Sara Jane Ahmed, Energy Finance Analyst
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Institute for Energy Economics and Financial Analysis
IEEFA.org

Renewables Are a More Affordable, Reliable and Resilient Solution for Small Island and Isolated Power Grids

Diesel Is Failing the Philippines' Small Island and Isolated Grids

Introduction

Over half the population of the Philippines – more than 50 million people – reside in isolated and island grids served by under-funded electric cooperatives that rely on diesel-powered generation. Despite ongoing support from the National Power Corporation's Small Power Utilities Group (NPC-SPUG) in the form of cross-subsidies for generation, over 2.3 million households lack access to energy while millions more lack access to reliable power.[1]

The case for diesel generation rests on a growth agenda premised on unsupported arguments that diesel is the only way to reach the off-grid market. The affordability problem is acute: diesel-powered generation prices range between PHP 10.6 (USD 0.22) to PHP 117.75 (USD 2.45) per kilowatt hour (kWh)—pricing that would never be accepted in the main Luzon grid. Renewable energy is now roughly 60% cheaper than diesel-fired power but the isolated and island grids are dominated by diesel power, resulting in expensive, intermittent and unreliable power. Both solar and wind prices can reach as low as PHP 3.5 (USD 0.07) in the main grids and even if delivered at double or triple the cost in island and isolated grids, solar and wind can still undercut the price of diesel.

Despite cheaper solar and wind prices, diesel power still dominates isolated and island grids.

The problem has reached breaking point this year. As a result of a series of record-breaking climate-induced disasters, the electric cooperatives have been hit with at least PHP 3.16 billion (USD 65 million) in infrastructure damages over the last 6

[1] CNN. Over 2.3 million households remain without electricity – NEA. 27 August 2019.

months. With working capital funds totalling PHP 10.1 million (USD 206,000), there is no likelihood that the electric coops can cover PHP 730 million in damages. Table 1 illustrates the damages as a percentage of the working capital fund of the electric cooperative affected. The increase in both intensity and frequency of climate-induced disasters further underscores the importance of decentralized modular renewable energy generation and the need for power sector resilience.

Table 1: Damages to Electric Cooperatives

Typhoon Name & Date	Electric Cooperative (EC)	Damage to Power Sector Infrastructure	Working Capital Fund from 2019
Ambo (Vongfong) May 2020	NORSAMELCO	PHP 91.7 million	PHP 140,000
	ESAMELCO	PHP 55 million	PHP 150,000
	QUEZELCO I	PHP 23.7 million	PHP 240,000
	SAMELCO I	PHP 6.5 million	PHP 120,000
	MASELCO	PHP 6.4 million	Did not submit working capital information
	QUEZELCO II	PHP 3.4 million	PHP 110,000
	SORECO I	PHP 1.3 million	PHP 87,000
	MARELCO	PHP 614,000	PHP 30,000
	SAMELCO II	PHP 356,000	PHP 150,000
	CASURECO II	PHP 83,900	PHP 623,000
	Total	PHP 189 million (USD 3.9 million) in damages	
Quinta (Molave) October 2020	ORMECO	PHP 14.7 million	PHP 300,000
	CASURECO IV	PHP 9.5 million	PHP 220,000
	MARELCO	PHP 8.5 million	PHP 31,000
	CASURECO III	PHP 5.5 million	PHP110,000
	CASURECO II	PHP 4.6 million	PHP 620,000
	Total	PHP 51 million (USD 1.1 million) in damages	
Rolly (Goni) October 2020	FICELCO	PHP 133 million	PHP 48,000
	CASURECO III	PHP 82.3 million	PHP 113,000
	CASURECO IV	PHP 39.4 million	PHP 224,000
	QUEZELCO I	PHP 36.5 million	PHP 242,000
	Total	PHP 370 million (USD 7.7 million) in damages Approx. PHP 2.4 billion in damages to 45 ECs in 7 regions, bringing total to PHP 2.8 billion (USD 57 million)	
Ulysses (Vamco)	43 Affected Electric Cooperatives – Benguet, Ifugao, Mountain Province, and Kalinga in CAR; Pangasinan in Region I; Cagayan, Isabela, Quirino, and Nueva Vizcaya in Region II; Aurora, Pampanga, Tarlac, Zambales, and Nueva Ecija in Region III; Quezon, Laguna, and Batangas in CALABARZON; Catanduanes, Camarines Sur, Camarines Norte, Albay, and Sorsogon in Region V (Bicol)	PHP 122 million	PHP 6.6 million
	Total	PHP 122 million (USD 2.5 million) in damages	

Source: NEA, Business World.[2]

[2] NEA. Electricity mostly restored in typhoon-hit provinces May 2020, 26 May 2020; Business World. Damage to rural utilities from typhoon Quinta initially estimated at P51-M, 30 October

Diesel Power Versus Renewable Energy Prices

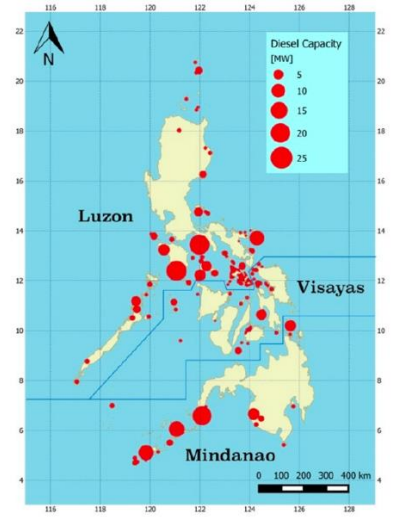
Based on IEEFA's analysis of the small and isolated grids, it can be demonstrated that solar PV plus lithium-ion batteries can now reliably deliver power at a significant discount to the price-performance potential of the current diesel-power fleet.

The Solar + Battery Solution Fits Geographic Need

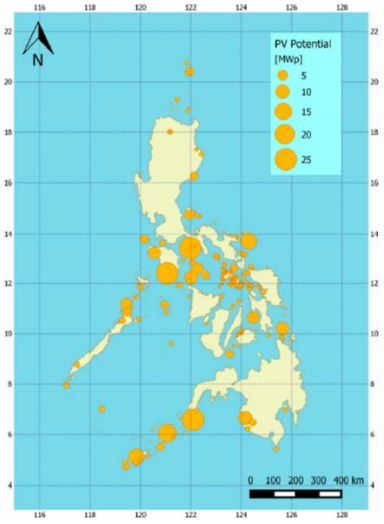
Figure 1 (a) illustrates the current locations and capacities of diesel power plants located in Luzon (139 plants) while the rest are located in Visayas (55 plants) and Mindanao (21 plants). Figure 1 (b) illustrates the hybridization potential of solar PV, equivalent to 260 megawatt peak (MWp). Figure 1 (c) illustrates the lithium-ion battery potential, equivalent to 400 megawatt hours (MWh).

Research shows that hybridizing the existing 215 diesel plants can avoid 92 million liters of diesel imports per year.

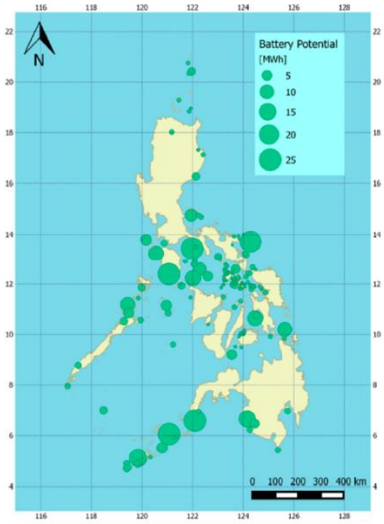
Figure 1: Diesel Power Plants vs. Solar PV Potential and Lithium-ion Battery Potential



(a) 215 NPC-SPUG diesel power plants and its peaking capacity



(b) Solar PV potential in NPC-SPUG island grids



(c) Lithium-ion battery potential in NPC-SPUG island grids

Source: Ocon, J. D., Bertheau, P., Energy Transition from Diesel-based to Solar Photovoltaics-Battery-Diesel Hybrid System-based Island Grids in the Philippines – Techno-Economic Potential and Policy Implication on Missionary Electrification, Journal of Sustainable Development of Energy, Water and Environment Systems, 7(1), pp 139-154, 2019.

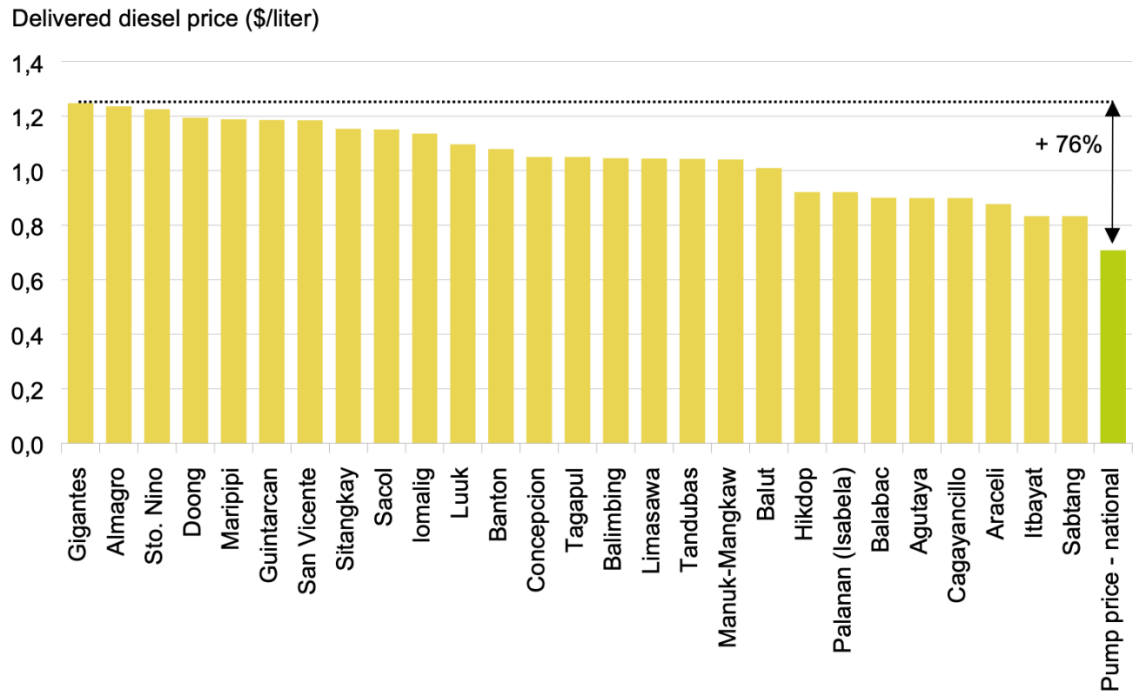
2020; NEA, Power restored in parts of Bicol region; damage to power facilities due to 'rolly' reaches p370 million, 9 November 2020; NEA, Power restored in parts of Cagayan, other provinces hit by 'Ulysses', 17 November 2020.

High Diesel Prices Have Undermined the Competitiveness of Diesel Power

At a low price of USD 0.72 per liter and a high price of USD 0.9 per liter, not taking into consideration transportation costs, the savings from a shift to renewables can range between USD 66 million (PHP 1.38 billion) and USD 82 million (PHP 1.7 billion).[3]

Figure 2 is a snapshot of delivered diesel prices between USD 0.9 per liter to USD 1.25 per liter in some mini-grids in 2018, illustrating that delivered diesel prices reached 76% higher in the other regions versus the national capital region.

Figure 2: Delivered Diesel Prices in Microgrids (2018)



Source: State of the Global Mini-grids Market Report 2020, June 2020.

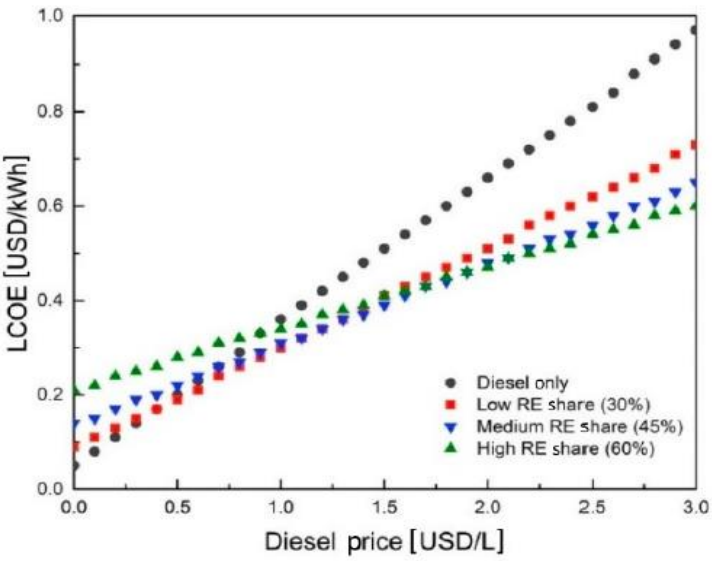
Increasing the Mix of Renewables Would Cut Costs for Small Grids

Figure 3 illustrates the levelized cost of energy for diesel power plants versus low shares of renewables (30%), medium shares of renewables (45%) and high shares of renewables (60%). There are cost savings between 17% and 29% over a 20-year period.

[3] Journal of Sustainable Development of Energy, Water and Environment Systems. Ocon, J. D., Bertheau, P. Energy Transition from Diesel-based to Solar Photovoltaics-Battery-Diesel Hybrid System-based Island Grids in the Philippines – Techno-Economic Potential and Policy Implication on Missionary Electrification. 7(1), pp 139-154, 2019.

Considering the deflationary trend of renewable energy and the volatility of oil prices to international market prices, renewable energy offers small island and isolated grids both low prices and price stability. Further, it is important to note that the repeated argument of limited absorptive capacity versus renewable energy sources do not apply to hybrid power systems, where diesel and PV or wind power are designed to complement each other.

Figure 3: Sensitivity Analyses for Diesel Fuel Price at Different Hybrid System Configurations According to the Optimized Renewable Energy Shares



USD 0.44 (PHP 22) per kWh

USD 0.362 (PHP 18.1) per kWh

USD 0.352 (PHP 17.6) per kWh

USD 0.315 (PHP 15.75) per kWh

Source: Journal of Sustainable Development of Energy Water and Environment Systems, 7(1), pp 139-154, 2019.[4]

The Cost Benefits Would Be Enhanced by Greater Reliability

This renewable solution is not solely dependent on solar PV but could be tailored to local grid characteristics. In addition to solar and storage, wind, run-of-river hydro and biomass from coconut husks and fronds also have prices well below diesel-power generation. Lower electricity prices and improved reliability will enable communities to improve the value of local production through processing and value engineering. Moreover, ongoing cost and efficiency improvements for renewables will mean that renewable energy cost deflation will enable the government to reach its goal of 100% electrification by 2022.

[4] Ocon, J. D., Bertheau, P., Energy Transition from Diesel-based to Solar Photovoltaics-Battery-Diesel Hybrid System-based Island Grids in the Philippines – Techno-Economic Potential and Policy Implication on Missionary Electrification, Journal of Sustainable Development of Energy Water and Environment Systems, 7(1), pp 139-154, 2019

NPC-SPUG

NPC-SPUG is the key player in the small and isolated grid policy dynamic. National Power Corporation is a government-owned and controlled corporation, mandated to perform so-called "missionary" electrification through its Small Power Utilities Group (NPC-SPUG). NPC-SPUG's primary responsibility is to provide power generation and its associated power delivery systems in areas not connected to the main transmission system.

Affordability is a key concern in missionary areas and NPC-SPUG uses a cross-subsidy – the Universal Charge for Missionary Electrification (UCME) – to underwrite the cost of electricity for designated areas. The UCME budget is derived from rates on a per kilowatt hour (kWh) basis set by the Energy Regulatory Commission (ERC) and paid for by all end-users through utility bills, in both small island grids and main grids (referred to as a "cross subsidy" for this reason).

In addition to affordability, the local electric cooperatives also face serious reliability challenges. Most off-grid areas with electricity face rolling blackouts and unplanned power outages as a result of grid instability and inadequate generation capacity due to underinvestment or a lack of subsidized fuel to run diesel plants. Currently, NPC-SPUG has supplied only 14% of its designated areas with 24/7 electrification, while the remaining 86% of its areas are underserved with less than 24 hours of electricity per day or are unserved with no power. It is important to note that there are also underserved and unserved areas outside the NPC-SPUG missionary areas that warrant support.

Because NPC-SPUG offers electric cooperatives subsidized electricity, electric cooperatives prefer to buy from NPC-SPUG. This reliance on NPC-SPUG also highlights their decisive role in shaping energy transition and the speed with which more cost-effective options can be implemented. Currently, while the true cost of renewable energy is typically lower than NPC-SPUG's diesel-dependent power, the electric cooperatives tend to purchase power from NPC-SPUG because the UCME is baked into these subsidized rates from NPC-SPUG.

Current regulatory design does not incentivize electric cooperatives to procure their own renewable energy, even at lower cost.

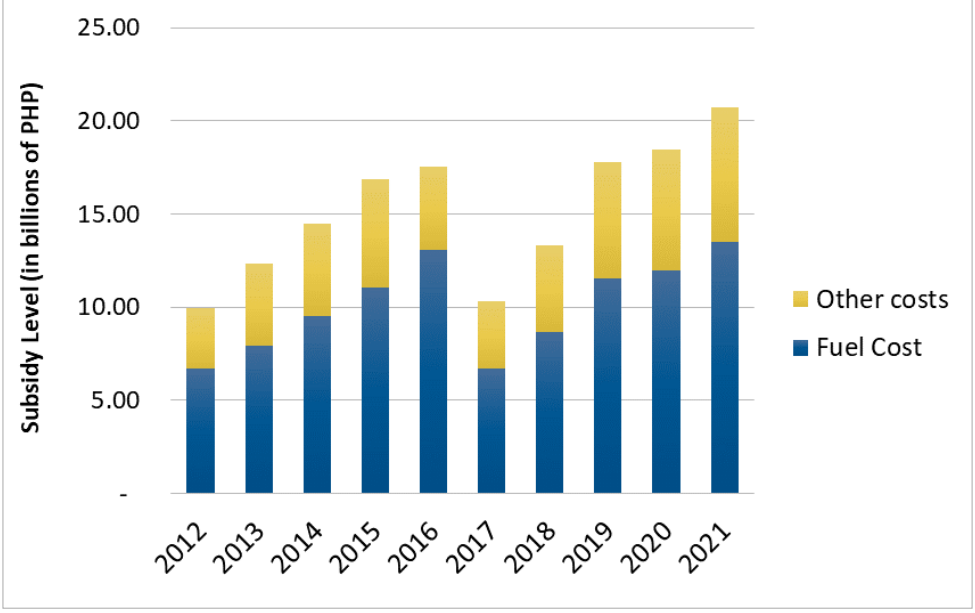
The net effect of this subsidy pass-through mechanism is that the electric cooperatives are effectively blocked from accessing the UCME subsidy themselves. Without some ability to restructure the relevant incentive structures, the current regulatory design is a barrier to unlocking more cost-effective power options for small and island grids.

While NPC-SPUG has been an important player in rural electrification in the Philippines, its ability to meet the government's aggressive electrification goal is

limited considering its current trajectory. NPC-SPUG has been slow to build generation in new areas in recent years, and recently it was announced that NPC-SPUG will not be expanding generation to areas that are currently unserved.

Just this year, it was made public that NPC-SPUG was looking for an additional PHP 15 billion (USD 300 million) for 2021 from the cross-subsidy, collected from all households, increasing the total budget from PHP 13.2 billion (USD 265 million) to PHP 28.4 billion (USD 567 million). Figure 4 gives an overview of the ballooning cross-subsidy. While it is warranted to increase funding to reach households in small islands and isolated grids, it is equally important to consider a financially sustainable solution that enables affordability and price stability and improves energy security. Should NPC-SPUG shift away from diesel, the savings realized can be up to PHP 13.5 billion (USD 275 million).

Figure 4: Total Cross-Subsidy (2012-2021)



Source: Missionary Electrification Development Plan 2016 – 2020.

Recommendations

The high cost of the diesel lock-in strategy by NPC-SPUG runs contrary to the benefits of renewable energy in terms of affordability, price stability and improved energy security. The expertise of the Department of Finance, whose Secretary is the Chair-designate of the Climate Change Commission, the ex-officio Chairman of NPC, can help realize the Department of Energy's vision to provide not only clean, but also reliable, secure, and affordable power for residents of small island grids.

IEEFA recommends the following action items to realize both savings and investment.

1. **Halt new diesel power investments immediately and accelerate hybridization:** NPC-SPUG should halt all diesel plans and exclusively hybridize existing systems or roll out micro-grids in new areas. Private sector participation should be encouraged through competition to enable cost-effectiveness. NPC-SPUG may wish to develop systems in more difficult areas where private sector participation is unlikely.

2. **Redirect UCME subsidies:** The Department of Finance is best placed to oversee an incentive strategy that is performance based and can instruct NPC-SPUG to redesign the UCME subsidy to become a pure capital expenditure (CAPEX) subsidy with an exit strategy, instead of a recurring operational expenditure subsidy without an exit strategy. This would improve procurement incentives for electric cooperatives to buy the least-cost power option, give certainty to project developers about what to expect from NPC-SPUG on the UCME rationalization, and ensure cross-subsidy reductions and/or an exit strategy for all ratepayers. Moreover, this would complement the renewable portfolio standard (RPS) for off-grid areas. In practice, the DOE's Simplified Planning Tool (SPT), which is an Excel-based simulation of the HOMER app, can define mandatory renewable energy shares per area which can then support the UCME in the form of a CAPEX subsidy. The shift to a capital expenditure subsidies for renewable energy instead of diesel also provides an exit strategy for all ratepayers, allowing for everyone to benefit.

3. **Results-based financing of UCME subsidies:** Currently, the UCME subsidies are being used solely on a cost basis rather than on results-based delivery of an electrification service. A shift to results-based financing would mean that the UCME subsidies can be better linked to verified delivery of pre-defined results including sustainability and resilience. NPC-SPUG which manages the subsidy should create an incentive chart that indicates level of incentives per connection and energy output, taking into consideration level of isolation as this drives up costs and emissions targets. For areas or cooperatives that are considered unviable for private sector participation due to collections issues or indebtedness, NPC-SPUG may consider credit strengthening tools such as guaranteeing payment upon delivery of connections and energy output.

4. **Training by the Technical Education and Skills Development Authority (TESDA):** In addition to lower prices and price stability, communities can benefit from the energy transition by being able to capture socio-economic benefits in the form of increased employment and job quality. TESDA should provide training and certification for community members to enable them to install, operate and maintain solar, wind, batteries and micro-grids.

5. **Create a sustainable insurance facility for electric cooperatives:** The increasing intensity and frequency of climate-induced disasters and the electric cooperatives' lack of financial reserves given the lack of working capital provides an opportunity for the delivery of climate-smart insurance products (either index- or indemnity-based) to electric cooperatives.

6. **Support from multilateral development banks:** The World Bank or Asian Development Bank should provide both policy support and financial support to NPC-SPUG to enable a transition towards reliable and lower priced renewable energy supported electrification.

7. **Carbon pricing economic benefit:** Should the Department of Energy decide to price carbon, a shift to renewable energy will economically benefit small island and isolated grids in the form of lower prices and price stability. Additional benefit will be derived from the saving of approximately 246,000 metric tons of carbon dioxide emissions per year through the hybridization of 215 diesel generation sets. At a price of USD 75 per metric ton, estimated by the International Monetary Fund (IMF), small islands and isolated grids could generate up to USD 19.7 million in additional revenue per annum, equivalent to USD 393.6 million in additional revenue over a 20-year period.

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The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

About the Author

Sara Jane Ahmed

Energy Finance Analyst Sara Jane Ahmed is the author of several studies on island grid transition, coal stranded asset risk, and rooftop solar. She is a former investment advisor specializing in originating and structuring energy opportunities in emerging markets. sahmed@ieefa.org