Grid Modernization as part of the Philippines' Nationally Determined Contribution Enhancement

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Financial and Fiscal Stability

Financial and fiscal stability in the face of climate and transition risk is a growing concern for V20 countries. Financial institutions, especially banks and insurance companies, face higher exposures to economy-wide default risks, as a result of two key pressures. First, climate change itself will inflict damages and losses in general infrastructure including the power sector in particularly climate-vulnerable economies like the Philippines (e.g. cost of power outages or damage to infrastructure caused by severe weather). Second, the arc of technology development in renewables and storage will undermine the competitiveness and return on investment of fossil fuel assets. To mitigate the second, transition risk, global capital is already fleeing the thermal coal sector in terms of financing, insuring and investing. More than 100 banks and insurers/reinsurers, with assets under management or loans outstanding in excess of $10 billion each, now have formal coal exit policies.[1] More recently investors are also leaving the oil and gas sector, such as oil, LNG, fossil gas, oil sands and arctic drilling.[2]

"More than 100 banks and insurers/reinsurers, with assets under management or loans outstanding in excess of $10 billion each, now have formal coal exit policies."

[1] https://ieefa.org/finance-exiting-coal/#1600953078998-095ec388-fe21
[2] https://ieefa.org/finance-exiting-oil-and-gas/#1596145653395-89446f18-be8d5452-4622

Strategic Context for the Department of Energy

Transmission planning is a key control lever that the Department of Energy can use to influence the grid's capacity and prioritize domestic renewable energy sources. Mapping the grid and understanding the implications of new technologies is crucial because grid investment shapes future options, and grid investment can also become stranded (or non-performing) if it fails to anticipate new more cost-effective generation strategies. Moreover, using software can improve grid governance in terms of the way in which users such as domestic cost-effective renewable energy and storage is prioritized.

> “The implications of new technologies are crucial because grid investment shapes future options”

Modernize the Ancillary Services Market

A modernized grid aims for increased flexibility for the integration of new market opportunities in the form of a new ancillary services market (refer to Figure 1) for ramping products, fast frequency response by batteries, as well as for new market participants to provide ancillary services such as wind turbines providing inertial response, solar PV and utility-scale storage providing voltage support, and distributed energy resources (DERs) providing frequency and voltage control.

Figure 1. Types of Modernized Ancillary Services and Associated Products

Ancillary service	Product	Description	Typical response time
Frequency regulation	Primary regulation	The automatic local regulation provided by generating unit speed regulators. This level of regulation sustains frequency levels, preventing large deviations from the scheduled value.	Sub-seconds to seconds
		Innovations: • Fast frequency response is a new product designed to remunerate the provision of fast response[1]. Batteries are great providers of such services, creating the possibility of additional revenue streams for battery operators/owners. • Wind turbines can provide inertial response through power electronic converters. • Photovoltaic (PV) installations, direct current systems and batteries can also provide synthetic inertial response if the inverter is programmed to do so. However, as inverters are not stuck with characteristics of large spinning masses and have more options to provide system stability, this might not be the best use of them. • If regulation allows, DERs can provide this service.	
	Secondary regulation	The automatic regional regulation provided by automatic generation control (AGC), which sends signals from the control centre to certain generators to reestablish the nominal frequency value and restore then primary reserve capacity.	5-15 minutes
		• If regulation allows, DERs can provide this service.	
	Tertiary regulation	The manual regional regulation provided by generating units and controlled by the system operator	>15 minutes
Non-frequency regulation	Voltage support	The injection of reactive power to maintain system voltage within a prescribed range.	Seconds
		Innovations: • Voltage control through reactive power provided by resources connected to the power system through inverters, such as solar photovoltaic and battery storage. • If regulation allows, DERs can provide this service.	
	Black start	The ability to restart a grid after a blackout.	Minutes
	Innovations: • Ramping products	Fast ramping resources that can respond to large net load variations in a short time. This product properly remunerates the fast ramping capability of generators and incentivizes flexibility.	Minutes

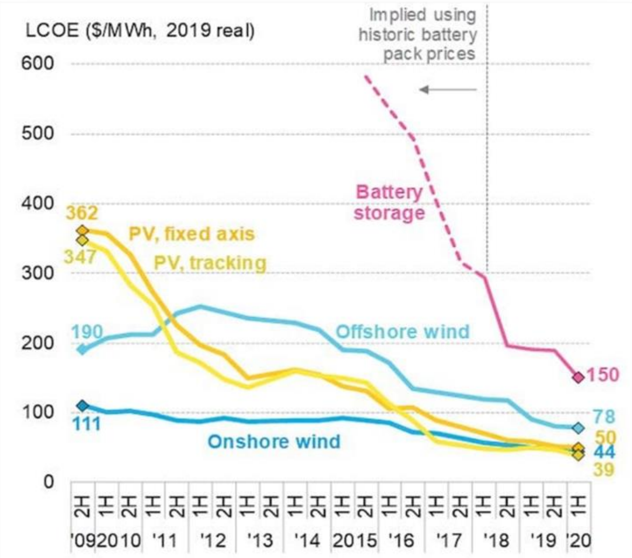
Innovations in ancillary services

SOURCE:
https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Feb/IRENA_Innovative_ancillary_services_2019.pdf?la=en&hash=F3D83E86922DEED7AA3DE3091F3E49460C9EC1A0

Moreover, while imported fossil gas suppliers advocate for balancing renewable energy, there are more cost-competitive system options for balancing renewable energy on a cost-competitive basis that involve far less stranded asset risk in a time of an energy transition. Asian fossil gas spot prices have very recently spiked, rising more than 18-fold on prices of just six months ago.[3] There is an expectation of more volatile and higher fossil gas prices as a result of lower levels of drilling, financial instability in the oil and gas industry, and low levels of industry investment.[4]

> "The rapid scale-up of more cost-competitive renewable technology and storage options is certain to undermine the financial case for large new commitments to imported fossil gas."

Figure 2. Battery Cost Deflation Steeper Than Wind / Solar



To meet traditional return objectives, imported fossil gas infrastructure including regasification and storage facilities, and pipelines range from 25 to 40 years in lock-in. Grid scale battery usage is increasing rapidly, and battery cost deflation is faster than wind or solar (refer to Figure 2). The rapid scale up of more cost-competitive renewable technology (refer to Figure 3 and 4) and storage options is certain to undermine the financial case for large new commitments to imported fossil gas.

Source: Bloomberg New Energy Finance, https://ieefa.org/ieefa-grid-scale-battery-costs-have-reached-a-tipping-point/

[3] https://www.lngindustry.com/special-reports/19012021/ieefa-reports-on-status-of-lng-projects-in-emerging-markets/

[4] http://ieefa.org/wp-content/uploads/2021/01/Gas-and-LNG-Price-Volatility-To-Increase-in-2021_January-2021.pdf

Figure 3. Distribution of Optimized Competitive Renewable Energy Zones Solar PV Development

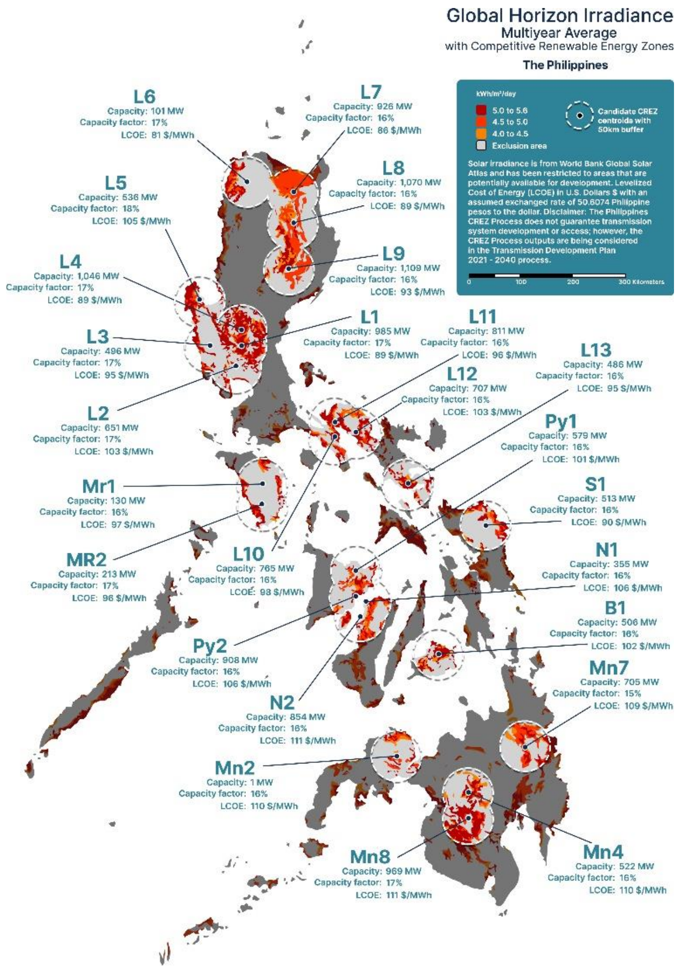
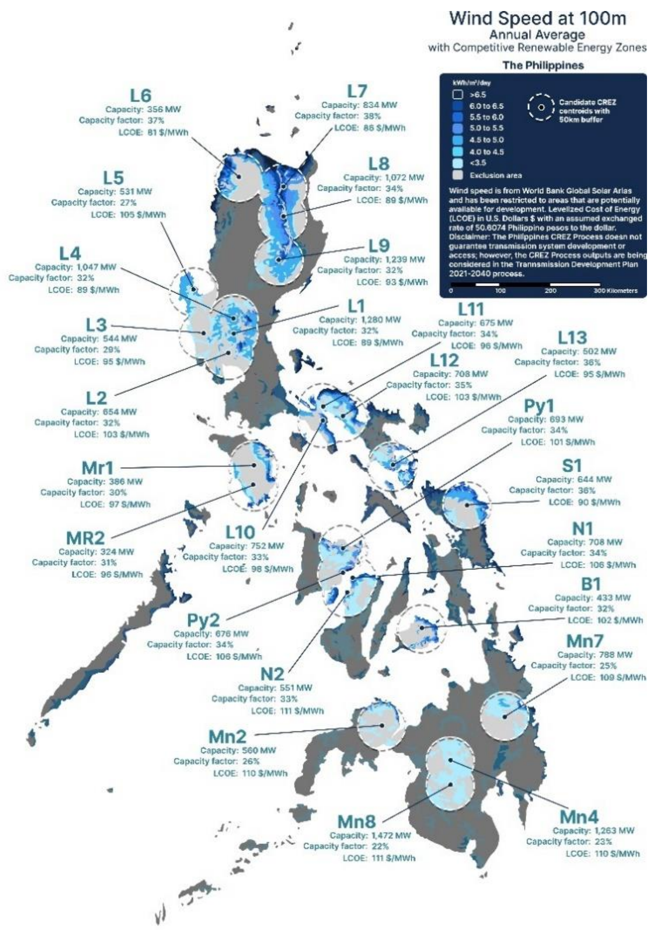


Figure 4. Distribution of Optimized Competitive Renewable Energy Zones Wind Development

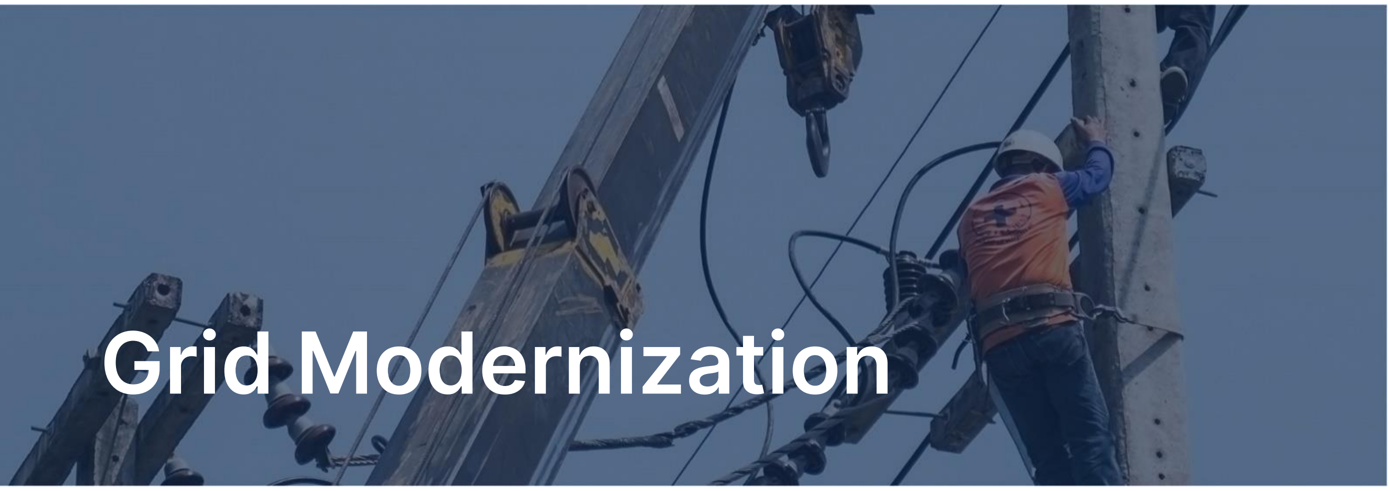


Source: https://www.nrel.gov/docs/fy20osti/76235.pdf

Equally important to note is that the cost of producing green hydrogen have fallen 50% since 2015 and may reduce by an additional 30% by 2025 as a result of benefits of increased scale and more standardized manufacturing, among others. Fitch is seeing growth opportunities in the Asia-Pacific for green hydrogen with the potential to reach 10GW in the next decade. A key driver to the development of green hydrogen is linked to the abundance low-cost renewable energy and the industry applications of green hydrogen.[6] As a result, the pace of cost reductions in green hydrogen may begin to affect fossil fueled generation plant asset values as early as 2025.

[5] https://ieefa.org/ihs-markit-says-green-hydrogen-will-be-cost-competitive-by-2030/

[6] https://asian-power.com/power-utility/news/growth-opportunities-arise-green-hydrogen-in-asia-pacific



Grid Modernization

Grid modernization allows for the power system to take advantage of rapid technological improvements to improve cost-competitiveness and socio-economic outcomes. Refer to Table 1.

A. Modernization towards:

1. High shares of renewable energy
2. Increased installation of storage technology
3. Increased distributed energy resources

B. Through climate finance investment in:

1. Infrastructure
2. Software (e.g., Advanced Distribution Management System software applications)

C. For the following outcomes:

1. Flexibility through cost reductions associated in forecast errors, reductions in losses associated with renewable energy curtailment, and / or reductions in price spikes
2. Flexibility to be able to respond to adapt to economic variabilities and to take advantage of the arc of new technology development
3. Reliability to maintain delivery of electric services and quality of power and reduced interruption by distribution systems
4. Resilience to be able to adapt to changing conditions such as a set of defined hazards.
5. Sustainability to reduce health and environmental costs
6. Affordability to not exceed a customer's willingness and ability to pay
7. Security to prevent external threats and malicious attacks including reliance on unstable or volatile supply

Table 1. Grid Modernization Aims, Investment and Outcomes

Adapted from:
https://gmlc.doe.gov/sites/default/files/resources/GMLC1.1_Vol4_Flexibility.pdf

Potential Climate Prosperity Outcomes

Achieving Climate Prosperity means catalyzing an economic transformation to launch a decade of progress with 5-years of fast-tracked action aimed at ultimately achieving, by 2030, "climate prosperity", and the reversal of systemic climate vulnerability towards becoming systemically climate resilient economies with a high share of renewable energy and storage. Some estimated climate prosperity outcomes as a result of grid modernization include those detailed in Table 2.

Table 2. Potential Climate Prosperity Investment and Outcomes

INVESTMENT OPPORTUNITY	
Hybrid systems in small island and isolated areas (e.g., including RE, storage, energy management systems, interconnection components, and diesel) eligible so long as RE is >50% of investment costs. May be 'island mode' or grid-connected micro-or-mini-grid system. May include storage.	Est. USD 1.8 billion[7]
Software including training, e.g., • Advanced distribution management systems (ADMS) • Geographic information system (GIS) • Distribution system supervisory control and data acquisition (DSCADA) • Outage management system (OMS) • Distributed energy resource management system (DERMS) • Fault location, isolation & service restoration (FLISR) a/k/a/ dist. automation • Volt-var optimization (VV) • Advanced metering infrastructure (AMI) • Networking monitoring e.g., substation decides, field (feeder) level devices	Est. USD 21 million per annum[8]

[7] 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, J. sustain. dev. energy water environ. syst., 7(1), pp 139-154, 2019, DOI: https://doi.org/10.13044/j.sdewes.d6.0230

[8] https://www.adb.org/sites/default/files/evaluation-document/167391/files/pper-phi-electricity-market.pdf

Incremental T&D costs for fortify grid infrastructure (e.g., substations, transformers, medium or low voltage lines, metering and associated components. This may include smart software platforms for utilities, automation components (hard or soft), remote monitoring, energy management systems, or other basic distribution infrastructure upgrades.	To be determined
Incremental ancillary service costs to improve grid flexibility (e.g., operational reserves and regulation) and contingencies (such as voltage regulation and frequency response).	To be determined
Smart Meters (e.g., May be pre-paid, bi-directional, or other "advanced" meter)	Est. USD 1.393 billion over the next decade

SOCIO-ECONOMIC OUTCOMES	
New Economy Jobs Created	Over 35,000[10]
Reductions in Wholesale Electricity Costs	~20%[11]
Health and Environmental Cost Savings	To be determined
Carbon reductions quantified and sold	To be determined

Note: These estimates need to be validated through a feasibility study and scenario analyses

[9] Est 19.9 million households x Est. USD 70 per smart meter

[10] https://www.iea.org/reports/sustainable-recovery/evaluation-of-possible-recovery-measures
Note: In developed economies, job creation opportunities are as follows: 9.9 jobs per USD 1 million invested in storage; 6.8 jobs per USD 1 million invested in solar PV; 5.3 jobs per USD 1 million invested in grid modernization; 0.9 jobs per USD 1 million invested in wind; and 5.9 jobs per USD 1 million invested in hydrogen production.

[11] https://asian-power.com/power-utility/news/renewables-may-cut-philippines-electricity-rates-30

Next Steps Towards Climate Prosperity Planning

1. Analysis of grid modernization investment need and feasibility study to utilize cost-effectively a portfolio of high shares of renewable energy and storage
2. Outline investment required to maximize progress towards domestic renewable energy rich, and climate resilient growth alongside primary socio-economic outcomes
3. Assessment of the main low-carbon and resilient technology deficits that are most acute in the Philippines and if plugged would have the highest socio-economic benefit
4. Support from International Renewable Energy Agency (IRENA) to adapt market design to high shares of renewable energy and storage
5. Specify financing structures for all identified projects and programs, and the levels and forms of international support being sought to realize these
6. Detail their socio-economic benefits, including: increased employment and job quality, reduced air and water pollution, increased energy independence and energy access, and reduced inflationary and financial risks

Note: The Plans do not replace existing national planning instruments and processes, but aim to reflect and contribute to realize or exceeding the investment targets of these to maximize socio-economic and climate prosperity outcomes.