Electricity-Sector Opportunity in the Philippines

The Case for Wind- and Solar-Powered Small Island Grids

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Executive Summary

This paper describes how small islands in the Philippines can modernize outdated power-generation systems that currently rely on imported diesel fuel and how solar- and wind-powered grids on these islands can supply affordable, reliable, more efficient, more secure, and cleaner power.

Many Philippine small island grids served today by diesel generators suffer from frequent blackouts and unplanned power outages. The problem is far from intractable, however.

Our research suggests that a reasonably swift transition to renewable energy is feasible across these islands and that it can be driven largely by market forces that support modernization and savings through advances in renewable energy and storage .

The core policy question posed here is how the national government can speed this transition through the adoption of appropriate forward-looking policy and oversight.

Key Takeaways:

- Small island grids powered by solar, wind, and other renewable energy can reduce dependence on expensive imported fossil fuel generation without compromising availability of power and grid reliability.
- Hybridization of existing diesel-powered generation with solar photovoltaics (PV), wind turbines, biomass gasification, small hydro installations, and battery energy systems, holds great promise.
- Electricity cooperatives that continue to procure diesel supply via long-term contracts run stranded-asset risk.
- While sizeable regulatory barriers exist to the modernization of small island electricity systems—and indeed while the Philippines present a prime example of how techno-economic change has outpaced government regulation—these barriers can be overcome.
- The Department of Energy (DOE) can incentivize the Small Power Utilities Group (SPUG) under the National Power Corporation (NPC) to speed up hybridization of its plants. Moreover, the National Electrification Administration (NEA) can direct electric cooperatives to be technology-neutral in the procurement of power.
- The Philippine Renewable Energy Act of 2008 has spurred international and local interest in renewable investment, but uneven and uncertain implementation pose formidable barriers. The incentive in this act most germane to small island grids is the entitlement of renewables developers to half of the savings on existing subsidies that arise from their projects. A provision also entitles renewables developers to a cash incentive equal to half of the savings that arise from lower cost renewables generation.

In short, small island grids represent a largely overlooked opportunity for investors in renewable energy and storage that can readily replace imported diesel generation throughout the Philippines.

The case for investment in modernization can be made on straight financial merit, and provides win-win outcomes. We estimate that while modernization will require at least $1 billion in private investment in the short term, it will substantially diminish the cross-subsidies of at least $200 million borne by ratepayers on the main grids annually.

Modernization of small island power systems through the uptake of renewables will supply cheaper, efficient, secure, cleaner power.

Introduction

The Philippines is an archipelago nation of 7,461 islands that faces unique challenges and opportunities as most of its islands are inaccessible to larger electric-grid infrastructure. Because the load characteristics of most of these islands do not economically justify connection to main grids via submarine or overhead cables, these islands are often served by mini-grids powered by generators fueled by imported diesel and bunker (freighter) oil. Lacking scale economies in both wires and generation capacity, the true cost of service on these island systems is much higher than those on the main Philippine grids.

Many small island grids served by diesel generators suffer from rolling blackouts and unplanned power outages as a result of grid instability, inadequate generation capacity, and lack of subsidized fuel. In many cases, weak daytime demand does not justify 24/7 service.

The policy question posed here is whether it makes sense for the national government to continue to allow expensive imported fossil fuels to dominate the energy mix of small island grids, or should it look to modernize the electric power sector overall to ensure affordability and reliability in the face of rapidly declining costs and technological advances in renewable energy and storage.

Renewable energy can reduce dependence on fossil fuel generation, and can do so without compromising the availability of power and grid reliability. Imported diesel may continue to serve as a base-load supply that is flexible enough to absorb renewable energy generation in the transition from oil-based to renewable-powered electricity. As Philippine small island grids modernize, renewable energy technologies and storage can ultimately produce reliable and clean power.

Modern energy systems include the hybridization[1] of existing diesel-powered generation with solar photovoltaics (PV), wind turbines, biomass gasification, small hydro installations, and battery energy systems.

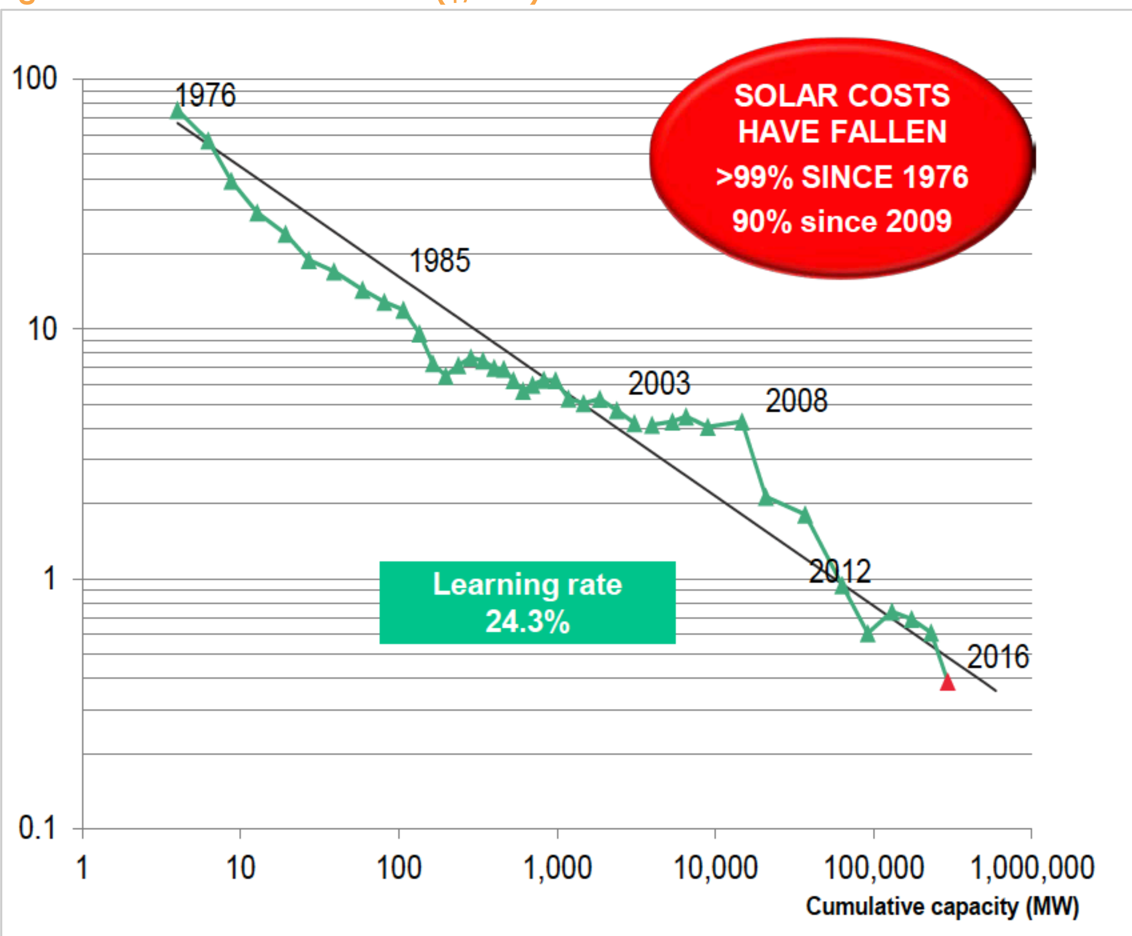
[1] "Hybrid Systems" refers to any power or energy generation facility that makes use of two or more types of technologies powered by conventional and/or renewable fuel sources that include but are not limited to integrated solar/wind systems biomass/fossil fuel systems, hydro/fossil fuel systems, integrated solar/biomass systems and integrated wind/fossil fuel systems with a minimum of 10 megawatts or 10% of the annual energy output provided by renewables.
Source: http://www.lawphil.net/statutes/repacts/ra2008/ra_9513_2008.html

The Cost-Deflation Effect of Renewable Energy Technologies and Batteries

Solar-powered electricity costs have fallen by 99% since 1976 and 90% since 2009 (Figure 1) while the cost of wind-powered generation has fallen 50% since 2009 (Figure 2), according to Bloomberg New Energy Finance.

As solar power, especially, is added to a grid, the cost of each additional unit of capacity to producers goes down, a phenomenon that stands to drive solar's eventual domination of energy mixes. Investment in rooftop solar in the U.S. alone hit $13.1bn in 2016, up from $3.2bn in 2015[2].

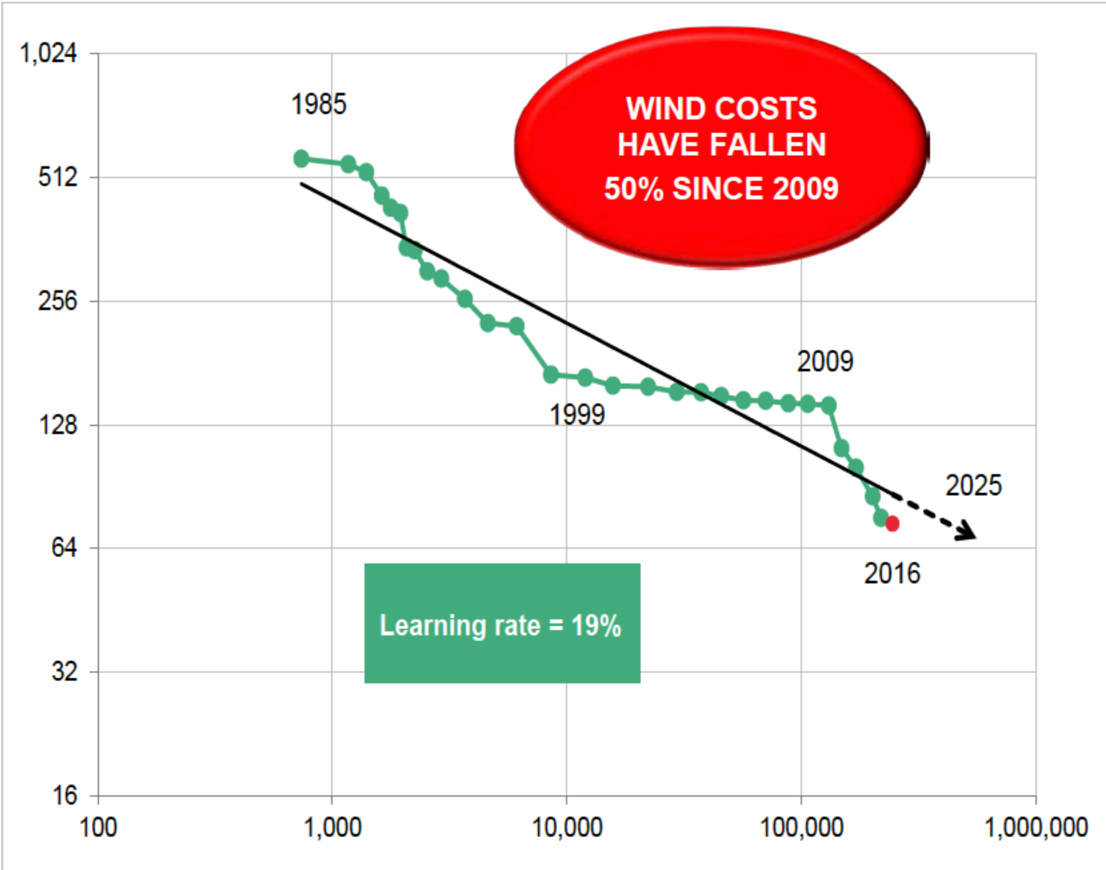
Figure 1: Solar PV Module Cost ($/MW)



Note: Prices are in real (2015) USD. 'Current price' is $0.4/W.
Source: Bloomberg New Energy Finance, Maycook

[2] http://www.bcse.org/sustainableenergyfactbook/

Figure 2: Onshore Wind Levelized Cost ($/MWH)



Note: Pricing data has been inflation corrected to 2014. Assumptions: debt ratio of 70%; cost of debt, 175 bps over LIBOR; and cost of equity of 8%.

Source: Bloomberg New Energy Finance

Energy storage system (ESS) expansion is occurring alongside fast-growing global uptake of solar and wind. ESS will prove crucial to 24/7 electricity availability from renewable energy sources, and it promises grid operators the important ability to manage variable generation. ESS costs have come down tremendously in recent years, according to the International Finance Corporation[3], and are expected to continue to decline (Figure 3).

Figure 4 below illustrates the estimated fuel and system cost savings of energy storage technologies in remote microgrids by battery type. ESS technology offers both enhanced energy capacity and ancillary services[4]. Batteries bring extensive cost deflation to electricity providers, but government regulating authorities have to modify rate structures in a way that allows utilities to work with storage providers.

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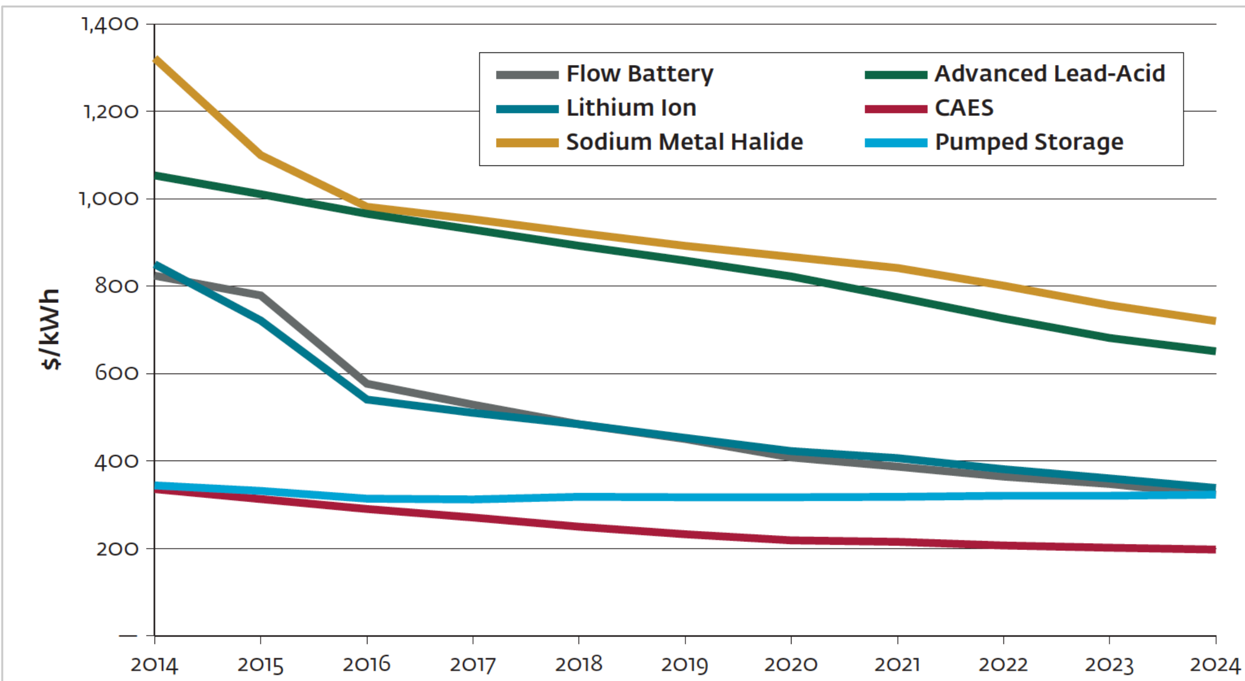
[3] https://www.ifc.org/wps/wcm/connect/ed6f9f7f-f197-4915-8ab6-56b92d50865d/7151-IFC-EnergyStorage-report.pdf?MOD=AJPERES

[4] "Ancillary Services" refers to services necessary to support the transmission of electric power from seller to purchaser given the obligations of control areas and transmitting utilities within those control areas to maintain reliable operations of the interconnected transmission system (Source: Federal Energy Regulatory Commission). These services address the need to stabilize grid frequency and voltage instantaneously (load-following service) as power demand varies through time, as power grids need to meet demand 24/7; and re-energization of the grid after power blackouts (black-start services). These services are provided by facilities with fine-tuning generation capabilities such as storage hydro, natural gas, diesel generation, etc. Storage batteries address these needs perfectly.

The Philippines is taking the lead in electricity storage in an emerging market.

In the Philippines, pumped-storage capacity of more than 650MW has been operational for more than 10 years, and developers say that as much as 1000 MW more is being planned. As for battery technology, the International Finance Corporation reports that "in 2016, AES completed a 10 MW installation in the Philippines, the first grid-scale battery energy storage facility in Southeast Asia" and "141.5 MW of lithium-ion storage projects [are] in the pipeline with 100 MW in the Philippines, and 41.5 MW in China."

Figure 3: Utility-Scale Energy Storage System Cost Trends by Technology, Global Averages: 2014–2024



Source: International Finance Corporation and Navigant Research

Figure 4: Estimated Fuel Savings and System Costs of Energy Storage Technologies in Remote Microgrids by Battery Type, World Markets: 3Q 2016

Battery Type	Installed Cost ($/kW)	Est. Annual O&M Cost ($/kW)	Avg. Round-Trip Efficiency	Est. Annual Fuel Savings (L/kW)	Est. Annual Fuel Savings ($/kW)
Flow Battery: Utility-Scale	2,300.2	31.1	70%	1,680	1,831.2
Flow Battery: Distributed	2,874.4	34.5	70%	1,680	1,831.2
Advanced Lead-Acid: Utility-Scale	2,903.5	66.2	80%	1,920	2,092.8
Advanced Lead-Acid: Distributed	3,284.5	66.8	80%	1,920	2,092.8
Lithium Ion: Utility-Scale	2,062.0	47.3	90%	2,040	2,223.6
Lithium Ion: Distributed	2,150.3	50.8	90%	2,040	2,223.6

Source: International Finance Corporation and Navigant Research

A Working Example of Island Grid Network Demonstration in Indonesia

The Sumba Island microgrid in Indonesia is an example of how integration of energy storage into remote microgrids can bring electrification to island communities. The initiative on the mountainous Island, home to 650,000 people, received strong support from the Indonesian Ministry of Energy, which sought to help achieve 100% renewable energy for Sumba.

The island initially had two separate electricity grids supplied by imported diesel fuel with peak capacity of 13.0 MW (a night-time peak of 9.3 MW and daytime peak of 5.9 MW). Demand by 2020 is forecast to increase to 28.5 MW.

The Ministry of Energy garnered crucial external support from financiers that included the Asian Development Bank, supporting projects like a 660 kW wind-powered flywheel hybrid system, 6.5 MW of solar PV plants, and 800 kW of micro-hydro power plants (each of which produces less than 50kW). Additional external support came in the form of studies on renewable energy potential on Sumba, which could produce up to150 MW of wind-power electricity.

Optimizing the new variable generation was a challenge, and an energy storage system (ESS) was commissioned as a way to ensure grid stability and effective absorption of renewables. Government support by way of the Indonesian Agency for the Assessment and Application of Technology was key in enabling the financing for the ESS.

The financial and economic case for the ESS project was made largely on the high cost of imported diesel fuel. In 2009, electricity produced by imported diesel fuel cost $0.26/kWh. A 50% reduction in the use of imported diesel via the use of storage, wind power, solar power, and hydro power resulted in end-user cost savings of 35%, equivalent to approximately $0.09/kWh. The switch to renewable microgrid energy power also limited the need for costly new transmission and distribution infrastructure.

An important component of program success was collaboration between the national utility, Perusahaan Listrik Negara (PLN), and the island's electric cooperative, Corporasi Peduli Kasih.

Moreover, governments around the world are hastening efforts to reduce carbon emissions, modernize electricity infrastructure, expand and improve grids and beef up grid resilience to natural disasters and terrorism.

Renewable technologies and batteries can complement these national objectives, and the extensive deflation effect can drive economic growth and development by improving the affordability and reliability of electricity.

India is a powerful case in point. IEEFA, in recent research, has highlighted how the clear policy vision of the nation's Energy Minister, Piyush Goyal, has been the key factor in driving down the cost of solar electricity in India and mobilizing international and national capital toward India's ambitious renewable energy initiatives.

Other forces driving the uptake of renewables across India include a 30% drop in solar module costs in 2016, interest rate cuts since 2015 by the Reserve Bank of India (driving finance costs down), stabilization of India's currency exchange rate, and growing access to global capital for renewable energy infrastructure investments. The list grows from there and includes greater lending capacity of Indian banks with the expansion of debt tenors (the length of time until the loan is fully paid); growing technical expertise among Indian installers; new tender processes allowing for initial tariffs to include partial inflation protection via indexation; and solar tenders now backed by the Solar Energy Corporation of India (SECI), a central government entity that steps in as a bankable counterparty, thus avoiding unbankable state utilities.

As previous IEEFA research has noted: "The investment needs of the Indian electricity sector over the next decade are approaching US$1 trillion — an investment opportunity large enough to draw attention from the global majors who have historically overlooked India's 1.3 billion people and the ongoing 7% annual economic growth rate."

Renewable energy capacity is growing fast in India, and is targeted now to increase by fivefold to 258GW.

A Flawed Model: Small Island Grids Under Electric Cooperative Franchises in the Philippines

This section provides an overview of power markets and regulatory features of small island grids under electric cooperative franchises in the Philippines.

On small islands, mini-grid power is supplied either by the Small Power Utilities Group (SPUG) under the National Power Corporation (NPC) or by Independent Power Providers (IPPs), otherwise known as new power providers (NPPs). NPC-SPUG is a government-owned and -controlled corporation that is mandated to conduct missionary electrification, which involves both generation supply and grid extension to the most distant villages.

Some detail:

"As of October 2015, 291 NPC-SPUG power plants and 19 NPPs/QTPs with total installed and dependable capacity of 316 MW and 267 MW, respectively, rely on the UCME subsidy to sustain the power supply requirements of 47 electric cooperatives and local government units in 34 provinces consisting of 196 municipalities, 242 missionary areas and 2,929 barangays."[5]

NPC-SPUG gross power generation was 405,097 MWh in 2015 nationally, accounting for 0.49% of total gross generation in the Philippines. This power served approximately 800,000 households from 298 SPUG plants[6].

On Mindanao, which has the largest concentration of such generation, NPC-SPUG gross power generation totaled 147,309 MWh in 2015, accounting for 1.45% of total generation on the island. This total excluded NPC-SPUG areas declared open for private sector participation via NPPs.

In 2012, NPC-SPUG and IPPs operated 529 generating units with a total rated capacity of 283.06 MW[7]. The total installed capacity of small island grids has grown considerably since then with the participation of IPPs. Even with a clear mandate in the Electric Power Industry Reform Act of 2001[8] (EPIRA) for SPUG to use renewable energy resources whenever feasible, the group has been unable to comply with the directive because of technical and legal difficulties[9]. While it has not yet installed any renewable energy hybrid systems, it is formulating tenders for hybrid systems in 50 sites.[10]

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[5] Urbano Mendiola, "Missionary Electrification Subsidies in the Philippines." Asian-power.com. Mendiola is NPC vice president for corporate affairs of SPUG.

[6] This number certainly understates demand in small island grids because true potential demand is omitted and generation ranges from 6 to 24 hours in these grids, constrained by the budget of NPC-SPUG.

[7] http://report.spug.ph/about.asp

[8] https://www.doe.gov.ph/sites/default/files/pdf/downloads/final_irr_dtd_02.27.02.pdf

[9] Interview with Edmundo Veloso, NPC vice president for NPC-SPUG, Jan. 30, 2017.

[10] Interview with Ferdinand Larona, GiZ energy advisory to the Philippines, March 15, 2017.

Figure 5 gives an overview of existing generation rates, which range from 5 pesos per kWh to 7 pesos per kWh as of December 2016 in SPUG areas. The existing Subsidized Approved Generation Rate (SAGR) is the generation rate paid by cooperatives powering SPUG areas, while the effective rate is the cost of power generation including the generation charge and system loss. (These SAGRs are subsidized rates, as the true cost of diesel generation is between 13 and 28 pesos per kWh [refer to Figure 6]. The cost of power generation in the main grids varies from 5 pesos per kWh to 6 pesos per kWh). The difference between the true cost of diesel generation and the effective electricity rates is paid for by ratepayers under the Universal Charge for Missionary Electrification (UCME). The subsidized rates are set by the Energy Regulatory Commission (ERC).

Figure 5. Existing Effective Rates of Small Power Utilities Group as of December 2016

Areas	Existing Subsidized Approved Generation Rate (SAGR)	Effective Rate, P/kWh
Mindoro Area	5.64	6.20
Marinduque	5.64	6.20
Mainland Palawan	5.64	6.20
Catanduanes	5.64	6.20
Masbate	5.12	5.68
Tablas	5.64	6.20
Romblon	6.25	6.20
Bantayan	6.25	7.06
Camotes	6.25	7.06
Siquijor	6.25	7.06
Tawi-Tawi	5.12	5.12
Basilan	5.12	5.12
Sulu	5.12	5.12
Other Luzon		
Group 1	4.8	5.36
Group 2	5.64	6.20
Other Visayas	5.64	6.45
Other Mindanao	4.80	4.80

Source: http://www.napocor.gov.ph/index.php/2013-09-13-01-23-51/spug-rates

Figure 6: True Cost of Diesel Operated by NPC SPUG vs. Effective Selling Rate in 2012

NPC SPUG Area	Municipality	True Cost of Diesel (pesos per kWh)	Effective Selling Rate (pesos per kWh)	Difference
ROMBLON	Alad	28.03	6.59	21.44
CATANDUANES	Palumbanes	21.56	6.59	14.97
MINDORO	Cabra	19.8	5.75	14.05
LEYTE	Caluya	18.89	6.84	12.05
TAWI-TAWI	Manuk Mankaw	17.6	6.27	11.33
KALINGA	Lubuagan	16.52	5.76	10.76
DAVAO DEL NORTE	Talicud	16.87	6.27	10.6
SIQUIJOR	Siquijor	15.49	6.07	9.42
CEBU	Camotes	15.35	6.07	9.28
PALAWAN	El Nido	14.93	6.59	8.34
BATANES	Basco	14.04	6.59	7.45
QUEZON	Polilio	13.92	6.59	7.33
BASILAN	Basilan	13.7	6.58	7.12

Source: GIZ, SPUG-NPC (2012)

These subsidies are justified as a way to achieve social equity. All Filipinos have a right to electrification. Subsidies are also seen as a way to incentivize IPPs to invest in power generation in small islands. Though the true costs under IPPs have to be lower than existing SPUG costs in order for IPPs to be profitable, the difference is still paid for by ratepayers on the main and small grids under the UCME.

NPC estimates that it will cost approximately 10.32 billion pesos to cover projected fuel costs, operating expenses to meet demand in missionary areas in 2017. Fuel cost accounts for 75% of NPC-SPUG's cost of generation[11] (refer to Figure 7). According to NPC, funds from the UCME subsidy are not enough to cover operating costs. This opens NPC-SPUG areas to the risk of curtailment of service hours, delays in the rehabilitation or repair of generation facilities, as well as underinvestment in electrification. Moreover, NPC-SPUG areas are also at risk of dependence on cross-ratepayer and taxpayer subsidies; should the subsidies disappear, NPC-SPUG ratepayers would end up paying the true cost of imported diesel.

[11] https://www.doe.gov.ph/sites/default/files/pdf/electric_power/development_plans/medp_2012.pdf

Figure 7: UCME Requirements of NPC-SPUG for 2012-2016(in PHP billions)

Item	2012	2013	2014	2015	2016
Fuel Cost	6.72	7.93	9.53	11.03	13.07
Payroll	0.76	0.93	0.93	0.93	0.93
Plus, Maintenance and Other Operating Expenses	1.67	1.95	2.05	2.15	2.26
Equals Subtotal Operating Expenses	**9.15**	**10.92**	**12.51**	**14.11**	**16.25**
Plus, Depreciation	0.35	0.34	0.34	0.34	0.34
Equals Cost of Generation	**9.50**	**11.15**	**12.84**	**14.45**	**16.59**
Estimated Revenue	2.98	3.48	3.60	3.80	4.02
UMCE Subsidy	6.52	7.68	9.24	10.65	12.57
Pesos per kWh	0.10	0.12	0.14	0.16	0.19

Source: https://www.doe.gov.ph/sites/default/files/pdf/electric_power/development_plans/medp_2012.pdf

The Economic Case for Renewable Generation in the Philippines

The true cost of diesel-fired generation begs the question of why more cost-effective solar- and wind-powered generation is not deployed more broadly across small island grids in the Philippines.

Below are three modernization scenarios:

I. Fuel Displacement Model

On grids where peak demand is now fully met by diesel plants, and where average cost of renewable energy is less than the variable costs of diesel generation (which consists mostly of fuel and lubes), electricity produced by run-of-river hydro, biomass, solar, and wind is now positioned to compete economically and to progressively displace imported-diesel-fired generation by way of hybridization initiatives.

Figure 8 illustrates the price of renewable generation in the Philippines. Figure 9 illustrates the levelized cost of energy generation technologies[12].

It is evident from the data that imported diesel fuel is far more expensive than renewable energy.

Figure 8: Alternative Generation

Alternative Generation	2012
Roar Hydro	6.0
Solar PV	6.0
Wind Turbine	6.0
Biomass	6.5

Source: ERC indicative rates

[12] https://www.lazard.com/media/438038/levelized-cost-of-energy-v100.pdf

Figure 9: Levelized Cost of Energy Generation Technologies

		Levelized Cost of Energy	Carbon Neutral/Rec Potential	State of Technology	Location			Dispatch			
					Distributed	Centralized	Geography	Intermittent	Peaking	Load-Following	Base- load
Alternative Energy	Solar PV	$46 - 222	✔	Commercial	✔	✔	Universal	✔	✔		
	Solar Thermal	$199 - 182	✔	Commercial		✔	Varies	✔	✔	✔	
	Fuel Cell	$106 - 167	?	Emerging/ Commercial	✔		Universal				✔
	Micro turbine	$76 - 89	?	Emerging/ Commercial	✔		Universal				✔
	Geothermal	$79 - 117	✔	Mature		✔	Varies				✔
	Biomass Direct	$77 - 110	✔	Mature		✔	Universal			✔	✔
	Onshore Wind	$32 - 62	✔	Mature		✔	Varies	✔			
Conventional Energy	Diesel Reciprocating Engine	$212 - 281	✗	Mature	✔		Universal	✔	✔	✔	✔
	Natural Gas Reciprocating Engine	$68 - 101	✗	Mature	✔		Universal	✔	✔	✔	✔
	Gas Peaking	$165 - 217	✗	Mature	✔	✔	Universal		✔	✔	
	IGCC	$94 - 210	✗	Emerging		✔	Co-located or rural				✔
	Nuclear	$97 - 136	✔	Mature/ Emerging		✔	Co-located or rural				✔
	Coal	$60 - 143		Mature		✔	Co-located or rural				✔
	Gas Combined Cycle	$48 - 78	✗	Mature	✔	✔	Universal			✔	✔

Source: Lazard

Viable renewable-generation models today indicate that diesel generation can be reduced as the grid takes in variable renewable energy generation.

The economics of transition through hybridization are compelling.

II. Meeting Incremental Capacity

An incremental capacity approach brings additional electricity-generation capacity at a lower cost than the fuel-displacement model, at a quicker pace, and with a greater element of permanence.

Adding solar and wind capacity incrementally to the electricity-generation mix across the many islands of the Philippines makes for compelling economics, because renewables now offer lower average energy costs compared to diesel generation. But this model also suggests a greater renewable-energy-to-imported-diesel capacity ratio than that of the fuel displacement scenario.

This model suggests the possibility of 100% renewable energy in island grids either when diesel contracts expire, or even before then, as cost thresholds are crossed.

III. Fuel Renewble Energy Displacement of Thermal Generation

When average cost of renewable energy technologies plus residual (inertial) capital recovery cost from extant thermal contracts are less than the true cost of generation from NPPs with diesel generation, all thermal generation can be displaced. How quickly this happens depends on how the ERC and the DoE can assure the NPPs of cost recovery. In any case, ratepayers will still be burdened by "stranded costs,"

IV. A New Business Model

We propose a new business model that takes into account the equity-raising limitations of the electric coops in missionary areas. The NEA ranks electric coops based partly on creditworthiness.[13] Our model addresses this problem by resorting to a corporate structure that the island coops can qualify as a new power provider. The coop NPP would seek tenders from private developers for a joint venture to provide renewable energy power to displace NPC-SPUG capacity and generation.

In order to supply reliable and secure clean power, it is important to look to electrify households and communities through a solar-diesel hybridization or a wind-solar-diesel hybridization with a requirement to displace at least a pre-determined percentage of total diesel generation to start. As mentioned in the previous section, in order to validate the economic viability of solar and wind to displace fuel, the tariff must be well below the variable cost of thermal generation.

Increased electrification with alternative generation sources is a win-win situation for both the ratepayers of Siquijor through more reliable electricity and cheaper rates, and for the provincial government through taxes. Increased productivity would lead to economic growth prospects and a related reduction in poverty.

Electric cooperatives like Prosielco can expand their ability to finance by diversifying their equity and revenue sources and ability to optimize procurement of an alternative generation source. A new power provider ownership structure example that allows for a fair revenue share and the best overall benefit to ratepayers is shown in Figures 14.

For purposes of discussion, this section assumes a 20-80 joint venture ownership structure in favor of the private joint venture (JV) partner. All three ownership options allocate the dividends as a result of the 20% ownership to finance grid modernization, and other projects, including future power generation. Moreover, in order to further incentivize the electric cooperative, the JV partner can give additional sweat equity up to a predetermined limit (an additional 5% to 10%, for example) subject to key performance indicators.

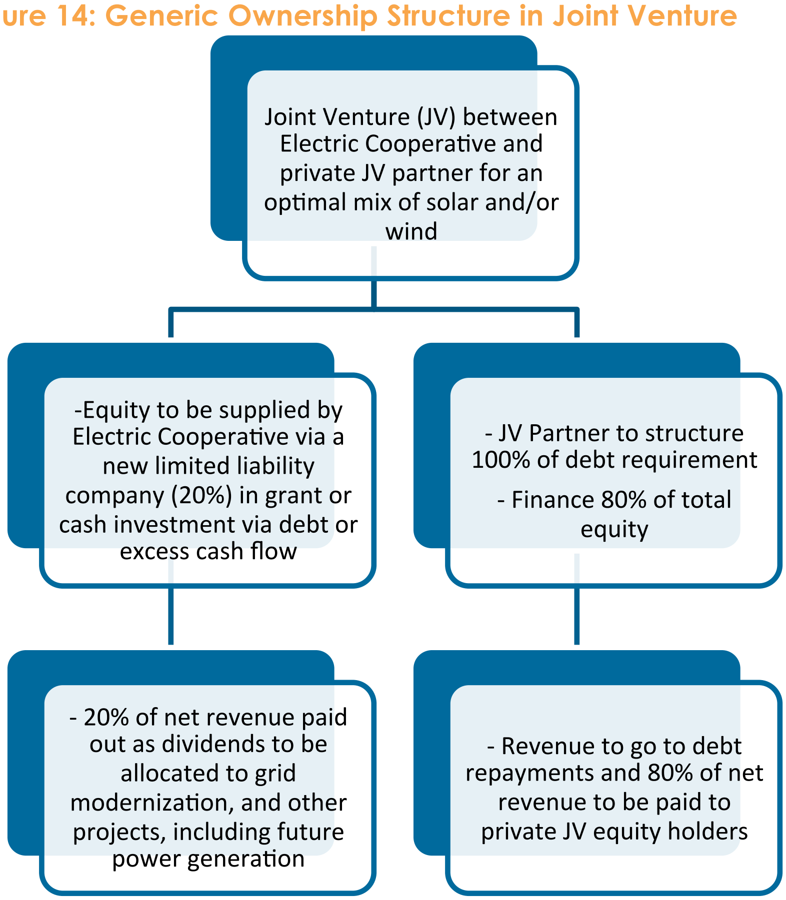
The options below illustrate how electric cooperatives can fund their equity stake in new power provider companies – either with a grant, excess cash flow, debt, or future buys-in. The

[13] Epira mandated debt forgiveness for coops. This amounted to P16 billion as of 2003. Since then, the outstanding debt of coops, mainly in missionary has ballooned again to P26 billion, most of which are from island grids. Half of this total is from island grids in the ARMM.

private JV partner is in charge of structuring 100% of the debt requirement upfront and the rest of the remaining equity requirement. It is in the best interest of the JV partner to ensure that the electric cooperatives are able to finance grid modernization and extension of the grid to previously unserved areas. By ensuring grid stability and high absorptive capacity, as well as extending access to more ratepayers, new power providers are in a better position to expand their business to new previously unserved areas.

The electric cooperative would issue a call for proposals requiring the JV partner to compete in a free and open tender system subject to qualifying thresholds on financial and operating capacity parameters. A specific bid evaluation parameter would be in pesos per kWh and depend on the JV partner's ability to operate and manage or source an operator and manager. The JV partner would not be not required to use balance sheet financing; it could source the debt from either a bank or alternative financing groups including private equity. The JV partner would then be asked to deposit a predetermined amount upon winning the award to ensure delivery (i.e., 5% of total project cost). The award would also be subject to a predetermined schedule; and the deposit would be forfeited to the electric cooperative if the time limit for any major deliverable is breached. This process would aim to ensure more competition among large and small power providers.

Figure 14: Generic Ownership Structure in Joint Venture



The chart above illustrates the generic structure. A major variant is one where the coop equity is paid in full or in part by projected revenues. This relaxes the pressure to raise equity upfront in exchange for lower returns, and addresses the creditworthiness issue of the coops in the island grids.

The major point here is that nothing in the current regulatory environment prohibits the island coops from exploring partnerships to their advantage.

Figure 10: True Cost of Diesel Operated by NPC-SPUG vs. Cost of Alternative Generation

NPC SPUG Area	Municipality	True Cost of Imported Diesel (pesos per kWh)	SAVINGS				
			Solar (6 pesos per kWh)	Solar + Battery (9.5 pesos per kWh)	Wind (6 pesos per kWh)	Small ROR Hydro (6 pesos per kWh)	Biomass (6.5 pesos per kWh)
ROMBLON	Alad	28.03	22.03	18.53	22.03	22.03	21.53
CANTANDUANES	Palumbanes	21.56	15.56	12.06	15.56	15.56	15.06
MINDORO	Cabra	19.8	13.8	10.3	13.8	13.8	13.3
LEYTE	Caluya	18.89	12.89	9.39	12.89	12.89	12.39
TAWI TAWI	Manuk Mankaw	17.6	11.6	8.1	11.6	11.6	11.1
KALINGA	Lubuagan	16.52	10.52	7.02	10.52	10.52	10.02
DAVAO DEL NORTE	Talicud	16.87	10.87	7.37	10.87	10.87	10.37
SIQUIJOR	Siquijor	15.49	9.49	5.99	9.49	9.49	8.99
CEBU	Camotes	15.35	9.35	5.85	9.35	9.35	8.85
PALAWAN	El Nido	14.93	8.93	5.43	8.93	8.93	8.43
BATANES	Basco	14.04	8.04	4.54	8.04	8.04	7.54
QUEZON	Polilio	13.92	7.92	4.42	7.92	7.92	7.42
BASILAN	Basilan	13.7	7.7	4.2	7.7	7.7	7.2

Note: Solar+Battery can range from 9 pesos to 11 pesos per kWh

Source: GIZ, SPUG-NPC, Solar Philippines, SolarNRG Philippines

Demand for electricity is suppressed when supply is unstable and limited. When electricity supply and access become more reliable, however, households demand a greater amount of power as they acquire more electrical appliances. New businesses or income-generating activities also arise with stable power. This snowball effect makes it difficult for electric cooperatives to forecast (and meet) demand. A speedy incremental capacity expansion can address this effect.

Solar provides small island grids the ability to add production faster and at a lower incremental cost than with imported diesel. This is thanks to the modularity of solar — incremental increases can be small, and pre-construction and construction lead times are less than those of imported diesel-fired generation. Moreover, modular expansion can allow electric cooperatives to avoid both costly temporary overcapacity and higher costs from environmental requirements that are becoming more stringent and making diesel-generated expansion more expensive.

The economics of transition through incremental capacity requirements are even more compelling than those of fuel displacement models.

A Major Barrier: Outdated Regulations and Unfulfilled Renewable Energy Mandates

Barriers to small island grid uptake of modern renewable energy power include outdated regulations that have not kept up with technology. Indeed, the Philippines presents a prime example of how techno-economic change has outpaced government regulation.

Under current regulation, for example, no incentives exist for island electric cooperatives (or those in SPUG areas) to procure cheaper sources because whatever the outcome, savings accrue exclusively to the missionary fund and none to the franchise ratepayers. This is a classic case of moral hazard. This system tends to be biased against renewable generation because franchise managers would rather stick with diesel generation they are used to, even though more expensive.

Section 12 of the Renewable Energy Act of 2008 mandated the DoE, upon recommendation of the National Renewable Energy Board (NREB) to set a minimum renewable energy uptake in off-grid areas from available renewable resources in the islands. According to Pete Maniego, former NREB chair, the recommendatory task was delegated to NPC-SPUG. As of June 2016, however, NPC-SPUG had not made any final recommendations.

Since sunlight is abundant in all off-grid areas, the binding constraint would be land availability, and anecdotal evidence suggests large tracts are available.

Furthermore, the tariff-setting system for island electric cooperatives under the ERC is based on cash adequacy for operating and maintenance costs and an arbitrarily set cap on capital expenditures. This means there is no incentive for electric cooperatives to even be more efficient or reduce costs. Private distribution utilities, on the other hand, benefit from a performance-based regulation, which leads to operational and investment efficiency. Still, private distribution utilities lack incentives to procure least-cost power supply because of full pass-through of fuel costs on contracts that address demand from captive customers, most of which are residential.

Prudent reform would have the ERC and NEA set up and enforce policy to require electric cooperatives and private distribution utilities alike to optimize procurement. Such reform would reduce the cost of electricity by tightening competition between power generators. For fossil-fuel power generators, up to 80% of operating cost comes from fuel. Optimizing procurement levels the playing field for renewable power generators and reduces the UCME cost for ratepayers and taxpayers by phasing out subsidies for imported diesel.

The ERC and NEA can amend their tariff-setting system to favor performance and thus award gains as a result of increased efficiency and lower costs. It is clear that from a technological standpoint, there is the capability to implement cheaper alternatives, but in terms of integrating that capability into government regulation, there has not been much progress.

Cooperatives will also require training in renewable energy supply procurement—in part because of unfounded fears of running afoul of their diesel contract obligations.

The Department of Energy (DOE) can enjoin NPC-SPUG to speed up hybridization of its plants and to install maximum renewable energy for incremental load and in new sites identified for electrification. Moreover, the NEA can direct electric cooperatives to be technology-neutral in the procurement of power.

Case Study: Siquijor Island

Lack of access to electricity in small islands is prevalent in the Philippines. Most small island grids are powered by NPC-SPUG[i].

Siquijor is an island province composed of six municipalities with approximately 17,472 households composed of 91,066 people. Approximately 25% of Siquor households have yet to be electrified, while the electrified 75% have access largely to unreliable and expensive imported diesel electricity. Figure 11 gives an overview of Siquijor's electrification and demand.

Before 2015, Siquijor's electricity was supplied solely by NPC-SPUG from three power plants with a total installed capacity of 7.6 MW. Because of a lack of incentives to upgrade infrastructure, NPC's generation facilities had frequent breakdowns.

Figure 11: Overview of Electrification and Demand

Municipality	Total No. of Households	Total No. of Households without Access to Electricity	% with Electricity	% Without Access to Electricity
Enrique Villanueva	1,126	171	84.37%	15.19%
Larena	2,629	308	88.10%	11.71%
Lazi	3,280	1,461	53.78%	44.23%
Maria	2,372	740	67.03%	31.20%
San Juan	2,943	879	70%	30%
Siquijor	5,122	947	80.58%	18.48%
Total	17,472	4,506	74.22%	25.78%

Source: Rapid Community Based Monitoring of the National Anti-Poverty Commission as of 2013

In 2015, the private Siquijor Island Power Corporation (SIPCOR) installed a 6.4 MW diesel plant under a 20-year Power Supply Agreement (PSA) with the Province of Siquijor Electric Cooperative Inc. (Prosielco), the sole power distributor. SIPCOR also assists with voltage regulation of Prosielco's distribution system during peak or heavy conditions. Even with this capacity increase, Siquijor does not have enough electricity (refer to Figure 12). To alleviate its shortage over the short term, Prosielco can rent diesel modular generator sets for 2-3 years but there remains an immediate need for the cooperative to upgrade its distribution system and a medium-term need for grid modernization.

Figure 12: Energy and Load Demand Forecast

Year	ENERGY FORECAST (MWH)	DEMAND FORECAST (MW) NEA FORECAST MODEL NO.					Percent Loading on SIPCOR plant
		NO.20	NO.28	NO.48	NO.52	AVERAGE	
2016	20,184.77	5.36	5.13	5.15	5.21	5.21	87%
2017	21,511.55	6.15	5.83	5.86	5.94	5.94	99%
2018	24,421.49	6.97	6.59	6.62	6.72	6.72	112%
2019	27,786.54	7.81	7.38	7.42	7.53	7.54	126%
2020	31,630.61	8.67	8.21	8.24	8.36	8.37	139%
2021	35,980.99	9.53	9.05	9.09	9.21	9.22	154%
2022	40,867.66	10.38	9.91	9.95	10.07	10.08	168%
2023	46,322.74	11.24	10.79	10.82	10.94	10.95	182%
2024	52,380.07	12.09	11.67	11.70	11.81	11.82	197%
2025	59,074.82	12.93	12.55	12.59	12.68	12.69	211%
2026	66,443.32	13.76	13.44	13.45	13.55	13.56	226%
2027	74,522.77	14.58	14.33	14.35	14.42	14.42	240%
2028	83,351.11	15.39	15.22	15.24	15.28	15.28	255%
2029	92,966.89	16.19	16.11	16.12	16.14	16.14	269%
2030	103,409.16	16.98	17.00	17.00	17.00	16.99	283%

Source: Prosielco

Figure 13 gives an overview of an electricity bill for a typical Siquijor ratepayer. In August 2016, the final retail rate per kWh was 10.81 pesos. Should the subsidy disappear, ratepayers will have to pay an additional 7.75 pesos per kWh[14], leading to a total rate per kWh of 18.56 pesos[15].

Figure 13: Electricity Bill in Siquijor - August 2016

Charges	Amount	Percentage	Where it goes?
Power Cost:			
Generation Charge	6.15		To SIPCOR (Diesel generation company)
System Loss – 8.82%	0.59		To SIPCOR (Diesel generation company)
	6.74		To SIPCOR (Diesel generation company)
3rd GRAM	0.80		To the government (NPC thru SIPCOR)
TOTAL POWER COST (Subsidized rate)	**7.54**	61.84%	
Universal Charge:			
Missionary Charge	0.16		To NPC to subsidize the missionary electrification of the government.
Environmental Charge	0.0025		To NPC to be used for watershed rehabilitation and management.
Stranded Cost	0.19		To the Power Sector Assets and Liabilities Management (PSALM) Corporation for Independent Power Producers (IPPs) contracts entered by the government to cover the power crisis of the 1990s.
TOTAL UNIVERSAL CHARGE	**0.35**	2.87%	
VALUE ADDED TAX	1.23	10.08%	To the government (BIR)
SUBTOTAL	1.48	12.14%	
DISTRIBUTION CHARGE	1.59	13.04%	To PROSIELCO for operation & payment of Loan Amortization
TOTAL RATE PER KILOWATTHOUR	**12.19**	100%	

[14] True Cost of Diesel – Subsidized Rate = PHP 15.49 – PHP 7.74 = PHP 7.75
[15] Subsidized Total Price + Subsidy = PHP 10.81 + PHP 7.75 = PHP 18.56

Source: Prosielco, August 2016

Risk Mitigation

This section offers a brief overview of the risks involved in renewable generation investments and the common ways to effectively mitigate such risks.

Financial risk includes the illiquid nature of renewable energy investments, which makes valuation difficult to monitor. Illiquidity can also make such investments difficult to sell in the event of adverse market events.

Political risk comes from the possibility of change that can result in investors sometimes having to accept delays, renegotiation of existing contracts, and unfavorable tariff changes. Such events can result in significant cost overruns to development budgets and revenue reductions or cost increases on the operating side. Political risk also arises from the possibility that the authorities in a host jurisdiction will interfere with the timely development and/or long-term economic viability of a project. These risks include the imposition of additional taxes and additional legal restrictions after a project is operational. An extreme case of political risk is that of expropriation.

Regulatory risk stems from the fact that renewable energy investments are typically made based on regulatory schemes that can change. Such change can have an impact on major terms and conditions of the investments, most notably on the flow of revenue.

Reputational risk arises from the reality that energy projects can involve high-visibility public goods and services. Public controversy around energy projects is not uncommon.

Other risks include collection risk, which comes from the possibility that ratepayers will not pay their bills or will not do so on time. Construction risk stems from delays due to permits/clearances, financing, weather, and community or local unrest. Currency risk can come from fluctuations that affect projected returns when a project's revenue or costs is denominated in more than one currency and when the currencies involved affect the ability to service debt.

The risks noted above can be mitigated.

Currency risk, for instance, can be passed to off-takers through tariff-setting and with currency hedging. Collections risk can be mitigated by prepaid metering. One general risk-mitigation technique is to take a portfolio-management approach that includes geographic diversification. Another is to borrow from a major local bank, a strategy that can mitigate expropriation risk. Other tactics include stakeholder or government direct or indirect ownership.

Additional project-specific risk mitigation tools included insurance solutions from multilateral institutions and their partners, from insurance and re-insurance companies, or from local financing institutions. Types of risk typically insured against include currency inconvertibility and transfer restriction, breach of contract, expropriation, war, terrorism, and civil disturbance. Other risk-mitigation instruments include guarantees in the event of default or inability to service debt.

Broadly speaking, investors have developed sophisticated financial, governance, and operating strategies to manage common risks associated with renewable energy investments.

The track record for renewables works to offset common risks as well. Technological improvements have driven down costs, improving competitiveness and the regulatory environment around such projects, and have given rise to broad public acceptance of renewable energy.

An Opening for Investors

Investors in general have long faced considerable challenges due to the fact that up to 50% of government bonds in Western markets are paying negative interest while 20-year government bonds are paying less than 1% per year and that equity markets in the U.S. and Europe are at or near historic highs, suggesting that they are too expensive.

The risk-return profile of real assets, also known as physical assets, are well suited to inflationary times and are appropriate now because of their low correlation with equity markets and bonds.

In the Philippines, the utility scale market supported by feed-in-tariffs (FiT) is over-subscribed — and it lacks transparency — making it difficult for small developers to secure funding and for solar players overall to compete. A transparent price-based competitive selection process (lowest Php/kWh) via open tender instead of the current cost-based rate fixing (FiT) would offer developers, both small and large, a better way to compete. Such reform would also encourage private sector investment in small island grids.

Opportunity is abundant already, however. The Renewable Energy Act of 2008 (Act No. 9513)[16] offers certified renewable energy developers and their investors incentives.

The most powerful incentive for small island grids is the 'Cash Incentive of Renewable Energy Developers for Missionary Electrification.' It entitles renewable energy developers to a generation-based cash incentive pegged at 50% of the UCME.

Whether for fuel displacement or as incremental load, renewables offer stable costs to missionary electrification programs as compared to fluctuating diesel costs.

[16] http://www.lawphil.net/statutes/repacts/ra2008/ra_9513_2008.html

Incentives from the Renewable Energy Act of 2008 (Act No. 9513)

- An income tax holiday for the first seven years of commercial operations.
- Duty-free importation of renewable energy machinery, equipment and materials.
- Special realty tax rates on equipment and machinery where renewable energy facilities shall not exceed 1.5% of their original cost, less accumulated normal depreciation or net book value.
- A net operating loss carryover to renewable energy developers in the first three years after the start of commercial operation.
- A guarantee that if the renewable energy project fails to receive an income tax holiday before full operation, it may apply for accelerated depreciation (either declining balance method or sum-of-the year's digit method) in its tax books.
- A provision ensuring that the sale of fuel or power generated from renewable sources of energy and other emerging energy sources using technologies such as fuel cells and hydrogen fuels shall not be subject to value-added tax (VAT).
- A provision that entitles renewable energy developers to zero-rated value-added tax on its purchases of local supply of goods, properties and services needed for the development, construction, and installation of its plant facilities.
- A provision that makes all proceeds from the sale of carbon emission credits exempt from all taxes.
- A tax credit equivalent to 100% of the value of the value-added tax and custom duties on the renewable energy machinery, equipment, and materials.

Conclusion

Small island grids represent a largely overlooked opportunity for investors in renewable energy and storage that can readily replace imported diesel generation in such locales across the Philippines.

The case for such investment can be made on straight financial merit. Local deployment of renewables would lead to the dismantling of outdated and unnecessary regulatory infrastructures and of outmoded forms of electricity generation that rely on diesel imports.

Modernization of small island power systems through the uptake of renewables will supply secure, cheaper, and cleaner power.

A full transition to renewable energy in small island grids is possible in the short term without financial support from the national government. Such a transition, driven in the main by natural economic forces, can spur private investment of at least $1 billion in 5 years. Furthermore, the transition leads to a significant reduction in cross-subsidies from ratepayers in the mainland grids.

Institute for Energy Economics and Financial Analysis

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[i] Mainland grids can use locally available variable clean energy sources such as solar, wind, run-of-river hydro, and biomass, thanks to the feed-in-tariff system and the existence of a wholesale spot market. They can also provide stable supply when combined with storage and advanced controls