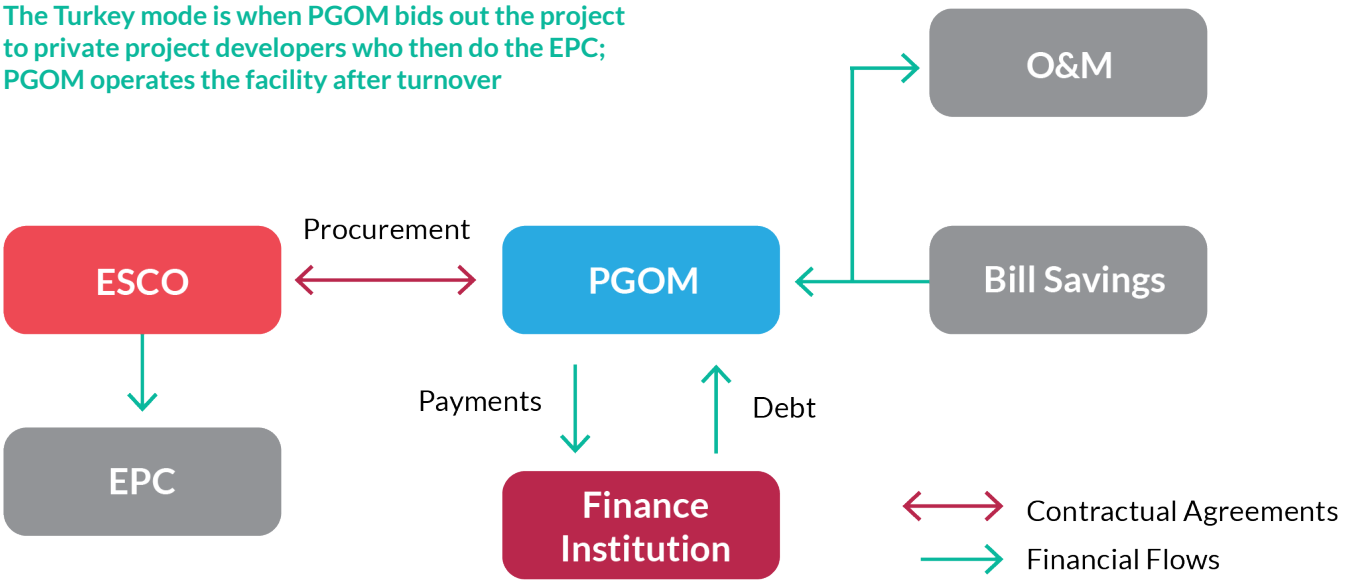

Figure 10 – *Potential Deal flow for turnkey project on Rooftop Solar PV facility*

Entity (DAE) and International Accredited Entity (AE) under the endorsement from the Nationally Designated Authority (NDA) - which is the Department of Finance (DOF). Currently the DAEs in the Philippines are the Land Bank of the Philippines (LBP) and the Development Bank of the Philippines (DBP). Aside from, and also for the preparatory work for the GCF access, PGOM may explore discussion with the other bilateral and multilateral development partners.

Possible Options

There are primarily two financing options that PGOM may explore for the rooftop solar PV facility. The first option is to finance a turnkey rooftop solar PV facility for its Capitol Main Building through a combination of self-financing and securing of a loan from a government financial institution. The second option is through a public-private partnership with a project developer. The recommendation is to evaluate these available opportunities which may optimally fit to the specific circumstances of the province.

7.1 Turnkey Project from Budget and Loan Facility

In this financing scheme, the Provincial Government allocates a portion of its annual budget to partially pay for the project cost[83], while availing of a loan for the rest of the amount.

In essence, the PGOM, through its Bids and Awards Committee (BAC), engages a private company for a turnkey project by preparing bid documents and following the guidelines and regulations of Republic Act 9184 (RA 9184) or the Government Procurement Reform Act. As the energy end-user, PGOM will be the legal owner of the facility once it is installed and commissioned by the project developer. PGOM may opt to build its capacity for the operations and maintenance of the facility or enter into a contract with a third party for these services.

The Department of Finance (DOF), through its Bureau of Local Government Finance (BLGP), has

83 following the Budget Operations Manual (BOM) of the Department of Budget and Management (DBM) for LGUs

The Build-Operate-Transfer contract is when the ESCO collects portion of the bill savings then turns over the facility to PGOM after an agreed-upon term

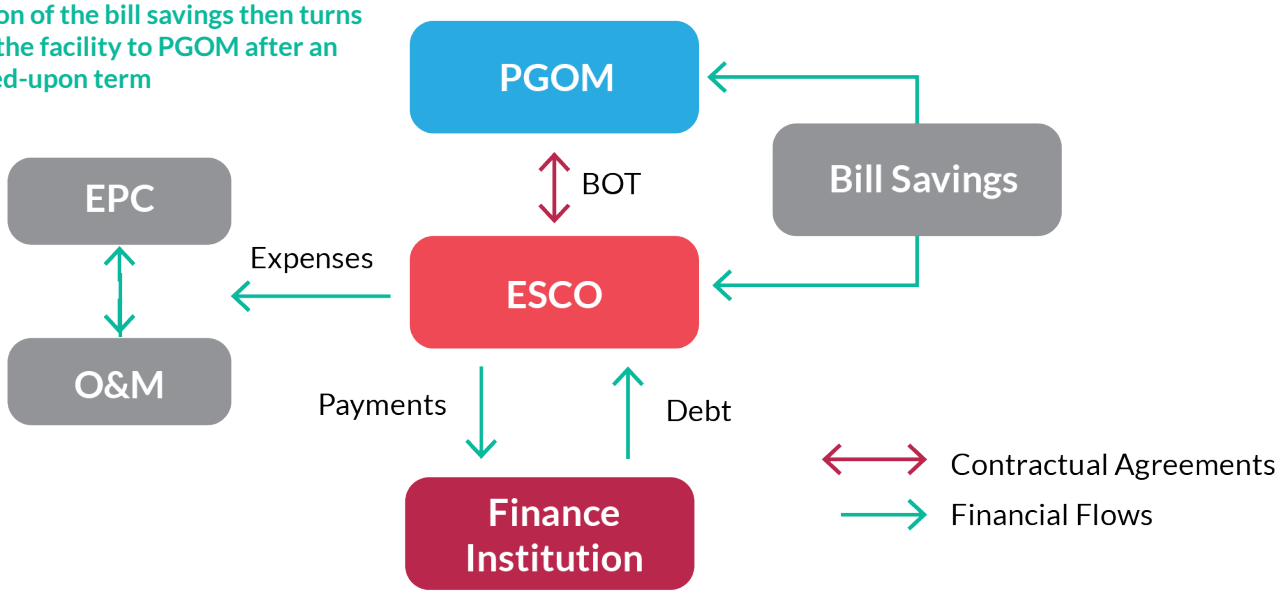

Figure 11 – *Potential Deal Flow for PPP with ESCO for a Rooftop Solar PV facility*

been encouraging LGUs to avail of a PhP300-billion credit facility being administered by the LBP in undertaking renewable energy projects.[84]

Figure 10 shows a proposed deal flow for this type of project. PGOM and a development partner (DP) of its choosing may enter into a Memorandum of Agreement (MOA), under which the DP may fund a pre-feasibility study or formulate a policy advisory. The pre-feasibility study may foster a favorable investment atmosphere with third-party partners will fund the facility, while the policy advisory may build the capacity of PGOM to procure a rooftop solar PV facility in terms of assessing its ability to fund the procurement itself.

Other credit facilities such as international finance institutions are also potential sources of funding to complement PGOM's contribution to the project cost.

7.2 Public-Private Partnership with Project Developer

Public-private partnerships (PPP) may be a viable financing option for the rooftop solar PV program of PGOM. It de-risks the provincial government from using public funds since the private partner will finance the project.

Several PPP in power projects are being undertaken in the Philippines in the last decades through contractual arrangements allowed under the Republic Act 6957 or the Build-Operate-and-Transfer Law of 1990 and its amending law RA 7718. [85, 86] The PPP Center is the government agency mandated by the national government to oversee and assist local governments in the implementation of PPP projects. Given the current momentum on RE projects, the PPP Center reported during an investment forum

84 Press Release, Department of Finance website. "Dominguez urges LGUS to tap P300-B credit facility for development projects", https://www.dof.gov.ph/dominguez-urges-lgus-to-tap-p300-b-credit-facility-for-development-projects/

85 DOE, Luzon Private Sector-Initiated Power Projects. https://www.doe.gov.ph/sites/default/files/pdf/electric_power/luzon_committed_2020_august.pdf

86 DOE, Visayas Private Sector-Initiated Power Projects. https://www.doe.gov.ph/sites/default/files/pdf/electric_power/visayas_indicative_2020_october.pdf

that several RE projects are in their current pipeline.[87]

A possible deal flow of this type of financing option is shown in Figure 11 above. PGOM may explore entering into a formal agreement with project developers (including development institutions) that will facilitate a pre-feasibility study. Private sector energy developers may be engaged by PGOM for the design, procurement, construction, and operations and maintenance of the project. The contractual arrangement between the private developer/s and PGOM may be in the form of a Build-Operate-Transfer (BOT) modality or any other PPP contractual arrangement suitable for this project.

The Project Development and Monitoring Facility (PDMF) of the PPP Center may be tapped by PGOM during the development of the project. The PDMF is a revolving fund to facilitate pre-investment activities of PPP projects, including preparation of feasibility studies, project structuring, preparation of bid documents and draft contracts, transaction advisory, and support for the tendering process through bid evaluation, and awarding of contract through competitive selection. The steps in availing PDMF support are briefly explained in the succeeding discussions.

The full details and procedures of this process can be found in the PPP Center's PDMF Guidelines. In the

87 Investment Forum on Energy Transition: Unlocking Opportunities at the Local Level, 20 May 2021, Manila.

Business Model	Key Features
Build-Operate-Transfer of individual rooftop solar PV facilities	Private sector takes financial risk in installing and operating the rooftop solar PV facility during the contract term Private sector and PGOM share in electricity savings PGOM takes ownership automatically after contract term
Build-Lease-Transfer of individual rooftop solar PV facilities	Private sector takes financial risk in installing and operating the rooftop solar PV facility during the contract term Private sector leases rooftop space from PGOM while taking all electricity savings as profit PGOM takes ownership automatically after contract term
Virtual Power Plant/s	Private sector takes financial risk of aggregating rooftop solar PV facilities that will operate as a virtual power plant controlled by proprietary software Private firm will negotiate directly with ORMECO as an IPP

Table 13 *shows the PPP business models and corresponding arrangement.*

PDMF Stage	PGOM Rooftop Solar PV Project
1. Project conceptualization	
• LGU submits an application to the PPP Center for the screening of its PDMF Committee. • Upon successful review, a Technical Assistance Agreement (TAA) between the LGU and the PPP Center is signed.	• The Final Policy Advisory that GGGI shall provide to PGOM can be used as a reference for the application, should PGOM decide to pursue PPP.
• Terms of Reference (TOR) and/or the Request for Proposals (RFP) are prepared for the conduct of the business case or the feasibility study, which shall be undertaken by third-party consultants.	• PGOM must conduct a Public Bidding for the feasibility study of the Rooftop Solar PV Project
2. Project preparation and appraisal	
• The project preparation stage is when the business case or feasibility study is prepared by the consultants. • The LGU works closely with the PPP Center to review and accept the feasibility study. The LGU also monitors and oversees the work of the consultant for the successful conduct of the feasibility study. • The LGU registers with the DOE under Direct Application[88]	• The case study within the Final Policy Advisory contains preliminary information for the feasibility study.
• The preliminary designs and project cost can be developed and refined during this stage and can be a part of the scope of the feasibility study.	• Stakeholder and public consulting sessions may be conducted by PGOM during this stage to ensure that all sectors are given the opportunity to give their inputs into the project.
3. Bidding Stage	
• The results of the feasibility study will be used to prepare the bid documents. Depending on the level of design and costing developed in the feasibility study, the terms of reference for the bid documents can indicate the project cost and contractual arrangements of the PPP structure chosen by the LGU.	• PGOM prepares Bid Documents for the installation of the rooftop solar PV facility • The standard regulations set forth by RA 9184 or the Government Procurement Act and its implementing rules and regulations are strictly followed at this stage.
It is also at this stage of the PDMF process where the options for which PPP structure will be selected. For the purposes of this project, the following PPP structures can be considered by PGOM to implement the rooftop solar PV program of its public buildings • Build-Operate-Transfer (BOT) – a rooftop solar facility can be financed, constructed, and operated by a project proponent for a fixed term, during which an agreed upon portion of the projected savings generated can be collected, and after which the ownership of the facility will automatically be turned over to the PGOM • Build-Lease-Transfer (BLT) - a rooftop solar facility can be financed, constructed, and operated by a project proponent on a lease arrangement of the rooftop space for a fixed term, and after which the ownership of the facility will automatically be turned over to the PGOM • Virtual Power Plant Public-Private Partnership – A comprehensive program to solarize public building rooftops grouped into geographical proximity with one or several private partners, creating virtual power plants with capacities that are more than 100kW	
• It is also at this stage that the PPP contract between the LGU and the prospective proponent is drafted.	• PGOM collaborates closely with the PPP Center to draft a contract that is beneficial to both PP partners
4. Project implementation	
• The project implementation stage is when the project is constructed by the successful proponent.	• Oversight will be done by PGOM through its engineering and accounting departments as well as other departments and divisions that are deemed necessary. • Project turnover as required by government procurement procedures will also be observed.
5. Impact monitoring and evaluation	
• Under the PDMF process, the impact of the project will be monitored and evaluated following the guidelines set by the PPP Center. This is to ensure that the project achieves its stated goals and vision.	• PGOM coordinates with the PPP Knowledge Corner at the NEDA MIMAROPA office to set up regular monitoring and evaluation meetings for the project.

88 The LGU registers under Direct Application either for (1) net-metering or for (2) Certificate of Registration for Own Use (CORFOU). This involves financial requirements, applicable fees dependent on the capacity and area for development, feasibility study and reportorial obligations. Application process is 20 days (CORFOU) to 1 month (Direct Application).

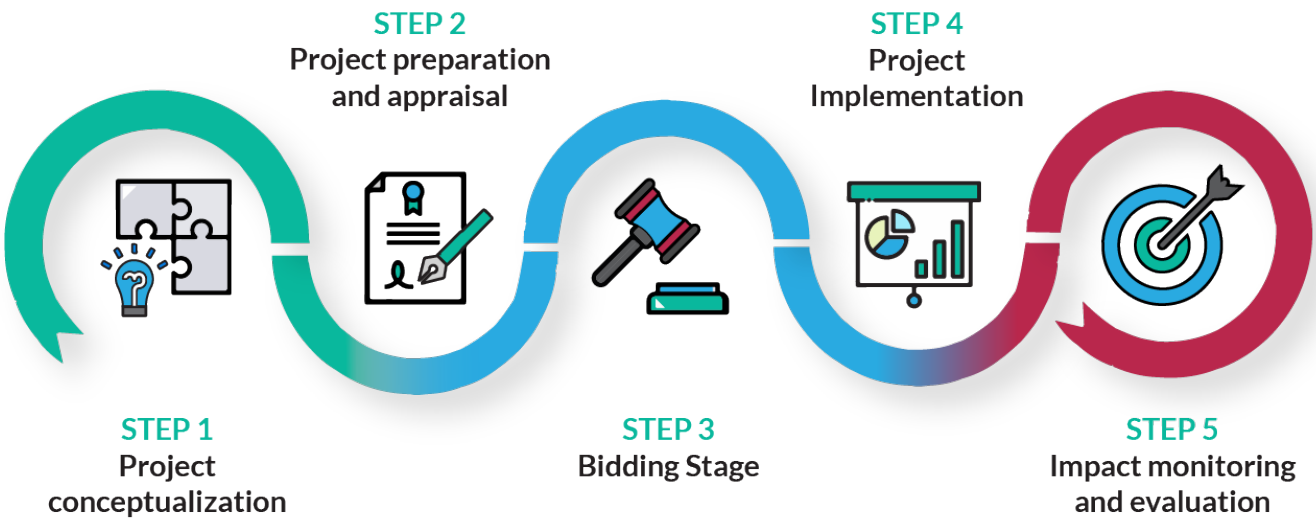

Table 12. *PPP Center Project Development Monitoring Facility*

Benefits	Risks
• No capital outlay is required for PGOM as this falls on the private sector partner • Capacity building and knowledge transfer for the operations and maintenance of rooftop solar PV facility • Once the project is awarded, the private partner is incentivized to finish construction as quickly as possible and within budget • Potential to attract more investors for similar projects in private establishments • Risks in PPP projects are addressed by keeping a continuously updated risk register together with the corresponding mitigation actions. Several risks and their corresponding mitigation measures are briefly enumerated below.	• Force majeure risks to the facility - to anticipate risks from damage due to force majeure incidents, insurance instruments need to be incorporated into the total project cost, including the payment premiums in the cash flow • Performance of the private partner might be sub-standard – oversight by the PGOM Department of Engineering and other related departments during the construction period will mitigate the risk of sub-standard project development performance • The technology might become obsolete during the contract terms - a robust set of bidding documents will address the risk of obsolescence by language that will ensure that the technologies chosen are adaptable to any future technologies • Risk of loan default - in the scenario that PGOM takes on part of the loan for the PPP project, it may coordinate with the Bureau of Local Government Finance to assess its capacity for debt servicing, as well as for guidance; it will also have to be diligent in monitoring its fiscal performance in relation to debt servicing. In the case of the private project developer's risk of loan default, the bidding process needs to ensure that the private partner is financially (as well as technically and legally) capable of undertaking the PPP project.

Table 13 – *Benefits and Risks of PPP Projects*

event that PGOM pursues the PPP route of initiating its rooftop solar PV projects, PGOM shall encourage them to coordinate with the PPP Knowledge Corner of the NEDA MIMAROPA office. [89][90]

PPP projects have been successful in the Philippines in the last several years and have demonstrated specific benefits where they have been implemented well. There are also inherent risks to these types of projects. For the financing of the rooftop solar PV project in Oriental Mindoro, as indicated in Table 13, the following benefits and risks as they relate to the provincial government are enumerated for consideration.

89 MIMAROPA Government website, "NEDA MIMAROPA launches PPP Knowledge Corner" http://mimaropa.neda.gov.ph/neda-mimaropa-launches-ppp-knowledge-corner/

90 PPP Center, "PPP Center Project Development and Monitoring Facility Guidelines Revised January 2020". https://ppp.gov.ph/wp-content/uploads/2020/01/PDMFS_200190128_REP_Revised-Guidelines-January-2020.pdf

8. RECOMMENDATIONS

Interlinked strategies are proposed to address the gaps in terms of public value, enabling environment, and operational capacity, with the support from financing options. Public value derived from the project should be institutionalized and communicated with stakeholders to create a shared aspiration. Meanwhile, a local policy, complementary mechanisms, and strong broad-based stakeholder support are key to improving legitimacy. Gaps between public value delivery and the operational capacity should be filled through improvements in PGOM's policy capacity and ORMECO's technical capacity to achieve value creation, as illustrated in Figure 9. Finally, the approach can be tested and scaled up via various financing options available.

8.1 Engage Stakeholders toward Shared Public Value and Improved Legitimacy and Support

To create a shared appreciation among stakeholders of the public value created from scaling rooftop solar PV installations the following activities are recommended.

Communicate the Public Value to Stakeholders

Information, Education, and Communications (IEC) campaign and public consultations about Oriental Mindoro's Clean Energy Agenda is proposed across the province to highlight the value created by the solar PV project, including service reliability due to additional power supply, more affordable power, green jobs, cleaner air, and economic development.

PGOM can also emphasize in its communications the potential value creation of solar PV installations for other use, such as in the agricultural and fisheries sector through solar power for irrigation, drying, refrigeration, and desalination processes. This is aligned with the national government initiatives to mainstream renewable energy in the delivery of various social services, including critical health facilities, emergency shelters, and water systems, among others.[91]

91 Philippine Energy Plan 2018-2040 and Draft NREP 2020-2040

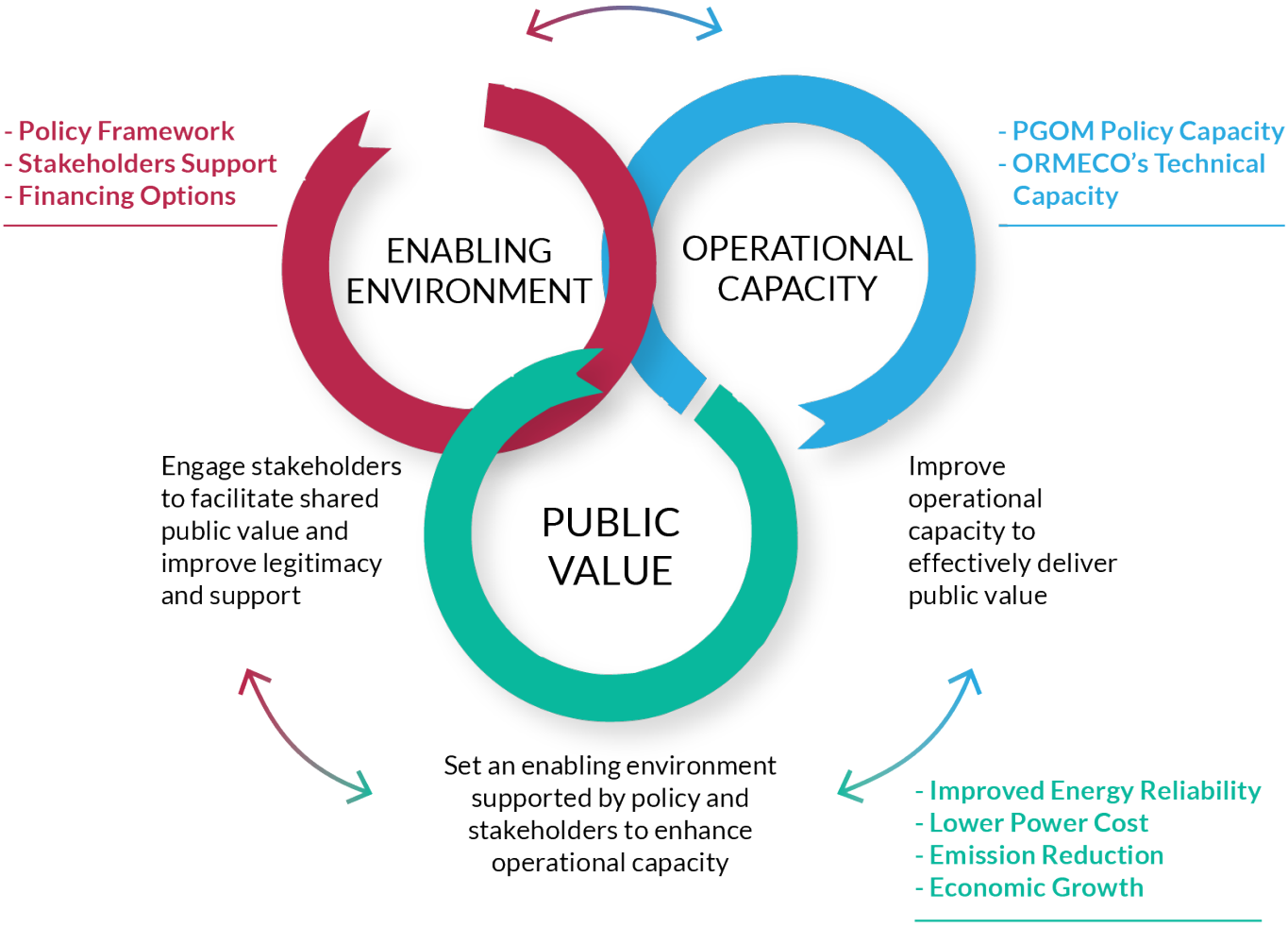

Figure 9. *Interlinked strategies are proposed to strengthen the alignment of Value Creation, Authorizing Environment, and Operational Capacity for effective project implementation.*

Institutionalize the Clean Energy Agenda

Anchored on PGOM's mission statement, a Clean Energy Agenda should be institutionalized through local ordinance and integrated in the Provincial Development and Physical Framework Plan (PDPFP). The Clean Energy Agenda should be declared as a policy to reduce dependence on fossil-fuel by accelerating development of renewable energy to achieve energy self-reliance, with an emphasis on solar PV installations due to their relative feasibility among other renewable technologies in off-grid areas.

PGOM can set the goal of positioning Oriental Mindoro under the Clean Energy Agenda as the first net-metering-compliant province in off-grid locations. Oriental Mindoro's net-metering compliance and readiness will send a positive signal to the private sector that the province is a location-of-choice for investments that prefer a business environment with a green growth foundation.

8.2 Improve Operational Capacity to Effectively Deliver Public Value

The policy capacity of PGOM and the technical capacity of ORMECO are crucial as these primary stakeholders collaborate in scaling up the solar PV projects in the province.

Improve PGOM's Policy Capacity

Provincial Government's policy capacity needs to be strengthened, primarily to formulate and implement

policies and mechanisms to facilitate private sector investments into the sector. Specifically, PGOM should have the capability to draft a local renewable energy plan that is supported by a local ordinance, conduct investment promotion activities to entice private sector interest into the project, facilitate regulatory requirements such as local permits, including those for net-metering implementation and right-of-way acquisition, and provide overall coordination among stakeholders.

To align its policy capacity with the functions and requirements related to the project and its overall development aspirations, PGOM needs to conduct a capacity needs assessment to identify areas for improvement and new capabilities that need to be developed. The capacity needs assessment also covers identification of manpower, financial resources, and organizational structures required to implement the province's Clean Energy Agenda.

PGOM may tap the DOE and the NEA for policy and technical support, as well as linkages to potential resources for capacity-building, e.g. national government programs assisting LGUs on solar PV development, donor agencies for capacity development initiatives related to renewable energy policy planning and implementation.

PGOM may also coordinate with the Public-Private Partnership Center (PPP Center), which provides technical and capacity development assistance to LGUs which aspire to develop renewable energy projects through the PPP modality.

PGOM should consider setting up capacity development programs, such as technical and vocation trainings for its constituents to enable the green jobs creation potential of the solar PV project in Oriental Mindoro.

Improve ORMECO's Technical Capacity

ORMECO should take an active role in coordinating with DOE, NEA, and NGCP in relation to the Batangas-Mindoro Interconnection Project and the CREZ Program, which will complement its initiatives to build its technical capacity in response to the increasing power demand in the province.

ORMECO may tap NEA's net-metering workshops customized to the specific capacity needs of electric utilities in energy planning, demand management, net-metering implementation, including compliance with system parameters, interconnection standards, and administrative requirements, among others.[92]

ORMECO may also conduct peer-to-peer learning sessions with other electric cooperatives already implementing the net-metering scheme and undertaken investments in solar PV systems.

8.3 Set up an Enabling Environment Supported by Policy and Stakeholders to Enhance Operational Capacity

The following are the recommendations in creating the regulatory environment that facilitates capacity development and removes barriers to entry of private sector investments in the solar PV sector in the province.

Provincial Ordinance on Renewable Energy

PGOM should enact a provincial ordinance translating national renewable energy policies into local legislative agenda to support the development of operational capacities and resource mobilization for the rooftop solar PV project. The provincial ordinance should promote use of renewable energy resources in the province, and strengthen existing organizational structures and create new ones as necessary, to implement renewable energy planning, facilitate public-private partnerships and investment promotions, including streamlining of regulatory requirements, capacity building, and overall coordination with stakeholders.

Local RE Plan (LREP) for Oriental Mindoro

Complementing Oriental Mindoro's Provincial Development and Physical Framework Plan, the LREP should set a roadmap to facilitate adequate energy supply in account of the LGU's economic

92 Letter by NEA to Electric Cooperatives on Renewable Energy 101 and Introduction to Net-Metering. 26 January 2017.https://www.nea.gov.ph/ao39/phocadownload/MEMO%20TO%20ECs/2017//009.%20Advisory%20for%20All%20ECs%20-%20Renewable%20Energy%20101%20+%20Introduction%20to%20Net-Metering%20Program.pdf

development targets, which may increase energy demand in the province more than initially forecasted. With support from the DOE in terms of policy guidance and technical assistance, PGOM can formulate an LREP that lays the foundation for renewable energy development in the provincial level, including the following information: current and forecasted energy demand and supply; planned grid upgrades and interconnections; mapping of renewable energy potential; assessment of renewable energy options based on feasibility and cost-effectives; Renewable Energy Roadmap outlining targets and timelines (public buildings as pilot projects for solar PV, mainstreaming of solar PV in other sectors, e.g. agriculture and fisheries, and development of other renewable energy technology); complementary organizational structures, policy support mechanisms, capacity building, resource mobilization, and investment promotions

Mobilize Stakeholders Support

PGOM may leverage the policy direction from the national government to utilize renewable energy and implement corresponding policy instruments, such as the net-metering scheme. As indicated in the proposed NREP 2020-2040 and with the issuance of the Enhanced Net Metering Rules, distribution utilities in off-grid areas will need to plan readiness to accommodate solar PV installations, given significant cost reductions on installation and clean energy preference by an increasing number of consumers.

PGOM may take advantage of the increasing preference for renewables and encourage diesel generators to transition their investments into developing the renewable resources of the province. Diesel generators in Oriental Mindoro need to consider the viability of their business in the near future, given more rigid regulatory constraints on fossil fuels and shift by banks to renewable energy financing due to increasing exposure on investments that impact environmental sustainability. In the Philippines, more local financial institutions are complying with the Philippine Central Bank's call to adopt sustainable principles in lending as shown by the recent issuance of PHP 90B worth of debt securities that meet environmental and climate risk standards.[93] One of the large banks in the country also announced in 2020 that it will cease its coal financing and reached PHP52B worth of sustainable loans in the same year, 61% of which is for renewable energy projects.[94]

PGOM needs to sustain the support for the project by grassroots stakeholders, particularly the municipal LGUs which will be included in piloting the solar PV project. Municipal LGUs in Oriental Mindoro expressed their support for the project and readiness to provide counterpart funding for retrofitting their respective facilities to accommodate solar PV systems.

PGOM should also capitalize on the strong support from national government in facilitating policy and technical capacity needed for local policy frameworks and delivery mechanisms. Positioning Oriental Mindoro as first-mover on net-metering in off-grid areas may mobilize political, technical, and financial resources as this gives national government agencies an opportunity to demonstrate effectiveness of RE Law implementation instruments and encourage further renewable energy development.

Implement collaborative, transparent, and inclusive processes in formulating the provincial ordinance on renewable energy, the LREP, and other policy support mechanisms. Public consultations and membership in technical working groups by diverse stakeholders and subject matter experts are some examples of inclusive processes which enhance support and provide procedural legitimacy in policymaking.

Explore diverse financing options

There are primarily two financing options that PGOM may explore for the rooftop solar PV facility

93 Lucas, D. More *"PH banks subscribing to BSP's "green" finance principles."* Philippine Daily Inquirer. 28 August 2020. https://business.inquirer.net/306082/more-ph-banks-subscribing-to-bsps-green-finance-principles

94 *"RCBC sustainable loans hit P52B in 2020."* Business World. 15 April 2021

as discussed in the previous section. The first option is to finance a turnkey rooftop solar PV facility for its Capitol Main Building through a combination of self-financing and securing of a loan from a government financial institution. The second option is through a public-private partnership with a project developer. The recommendation is to keep communication channels open towards domestic and international financing institutions as well as project developers including development partners who can provide support (e.g. techno-commercial feasibility study) so that the PGOM purse a route that may optimally fit to the specific circumstances of the province.

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