EMPOWERING LOCAL ENERGY

Unleashing the Potential and Opportunities of Rooftop Solar in Philippine Public Buildings

PEOPLE OF ASIA FOR
CLIMATE SOLUTIONS

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ACKNOWLEDGMENT

We would like to thank everyone who supported our work and provided invaluable feedback on this research study. Our discussions have been enlightening, and though some were not reflected in the report in the interest of brevity, they have been well-documented and will be considered in future work and iterations of this report. This initiative is intended to be an ongoing study that will always be open to improvements, with the main goal of helping local communities adopt distributed renewable energy in a way that is just and contextualized to their specific locality.

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EXECUTIVE SUMMARY

The Philippines is one of the most vulnerable countries to climate change, consistently topping the list in the World Risk Report for three consecutive years. It faces frequent threats from extreme weather events such as typhoons, floods, and rising sea levels that are exacerbated by climate change. Furthermore, its energy mix relies heavily on the drivers of the climate crisis—imported fossil fuels, with coal and natural gas accounting for over 60%. Coal-fired power generation accounted for 61.9% in 2023, with 75% of coal imported. Electricity prices have risen by 53.4% over the past six years. The Malampaya field, the only domestically produced commercial gas source, is expected to be depleted in 2027, worsening future reliance on imported liquefied natural gas. This not only drives up electricity costs but also exposes national energy security to international price fluctuations, placing an increasingly severe burden on energy security and livelihoods.

Amid this crisis, the Philippines' abundant renewable energy resources, particularly its solar energy resource, have become crucial for achieving a breakthrough in energy transition. With an average annual sunshine of 1,800-2,600 hours and a total annual solar radiation of 1,500-2,100 kWh/m², the Philippines boasts a theoretical photovoltaic (PV) potential of 122 GW. In particular, the Philippines' public building rooftops hold immense potential for harnessing solar power, urgently awaiting development and unlocking. However, high initial costs and limited financing options for private households of residents make it difficult to maximize the development of the country's abundant solar energy resources. In contrast, the vast solar potential that can be harnessed by rooftops of public buildings in the Philippines remains largely untapped and urgently awaits development and utilization—a potential whose effective transformation critically relies on the leading role of Local Government Units (LGUs). Leveraging their fiscal autonomy under the decentralized governance system, LGUs can adjust budget priorities by utilizing increased shares of national tax allocations to channel public funds specifically into solar photovoltaic projects and also access other funding allocations that are relevant to renewable energy adoption and just energy transition, such as the Community Development Funds (CDF), to overcome financial constraints. Additionally, it is imperative to streamline approval processes and facilitate partnerships to accelerate implementation of Distributed Renewable Energy (DRE) projects. Given the pressing realities of high traditional electricity costs and urgent energy security needs, LGUs must take the role of central actors in unlocking the solar potential of public rooftops and advancing the energy transition.

Research done by the *People of Asia for Climate Solutions* in a selected barangay, municipality, and city examines distributed solar generation on public building rooftops which is home-grown, natural, clean, renewable, and independently-managed. Utilizing idle public rooftop space to develop distributed solar PV systems can rapidly jumpstart the country's clean energy transition at a relatively low cost and without occupying land resources, which creates a stark contrast to the costly and environmentally damaging effects of the usage of fossil fuels. Furthermore, large-scale development of PV on public building rooftops can not only reduce energy costs and reduce reliance on fossil fuels but also generate savings for the LGUs which can be reallocated to support other programs and services such as in education and healthcare, effectively improving people's well-being and community welfare. For LGUs, developing the PV potential of public building rooftops is greatly significant from an economic, social, and environmental standpoint.

Core research findings identify public building rooftops as a critical, yet underutilized, asset for achieving the energy transition. Through detailed case simulations and scenario analysis within the frameworks of the existing Net-Metering Program (NMP) and the forward-looking Expanded Roof-mounted Solar Program (ERSP), the study yields clear and compelling economic conclusions:

● Net Metering Program (NMP)

Provides Local Government Units (LGUs) with a readily implementable and low-risk fiscal optimization tool. Its core value lies in transforming traditionally high and fixed public electricity expenditures into sustainable fiscal savings through the mechanism of "self-consumption, surplus fed into the grid." This study conducted a quantitative analysis using Barangay Bicos in Rizal, Nueva Ecija as a case study. Under the NMP framework, and considering the barangay's context – a monthly electricity load of 2,094 kWh, an electricity rate structure of 10.23 PHP/kWh, and a limited budget of 200,000 Philippine Pesos – an 11 kW rooftop photovoltaic system was determined to be appropriate. Economic analysis shows that even with a self-consumption rate as low as 10%, the investment payback period is only 1.74 years; if the consumption rate increases to 30% and 50%, the payback period can be further shortened to 1.47 years and 1.27 years, respectively, fully demonstrating the economic viability of this rooftop solar PV project under varying conditions. However, it must be emphasized that the 11 kW system-size solar installation modelled, which yielded corresponding excellent return data in this case, is strictly tailored to the specific conditions of Barangay Bicos and is not a universal installation capacity standard applicable to all LGUs. The universality of this study lies in emphasizing that there is a way for LGUs to utilize NMP, contextualized to their own building electricity consumption profiles, local electricity rate structures, and local fiscal budgets, to conduct customized system design and benefit calculations, effectively transforming energy expenditures into long-term savings.

●Expanded Roof-mounted Solar Program (ERSP)

Represents a more ambitious paradigm aimed at achieving distributed electricity trading within the surrounding community through the "restricted peer-to-peer (P2P) energy trading" business model. This study's assessment of the rooftop potential of public buildings in the municipality of Rizal shows that the rooftops of their 156 public buildings could theoretically deploy approximately 6.61 MW of photovoltaic systems, coupled with 3.31 MW of energy storage systems to form a "community microgrid." This system could generate approximately 12,069,090 kWh annually, sufficient to meet the annual electricity demand of 5,028 typical households with a monthly consumption of 200 kWh, positioning it as a community energy hub. However, the economic feasibility of this model highly depends on a series of stringent, ideal prerequisites, including but not limited to: exceptionally large initial investment exceeding conventional levels, stable and high community electricity consumption/demand, a fully supportive policy and regulatory framework for P2P trading, and complex technical operational management. Its idealized economic model (investment payback period of 3.26 years) relies on the strict assumption of 100% consumption, which is challenging to achieve in the current Philippine context. Therefore, the discussion of ERSP in this study is strictly limited to revealing its theoretical potential and practical bottlenecks in specific case areas, aiming to illustrate it as a high-risk, long-term strategy and a more ambitious future direction that combines potential high returns with high risks.

Based on the analysis, Local Government Units (LGUs) are uniquely positioned to harness this potential. Their distinct advantage stems from the capacity to fund initial investments through internal budget reallocations and existing mechanisms like the Community Development Fund (CDF), avoiding reliance on complex external financing. Once operational, these systems generate electricity savings that flow directly back into barangay/municipal coffers, creating discretionary fiscal space. This initiates a powerful virtuous cycle: by deploying clean energy, LGUs achieve direct fiscal savings, which can then be reinvested to enhance essential services such as education and healthcare.

This approach transforms idle public rooftops into productive assets. In a country as vulnerable to natural hazards as the Philippines, solar-equipped public buildings can serve as resilient hubs, maintaining critical operations during emergencies and strengthening community-wide disaster preparedness. Moreover, LGU-led solar initiatives stimulate local economic ecosystems by fostering green supply chains and creating skilled employment opportunities, thereby building endogenous momentum for sustainable development.

Consequently, LGUs are not only positioned to take the first step but must do so, establishing themselves as pioneers in the national renewable energy transition. Prioritizing the solarization of public buildings has transcended being a mere option for LGUs; it is now an imperative for local economic well-being and long-term development.

We have the following strategic calls to action:

To Local Government Units (LGUs)

Adopt an immediate "phased" development approach. Prioritize the widespread adoption of the Net-Metering Program (NMP) to secure quick economic returns and build experience. Subsequently, study the Expanded Roof-mounted Solar Program (ERSP) in communities with favorable conditions. The immediate priority is to conduct localized assessments and integrate rooftop solar into the core development agenda.

To the National Government

Focus on optimizing the NMP policy environment and standardizing and streamlining approval and permitting processes. Concurrently, accelerate the establishment of a clear regulatory framework and risk mitigation guidelines for the ERSP. Providing comprehensive capacity-building support to LGUs—covering technical, financial, and project management aspects—is crucial for successful implementation.

Ultimately, the path to energy transformation in the Philippines begins on the rooftops of its public buildings across more than 7,000 islands. Awakening this vast "dormant asset" and transforming it into a powerful engine for local prosperity and sustainable development is a mission and opportunity entrusted to its local governments.

CONTENT LIST

CHAPTER 1

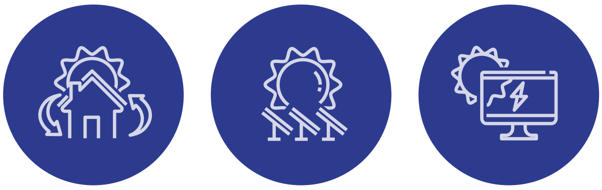
STATE OF ENERGY AND CLIMATE CHALLENGES IN THE PHILIPPINES

1.1 CLIMATE VULNERABILITY: SUSCEPTIBILITY TO CLIMATE CHANGE

The Philippines is located in Southeast Asia, bordering the West Philippine Sea to the west and the Pacific Ocean to the east. As an archipelagic nation, it covers an area of approximately 300,000 square kilometers, with more than 7,000 islands scattered between the tropical Pacific Ocean and West Philippine Sea. According to the latest World Bank data, the Philippines has a population of 112 million, making it the second most populous country in Southeast Asia and 13th in the world in 2024.

The country has a monsoon-type tropical rainforest climate, influenced year-round by the monsoon circulation, and faces frequent threats from extreme weather events such as typhoons, heavy rains, floods, and sea level rise. According to the 2021 World Risk Report cited in the ASEAN Climate Change Status Report, the Philippines had the highest number of people affected by natural hazards. Furthermore, the Philippines topped the 2024 World Risk Report Index for three consecutive years, highlighting the country's vulnerability and underscoring the urgent need to address and mitigate the impacts of climate change.

According to data from the Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA) in March 2025, 11 regions, including Manila, faced dangerous heat indices of 41-45°C for several consecutive days. The Department of Agriculture also stated that the El Niño phenomenon, characterized by persistently high sea temperatures in the central and eastern equatorial Pacific resulting in atmospheric circulation anomalies, caused agricultural losses totaling 1.75 billion pesos in eight regions of the Philippines. Approximately 32,000 hectares of farmland were destroyed, affecting more than 29,437 farmers.



On July 26, 2025, the National Disaster Risk Reduction and Management Council (NDRRMC) reported that the combined effects of Tropical Cyclones Crising, Dante, and Emong, along with the southwest monsoon, caused severe damage across the country, resulting in 30 deaths, 7 missing persons, and 5.299 million people affected. The agriculture and fishery sectors suffered severe losses, with estimated direct economic losses of approximately 484 million pesos, affecting 19,086 hectares of farmland and 19,662 fisherfolk, and a reduction in agricultural production of 14,314 tons. The National Irrigation Administration also reported damage to irrigation facilities worth 282 million pesos.

The Philippines' unique geographical location and large population make it one of the most vulnerable countries in the world to climate change. Intensifying global warming is significantly increasing the frequency and intensity of various extreme weather events.

This climate vulnerability is further reflected in the threat posed by rising sea levels. The Philippines boasts a 36,000-kilometer coastline, and approximately 60% of the population lives in coastal areas. Rising sea levels threaten the survival of coastal localities and communities.

Furthermore, coral bleaching and mangrove degradation caused by climate change are further weakening the natural defenses of coastal areas, accelerating the loss of habitats and ecosystem services, and creating a vicious cycle of "intensified disasters, ecological damage, and economic losses." In addition, the significant increase in coral bleaching threatens the Philippines' fishing economy. This systemic vulnerability not only threatens the lives and property of citizens but also poses a long-term challenge to the Philippines' sustainable development, highlighting the urgency of transitioning to clean energy to address climate change.

1.2 ENERGY STRUCTURAL DILEMMA: FOSSIL FUEL DEPENDENCE AND RISKS OF IMPORT

The energy system of the Philippines has long been characterized by a fossil fuel-dominated structure. According to the report of the International Energy Agency (IEA) in 2022 (Fig. 1), coal and oil collectively accounted for approximately 60% of the nation's total primary energy supply (IEA, 2024).

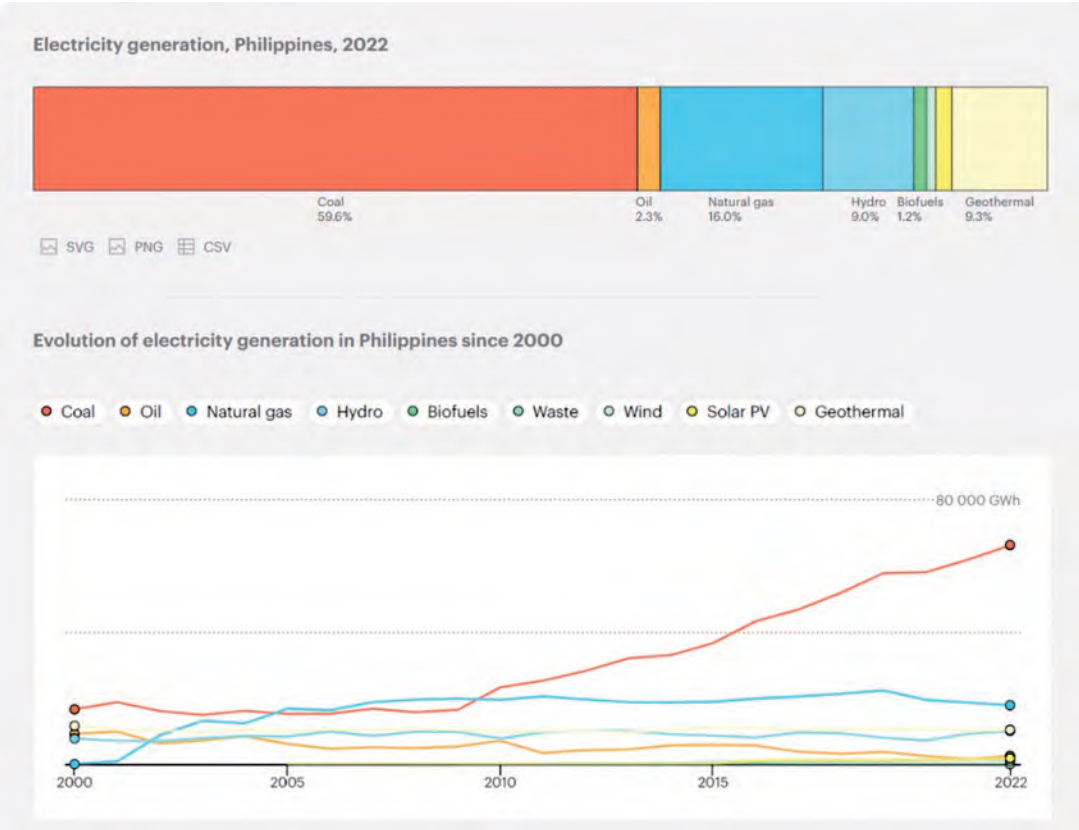


Figure 1. Electricity generation, Philippines, 2022 (IEA, 2024)

The country's electricity generation mix is composed of petroleum, hydropower, thermal power, coal, and natural gas at 7.14%, 10.51%, 13.40%, 44.51%, and 22.90% respectively, according to the report released by the Department of Energy of the Philippines in 2017. As of 2023, the proportion of coal-fired power generation in the Philippines had surged to 61.92% (Fig. 2), showing a significant increase compared with the 58.5% in 2022 (Global-Climatescope, 2024). The Philippines' escalating coal dependence has even surpassed historically coal-dependent nations, such as China, Indonesia, and Poland. Furthermore, its coal-fired power generation expanded by 9.7% in 2023, significantly outpacing the 4.6% growth in electricity demand during the same period (in-en.com, 2024). More critically, 75% of the country's coal supply depends on imports from neighboring countries such as Indonesia.

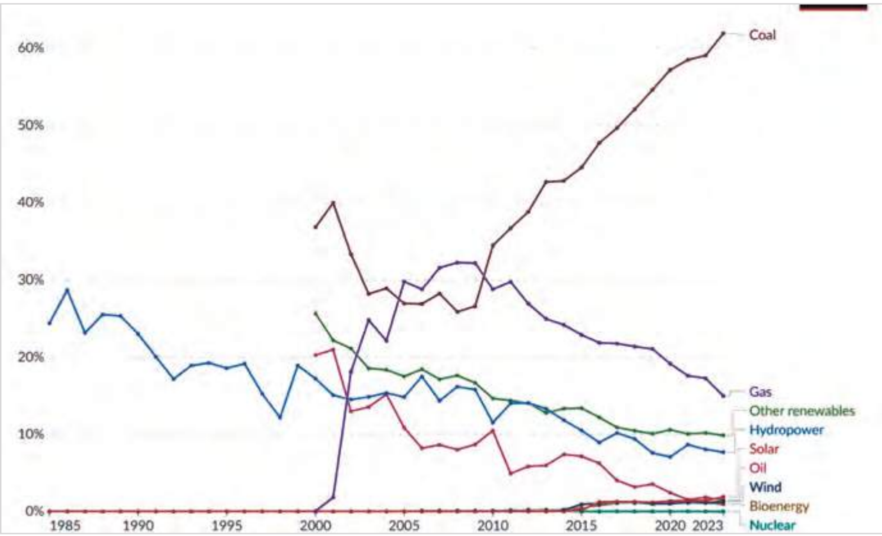


Figure 2. Electricity generation, Philippines, 2023 (IEA, 2024)

Beyond coal, the Philippines' electricity generation derives from natural gas and renewable energy. Renewable energy constitutes only 20% of the total energy mix and shows a pronounced structural disparity. Hydropower and geothermal dominate with a combined 17.5% share of the total energy mix, whereas solar and wind remain marginal at a mere 2.5%. Notably, the solar and wind penetration rate measures 10.5% points below the global average of 13% and falls short of the Association of Southeast Asian Nations (ASEAN) regional standard of 4.4% by 1.9% points.

Natural gas, accounting for approximately 16% of the total energy mix, faces a fundamental supply crisis. The Malampaya gas field, which has been in operation for over two decades and is the only domestic commercial gas source, accounts for one-fifth of electricity generation in the Philippines. Its production was projected to decline in 2024, with complete depletion expected in 2027. The Department of Energy (DOE) has warned that this scenario will create a permanent gas supply deficit. Although expansion of exploration activities was planned, domestic production capacity remains uncertain in the medium term, potentially requiring complete reliance on imported liquefied natural gas (LNG) after 2025 (Jihuc.com, 2024).

The country also faces challenges posed by its geographical conditions. Geographic limitations of many isolated island power grids have slowed down the robust development of the power grid. The cost of power generation in some outlying islands is nearly twice that of the main power grid. Due to the lag in power construction, power outages often occur. As a result, about 1.8 million households out of a population of over 100 million still lack access to electricity.

The dependence on imports of the Philippine energy system directly leads to the significant price inelasticity and supply-demand imbalances in its electricity market (EnergyTracker Asia, 2024). As a country with scarce domestic fossil fuel resources, the Philippines gets 75% of its coal for power generation from Indonesia, and it has long relied on the Malampaya gas field and LNG imports for natural gas. This structural dependence exposes the power sector to the risks of international energy price fluctuations. The national average electricity price in the Philippines has increased from $122.29/MWh in 2017 to $187.60/MWh in 2023 (Fig. 3), representing a 53.4% surge over six years (Global-Climatescope, 2024). Based on the average daily wage of 408 pesos for ordinary Filipino workers in 2017, the cost of 100 kWh of electricity per month accounted for 8.5% of the monthly income of a minimum wage worker.

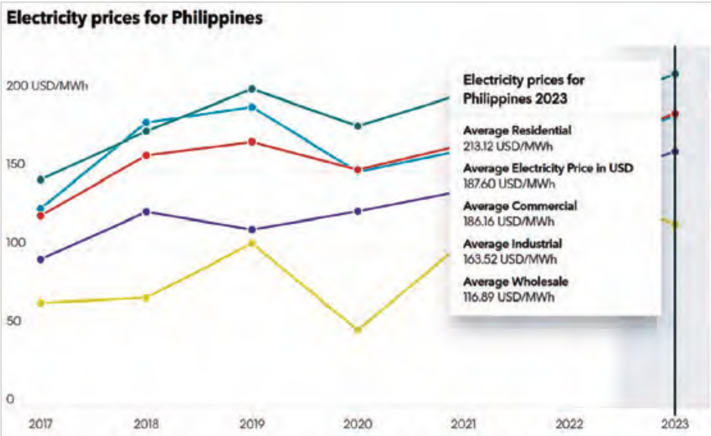


Figure 3. Electricity prices for the Philippines (Global-Climatescope, 2024)

The Philippines' persistently high electricity prices have imposed substantial pressures on people's lives and livelihoods. The case of the electricity price adjustment by the Manila Electric Company (Meralco) in February 2025 exemplified the cost transmission mechanism in utility pricing. This adjustment was caused by two primary factors: a 9.2% year-on-year increase in transmission and distribution costs as well as modifications to the renewable energy subsidy framework. Consequently, Meralco implemented a tariff increase of 2.6 centavos per kilowatt-hour (kWh), elevating the residential electricity rate from ₱12.0262 to ₱12.2901 per kWh, resulting in an additional ₱53 per billing cycle for households with typical 200-kWh monthly consumption. Meralco is the largest private sector electric distribution utility company in the Philippines accounting for 55% of the country's electricity output. One of the causes of high electricity prices in the Philippines is that there is limited competition in the power generation sector. Gaps in governance deter the entry of new players, which results in a small number of companies controlling the energy industry. Reduced competition leads to higher prices and limited choices for consumers. Cross-ownership between DUs and generation companies also increases prices.

As the third-largest economy in Southeast Asia, the Philippines grapples with compounding pressures from demographic expansion and surging energy demand. Structural vulnerabilities in its energy system emerge from the trilemma of geographic constraints, the developmental pathway, and energy structure. As the world's fifth-largest coal importer, the nation sustains a carbon-intensive generation mix (61.9% coal), facing dual pressures of high emissions and susceptibility to international price fluctuations. The imminent depletion of the Malampaya gas field by 2027—which currently supplies 20% of national electricity—has exacerbated a systemic crisis characterized by three interlocking challenges: heavy reliance on coal-fired power, vulnerability to imported fuel price volatility, and sustained high electricity costs (Global-Climatescope, 2024). Confronting this energy-security-climate nexus, it is urgent for the Philippines to prioritize an accelerated transition to renewable energy systems.

Facing the dual crises of climate and energy, rooftop solar energy on public buildings emerges as an optimal solution for the Philippines because of its low land occupation, rapid implementation, and scalability potential.

1.3 POSITION SOLAR ENERGY DEVELOPMENT: RESOURCE POTENTIAL AND DEVELOPMENT GOALS

The Philippines has taken strides in the adoption of renewable energy, with the aim of achieving the power generation mix target for renewable energy as reflected in the Philippine Energy Plan (PEP) 2020-2040. This target consists of a 35% renewable energy share by 2030, and a 50% renewable energy share by 2040. Investment and adoption of renewable energy are decarbonization strategies that will support the attainment of the Nationally Determined Contributions (NDC) submitted by the Philippines to the United Nations Framework Convention on Climate Change (UNFCCC) in 2021, as a signatory to the Paris Agreement. The goal is to reduce the country's GHG emissions by 75% by the year 2030. The diversified portfolio of renewable energy will completely change the current energy landscape that is heavily dependent on coal and natural gas (EnergyTracker Asia, 2024).

Located in the equatorial convergence zone, the Philippines has the best solar energy resources in Southeast Asia. The country enjoys an average annual sunshine of 1,800-2,600 hours, with a total annual solar radiation of 1,500-2,100 kWh/m². Peak insolation in some areas exceeds 5 kWh/m²/day, resulting in a theoretical photovoltaic potential of 122 GW (NetEase, 2024), around four times the country's current installed capacity. This natural endowment provides the foundation for energy transformation.

Just recently, the Energy Regulatory Commission (ERC) amended the net-metering rules to make it easier and more beneficial for people to install solar PV systems and join the net-metering program. Under the new rules, Distribution Utilities (DUs) must publish detailed program information on their websites, including application forms, processes, and data on capacities on a per-distribution-transformer basis every quarter. The new rules also allow credit banking and transfer, and renewable energy certificate meters are now voluntary rather than mandatory, making it possible for PV system set-ups to be simpler and cheaper. DUs are also urged to have few—only 3 or 4—requirements to make the program easier for users to adopt. They are also instructed to have uniform requirements, and processing of applications should be done in the shortest time possible.

In 2024, green energy advocacy organizations launched the 10 million solar rooftops challenge for the widespread adoption of distributed renewable energy across the country. The initiative calls on government bodies, private enterprises, schools, different establishments, churches, households, and individuals to take part in the collective goal of installing ten million solar rooftops in the country through multi-sectoral advocacy and cooperation. With a target of as low as 1 kW per solar rooftop, the collective action from people and groups could result in at least 10 GW of clean energy for households and communities.

In the province of Negros Occidental, Governor Eugenio Jose Lacson is working towards the use of solar energy in all LGUs of the province in the next three years, as he stated during the opening of the Renewable Energy Week Expo 2025. His strategy is to capitalize on collaborations to help Negros Occidental in its clean energy adoption and just energy transition efforts. In April of 2025, the province signed a contract with WeGen Energy Philippines Inc. to install solar PV systems with a total generation capacity of 1,270.5 kW in seven facilities of the provincial government. The solar system will supply at least 40% of the power requirement of the LGUs, and will result in savings of up to PHP 9.6 million annually. Governor Lacson stressed the need to "harmonize investment codes, local energy codes and other ordinances, establish working electronic virtual one-stop-shops, and comply with national issues such as guidelines to streamline and standardize the processing of energy infrastructure projects."

Figure 4. Gym in Barangay Villa Labrador, Rizal, Nueva Ecija, with a rooftop capable of supporting solar PV installations adaptable to various roof sizes and forms.

Figure 5. Data gathering at Barangay Villa Labrador, with PACS and a solar PV company

These initiatives show awareness of solar energy occupying a crucial position in this transition blueprint, with planned capacity additions reaching 27.16 GW, accounting for 51% of the total renewable target. According to the National Renewable Energy Program (NREP), the country aims to expand its renewable energy capacity to 15,304 MW by 2030, which nearly triples the current installed capacity, and solar power will be expected to contribute 10% of this target. In 2023, the Department of Energy allocated development quotas of 1,870.8 MW and 90 MW for ground-mounted photovoltaic systems and floating solar projects, respectively. This ambition aligns with growing market demand: in 2022, the national peak electricity demand reached 16,600 MW, with residential, commercial, and industrial sectors consuming 35.324 TWh, 24.294 TWh, and 28.84 TWh, respectively. With GDP growing at an annual rate of 7.6% and the industrial sector accounting for 28% of economic output, electricity consumption is increasing by 4.6% yearly. Projections indicate that peak demand will rise to 24,534 MW by 2030, which further underscores the Philippines' urgent need for sustainable energy solutions.

However, solar and wind remain marginal at a mere 2.5% of total energy mix, which is not only below the global average of 13%, but also falls short of the ASEAN regional standard of 4.4%. The country's solar development remains at a nascent stage. While wind and solar generation grew from less than 1 TWh in 2015 to 3.7 TWh in 2023, this expansion pace lags significantly behind that of other countries in Southeast Asia. From 2015 to 2023, the electricity generation from wind and solar energy in the entire Southeast Asian region surged by 46 TWh, with the Philippines contributing less than 10% of this growth (in-en.com, 2024).

To address this, the Philippines has actively promoted rooftop solar in recent years to curb high electricity costs and achieve its renewable energy goals. The Net Metering Program and Expanded Roof-mounted Solar Program are key policy initiatives to promote renewable energy development in the country. Since its launch in 2013, the Net Metering Program has allowed users with PV systems to transfer excess electricity to the grid in exchange for electricity bill credits, significantly reducing electricity costs for households and businesses while promoting the adoption of distributed energy resources and paving the way for larger-scale rooftop solar projects. According to the Philippine Department of Energy, by early 2025, the Net Metering Program had contributed 141 MW of electricity to the grid, and the net metering capacity limit was increased from 100 kW to 1 MW in 2022. At the same time, to further expand renewable energy coverage, the Philippine government has the innovative ERSP which is applicable to both on-grid and off-grid areas. The ERSP was launched with policies and guidelines under three business models of roof mounted solar facilities (RSF) with a capacity of more than 100 kWp to further unlock the potential of distributed energy. One of the business models is through a restricted peer-to-peer (P2P) electricity trading model, which was explored in this study. Under this setup, the LGUs functions as the Rooftop Solar Provider (RSP) and can sell electricity generated from LGUs public rooftops to nearby households and businesses for a lower cost compared to the rate of the DU, creating a micro-market. If there is surplus electricity, this may also be sold to the grid under a Power Purchase Agreement . These policies not only help reduce dependence on fossil fuels and lower carbon emissions but also enhance grid resilience, especially in remote areas. As the Philippine government continues to optimize its regulatory framework and increase publicity efforts; rooftop PV installed capacity is expected to grow steadily, providing key support for the country's goal of achieving a 35% renewable energy share by 2030.

As part of this research, a series of interviews were conducted with barangay local government officials in the municipality of Rizal, Nueva Ecija, to solicit their insights on the adoption of distributed solar PV. The discussions reveal that barangays are willing to adopt distributed solar energy systems, but they also recognize the need for proper tools, knowledge, and support to move forward with it.

Barangay leaders all testify to the rising cost of electricity in their locality. Bills for barangay services and operations, including streetlights, air conditioning in the barangay hall buildings, electric power for day care and senior citizens' centers, water pumps, and other facilities, show significant increases in recent months. Officials are of the opinion that transitioning to solar energy could help reduce the burden of high electricity costs and free up funds that could be reallocated to other essential services.

In terms of willingness to adopt distributed rooftop solar, the interviews can fall into two categories:

- Highly willing and already taking steps
- Willing but needs more support

Highly Willing

Some barangays, such as Barangay Poblacion East, have already expressed readiness to allocate part of their development fund for the adoption of distributed solar energy systems. Others, like Villa Labrador, already benefit from small-scale solar irrigation projects and are looking to expand it further for other facilities.

An official from Barangay Casilagan opined, *"If we can save on electricity, we can use that money for roads, livelihood, and facilities for PWDs. Solar is not just about power, it's about progress."*

Another official from Barangay Bicos said, *"If we spend less on electricity, we can spend more on senior citizens, health care, and fixing our drainage. Every peso saved on the bill can go back to the community."*

They also see solar, not just as a way to cut costs, but as an opportunity to link energy savings with other development goals such as nutrition programs, improvement of waste management systems and facilities, education investments for children in their locality, construction of roads, strengthening peace and order, and health services.

Figure 6. Data gathering at Barangay Poblacion East, with PACS and a solar PV company

Willing But Needs More Support

Despite the openness of barangay officials to the adoption of distributed solar energy, they also said that proposals should first pass through their councils and gain the support of fellow leaders and residents. Some barangays have already discussed allotting funds for solar investment in their meetings but have heard hesitations from some council members. Other barangays have yet to discuss solar formally in public forums and discussions.

Officials say that one of the key barriers to adopting rooftop solar is the high upfront costs of installation and the annual cost of maintaining the system. This is why they are hoping for external support or a good business model that takes into account their context.

An official from Barangay Pagasa said, "*We are willing, but we need help to start. The initial cost is too heavy for us, especially with the maintenance. But once the savings come, we can sustain it.*"

Another official from Barangay Pagasa shared, "*Half of my salary goes to paying for electricity. If we can show people that solar brings savings, they will understand why it is worth it.*"

An official from Barangay Cabucbucan added, "*The sanggunian needs details. If we can show them the numbers—the cost, the savings, the benefits—then we can defend solar properly.*"

Barangay leaders believe that the best way to gain support for the adoption of solar energy is still through calling for face-to-face meetings with residents so that benefits can be explained clearly, and any misconceptions or concerns can be addressed. They said that they need the help of experts to assist them in making a strong case for solar in their councils.

To take a further step from willingness to action, barangay officials are requesting IEC materials, capacity-building training, and workshops on cost-benefit analysis. They emphasized that their council members and citizens should be able to fully understand the technology, the savings potential, and how the adoption of solar could play a significant role in community development.

Across all interviews, leaders expressed the desire to transition to distributed solar, but also that they need support. With financial assistance, IEC campaigns, and capacity-building, barangays can confidently present solar projects to their councils and citizens, defend their cost-effectiveness, and ensure long-term sustainability.

For these barangays, solar is not just a way to light the streets, it will also light the way for more programs that people truly need.

Figure 7. Students from the Philippines visiting rooftop solar panels.

1.4 PRACTICAL BOTTLENECK OF PHOTOVOLTAICS: THE DIFFERENCE IN COST BETWEEN HOUSEHOLD AND PUBLIC UTILITIES

Under the urgent need for energy transformation in the Philippines, rooftop solar energy has shown advantages over traditional ground-based photovoltaics in adapting to local conditions and has become a more feasible development path. Although ground-based photovoltaic power stations can achieve large-scale power generation, they face multiple practical constraints. Firstly, land resources are limited, especially around major islands and cities, and renewable energy projects often need to compete with agricultural, residential, or ecological land. Secondly, land approval involves multiple levels of local governments and national agencies, with complex processes and long cycles, significantly delaying project progress. In addition, ground power stations are often located in remote areas, and electricity needs to be transmitted and distributed over long distances to load centers, resulting in high transmission losses and increased actual power supply costs.

In contrast, rooftop solar energy directly utilizes existing idle building rooftop resources without occupying additional land, adapting to the scattered island terrain and dense community layout of the Philippines. Although there are still challenges in permitting processes and approvals, on-site consumption of power generation effectively reduces transmission losses. The characteristics of "land exemption, efficient deployment, and nearby power supply" make rooftop solar energy a more practical and feasible clean energy option under current conditions in the Philippines.

The core contradiction in the current development of rooftop solar in the Philippines lies in the fact that while distributed PV systems can significantly reduce electricity costs over long-term use, existing promotion models are stuck in a dilemma of “sluggish household adoption and untapped public potential.” In practice, the high cost of residential rooftop installations remains a major barrier to adoption. Household users face prohibitive cost thresholds when deploying PV systems: a 2023 report by the International Renewable Energy Agency (IRENA) indicates that the installation cost of a residential rooftop solar system in the Philippines can be as high as $1,500-2,500 per kilowatt (approximately 84,000-140,000 pesos). For a 3-5 kW system, the average household will need to make a one-time investment of 25,200-70,000 pesos (approximately $450-1,250), equivalent to two to three times the minimum monthly wage in the Philippines. Carlo Paolo Octavo, technical director of local photovoltaic installer UpGreen Solar, further noted that a complete 5 kW system, including equipment, installation, and net metering application, can cost 240,000-280,000 pesos, with net metering eligibility from distribution companies (such as Meralco) alone costing an additional 50,000 pesos. According to 2024 data from the Philippine Solar Photovoltaic Association (PSPA), the initial cost of a 5-kilowatt rooftop photovoltaic system (including installation and grid-connection equipment) to meet the electricity needs of an average household is approximately equivalent to 18-25 months’ income for a minimum-wage worker in the country. Limited access to financing expands the difficulty. The Development Bank of the Philippines’ 2024 Renewable Energy Financing Report shows that banks generally require a 30% down payment and an annual interest rate of 8%-12% for household photovoltaic projects, extending the payback period to 8-12 years, far exceeding the average of 4-6 years in developed countries.

Figure 8. Rooftop solar PV installation in a household in Barangay Cabucbucan, Rizal, Nueva Ecija, which reduced the Santos family’s monthly electric bill from about ₱8,000 to ₱1,000.

While public buildings have demonstrated the feasibility of photovoltaic development within the existing policy framework, their potential remains far from being fully realized. Data from the Institute for Climate and Sustainable Cities (ICSC) mapping of 174 cities nationwide in July 2025 shows that the total installed solar rooftop capacity detected is 1,846.08 MW, of which utility-scale installations (primarily public buildings) account for 1,398.25 MW. This data confirms the substantial foundation for public buildings to develop photovoltaics, demonstrating that they are more capable of overcoming implementation bottlenecks than the residential market. It is particularly noteworthy that public buildings are usually located in densely populated communities, and on-site electricity consumption can reduce transmission and distribution losses, which is an unparalleled location advantage for ground power stations in remote areas. More crucially, however, this developed capacity represents only the tip of the iceberg of public building rooftop resources: numerous public buildings, such as schools, hospitals, and government offices, still have unused, flat, open, and load-bearing rooftops that remain available. This unused space is particularly pronounced in economically underdeveloped regions or areas with weak energy infrastructure. Jephraim Manansala, Chief Data Scientist at the ICSC stated: “Public rooftops are not just physical spaces for energy transition but also testing grounds for policy innovation. By streamlining grid connection approvals and establishing dedicated subsidy funds, the Philippines can fully transform its 7,000 islands into energy-independent islands.”

Amid the practical challenges in scaling up rooftop solar adoption, the key advantage of public building rooftop PV development lies in the ability of LGUs to overcome traditional constraints through flexible fiscal coordination mechanisms. The Philippines' decentralized political system positions LGUs as effective partners in achieving national goals, granting them greater authority, autonomy, responsibilities, and resources. With their own legislative bodies and elected officials who can directly influence funding allocation, LGUs serve as crucial drivers of PV development on public buildings.

The 2022 Mandanas-Garcia Supreme Court ruling significantly enhanced LGUs’ financial autonomy by increasing their share of the national tax allotment by about 38%. This substantial boost in funds not only expands LGUs’ budgetary space but also empowers them to reprioritize and reallocate budgets at their discretion without relying on central government approvals, enabling more agile and responsive financial management. Furthermore, the Philippine Climate Change Act mandates government financial institutions to provide LGUs with preferential loan packages for climate-related initiatives.

The key to flexible fiscal coordination mechanisms is optimizing the allocation of existing financial resources: LGUs can reorient current public funds toward PV project initiation and deployment by adjusting annual budget priorities.

Figure 9. Rooftop solar PV installation in a household in Barangay Cabucbucan, Rizal, Nueva Ecija, which reduced the Santos family’s monthly electric bill from about ₱8,000 to ₱1,000.

This budget priority realignment can be applied in diverse contexts—whether in high-population urban centers or areas with relatively limited infrastructure. Integrating PV projects into core local public service planning allows implementation within existing fiscal frameworks.

Beyond the flexibility in budget reallocation, LGUs-led rooftop PV projects also benefit from a self-sustaining investment cycle: revenues generated from electricity sales after project operation can be reinvested to fund new projects, enabling ongoing capacity growth. This contrasts sharply with the dilemma faced by individual households, which must independently bear the full financial burden and risks of their solar installations. By leveraging economies of scale and benefiting from the relative stability of public finances, LGUs can reduce upfront complexity and risk associated with PV deployment. This LGUs-led approach offers a more sustainable and scalable pathway for expanding rooftop solar capacity compared to residential self-development.

This optimization of existing fiscal systems provides a practical foundation for large-scale public rooftop PV deployment while offering a new perspective on overcoming funding bottlenecks in clean energy adoption.

Therefore, the development of solar PV on public building rooftops does not require the use of land resources, can reduce unit costs through large-scale procurement, and can achieve efficient resource integration through government coordination. This naturally offers the advantage of overcoming the bottlenecks of high initial costs and long payback periods for household solar. Existing data demonstrates the feasibility of solar PV development in public buildings. However, the untapped rooftops of public buildings, which could be transformed into high-quality clean energy production bases, have long remained underutilized due to a lack of systematic development planning and inadequate policy coordination. Therefore, these potential resources, which could be key breakthroughs in the Philippines' energy transition, have become a "blank area" that urgently needs to be filled in order to achieve its renewable energy goals and are a key strategic opportunity for the Philippines to achieve its 35% renewable energy target by 2030.

It is important to note that the allocation of budget for the procurement, installation, and maintenance of distributed solar systems is predicated upon the political will and leadership commitment of the mayor and LGUs officials to prioritize solar adoption. It should be supported by clear local policies and ordinances on rooftop solar integration, as well as investment in building the technical capacities of LGUs staff for operation and maintenance of solar projects. Many government projects are hampered by bureaucratic processes, thus, it is imperative to streamline permitting processes for faster installation approval. Initiating and sustaining partnerships with solar providers, financing institutions, and even non-government organizations will greatly assist in facilitating successful solar adoption and RE transition, as well as getting the buy-in of the citizenry through community engagement programs to encourage public awareness and acceptance. Lastly, it is just as important to continuously monitor, evaluate, and report on performance of the solar project and LGUs savings for trust-building and to showcase replicability in other localities.

Based on this background, this study focuses on distributed photovoltaic potential on public buildings. Taking Barangay Bicos and the municipality of Rizal as examples, this study systematically evaluates the power generation potential and economic and environmental benefits of public building rooftop PV through satellite surveys, power generation simulations, and cost-benefit analysis. By analyzing the local benefits brought by the available rooftop solar potential of public buildings, this study aims to provide replicable insights for local energy planning and to advance the Philippines' nationwide target of 35% renewable energy share by 2030.

CHAPTER 2

METHODOLOGY

2.1 RESEARCH APPROACH AND FRAMEWORK

This report features case studies utilizing scenario analysis. In the highly viable NMP scenario, the study area is Barangay Bicos, in the municipality of Rizal, province of Nueva Ecija. It is situated in the Central Luzon Region of the Philippines (Region III) with coordinates 15.6588, 121.0422 (15° 40' North, 121° 3' East). Elevation at this location is estimated at 75.9 meters or 249.0 feet above mean sea level. As of 2020, it had a total population of 5,869, which comprised 8.36% of the total population of Rizal. Taking the barangay halls of Barangay Bicos, a local government office building in the Philippines, as the specific research object. Through quantitative analysis of the costs and benefits of the photovoltaic system, the technical and economic feasibility of the barangay halls of Barangay Bicos LGUs rooftop photovoltaic project under the net metering plan is evaluated systematically.

The research integrates multi-dimensional data, including the historical electricity consumption of the barangay halls of Barangay Bicos (approximately 2,094 kWh/month), the prevailing tariff structure (approximately 10.23 PHP/kWh), and the available budget of the Barangay Bicos government (200,000 PHP). The framework explicitly accounts for the local Philippine context—including the policy environment, geographical conditions, and fiscal constraints—forming a comprehensive assessment process that spans from solar resource evaluation and system sizing to economic benefit analysis.

2.2 SYSTEM SIZING AND ENERGY YIELD ASSESSMENT

To determine feasible photovoltaic installation capacity, this study selected Chinese photovoltaic equipment as the cost and performance benchmark. This choice is based on the leading technological position of China's photovoltaic manufacturing industry in the global market. Its products not only have significant cost-effectiveness advantages but also perform excellently in key performance indicators such as conversion efficiency, rated power, annual attenuation rate, typhoon resistance, and long-term reliability. The unit cost is set at 2.1 CNY/Watt (approximately 17.35 PHP/Watt), which reflects both the cost advantage of large-scale production and the power generation gain brought by high-efficiency and high-reliability components throughout their entire lifecycle. With the limited budget and typhoon- frequented climate environment of the Philippines, this benchmark ensures that the system can meet the dual requirements of optimal performance and minimum risk while keeping costs under control.

This study takes the financial budget of Barangay Bicos as an example, through exchange rate conversion and budget analysis, it is shown that a budget of 200,000 Pesos can support the installation of an 11 kW capacity PV system. The scale of this system not only matches the typical electricity demand of public buildings, but also maximizes the installed capacity within the budget, and has the ability to operate stably under adverse weather conditions.

The study adopts the equivalent full-load hours method for calculating PV energy yield. This method is widely used in the Philippine PV project evaluation due to its intuitiveness, practicality, and strong alignment with local engineering practices. The core calculation formula is:

Annual Energy Yield = Installed Capacity × Daily Effective Generation Hours × 365 Days.

The Daily Effective Generation Hours parameter is set at 5 hours. This benchmark is determined following a conservative and pragmatic principle, based on long-term monitoring data from the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA). The data indicates that the annual average peak sun hours in major regions, including Metro Manila, range consistently from 4.8 to 5.2 hours. Selecting 5 hours as the baseline adequately captures the country's excellent solar resources while reasonably accounting for real-world system efficiency losses, such as performance degradation due to high tropical temperatures, cloud cover during the rainy season, and routine equipment maintenance.

This methodology is well-suited for technical decision-making in the public sector: its calculation process is transparent and easy for non-specialists to understand and verify; parameter selection is based on localized empirical data, avoiding uncertainties from more complex models; and it aligns with prevailing standards in the Philippine engineering community, ensuring the practical applicability of the assessment results. This establishes a reliable technical foundation for subsequent economic analysis and provides local governments with a user-friendly decision-making tool.

Figure 10. Gym in Barangay Poblacion East, Rizal, Nueva Ecija, whose roof can host solar PV while supporting various community activities

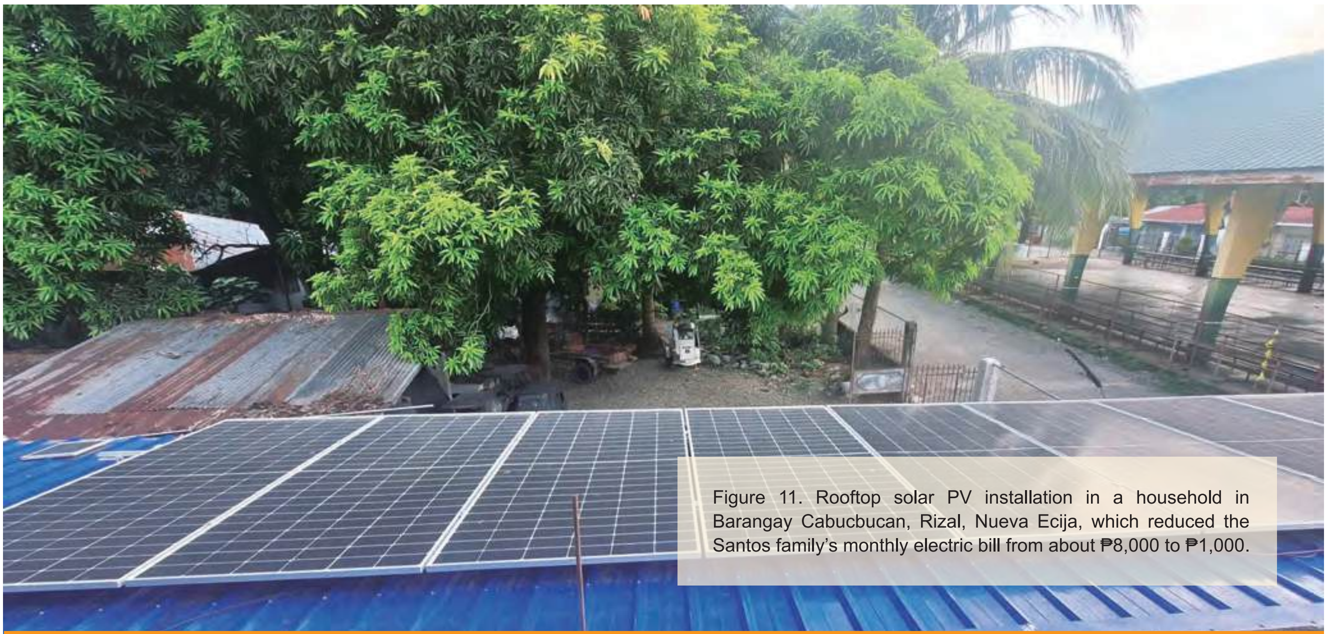


Figure 11. Rooftop solar PV installation in a household in Barangay Cabucbucan, Rizal, Nueva Ecija, which reduced the Santos family's monthly electric bill from about ₱8,000 to ₱1,000.

2.3 SCENARIO DESIGN UNDER THE NMP

The core objective of the scenario design is to systematically evaluate the project's economics under different levels of self-consumption. The analysis models three scenarios within the framework of the Philippine Net-Metering Program, which operates on a "self-consumption priority, excess electricity fed to the grid" principle.

The Net-Metering Program is a non-fiscal strategy prescribed under RA 9513 of 2008 to promote the utilization of RE in the country. It is designed as an incentive scheme that aims to encourage electricity customers to participate in the generation of RE to meet part of its load demand, thereby reducing its purchased electricity from the DU.

Under the Net-Metering Program, which commenced implementation in 2013, the electricity End-users are allowed to install an on-site (within the premises of the Electricity End-users), RE system not exceeding 100 kilowatts (kW) in capacity to generate electricity for their own use. The RE systems include wind, biomass, biogas energy systems, run-of-river micro-hydro or such other RE systems. The rooftop solar photovoltaic (PV) is currently the popular RE Net-Metering technology (DOE, Guidebook on Net Metering in the Philippines 2021).

It is also important to note that under the new NMP rules, credit banking is allowed, meaning the extra credits could be rolled over to future months' bills, when before they would just expire after some time or could only apply to the current bill. Thus, this new rule supports more savings for consumers.

Electricity consumed directly from the PV system is valued at the full retail electricity rate (10.23 PHP/kWh) in our case study of Barangay Bicos, displacing power that would otherwise be purchased from the grid. This essentially means that the "avoided cost" is approximately the full retail rate. Any excess electricity is fed to the grid. Under the NMP, this excess is converted into credits at a 1:1 ratio (1 kWh generated = 1 credit). Excess generation is valued at the DU's blended generation cost (in Peso/kWh) which is usually much lower than the retail rate. The blended generation cost may differ month by month and by DU, however, for the purpose of this study, we model a fixed credit value of 5.00 PHP/kWh which is around half of the full retail electricity rate (10.23 PHP/kWh in our case study). We deem that half of the retail rate as the export credit is sound because it is conservative. For instance, in the PSSEA's Market Report on Rooftop Solar in the Philippines, an electric bill with net-metering charges was provided as an example for the computation of energy charge for a billing period. In the bill, the import rate for the month is at 11.29 PHP/kWh, and the export rate is at 7.12 PHP/kWh. For simplicity, we will just take it to be half of the full retail price, although the actual credit is in terms of peso value based on the rate applied by the DU.

In this case, the total revenue generated by the PV system consists of two components:

Direct Revenue

● Direct RevenueDirect Revenue comes from savings on electricity bills resulting from self-consumed PV generation, calculated as the self-consumed energy (Econsumed) multiplied by the electricity price in grids (EP):

Direct Revenue = Econsumed × EP

Indirect Revenue

● Indirect Revenue is obtained from the credit compensation for surplus electricity fed into the grid. It is calculated as the total PV electricity generation (Etotal) minus self-consumed energy (Econsumed), multiplied by the credit value (CV):

Indirect Revenue = (Etotal - Econsumed) × CV

Thus, the total revenue is expressed as:

Total Revenue = Econsumed × EP + (Etotal -Econsumed) × CV

This revenue structure clearly reflects the comprehensive economic benefits of PV systems under varying self-consumption levels, achieved through the dual mechanisms of reducing grid electricity purchases and earning credits from surplus power.

This mechanism simulates the NMP's actual financial impact: it navigates around the regulatory complexity of direct electricity sales while significantly reducing the public sector's long-term electricity costs through bill credits. This approach is particularly suitable for public projects with limited budgets, as it enables flexible management and value maximization of generated electricity without requiring costly battery storage systems.

Figure 12. PACS Renewable Energy Engineering Scholars Batch 3 in dialogue with the PACS team and a solar PV company on current renewable energy trends and community solar opportunities.

This study establishes a three-tier scenario analysis framework, setting self-consumption rates at 50%, 30%, and 10%. This design is based on an in-depth examination of typical public building electricity consumption patterns, aiming to comprehensively evaluate the economic benefits and energy value of the public building PV system under various operational conditions:

50%

Self-Consumption Rate (Optimistic Scenario)

This scenario represents the potential upper limit of self-consumption achievable through active load management and operational adjustments, without requiring major capital investments. It is predicated on strategically shifting flexible electrical loads—such as HVAC operation and the use of high-power office equipment—into peak sunlight hours (e.g., 10:00 AM - 4:00 PM). The 50% rate demonstrates the system's potential when synergizing disciplined energy consumption practices with solar generation patterns. This scenario provides a valuable reference for the long-term energy and economic benefits achievable through proactive energy management.

30%

Self-Consumption Rate (Baseline Scenario)

This scenario reflects the typical performance achievable under standard operating conditions without significant behavioral or managerial interventions. It leverages the inherent synergy between the building's base load—primarily from lighting, computers, and routine office equipment—and daytime solar generation. The 30% rate is grounded in the natural alignment of government office hours (e.g., 9:00 AM - 5:00 PM) with peak insolation periods. This scenario serves as the most probable and critical benchmark for evaluating the project's core financial viability and expected performance under normal circumstances.

10%

Self-Consumption Rate (Conservative Scenario)

This scenario evaluates the project's economic resilience under suboptimal conditions and establishes a risk-aware baseline. It accounts for real-world constraints that limit self-consumption, such as significantly reduced building occupancy on weekends and holidays, the transient nature of PV output due to cloud cover, and inherent inefficiencies in perfectly aligning generation with instantaneous load. The 10% rate represents a lower-bound estimate, ensuring that the project remains financially viable even during periods of low self-consumption and providing decision-makers with a clear understanding of the downside risks.

This differentiated scenario design comprehensively captures the project's potential performance across different operational strategies. It includes the benefits of active management optimization while also providing reference benchmarks for baseline operation. Active management optimization includes solar PV peak shaving, which means using solar power to reduce the use of electricity from the grid, specifically during times of highest demand. Comparing these scenarios allows for a quantitative analysis of how the self-consumption rate impacts the investment payback period, the extent of electricity bill savings, and net metering benefits. This multi-scenario analytical approach aims to provide decision-makers with a complete spectrum of references, from optimistic to conservative, ensuring a thorough project assessment and controlled risk exposure.

2.4 PROSPECTIVE ANALYSIS OF THE EXPANDED ROOF-MOUNTED SOLAR PROGRAM

Following the detailed evaluation of the rooftop PV project under the NMP, this study conducts a prospective analysis to explore the potential and challenges of the more ambitious ERSP.

The ERSP is a different policy from the NMP. It will apply to both on-grid and off-grid areas. It covers roof mounted solar facilities (RSFs) with a capacity of above 100 kWp, for own use or exported to the host DU or the grid. It lays out the policies and guidelines for three business models of RSFs: Supply Contingency Option, Lease to Generate Option, and restricted peer to peer energy trading (PSSEA, Market Report on Rooftop Solar in the Philippines).

In this study, the restricted peer to peer energy trading model under the ERSP shall be adopted. This business model applies to a confined area where roof mounted solar providers (in this case, the LGUs with the public rooftop solar) sell or share directly with other participants such as nearby households and businesses. It should be noted that this setup requires enabling regulation for local energy sharing and smart metering infrastructure to track transactions, and requires strong local coordination and governance. The value of this is turning public building rooftops into a mini solar network that reduces electricity costs for the community, boosts local energy independence, and generates profit for the LGUs to append to the local budget.

Unlike NMP's "surplus electricity grid connection" model, ERSP adopts a "peer-to-peer trading" business model aimed at transforming public buildings from mere electricity consumers to regional energy hubs. The methodology for this exploratory analysis follows a logical sequence: Resource Assessment → System Configuration → Potential Estimation → Economic and Risk Analysis.

Regarding system configuration, the ERSP model requires building a "PV + Energy Storage" microgrid system to ensure the stability and reliability of P2P electricity trading. Therefore, the installed capacity estimation considered not only the available roof area but also preliminary sizing ratios for the energy storage system (PV: Energy Storage, 1:0.5). Using performance and cost benchmarks aligned with Chinese PV equipment and referencing current mainstream commercial lithium battery storage system costs (3CNY/W, approximately 24.78PHP/W) , the theoretical maximum PV capacity achievable by fully utilizing all available rooftops under the ERSP model, along with the corresponding storage configuration, was calculated. This capacity represents the upper limit of energy supply that public building rooftops can contribute under this policy framework. In this scenario, the municipality of Rizal is the case study area.

Rizal is a municipality located in the landlocked province of Nueva Ecija, in the Central Luzon Region (Region III) of the Philippines, with coordinates 15° 43' North, 121° 6' East (15.7087, 121.1050). It has a land area of 120.55 km2 and an estimated elevation above sea level of 90.5 meters. Rizal has 26 barangays under its purview (including Barangay Bicos), and its population, according to the 2020 census, was at 70,196.

First, manual identification and plotting of public buildings in Rizal was done using Google Earth imagery (Fig. 7). The buildings considered were schools, hospitals, gymnasiums, and other local government facilities. A total of 156 buildings identified and mapped, with a total area of 49531.859 square meters, provide an ideal platform for large-scale photovoltaic deployment, suitable for distributed small-scale development. Considering setbacks required for solar installation, roof slope, load-bearing structures, and other factors, 60% of the effective installation area was used as the research baseline, amounting to 29719.1154 square meters.

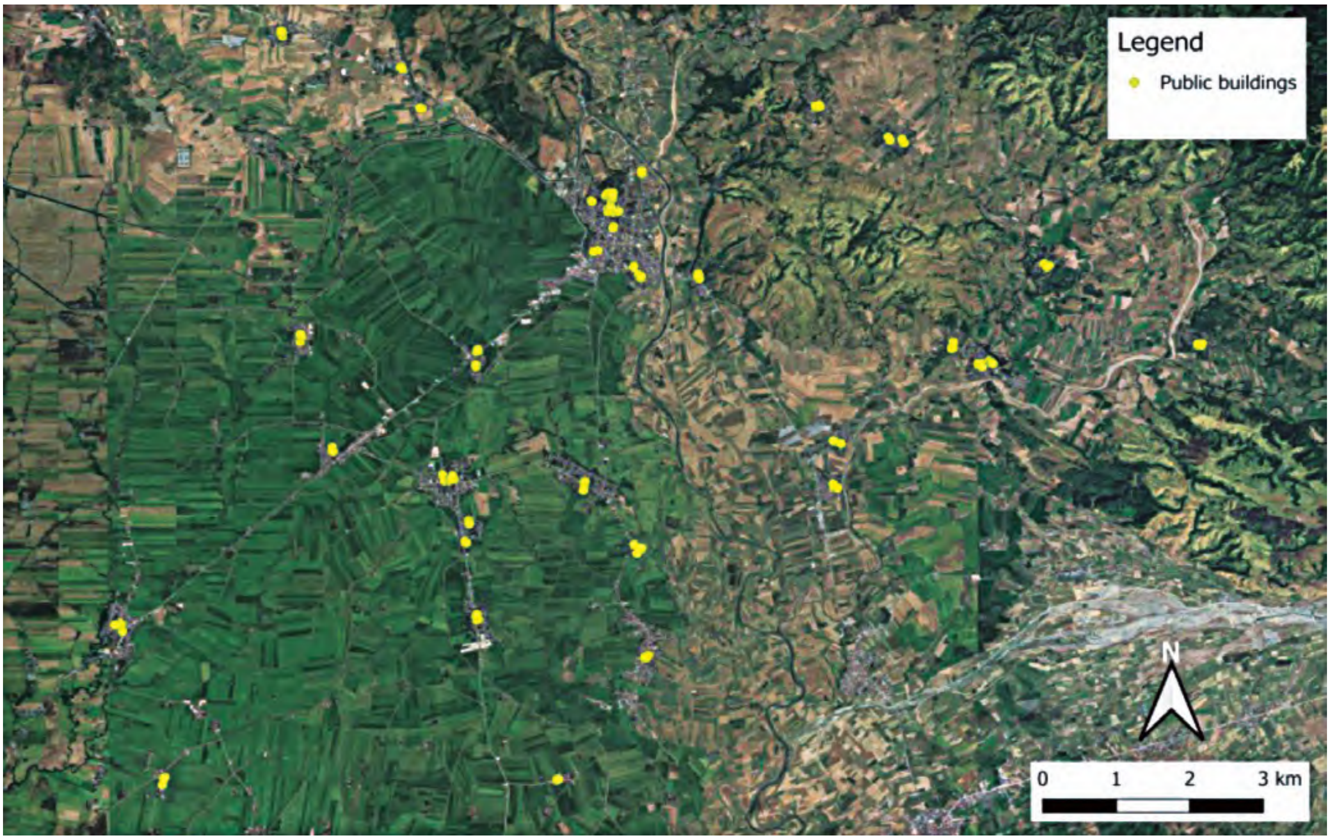


Figure 13. Municipality of Rizal, Nueva Ecija Public Buildings

For estimating power generation and supply potential, the same Equivalent Full Load Hours method (5 hours daily average) used in the NMP analysis was applied to calculate the annual total generation potential under the theoretical maximum PV capacity. The analysis then focused on the electricity utilization pathways:

P2P Trading Potential

The total power generation is the theoretical power supply potential for peer-to-peer trading in surrounding communities. The magnitude of this potential value intuitively reflects the potential scale of public buildings as "community power plants".

To assess the upper limit of ERSP benefits, an idealized economic model was constructed based on the following core assumptions:

Trading Mechanism

Public buildings act as electricity sellers, engaging in P2P trading with nearby residential users at an agreed tariff which is lower than what households typically pay to the DU.

Ideal Utilization

Assuming the community has 100% absorption capacity, meaning all of the electricity generated can be successfully sold.

Revenue Composition

Refers to the sales revenue of electricity:

○ Revenue from Electricity Sales: Theoretical power supply potential multiplied by the set agreed tariff (this tariff typically falls between the grid retail price and the feed-in credit price; for this calculation, based on relevant discussions in the Philippines, it was set at 5 PHP/kWh).

Under this idealized scenario, the project's theoretical total revenue, total investment cost (including PV and storage systems), and investment payback period were estimated to demonstrate the potential economics of the ERSP model under optimal conditions.

The methodological innovation of this study lies in constructing a multi-dimensional evaluation framework that integrates technical feasibility, economic efficiency, and policy compatibility. This framework moves beyond the limitations of analyzing a single policy scenario. Through a tiered analysis—progressing from the well-established NMP to the forward-looking ERSP—it comprehensively covers different development stages, from basic application to advanced energy management.

The research systematically identifies optimal pathways under different models by combining limited local budget constraints with optimized technical solutions, all within the prevailing policy framework. This methodology is particularly well-suited to the incremental governance structure and practical fiscal realities of Philippine local government units.

The study's outcomes not only provide comprehensive decision-support for the specific project in the case-study town, from implementation to potential upgrade, but more importantly, demonstrate how to unlock the renewable energy potential of public buildings in phases under constrained resources. They thereby offer a replicable and scalable analytical paradigm and practical pathway for the Philippines to achieve its 2030 renewable energy goals. Particularly regarding key issues such as overcoming the cost barriers of residential PV, optimizing public resource allocation, and advancing energy democratization, this study charts a viable and practical development path from the current reality towards a long-term vision.

Figure 14. Barangay Hall of Villa Labrador, Rizal, Nueva Ecija, a structurally sound LGU facility capable of hosting rooftop solar PV for clean, local energy.

CHAPTER 3

SCENARIO ANALYSIS

This study conducted an in-depth analysis of three scenarios of self-use electricity ratios for the envisioned Barangay Bicos rooftop PV system, based on the framework of the Philippines' net metering plan. Through a detailed analysis of the technical characteristics, economic performance, and policy implications of each scenario, multidimensional decision-making references are provided for the implementation of public building photovoltaic projects.

3.1 SCENARIO COMPARISON AND CORE INSIGHTS UNDER NMP

Research Results of the envisioned Barangay Bicos Rooftop PV System under NMP

	50% Scenario		30% Scenario		10% Scenario	
	Per month	Per year	Per month	Per year	Per month	Per year
Power from the PV (kWh)	825.00	9,900.00	495.00	5,940.00	165.00	1,980.00
Direct Revenue(Peso)	8,442.76	101,313.12	5,065.66	60,787.87	1,688.55	20,262.62
Surplus Power to Grid(kWh)	825.00	9,900.00	1,155.00	13,860.00	1,485.00	17,820.00
Indirect Revenue Credit Points	4,125.00	49,500.00	5,775.00	69,300.00	7,425.00	89,100.00
Power from the Grid(kWh)	1,269.00	15,228.00	1,599.00	19,188.00	1,929.00	23,148.00
Electricity Bills without the Credits(Peso)	12,986.50	155,838.00	16,363.60	196,363.25	19,740.71	236,888.50
Electricity Bills with the Credits(Peso)	8,861.50	106,338.00	10,588.60	127,063.25	12,315.71	147,788.50
Total Revenue(Peso)	12,567.76	150,813.12	10,840.66	130,087.87	9,113.55	109,362.62
Payback Year	1.27		1.47		1.74	

Table 1. Research Results of the envisioned Barangay Bicos Rooftop PV System under NMP

50%

Self-Consumption Scenario

This scenario aims to maximize the self-consumption ratio of the rooftop PV system through refined energy management measures, thereby enhancing both energy utilization efficiency and economic benefits. Achieving this requires the public building to be equipped with an advanced and efficient energy management system capable of precise control and intelligent management of various electrical equipment. Furthermore, seasonal electricity management protocols must be established to dynamically adjust equipment operation strategies based on seasonal variations in solar irradiance and building energy demand.

Under this scenario, the envisioned rooftop solar PV project in the Barangay Halls of Barangay Bicos demonstrates optimal economic performance:

●Monthly direct electricity bill savings reach PHP 8,442.76, accounting for 67.2% of the total expected benefits. This highlights the significant advantage of self-consumption in reducing electricity costs.

●The actual revenue per self-consumed kilowatt-hour is PHP 10.23, compared to the equivalent feed-in tariff of PHP 5/kWh. The unit revenue from self-consumption is 2.05 times that of feeding surplus electricity into the grid, validating the economic value of optimizing consumption to increase the self-consumption ratio.

●The initial investment can be recovered rapidly within just 1.27 years. This excellent payback performance primarily stems from the high self-consumption rate maximizing the displacement of expensive grid electricity, enabling swift cost recovery and fiscal savings.

●The annual total revenue reaches PHP 150,813.12, the highest among the three scenarios, further proving this scenario's superiority in economic returns. These results can serve as a long-term operational optimization target, guiding the continuous improvement of the energy management system.

Figure 15. A multi-purpose gym in Barangay Pagasa, Rizal, Nueva Ecija, with a rooftop sturdy enough to support solar PV installations.

30%

Self-Consumption Scenario

This scenario reflects the natural alignment between PV power generation and the electricity consumption patterns of government office buildings, characterized by their specific operational traits and inherent mechanisms. During standard office hours (9:00 AM–5:00 PM), the building's base electricity load naturally coincides with peak PV generation hours, allowing a portion of the PV electricity to be smoothly consumed on-site without complex energy dispatch or significant equipment adjustments. Essential loads like lighting, office equipment, and computers operate continuously during this period, creating stable demand. Simultaneously, the rooftop PV system operates at high efficiency due to ample daylight.

The Barangay Bicos rooftop PV project in this scenario offers a balanced revenue structure:

- The project's monthly total revenue is PHP 10,840.66, with an annual revenue of PHP 130,087.87.
- Direct benefits constitute 46.7% of the total, while indirect benefits account for 53.3%.
- The investment payback period is 1.47 years, which is highly competitive for renewable energy projects and is significant for long-term stable operation.
- The stable annual revenue provides a solid financial foundation for sustained operations, allowing for ongoing investment in maintenance, upgrades, and operational optimization.
- As this scenario most closely resembles the current operational state of typical government buildings, its implementation difficulty is low. It does not require large-scale modifications to existing electrical equipment or operational management practices, making it highly replicable and suitable for widespread deployment across various government buildings.

10%

Self-Consumption Scenario

This scenario considers the combined impact of various challenging operating conditions: significant fluctuations in building occupancy (e.g., dropping below 20% during long holidays), the effects of abnormal weather on generation, and unexpected changes in electricity demand. These factors can substantially reduce the actual self-consumption ratio.

Despite the extreme conditions, the Barangay Bicos rooftop PV project maintains significant economic viability:

Figure 16. Ceiling of the Barangay Bicos gym in Rizal, Nueva Ecija, showing a structurally sound rooftop suitable for solar PV.

- Although the share of direct benefits decreases to 18.5%, indirect benefits obtained through the net metering mechanism rise to 81.5%, ensuring the project's overall profitability.
- The investment payback period extends to 1.74 years but remains highly attractive. This demonstrates that the project retains sound economics even when actual operating conditions deviate significantly from expectations, providing investors with an important risk buffer.
- This scenario underscores the risk mitigation value of the net metering policy. During the initial promotion phase or in less ideal locations, even with limited self-consumption benefits, the policy safeguard ensures the fundamental economic feasibility of projects, providing crucial institutional support for large-scale adoption.

Scenario comparison and core insights

The fundamental distinction among the three scenarios lies in the ratio of self-consumption to grid feed-in. From the 50% to the 10% scenario, the self-consumption ratio decreases in steps of 20% points, while the surplus feed-in ratio increases correspondingly. This structural change directly influences the project's revenue composition and risk profile.

The Barangay Bicos rooftop PV project's revenue structure varies significantly across scenarios: the 50% self-consumption scenario relies primarily on high-value self-consumption; the 30% scenario achieves a balanced mix of self-consumption and surplus feed-in revenues; while the 10% scenario depends heavily on the net metering mechanism for revenue generation. These distinct revenue pathways reflect a clear gradient in revenue quality among the scenarios.

As the self-consumption ratio decreases, the Barangay Bicos rooftop PV project's dependence on the policy environment increases substantially. In the 10% self-consumption scenario, up to 90% of power generation revenue relies on the continuity of the net metering policy, whereas only 50% of revenue is policy-dependent in the 50% scenario. This contrast highlights their differing vulnerabilities to potential policy changes.

The variation in electricity allocation structures corresponds to different levels of operational complexity. The 50% self-consumption scenario requires a comprehensive load management system and detailed electricity optimization measures; the 30% scenario only needs to maintain existing operations; and the 10% scenario demands the least operational management effort—though this also indicates insufficient energy utilization efficiency.

The Barangay Bicos rooftop PV project case illustrates that even in scenarios where the matching degree between electricity consumption and generation is low, the PV system can still achieve rapid cost recovery through the integration deduction rule of the NMP, providing a replicable economic analysis framework for the PV transformation of public buildings in other towns.

3.2 ANALYSIS OF THE ERSP POTENTIAL AND RISKS

Building upon the baseline scenario analysis under the NMP, this study further investigates the potential and challenges of the more ambitious ERSP. Unlike the "behind-the-meter, surplus to grid" mechanism of the NMP, the ERSP aims to transform public buildings from mere consumers into regional energy hubs through a P2P trading model, thereby fully unlocking the resource potential of public building rooftops. This section analyzes the system scale, generation potential, ideal economics, and practical risks.

System Scale and Generation Potential: A Theoretical Community Energy Hub

Based on high-precision satellite imagery data, this study identified and measured the rooftop areas of all public buildings in the target areas (Rizal). After comprehensively considering installation setbacks, roof pitch, and structural load-bearing capacity, an effective installation area ratio of 60% was determined. Accordingly, the theoretical maximum photovoltaic capacity that can be installed under the ERSP model is as high as 6.61 MW. To ensure the stability and reliability required for P2P trading, the ERSP model must incorporate a "PV + storage" microgrid system. This study configured a 3.31 MW commercial battery energy storage system at a 1:0.5 capacity ratio. This configuration significantly increases the initial investment, totaling 196,650,115.20 Philippine Pesos, but it also brings enormous generation potential. Using the same equivalent full-load hours method (5 hours daily), this 6.61 MW system can generate up to 12,069,090 kWh annually. All electricity is sold to surrounding communities at a price of 5PHP/kWh, theoretically meeting the annual demand of approximately 5,028 typical households with a monthly electricity consumption of 200 kWh, fully demonstrating the magnificent potential of public buildings as "community power plants".

Research Results of the PV Potential of Rizal under ERSP	
Public Building Rooftop Area Unit: m^2	49,531.86
60% Available Rooftop Area Unit: m^2	29,719.12
PV Size Parameter Unit:m^2	3.24
Rated Power of Equipment Unit: W	720
Total Panel Required	9,185
Installed Capacity Unit: MW	6.61
Storage Capacity Unit: MW	3.31
PV Cost Unit: PHP	114,712,567.20
Storage Cost Unit: PHP	81,937,548. 00
Initial Cost Unit: PHP	196,650,115.20
Annual Electricity Generation Unit: kWh	12,069,090.00
Revenue Unit: PHP	60,345,450.00
Payback Year	3.26

Table 2 Research Results of the PV Potential of Rizal under ERSP

To assess the theoretical upper limit of revenue for the ERSP model, this study constructed an idealized economic model. Its core assumptions include: the community having 100% electricity absorption capacity and all electricity generated being successfully sold at an agreed price of 5 Pesos/kWh. Under this ideal scenario, the project's annual total revenue amounts to 60,345,450 Pesos. Despite the huge initial investment, the project's payback period in this ideal model is only 3.26 years. This highly attractive return period reveals the exceptional economy that the ERSP model could achieve under optimal conditions, showcasing its significant potential as a large-scale renewable energy investment.

However, the realization of this ideal economic viability relies on a series of stringent assumptions. The ERSP model faces multiple high-risk challenges in practical implementation. Firstly, the high initial investment barrier, exceeding 196,650,115.20 Pesos, far exceeds the conventional budgets of LGUs. It must rely on complex financing models such as private capital, international green loans, or Public-Private Partnerships (PPP), the feasibility and cost of which are highly uncertain. Secondly, the complex policy and regulatory environment in the Philippines, where the current electricity regulatory framework is designed for traditional grid operations, poses a significant hurdle. P2P trading, as an emerging model, lacks a clear legal basis and detailed implementation rules for transaction mechanisms, transmission and distribution cost accounting, and settlement, resulting in extremely high policy risk. Thirdly, the uncertainty of community absorption capacity is a major market risk. The ideal model assumes 100% community absorption, but in reality, the electricity demand, willingness to pay, and grid connection conditions of surrounding residents may lead to actual transaction volumes and agreed prices being far lower than expected. Finally, the technical operation and maintenance complexity of a large-scale PV-storage microgrid system presents far greater technical requirements than a simple grid-tied PV system, posing a significant challenge to the technical management capabilities of local governments.

In summary, the Net-Metering Program and the Expanded Roof-mounted Solar Program respectively present different development scenarios for photovoltaics in public buildings in the Philippines. The NMP model has demonstrated its practical ability to rapidly increase renewable energy generation under current conditions through its robust economy and wide applicability. The ERSP model reveals the enormous potential for public buildings to play the role of regional energy producers in the future, pointing to the possibility of deeper changes in the energy system. Both reflect the value of photovoltaic technology in different stages of development and application scenarios in the Philippines, and are of great significance for achieving the country's 2030 and 2040 renewable energy goals.

CHAPTER 4

FUNDAMENTAL DIVERGENCE

The core divergence between NMP and ERSP originates from their fundamentally different answers to the critical question of "how to allocate and monetize surplus electricity." This difference directly shapes their entire operational logic and cost-benefit structures.

4.1 NMP: A LOW-RISK, BILL-REDUCTION STRATEGY

Implemented in the Philippines since 2013, the NMP is a key policy for promoting distributed solar. Its core principle is "self-consumption first, with excess fed into the grid," operating under a unique "credit offset" mechanism. Electricity consumed directly by the user saves the full retail rate, while surplus electricity exported to the grid is converted into credits at a 1:1 ratio (kWh for kWh), used to offset future electricity consumption from the grid. Crucially, the monetary value of each credit is typically significantly lower than the retail electricity price.

It is essential to recognize that under NMP, exporting excess electricity to the grid is not a genuine power sales transaction; it is fundamentally a bill crediting mechanism. All exported energy is converted into credits, whose sole purpose is to offset that specific building's future electricity bills. This mechanism defines the fundamental nature of an NMP project: it is not a for-profit venture but a capital investment aimed at minimizing electricity expenditures. Consequently, the economics of NMP projects depend heavily on precisely matching the system capacity to the building's actual electricity load, rather than blindly maximizing installed capacity. Project benefits are realized entirely through the reduction of the public building's original electricity bills, thereby freeing up significant fiscal resources for the LGU.

Therefore, a key conclusion is that there is no universally "standard" system size applicable to all LGUs. For instance, the 11kW system selected for Barangay Bicos was the tailor-fitted result based on specific local conditions—including a monthly consumption of approximately 2,094 kWh and an annual budget of 200,000 PHP—aiming to maximize fund utilization while avoiding credit surplus caused by over-generation.

The system's economics and investment payback period are closely tied to the self-consumption ratio (i.e., the proportion of generated electricity consumed on-site). Scenario analyses assuming self-consumption ratios of 50%, 30%, and 10% clearly demonstrate the following patterns:

- **At a 50% self-consumption ratio,** the project demonstrates optimal economics and the shortest payback period. This validates the core benefit logic of NMP: a higher self-consumption ratio yields greater savings by displacing expensive grid electricity at the 1:1 credit value, accelerating the return on investment.
- **At a 30% self-consumption scenario,** benefits are more balanced, reflecting the typical performance for a standard public building operation, making it a highly valuable and replicable reference case.
- **At a low 10% self-consumption ratio,** while direct bill savings are limited, the "fiscal safety net" function of the net metering policy becomes prominent. By exporting most generated electricity as credits to the grid, the project can still effectively offset the majority of the annual electricity expenditure, ensuring the payback period remains within an acceptable range.

This gradient analysis indicates that while higher self-consumption ratios lead to superior returns and faster payback, the project remains economically feasible even with lower self-consumption, provided the generated credits are utilized to offset actual bills within their validity period. The critical constraint is that the total monetary value of credits used cannot exceed the building's total annual electricity bill. As long as the credits from exported electricity do not surpass this ceiling, the objective of fiscal relief is achieved.

Conversely, if the system is oversized, generating excessive credits beyond the building's own billing requirements, the surplus credits become worthless as they cannot be monetized, leading to wasted investment. Therefore, NMP project planning must avoid indiscriminate capacity maximization and instead focus on meticulously matching system generation with the building's load profile and billing structure.

The scenario analysis underscores NMP's inherent robustness. Even under the unfavorable assumption of a 10% self-consumption ratio, the core mechanism of credit offsetting provides a solid floor for project economics, ensuring stable fiscal savings despite consumption fluctuations. This resilience to short-term variations in a building's self-consumption makes NMP a "low-resistance entry point" for public buildings embarking on their energy transition.

The policy's primary advantages are its low comprehensive cost and implementation barrier.

●**Controlled Initial Investment:** Because the value of surplus power is restricted to "credit offset" rather than "sale," project economics inherently depend on maximizing "self-consumption" to save on high electricity costs. This naturally steers projects toward right-sized systems, avoiding the cost and complexity of energy storage and keeping the initial investment within a necessary and manageable range.

●**Simple Operation and Maintenance (O&M):** The absence of storage means O&M focuses solely on the PV equipment itself, eliminating the need for complex power dispatch, user-side management, or electricity trading, thereby minimizing technical thresholds and long-term O&M costs.

However, this model has inherent limitations. The most significant is the existence of an earnings ceiling. Total project revenue is strictly capped by the building's own total electricity expenditure, as all benefits are realized through bill savings or credits. Once PV generation (or the resulting credits) covers the entire electricity bill, additional generation cannot create further value. Furthermore, the model is highly dependent on grid hosting capacity. If numerous distributed PV systems inject power back into the grid simultaneously, it can cause grid instability. Capacity limits imposed by utilities for grid safety reasons can thus become a hidden bottleneck for large-scale replication of this model.

In summary, the Net Metering Program offers public buildings a low-risk, straightforward pathway to adopting distributed solar. Its economic viability does not demand advanced energy management capabilities from LGUs. Even with significant load variations or low self-consumption ratios, the credit mechanism reliably delivers fiscal savings. LGUs should determine their optimal system size based on their specific consumption patterns and budget constraints to maximize the policy's energy-saving and economic benefits.

4.2 ERSP: A HIGH-POTENTIAL, HIGH-RISK STRATEGIC PATHWAY

In contrast to the NMP, which is primarily designed for fiscal relief, the ERSP represents a more ambitious energy paradigm. Its core operational model is P2P energy trading. By deploying integrated "PV + Storage" systems, the ERSP P2P is designed to transform public buildings into community energy hubs. These hubs can form semi-autonomous "community microgrids" and sell electricity directly to surrounding residents at a predetermined contractual price.

The defining characteristics of the ERSP model are its community microgrid architecture and market-oriented transaction mechanism. Consequently, energy storage systems become an indispensable component. They are essential not only for mitigating the intermittency of solar generation and ensuring a reliable power supply but also for shifting energy temporally—storing excess daytime electricity for use during the evening peak demand period within the community. Regarding the revenue mechanism, ERSP enables the sale of electricity from public building rooftops directly to community users. This transforms electricity into a genuine tradable commodity, marking a fundamental shift from an "energy efficiency investment" to the "commoditization of energy," thereby theoretically removing the revenue ceiling present in the NMP model.

To achieve reliable microgrid operation and facilitate P2P trading, ERSP projects necessitate extensive electrical circuit upgrades and the deployment of critical infrastructure, including smart meters, Battery Management System (BMS), smart Energy Management Systems (EMS), and potentially even Virtual Power Plant (VPP) platforms.

However, realizing this model is predicated on overcoming significant technical complexity and securing substantial capital investment. The core technological suite required for a sophisticated ERSP implementation acts as the microgrid's "central nervous system":

- **Battery Management System (BMS):** Ensuring the safe operation, status monitoring, and lifespan optimization of the storage batteries, forming the foundational layer for microgrid stability.
- **Smart Energy Management System (EMS):** Realizing multiple functions such as power generation forecasting, load management, real-time scheduling, and transaction settlement.
- **Virtual Power Plant (VPP) or Digital Grid Platform:** Representing the highest form of technical integration, these platforms require robust capabilities for data fusion, algorithmic optimization, and coordinated control.

Furthermore, operational complexity increases dramatically. Success no longer depends solely on hardware functionality but critically on soft capabilities: managing community electricity demand forecasting, optimizing storage dispatch strategies, coordinating internal power distribution, and handling multi-user billing and settlements. The project's viability becomes highly dependent on maintaining a stable internal energy supply-demand balance. Factors such as changes in residents' consumption patterns or community demographic shifts that reduce local energy absorption capacity can directly impact revenue realization.

Therefore, while this model can unlock the full energy potential of public building rooftops, the construction and maintenance of a microgrid demand a more sophisticated local management framework. Implementation is likely to face challenges related to policy integration and execution. Even with a relatively simplified system configuration, the complexities of strategic optimization and multi-asset coordination present serious technical and managerial challenges for local governments, making the model susceptible to external disruptions and inherently higher risk.

The potential analysis in this study reveals an ambitious yet theoretically fragile picture. Under ideal conditions, ERSP's theoretical annual revenue and payback period appear highly attractive. However, this "ideal model" starkly contrasts with the stringent real-world assumptions required for its success:

- **Financing Feasibility:** The substantial initial investment far exceeds the conventional budgets of LGUs, creating a heavy reliance on complex and uncertain financing mechanisms like Public-Private Partnerships (PPPs) or international green funding.
- **Technical Implementation Hurdles:** Each implementation phase—from circuit upgrades and smart meter installation to EMS deployment—involves high costs and technical adaptation challenges. For instance, installing smart meters and upgrading wiring for every household represents not just a major engineering hurdle but also significantly increases overall project costs.
- **Policy and Regulatory Risk:** The current regulatory framework for the electricity market lacks robust support for P2P trading. Ambiguities persist in key areas such as transaction mechanisms, allocation of distribution use-of-system charges, and settlement rules.
- **Market Absorption Risk:** The theoretical model's assumption of 100% absorption is difficult to achieve in practice. Fluctuations in community electricity demand, residents' willingness to pay, and demographic changes introduce significant uncertainty, meaning actual transaction volumes and prices could fall far short of projections.

Therefore, ERSP should not be considered an immediate, large-scale replacement for NMP. Instead, it should be positioned as a forward-looking strategic direction with high potential but concomitantly high risk. The implementation path must be gradual, starting from demonstration areas with stable electricity demand and harmonious community relationships, gradually accumulating technical, operational, and market experience, and cautiously promoting on the basis of further policy support and financing mechanisms.

In summary, the Net-Metering Program and the Expanded Roof-mounted Solar Program represent two parallel and complementary development pathways for the solarization of public buildings in the Philippines. NMP, with its robust economics and low implementation threshold, provides a practical solution grounded in the present, offering quick returns. ERSP, with its potential to reshape the local energy ecosystem, points towards a strategic, future-oriented direction aimed at greater energy autonomy.

CHAPTER 5

SYNERGISTIC POTENTIAL AND IMPLEMENTATION CORE: PUBLIC BUILDINGS AS THE FOUNDATION FOR REGIONAL ENERGY TRANSITION

This study demonstrates that, whether through the present-focused NMP or the future-oriented ERSP P2P, the rooftop resources of Philippine public buildings are far more than isolated physical spaces. They represent activatable nodes that can be deeply integrated into the regional energy system. Despite their differing operational models and cost-benefit structures, their true value lies in their complementarity and synergy, collectively forming a clear evolutionary path from "internal energy efficiency" to "external energy empowerment," and from "experience accumulation" to "energy autonomy." The most critical actor in unlocking this potential is the LGUs—serving not merely as project implementers, but as builders of the regional energy ecosystem and maximizers of public benefit.

5.1 THE DEEP VALUE SYNERGY OF NMP AND ERSP

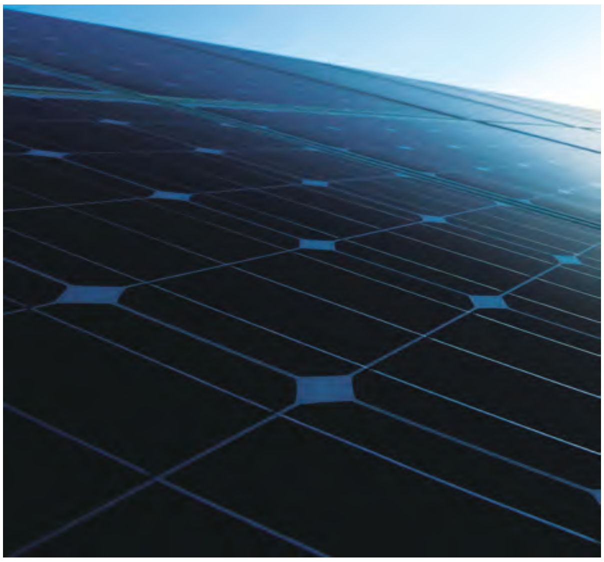
NMP and ERSP share a common underlying logic for driving the Philippine energy transition: transforming public buildings from cost centers within the energy system into hubs of value creation, and in the process, building a locally-managed energy governance system with continuous evolutionary capacity.

First, both strategies collectively enable the strategic activation of public assets and the accumulation of sustainable operational capabilities. In a context where infrastructure investment often faces funding constraints, public building rooftops largely remain dormant. The introduction of NMP and ERSP turns these rooftops from "liabilities" generating no direct revenue into "productive assets" that directly create fiscal savings or new revenue streams. This transformation's essence is the creation of a new, sustainable source of fiscal income for local governments without requiring new land acquisition or major infrastructure investment. This is not only an innovation in financial management but also a profound shift in public resource management philosophy—from consumptive maintenance to productive investment.

By implementing NMP, LGUs can achieve rapid investment payback, accumulate operation and maintenance experience, and gradually build local capacity for the full lifecycle management of distributed PV systems. This not only builds a technical and managerial foundation for subsequent, more complex energy projects but also fosters local employment in PV installation, maintenance, and related fields, enhancing community green skills. As capabilities and experience grow, LGUs can progress to the ERSP stage, constructing community microgrids and achieving the leap from "bills savings" to "revenue generation," and from "independent operation" to "community interconnection." This process itself is a manifestation of strengthening local energy governance.

Second, they form a strategic synergy in enhancing energy security and resilience at the national and regional levels. The Philippines is highly dependent on imported fossil fuels and has a vulnerable grid, especially in remote island areas. NMP enhances resilience at specific "points" by reducing the dependence of individual critical public facilities (e.g., hospitals, town halls, schools) on the main grid, ensuring the continuity of essential public services during power price fluctuations or grid outages. ERSP takes this further by creating local energy autonomy at the "line" and "area" levels through community microgrids, providing critical power support to the surrounding community, even when disconnected from the main grid, thereby significantly boosting the community's overall energy self-sufficiency and even disaster response and recovery capacity. The progression from NMP to ERSP represents a resilience upgrade from "securing oneself" to "supporting the community", and a process of continuously strengthening the sustainability of energy infrastructure.

The stable cash flow generated by PV projects for LGUs creates an effective mechanism for "energy budget reallocation"—diverting funds previously paid to power utilities into internal capital that can be reinvested into critical public services like education, healthcare, and disaster preparedness.



Ultimately, all pathways lead to a sustainable cycle: Clean Electricity → Fiscal Savings/Revenue → Upgraded Public Services. This is the most compelling long-term value proposition for local governments. The electricity bill savings from NMP and the electricity sales revenue from ERSP not only directly translate into discretionary local fiscal resources but also gradually build the LGU's capacity in energy planning, operation, and financing throughout the project lifecycle. These newly freed fiscal resources and local capabilities enable LGUs to continuously improve public services like education and infrastructure or use them as capital for a new round of green investment, further expanding renewable energy deployment. Thus, public buildings transform from pure energy consumers into "energy hubs" and "capacity incubators" that drive local green development and governance modernization, ultimately promoting comprehensive and sustainable regional development.

5.2 FEASIBILITY OF LGU-LED ROOFTOP SOLAR ENERGY IN PUBLIC BUILDINGS

The analysis in this study indicates that LGUs are the most suitable and feasible implementing bodies for unlocking the potential of public building rooftops. Their leading role in the energy transition is justified not only by clear financial evidence but also by their unique public attributes and sustained capacity for action.

First, LGUs possess the unique ability to translate project economics into momentum for regional sustainable development. Case studies show that NMP projects can demonstrate significant economic viability, provided the system size is well-matched to the building's electricity consumption profile. This means that after project launch, LGUs can redirect funds previously spent on electricity bills into discretionary fiscal resources. Over the typical 25-year PV system lifetime, these sustained savings can be strategically reallocated to public services like education and healthcare or used as seed funding for developing subsequent PV projects. It is crucial to emphasize that achieving optimal economics depends on meticulously matching system capacity with the building's load profile, tariff structure, and available budget. Each LGU must select the most suitable installed capacity based on its specific consumption patterns, electricity rates, and financial situation to maximize benefits over the entire project lifecycle.

Second, LGUs hold institutional advantages in driving the progressive evolution of projects. Through budget reprioritization and the lawful use of existing funds, LGUs can initiate NMP projects with relatively low administrative cost and gradually advance to more complex models like ERSP as their capabilities mature. Existing mechanisms in the Philippines, such as the Community Development Fund (CDF), can provide sustainable funding channels for such local development projects with clear returns. This ability to redirect established budgets from traditional consumption to productive investment is a key enabler for LGUs to achieve this stepped energy pathway upgrade.

Furthermore, in a hazard-prone country like the Philippines, LGU-led PV deployment directly enhances the operational continuity of critical public services and long-term community resilience. When disasters disable the main grid, PV-equipped public buildings under LGU control become reliable emergency energy hubs, powering command centers, evacuation sites, and medical facilities. This strategic perspective, which positions distributed energy as "critical lifeline infrastructure," is central to the LGU's role as a guardian of public safety, and its sustainable value far exceeds mere economic return.

In summary, the leading role of LGUs is rooted in their public mandate and sustained operational capacity. Their direct management authority over public assets ensures efficiency in resource integration for projects; their responsibility for paying public electricity bills creates a direct incentive for project implementation; and their community credibility serves as the essential foundation for coordinating interests, building trust, and ensuring fairness, especially when advancing complex community energy projects like ERSP.

Therefore, the most sustainable strategy for Philippine LGUs is not to choose between NMP and ERSP, but to adopt a "staged or phased development" approach: prioritize the widespread adoption of NMP to rapidly accumulate experience, capital, and local skills; based on this foundation, cautiously pilot ERSP in communities with ripe conditions to gradually unleash the deeper energy potential of public buildings. Through this phased, capacity-driven approach, the Philippines can achieve not only a technical energy transition but also strengthened local autonomy in governance, cultivated green skills in human resources, and built endogenous momentum for continuous evolution at the community level, ultimately laying a solid foundation for achieving the long-term goals of national energy security and regional sustainable development.

CHAPTER 6

CONCLUSION

This study, through a systematic analysis of the Philippines' energy and climate challenges, combined with a case simulation of a rooftop solar project in Barangay Bicos and an assessment of rooftop potential in Rizal, clearly delineates the critical pathways and core drivers for distributed solar in the nation's energy transition.

First, the research establishes the fundamental differences and strategic positioning of the NMP and the ERSP. NMP is demonstrated to be an immediately viable "cash-flow" project. The Barangay Bicos case analysis reveals that, within its available budget and specific consumption profile, the NMP model delivers exceptional investment value. The sustained electricity bill savings generated over the system's 25-year lifespan will provide a stable revenue stream for local government coffers. This low-risk, high-return profile makes NMP the undisputed "low-resistance entry point" and preferred starting option for LGUs embarking on their energy transition. It must be strongly emphasized, however, that a one-size-fits-all system size is not appropriate for every LGU. The optimal system capacity must be determined through meticulous calculation based on the specific electricity load of local public buildings, the tariff structure, and the available budget. The core objective is to achieve the best possible match between system generation and the building's own consumption, avoiding investment waste from oversizing.

In contrast, the ERSP represents a more ambitious and potentially transformative future direction. Our case study in Rizal indicates that fully utilizing public building rooftops could potentially transform these structures into community energy hubs through P2P trading. However, this model is accompanied by significant complexity, substantial initial investment, and notable risks spanning technological, financial, regulatory, and market absorption domains. Presently, the mature regulatory framework, financing mechanisms, and market conditions required for ERSP are not yet fully developed in the Philippines. Therefore, it should be regarded as a strategic long-term goal requiring gradual piloting and cultivation, rather than a practical choice for immediate large-scale replication.

The central argument of this report is that LGUs are not merely the implementing bodies for public building solar projects, but also their primary beneficiaries and inevitable leaders. Compared to individual households or private businesses, LGUs possess unique and unparalleled advantages in advancing such initiatives:

- **Operational Agility and Financing:** Unlike household users who often depend on high-interest commercial loans or face lengthy personal decision-making processes, LGUs possess a distinct advantage in fiscal maneuverability. By reallocating annual budget priorities and leveraging existing financial instruments such as the Community Development Fund (CDF), LGUs can directly allocate the initial investment required for NMP projects. This significantly lowers the barrier to project initiation, enabling swift and decisive action.
- **Internalized Benefits and a Virtuous Cycle:** The electricity cost savings or potential revenue from power sales generated by these projects flow directly back into local government funds. This allows LGUs to strategically and precisely reinvest these newly unlocked fiscal resources into higher-priority public sectors such as education, healthcare, and infrastructure. This creates a powerful, self-reinforcing cycle: deploy clean energy → achieve direct fiscal savings/revenue → reinvest to enhance core public services. This not only addresses energy challenges but also activates endogenous drivers for local development.
- **Maximizing Public Asset Value:** LGUs are uniquely positioned to efficiently integrate underutilized public assets, such as building rooftops, transforming them into productive capital. In the hazard-prone Philippines, public buildings equipped with solar power and managed by LGUs become vital "lifeline hubs" that ensure continuity of essential social functions during emergencies, thereby significantly strengthening overall community resilience.
- **Fostering Community Sustainability:** LGU-led promotion of solar projects can stimulate the local supply chain, nurture green installation and maintenance enterprises, and catalyze the emergence of a domestic green industry ecosystem. This approach translates into momentum for local sustainable development, not only enhancing the community's capacity to address energy challenges but also cultivating future-oriented core competencies. Consequently, the LGU solidifies its role as a key engine driving regional sustainable development.

In summary, solarizing public buildings has transcended the status of a mere "option" for Philippine LGUs; it has become a "necessity" integral to local economic well-being and long-term development. This is not just a passive response to national policy but a proactive endeavor to secure fiscal space, enhance governance capacity, and safeguard public welfare.

Consequently, PACS issues the following strategic call to action:

For Local Government Units (LGUs): LGUs must strategically leverage their fiscal autonomy to treat public building rooftop photovoltaics as high-priority infrastructure that delivers immediate financial returns. This begins with:

- **Strategic Planning and Integration,** where conducting a detailed local assessment of roof resources, electricity data, and budgets is crucial. Based on this inventory, a realistic installation target should be set and formally integrated into local plans like the Comprehensive Development Plan and Local Climate Change Action Plan to ensure project continuity.
- **Execution requires Budgetary and Institutional Action.** To ensure dedicated funding, the project must be listed as a specific line item—such as "Rooftop Solar PV System Installation and Ongoing Maintenance"—within the Annual Investment Plan and Budget. Concurrently, clear institutional ownership is essential, requiring the designation of a specific department or office (e.g., Engineering Office, Environment and Natural Resources Office, or General Services Office) to manage and oversee the project.
- **Successful implementation is further driven by Partnerships and Community Engagement.** LGUs should actively explore partnership mechanisms such as with cooperatives or third-party ownership through Power Purchase Agreements (PPAs), which can mitigate upfront costs and operational burdens by having a partner handle maintenance of the system. Mobilizing key community stakeholders, including schools and churches, as project advocates can significantly enhance public acceptance and credibility.
- **Transparency and Accountability are key to sustaining community trust.** LGUs must systematically record project performance and financial savings and regularly share these results in public forums. The communication should explicitly demonstrate the amount of cost savings and, critically, how these freed-up funds are being re-invested into other vital public services like education or healthcare, thereby making the tangible benefits of the clean energy project clear to all citizens. Furthermore, LGUs should enter into Memoranda of Understanding (MOUs) with national government agencies to secure top-level support and facilitate collaboration.

For the National Government: The National Government's role is to construct a robust, enabling ecosystem that empowers local action. This starts with:

- **Direct Support and Incentivization.** The national government should establish targeted pilot programs and competitive funds to encourage and support pioneering LGUs, enabling them to test approaches and generate replicable best practices. Complementing this, consolidated, one-stop capacity-building support—covering technical, financial, and project management areas—is fundamental to ensuring local projects are successfully implemented and achieve their goal of converting savings into community benefits.
- **Policy and Regulatory Optimization,** which involves not only streamlining the grid connection process but also accelerating the development of clear regulatory frameworks and risk management guidelines for innovative models like ERSP. This provides the certainty and security needed for large-scale investment and adoption.
- **Foster Collaboration and Standardization by proactively engaging with LGUs.** This can be achieved by initiating Memoranda of Understanding (MOUs) with LGUs for demonstration projects, which allow for the provision of coordinated central support and help to formalize successful models and operational standards for broader adoption across the country.

In conclusion, the Philippines' path to energy transition begins on the rooftop of every public building across its more than seven thousand islands. Awakening this vast expanse of "dormant assets" and transforming them into a powerful engine driving local prosperity and sustainable development is the mission and opportunity bestowed upon local governments. It is the time for action now.

RESEARCH LIMITATIONS

While this study strives to provide a viable pathway for rooftop solar development on Philippine public buildings through rigorous data analysis and scenario modeling, it is subject to several limitations inherent in the research timeline, data accessibility, model complexity, and the dynamic real-world environment.

Limitations in Data Acquisition and Geographic Representativeness

●**Data Estimation and Lack of Field Verification:** The study faced constraints in time and resources during the data collection phase. Key data points, such as the detailed structural integrity and precise load-bearing capacity of public building rooftops, shading conditions, and the actual capacity of grid connection points, were not fully verified through comprehensive field surveys. Reliance primarily on satellite imagery and public data sources may introduce a margin of error.

●**Limited Geographic Scope:** The case studies are primarily focused on areas like Rizal. The findings' applicability to other Philippine islands, particularly remote off-grid ones, or regions with vastly different socio-economic profiles, requires careful contextual assessment and adaptation, as local conditions regarding solar resources, building types, and energy demand may vary significantly.

Simplifications in Technical and Economic Modeling

●**Idealized Assumptions in the ERSP Model:** The analysis of the ERSP is based on a series of idealized assumptions, including 100% community absorption capacity, stable negotiated electricity rates, and a frictionless policy environment for P2P trading. As these conditions are challenging to achieve in practice, the model may overestimate the real-world benefits of the ERSP.

●**Absence of Multi-Scenario Risk Analysis for ERSP:** Unlike the NMP analysis, the ERSP model was not subjected to systematic multi-scenario testing (e.g., varying levels of community participation, electricity price volatility, battery efficiency degradation). Consequently, the study does not fully illuminate the potential risks and sensitivities related to financing, policy, market uptake, and technical operations for the ERSP model.

●**Exclusion of Full Lifecycle Cost Analysis:** The study focuses on initial investment and returns, without an in-depth exploration of the full lifecycle costs over a typical 20-25 year operational period. These costs, including ongoing O&M, performance degradation, equipment replacement, insurance, and potential system upgrades, could impact the long-term economic assessment. For the ERSP scenario specifically, this includes the additional costs of infrastructure and system upgrades (e.g., smart meters, grid interface hardware) and the complexity of assessing its profitability during periods of low community demand.

Incomplete Consideration of Dynamic Policy and Market Environments

●**Policy Environment Uncertainty:** The renewable energy policy landscape in the Philippines remains dynamic. The regulatory framework for the P2P trading mechanism, which is central to the ERSP, is not yet fully matured or stabilized. The study does not extensively model the impacts of potential policy shifts, bureaucratic delays, or changes in regulatory leadership on project feasibility and timeline.

●**Omission of Macro-Market Risks:** Broader macroeconomic risks, such as currency exchange rate fluctuations, inflation, and the impact of volatile international fuel prices on the national electricity tariff structure, were not integrated into the model. These factors could fundamentally alter the competitive economics of distributed solar projects.

Unquantified Social and Institutional Complexities

●**Challenges of Social Acceptance and Community Governance:** While the study acknowledges the importance of community participation, it does not quantify soft factors such as residents' willingness-to-pay, trust in new energy models, or intra-community benefit-sharing mechanisms. For the ERSP model, these social dynamics could be critical determinants of success or failure.

●**Varying LGUs Implementation Capacity:** The research assumes that LGUs possess the necessary project management, technical oversight, and financial control capabilities. In reality, there are significant disparities in governance levels, technical bureaucratic capacity, and institutional integrity across Philippine LGUs. Furthermore, the sustainability of both the NMP and ERSP projects is susceptible to political factors and contingent on the technical proficiency of LGU staff. These "soft constraints" could be a major bottleneck in practical implementation but are difficult to quantify and compare within this study's scope.

Limited Exploration of Technical Integration and Grid Impact

●**Simplified Treatment of Distribution Grid Impact:** The study implicitly assumes that distributed solar can be integrated into the existing distribution grid without significant issues. In reality, high penetration levels of rooftop PV can pose challenges to local grid stability, including voltage fluctuations, reverse power flow, and protection coordination, the mitigation costs of which are not considered here.

●**Homogenized Technology Selection and Supplier Risk:** Using Chinese PV equipment as a unified benchmark for cost-benefit analysis, while representative, overlooks the diversity of technology options, performance variations among different suppliers, and potential supply chain risks associated with geopolitics.

Notwithstanding these limitations, this study establishes a clear analytical framework and provides robust findings—even under conservative scenarios—offering a strong foundation and a practical entry point for Philippine LGUs to initiate rooftop solar projects on public buildings. Future research can build upon this work by conducting more localized and in-depth analyses addressing the above limitations to further refine and optimize implementation strategies.

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APPENDIX

Case Study of Barangay Bicos under NMP

Budget of Barangay Bicos	200,000.00 PHP
Power Consumption of Barangay Bicos in May 2025 (April 17-May 19)	2,094.00 kWh/month
Power Consumption of Barangay Bicos	25,128.00 kWh/year
Electricity Bills of Barangay Bicos in May 2025 (April 17-May 19)	21,429.26 PHP/mouth

Data from building of Barangay Bicos   Assuming equal monthly electricity consumption   The calculation results should be rounded to two decimal places

$$\text{Electricity Price} = \frac{\text{Power Consumption of Barangay Bicos in May 2025 (April 17-May 19)}}{\text{Electricity Bills of Barangay Bicos in May 2025 (April 17-May 19)}}$$

$$\text{Electricity Price} = \frac{\text{21429.26 Peso}}{\text{2094 kWh}} \approx \text{10.23 Peso/kWh}$$

$$\text{Installed Capacity} = \frac{\text{Budget}}{\text{PV Cost in Peso}} = \frac{\text{200,000 Peso}}{\text{17.35 Peso/W}} \approx \text{11530.04W} \approx \text{11.5kW}$$

We take integers to cope with exchange rate fluctuations.

Thus, the Initial Cost (Take 11kW, 11,000W)

Initial Cost = PV Cost ×Installed Capacity = 17.35Peso/W × 11,000 W ≈ 190,806.00 Peso

Annual Power Generation = Installed Capacity×5hours×30days×12mouths

Annual Power Generation = 11kW × 5hours × 30days × 12mouth = 19,800 kWh

Barangay Bicos Case Study		
Budget of Barangay Bicos	200,000.00	Peso
PV Cost in CNY	2.10	CNY/W
PV Cost in Peso	17.35	Peso/W
Installed Capacity	11,530.04	W
Installed Capacity	11.00	kW
Initial Cost (Take 11kW, 11000W)	190,806.00	Peso
Power generation per day	55.00	kWh
Power generation per month	1,650.00	kWh
Power Consumption of Barangay Bicos in May 2025 (April 17-May 19)	2,094.00	kWh/month
Power Consumption of Barangay Bicos	25,128.00	kWh/year
Electricity Bills of Barangay Bicos in May 2025 (April 17-May 19)	21,429.26	Peso/mouth
Electricity Price	10.23	Peso/kWh

In this case, the total revenue generated by the PV system consists of two components:

Direct Revenue comes from savings on electricity bills resulting from self-consumed PV generation, calculated as the self-consumed energy (Econsumed) multiplied by the electricity price in grids (EP): **Direct Revenue** = Econsumed × EP

Indirect Revenue is obtained from the credit compensation for surplus electricity fed into the grid. It is calculated as the total PV electricity generation (Etotal) minus self-consumed energy (Econsumed), multiplied by the credit value (CV): **Indirect Revenue** = (Etotal - Econsumed) × CV

Thus, the total revenue is expressed as:**Total Revenue** = Econsumed × EP + (Etotal -Econsumed) × CV

Taking 50% Scenario as an example:

Power from the PV (kWh)= Annual Power Generation ×50% = 19,800 kWh ×50% = 9,900 kWh

Direct Revenue = Power Used from the PV ×Electricity Price = 9,900 kWh ×10.23 Peso/kWh ≈ 101,313.12 Peso

Surplus Power to Grid = Annual Power Generation - Power Used from the PV = 19,800 kWh - 9,900 kWh = 9,900 kWh

Indirect Revenue = 9,900 kWh ×5= 49,500 offset

Total Revenue = Direct Revenue + Indirect Revenue = 101,313.12 Peso + 49,500 offset ≈ 150,813.12 Peso

$$\text{Payback Year} = \frac{\text{Initial Cost}}{\text{Total Revenue}} = \frac{\text{190,806 Peso}}{\text{150,813.12 Peso}} \approx 1.27$$

Case Study of Rizal under ERSP

List of Bulidings

Name	Roof top Area Unit:m²	60%Usable Area Unit: m²	PV Pannel Required, Take non rounded integers
Mr and Mrs Park	725.26	435.16	134
Pag-asa Gym	1727.09	1036.26	320
Rizal Central School Building 1	87.14	52.29	16
Rizal Central School Building 2	92.08	55.25	17
Rizal Central School Building 3	700.62	420.37	129
Rizal Central School Building 4	390.52	234.31	72
Rizal Central School Building 5	304.37	182.62	56
Rizal Central School Building 6	196.43	117.86	36
Rizal Central School Building 7	115.08	69.05	21
Rizal Central School Building 8	228.81	137.29	42
Rizal National High School building 1	720.22	432.13	133
Rizal National High School building	603.44	362.06	111
Rizal National High School B3	397.35	238.41	73
Rizal National High School B4	212.99	127.79	39
Rizal National High School B5	216.39	129.83	40
Rizal National High School B6	186.67	112.00	34
Rizal National High School B7	512.61	307.57	95
Rizal National High School B8	304.68	182.81	56
Rizal National High School B9	423.85	254.31	78
Rizal National High School B11	335.29	201.17	62
Rizal National High School B12	443.38	266.03	82
POB NORTE BRGY HALL	117.13	70.28	21
POB NORTE GYM	303.38	182.03	56
POB NORTE GYM 2	500.06	300.04	92
RNE SLAUGHTER HOUSE	163.63	98.18	30
POB CENTRO BRGY HALL	56.18	33.71	10
POB SUR BRGY HALL AND GYM	617.98	370.79	114
RIZAL MUNICIPAL HALL	974.96	584.97	180
CALAOOCAN BRGY GYM	401.16	240.69	74
BRGY CALAOCAN HALL	57.80	34.68	10
SAN GREGORIO Elementary School B1	82.04	49.23	15
VILLA PARAISO Elementary School B3	154.46	92.68	28
VILLA PARAISO Elementary SCHOOL B2	270.02	162.01	50
VILLA PARAISO Elementary SCHOOL GYM	170.94	102.56	31
VILLA PARAISO Elementary SCHOOL B4	160.19	96.11	29
VILLA PARAISO Elementary SCHOOL GYM	606.21	363.72	112
VILLA PARAISO Elementary SCHOOL B5	81.83	49.10	15
VILLA LABRADOR BRGY HALL	294.45	176.67	54
VILLA LABRADOR GYM	650.55	390.33	120
VILLA LABRADOR Elementary School B1	268.19	160.91	49
VILLA LABRADOR Elementary School B2	283.69	170.21	52
VILLA LABRADOR Elementary School GYM	190.66	114.39	35
SAN GREGORIO Elementary School B1	279.35	167.61	51
SAN GREGORIO Elementary School B2	255.48	153.29	47
SAN GREGORIO Elementary School GYM	488.21	292.93	90
SAN ESTEBAN Elementary School B1	165.42	99.25	30
SAN ESTEBAN Elementary School GYM 1	475.51	285.30	88
SAN ESTEBAN BRGY HALL	181.66	109.00	33
SAN ESTEBAN GYM 2	611.60	366.96	113
MACAPSING ELEMENTARY SCHOOL B1	584.54	350.73	108
MACAPSING ELEMENTARY SCHOOL B2	440.42	264.25	81
MACAPSING ELEMENTARY SCHOOL	148.06	88.83	27
MACAPSING BRGY HALL	67.65	40.59	12
CANAAN WEST ELEMENTART SCHOOL B1	217.61	130.56	40
CANAAN WEST ELEMENTART SCHOOL B2	417.02	250.21	77
CANAAN WEST ELEMENTART SCHOOL GYM	177.77	106.66	32
CANAAN WEST ELEMENTART SCHOOL GYM2	523.44	314.06	97
CANAAN EAST ELEMENTART SCHOOL B1	550.35	330.21	102
CANAAN EAST ELEMENTART SCHOOL GYM	230.05	138.03	42
CANAAN EAST ELEMENTART SCHOOL B2	96.43	57.86	17
CANAAN EAST ELEMENTART SCHOOL GYM	626.22	375.73	116
CANAAN EAST HIGH SCHOOL B1	365.18	219.11	67
CANAAN EAST HIGH SCHOOL GYM	490.37	294.22	90
CANAAN EAST HIGH SCHOOL B2	264.45	158.67	49
CANAAN EAST HIGH SCHOOL B3	190.67	114.40	35
CANAAN EAST HIGH SCHOOL B4	188.19	112.91	34
CANAAN EAST HIGH SCHOOL B5	278.58	167.15	51
GEN LUNA ELEMENTARY SCHOOL GYM	499.37	299.62	92
GEN LUNA ELEMENTARY SCHOOL BRGY HALL	96.24	57.75	17
GEN LUNA ELEMENTARY SCHOOL B2	368.49	221.09	68
GEN LUNA ELEMENTARY SCHOOL GYM	377.15	226.29	69
CASILAGAN ELEMENTARY SCHOOL B1	214.11	128.47	39
CASILAGAN ELEMENTARY SCHOOL B2	174.38	104.63	32
CASILAGAN ELEMENTARY SCHOOL GYM	189.80	113.88	35
CASILAGAN GYM 1	592.21	355.33	109
CASILAGAN GYM 2	378.38	227.03	70
CASILAGAN BRGY HALL	93.34	56.00	17
DON LORENZO ALETA ES GYM	603.54	362.13	111

Name	Roof top Area Unit:m²	60%Usable Area Unit: m²	PV Pannel Required, Take non rounded integers
DLEA ELEMENTARY SCHOOL B1	150.60	90.36	27
DLEA ELEMENTARY SCHOOL B2	266.02	159.61	49
DLEA ELEMENTARY SCHOOL CANTEEN	192.39	115.43	35
CABUCBUCAN ELEMENTARY SCHOOL B1	302.56	181.53	56
CABUCBUCAN ELEMENTARY SCHOOL GYM	498.89	299.34	92
CABUCBUCAN CDC	80.58	48.35	14
CABUCBUCAN BRGY HALL	67.64	40.58	12
CABUCBUCAN GYM	631.91	379.14	117
CABUCBUCAN NATIONAL HIGH SCHOOL GYM	626.89	376.13	116
CABUCBUCAN NATIONAL HIGH SCHOOL B1	772.16	463.29	143
CABUCBUCAN NATIONAL HIGH SCHOOL B2	503.33	302.00	93
CABUCBUCAN NATIONAL HIGH SCHOOL B	183.51	110.11	34
CABUCBUCAN 4ATIONAL HIGH SCHOOL B2	395.39	237.23	73
ESTRELLA BRGY HALL	90.18	54.11	16
ESTRELLA GYM	632.90	379.74	117
ESTRELLA ELMENTARY SCHOOL B1	181.16	108.70	33
ESTRELLA ELEMENTARY SCHOOL B2-4	752.87	451.72	139
AGBANNAWAG CS HALL	146.70	88.02	27
AGBANNAWAG BASKETBALL COURT	626.52	375.91	116
AGBANNAWAG BRGY HALL	102.16	61.30	18
AGBANNAWAG NATIONAL HIGH SCHOOL B1 AND 2	274.51	164.71	50
AGBANNAWAG NATIONAL HIGH SCHOOL B3	173.24	103.94	32
AGBANNAWAG NATIONAL HIGH SCHOOL GYM	180.71	108.42	33
AGBANNAWAG NATIONAL HIGH SCHOOL B4	200.38	120.23	37
AGBANNAWAG ELEMENTARY SCHOOL B1	212.67	127.60	39
AGBANNAWAG ELEMENTARY SCHOOL B2-3	428.86	257.31	79
AGBANNAWAG ELEMENTARY SCHOOL GYM	284.37	170.62	52
PAG ASA BRGY HALL	92.79	55.67	17
PAG ASA SC HALL	279.40	167.64	51
PAG ASA GYM	717.59	430.55	133
PAG ASA ELEMENTARY SCHOOL GYM	167.91	100.75	31
PAG ASA ELEMENTARY SCHOOL B1	170.44	102.26	31
PAG ASA ELEMENTARY SCHOOL B2-3-4	349.76	209.85	64
PACO ROMAN GYM	496.23	297.74	92
PACO ROMAN BRGY HALL	63.01	37.81	11
PACO ROMAN ELEMENTARY SCHOOL B1	146.97	88.18	27
PACO ROMAN ELEMENTARY SCHOOL B2 AND 3	208.97	125.38	38
BALESTEROS ELEMENTARY SCHOOL GYM	271.35	162.81	50
BALESTEROS ELEMENTARY SCHOOL B1	79.47	47.68	14
BALESTEROS ELEMENTARY SCHOOL B2	130.44	78.26	24
MALIGAYA BRGY HALL AND GYM	184.32	110.59	34
MALIGAYA ELEMENTARY SCHOOL GYM	235.20	141.12	43
MALIGAYA ELEMENTARY SCHOOL B1	196.92	118.15	36
MALIGAY ELEMENTARY SCHOOL B2	123.44	74.06	22
BICOS ELEMENTARY SCHOOL B1,2	428.60	257.16	79
BICOS ELEMENTARY SCHOOL B3	135.39	81.23	25
BICOS NATIONAL HIGH SCHOOL B1	418.72	251.23	77
BICOS NATIONAL HIGH SCHOOL B2	194.07	116.44	35
BICOS NATIONAL HIGH SCHOOL B3	154.87	92.92	28
BICOS NATIONAL HIGH SCHOOL GYM	452.10	271.26	83
BICOS BRGY HALL AND CHILD CENTER	249.15	149.49	46
BICOS GYM	492.59	295.55	91
AGLIPAY ELEMENTARY SCHOOL BLDG 1 AND 2	394.06	236.43	73
AGLIPAY BRGY HALL	64.24	38.55	11
AGLIPAY GYM	86.71	52.02	16
DEL PILAR GYM	561.13	336.68	104
DELPILAR BRGY HALL	150.95	90.57	27
DELPILAR CDC	141.64	84.99	26
DELPILAR ELEMENTARY SCHOOL B1	260.65	156.39	48
DELPILAR ELEMENTARY SCHOOL B2	181.68	109.01	33
DEL PILAR ELEMENTARY SCHOOL GYM	302.63	181.58	56
RWES B1-3	408.26	244.96	75
RWES GYM	178.36	107.01	33
STA MONICA ELEMENTARY SCHOOL B1	423.42	254.05	78
SANTA MONICA ELEMENTARY SCHOOL GYM	379.00	227.40	70
STA MONICA GYM	617.03	370.22	114
STA MONICA BRGY HALL	96.33	57.80	17
PORTAL BRGY GYM	636.41	381.85	118
PORTAL BRGY HALL	107.23	64.34	19
PORTAL ELEMENTARY SCHOOL HALL	110.91	66.55	20
PORTAL ELEMENTARY SCHOOL B1	401.25	240.75	74
PORTAL ELEMENTARY SCHOOL GYM	191.05	114.63	35
PORTAL ELEMENTARY SCHOOL B2	133.82	80.29	24
SITIO KAUNLARAN GYM	625.90	375.54	116
KAUNLARAN ELEMENTARY SCHOOL GYM	97.23	58.34	18
KAUNLARAN ELEMENTARY SCHOOL B1	92.30	55.38	17
KAUNLARAN ELEMENTARY SCHOOL B2	126.00	75.60	23
KAUNLARAN ELEMENTARY SCHOOL B3	133.93	80.36z	24

Data of ERSP	
TOTAL AREA Unit: m²	49,531.86
60% Usable Area Unit: m²	29,719.12
PV Size Paramete Unit: m²	3.24
Rated power of PV Panel Unit: W	720
PV Cost in CNY/W	2.10
PV Cost in Peso/W	17.35
Energy Storage Cost in CNY/W	3.00
Energy Storage Cost in Peso/W	24.78
TOTAL PANEL	9,185

Data of ERSP	
Installed Capacity Unit: W	6,613,200
Energy Storage Capacity (PV: Energy Storage, 1:0.5) Unit: W	3,306,600
TOTAL AEG Unit: kWh	12,069,090
Annual Revenue (Peso 5 / kWh)	60,345,450
Total PV Capital Cost in Peso	114,712,567.20
Energy Storage Cost in Peso	81,937,548.00
Toal Initial Cost	196,650,115.20
Paybake Year	3.26

EXPRESSIONS OF GRATITUDE

We would like to thank the following Barangays for taking part and providing important information in our data gathering and interviews, to learn about local context and needs:

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PACS

About PACS

People of Asia for Climate Solutions (PACS) is a civil society organization based in Manila, Philippines advocating for just transition to renewable energy and people-led climate solutions.

PACS delivers three main programs in line with its focus on climate solutions: A Coal-Free Future, Belt and Road Initiative Directed towards Green Energy(BRIDGE), and Climate Actions.

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