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Philippine Council for Industry, Energy, and Emerging Technology Research and Development (DOST - PCIEERD)
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Powering Missionary Areas With Solar Energy

Based on global data on energy consumption, fossil fuels remain the top source of energy in the world (Ritchie and Roser, 2017). Renewable energies account for only 36.39% of the total energy consumption worldwide. Of this, 2.65% is from solar energy. Thus, there remains a huge discrepancy between fossil fuels and solar energy. However, solar photovoltaic (PV) installations continue to increase worldwide. Solar PV capacity increased from 15 to 505 gigawatts (GW) from 2008-2018, indicating a continuous interest in the development and utilization of solar energy in the world with China, U.S., Japan, Germany, and India as the leading countries (REN21, 2019).

The Philippines aligns with this trend. In 2017, the country ranked 1st in Asia and 5th in the world in terms of operational solar PV projects. It was also noted to have seven active solar power projects ranked in the top 50 list (Dorothal, 2017). However,

solar energy in the country shares a very small portion of the total power generation by source. Total power generation in the Philippines was 106,041 Gigawatt hours (GWh) in 2019 (DOE, 2020). Out of this, 20.7% (22,044 GWh) was generated from renewable energy (RE) resources. Around 5.7% (1,246 GWh) of it came from solar energy.

These figures show that there is still work to do with regards to solar energy and RE sources in the country. Policies such as the National Renewable Energy Program (NREP) and other renewable energy guidelines enshrined in Republic Act No. 9513 or the Renewable Energy Act of 2008 are formulated to develop and sustain the RE sources in the country.

Fossil Fuels and Solar Power

Solar energy is a very promising energy source. Making use of RE resources such as solar energy for power generation could improve fuel security in the country. Along with other REs, the clean and renewable nature of solar energy coupled with its cost-effectiveness make it the energy resource of the future.

Despite advancing policies on REs, the Philippines remains heavily reliant on fossil fuels. Coal accounts for 52% of gross power generation as of December 2018. In its Coal Roadmap 2017-2040, the DOE stated plans to increase coal production from 23 million metric tons as of 2017-2018 to 282 million metric tons from 2023-2040 (The ASEAN Post, n.d.). Fossil fuels, the primary source of greenhouse gas emissions, are harmful to the environment from acquisition to utilization (Denchak, 2018). Aside from environmental impact, air pollution from fossil fuel consumption is attributed to causing 27,000 premature deaths in the country per year (Greenpeace Philippines, 2020). Economically, the import-reliant nature of fossil fuels in the country leaves the economy vulnerable to price shock, drastic increases in the prices of commodities, should there be fluctuations in scarcity and demand.

Powering the Philippines

Around 2.3 million households in the country have no electricity

Peralta, 2019

Pursuant to RA 9136 or the "Electric Power Industry Reform Act (EPIRA) of 2001", the National Power Grid (NPC) through its Small Power Utilities Group (SPUG) is mandated to complete total electrification of the country. In 2019, The National Electrification Administration (NEA) reported that around 2.3 million households in the Philippines still have no electricity (Peralta, 2019). Most of these households are in missionary areas where on-grid electrification is a challenge.

Without the need to connect to a main grid, micro-grid solar PV systems have the capability of resolving the issue. Through the use of these, the secure and renewable energy from the sun can be harnessed and turned into electricity for the people and the community.

Several projects from the government have been implemented in line with the National Electrification Program and the Renewable Energy Act of 2008. In 2018, as part of the rehabilitation program for Marawi City, the United States Agency International Development and Mindanao Development Authority started to install solar PVs in several barangays and towns in Marawi which are part of the Php 11.7 billion solar electrification project that is expected to be completed by 2030 (Suson, 2018).

Moreover, the country is increasing its capacities to generate power from solar energy. In a report by the Manila Bulletin in September 2020, several applications from different players in the solar industry have submitted totaling 13, 217 Mega-watts (MW). Of these, the Department of Energy (DOE) noted that 1,058 solar facilities are now in operation (Velasco, 2020).

Barangay Manurigao, Davao de Oro

A notable project of the Philippine Council for Industry, Energy, and Emerging Technology Research and Development (PCIEERD) and the Ateneo de Davao University is the establishment of the Mindanao Renewable Energy Center (MREC) which conducts R&D for the reinforcement of policies and development, utilization, and commercialization of renewable energy including solar energy. Part of this project is the installation of Micro-grid solar PV in Barangay Manurigao, Davao de Oro.

Bringing Power to the Remote: The Case of Manurigao in New Bataan, Davao de Oro

In 2018, PCIEERD, through DOST Region XI, the Ateneo de Davao University, and local government units collaborated to bring electricity to the community of Barangay Manurigao in New Bataan, Compostela Valley as part of the field-testing for the viability of an off-grid solar PV system in the electrification of missionary areas in the country which is under the MREC. The project aims to be the benchmark for the offshoot development of solar PV system in the country especially in providing electricity in remote areas of the Philippines.

The project team installed a micro-grid hybrid solar PV power system to supply electricity to the community. The 50-kW off-grid solar power system, supplying electricity to around 100 households in the area, produces at least 112 kWh of energy per day. The system has batteries that enable energy to be stored for future use. The system also has a generator which helps ensure the continuous supply of electricity.

Despite successful installation, the microgrid faces issues regarding the sustainability of the project. One issue is the high cost of generating electricity from the installed solar PV system. According to Project Leader Dr. Randell Espina, the community cannot sustain the P40.00 per kWh energy cost. The high cost per kWh covers the maintenance of the batteries and fuel for the generator, essential components of the system, and the manpower for system operations. A survey conducted by the implementers revealed that members of the community could only afford to pay for P20.00 per kWh.

To address the concern on sustainability, interventions are being introduced. First is the provision of a milling machine for the post processing of crops to increase the value of the community's products. Through this, income will increase, and, at the same time, the surplus energy generated will be utilized by the machine. Second is the establishment of a local cooperative. The cooperative, composed of community members, will manage the maintenance and repair of the power system's components and the generation of its funds. However, to setup a cooperative, community members must submit rigid requirements. The cooperative must also undergo training on operating the power system and management, which DOST Region XI and AdDU are ready to supply.

Challenges

Solar energy is a promising source of electricity. The self-sustaining and relatively low maintenance technology can be maximized in the electrification of remote areas as mandated by Section 70 of RA 9136 and Section 12 of RA 9513. However, it is important to note that there are issues and challenges to implementation of solar PV projects, particularly in sustainability, as demonstrated by the Manurigao project.

Socio-economic feasibility of adoption of solar PV for remote communities

Solar-powered systems require regular maintenance on batteries and fuel for hybrid systems' generators. Additionally, projects need to find a way to bring the price per kWh to a level that is sustainable or find a way to incorporate long-term subsidies. High prices for electric consumption in low-income communities are not feasible. Changes in political leadership also threaten the sustainability of projects.

Lack of knowledge and skills in operating the technology

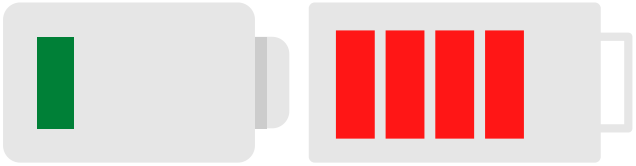
Communities in remote areas lack technological expertise in operating a power system.

Lack of incentive for off-grid PV systems in the law

Incentives offered for off-grid communities that may yield surplus energy can help in the maintenance of the power system. While RA 9513 provides incentives for users using RE system under the net metering policy, these incentives are exclusive for on-grid electrification because these users can supply their surplus energy back to the providers. Currently, there is no incentive provision for off-grid communities using RE that may yield surplus. Incentives offered for off-grid communities that may yield surplus energy can help in the maintenance of the power system. While RA 9513 provides incentives for users using RE system under the net metering policy, these incentives are exclusive for on-grid electrification because these users can supply their surplus energy back to the providers. Currently, there is no incentive provision for off-grid communities using RE that may yield surplus.

Lack of ex ante situational analysis

Every community involves social, economic, and political issues that need to be studied before project implementation. Most of the time, feasibility studies are disregarded before project implementation. This results in sustainability issues stemming from interrelated factors. The abovementioned issues can be provided with appropriate interventions through feasibility studies or situational analysis.



In 2015, 14.899% of electricity produced in the country came from renewable sources, while 74.563% came from oil, gas, and coal sources

International Energy Agency Statistics, 2014

Bureaucratic processes in developing RE facilities

Developers noted a very lengthy process which could see RE plants take four to five years to construct (Rosellon, 2017). In an interview, Renewable Energy Association of the Philippines President Erel B. Narida noted that putting up utility farms would require over 250 signatures from officials and stakeholders (Rosales, 2019).

Policy Recommendations

The following are policy recommendations from DOST-PCIEERD for the planning of future rural electrification projects by NGAs, and the ensuing implementation of these projects with concerned LGUs

Socio-economic feasibility of adoption of solar PV for remote communities

1. Incorporate socio-economic plans in projects or programs to assist the beneficiaries of power systems in sustaining the technology. In the Manurigao project, interventions such as the provision of the milling machine for the improvement of their livelihood are helpful in ensuring the sustainability of the project. Such interventions should be included immediately at the start of the project.

2. Offer employment opportunities and include training programs for community members who will manage the operations, in turn creating stable sources of income and ensuring community ownership and the sustainability of the project.

3. Install solar capacity as quickly and as much as possible. The U.S. Department of Energy introduced the "SunShot 2020" program in 2011. By rapid technological forcing, the program was able to reduce the price of solar energy systems by 75% in September 2017, three years ahead of their target date of 2020 (Shum, 2019). The reduction was expected to make unsubsidized solar energy cost competitive with other energy sources. This could be a possible policy avenue in order to address the inability of lower-income communities to match the P 40.00 per kWh rate.

4 Reevaluate the prevailing focal point of rural electrification. Development, especially that of socioeconomic nature, is a multifaceted undertaking. In order to improve the sustainability of the electrification, the existing objectives need to be reevaluated, shifting the current perception of household electrification from an end-goal to an instrument in achieving sustainable community development. A wider lens such as this would entail projects in conjunction with concerned departments and the governing LGU to ensure project durability.

5 Use livelihood electrification as the cornerstone of future projects. This means primarily directing the usage of rural solar PV projects towards electrification that can drive income for communities, as opposed to the model currently being used, which directs usage of rural solar PV towards household electrification. Focusing initially on livelihood electrification will create conditions for economic prosperity within the community which will subsequently increase the feasibility of building larger electrification projects.

6 Assess the current economic model used. Remote rural areas are often the poorest and most conflict-affected. The current market-oriented scheme has fueled debate about whether electrification is a public concern and, if so, should public funds be used until the communities can economically develop and pay for electrification services (Mesina, 2016). The social and economic returns of doing so could potentially be greater than the investments made. Keeping in mind the benefit of the communities, whose best interests should always be kept at the forefront of projects, it is worth revisiting and analyzing alternative rural economic electrification models.

Incentive for off-grid PV systems in the law and growing knowledge and skills in operating the technology

1 Develop parameters and models to include and incentivize lower-income households and farms in net metering, which will raise awareness and increase community participation in RE. This in turn creates a "learning-by-doing effect" (Shum, 2019).

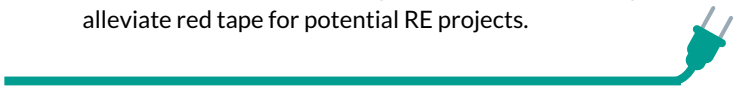
2 Pivot Universal Charge usage into RE facilities for microgrids in remote areas. Majority of fund usage by the NPC SPUG has been focused on fuel-based energy plant development in remote areas. A shift towards RE plant development would be a long-term benefit for the communities.

Conduction of ex ante situational analysis

1 Conduct feasibility studies/situational analyses by creating programs consisting of phases, through which these are conducted in the first phase. These will determine the overall situation of the community which will in turn determine other interventions that will be incorporated to support the sustainability of the technology.

Streamlining bureaucratic processes in developing RE facilities

1 Establish a full-service institution for the streamlining of RE development applications. Offering services to streamline bureaucratic processes would help alleviate red tape for potential RE projects.



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