CONSULTATION DRAFT

TRANSMISSION DEVELOPMENT PLAN 2022 2040

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MESSAGE
FROM THE PRESIDENT

NGCP is pleased to present the Transmission Development Plan 2022-2040, the plan enabling the Philippine Energy Transition that provides opportunities for grid enhancement and integration of new technologies for the expansion of the Philippine power grid. The TDP is guided by the overall objectives by 2040 set in the Power Sector Roadmap that is highlighted in the Philippine Energy Plan (PEP) 2020-2040 -- to ensure quality, reliable, affordable, and secure supply; expand access to electricity; ensure a transparent and fair playing field in the power industry; and total electricity access in the country.

In support of the PEP's Roadmap for the Transmission Sector, NGCP formulated the **T**ransmission **R**esiliency and **A**ugmentation for **N**ationwide **S**mart Grid **M**anagement through **I**nter-connected **SY**stems, **O**rganizations and **N**etworks 2040 or **TRANSMISYON 2040**. It is composed of NGCP's goal for every five-year Regulatory Period and the steps to be taken to achieve each goal. **TRANSMISYON 2040** complements the Power Development Program prepared by the Department of Energy (DOE) that is aligned with "AmBisyon Natin 2040," the collective and long-term vision of Filipinos for the country. In the planning horizon, the Luzon, Visayas, and Mindanao Grids will continue to evolve as a unified Philippine Grid towards a more robust, flexible, resilient, and smart grid.

The grid development thrust in the TDP 2022-2040 is geared towards the continuous advancement of major transmission backbones, implementation of grid resiliency programs, transmission projects to support the Competitive Renewable Energy Zones (CREZ), integration of emerging technologies, re-focused development strategy for 69 kV facilities, and increased electricity access through island interconnections. With NGCP both as the Transmission Network Provider and System Operator, the investment in the transmission network aims to meet the system requirements and at the same time meet the energy policies of the government.

NGCP's project drivers in the TDP are generally classified as Load Growth, Generation Entry, System Reliability and Security, Power Quality and Technology, Policy Direction, and Market Operation Support. The TDP 2022-2040 also contains the regulatory status of the transmission projects for five-year intervals until 2040.

In Luzon, grid development is driven by incoming large-capacity power plants that are mainly concentrated in Batangas, Quezon, Bataan, and Zambales. The establishment of the first 500 kV Extra High Voltage (EHV) transmission system for bulk power delivery in Taguig City in Metro Manila and the development of three additional 230 kV drawdown substations including the strengthening of the existing 230 kV transmission system will be implemented to improve power quality and supply reliability. There is also a need for looping configuration development for the 230 kV and 500 kV systems, as well as the installation of reactive power compensating equipment at various substations. Part of the long-term plan is the development of a 500 kV backbone extension both in the western and eastern sides of northern Luzon to serve as a power generation highway.

In the Visayas, the development of the 230 kV transmission backbone from Cebu up to Panay Island (Cebu-Negros-Panay 230 kV Backbone) and the 230 kV Backbone between Cebu and Bohol are among the ongoing projects. The continuous development of the 230 kV transmission backbone in the Visayas is intended to accommodate conventional and renewable energy-based generation projects and to improve grid resiliency. Similarly, as a complement to the development of 230 kV Visayas Backbone, gradual establishment of a looping configuration for the 138 kV transmission system to improve system reliability and resiliency will also be implemented.

In Mindanao, the newly developed transmission backbone accommodated the entry of new power plants, thus addressing the power deficiency especially during the dry season. With the continuous generation development in Mindanao, the immediate completion of the Mindanao-Visayas Interconnection Project (MVIP) is being prioritized to provide more opportunities for power exchange. To cater to the other requirements of the grid, reinforcement of the existing 138 kV substations, extension of some of the existing 230 kV and 138 kV transmission lines, looping of 69 kV transmission systems, as well as power quality projects are necessary for load growth and system reliability improvement.

With the support and valuable input of stakeholders in grid development, NGCP ensures an optimal and responsive plan for the benefit of electricity end-users.

ANTHONY L. ALMEDA
President & CEO

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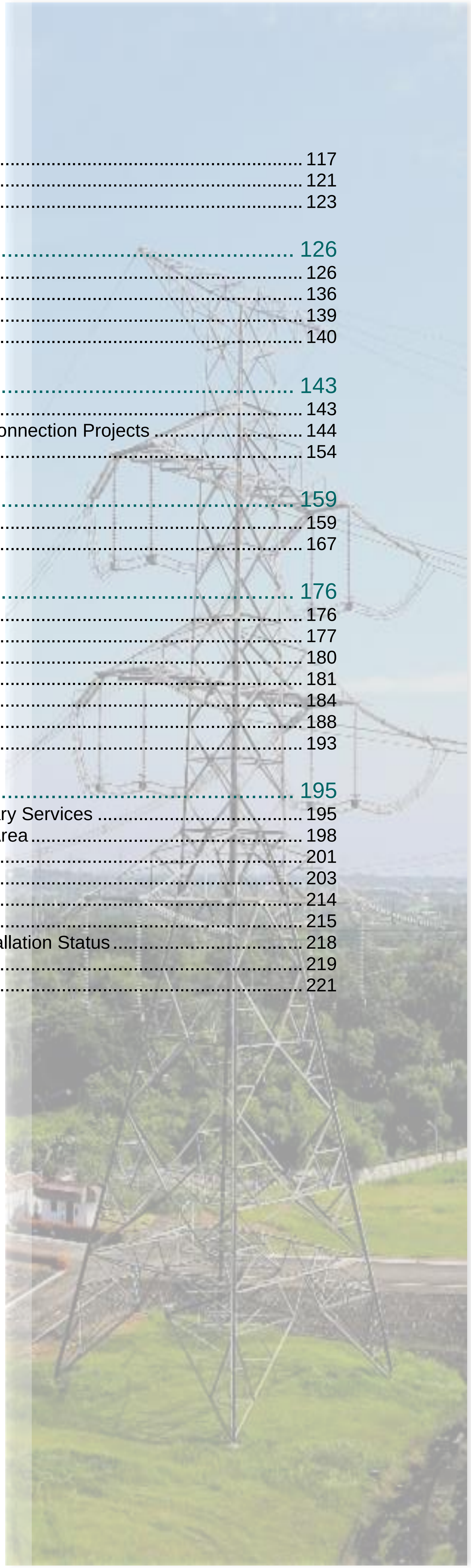


1 Background

1.1 NGCP as a Regulated Entity

With the enactment of the Philippines Electric Power Industry Reform Act of 2001 (EPIRA) into law in June 2001, the Philippine Electricity Industry was subdivided into four sectors: generation, transmission, distribution, and supply. Each sector is monopoly characteristics; hence these are regulated. Generation and supply or the aggregators for the sale of electricity, on the other hand, operate under a competitive environment.

As the Transmission Network Provider (TNP), NGCP is regulated by the Energy Regulatory Commission (ERC) under the Performance-Based Regulation (PBR). The PBR is a form of utility regulation that strengthens financial incentives to provide efficient service. The PBR methodology is outlined in the Rules for Setting Transmission Wheeling Rates or RTWR.

NGCP is persistently committed to the following international standards to advance the Vision and Mission of the corporation and currently on the process of re-certification for the following:

- Quality Management System (QMS)– International Organization for Standardization (ISO) 9001:2015
- Environmental Management System – ISO 14001:2015
- Occupational Health and Safety Management System (OHSMS) – ISO 45001:2018
- Business Continuity Management System (BCMS) – ISO 22301:2019
- Information Security and Management System (ISMS) – ISO 27001:2013

1.2 Transmission Grid Performance

The Rules for Setting Transmission Wheeling Rates (RTWR) provides for the establishment of a Performance Incentive Scheme (PIS) with rewards and penalties applied to the extent that the actual level of performance by the Regulated Entity exceeds or falls short of performance measures that have been established and approved, for implementation, by the Regulator within a certain regulatory period.

The Third Regulatory Period (3rd RP) ended in December 2015. In accordance with the regulatory reset process for the Fourth Regulatory Period (4th RP) under Article VII of the RTWR, a new PIS must be developed specifying the service quality measures/indices as well as the target level of performance that must be applied to the transmission grid. However, the 4th RP reset process has been delayed.

Notwithstanding the delay in the reset process, NGCP continuously monitors the performance of the transmission grid using the 3rd RP ERC-approved indices as discussed below:

System Interruption Severity Index (**SISI**) - the ratio of the unserved energy to the system peak load occurring during the rating/reporting period. Unserved energy is the energy not served due to transmission line interruption(s) computed by outage duration multiplied by the load involved before the interruption. System peak load, on the other hand, is the highest demand for a particular rating/reporting period measured in megawatts (MW).

Frequency of Tripping (**FOT**) per 100 ckt-km (FOT/100ckt-km) - measures the number of line outages (transients and permanent or sustained) initiated by tripping of the relay subject to exclusion of identified events.

System Availability (**SA**) - a proportion of total circuit time is the percentage of the system being considered on-line during the rating/reporting period. A circuit is regarded as being unavailable when it is out of service for construction, refurbishment, maintenance, or fault.
Frequency Limit Compliance (**FLC**) - refers to the percentage of time during the rating period that the system frequency is within the allowable frequency range of 60 ± 0.3 Hz.
Voltage Limit Compliance (**VLC**) - refers to the percentage of the number of voltage measurements during the rating period that the voltage variance did not exceed ± 5% of the nominal voltage of all buses identified in the inclusion (Luzon – 230 kV & 500 kV, Visayas – 138 kV & 69 kV, Mindanao – 138 kV) monitored at the high side of the substation.
Congestion Availability Indicator (**ConA**) for Luzon grid only - measures the availability of a subset of lines and transformers in the Luzon and Visayas Grids.
Ancillary Services Availability Indicator (**ASAI**) – measures the availability of ancillary services on each of the three grids in accordance with the requirements of Ancillary Services Procurement Plan (ASPP).

The 2021 performance of the transmission grid covering the period 26 August 2020 – 25 August 2021 is shown in Table 1.1.

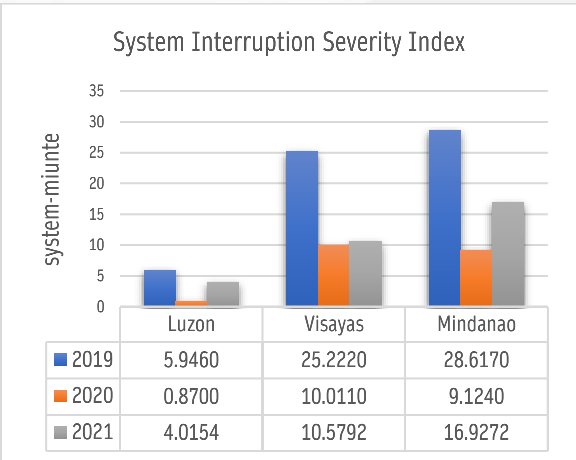
Table 1.1: 2020 Performance of Transmission Grid

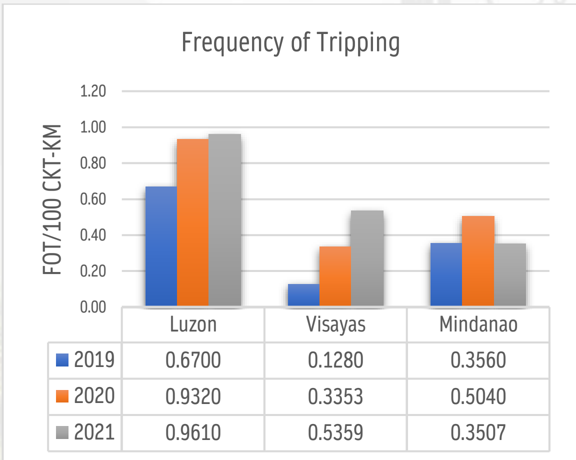
Performance Indicator	Luzon	Visayas	Mindanao
System Interruption Severity Index, system-min.	4.0154	10.5792	16.9272
Frequency of Tripping, count per 100ckt-km	0.9610	0.5359	0.3507
System Availability, %	99.2581	99.8000	99.8761
Frequency Limit Compliance, %	100.0000	99.9886	99.9903
Voltage Limit Compliance, %	99.9985	99.9921	100.0000
Congestion Availability Indicator, %	99.4914	-	-
Ancillary Services Availability Indicator, %	28.8071	21.1815	86.8807

NGCP continues to improve the overall performance of the transmission system since taking over the transmission business from the government and commencing commercial operations in 2009. While there are decreases in performance indices year-on-year, NGCP has continuously performed over and above the targets based on the 3rd RP-approved limits. This is a result of NGCP's relentless efforts to continuously upgrade, expand, and improve transmission facilities.

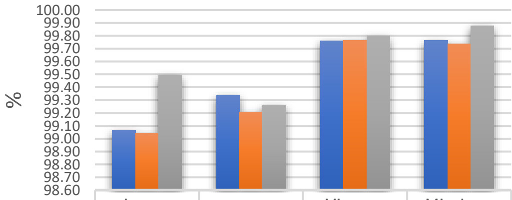
Reliability Indicators

As a regulated entity, NGCP provides Transmission Services to all users of the grid and is bound by the Transmission Reliability Standards under Chapter 3 of the Philippine Grid Code (PGC). Correspondingly, power interruptions caused or initiated by transmission lines and equipment that resulted in the loss of service to grid users were included in the evaluation.





System Availability and Congestion Availability

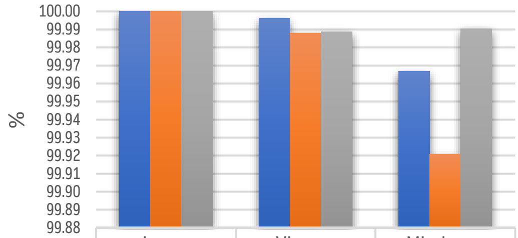


	Luzon ConA	Luzon SA	Visayas SA	Mindanao SA
2019	99.0665	99.3372	99.7619	99.7658
2020	99.0437	99.2081	99.7644	99.7369
2021	99.4914	99.2581	99.8000	99.8761

Power Quality

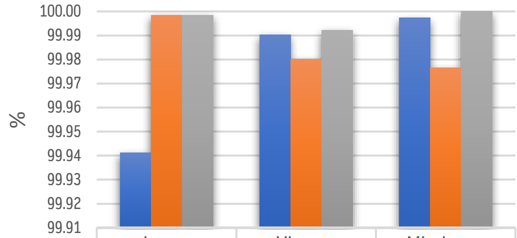
Quality of service is measured with reference to system voltage and frequency. The system is normally managed such that frequency is maintained within the allowable operational limits of 59.7 and 60.3 Hz. On the other hand, system voltages are monitored individually at connection points with the customers to ensure that voltages are within the allowable operational limits of +/- 5% of the nominal value is not exceeded.

Frequency Limit Compliance



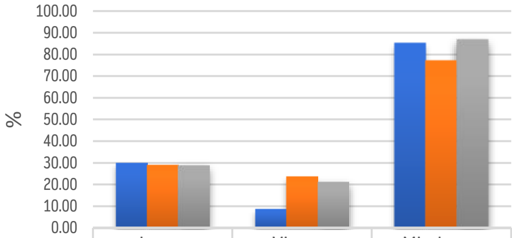
	Luzon	Visayas	Mindanao
2019	100.0000	99.9961	99.9668
2020	100.0000	99.9880	99.9208
2021	100.0000	99.9886	99.9903

Voltage Limit Compliance



	Luzon	Visayas	Mindanao
2019	99.9412	99.9902	99.9973
2020	99.9985	99.9801	99.9765
2021	99.9985	99.9921	100.0000

Ancillary Service Availability Indicator



	Luzon	Visayas	Mindanao
2019	29.9172	8.7847	85.2389
2020	29.0414	23.6024	77.2541
2021	28.8071	21.1815	86.8807

1.3 Introduction to NGCP's Transmission System Network

The country's transmission systems are composed of 500 kV, +/- 350 kV HVDC, 230 kV, 138 kV, 115 kV, and 69 kV facilities. As the sole TNP, NGCP plays a vital role in a safe and reliable transmission of electricity in response to system requirements and market demands. It continues to improve the reliability, adequacy, security, and stability of the grid in the three major regions of the Philippines: Luzon, the Visayas, and Mindanao.

As the System Operator of the Philippine power grid, NGCP balances the supply and demand of electricity to efficiently serve all its customers – power generators, private distribution utilities, electric cooperatives, government-owned utilities, economic zones, and directly-connected customers. It is responsible for dispatching the power plants and transmitting the generated power to various distribution utilities which, in turn, deliver the electricity at a lower voltage to households and other end-users. NGCP also operates and maintains metering facilities and provides technical services, particularly system studies, and operation and maintenance of customer facilities. NGCP also determines the levels of Ancillary Services required for each grid based on the results of assessment and simulation studies. These reserve levels which are variable according to network dynamics are meant to meet PGC-prescribed grid reliability and security requirements. Appendix 1 shows the NGCP plans for procurement of Ancillary Services.

1.4 TRANSMISYON 2040

NGCP has always been committed to build a strong and reliable power transmission network through various programs and projects that prioritize network development. Shown in Figure 1.8 is the medium (2020-2022) and long-term (2023-2040) Power Sector Roadmap involving the Transmission Sector based on the Philippine Energy Plan (PEP) 2020-2040 of the Department of Energy (DOE) issued in October 2021.

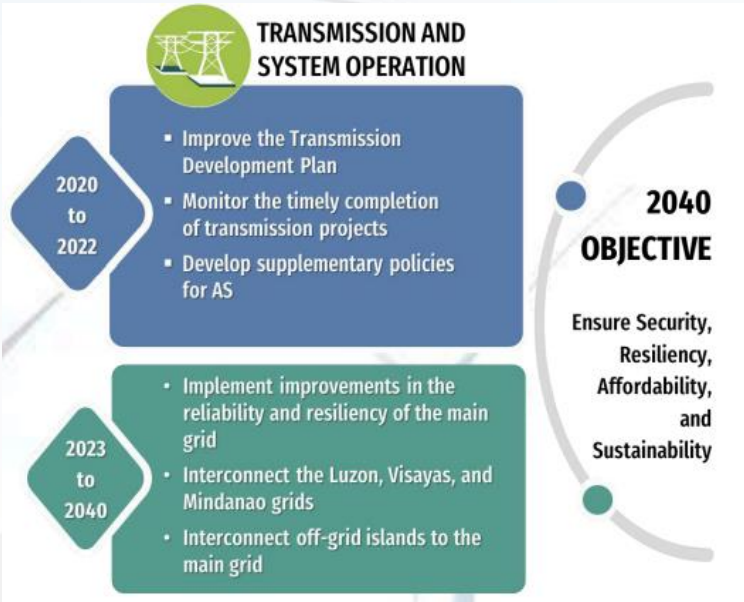


Figure 1.1: Power Sector Roadmap (Transmission) from DOE's PEP 2020-2040

In support to the PEP's Power Sector Roadmap, NGCP formulated the "TRANSMISYON 2040", i.e., Transmission Resiliency and Augmentation for Nationwide Smart Grid Management through Inter-connected Systems, Organization and Networks 2040. It highlights NGCP's goal for every Regulatory Period and the steps that will be taken to achieve each goal: enabling capacity-sharing through grid interconnection; transitioning to the smart grid one substation at a time; completion of grid looping configuration and mandatory redundancy; grid resilience through asset refresh; and full harmonization of Renewable Energy (RE) resources and alignment realization to AmBisyon Natin 2040. A more detailed Asset Administration complements the specific goal for each of the succeeding four Regulatory Periods towards the end of the planning period in 2040.

2 Existing Philippine Grid

2.1 Grid Profile

A total of 41,870.50 MVA substation capacity and 20,732.35 CKT-KM are accounted for in the transmission assets being managed by NGCP, as shown in Table 2.1. In addition, a total of 5,026.55 MVAR from Capacitor and shunt reactors have been installed in appropriate locations in different parts of the grid to ensure that voltages across the network are within the levels prescribed in the PGC.

Table 2.1: Summary of Existing Facilities as of August 2021

Particulars	Luzon	Visayas	Mindanao	Philippines
Substation Capacity (MVA)	29,976	5,753.50	6,141	41,870.50
Transmission Line Length (CKT-KM)	9,499.16	5,378.52	5,854.67	20,732.35
Capacitor (MVAR)	2,737.5	326.55	360	3,424.05
Shunt Reactor (MVAR)	965	545	92.5	1,602.50

2.2 Dependable Capacity Mix

The dependable capacity indicated in the following section is based on the DOE's List of Existing Power Plants (Grid-connected) as of December 2020.

The Philippines has a total dependable capacity of 22,954 MW excluding off-grid generators. Coal-fired power plants (CFPP) recorded the largest share with 10,245 MW, while Oil-based and Natural gas accounted for 2,650 MW and 3,286 MW, respectively. On the other hand, RE-based plants recorded 1,753 MW for Geothermal, 3,497 MW for Hydro, 285 MW for Biomass, 810 MW for Solar, and 427 MW for Wind.

Figure 2.1 and Table 2.2 show the distribution of dependable capacity for Luzon, the Visayas, and Mindanao.

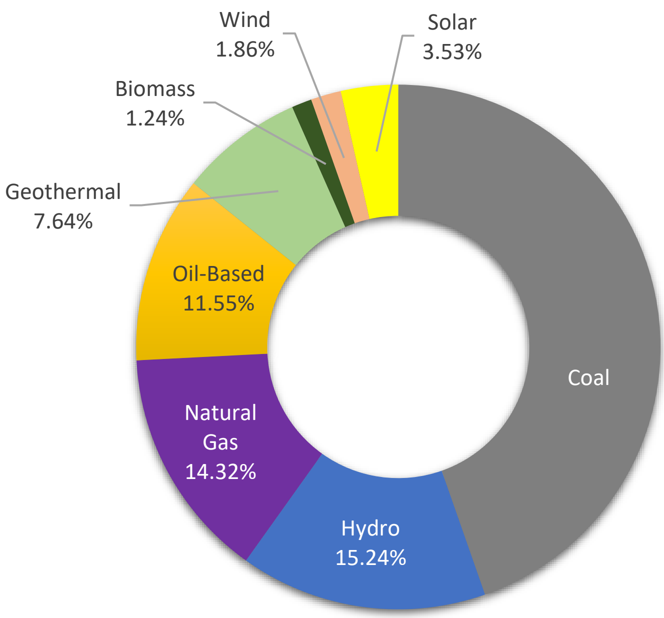


Figure 2.1: Philippine Dependable Capacity Mix (Grid-connected)

Table 2.2
Existing Dependable Capacity
Transmission Grid

Power Plant Type / Fuel Source / RE Source	Luzon		Visayas		Mindanao	
	MW	%	MW	%	MW	%
Conventional Power Plants	11,577	74.0%	1,829	54.9%	2,775	69.8%
▪ Coal	6,855	43.8%	1,349	40.5%	2,041	51.3%
▪ Oil-based	1,436	9.2%	480	14.4%	734	18.5%
▪ Natural Gas	3,286	21.0%	-	-	-	-
RE-Based Power Plants	4,068	26.0%	1,503	45.1%	1,200	30.2%
▪ Wind	337	2.2%	90	2.7%	-	-
▪ Solar PV	362	2.3%	381	11.4%	67	1.7%
▪ Biomass	131	0.8%	131	3.9%	23	0.6%
▪ Geothermal	769	4.9%	881	26.4%	103	2.7%
▪ Hydro	2,470	15.8%	20	0.6%	1007	25.3%
Total	15,645		3,333		3,976	

2.3 Luzon Transmission Network

The bulk generation sources in the Luzon Grid are in the northern and southern parts of Luzon Island while the load center is in the Metro Manila area. About 50% of the total demand in Luzon is drawn in Metro Manila. Because of this system configuration, NGCP's transmission backbone must have the capability to transfer bulk power from both northern and southern parts of Luzon to the Metro Manila area.

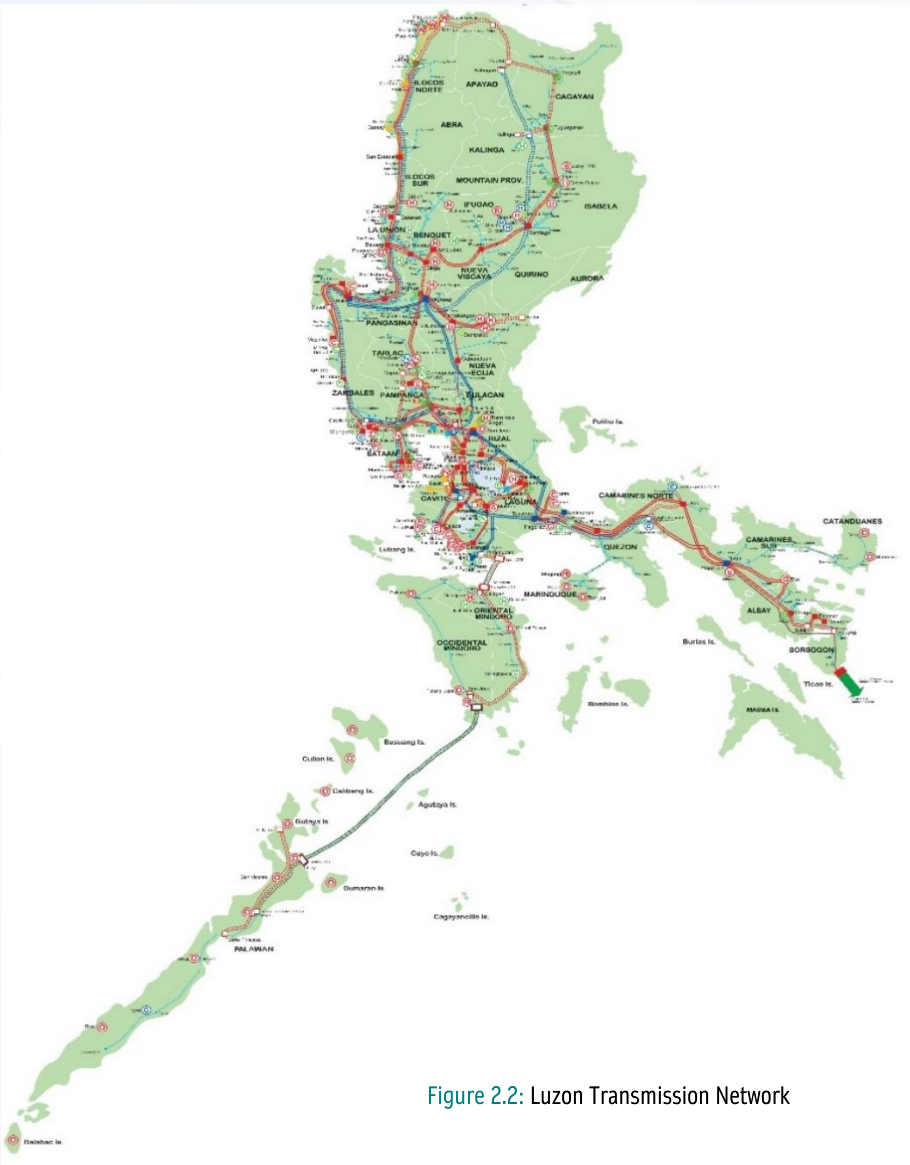


Figure 2.2: Luzon Transmission Network

Northern Transmission Corridor

The transmission corridor consists of several flow paths for transferring power from the generation sources located in northern Luzon to Metro Manila. The 500 kV double-circuit Bolo–Nagsaag–San Jose is rated at 2,850 MVA per circuit and is capable of transferring more than 2,200 MW generation from Masinloc and Sual CFPP to Metro Manila. Composed of six districts in northern Luzon while the southern part is three districts:

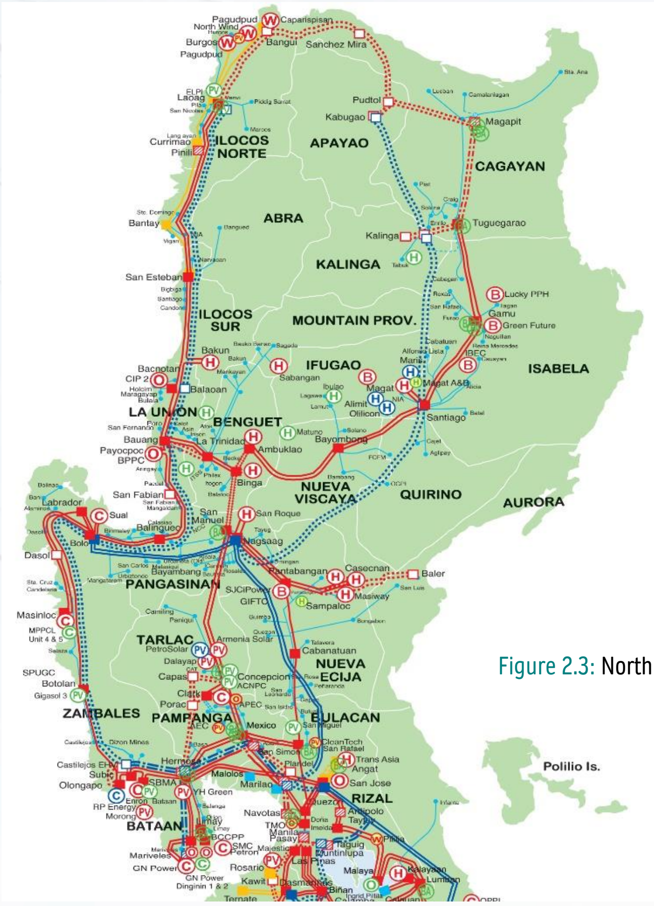


Figure 2.3: North Luzon Transmission Corridor

Northern Luzon is composed of six districts while southern Luzon has three districts:

Table 2.3 Northern Luzon Districts

District	Area	Province
1	Ilocos Area	Ilocos Norte, Ilocos Sur, Abra, La Union
2	Mountain Province Area	Mountain Province, Benguet
3	North Central Plain Area	Pangasinan
4	Cagayan Valley Area	Nueva Viscaya, Quirino, Ifugao, Isabela, Cagayan, Kalinga, Apayao
5	Western Central Plain Area	Bataan, Zambales
6	South Central Plain Area	Pampanga, Tarlac, Nueva Ecija, Aurora

The Bolo and Nagsaag 500 kV Substations are the receiving ends of generation from the north. The power is then delivered to Metro Manila mainly via Mexico and San Jose Substations.

Other underlying paths are the 230 kV transmission lines:

- Labrador–Botolan–Hanjin–Olongapo 230 kV Single Circuit Line
- Olongapo–Hermosa and Olongapo–Subic–Hermosa 230 kV Lines
- San Manuel–Concepcion–Mexico double-circuit line
- San Manuel–Pantabangan–Cabanatuan–Mexico single-circuit line

The San Manuel–Concepcion–Mexico 230 kV Line is an alternate corridor, which also caters the generation capacity of the HEPP delivering power to San Manuel 230 kV Substation.

Metro Manila

As the center of commerce and trade, a further increase in demand within Metro Manila is expected, thus requiring the expansion of existing substations and the building of new ones. The National Capital Region (NCR) accounts for more than half of the total load in Luzon but only relies on the import of power coming from the north and south Luzon.

One unique geographical feature of Metro Manila is its narrow land area between Manila Bay and Laguna Lake, which is only about 10 km wide. Thus, it will be challenging to secure the right of way to implement additional transmission lines.

The development of Antipolo, Navotas, and Pasay 230 kV Substation Projects will cater to the demand increase in Metro Manila.

Presently, there are three main load sectors within Metro Manila:

- Sector 1 is served through Quezon, Paco, Marilao (Duhat), and San Jose Substations. Both Paco and Marilao (Duhat) Substations are MERALCO-owned
- Sector 2 is served through Taytay and Doña Imelda 230 kV Substations
- Sector 3 is served through Muntinlupa and Las Piñas 230 kV Substations

The major supply lines for both Quezon and Taytay are the double-circuit 230 kV line from San Jose as these substations rely heavily on the supply from San Jose 500 kV Substation.

In the southern part of Metro Manila, the power requirements are being drawn from Dasmariñas 500 kV Substation and power plants directly connected to the 230 kV system. Las Piñas is connected through a double circuit 230 kV radial line from Dasmariñas, while Muntinlupa has a four-circuit supply line from Biñan.

Southern Transmission Corridor

The southern portion of the 500 kV transmission backbone stretches from Naga Substation in Bicol Region to Tayabas, Quezon. Tayabas is also connected to San Jose thereby completing the link between the north and south 500 kV transmission corridors.

Table 2.4 Southern Luzon Districts

District	Area	Province
1	South Western Tagalog Area	Batangas, Cavite, Biñan
2	South Eastern Tagalog Area	Laguna, Quezon Province
3	Bicol Area	Camarines Norte, Camarines Sur, Albay, Sorsogon

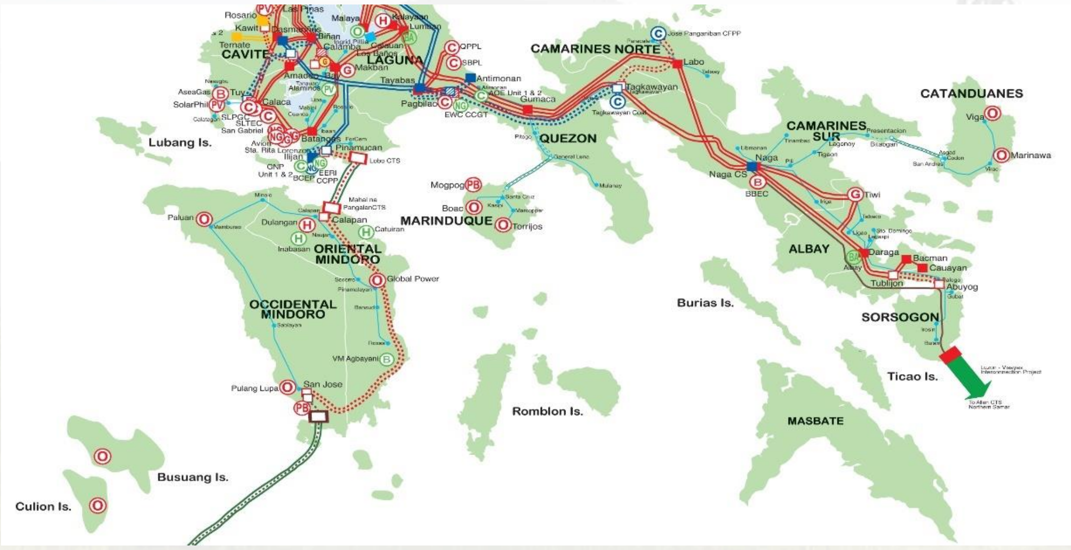


Figure 2.4 South Luzon Transmission Corridor

The 500 kV backbone segment from Tayabas to Naga Substation is currently energized at 230 kV. The Naga Substation is also the termination point for the HVDC Interconnection System (commissioned in 1998) that could allow the exchange of power for up to 440 MW between Luzon and the Visayas Grids.

The 500 kV backbone in the south facilitates the transfer of about 3,300 MW from Ilijan Natural Gas, Pagbilao, and QPPL CFPP. The 230 kV transmission system in Batangas and Laguna area caters more than 3,100 MW total generation capacity of Calaca CFPP and other Natural Gas Plants (San Lorenzo, Sta. Rita, and Avion).

From Tayabas Substation, the 500 kV backbone also stretches to Dasmariñas Substation which serves as a drawdown substation for the loads in the south of Metro Manila.

2.4 Visayas Transmission Network

The Visayas transmission system is divided into five different sub-grids: Panay, Negros, Cebu, Bohol, and Leyte-Samar. The sub-grids have existing AC interconnections with effective transfer capacity as of December 2020 as follows: Leyte-Cebu (1x200 MW, 1x240 MW), Cebu-Negros (2x90 MW), Negros-Panay (1x180 MW), and Leyte-Bohol (1x90 MW). These submarine cables provide the capability of sharing excess generation between islands to accommodate the Visayas' growing demand.

Table 2.5 Visayas Area Districts

District	Area	Province
1	Eastern Visayas Area	Leyte, Samar Island
2	Central Visayas Area	Cebu, Bohol Island
3	Western Visayas Area	Negros Oriental, Negros Occidental
4	Southern Visayas Area	Iloilo, Capiz, Antique, Aklan

The transmission backbone of the Visayas Grid extends from Allen Cable Terminal Station in Samar, all the way to Nabas Substation in Panay. This power delivery system comprises approximately 5,378 circuit kilometers of transmission lines.

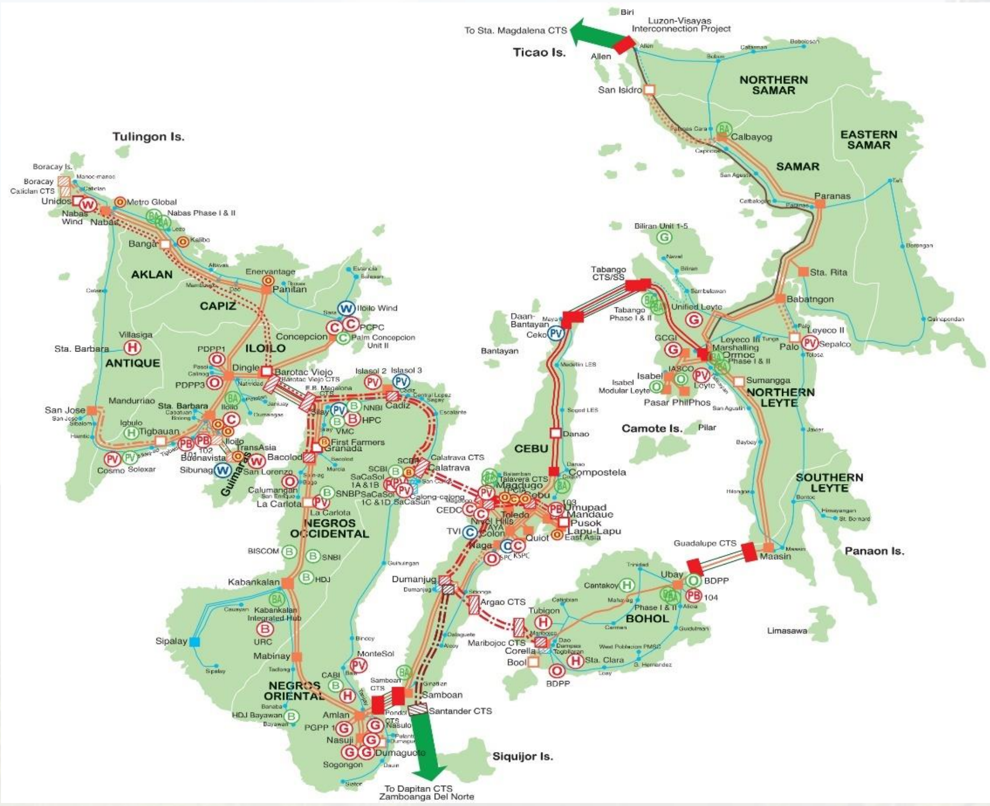


Figure 2.5: Visayas Transmission Network

Eastern Visayas is composed of Leyte and Samar Islands. Leyte remains the power supplier to Samar and Bohol Islands through the Ormoc–Babatngon and Ormoc–Maasin 138 kV Transmission Lines, respectively. Also, Leyte has a 230 kV interconnection to Cebu enabling the other islands to source power from cheaper geothermal resources. Leyte is the site of 645 MW geothermal resources that comprise about 20% of the total dependable capacity in the Visayas.

Figure 2.6: Eastern Visayas Transmission Network

Central Visayas is composed of Cebu and Bohol Islands. Cebu can be well considered as the major load center of the Visayas Grid. In 2020, it has a peak load of 1,058 MW which accounted for 48.1% of the grid's total demand. Bohol has the lowest peak load among sub-grids at 94 MW in 2020.

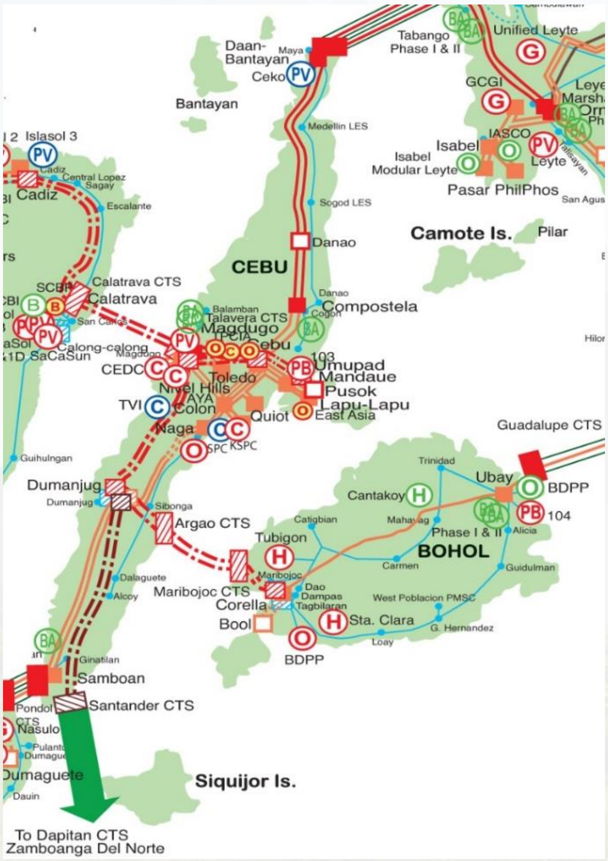


Figure 2.7: Central Visayas Transmission Network

In the Island of Negros, the load center is in Bacolod City in the northern part, while the bulk of generation, composed mostly of geothermal power plants, is in the southern part. There are also many generating power plants in Northern Negros which are composed mostly of solar and biomass power plants. There is a total of 264 MW solar generation capacity in Negros Island which accounted for 69.36% of the grid's total solar generation capacity.

Figure 2.8: Negros Island Transmission Network

Panay Island has many large coal power plants; PEDC (317.4 MW) in the southern part while PCPC (135 MW) in the southeastern part. Panay has become less reliant on power imports from other islands via the 230 kV Negros–Panay Interconnection (initially energized at 138 kV) and, most of the time, exports power to Negros.

Figure 2.9: Panay Island Transmission Network

2.5 Mindanao Transmission Network

The Mindanao transmission system is composed of the following:

Table 2.6 Mindanao Districts

District	Area	Province
1	Northwestern Mindanao Area (NWMA)	Zamboanga del Norte, Zamboanga del Sur Zamboanga Sibugay, Misamis Occidental
2	Lanao Area (LA)	Lanao del Norte, Lanao del Sur
3	North Central Mindanao Area (NCMA)	Bukidnon, Misamis Oriental
4	North Eastern Mindanao Area (NEMA)	Agusan del Norte, Agusan del Sur, Surigao del Norte, Surigao del Sur
5	South Eastern Mindanao Area (SEMA)	Davao del Sur, Davao Del Norte, Davao Oriental, Davao Occidental, Davao de Oro
6	South Western Mindanao Area (SWMA)	South Cotabato, Cotabato, North Cotabato, Sultan Kudarat, Maguindanao

A large portion of power being used in the island is a combination of renewable and conventional power plants located in Lanao and Misamis Oriental for northern Mindanao, and in Davao Area for southern Mindanao. To enable bulk power transfer between northern and southern Mindanao, the new 230 kV backbone is implemented.

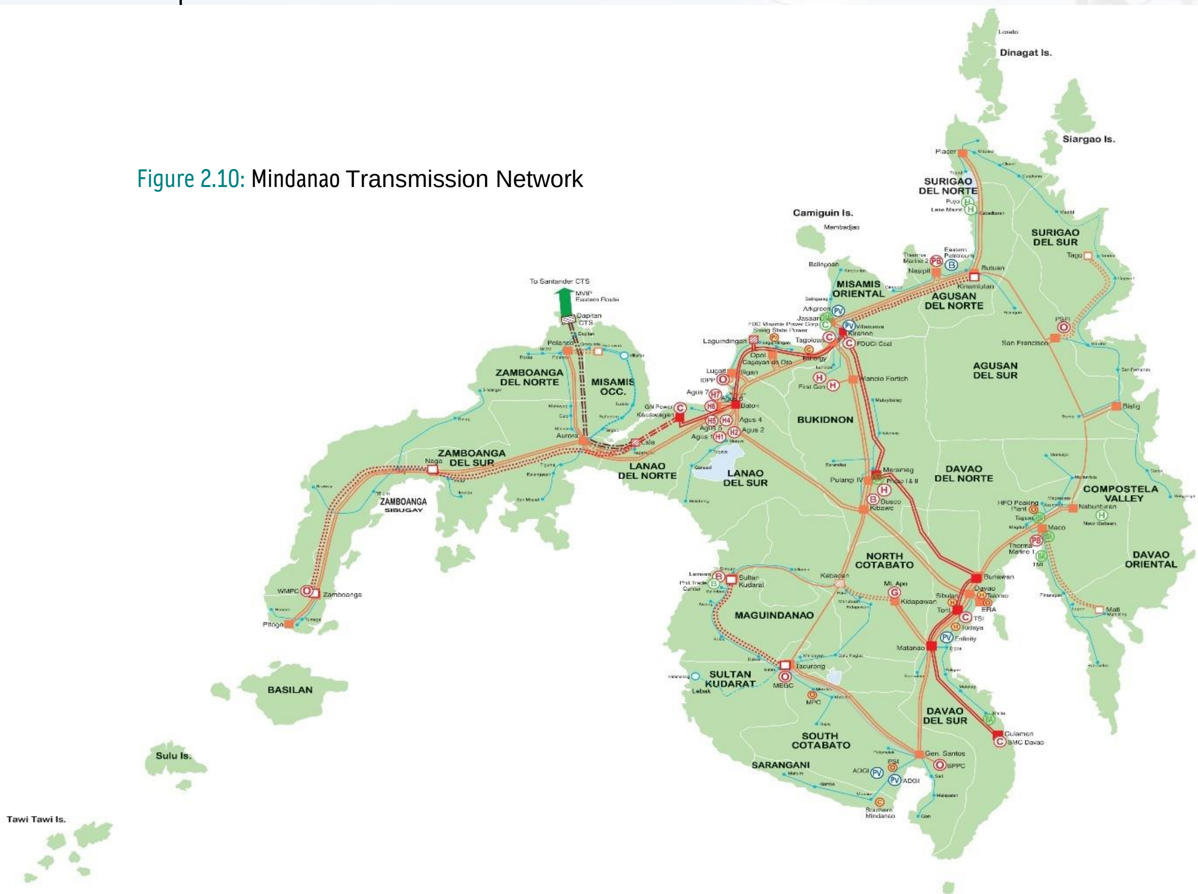


Figure 2.10: Mindanao Transmission Network

In terms of transmission system configuration, Mindanao is relatively a robust grid. However, the security of the island remains a serious concern, thus NGCP is still facing major challenges in implementing its operations and construction of key transmission projects. Another vital issue in the Mindanao grid is the looming low voltage in Zamboanga City. The long and radial configuration of transmission lines supplying the area, and the continuous increase in demand entails low voltage that cannot be resolved by new transmission facilities alone. In this case, a power plant must be constructed near Zamboanga City to balance the reactive power requirement of the system.

3 Planning Process and Drivers for Grid Development

3.1 TDP Process Flow

DOE Inputs

DOE's annual System Peak Demand Forecast and Generation Capacity Addition Line-up are the two major inputs in the TDP. In relation to the transmission network analysis, the system peak demand forecast shall be broken down and forecasted into individual transformer loads. On the other hand, NGCP's own non-coincident substation peak loading forecasts are used in determining load-end substation expansion requirements.

Stakeholders Engagement

One of the requirements of EPIRA in the preparation of the TDP is to conduct consultations with the electric power industry participants. NGCP regularly conducts Customers Interface Meetings to gather inputs from the Distribution Development Plans (DDP) of Distribution Utilities, expansion programs of Generator Companies, and other directly connected customers. In addition, coordination meetings with other stakeholders are also conducted.

TDP Update

The inputs from the DOE and the electric power industry participants are used to determine the system requirements of the grid for the next 20 years. This involves the conduct of load flow, short-circuit, and transient stability studies using special software in power system simulation. The assessments are made with reference to the planning criteria and limits prescribed in the PGC.

Consultation with Stakeholders

This step is part of the consultation process with the stakeholders as required by the EPIRA. Stakeholders are given the opportunity to raise comments and suggestions on the proposed transmission network developments contained in the TDP.

Submission to DOE

As provided in the EPIRA and its IRR, the TDP shall be submitted to the DOE for approval and for integration with the Power Development Program (PDP) and the PEP.

3.2 Planning Criteria

System Assessment. Taking off from the model of the existing baseline case of the transmission network, the system planners refer to the following:

- The latest list of generation capacity additions
- Utilize the updated system peak load forecast and disaggregate into per substation transformer level
- Develop the network model for the year covered planning horizon by the TDP

Simulation. Various generation dispatch scenarios are considered to provide a deterministic approach while providing sensitivity in the process as well as in the result in the simulation. This includes simulation considering single-outage contingency which can be very beneficial in determining the necessary or needed projects. This is to test whether the NGCP Facilities would be able to support the system requirement and power transfer capability in the instance of the worst scenario would take place.

To also evaluate the market impact, NGCP is continuously developing a market model utilizing a market-based approach program that can enhance and provide a probabilistic approach in the enhancements of long-term transmission planning. As there are many uncertainties in the future, the market simulation will aim to establish a range of plausible future scenarios both for load and generation development.

Table 3.1 Generation Dispatch Scenarios for each Grid

LUZON Dispatch Scenarios	
Maximum North Wet Season	All generation facility outputs in the northern part of the grid are set to their maximum capacities
Maximum South Dry Season	All generation facility outputs in the southern part of the grid are set to their maximum capacities
Typical Generation Scenario	Power generation is based on the typical output levels of power plants during system peak load
Other Generation Scenario	Specific study areas, e.g., Bataan, Batangas, etc. where varying dispatch of concentrated power generation could result in additional transmission constraints.
VISAYAS Dispatch Scenarios	
Maximum Leyte Scenario	The geothermal generation facilities in Leyte are maximized, while the generation facilities in Panay serve as regulating plants and the power plants in Cebu, Negros, and Bohol are also maximized
Maximum Panay Scenario	The generation facilities in Panay are maximized, while the geothermal generation facilities in Leyte serve as regulating reserve; the generation facilities in Cebu, Negros, and Bohol are also maximized.
MINDANAO Dispatch Scenarios	
Maximum North Dispatch Scenario	Generation from the north, especially those coming from hydro plants are maximized thereby causing the highest load to the transmission lines, which transmit power to the load centers in the south, e.g., Davao and Gen. Santos areas
Dry Season Dispatch Scenario	The significant decrease in power generation from hydro plants from the north is considered, thus all available power plants, particularly peaking plants are assumed to be dispatched to augment the power requirement
Other Future Scenarios	▪ Development of thermal generation in Southeastern Mindanao ▪ Linking of the Visayas and Mindanao Grids, through the implementation of the proposed Mindanao-Visayas Interconnection Project.

Evaluation of Results and Project Proposals. Based on the resulting transmission line loading, grid transformer loading, fault level at the substations, voltage profile, and system response to disturbance, the system planners shall provide solutions or mitigations. The following are the solutions or mitigations that can be proposed:

- New Transmission Line Project
- Transmission Line Upgrading Project
- New Substation
- Substation Expansion
- Power Circuit Breaker Replacement Program
- Installation of Reactive Power Compensation Equipment
- Transmission Network Reconfiguration Project.

One important consideration in the identification of projects is the overall long-term transmission development for each grid. This is where the line-up of projects in the given period is established as well as the required implementation period. Some projects may have to be implemented by stages or may be initially energized at a lower voltage level while waiting for the completion of other components, particularly for backbone and looping projects but will remain consistent with the target end-state of the grid. The selected solution from the network analysis, as well as, the conduct of economic assessment, will form part of the documentation of the TDP.

In the case of expansion plans for load-end substations, a direct comparison of the existing substation capacity and the load forecast would already result in the determination of capacity addition projects to meet load growth, both during normal and single-outage contingency conditions of the transformers. The transformer addition projects, however, would also consider the sizing and age of the existing units, optimization, and the space availability in a substation. Moreover, the development of a separate new substation is also an option in lieu of further expanding the transformer capacity at the existing locations. Under this case, system simulation studies will be required to fully assess the need and impact of load transfer or load reallocation to the new substation in the grid.

The TDP 2022-2040 will be used as a reference in the Regulatory Reset application and subsequent applications of NGCP. While the TDP already provides a long list of projects needed by the network, project prioritization and project ranking will be another important process and a separate exercise during the capital expenditure (CAPEX) application. This will involve further assessment on the probability of contingency events, assessment of the impact if a project is not implemented yet, and full documentation of economic analyses.

The major transmission projects for the period 2022-2040, with components shown in Chapters 8, 9, and 10, were based on the selected implementation scheme after considering all the technically feasible alternatives. The identification of project components would involve line routes, substation sites evaluation and selection, and other initial field investigations. A least-cost development approach was also applied consistent with various NGCP Planning and Design Standards utilizing the cost estimate database derived from recently completed projects and prices of materials and equipment obtained through vendor consultation.

3.3 Project Drivers

Project prioritization is generally based on the project drivers as follows:

Figure 3.1: Project Drivers

- **Load Growth**. This pertains to ensuring transmission facility adequacy and projects that address the projected overloading, which will occur even during normal conditions or no outage condition, are given topmost priority.
- **Generation Entry**. This pertains to the accommodation of new power plant connections to the grid and bulk generation capacity additions that include conventional and renewable energy power plants, which usually drive new transmission backbone development.
- **System Reliability and Security**. This pertains to projects that will ensure the reliability and security of the Grid as prescribed in the PGC. This includes projects that provide N-1 contingency, network security, and replacements for defective and ageing assets. The assets' conditions are evaluated to come up with effective planning for the replacement program to ensure that unwarranted asset failures will be prevented or mitigated. Procurement of spares for the high voltage equipment, secondary devices, and transmission line equipment is regularly planned to ensure stable system availability.
- **Power Quality and Technology**. This involves the installation of equipment that will aid in operating the grid within the PGC-prescribed limits. This also involves projects related to new and developing technologies that have a substantial application to the operation and maintenance of the transmission system, which includes, online monitoring of HVEs, centralized operation of substations, and the use of robots among others.
- **Policy Direction**. This pertains to DOE-issued policies to ensure the reliability, quality, and security of supply of electric power and other government or regulatory compliances related to safety, environmental, and technical standards. These include projects involving island/off-grid interconnection, Smart Grid, Grid Resiliency, Energy Storage System, Competitive Renewable Energy Zones (CREZ), among others.
- **Market Operation Support**. This pertains to projects related to the integration of grid control and the unification of market operation.

3.4 System Peak Demand

The annual peak demand forecast is one of the important input parameters in the preparation of the TDP. The demand forecast for the TDP 2022-2040 adopted the peak demand projections of the DOE based on the GDP-to-elasticity approach.

3.4.1 Historical Demand for Electricity

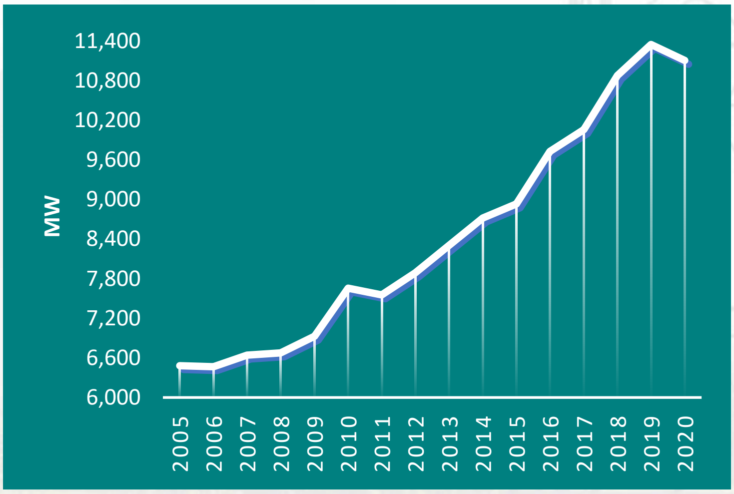
Total System Peak Demand (SPD), non-coincident sum, of the Philippines shows a consistent upward trend from 2005 to 2019. However, SPD in 2020 declined by 1.92% or 299 MW across all Grids – Luzon, Visayas and Mindanao. This can be largely attributed to the economic downturn brought about by the COVID-19 pandemic. The implementation of community quarantine in varying stringency levels beginning 15 March 2020 and lasting until the end of the year limited movement across the country and gravely affected the operations of commercial and industrial sectors causing the decline in demand. The Average Annual Compounded Growth Rate (AACGR) is at 3.91% for 2006 to 2020.

Table 3.2
Summary of Historical Demand per Grid 2005-2020, in MW

*Includes embedded generation monitored by NGCP

Actual	Luzon	Visayas	Mindanao	Philippines
2005	6,479	967	1,149	8,595
2006	6,466	997	1,228	8,691
2007	6,643	1,102	1,241	8,987
2008	6,674	1,176	1,204	9,054
2009	6,928	1,241	1,303	9,472
2010	7,656	1,431	1,288	10,375
2011	7,552	1,481	1,346	10,379
2012	7,889	1,551	1,321	10,761
2013	8,305	1,572	1,428	11,305
2014	8,717	1,636	1,469	11,822
2015	8,928	1,768	1,518	12,215
2016	9,726	1,893	1,653	13,272
2017	10,054	1,975	1,760	13,789
2018	10,876	2.053	1,853	14,782
2019	11,344	2.224	2,013	15,581
2020	11,103	2,201	1,978	15,282
%AACGR	3.66	5.64	3.69	3.91

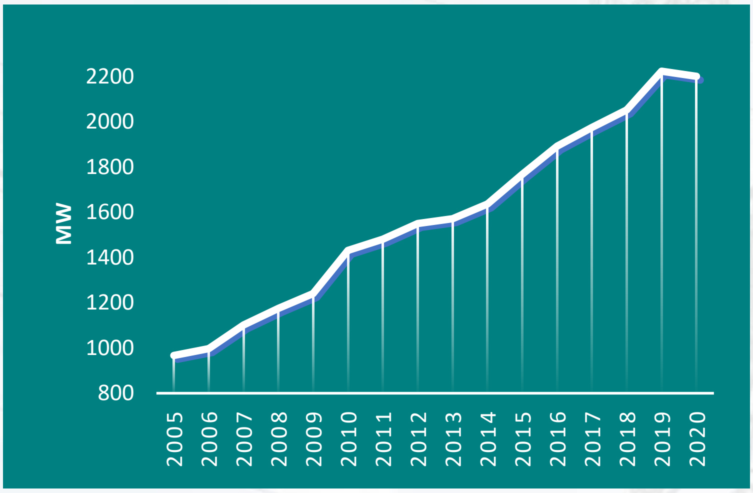
3.4.2 Luzon Historical Demand



The Luzon Grid has posted an AACGR of 3.66% for the period 2006-2020. In 2020, Luzon SPD has declined by 2.12% or 241MW. This was observed beginning in March of 2020 when Luzon was placed under community quarantine. Load centers Metro Manila, Central Luzon, and CALABARZON were placed under the most stringent Enhance Community Quarantine (ECQ) for three (3) months to prevent the spread of COVID-19. The government ordered under the ECQ that only essential establishments and industries shall operate during the quarantine period. This resulted to the temporary closure of large commercial, manufacturing, and industrial establishments over Luzon and Metro Manila, coincidentally occurred during the summer months when peak demand of Luzon was recorded for the past 10 years. Further, Metro Manila remained in General Community Quarantine (GCQ) by the end of 2020. The implementation of community quarantines resulted in lower electricity demand in 2020.

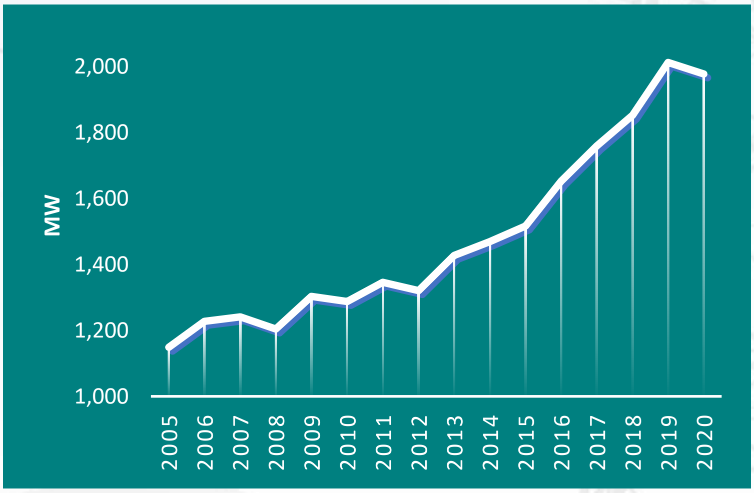
3.4.3 Visayas Historical Demand

The aggregate demand in Visayas Grid has posted an AACGR of 5.64% for the period 2006-2020. Decreased demand of 1.03% or 23 MW was recorded in 2020 in line with the onset of the COVID-19 pandemic. Load centers Cebu, Iloilo, and Bacolod City were placed under longer ECQ compared to other areas in the Visayas—the effect of which was evident in the recorded decreased demand of large distribution utilities serving these areas and nearby provinces from April to December in 2020 compared with the level recorded during the same period in 2019.



3.4.4 Mindanao Historical Demand

Mindanao Grid has posted an AACGR of 3.69% for the period 2006-2020. Similar to Luzon and Visayas, Mindanao SPD declined by 1.76% or 35MW in 2020. ECQ was also implemented in Davao, load center in Mindanao, for some time and was under GCQ by the end of 2020. Large DUs in Mindanao, including Davao, recorded decreased demand for the period of April to December in 2020 compared with the level recorded during the same period in 2019.



3.4.5 Forecast for TDP 2022-2040

The power demand for the country is expected to grow at an AACGR of 6.06% for the period 2022-2025, 6.73% for 2026-2030, and 6.49% for 2031-2040. It is projected that Mindanao will have the highest AACGR compared with the two other Grids. Mindanao is forecasted to reach an AACGR of 7.81% for 2022-2040 while the Luzon and Visayas Grids at 6.04% and 7.11%, respectively. Table 3.3 shows the projected demand disaggregated per O&M District based on the transformer peak demand coincident with the System Peak. It was derived from the DOE Forecast as of 19 August 2021 based on gross generation level.

The implementation of community quarantine, starting March 2020, throughout the country due to the COVID-19 pandemic has greatly affected the country's social and economic activities. High power demand expected to occur in the summer months of 2020 was not realized. With this, the DOE adopted National Economic and Development Authority's (NEDA) low Gross Domestic Product (GDP) economic growth assumption in updating the load forecast. The SPD forecast endorsed by the Department to NGCP contains the same levels used in the TDP 2021 to 2040.

A comparison of the projected load and generation capacity per area per grid is also available (see Appendix 2).

Table 3.3 Summary of Projected Demand per District (MW)

	Area	2021	2022	2023	2024	2025	2030	2035	2040
LUZON		11,841	12,387	13,125	13,917	14,769	20,070	27,138	36,101
MERALCO		8,381	8,714	9,032	9,371	9,718	11,670	14,021	16,852
1	NCR	5,659	5,885	6,099	6,328	6,563	7,880	9,468	11,379
2	North	367	381	395	410	425	511	614	738
3	South	2,355	2,448	2,538	2,633	2,730	3,279	3,939	4,735
North Luzon		2,607	2,767	3,089	3,445	3,841	6,586	10,623	16,101
1	Ilocos	214	223	241	263	290	466	680	878
2	Mt. Province	126	132	144	158	173	266	378	458
3	North Central	278	284	329	369	419	691	1,004	1,243
4	Cagayan Valley	284	292	321	353	390	670	1,036	1,358
5	West Central	478	505	554	615	690	1,244	2,107	3,245
6	South Central	1,168	1,271	1,438	1,620	1,810	3,154	5,295	8,779
7	North Tagalog	59	60	63	66	69	94	122	140
South Luzon		853	906	1,004	1,101	1,210	1,814	2,494	3,148
1	Batangas/Cavite	432	456	504	550	605	918	1,294	1,698
2	Laguna/ Quezon	112	118	128	135	144	177	197	202
3	Bicol	310	332	372	416	461	719	1,003	1,249
VISAYAS		2,394	2,528	2,691	2,891	3,111	4,423	6,280	8,827
1	Panay	447	472	502	539	580	825	1,172	1,647
2a	Cebu	1,151	1,215	1,294	1,390	1,496	2,126	3,019	4,244
2b	Bohol	102	108	115	123	133	188	268	376
3	Leyte-Samar	295	311	331	356	383	544	773	1,086
4	Negros	400	422	449	483	520	739	1,049	1,474
MINDANAO		2,098	2,223	2,395	2,584	2,789	4,138	6,088	8,751
1	North Western	248	258	278	304	332	531	822	1,215
2	Lanao Area	126	128	133	142	152	223	321	444
3	North Central	453	461	516	572	623	863	1,212	1,694
4	North Eastern	170	174	185	202	219	350	543	805
5	South Eastern	619	662	720	768	829	1,279	1,932	2,855
6	South Western	482	540	563	596	634	892	1,257	1,738
Philippines		16,333	17,138	18,211	19,392	20,669	28,631	39,506	53,679

3.4.6 Demand Projections for Substation Capacity Addition

The demand projections for substation expansion take off from the per meter forecast undertaken by NGCP. Forecast energy deliveries per metering point are derived from historical trends and/or information as to the potential expansion or contraction of demand of Grid-connected customers. Inputs are sought from customers in this bottom-up process to incorporate their operation plans.

Projected monthly energy deliveries (in MWh) to metering points connected to a given transformer are then summed up. Accounting adjustments for technical losses and substation use to this sum, the monthly per transformer energy delivery forecast is derived. The forecast transformer peak (in MW) is then calculated by applying the appropriate load factor to these energy delivery projections. This transformer peak becomes the basis for adding transformer capacities at the substations.

3.4.7 Demand Projections for Transmission Expansions

The SPD projection for each Grid is used in determining the necessary transmission expansion projects. For the values gathered to be effective in the power system analysis software, the values shall be distributed into individual transformer loads. Initially, all the embedded generation during system peak is subtracted from the SPD to come up with the non-embedded peak. Applicable plant station uses, and system loss were applied to the generation level to disaggregate the forecast down to the NGCP transformers. Then, the individual transformer maximum demand projections during the month when the system peak usually occurs (as determined in the previous section) are used to establish the percent share to arrive at the non-embedded peak that will be assumed for a specific transformer.

3.5 Generation Capacity Addition

This section shows the additional capacities and proposed generating plants in Luzon, the Visayas, and Mindanao Grids.

The DOE has also provided the list of generating plants that have clearance to undertake System Impact Study (SIS) but are not yet included in the DOE's list of Private Sector Initiated Power Projects (PSIPP) since the reports on the status of their development are not yet submitted. This list will fall under the new classification named as the Prospective Projects. Thus, there will be three generation project classifications, as follows:

- **Committed** – These are projects that have service contracts in place, are in the development/commercial stage and have reached financial closure already and have been declared as "committed" by the DOE.
- **Indicative** – Projects with service contracts, in the development/commercial stage but with no financing yet.
- **Prospective** – Projects with DOE clearance to undertake SIS and service contracts and on the predevelopment stage (See Appendix 3). These projects are not included in the official list of DOE's PSIPP.

It is worth noting that the proponents should regularly provide the DOE with their plans and updates regarding the status of their projects for monitoring and inclusion in the official list of DOE's PDP Generation Projects. Proponents are advised to regularly coordinate with the DOE's Electric Power Industry Management Bureau.

New generating power plants are linked to the grid every year to increase and maintain the demand-supply balance in the system. Table 3.4 shows the list of grid-connected additional capacities from 2020 to June 2021.

Table 3.4
List of Grid-Connected Additional Capacities as of June 2021

Power Plant	Location	Installed Capacity (MW)	Dependable Capacity (MW)	Connection Point
LUZON				
Masinloc U3	Masinloc, Zambales	351.8	335	Masinloc 230 kV Substation
Concepcion 2 Solar	Concepcion, Tarlac	70.9	56.7	Concepcion 230 kV Substation
VISAYAS				
TPVI DPP	Naga, Cebu	44.6	40.7	Naga 138 kV Substation
MINDANAO				
GNPOWER Kausawagan U4	Kauswagan, Lanao Del Norte	150	138	Kauswagan 230 kV Substation
	TOTAL	707.3	660.4	

In addition to the existing capacity, Table 3.5 shows the capacity summary of DOE's List of PSIPP as of 30 June 2021 for Luzon, the Visayas, and Mindanao. A detailed list of PSIPP is shown in Appendix 4.

Table 3.5
Capacity Summary of DOE's List of PSIPP as of June 2021

Grid Area	Total Committed Capacity (MW)	Total Indicative Capacity (MW)
Luzon	6,930.19	30,918.30
Visayas	314.92	2,593.10
Mindanao	383.07	1,575.94
PHILIPPINES	7,628.17	35,086.34

Note: BESS not included

It can be noted that the list includes small capacity plants which may not actually connect directly to NGCP. For relatively small capacity power plants connecting to the distribution system, the main impact is a slight reduction in the power being drawn by the Distribution Utility from NGCP substations and would not generally require reinforcement in the transmission network.

The following tables and figures show the list of major committed power plants based on the DOE list of PSIPP as of June 2021 in Luzon, the Visayas, and Mindanao Grids with associated transmission projects that will accommodate generation entry and the respective geographic location.

Table 3.6
Luzon Committed Power Plants and Associated Transmission Projects

* with SIS

Proposed Major Power Plants	Capacity (MW)	Comm. Year	Connection Point	Associated Transmission Project	ETC
COAL					
GNPower Dinginin Supercritical CFPP*	668	Unit 1 Ongoing	GN Mariveles 230 kV SS (Interim Connection) Mariveles (Alas-asin) 500 kV SS	Mariveles–Hermosa 500 kV TL	Dec 2022
	668	Unit 2 TBD		Hermosa–San Jose 500 kV TL	Dec 2022
MPPCL Masinloc Power Plant*	350	Unit 4 Mar 2024	Bolo 500 kV SS (interim) Palauig 500 kV SS	Western 500 kV Backbone Stage-2 (Masinloc-Bolo TL as Ph. 1 in 2024)	Dec 2025
	350	Unit 5 Mar 2024			
A1E CFPP*	668	Unit 1 Jun 2025	Pagbilao 500 kV SS	Pagbilao 500 kV SS Project	Jun 2022
	668	Unit 2 TBD		Pagbilao–Tayabas 500 kV TL Project	Mar 2025
Petron Corporation Refinery Solid Fuel-Fired Project – Phase 3*	44.4	May 2022	Petron 69 kV SS	Mariveles–Hermosa 500 kV TL	Dec 2022
				Hermosa–San Jose 500 kV TL	Dec 2022
OIL-BASED					
Ingrid Pililla DPP – Phase 1*	179.8	TBD	Malaya 230 kV SS	None	N/A
Ingrid Pililla DPP – Phase 2*	150	Jun 2024	Malaya 230 kV SS	None	N/A
SPC – Capas Bunker C-Fired DPP*	11.04	Mar 2022	TARELCO II Facility	None	N/A
NATURAL GAS					
EWC CCGT Power Plant*	650	Dec 2022	Pagbilao 230 kV SS	Pagbilao 500 kV SS	Jun 2022
Batangas CCPP - Phase 1, Unit 1*	437.5	Sep 2023	Ilijan 500 kV Switchyard	None	N/A
Batangas CCPP - Phase 1, Unit 2*	437.5	Mar 2024	Ilijan 500 kV Switchyard	None	N/A
Batangas CCPP - Phase 1, Unit 3*	437.5	Jun 2024	Ilijan 500 kV Switchyard	None	N/A
Batangas CCPP - Phase 2	437.5	TBD	Ilijan 500 kV Switchyard	None	N/A
GEOTHERMAL					
Montelago Geothermal Project - Phase 1	3	TBD	ORMECO Facility	None	N/A
Montelago Geothermal Project - Phase 2	10	Dec 2023	ORMECO Facility	None	N/A
Palayan Binary Power Plant*	29	Dec 2022	Bacman 230 kV SS	None	N/A
Bacman 3 (Tanawon) Geothermal Project*	20	Dec 2023	Bacman 230 kV SS (through Palayan 230 kV Switchyard)	None	N/A
HYDRO					
Man-Asok HEPP*	3.00	TBD	La Trinidad–Buguias–Mankayan 69 kV TL	None	N/A
Colasi HEPP	4.00	TBD	CANORECO Facility	None	N/A

Proposed Major Power Plants	Capacity (MW)	Comm. Year	Connection Point	Associated Transmission Project	ETC
Labayat River (Upper Cascade) HEPP*	3.46	TBD	Lumban-FAMY-Infanta 69 kV TL	None	N/A
Butao Irrigation Drop HEPP	1.30	TBD	Butao Irrigation Drop	None	N/A
Matuno HEPP*	8.00	TBD	Bayombong-Lagawe 69 kV TL	None	N/A
Lalawinan HEPP *	3.00	TBD	Lumban-FAMY-Infanta 69 kV TL	None	N/A
Biyao Hydroelectric Power Plant	0.80	TBD	KAELCO Facility	None	N/A
Laguio (Laginbayan) Malaki 1 HEPP	1.60	TBD	MERALCO Facility	None	N/A
Tubao Hydroelectric Power Plant	1.50	Dec 2022	LUELCO Facility	None	N/A
Labayat River (Lower Cascade) HEPP *	1.40	Dec 2022	Lumban-FAMY-Infanta 69 kV TL	None	N/A
Tibag HEPP *	4.40	Dec 2022	Lumban-FAMY-Infanta 69 kV TL	None	N/A
Rangas HEPP	1.50	Dec 2022	CASURECO IV Facility	None	N/A
Ibulao HEPP*	4.50	Dec 2022	Bayombong-Lagawe 69 kV TL	None	N/A
Dupinga HEPP	4.80	Dec 2023	NEECO II A2 Facility	None	N/A
Kapangan HEPP *	60.00	Dec 2023	Bacnotan 69 kV SS	None	N/A
Piapi HEPP *	3.30	Dec 2023	Lumban-FAMY-Infanta 69 kV TL	None	N/A
Daet HEPP	5.00	Dec 2024	CANORECO Facility	None	N/A
Tignoan River (Upper Cascade) HEPP*	1.50	Dec 2025	Lumban-FAMY-Infanta 69 kV TL	None	N/A
BIOMASS					
Isabela Rice husk-Fired Biomass	5.00	TBD	ISELCO II Facility	None	N/A
FEAC Biogas	2.40	TBD	PELCO III Facility	None	N/A
HEC Rice Husk-Fired Biomass	12	TBD	San Rafael 69 kV SS	None	N/A
FQBC Biogas	1.2	TBD	MERALCO Facility	None	N/A
BPPGI Biomass	3.5	Dec 2022	PALECO Facility	None	N/A
MHECI Biomass	8.00	Dec 2025	ORMECO Facility	None	N/A
SOLAR					
Bataan Solar Power Project Phases 1, 2, 3a, and 3b	100.459	Feb 2022	Balsik 230 kV SS	Hermosa-San Jose 500 kV TL	Dec 2022
Concepcion 1 Solar Power Project	115.000	Oct 2022	Concepcion 69 kV SS	None	N/A
Ilocos Norte Solar Power Project*	100.099	TBD	Laoag 115 kV SS	None	N/A
Gigasol3 Solar Power Project*	63.01	Nov 2022	Botolan-Candelaria 69 kV TL (Interim Connection) Botolan 69 kV SS (Final Connection)	None	N/A
Sta. Barbara Solar	20.00	Jan 2022	Balingueo 69 kV SS	None	N/A
SIAEP Rooftop Solar	0.50	TBD	CEDC Facility	None	N/A
Bataan Solar Power Project	4.377	TBD	Hermosa 69 kV SS	None	N/A
Bulacan 2 Solar Power Project*	22.004	TBD	San Rafael 69 kV SS	None	N/A
Tarlac Solar Power Project Phase 2*	20.00	Dec 2022	Concepcion 69 kV SS	None	N/A
Solarace Alaminos Solar	120.32	TBD	Bay 69 kV SS	None	N/A

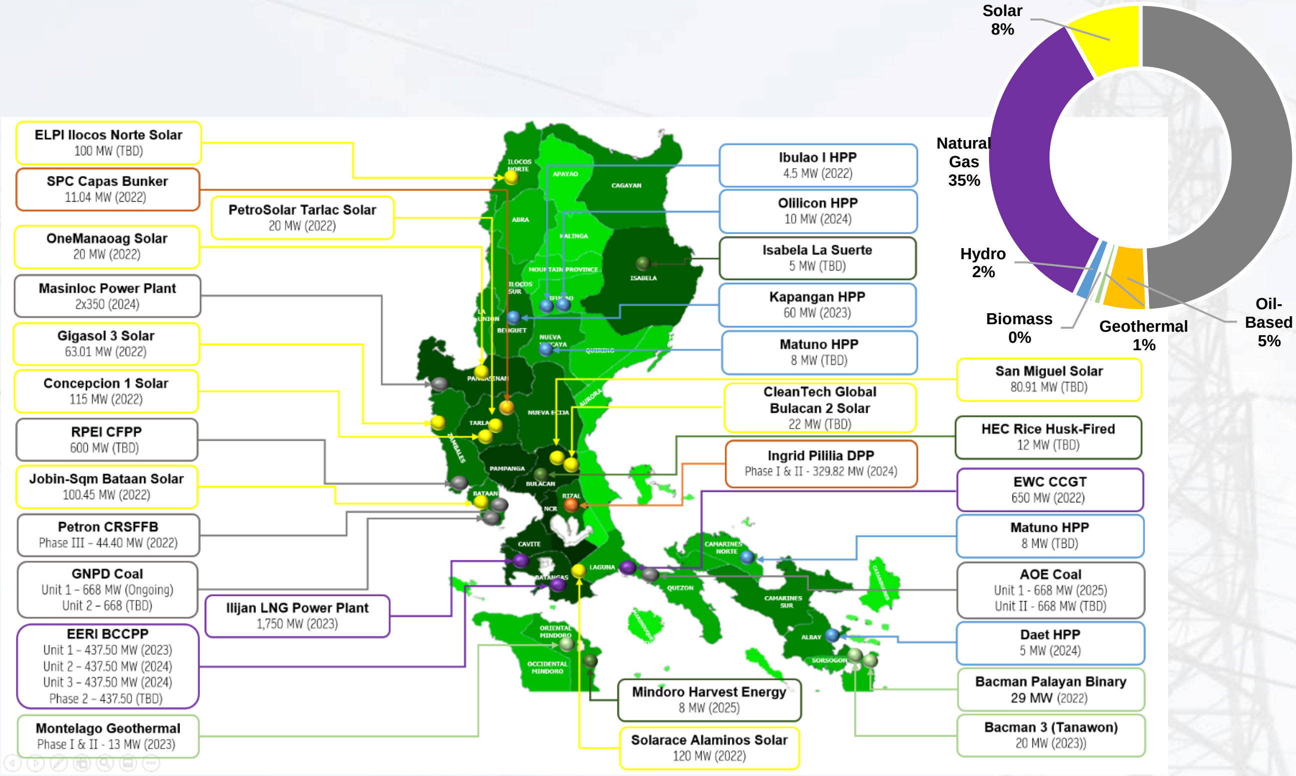


Figure 3.3: Luzon Major Committed Power Plants

Table 3.7
Visayas Committed Power Plants and Associated Transmission Projects

* with SIS

Proposed Major Power Plants	Capacity (MW)	Comm. Year	Connection Point	Associated Transmission Project	ETC
COAL					
Palm Concepcion CFPP Unit II*	135	Mar 2024	Direct connection to Concepcion SS	Eastern Panay TL Project	Completed
OIL-BASED					
Isabel Modular Diesel Ancillary Service Power Plant	86.32	TBD	Cut-in along Isabel – Pasar 138 kV Line 2 (Interim) Isabel 138 kV Substation	None	N/A
GEOTHERMAL					
Biliran GPP	50	3.5 MW - 2022 4.5 MW - 2024 10 MW - 2025 10 MW - 2026 22 MW - 2027	Cut-in along Lemon Tap-Naval 69 kV TL	Tabango–Biliran 69 kV TL Project	Sep 2027
HYDRO					
Timbaban HEPP*	18.0	Dec 2021	Tap Connection to Panitan-Nabas 69 kV TL	CNP 230 kV Backbone Stage 3	Ph. 1 - Jun 2022 Ph. 2 - Jun 2023
Igbulo (Bais) HEPP*	5.1	Dec 2021	Cut-in along Sta. Barbara-San Jose 69 kV TL	Tigbauan 138 kV SS Project	Dec 2022
Tubig HEPP*	16.0	Dec 2021	Tap connect along Paranas–Taft 69 kV line	None	N/A
BIOMASS					
HDJ Biomass Power Plant Project*	3	Dec 2021	Tap connection along Kabankalan–La Castellana 69 kV line	CNP 230 kV Backbone Stage 3	Ph. 1 - Jun 2022 Ph. 2 - Jun 2023
SOLAR					
Mandaue Solar Power Project	1.50	Feb 2023			

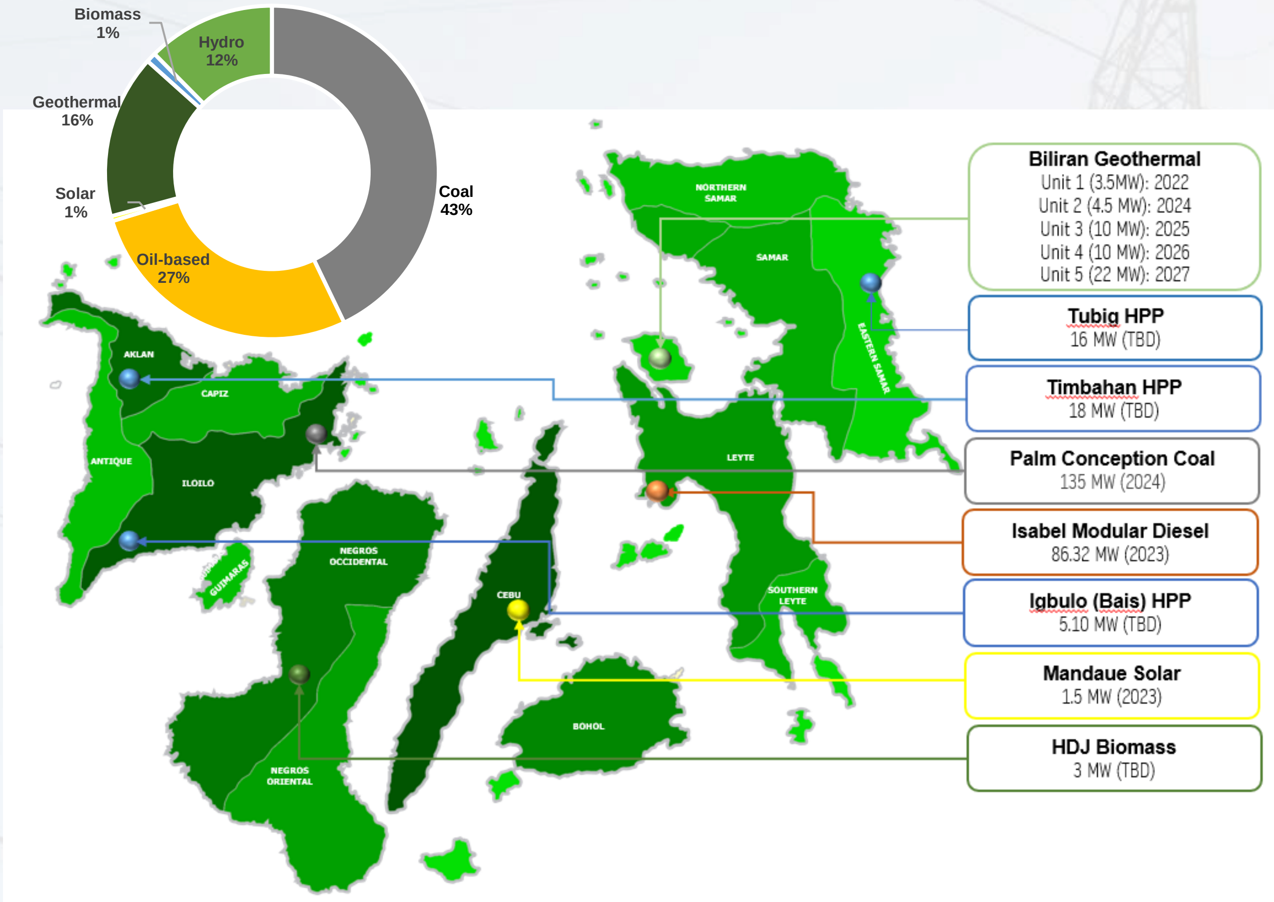


Figure 3.4: Visayas Committed Power Plants

Table 3.8
Mindanao Committed Power Plants and Associated Transmission Projects

* with SIS

Proposed Major Power Plants	Capacity (MW)	Comm. Year	Connection Point	Associated Transmission Project	ETC
COAL					
Misamis Oriental 2 x 135 MW Circulating Fluidized Bed CFPP*	270	Dec 2024	Villanueva 138 kV SS	None	N/A
OIL-BASED					
SPC DPP	11.04	TBD	Maco 138 kV SS	None	N/A
GEOTHERMAL					
Mindanao 3 Binary GPP	3.60	Jan 2022			
HYDRO					
Lake Mainit	25	TBD	Butuan 138 kV SS	None	N/A
Marbel 1 HEPP	0.79	TBD			
Alamada HEPP	2.84	TBD			
Sipangpang HEPP	1	TBD			
Siguil HEPP	15.1	Dec 2022			
Maladugao (Upper Cascade) HEPP	8.4	Dec 2023	Maramag 138 kV SS	None	N/A
Maramag HEPP	4.4	Dec 2025			
Liangan HEPP	11.9	Dec 2025	Agus 6 138 kV SS	None	N/A
BIOMASS					
PTCI Rice Husk-Fired Biomass	3	TBD	Sultan Kudarat 138 kV SS	None	N/A
CSCCI 10 MW Biomass	10.00	TBD			
DSCCI 10 MW Biomass	10.00	TBD			
LPEC 6 MW Biomass	6.00	Jun 2023			

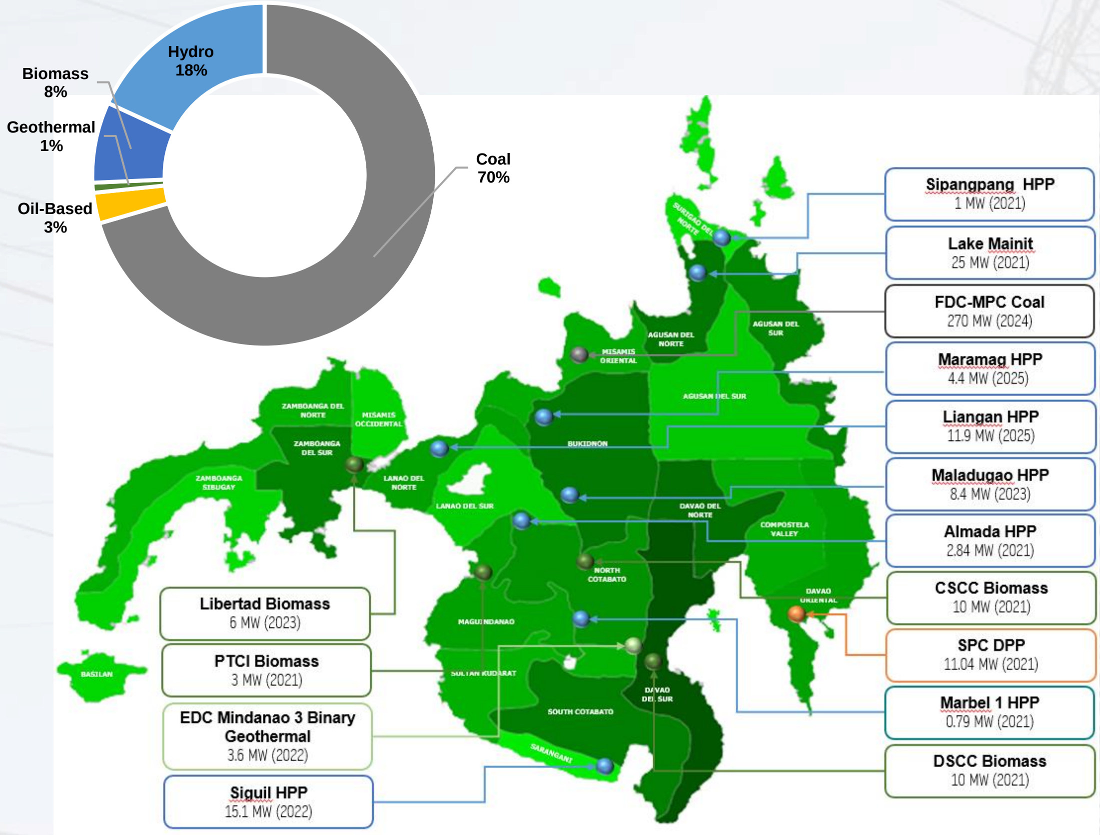


Figure 3.5: Mindanao Committed Power Plants

3.5.1 Potential Power Plant Connection Points

To serve as a guide for generation investors, this section identifies the substations where new power plants may connect without the need for any significant transmission reinforcement. These recommended connection points, however, should be viewed from a transmission planning perspective and are based on the capability of the existing grid and already considering the completion of ERC-approved projects and without consideration on the following other requirements in generation location siting, particularly for the non-site specific plants:

- fuel supply/transport
- topology/geology of site
- accessibility
- availability of area
- availability of cooling water
- fresh water supply
- security
- environmental/social concerns

It can be noted, however, that the existing transmission facilities in some generation potential areas barely have excess capacity to cater bulk generation addition. Thus, new transmission backbone developments are usually required first for the entry of new large capacity plants.

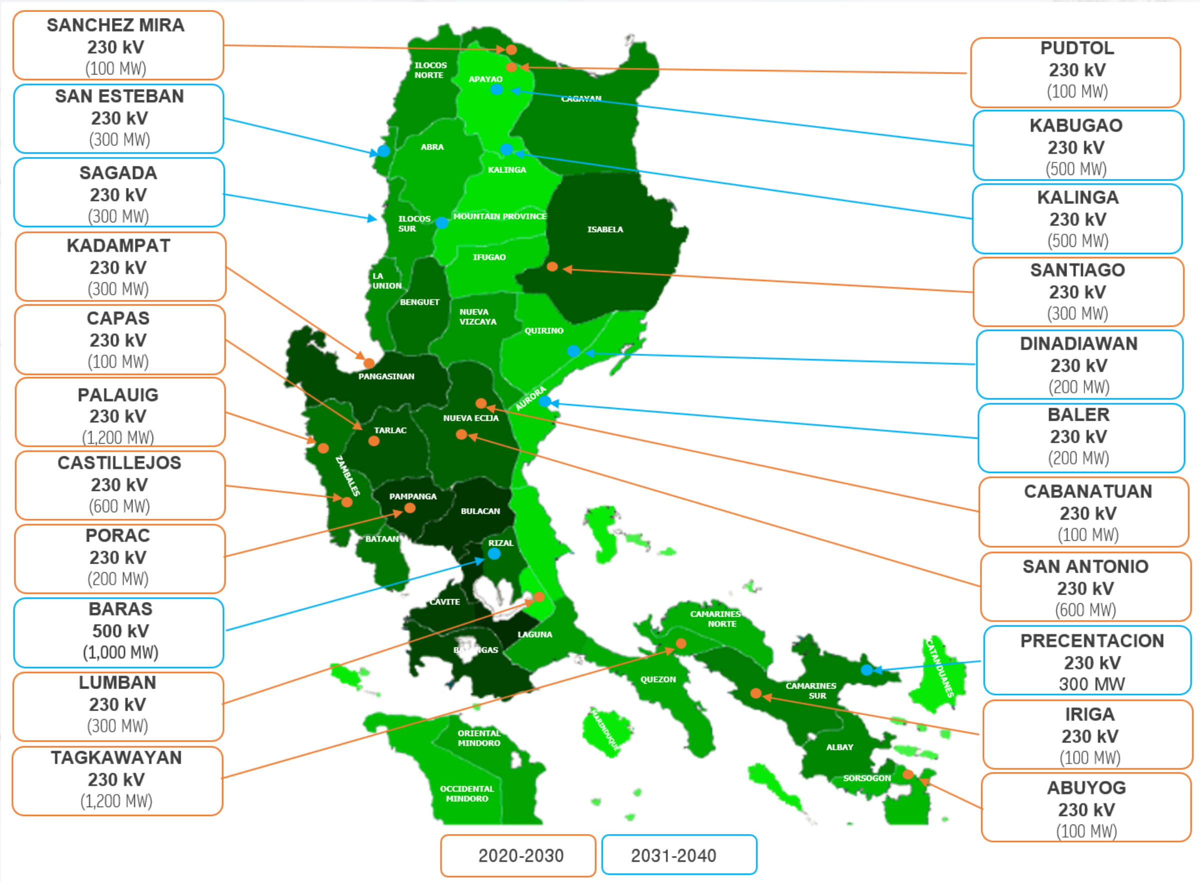


Figure 3.6: Recommended Power Plant Connection Points (Luzon)

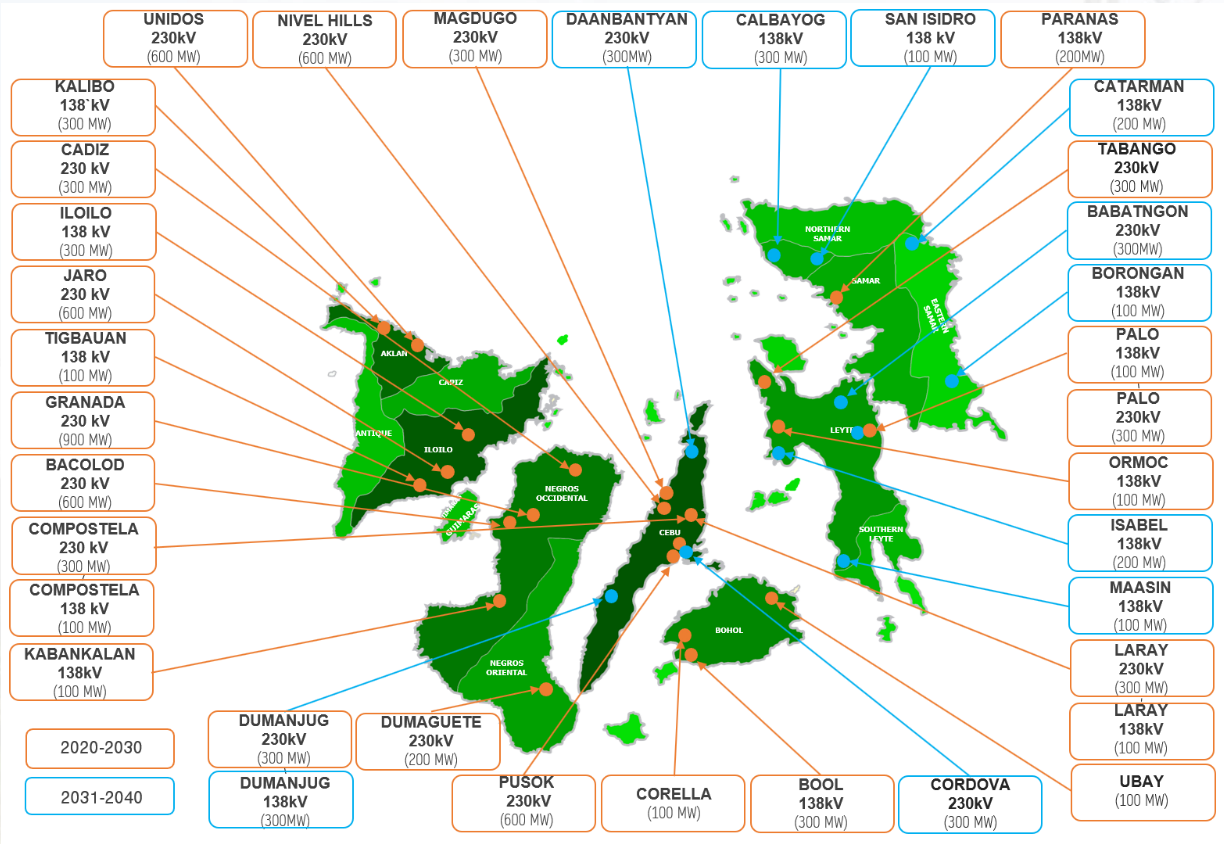


Figure 3.7: Recommended Power Plant Connection Points (Visayas)

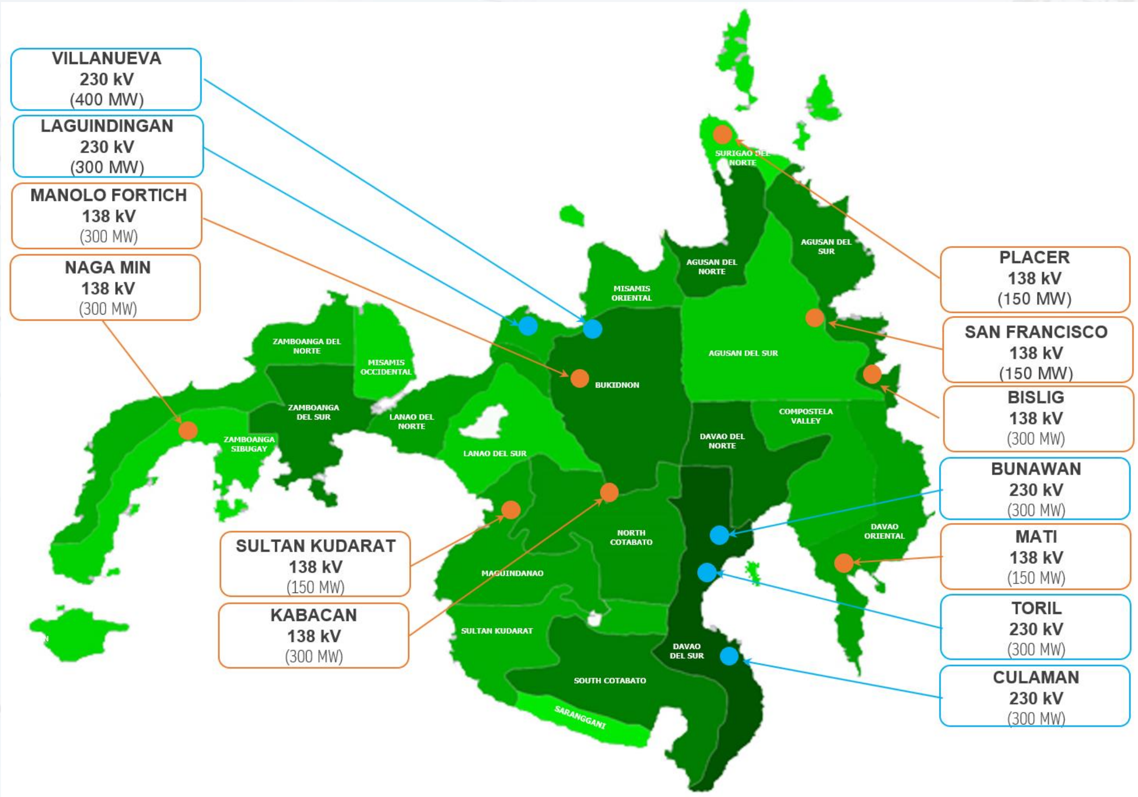


Figure 3.8: Recommended Power Plant Connection Points (Mindanao)

3.6 Project Clustering

To achieve optimal resource utilization, NGCP transmission projects were grouped in different clusters or components based on geographic location to enable sharing of resources, including manpower, project partner/suppliers, and knowledge. With clustering, resources can be optimized which would result in lower costs, better flexibility, and higher productivity.

The table below shows the list of project clusters from Luzon, the Visayas, and Mindanao. A cluster is defined technically as interrelated ventures with similar geographical location, project driver, and purpose based on NGCP's TRANSMISYON 2040:

Table 3.9
Project Clusters

Cluster	Project Name
A. Metro Manila Backbone (North) Project for Resiliency, System Reliability, and Smart Grid Development	
1	Marilao 500kV SS
2	Marilao-Mexico 230kV TL
3	Navotas-Dona Imelda 230kV TL
B. Metro Manila Backbone (South) Project for Resiliency, System Reliability, and Smart Grid Development	
1	Antipolo 230kV SS
2	Baras 500kV SS
3	Luzon Voltage Improvement Project 3
4	Manila (Navotas) 230kV SS
5	Pasay 230kV SS
6	San Jose-Angat 115kV TL Upgrading
7	San Jose-Quezon 230kV Line 3
8	Silang-Taguig 500kV TL
9	South Luzon SS Upgrading Project Stage 1
10	Taguig 500kV SS
11	Taguig-Taytay 230kV TL
C. North Luzon 230/115 kV Transmission Projects for System Reliability	
1	Capas 230 kV SS
2	Clark-Mabiga 69kV TL
3	Concepcion-Sta. Ignacia 69 kV TL
4	Luzon Voltage Improvement Project V
5	Minuyan 115 kV Switching Station
6	Nagsaag-Tumana 69 kV TL
7	North Luzon SS Upgrading Project II
8	Plaridel 230kV SS
9	Porac 230 kV SS
10	San Simon 230kV SS

Cluster	Project Name
D. North Luzon 500/230kV Backbone Project for Resiliency and System Reliability 1	
1	Bataan 230 kV Grid Reinforcement Project 2
2	Castillejos 230kV SS
3	Dasol 230kV SS
4	Hermosa-San Jose 500kV TL
5	Luzon Voltage Improvement Project 3
6	Mariveles-Hermosa 500kV TL
7	Olongapo 230kV SS Upgrading
8	Relocation of Steel Poles Along Hermosa-Duhat 230 kV TL
9	Western 500 kV Backbone Stage 1
10	Western Luzon 500kV Backbone Stage 2
E. North Luzon 500/230kV Backbone Project for Resiliency and System Reliability 2	
1	Ambuklao-Binga 230 kV TL
2	Baler 230kV SS
3	Binga-San Manuel 230 kV TL
4	Cabanatuan-Sampaloc-Nagsaag 230kV TL
5	La Trinidad-Calot 69kV TL
6	Luzon Voltage Improvement Project 3
7	Nagsaag-Santiago 500kV TL
8	Sampaloc 230kV SS
9	Sampaloc-Baler 230kV TL
10	San Manuel-Nagsaag 230kV TL Project
F. North Luzon 500/230kV Backbone Project for Resiliency and System Reliability 3	
1	Balaoan-Laoag 500kV TL
2	Bauang-La Trinidad 230kV TL Upgrading
3	Bolo 5th Bank
4	Bolo-Balaoan 500kV TL
5	Luzon Voltage Improvement Project 3
6	Line Structure Relocation Project (Ilocos)
7	North Luzon SS Upgrading Project
8	Northern Luzon 230kV Loop
9	Pinili 230kV SS
10	San Fabian 230kV SS Project
11	Tuguegarao-Lal-lo 230kV TL
12	Tuguegarao-Enrile 69kV TL
G. South Luzon 500/230 kV Backbone Project for Resiliency and System Reliability	
1	Calamba 230kV SS
2	Kawit 230kV SS
3	Luzon Voltage Improvement Project 6
4	Pagbilao 500kV SS
5	Pagbilao-Tayabas 500kV TL
6	Palawan-Mindoro Interconnection Project (Stage 1)
7	Pinamukan 500kV SS
8	Silang 500kV SS
9	Tanauan 230kV SS
10	Tuy 500/230kV SS (Stage 2)
11	Tuy 500kV SS

Cluster	Project Name
H. South Luzon 230/115 kV Transmission Project for Resiliency and System Reliability	
1	Abuyog 230kV SS
2	Batangas-Mindoro Interconnection Project
3	Daraga-Bitano 69kV Line
4	Eastern Albay 69kV Line Stage 2
5	Luzon Voltage Improvement Project 4
6	Luzon-Visayas HVDC Bipolar Operation Project
7	Salvacion(APEC)-Sto. Domingo 69kV TL
8	South Luzon SS Upgrading Project 1
9	South Luzon SS Upgrading Project 2
10	Tagkawayan 500kV SS
11	Tiwi SS Upgrading Project
12	Tower Resiliency of Bicol Transmission Facilities
13	Tower Structure Upgrading of Bicol Transmission Facilities
I. Leyte, Samar, and Bohol 230/138 kV Backbone Projects for Resiliency, System Reliability, and Island Interconnection	
1	Sta. Rita-Quinapundan 69 kV TL
2	Tagbilaran 69 kV SS Project
3	Babatngon-Palo 230 kV TL Project (138 kV energized)
4	Babatngon-Sta. Rita 138 kV TL Upgrading Project
5	Bool 138 kV SS Project
6	Calbayog-Allen TL Project
7	San Isidro-Catarman 138 kV TL Project
8	Corella-Ubay 138 kV Line 2 Stringing Project
9	Permanent Restoration of Panitan-Nabas 138 kV TL affected by Typhoon Ursula
10	Sumangga 138 kV SS Project
11	Tabango-Biliran 69 kV TL Project
12	Visayas SS Upgrading Project 1
13	Visayas SS Upgrading Project 2
14	Visayas Voltage Improvement Project 2
15	Visayas Voltage Improvement Project Stage 2
16	Cebu-Leyte 230kV Interconnection Line 3 and 4 Project
J. Negros and Panay 230/138 kV Backbone Projects for Resiliency, System Reliability and Island Interconnection	
1	Nabas-Caticlan-Boracy TL
2	Negros-Panay 230kV Interconnection Line 2
3	Panay-Guimaras 138 kV Interconnection
4	Banga 138kV SS Project
5	Amlan-Dumaguete 138 kV TL Project
6	Barotac Viejo-Natividad 69 kV TL Project
7	Barotac Viejo-Unidos 230 kV TL Project

Cluster	Project Name
8	Granada 230 kV SSProject
9	Mandurriao 138 kV SS Project
10	La Carlota 138 kV SSProject
11	Sipalay 138 kV SS Project
12	Tigbauan 138 kV SS Project
13	Visayas SS Upgrading Project 2
14	Visayas SS Upgrading Project 3
15	Visayas Voltage Improvement Project 2
16	Negros-Panay 230kV Interconnection Line 2
17	Panay-Guimaras 138kV Interconnection Project Line 2
K. Metro Cebu 230/138 kV Backbone Project for Resiliency and System Reliability	
1	Danao 230 kV SS Project
2	Cebu-Bohol 230kV Interconnection Project
3	Cebu-Lapu-Lapu 230kV TL Project
4	Cebu-Negros-Panay 230kV Backbone Project (Stage 3)
5	Cebu-Negros-Panay 230 kV Backbone Project (Stage 1)
6	Lapu-Lapu 230 kV SS Project
7	Laray 230 kV SS Project
8	Laray-Cordova 230kV Interconnection Project
9	Mindanao-Visayas Interconnection Project
10	Naga (Visayas) SS Upgrading Project & New Naga (Colon) SS Project
11	Nivel Hills 230 kV SS Project
12	Permanent Restoration of Colon-Samboan 138kV Lines 1 and 2 affected by Landslide
13	Visayas SS Upgrading Project 1
14	Visayas SS Upgrading Project 2
15	Visayas SS Upgrading Project 3
16	Visayas Voltage Improvement Project 2
L. Lanao Mindanao 230/138 kV Backbone Project for Resiliency, System Reliability, and Island Interconnection	
1	Agus 2 Switchyard Upgrading Project
M. Northeastern Mindanao 230/138 kV Backbone Project for Resiliency, System Reliability, and Island Interconnection	
1	Butuan-Placer 138 kV TL
2	Mindanao SS Rehabilitation Project
3	Mindanao SS Upgrading Project
4	Nasipit SS Bus-in
5	Eastern Mindanao 230 kV TL Project
6	Mindanao SS Expansion 4 Project
7	Mindanao SS Upgrading 2 Project
8	Opol SS Bus-in Project
9	San Francisco-Tago 138 kV TL Project

Cluster	Project Name
10	Villanueva-Kinamlutan 230 kV TL Project
N. Northwestern Mindanao 230/138 kV Backbone Project for Resiliency, System Reliability, and Island Interconnection	
1	Mindanao - Visayas Interconnection Project
2	Balo-i-Kauswagan-Aurora 230 KV TL (Phase I)
3	Mindanao SS Rehabilitation Project
4	Mindanao SS Upgrading Project
5	Agus 6-Kiwalan-Lugait 69 kV TL Project
6	Laguindingan 230kV SS Project
7	Naga-Salug 138 kV TL Project
8	Lala-Naga-Zamboanga 230 kV TL Project
9	Mindanao SS Expansion 4 Project
10	Mindanao SS Upgrading 2 Project
11	Lala-Naga-Zamboanga 230 kV TL Project
12	Oroquieta 69 kV Switching Station Project
13	Tigbao 138kV SS
14	Tumaga 138kV SS
15	Zamboanga Peninsula Voltage Improvement Project (ZPVIP)
O. Southeastern Mindanao 230/138 kV Backbone Project for Resiliency, System Reliability, and Island Interconnection	
1	Mindanao 230 kV Transmission Backbone
2	Mindanao SS Rehabilitation Project
3	Mindanao SS Upgrading Project
4	Eastern Mindanao Voltage Improvement Project
5	Maco-Tagum 69 kV TL
6	Maco-Mati 138 kV TL Project
7	Mindanao SS Expansion 4 Project
8	Mindanao SS Upgrading 2 Project
P. Southwestern Mindanao 230/138 kV Backbone Project for Resiliency, System Reliability, and Island Interconnection	
1	Kabacan SS
2	Mindanao SS Rehabilitation Project
3	Mindanao SS Upgrading Project
4	Sultan Kudarat (Nuling) Capacitor
5	Tacurong-Kalamansig 69 kV TL Project
6	Koronadal 138kV SS
7	Mindanao SS Expansion 4 Project
8	Sultan Kudarat-Tacurong 230 kV TL Project

4 Grid Resiliency

To improve the ability of the power system to withstand the effects of adverse environmental conditions, natural or man-made power interruptions, and other disturbances, there is a need to further reduce the technical and human risks to minimize disruption of power delivery service to the electricity end-users. A high degree of power system reliability is equivalent to the high availability of the electricity supply service, while excellent system security gives robustness to the power system to withstand unexpected events that have severe consequences[1].

4.1 Resiliency Policy

The Philippines, considering its geographical location and being an archipelago with one of the world's longest coastlines, is vulnerable to the impacts of climate change. In 2018, the DOE has introduced the Resiliency Policy, which is the adoption of resiliency planning and program in the energy industry to mitigate the adverse effects brought about by disasters. This contains adaptation measures that include both engineering and non-engineering options, to gauge infrastructure and human resource preparedness during and after the disruptive events.

The Philippines, considering its geographical location and being an archipelago with one of the world's longest coastlines, is vulnerable to the impacts of climate change. In line with this, the DOE has promulgated DOE DC 2018-01-001 "Adoption of Energy Resiliency in the Planning and Programming of the Energy Sector to Mitigate the Potential Impacts of Disasters". The DOE resiliency plans and programs are summarized as follows:

- Strengthen existing infrastructure facilities
- Incorporate mitigation improvements – "Build Back Better" principle
- Improve operational and maintenance standards and practices
- Develop resiliency standards

4.1.1 Resiliency Planning for Transmission System

In anticipation of the increasing frequency of super typhoons, earthquakes, volcanic eruptions, and other natural or man-made hazards, the challenge for the transmission system is to keep improving the preventive measures and risk reduction, adopt the "build back better" principle after disasters or build better from the start. This could be done by making disaster risk assessment a prerequisite for transmission infrastructure investment[2]. As the NGCP recognizes its critical role in the country's power industry, specifically in ensuring the uninterrupted transmission and availability of electrical power energy to end-user, hence its Plans and Program on Resiliency is summarized as follows:

- New transmission structures to be built using upgraded wind speed design
- Replacement of old transmission lines – stage by stage
- Establishment of transmission backbone loop configuration including the telecommunication network
- Enhanced substation site and transmission line route selection criteria using hazard maps issued by government agencies
- Establishment of spares for Emergency Restoration System (ERS), steel poles, and high voltage equipment including mobile transformers

[1] CIGREE-IEEE joint task force on stability terms and definitions

[2] Global Platform for Disaster Risk Reduction.

- Flood control at existing substations, slope protection/concrete bored-pile foundation for existing overhead transmission line structures

4.1.2 Enhancement of Transmission Line and Substation Site Selection

- In the process for transmission line route selection, careful evaluation is undertaken to avoid areas prone to flood, with steep slopes prone to soil erosions, and with sufficient distance from fishponds, rivers, lakes, swamps, and seashores
- For substation sites, the risk of flood or flash flood is carefully assessed, while avoiding areas that are considered possible sources of pollutions, e.g., industrial plants/buildings that generate polluted gases, storage areas for explosive or inflammable materials, bulk oil storage tanks, and oil/gas pipelines. If necessary, close proximity to seashores is also avoided to prevent or minimize corrosions and depletion or failure of insulations of substation equipment
- For existing overhead transmission lines that exhibit critical function to the grid and are in areas vulnerable to typhoon and storm surges, the use of HV underground cables will be thoroughly considered
- Furthermore, NGCP selects overhead transmission line routes and substation sites that have minimal effect on human settlement or as much as possible, minimize the removal of vegetation or cutting of trees

4.1.3 Increase of Transmission Towers Strength and Capacity

The maximum Wind Speed Design (WSD) of overhead transmission lines' (OHTL) support structures is based on three wind zones: Zone 1 (270 kph), Zone 2 (240 kph), and Zone 3 (160 kph), as shown in Figure 4.1. In view of the increasing frequency of super typhoons that hit various areas in the country in the past decade, NGCP will be increasing the maximum velocity design of support structures.

- OHTLs to be erected in Luzon are recommended to be upgraded to withstand wind speed of 300 kph to be able to meet the effects of super typhoon occurring due to climate change
- Existing transmission towers which are designed at 3-second gust wind speed 270 kph should be upgraded or retrofitted to carry higher wind speeds
- Anti-pilferage bolts are being specified to be used (instead of regular connection bolts) in all towers up to 9m from the ground for 138 kV lines and 12m for lines of at least 230 kV to prevent the pilferage of tower parts which can cause the toppling of steel towers/poles.

Based on the latest design of NGCP, a new tower design that can withstand 300 kph wind speed is being adopted and to be implemented for Tower Structure Upgrading of Bicol Transmission Facilities and Tower Resiliency of Bicol Transmission Facilities Projects.

4.1.4 Security of Transmission Assets

In areas with security issues, each proposed transmission project is subjected to security assessment as part of the transmission line route or substation site selection process. All security threats are thoroughly identified to determine the level of risk and the corresponding mitigation measures that will be implemented during construction and its eventual operation.

4.1.5 Transmission Line Looping Configuration

To further improve the system reliability, enhance the operational flexibility during events of natural calamities, and to support the connection of various incoming power plants, particularly RE, the long-term transmission planning involves the various transmission looping configurations. Various backbone transmission systems involving 138kV, 230kV, and 500kV lines will be implemented by stages, but part of several segments that will eventually form a transmission loop as the end state.

4.1.6 Use of HV Underground Cables

Power System could be made more resilient through underground cable installations as these are less susceptible to outages during extreme weather conditions, such as super typhoons and strong wind thunderstorms. However, because of the excessive cost of underground cable installation, initial applications are limited or confined only in highly urbanized areas, wherein the land is a valuable resource. Securing ROW is a great challenge and aesthetics is a paramount consideration.

4.2 Asset Replacement

NGCP replacement program adopts international best practices in the assessment of assets. The methodology being used is believed to provide the most informed decision pertaining to the management of the transmission assets. This will be applied to all NGCP's operational assets which will be discussed in the following sub-sections.

4.2.1 Asset Condition Assessment

Condition parameters for each asset type were developed based on the asset's operational and maintenance data, defects, and age. These condition parameters are determined to be the best factors that can accurately represent the overall condition of an asset. The parameters are ranked and evaluated, through the assignment of corresponding weights based on their contribution to asset degradation.

Condition and sub-condition parameters were developed for power transformers, power circuit breakers, current and potential transformers, and surge arresters. The condition parameters shall be used to calculate the health index of an asset. Asset health index refers to the quantitative measure of the relative condition of an asset. The health index can be interpreted as an approximate representation of the estimated life of an asset.

Based on the health index of an asset, its corresponding probability of failure can be derived by using a probability distribution function. The probability of failure of an asset can give a relative possibility of an equipment failure. The effect of such failure should be taken into consideration as part of the evaluation of the asset. To be able to quantify the relative consequence of failure or the criticality of an asset, the social, financial, and economic impact of an asset failure must first be identified.

4.2.2 Asset Prioritization

Prioritization of specific assets shall be based on a calculated health index which shows an estimate of the asset's relative condition. The assets that fall below the minimum threshold set shall be further evaluated to determine whether to replace or maintain the said asset. Only replacement programs are to be considered since this approach evaluates the condition of existing assets.

Figure 4.1: Asset Health Composition

4.2.3 Standard Asset Lives and Asset Database

As an initial step in the creation of an asset refresh program, NGCP considered the standard asset lives adopted in the 2008 re-valuation of transmission assets for the 3rd Regulatory Period (2011-2015). Appendix 5 shows the summary of Asset Lives. Figure 4.2 shows the 115 kV to 500 kV OHTL age profile.

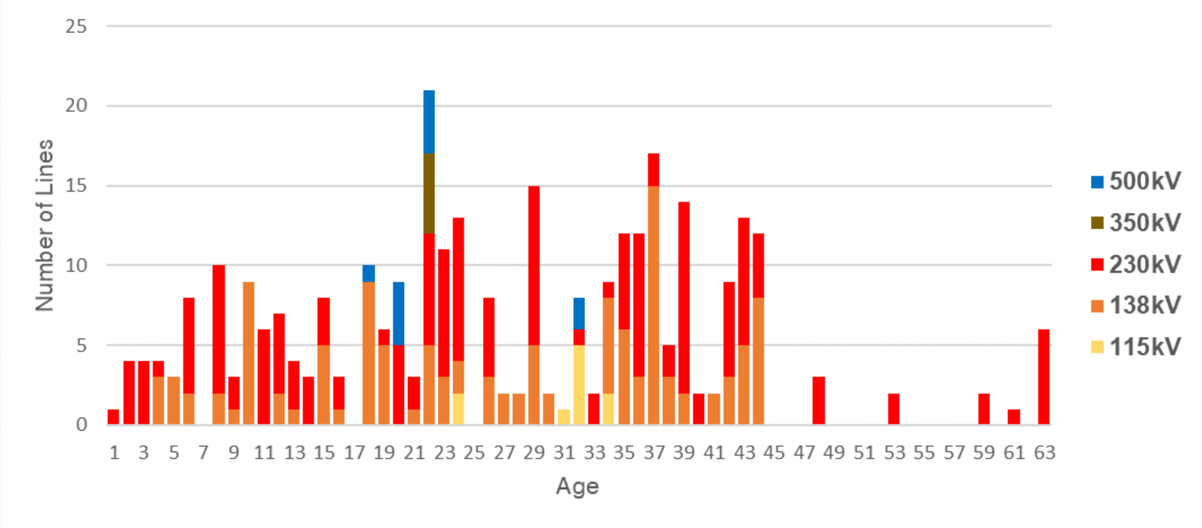


Figure 4.2: Overhead Transmission Line Age Profile (August 2021)

The existing asset database was obtained from Enterprise Asset Management (EAM) utilized by NGCP. This software is utilized to monitor and perceive existing major equipment in order to optimize the utilization of assets and their condition throughout their lifecycle as well as to provide a database for relevant information. In the succeeding years, a system-based tool capable of performing data analytics may be used to facilitate a corporate-wide prioritization of old transmission assets that will be programmed to be replaced.

5 Emerging Technologies

5.1 Battery Energy Storage System

In August 2019, the DOE issued Department Circular No. DC2019-08-0012 entitled, "Providing a Framework for Energy Storage System in the Electric Power Industry", establishing a policy on the operation, connection, and application of Energy Storage System (ESS) among others. It recognizes that the ESS technologies are applied to serve a variety of functions in the generation, transmission, and distribution of electric energy, which include Energy Generation, Peak Shaving, and Ancillary Services (AS). The increasing integration of VREs in the transmission system necessitates the recognition of ESS as one of the technologies to manage the intermittent operation of the VRE-generating plants' output to ensure stability. Moreover, ESS will be one of the key elements in the proposed Smart Grid Roadmap towards power system modernization.

Among the ESS, the Battery Energy Storage System (BESS) is still considered a new technology in the Philippines with various applications for the transmission system, these are: provision of AS, transmission facility upgrades deferment, and transmission congestion relief.

The increasing penetration of VREs has the potential to cause significant degradation of the power system performance due to their intermittent nature, which necessitates an increase in the required flexible generation. With a focus on large-scale wind and solar power generation connected to the grid, rapidly varying power output depending on many factors results in many challenges in the System Operations. BESS is now being widely used to mitigate the effects of integrating RE resources. BESS is capable of absorbing and delivering both real and reactive power in a millisecond time frame. With such capability, BESS is being used in addressing the challenges on the intermittency brought by RE, i.e., solar and wind energy sources on their ramp rate, frequency, and power quality.

Moreover, the applications considered for the BESS also include frequency regulation, RE fluctuation stabilization, etc. The system inertia, governor droop, and damping capability of the BESS can be set (dynamically) according to the power system requirements. Thus, BESS appears to offer one of the most flexible providers of AS to the transmission system.

Furthermore, BESS when connected to appropriate nodes may defer the need for additional transmission facility upgrades by supplying the peak demand of grid/end-users through BESS. It can also mitigate or eliminate transmission congestion when power demand exceeds the transmission network capability that may lead to a violation of thermal or voltage stability.

5.1.1 NGCP's Recommended Sites and Capacities for BESS

5.1.1.1 Methodology

The methodology used in determining the recommended capacities and sites of BESS involved load flow analyses to determine the maximum capacity that each site can accommodate during charging and discharging states of BESS with unity power factor.

The scenarios considered in the system simulation were base case peak demand. To test the available capacity of NGCP substation/facilities, the worst generation dispatch was used to see the total power flowing to the connection points. The generation dispatch scenarios discussed in Section 3.2 were considered in the system simulation involving BESS.

The following criteria are considered for normal and N-1 conditions:

- No overloading of the existing and future equipment and facilities once the BESS are connected and operating as a load and as a generator
- The resulting voltages are within the PGC prescribed limits
- Substation termination is available

5.1.1.2 Application

NGCP initially identified BESS's application as a provision for AS, particularly as a reserve. Considering the forthcoming transition to new AS classifications, i.e., primary, secondary, and tertiary reserves, and with BESS's fast response and flexibility, it is initially seen to be well suited as a primary reserve. Further studies will be conducted to explore other applications of BESS including the adoption of the best practices in other jurisdictions in determining additional reserves due to rapidly increasing VRE penetration in the grid.

5.1.1.3 List of Recommended Capacities and Sites

The following are the initial lists of recommended capacities and sites of BESS as a primary reserve in Luzon, the Visayas, and Mindanao Grids:

Table 5.1
Recommended BESS Capacities and Sites

Substation	Voltage Level	Recommended BESS Capacity (MW)
LUZON GRID		
Masinloc	69 kV	20
Daraga	69 kV	40
Laoag	69 kV	40
San Rafael	69 kV	20
Labo	69 kV	20
Mexico	69 kV	20
San Manuel	69 kV	20
Bay	69 kV	20
Labrador	69 kV	20
Lamao	230 kV	30
Lumban	69 kV	40
	Total Capacity	290
VISAYAS GRID		
Kabankalan	138 kV	10
Ormoc	69 kV	20
Samboan	69 kV	10
Sta. Barbara	138 kV	10
Compostela	230 kV	20
	Total Capacity	70
MINDANAO GRID		
Villanueva	138 kV	10
Davao	69 kV	20
Maco	69 kV	20
Kibawe	69 kV	20
Butuan	69 kV	20
	Total Capacity	90

5.1.2 Committed BESS

Several BESS power plants are included in the DOE list of Committed power plants as of June 2021 as shown in Figures 5.1 to 5.3.

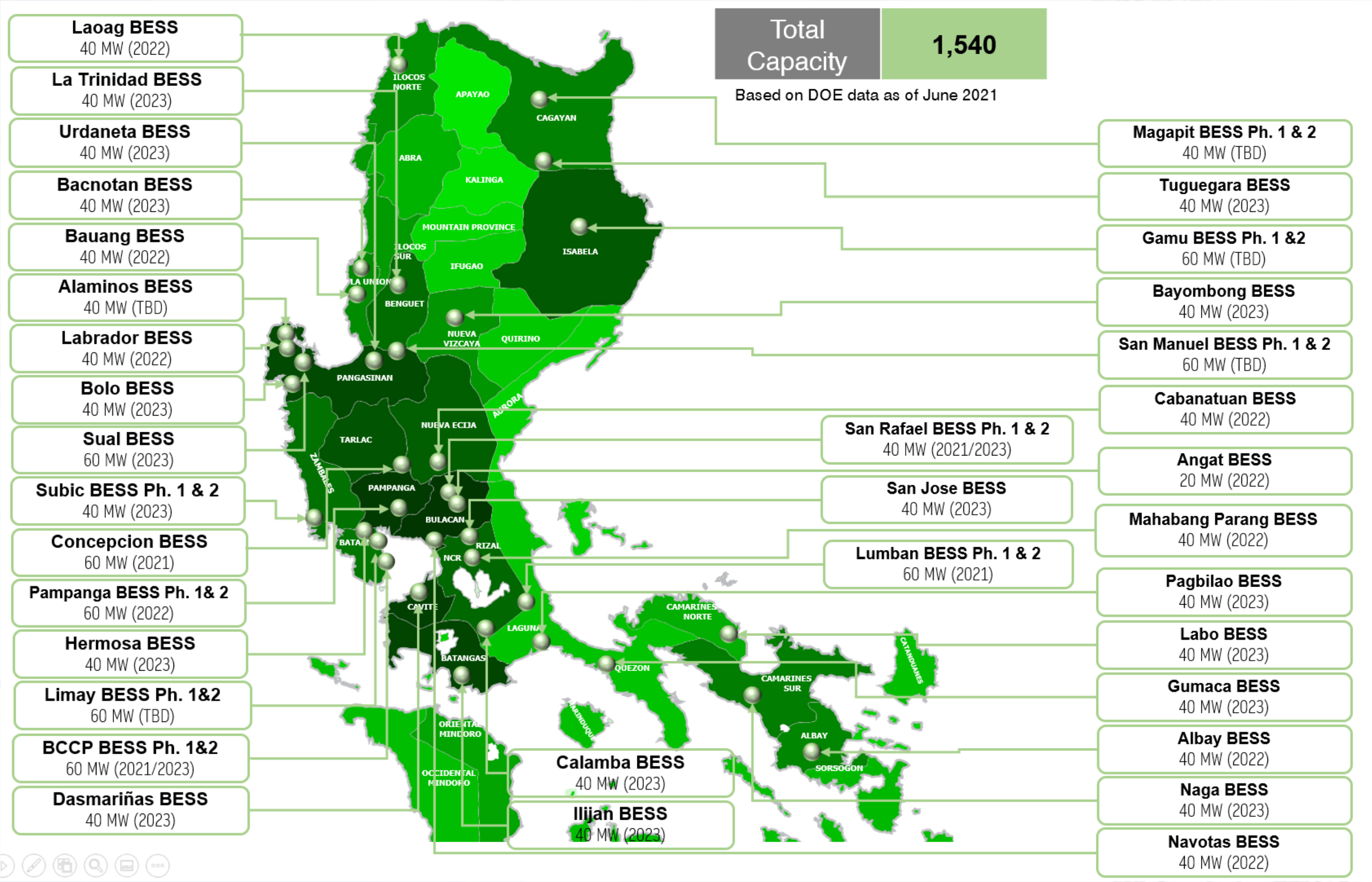


Figure 5.1: Committed BESS in Luzon

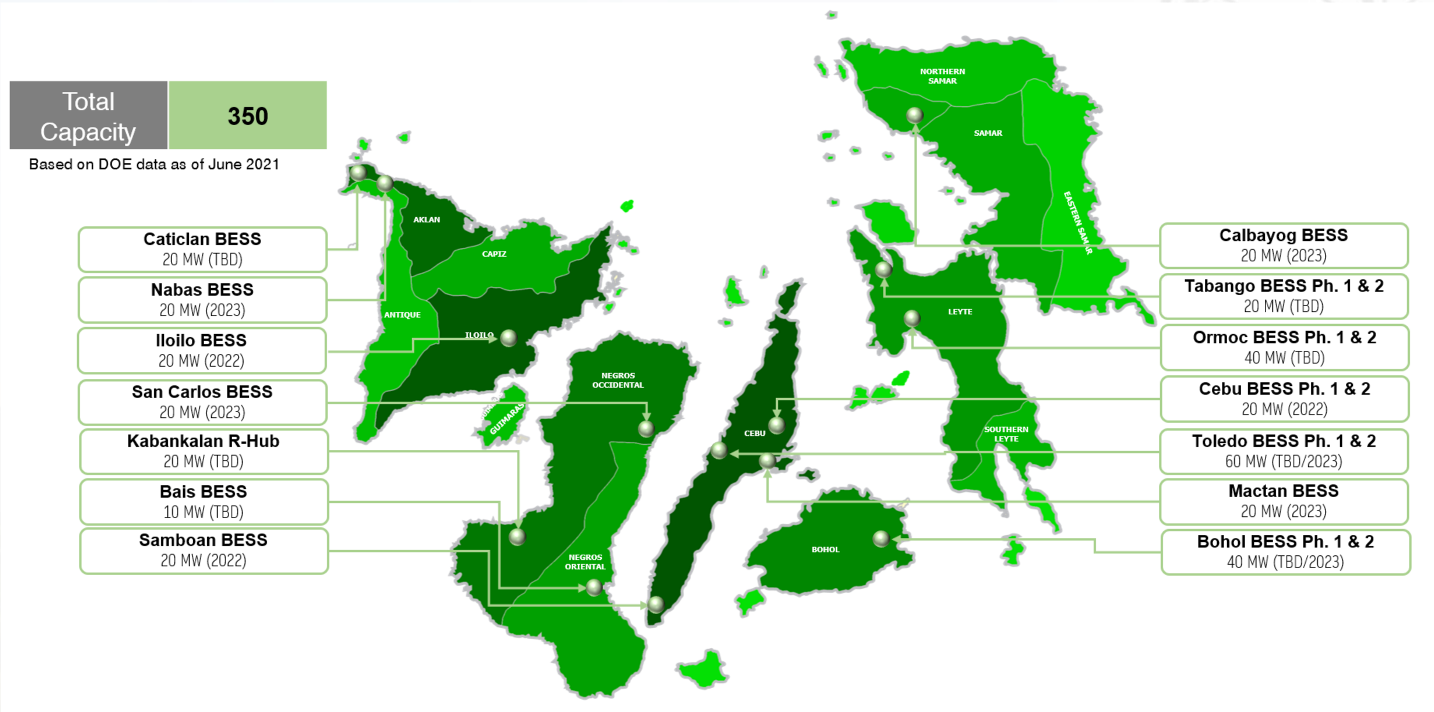


Figure 5.2: Committed BESS in Visayas

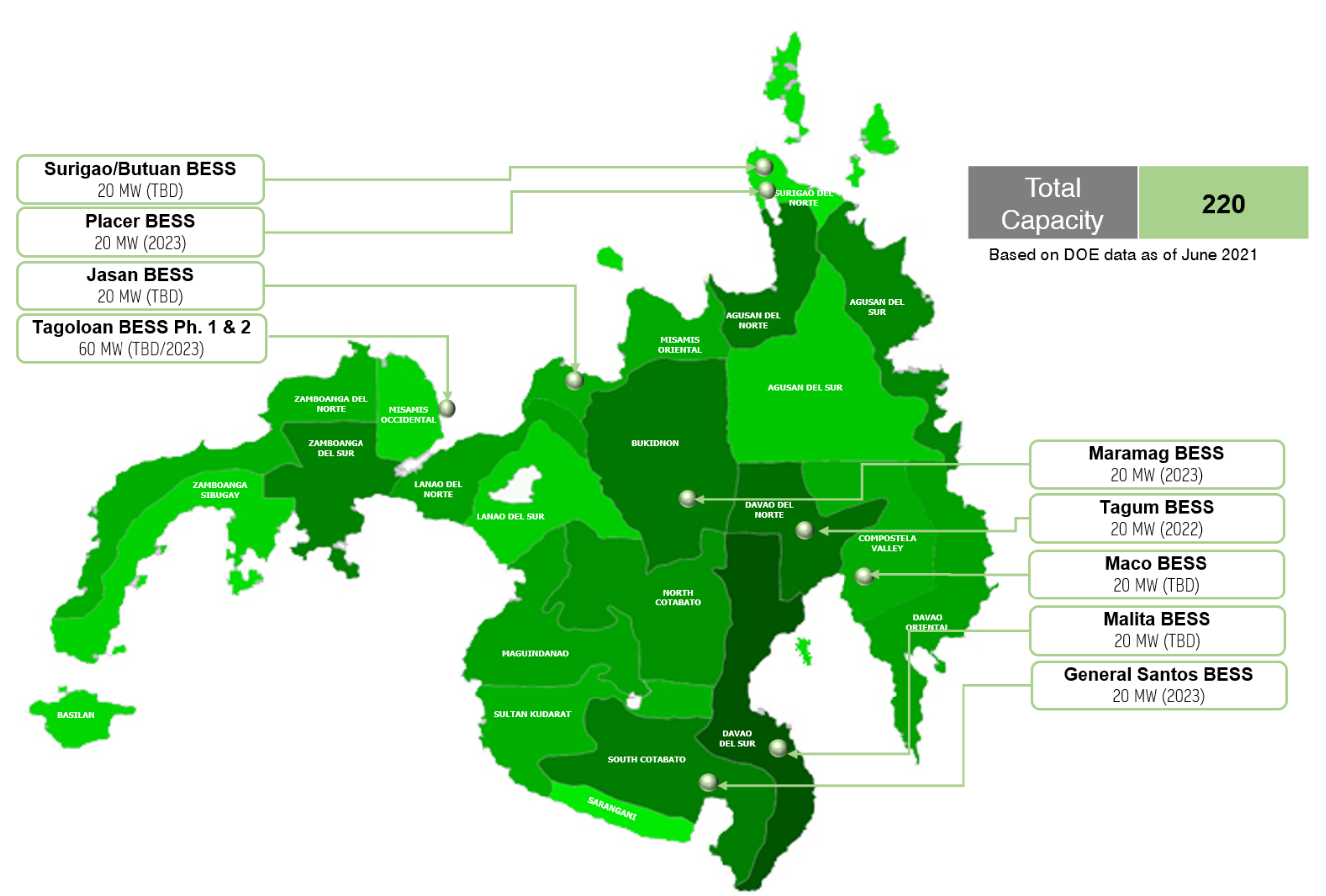


Figure 5.3: Committed BESS in Mindanao

5.2 Adoption of SMART Grid Technologies

There has been continuing research and development over the years toward the commercial realization of the Smart Grid. Nowadays, the adoption of Smart Grid technologies and the development of Smart Grid roadmaps and pilot projects have become a global trend for power utilities.

In the Philippines, with the goal to develop a Smart Grid Policy and Roadmap for the country, the DOE issued on 11 March 2013 Department Circular No. DC2013-03-0003 – Creating an Inter-Agency Steering Committee for the Development and Formulation of a Comprehensive and Holistic Smart Grid Policy Framework and Roadmap for the Philippine Electric Power Industry. This also aims to promote technological innovation, business growth, and job creation thereby enhancing the regional and global competitiveness of the Philippines.

On 6 February 2020, the DOE promulgated the Department Circular DOE DC 2020-02-0003 entitled "Providing a National Smart Grid Policy Framework for the Philippine Electric Power Industry and Roadmap for Distribution Utilities". It envisions the Philippines to reach a level of Smart Grid development capable of, namely:

- Self-healing grid
- Full implementation of Retail Competition and Open Access (RCOA), Renewable Portfolio Standards (RPS), Green Energy Option (GEOP), and Net Metering
- Full Customer Choice
- Demand Response and Peak Load Management
- Optimized Energy Storage Systems (ESS), Energy Management Systems (EMS), and Distribution Energy Resources (DERs) Management Systems; Virtual Power Plant Integration
- Smart Homes and Cities.

Smart Grid is the concept of modernizing the electric grid. The Smart Grid comprises everything related to the electric system in between any point of generation and any point of consumption. Through the addition of Smart Grid technologies, the grid becomes more flexible, interactive, and can provide real-time feedback.[3]

The power flow will change from a unidirectional power flow (from centralized generation via the transmission grids and distribution grids to the customers) to a bidirectional power flow. Furthermore, the way a power system is operated changes from the hierarchical top-down approach to a distributed control. One of the main points about Smart Grid is an increased level of observability and controllability of a complex power system. This can only be achieved by an increased level of information sharing between the individual component and subsystem of the power system. Standardization plays a key role in providing the ability of information sharing which will be required to enable the development of new applications for a future power system.[4]

Over the past 10 years, NGCP has implemented several smart grid initiatives including the upgrade of Supervisory Control and Data Acquisition-Energy Management System (SCADA-EMS), establishment of the Overall Command Center, implementation of Microprocessor-Based Substation Control (MBSC), time synchronization devices, transient fault recorders in major substations, as well as holistic cyber-security enhancement program.

In general, the smart grid strategies for power transmission in the Philippines under the operation of NGCP can be classified into three broad areas: transformation, consolidation, and standardization.

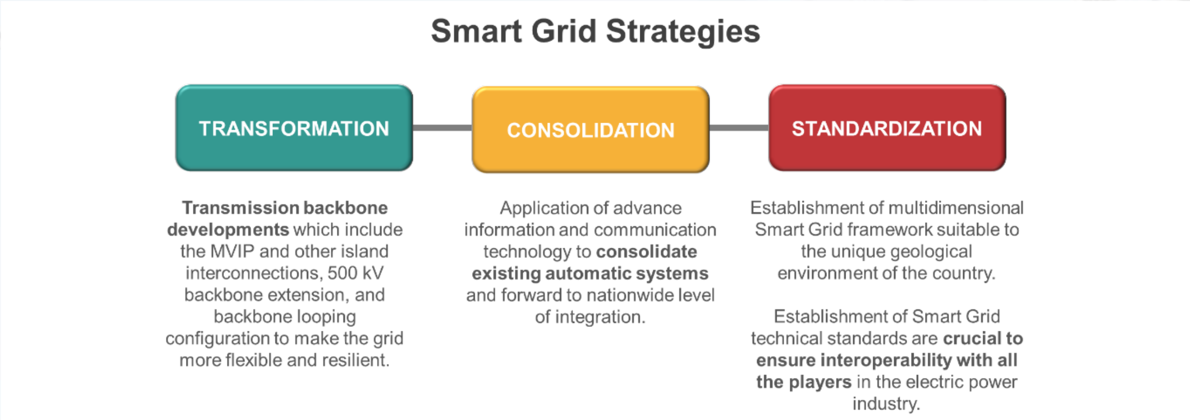


Figure 5.4: Smart Grid Strategies

Moreover, for an increased level of observability and controllability for the power grid, NGCP has a continuing program for further implementation of time synchronization devices, fiber optics to increase bandwidth to support the big data exchange that will be needed by the Smart Grid, SCADA-EMS enhancement, network protection enhancements, establishment of National Control Center and the integration of all monitoring systems of the grid. The Pasay Substation project will be the pilot substation with applied smart grid technology.

5.3 Static Synchronous Compensator

Static Synchronous Compensator (STATCOM) is a kind of Flexible AC Transmission System (FACTS) device with parallel reactive power compensation. The use of FACTS devices in a power system can potentially overcome the limitations of the present mechanically controlled transmission system.

[3] From IEC Definition of Smart Grid
[4] From IEC Smart Grid Standardization Roadmap

STATCOM is being proposed to help in the mitigation of the looming voltage problem in areas with inadequate local generation. The application of STATCOM in the Zamboanga Peninsula is being proposed to augment voltage support in the area.

Installation of STATCOM in the Zamboanga Peninsula

The Zamboanga Peninsula is located at the load end of the radially configured Northwestern Mindanao Area network and most of the customer feeders are radially connected with long lines. Moreover, the absence of local generation makes the Zamboanga Peninsula very fragile and susceptible to low voltage and voltage fluctuation during normal and contingencies. On the other hand, the installation of additional Capacitor in Gen. Santos and Tacurong Substations will provide additional reactive power support in the network to maintain the system voltage within the nominal voltage during normal conditions and contingencies. The installation of reactive power compensating device is proposed based on the following reasons:

- To balance the reactive power in the system and attain better voltage regulation
- To accept the import of power from distant sources
- To achieve rapid and smooth power factor correction preventing voltage spikes

Figure 5.6 shows the proposed installation of reactive power compensating devices in the Zamboanga Peninsula with 200 MVAR STATCOM in the Zamboanga substation and additional Capacitor in Naga and Pitogo substations.

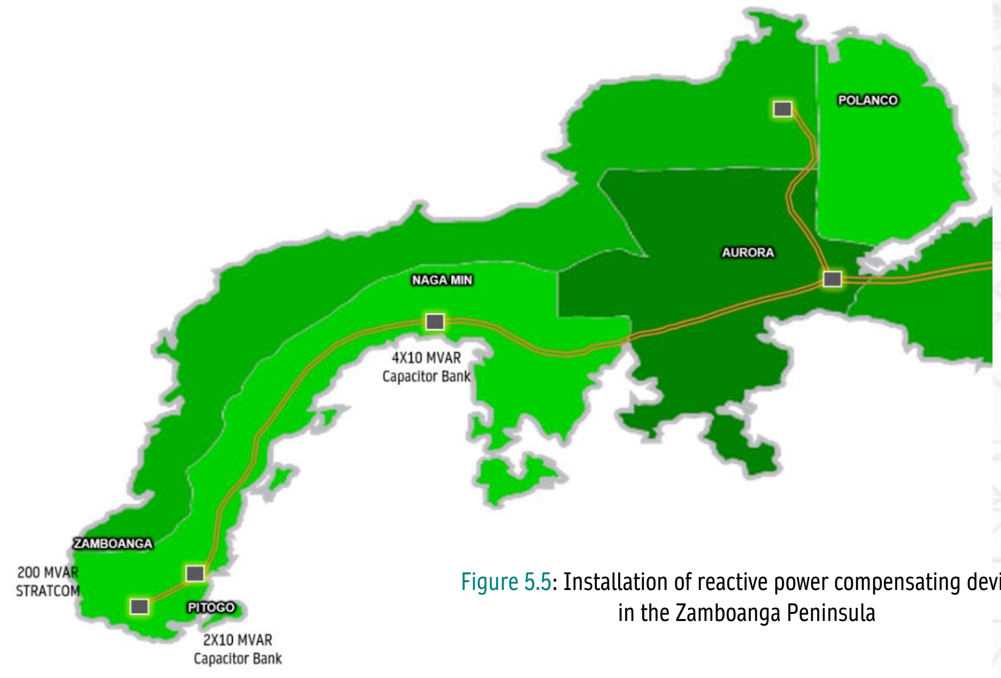


Figure 5.5: Installation of reactive power compensating devices in the Zamboanga Peninsula

5.4 Other Technology

With the continuous advancement in technology, NGCP is open to the adaption of new and developing technologies that have a substantial application to the operations and maintenance of the transmission system. Various pilot studies have been conducted to check the viability of these new technologies. The following sections below will introduce the application in operations and maintenance.

5.4.1 Aerial Drone for Transmission Line Inspection

The pilot application of transmission line drone inspection showed positive results in terms of the reduction of inspection time compared to the manual inspection. The output of the drone was sufficiently enough to identify common line hardware defects in a fast and efficient manner. With this, NGCP plans to procure a more advanced drone to address the limitations encountered that will be used by transmission line groups all over the country.

A total of forty-five (45) drones have been delivered to different Regions. There are twelve (12) drones for North Luzon O&M, two (2) for NCR O&M, seven (7) for South Luzon O&M, ten (10) for Visayas O&M, and fourteen (14) for Mindanao O&M. All the delivered drones have gone through functionality testing and an In-House Training is facilitated for drone pilots flight assessment.

5.4.2 Online Monitoring of HVEs

To remotely check the status of critical transmission assets, NGCP plans to install various online monitoring devices. Transformers and Power Circuit Breakers were chosen as the ideal assets for the online monitoring as these are the most vital equipment in the substation. The following are the online monitoring devices that will be installed:

- Online Bushing Monitor
- Oil/Winding Temperature
- Online Dissolved Gas Analysis

The installation of online monitoring will enable technical personnel far from substations to assess the physical condition of the equipment.

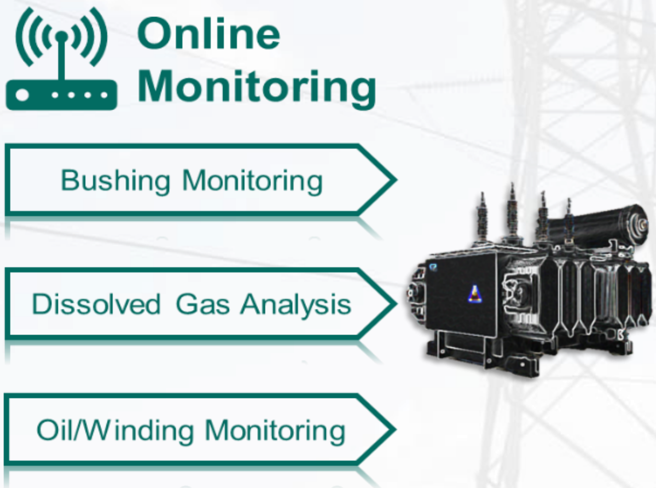


Figure 5.6: Online Monitoring System framework

5.4.3 Central Control and Monitoring System

As part of its continuing drive to uphold its vision, NGCP will be implementing the centralization of operation of its substations. The result of this centralization will be the unmanning of substations across the country. The unmanned substations will be clustered, and the operation management of these clusters will be in one strategically located control center per area. NGCP believes that centralization will improve the operational performance of the substations by simplifying the process coordination and by reducing the manpower involved in monitoring and switching operations.

For the project to be realized, the technical requirements must be met: all substations should be MBSC compliant, all manually operated disconnecting/earthing switches (DS/ES) should be replaced with motorized-operated DS/ES, all manually reset lockouts should be replaced with electrical reset lockout relays, and all connections should be properly wired to prevent misoperation.

Central Control and Monitoring System (CCMS) implementation accomplishments are within the target, where all the Pilot CCMS stations can present through actual Go-Live demonstration showcasing the features of the system in monitoring and controlling of primary and secondary devices of the priority substations in December 2021.

6 Competitive Renewable Energy Zone

6.1 Philippine Competitive Renewable Energy Zone

The general objectives and principles behind the CREZ were adapted from the DOE's Department Circular 2018-09-0027intended to enhance the planning process and implementation of the PEP, PDP, TDP, and National Renewable Energy Program (NREP). The Zone Working Group (ZWG) in partnership with NREL set objectives to:

- Identify candidate RE Zones and low-cost RE potential
- Identify a set of transmission expansion and/or upgrade scenarios that enhance the deliverability of energy originating from candidate RE Zones
- Analyze the economic, operational, environmental, and other cost and benefits
- Specify cost-effective transmission line enhancement

Since traditional transmission planning could not efficiently support the RE Developments mainly due to misalignment in terms of planning and construction time of RE and transmission facilities which could take more than 5 years. Both the transmission development and VRE projects go through circular dilemmas when these two do not meet (see figure 6.1 Circular Dilemma[5]).

The ZWG outlined a CREZ Transmission Planning Process that aims to assess RE resources and connect RE Zones to the power system. The group selected a candidate Competitive RE Zones which are considered as a geographical area that enables the development of profitable, cost-effective, grid-connected RE. These zones were considered to have high-quality RE resources, suitable topography, and land-use designations, and demonstrated interest from developers.

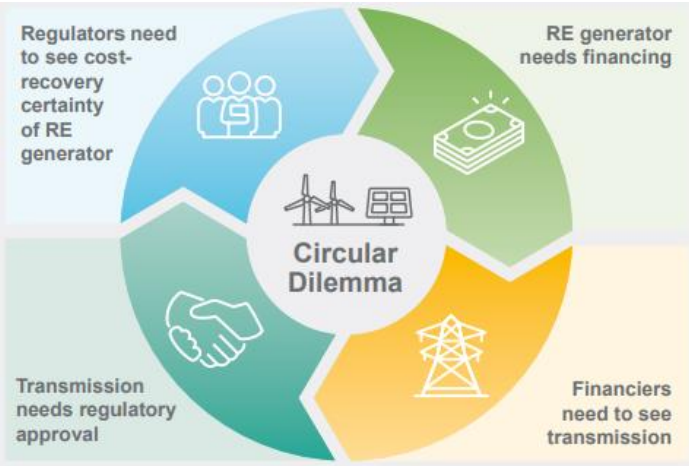


Figure 6.1: Circular Dilemma

For the Philippines CREZ, there are two processes involved outlined. In Phase 1 of the CREZ Process, NREL and USAID supported the development of a vision for the CREZ Process, the ZWG initially identified 34 CREZ study areas and selected and identified a total of 25 CREZ in the Philippines based on the selection criteria (Table 6.1). The development of transmission expansion options that connect these CREZ to the grid, and incorporation of the CREZ process in the TDP. Shown in Figures 6.3 and 6.4 below are the resulting Capacity Mix and Energy Mix by 2040, respectively, when CREZ are included in the system. For Phase 2 of the CREZ Process, NREL and USAID will provide technical support to DOE and ERC to prepare a CREZ implementation plan. TransCo and NGCP are also engaged as key stakeholders of this activity.

[5] Ready for Renewables: Grid Planning and CREZ in the Philippines

Table 6.1
Identified CREZ

CREZ	PV (MW)	WIND (MW)	Associated Transmission Project
LUZON			
L1	985	1,280	▪ San Antonio 500 kV Substation ▪ Baras-San Antonio 500 kV Transmission Line
L2	651	654	▪ Castillejos 230 kV Substation
L3	496	544	▪ Western Luzon 500 kV Backbone
L4	1,046	1,047	▪ Capas 230kV Substation
L5	536	531	▪ Western Luzon 500 kV TL Stage 2 ▪ Palauig 500 kV Substation
L6	101	356	▪ Balaoan-Laoag 500 kV Transmission Line ▪ Northern Luzon 230 kV Loop Transmission Line
L7	926	834	▪ Northern Luzon 230 kV Loop Transmission Line ▪ Kabugao 500 kV Substation
L8	1,070	1,072	▪ Kalinga-Kabugao 500 kV Transmission Line ▪ Kabugao 500 kV Substation
L9	1,109	1,239	▪ Santiago-Nagsaag 500 kV Transmission Line ▪ Kalinga 500 kV Substation ▪ Santiago 500 kV Substation
L10	765	752	▪ Pagbilao 500 kV Substation
L11	811	675	
L12	707	708	▪ Tagkawayan 500 kV Substation
L13	486	502	▪ Luzon Visayas HVDC Bipolar Operation
Mr1	130	386	▪ Batangas-Mindoro Interconnection Project
Mr2	213	324	
Sub-Total	10,032	10,904	
VISAYAS			
B1	506	443	▪ Cebu-Bohol 230 kV Interconnection ▪ Bohol-Leyte 230 kV Interconnection
N1	355	708	▪ CNP 230 kV Backbone
N2	854	551	▪ Cebu-Negros 230 kV Interconnection Line 3 and 4 ▪ Luzon-Visayas HVDC Bipolar Operation ▪ Mindoro-Panay Interconnection Project
Py1	579	693	▪ CNP 230 kV Backbone
Py2	908	676	▪ Negros-Panay 230 kV Interconnection Line 2 ▪ Cebu-Leyte 230 kV Interconnection Lines 3 and 4 ▪ Luzon-Visayas HVDC Bipolar Operation ▪ Mindoro-Panay Interconnection Project ▪ Barotac Viejo-Unidos 230 kV TL Project
S1	513	644	▪ Calbayog-Allen TL Project ▪ Cebu-Leyte 230 kV Interconnection Lines 3 and 4 ▪ Luzon-Visayas HVDC Bipolar Operation ▪ Borongan-Catarman 138 kV TL Project ▪ Babatngon-Borongan 138 kV TL Project ▪ San Isidro-Catarman 138 kV TL Project ▪ Palo-Javier 230 kV TL Project ▪ Cebu-Bohol 230 kV Interconnection ▪ Bohol-Leyte 230 kV Interconnection
Sub-Total	3,715	3,715	
MINDANAO			
Mn2	1	560	• Lala-Naga-Zamboanga 230 kV Transmission Line
Mn4	522	1,263	• Balo-I--Villanueva- Maramag 230 kV Transmission Line
Mn7	705	788	• Eastern Mindanao 230 kV Transmission Line
Mn8	969	1,472	• Kabacan Substation
Sub-Total	2,197	4,083	
Total	15,944	18,702	
PHILIPPINES	34,646		

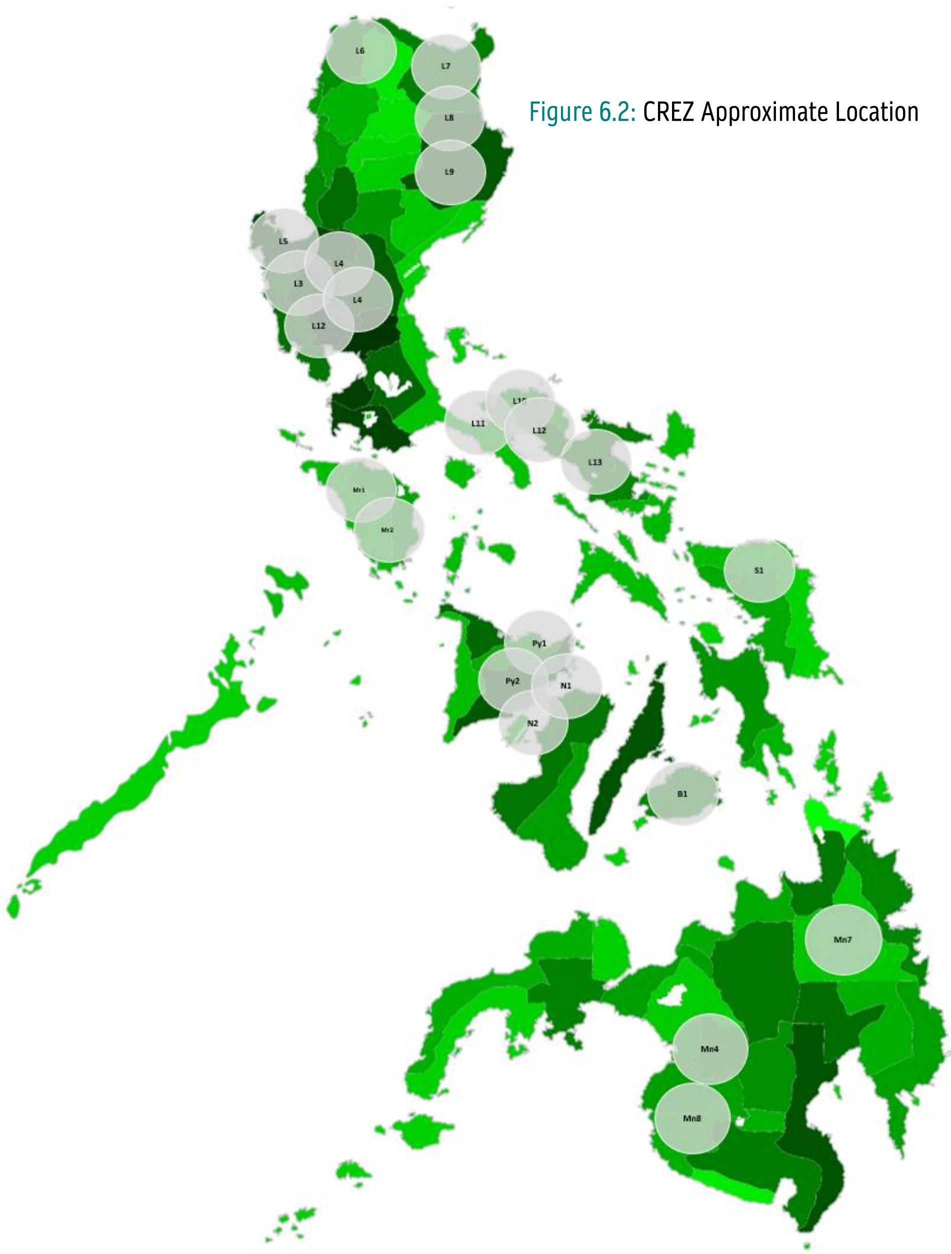


Figure 6.2: CREZ Approximate Location

2040 CAPACITY MIX

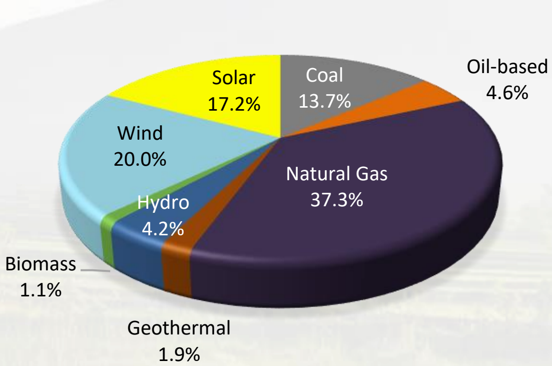


Figure 6.3: 2040 Philippine Capacity Mix with CREZ

2040 ENERGY MIX

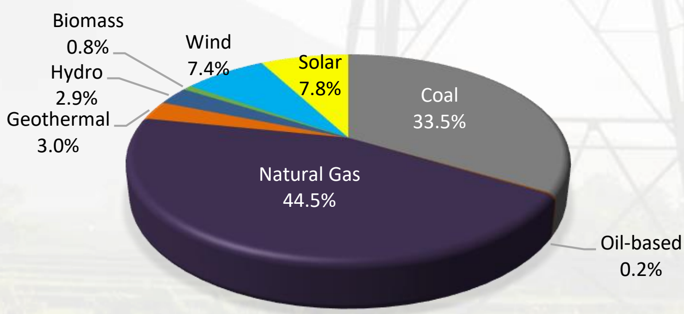


Figure 6.4: 2040 Philippine Energy Mix with CREZ

With the 25 candidate zones identified under CREZ Phase 1 and the generation and transmission planning and modeling undertaken, CREZ Phase 2 is now being undertaken to support the DOE's energy sector goals through the following activities: CREZ implementation support; enhanced load modeling and forecasting for long-term power system planning; and improved energy storage modeling and considerations. CREZ Phase 2 supports the vision to attain sustainable, stable, secure, sufficient, accessible, and affordable energy for the country.

CREZ implementation support's main goal is to develop a procedural framework wherein ERC can make a just and reasonable balance between national energy policy and costs paid by the electricity end-users for transmission expansion for the CREZ process.

Enhanced load modeling and forecasting for long-term power sector planning – these activities are based on scenario planning, which considers possible disruptions to the power sector (such as COVID-19 or declining natural gas reserves) so that new infrastructure investments will remain useful. Outputs of the scenario process provide inputs to the production cost modeling, capacity expansion modeling, and power flow modeling that can also help inform strategic energy policies. This activity focuses on translating the scenarios considerations for energy system modeling that can support long-term power system planning.

Improved energy storage modeling, and considerations – this activity is divided into two distinct technical activities designed to evaluate potential energy storage deployment and to understand the operational impacts and potential cost savings of energy storage for bulk power system applications. It will help inform decisions on the location, timing, type, and capacity of energy storage could be a cost-effective alternative to the conventional generator and transmission investments. It will also review and include international best practices to help evaluate and benchmark power system flexibility (supply and demand balance) status with other countries that have significant VRE. Furthermore, this activity focuses on enhancing the existing power system modeling tools of the DOE and NGCP to assess various technical configurations and dispatch strategies for grid-scale energy storage systems. The goal is to develop capacity at the DOE and NGCP to assess energy storage opportunities in long-term capacity expansion modeling activities and operational models. The operational impacts and potential savings from bulk power energy storage will also be assessed.

7 69 kV Facilities

7.1 Background

The EPIRA provides that the 69 kV facilities or the subtransmission assets shall be operated and maintained by TransCo until their divestment to qualified distribution utilities which are able to take over the responsibility for operating, maintaining, upgrading, and expanding said assets. TransCo shall negotiate with and thereafter transfer such functions, assets, and associated liabilities to the qualified distribution utility or utilities connected to such subtransmission facilities not later than two (2) years from the effectivity of the EPIRA or the start of open access, whichever comes earlier.

The ERC also issued the Guidelines to the Sale and Transfer of the TransCo's Subtransmission Assets and the Franchising of Qualified Consortiums on October 17, 2003 to establish the approval process of the sale and transfer of subtransmission assets to distribution utilities. This is later amended by ERC Resolution no. 15, series of 2011 with objectives to:

- Ensure continued quality, reliability, security, and affordability of electric service to end-users
- Ensure the transparent and reasonable prices of electric service in a regime of free and fair competition and to achieve greater operational and economic efficiency
- Enhance the inflow of private capital and broaden the ownership base of subtransmission assets
- Provide for the orderly and transparent sale and transfer of subtransmission assets of TransCo or NGCP to qualified buyers

Further, the Final Determination issued by the ERC for the 2nd Regulatory Period (2006 – 2010) for the TransCo states that:

"The ERC does not anticipate that TransCo will be financing anymore subtransmission projects in 3-4 years time. Considering that the cost of these sub transmission assets shall be solely borne by connected customers, who shall eventually acquire these assets, projects such as these shall already be undertaken by the concerned customers requiring installation/upgrade."

Thus, NGCP highly encourages the distribution utilities to invest and focus on subtransmission assets' future development.

7.2 Age Distribution of 69 kV Lines Nationwide

The majority of NGCP-operated 69 kV Lines nationwide are composed of Wood Pole Structures that already exceeded its 25-year asset life, as seen in Figure 7.1. Although these assets are part of the Wood Pole Replacement Program of NGCP, it is still highly encouraged that Distribution Utilities take the responsibility to operate, maintain, upgrade, and expand these assets.

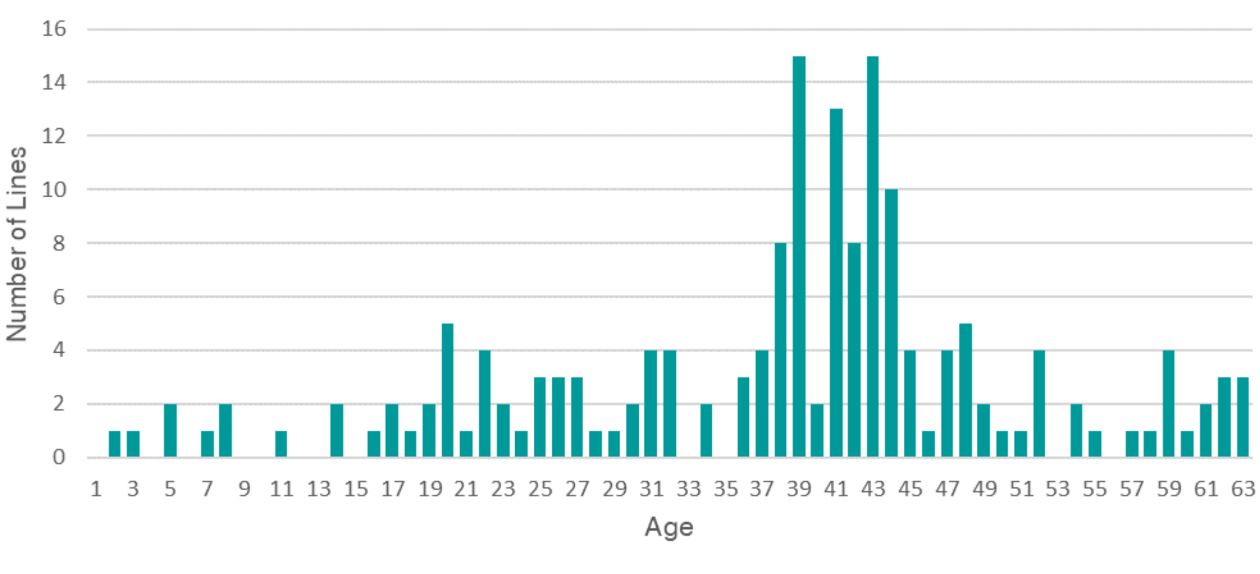


Figure 7.1: Age Distribution/Profile of NGCP-operated 69 kV Lines Nationwide (August 2021)

7.3 Way Forward

As a way forward, short and long-term plans by NGCP and the DU need to be realized to comply with the EPIRA and transmission regulations set by the ERC.

Short-Term

- Co-location of NGCP-operated 69kV capacitor at DU load-end substations
- Implementation of new 69 kV lines or reconductoring of existing lines
- Installation of RTU at load-end substations to support the market operation
- Relocation of metering location pursuant to ERC Resolution 23, S. 2016

Long-term

- NGCP to develop new 230/69 kV or 138/69 kV substations to serve as an alternate source of the DU
- For all new load-end substations to be developed by DU – capacitor installation to be considered or at least with space provision
- Encourage the distribution utilities to implement additional outgoing 69 kV lines from existing NGCP 69 kV substations

8 Luzon Transmission Outlook

The DOE list shows that there are many committed and indicative power plant projects in Luzon Grid, which can well support the increasing demand for the next 10 years. The incoming large capacity coal-fired power plants, as well as natural gas-fired power plants, are mainly concentrated in Batangas, Quezon, Bataan, and Zambales, which would result in huge excess power in these areas. Since the remaining transmission capacity of the existing facilities is also very limited for the grid integration of additional bulk generation, the development of the Luzon Grid is geared towards the implementation of new 500 kV transmission facilities that would allow power export from generation sites going to the load center.

With the increasing delivery of bulk power to the 500 kV system, the two existing 500 kV substations located at San Jose del Monte City in Bulacan and Dasmariñas in Cavite that serve as the only Extra High Voltage (EHV) drawdown facilities supporting the Metro Manila loads, will become critical nodes in the grid. The capacity expansion and space limitations in these substations could result in grid congestion unless new 500 kV drawdown substations will be developed. In the TDP, new 500 kV substations are being proposed with the priority site in Taguig City. Being close to the load center, Taguig is a strategic location, but it has major challenges in the construction of its associated 500 kV transmission line that traverses the portion of Laguna Lake.

Along with the support given to grid integration of new power plants, NGCP is paying special attention to strengthening the transmission facilities in Metro Manila, which is the country's load center. The existing 230 kV transmission line traversing from Quezon City to Muntinlupa City is a very critical line given its heavy loading condition and single-circuit configuration. Such conditions pose a great risk both on power quality and supply reliability in the area. In addition, the existing 230/115 kV substations in Metro Manila are heavily loaded already and most have capacity expansion limitations, thus, the development of new substations is very important in supporting load growth in the long term.

Being the center of the nation's economy, the grid reinforcement projects that ensure the long-term adequacy, reliability, and security of power supply in Metro Manila can be regarded as "projects of national significance". As can already be expected in a highly urbanized area, securing the right-of-way for new transmission facilities is increasingly becoming difficult. It is therefore important to immediately start its implementation to realize these important transmission development plans and it should be coupled with support from the local and national government. Aside from Taguig EHV, the proposed new facilities include Antipolo, Pasay, and Navotas Substations which would also involve the implementation of associated 230 kV transmission lines.

After Metro Manila, together with the industrialized areas of Cavite and Laguna, the province of Pampanga is expected as the next major load growth area. In the long-term, new 230 kV backbone and new 230/69 kV substations would be needed for Porac and Clark to support the load increase in the coming years. Other provinces, on the other hand, will be supported by the installation of additional transformers at existing substations or the development of new substations and reinforcements of the 69 kV transmission lines.

To help improve the system reliability and to maintain the power quality within the grid code-prescribed standards, included in the development plans are the implementation of transmission looping configurations for the 500 kV system, upgrading of old transmission lines and substations as well as installation of reactive power compensation equipment at various substations.

8.1 Transmission Outlook for 2025

The major transmission projects covering the years 2022-2025 aim to support the adequacy and reliability of power supply to Metro Manila, which is the country's center of commerce and trade. These can be attained by the seamless delivery of existing and new generation capacities from the identified generation hubs going to Metro Manila through adequate and reliable transmission facilities.

To accommodate generation capacities in Bataan and Zambales Area, the Mariveles–Hermosa–San Jose 500 kV Transmission Line Projects and Western 500 kV Backbone will be developed. In Batangas, the development of the Tuy 500 kV Substation (Stage 1) and Pinamucan 500 kV Substation will accommodate around 3,000 MW from coal and LNG generation capacities. Meanwhile, the Pagbilao–Tayabas 500 kV Transmission Line Project will accommodate an additional 1,200 MW from coal generation capacity in Quezon Province.

To meet the forecasted load growth in Metro Manila, three (3) major 500/230 kV drawdown substations will be developed around Metro Manila. These will be in Taguig City, Marilao Bulacan, and Silang Cavite. These will be also complemented by the development of additional 230/115 kV drawdown substations in Antipolo, Navotas, and Pasay.

The reliability of power transmission delivery to Metro Manila will be addressed through the development of new transmission corridors in Metro Manila such as the Silang–Taguig 500 kV Transmission Line, Taguig–Taytay 230 kV Transmission Line.

Outside Metro Manila, several drawdown substations will also be developed to address the forecasted load growth. These are the Lal-lo 230 kV Substation (Tuguegarao – Lal-lo 230 kV Transmission Line Project) in Cagayan, Pinili 230 kV Substation in Ilocos Norte, San Simon and Porac 230 kV Substations in Pampanga, Capas 230 kV Substation in Tarlac, Kawit 230 kV Substation in Cavite, Sampaloc 230 kV Substation in Nueva Ecija, Castillejos 230 kV Substation in Zambales, Tanauan 230 kV Substation in Batangas, and Abuyog 230 kV Substation in Sorsogon. In addition to these substations, new 69 kV transmission facilities will also be developed.

For renewable energy developments particularly in the northern part of Luzon, the implementation of the Northern Luzon 230 kV Loop will provide the needed transmission capacity augmentation.

Shown in Table 8.1 is the list of Luzon transmission projects for the period 2022-2025.

Table 8.1 Luzon Transmission Outlook for 2025

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Project Components	ETC
500 kV	Western Luzon 500 kV Backbone (Stage 1) ERC-approved	Generation Entry *Substation:* ▪ New Hermosa 230 kV SS, 4-230 kV PCB *Transmission Line:* ▪ Castillejos–Hermosa 500 kV TL, ST-DC, 4-410 mm2 TACSR/AS, 34 km Project Cost: 2,631 Million Pesos Location: Bataan, Zambales	Oct 2022
	Hermosa–San Jose 500 kV TL ERC-approved	Generation Entry *Substation:* ▪ New Hermosa 500 kV SS, 2x1,000 MVA, 500/230-13.8 kV Transformers, 10-500 kV PCB, and 12-230 kV PCB; 2x60 MVAR 500 kV Shunt Reactors, 1x90 MVAR 500 kV Line Reactor; and 2x100 MVAR, 230 kV Capacitor *Transmission Line:* ▪ Hermosa-San Jose 500 kV TL, ST-DC, 4-410 mm2 TACSR/AS, 82.41 km ▪ New Hermosa–Old Hermosa Tie Line, SP-DC, 4-795 MCM ACSR, 0.5 km Project Cost: 10,348 Million Pesos Location: Bataan, Bulacan	Dec 2022

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Project Components	ETC
	Mariveles–Hermosa 500 kV TL ERC-approved	Generation Entry *Substation:* ▪ Mariveles 500 kV Switching Station (New), 12-500 kV PCB ▪ Hermosa 500 kV SS, 2-500 kV PCB *Transmission Line:* ▪ Mariveles–Hermosa 500 kV TL, ST-DC, 4-410 mm2 TACSR/AS, 49.2 km ▪ Mariveles–Mariveles (GN Power): Power Supply 13.8 kV TL, SP-DC, 1-2/0 MCM ACSR, 3.28 km Project Cost: 6,057 Million Pesos Location: Bataan	Dec 2022
	Bataan–Cavite TL Feasibility Study ERC-approved	Generation Entry Study Components: ▪ Power System Study ▪ Feasibility Study Project Cost: 194 Million Pesos Location: Bataan, Cavite	Jun 2023
	Pagbilao–Tayabas 500 kV TL Filed to ERC	Generation Entry *Substation:* ▪ Pagbilao 500 kV SS, 4-500 kV PCB 4-230 kV PCB, 1x30 MVAR, 500 kV Line Reactor *Transmission Line:* ▪ Pagbilao–Tayabas 500 kV TL, ST-DC, 4-795 MCM ACSR/AS, 21 km ▪ Naga Line Extension 230 kV TL, ST-DC, 4-795 MCM ACSR/AS, 1.5 km Project Cost: 3,375 Million Pesos Location: Quezon Province	Mar 2025
	Western Luzon 500 kV Backbone (Stage 2) Filed to ERC	System Reliability *Substation:* ▪ Castillejos 500 kV SS, 2x1,000 MVA, 500/230-13.8 kV Transformers, 2x90 MVAR, 500 kV Shunt Reactor, 2x60 MVAR, 500 kV Line Reaactor, 12-500 kV PCB ▪ Castillejos 230 kV SS, 2x200 MVAR, 230 kV Shunt Capacitor, 4-230 kV PCB ▪ Bolo 500 kV SS, 6-500 kV PCB; 8-230 kV PCB ▪ Hermosa 500 kV SS, 4-500 kV PCB *Transmission Line:* ▪ Castillejos–Bolo 500 kV TL, ST-DC, 4-410 mm2 TACSR, Castillejos–Masinloc: 84 km, Masinloc–Bolo: 90 km. Project Cost: 18,965 Million Pesos Location: Pangasinan, Zambales	Dec 2025
500 kV / 350 kV HVDC	Luzon–Visayas HVDC Bipolar Operation	▪ The project will provide an additional 440 MW transfer capacity between Luzon and Visayas. It involves the construction of Naga 500 kV SS with 2x750 MVA, 500/230-13.8 kV Power Transformers as well as upgrading of the Naga and Ormoc Converter/Inverter Stations in order to provide an additional transfer capacity between Luzon and Visayas. Upgrading of the 230 kV network between Cebu and Leyte is a requirement in order to fully utilize the transfer capacity of the Luzon–Visayas HVDC System. ▪ Location: Camarines Sur and Leyte	Dec 2025
230 kV	San Manuel–Nagsaag 230 kV TL ERC-approved	System Reliability *Substation:* ▪ Nagsaag 500 kV SS (Expansion), 1x600 MVA, 500/230-13.8 kV Transformers, 2-500 kV and 8-230 kV PCB ▪ San Manuel 230 kV SS (Expansion), 3-230 kV PCB	Dec 2022

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Project Components	ETC
		Transmission Line: ▪ San Manuel–Nagsaag 230 kV Tie-Line Upgrading, SP-DC, 2-410 mm2 TACSR/AS, 0.6 km ▪ Binga 230 kV TL Extension, SP-DC, 2-795 MCM ACSR/AS, 0.8 km. Project Cost: 1,874 Million Pesos Location: Pangasinan	
	Relocation of Steel Poles along Hermosa–Duhat 230 kV TL ERC-approved	System Reliability *Transmission Line:* ▪ Hermosa–Duhat 230 kV TL, 230 kV, SP-SC, 2-795 MCM, 20 steel poles Project Cost: 222 Million Pesos Location: Bataan	Dec 2022
	Tuguegarao–Lal-lo 230 kV TL ERC-approved	Power Quality and Load Growth *Substation:* ▪ Lal-lo 230 kV SS, 2x100 MVA 230/69-13.8 kV Transformers, 6-230 kV PCB, 8-69 kV PCB ▪ Tuguegarao 230 kV SS, 3-230 kV PCB. *Transmission Line:* ▪ Tuguegarao–Lal-lo 230 kV TL, ST-DC, 1-795 MCM ACSR, 64 km. Project Cost: 2,082 Million Pesos Location: Cagayan	Mar 2023
	Ambuklao–Binga 230 kV TL Upgrading ERC-approved	System Reliability *Substation:* ▪ Ambuklao 230 kV SS, 7-230 kV PCB *Transmission Line:* ▪ Ambuklao–Binga 230 kV TL, ST/SP-DC, 2-410mm2 TACSR, 11 km. Project Cost: 1,021 Million Pesos Location: Benguet	Dec 2023
	Binga–San Manuel 230 kV TL Stage 1 & 2 ERC-approved	System Reliability *Substation:* ▪ San Manuel 230 kV SS, 2-230 kV PCB ▪ Binga 230 kV SS, 50 MVA 230/69-13.8 kV Transformer, 14-230 kV PCB, 2-69 kV PCB *Transmission Line:* ▪ Binga–San Manuel 230 kV TL, ST-DC, 2-410 mm2 TACSR, 40 km. Project Cost: 3,633 Million Pesos Location: Benguet	Stage 1 Feb 2024 Stage 2 Jul 2023
	Santiago–Magat 230 kV Transmission Line Reconductoring Project	Generation Entry Substation: ▪ Santiago 230 kV SS, 3-230 kV PCB ▪ Magat 230 kV SS, 6-230 kV PCB Transmission Line: ▪ Santiago–Magat 230 kV TL, ST-DC, 1-410 mm2 STACIR, 14.47 km Project Cost: 873 Million Pesos Location: Isabela	Oct 2024
	Taguig–Taytay 230 kV TL Filed to ERC	System Reliability *Substation:* ▪ Taytay 230 kV SS Expansion, 6-230 kV PCB *Transmission Line:* ▪ Taguig–Taytay 230 kV TL, SP-DC, 2-610 mm2 TACSR/AS, 10 km.	Dec 2024

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Project Components	ETC
		Project Cost: 3,256 Million Pesos Location: Rizal, Metro Manila	
115 kV	San Jose–Angat 115 kV Line Upgrading ERC-approved	System Reliability *Substation:* ▪ San Jose 115 kV SS, 2-115 kV PCB *Transmission Line:* ▪ San Jose-Angat 115 kV Tl, ST-DC, 2-795 MCM ACSR, 18 km. Project Cost: 307 Million Pesos Location: Bulacan	Jul 2022
69 kV	Clark–Mabiga 69 kV TL ERC-approved	Load Growth *Substation:* ▪ Clark 230 kV SS (Expansion), 1x300 MVA 230/69-13.8 kV Transformer, 1-230 kV PCBand 3-69 kV PCB *Transmission Line:* ▪ Clark-Mabiga 69 kV TL, 1-410mm2 TACSR/AS, SP-DC, 6 km. Project Cost: 549 Million Pesos Location: Pampanga	Jul 2023
	Nagsaag–Tumana 69 kV TL Filed to ERC	Load Growth *Transmission Line:* ▪ Nagsaag–Tumana 69 kV TL, 69 kV, ST/SP-DC1, 1-795 MCM ACSR, 23 km. Project Cost: 588 Million Pesos Location: Pangasinan	Sep 2023
	Eastern Albay 69 kV Line Stage 2 ERC-approved	System Reliability *Substation:* ▪ Sto. Domingo SS, 1-69 kV PCB *Transmission Line:* ▪ Sto. Domingo–Tabaco 69 kV TL, ST-SC, 1-336.4 MCM ACSR, 18 km. Project Cost: 382 Million Pesos Location: Albay	Dec 2023
	Concepcion–Sta. Ignacia 69 kV TL Filed to ERC	Load Growth *Transmission Line:* ▪ Concepcion–Sta. Ignacia 69 kV TL, 69 kV, SP-DC, 1-795 MCM ACSR, 33 km. Project Cost: 896 Million Pesos Location: Tarlac	Phase 1 Jun 2023 Phase 2 Dec 2024
	Daraga–Bitano 69 kV TL Filed to ERC	Load Growth *Substation:* ▪ Daraga 69 kV SS, 2-69 kV PCB *Transmission Line:* ▪ Daraga–Bitano 69 kV TL, SP-SC, 1-795 MCM ACSR, 6 km Project Cost: 201 Million Pesos Location: Albay	Dec 2024
	La Trinidad–Calot 69 kV TL ERC-approved	System Reliability *Substation:* ▪ La Trinidad 69 kV S/Y Expansion, 1-69 kV PCB Transmission Line: ▪ La Trinidad–Calot 69 kV TL, ST/SP-DC, 1-795 MCM ACSR/AS, 21 km ▪ 69 kV Line Tapping Points, 5-72.5 kV, 3-way Air Break Switch. Project Cost: 410 Million Pesos Location: Benguet	Dec 2024

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Project Components	ETC
	Tuguegarao–Enrile 69 kV TL Filed to ERC	Load Growth *Substation:* ▪ Tuguegarao 69 kV SS, 2-69 kV PCB *Transmission Line:* ▪ Tuguegarao–Enrile 69 kV TL, 1-795 MCM ACSR, SP-SC, 30 km. Project Cost: 734 Million Pesos Location: Tuguegarao	Oct 2025

SUBSTATION PROJECTS			
Voltage	Project Name	Project Driver and Components	ETC
500kV	Pagbilao 500 kV SS ERC-approved	Generation Entry *Substation:* ▪ Pagbilao 500 kV SS, 3x1,000 MVA, 500/230 kV Transformers, 8-500 kV PCB, and 11-230 kV PCB ▪ Tayabas 500 kV SS Expansion, 3-500 kV PCB and 1-230 kV PCB *Transmission Line:* ▪ Swinging of Naga–Tayabas EHV Line at Tayabas 500 kV SS ST/SP-DC, 4-795 MCM ACSR, 0.5 km ▪ Naga–Tayabas Line Extension to Pagbilao 500 kV SS, 500 kV, ST-DC, 4-795 MCM ACSR, 0.5 km ▪ Pagbilao–Tayabas Line Extension to Pagbilao 500 kV SS, 230 kV, ST-DC, 4-795 MCM ACSR, 2.75 km; Pagbilao–Tayabas connection to Naga-Tayabas, 230 kV, ST-DC, 4-795 MCM ACSR, 2.75 km. Project Cost: 4,016 Million Pesos Location: Quezon	Jun 2022
	Tuy 500/230 kV SS (Stage 1) Filed to ERC	Generation Entry *Substation:* ▪ Tuy SS, 1x100 MVA,500/230-69 kV Transformer,12-230 kV PCB, 3-69 kV PCB, ▪ Dasmariñas SS Expansion, 2-230 kV PCB ▪ Sta. Rita Switchyard Expansion, Line Protection and Communication System ▪ Calaca SS, Replacement of Current Transformers and Busworks *Transmission Line:* ▪ Tuy–Silang (initially 230 kV-energized), 500 kV, ST-DC, 4-410 mm2 TACSR, 40 km, ▪ Silang–Dasmariñas, 230 kV, ST-DC, 4-410 mm2 TACSR/AS, 8.6 km ▪ Sta. Rita 230 kV Line Extension, 230 kV, ST-DC, 4-795 MCM ACSR/AS, 10 km. ▪ Calatagan/Nasugbu Line Extension, 69 kV, SP-DC, 1-795 MCM ACSR/AS, 3.5 km. Project Cost: 8,164 Million Pesos Location: Batangas, Cavite	Jun 2023
	Taguig 500 kV SS ERC-approved	Load Growth *Substation:* ▪ Taguig 500 kV SS, 2x1,000 MVA, 500/230-13.8 kV Transformers, 1x90 MVAR, 500 kV Shunt Reactor, 3x100 MVAR, 230 kV Capacitor, 8-500 kV PCB (GIS), 10-230 kV PCB (GIS) *Transmission Line*: ▪ Taguig Cut-in to San Jose–Tayabas 500 kV TL, 500 kV, ST-DC, 4-795 MCM ACSR/AS, 37 km ▪ Taguig bus-in to Muntinlupa–Paco 230 kV TL, 230 kV, SP-DC1, 2-410 mm2 TACSR/AS, 2x2.4 km Project Cost: 9,529 Million Pesos Location: Taguig	Feb 2024

SUBSTATION PROJECTS			
Voltage	Project Name	Project Driver and Components	ETC
	Marilao 500 kV SS Filed to ERC	Load Growth *Substation:* ▪ Marilao 500 kV SS, 2x1,000 MVA, 500/230-13.8 kV Transformers, 16-500 kV PCB, 12-230 kV PCB, 2x90 MVAR, 500 kV Line Reaactor, 2x100 MVAR Shunt Capacitor *Transmission Line:* ▪ Nagsaag–San Jose 500 kV Line Extension to Marilao 500 kV SS, ST-DC, 4-795 MCM ACSR/AS, 8.7 km ▪ Marilao Bus-in to Hermosa–San Jose 500 kV Line, ST-DC, 4-410mm2 TACSR/AS, 1.5 km ▪ Marilao–Duhat 230 kV TL, SP-DC, 2-795 MCM ACSR/AS, 3.2 km ▪ Navotas Line Extension to Marilao 230 kV TL, SP-DC, 4-795 MCM ACSR/AS, 3.6 km Project Cost: 6,060 Million Pesos Location: Bulacan	Phase 1 Jun 2023 Phase 2 Sep 2024
	Pinamucan 500 kV SS Filed to ERC	Generation Entry *Substation:* ▪ Pinamucan 500 kV SS, 2x1,000 MVA, 500/230 kV Transformers, 12-500 kV PCB ▪ Pinamucan 230 kV SS, 2x100 MVA 230/69 kV Transformers, 10-230 kV PCB, 4-69 kV PCB *Transmission Line:* ▪ Pinamucan 500 kV bus-in TL, ST-DC, 4-795 MCM ACSR, 1 km ▪ Pinamucan–Taysan 69 kV TL, SP-DC, 1-795 MCM ACSR, 10 km Project Cost: 4,117 Million Pesos Location: Batangas	Dec 2024
	Palauig 500 kV SS	Generation Enry *Substation:* ▪ Palauig 500 kV SS, 2x1000 MVA, 500/230 kV Power Transformers and accessories, 16-500 kV PCBs and associated equipment, 10-230 kV PCBs and associated equipment. ▪ Botolan 230 kV SS Expansion, 2-230 kV PCBs and associated equipment. *Transmission Line:* ▪ Palauig 'bus-in' along Castillejos–Bolo 500 kV Transmission Line, ST-DC, 4-410 mm2 TACSR, 2x1 km. ▪ Botolan–Palauig 230 kV Transmission Line, ST-DC, 4-795 MCM ACSR, 18.3 km Project Cost: 9,672 Million Pesos Location: Zambales	Dec 2025
230 kV	Antipolo 230 kV SS ERC-approved	Load Growth *Substation:* ▪ Antipolo 230 kV SS, 12-230 kV PCB, 2x100 MVAR 230 kV Capacitor *Transmission Line:* ▪ Bus-in point along San Jose–Taytay 230 kV TL, ST-DC, 4-795 MCM ACSR, 2-0.75 km. Project Cost: 1,153 Million Pesos Location: Rizal	Jun 2022
	Tiwi SS Upgrading ERC-approved	System Reliability *Substation:* ▪ Tiwi A 230 kV SS, 4-230 kV PCB ▪ Tiwi C 230 kV SS, 1x50 MVA, 230/69-13.8 kV Transformer, 12-230 kV PCB and 3-69 kV PCB	Dec 2022

SUBSTATION PROJECTS			
Voltage	Project Name	Project Driver and Components	ETC
		Transmission Line: ▪ Daraga/Naga–Tiwi C Line Extension 230 kV TL, ST-DC, 1-795 MCM ACSR/AS, 0.7 km ▪ Tiwi A–Tiwi C Line Extension 230 kV TL, ST-DC, 1-795 MCM ACSR/AS, 0.3 km ▪ Malinao/Ligao–Tiwi C Line Extension 69 kV, SP-SC, 1-336.4 MCM ACSR/AS, 1.5 km Project Cost: 1,467 Million Pesos Location: Albay	
	Malaya 230 kV Collector Station	Generation Entry *Substation:* ▪ Malaya 230 kV SS, 3-230 kV PCB ▪ Malaya 230 kV Collector Station, 17-230 kV PCB *Transmission Line:* ▪ Bus-in connection along Malaya–Lumban SS 230 kV TL, 2-2500 mm2 XLPE, 1 km. Project Cost: 1,218 Million Pesos Location: Rizal	Dec 2022
	North Luzon 230 kV SS Upgrading ERC-approved	System Reliability Stage 1: *Substation:* ▪ Bauang 230 kV SS (Replacement), 1x100 MVA 230/115/69-13.8 kV Transformer, 7-230 kV PCB ▪ Gamu 230 kV SS, 1x100 MVA Transformer,10-230 kV PCB, 2-69 kV PCB ▪ Bayombong 230 kV SS, 1x100 MVA Transformer, 5-230 kV PCB, 3-69 kV PCB ▪ Hermosa 69 kV SS, 10-69 kV PCB ▪ Malaya 230 kV SS (Expansion), 1x300 MVA, 230/115-13.8 kV Transformer, 9-230 kV PCB, 1-115 kV PCB ▪ Quezon 230 kV SS (Expansion), 3-230 kV PCB ▪ San Jose 230 kV SS (Expansion), 1x300 MVA, 230/115-13.8 kV Transformer, 1-230 kV PCB, 7-115 kV PCB ▪ Doña Imelda SS, 1-115 kV PCB and neutral grounding transformer Stage 2: *Substation:* Bacnotan 230 kV SS (Expansion), 1x100 MVA 230/69-13.8 kV Transformer, 1-230 kV PCB, 6-69 kV PCB ▪ Balingueo 230 kV SS (Expansion), 1x100 MVA 230/69-13.8 kV Transformer, 5-230 kV PCB, 4-69 kV PCB ▪ Labrador 230 kV Ss (Replacement), 1x100 MVA 230/69-13.8 kV Transformer, 5-230 kV PCB, 2-69 kV PCB ▪ San Rafael 230 kV Ss (Expansion), 1x300 MVA 230/69-13.8 kV Transformer, 1-230 kV PCB, 2-69 kV PCB Project Cost: 5,778 Million Pesos Location: La Union, Isabela, Nueva Vizcaya, Bataan, Quezon, Occidental Mindoro, Pangasinan, Bulacan	Apr 2023
	Pinili 230 kV SS Filed to ERC	Load Growth *Substation:* ▪ Pinili 230 kV SS (New), 2x100 MVA 230/69-13.8 kV Transformer, 10-230 kV PCB, 8-69 kV PCB *Transmission Line:* ▪ Pinili Bus-in to San Esteban–Laoag 230 kV TL, ST-DC, 1-795 MCM ACSR/AS, 2x1.0 km ▪ Pinili–Currimao 69 kV TL, ST-DC, 1-795 MCM ACSR/AS, 7.0 km	Sep 2023

SUBSTATION PROJECTS			
Voltage	Project Name	Project Driver and Components	ETC
		Project Cost: 1,692 Million Pesos Location: Ilocos Norte	
	South Luzon 230 kV SS Upgrading ERC-approved	Load Growth and System Reliability Stage 1: *Substation:* ▪ Las Piñas 230 kV SS, 1x300 MVA, 230/115 kV transformer ▪ Lumban 230 kV SS (Expansion), 1x100 MVA, 230/69-13.8 kV Transformer, 1-230 kV PCB; 2-69 kV PCB ▪ San Juan (Kalayaan) S/Y, 8-230 kV PCB ▪ Naga 230 kV SS (Replacement), 1x300 MVA, 230/69-13.8 kV Transformer, 1-230 kV PCB, 1-69 kV PCB Stage 2: *Substation:* ▪ Daraga 230 kV SS (Replacement), 1x100 MVA 230/69-13.8 kV Transformer, 4-230 kV PCB, 2-69 kV PCB ▪ Gumaca 230 kV SS (Replacement), 1x100 MVA 230/69-13.8 kV Transformer, 1-230 kV PCB, 3-69 kV PCB ▪ Labo 230 kV SS, Line terminations reconfiguration. Project Cost: 2,175 Million Pesos Location: Laguna, Batangas, Albay, Quezon, Camarines Norte	Dec 2023
	South Luzon 230 kV SS Upgrading 2 Filed to ERC	Load Growth *Substation:* ▪ Lumban 230 kV SS (Replacement), 1x100 MVA 230/69-13.8 kV Transformer, 1-69 kV PCB ▪ Gumaca 230 kV SS (Replacement), 1x100 MVA 230/69-13.8 kV Transformer; 1-69 kV PCB ▪ Tuy 230 kV SS, 1x300 MVA, 230/69-13.8 kV Transformer, 2-230 kV PCB, 3-69 kV PCB ▪ Calaca 230 kV SS (Replacement), 2x300 MVA, 230/69-13.8 kV Transformer; 2-230 kV PCB, 8-69 kV PCB ▪ Labo 230 kV SS (Replacement), 1x100 MVA, 230/69-13.8 kV Transformer; 1-69 kV PCB ▪ Daraga 230 kV SS (Replacement); 4-230 kV PCB ▪ Taytay 230 kV SS, 3x100 MVAR, 230 kV Capacitor, 3-230 kV PCB ▪ Quezon 230 kV SS, 1x100 MVAR, 230 kV Capacitor, 1-230 kV PCB ▪ Biñan 230 kV SS, 6-230 kV PCB, 6-115 kV PCB ▪ Dasmariñas 115 kV SS, 11-115 kV PCB ▪ Naga 69 kV SS, 2-69 kV PCB ▪ Muntinlupa 115 kV SS, 10-115 kV PCB ▪ Doña Imelda 115 kV SS, 10-115 kV PCB (GIS) , 2-115 kV PCB ▪ Bay 69 kV SS, 2-69 kV PCB Project Cost: 5,775 Million Pesos Location: Batangas, Laguna, Quezon, Camarines Norte, Albay, Rizal and Metro Manila	Dec 2023
	Navotas 230 kV Substation ERC-approved	Load Growth *Substation:* ▪ Navotas 230 kV SS, 2x300 MVA, 230/115-13.8 kV Transformers, 9-230 kV PCB (GIS) and 15-115 kV PCB (GIS) *Transmission Line:* ▪ From Marilao–Quezon cut-in point to Navotas SS, 230 kV, ST/SP-DC, 4-795 MCM ACSR/AS, 20 km Project Cost: 3,486 Million Pesos Location: Navotas	Feb 2024

SUBSTATION PROJECTS			
Voltage	Project Name	Project Driver and Components	ETC
	Abuyog 230 kV SS Filed to ERC	Load Growth *Substation:* ▪ Abuyog 230 kV SS, 2x100 MVA 230/69-13.8 kV Transformer, 3x25 MVAR, 230 kV Shunt Capacitor, 3x25 MVAR, 230 kV Shunt Reactor, 12-230 kV PCB, 5-69 kV PCB ▪ Toblijon 230 kV Switching Station, 10-230 kV PCB *Transmission Line*: ▪ Toblijon-Abuyog 230 kV TL, 2-795 MCM ACSR/AS, ST-DC, 25.4 km. ▪ Toblijon-Daraga 230 kV Bus-in TL, 2-795 MCM ACSR/AS, ST-DC, 0.86 km. ▪ Toblijon-BacMan 230 kV Bus-in TL, 1-795 MCM ACSR/AS, ST-DC, 0.86 km. ▪ Abuyog-Gubat 69 kV Line Extensions, 1-336.4 MCM ACSR, SP-SC, 0.20 km. ▪ Abuyog-Balogo 69 kV Line Extensions, 1-336.4 MCM ACSR, SP-SC, 0.20 km. ▪ Abuyog-Irosin-Bulan 69 kV Line Extensions, 1-336.4 MCM ACSR, SP-SC, 1.14 km. Project Cost: 3,326 Million Pesos Location: Sorsogon	Apr 2024
	San Simon 230 kV SS Filed to ERC	Load Growth *Substation:* ▪ San Simon 230 kV SS, 2x300 MVA 230/69 kV Transformer, 2x100 MVAR 230 kV capacitor, 14-230 kV PCB, 10-69 kV PCB ▪ Mexico 230 kV SS, 6-69 kV PCB *Transmission Line:* ▪ San Simon cut-in connection to Hermosa–Duhat-Balintawak 230 kV Line, 2-795 MCM ACSR/AS, SP-DC, 1.5 km. ▪ Mexico–STR 120D (Calumpit Line Segment) 69 kV Line, SP-SC, 1-410 mm2 TACSR/AS, 12.3 km ▪ STR 120D–PELCO 3 (Apalit Tap) 69 kV Line, SP-SC, 1-410 mm2 TACSR/AS, 2.52 km ▪ San Simon–SKK 69 kV Line, SP-SC, 1-410 mm2 TACSR/AS, 7.56 km ▪ San Simon–Melters 69 kV Line, SP-SC, 1-410 mm2 TACSR/AS, 4.75 km ▪ San Simon–Wan Chiong 69 kV Line, SP-SC, 1-795 MCM ACSR/AS, 6.8 km Project Cost: 3,812 Million Pesos Location: Pampanga	Phase 1 Dec 2022 Phase 2 Sep 2024
	Tanauan 230 kV SS Filed to ERC	Load Growth *Substation:* ▪ Tanauan 230 kV SS, 2x100 MVA, 230/69 kV Transformers, 8-230 kV PCB 4-69 PCB ▪ Calamba 230 kV SS, 2-230 kV PCB *Transmission Line:* ▪ Calamba–Tanauan 230 kV TL, ST/SP-DC, 1-795 MCM ACSR/AS, 12 km. Project Cost: 2,435 Million pesos Location: Batangas	Jan 2025
	Porac 230 kV SS Filed to ERC	Load Growth *Substation:* ▪ Porac 230 kV SS, 2x300 MVA 230/69 kV Transformers, 3x100 MVAR, 230 kV Shunt Capacitor, 13-230 kV PCB, 19-69 kV PCB ▪ Hermosa 230 kV SS (Expansion), 2-230 kV PCB ▪ Clark 230 kV SS (Expansion), 2x100 MVAR, 230 kV Shunt Capacitor, 8-230 kV PCB ▪ Capas 230 kV SS (Expansion), 4-230 kV PCB *Transmission Line:* ▪ Hermosa–Porac–Capas 230 kV TL, ST-DC, 4-795 MCM ACSR, 64 km.	Phase 1 Jun 2024 Phase 2 Dec 2025

SUBSTATION PROJECTS			
Voltage	Project Name	Project Driver and Components	ETC
		▪ Clark 230 kV TL Extension, ST-DC, 4-795 MCM ACSR, 5 km. Project Cost: 6,384 Million Pesos Location: Pampanga	
	Capas 230 kV SS Filed to ERC	Load Growth *Substation:* ▪ Capas 230 kV SS, 2x300 MVA 230/69-13.8 kV Transformers, 3x100 MVAR 230 kV Shunt Capacitor; 11-230 kV PCB, 14-69 kV PCB; ▪ Concepcion 230 kV SS (Expansion), 4-230 kV PCB *Transmission Line:* ▪ Concepcion–Capas 230 kV TL, ST-DC, 4-795 MCM ACSR, 15 km. Project Cost: 2,605 Million Pesos Location: Tarlac	Dec 2025
	Sampaloc 230 kV SS Filed to ERC	Load Growth *Substation:* ▪ Sampaloc 230 kV SS, 2x100 MVA 230/69 kV Transformer, Control Room, 2x50 MVAR, 230 kV Shunt Capacitor, 12-230 kV PCB, 5-69 kV PCB *Transmission Line:* ▪ Sampaloc Bus-in to Cabanatuan-Pantabangan and Nagsaag-Pantabangan 230 kV TL, ST-DC, 1-795 MCM ACSR/AS, 2 km ▪ Sampaloc Cut-in to Cabanatuan-Pantabangan 69 kV TL, ST-DC, 1-336 MCM ACSR/AS, 1 km ▪ Sampaloc–SAJELCO 69 kV TL, SP-SC, 1-410 mm2 TACSR/AS, 7 km. Project Cost: 1,718 Million pesos Location: Nueva Ecija	Dec 2025
	Pasay 230 kV SS ERC-approved	Load Growth *Substation:* ▪ Pasay 230 kV SS, 9-230 kV PCB (GIS) *Transmission Line:* ▪ Las Piñas–Pasay 230 kV TL, 230 kV Double Circuit Underground Cable, 2-2,500 mm2 XLPE (1-core), 9.0 km. Project Cost: 12,871 Million Pesos Location: Las Piñas, Pasay	Dec 2025
	Castillejos 230 kV SS Filed to ERC	Load Growth *Substation:* ▪ Castillejos 230 kV SS, 2x100 MVA, 230/69 kV Transformer, 16-230 kV PCB, 4-69 kV PCB *Transmission Line:* ▪ Hermosa–Castillejos 500 kV Line Extension, 4-410 mm2 TACSR/AS, ST-DC, 5.5 km ▪ Hanjin 230 kV Line Extension, 1-795 MCM ACSR, ST-DC, 7 km ▪ RP Energy 230 kV Line Extension, 2-795 MCM ACSR, ST-DC, 7 km ▪ Castillejos 69 kV Line Extension, 1-410 mm2 TACSR/AS, SP/ST-DC, 3km. Project Cost: 3,068 Million Pesos Location: Zambales	Dec 2025

<table>
<tr><th colspan="4">VOLTAGE IMPROVEMENT PROJECTS</th></tr>
<tr><th>Voltage</th><th>Project Name</th><th>Project Driver and Components</th><th>ETC</th></tr>
<tr><td>230 kV</td><td>Luzon Voltage Improvement Project 3

ERC-approved</td><td>System Reliability
Stage 1:
<u>Substation:</u>
Baler Load-End 69 kV SS, 3x2.5 MVAR, 69 kV Capacitor, 4-69 kV PCB
Pantabangan Load-end 69 kV SS, 1x5 MVAR, 69 kV Capacitor, 1-69 kV PCB
Umingan Load-end 69 kV SS, 3x5 MVAR 69 kV Capacitor, 4-69 kV PCB
Camiling Load-end 69 kV SS, 3x5 MVAR 69 kV Capacitor, 4-69 kV PCB
Stage 2:
<u>Substation:</u>
San Esteban 230 kV SS, 2x25 MVAR, 230 kV Capacitor, 2-230 kV PCB
Botolan 230 kV SS, 1x25 MVAR 230 kV Shunt Reactor 6-230 kV PCB, 3-69 kV PCB
Itogon Load-end 69 kV SS, 1x7.5 MVAR, 69 kV Capacitor, 1-69 kV PCB
Antipolo 230 kV SS, 2x100 MVAR, 230 kV Capacitor, 2-230 kV PCB
Bautista Load-end 69 kV SS, 3x5 MVAR 69 kV Capacitor, 4-69 kV PCB
Project Cost: 3,383 Million Pesos
Location: Aurora, Nueva Ecija, Pangasinan, Tarlac, Ilocos Sur, Zambales, Benguet</td><td>Apr 2024</td></tr>
<tr><td>69kV</td><td>Luzon Voltage Improvement 4

ERC-approved</td><td>System Reliability
Stage 1:

<u>Substation:</u>
Irosin 69 kV SS, 3x2.5 MVAR, 69 kV Capacitor, 4-69 kV PCB
Lagonoy Load-end 69 kV SS, 3x5 MVAR, 69 kV Capacitor, 4-69 kV PCB
Tanauan Load-end 69 kV SS, 3x5 MVAR, 69 kV Capacitor, 4-69 kV PCB
Stage 2:
<u>Substation:</u>
Ligao Switching Station, 3x5 MVAR, 69 kV Capacitor, 4-69 kV PCB
Iriga Load-end 69 kV SS, 2x5 MVAR, 69 kV Capacitor, 5-69 kV PCB
Mabini Load-end 69 kV SS, 3x7.5 MVAR, 69 kV Capacitor, 4-69 kV PCB
Cuenca Load-end 69 kV SS, 3x7.5 MVAR, 69 kV Capacitor, 5-69 kV PCB
San Roque Load-end 69 kV SS, 3x7.5 MVAR, 69 kV Capacitor, 4-69 kV PCB
Taysan Load-end 69 kV SS, 3x5 MVAR, 69 kV Capacitor, 5-69 kV PCB
Project Cost: 3,122 Million Pesos
Location: Sorsogon, Camarines Sur, Batangas, Albay,</td><td>Apr 2024</td></tr>
<tr><td></td><td>Luzon Voltage Improvement Project 5

Filed to ERC</td><td>Load Growth
<u>Substation:</u>
Solana Load-end SS, 4x7.5 MVAR, 69 kV Capacitor; 5-69 kV PCB
Bongabon Load-end SS, 4x5 MVAR, 69 kV Capacitor; 5-69 kV PCB
Candelaria Load-end SS, 4x2.5 MVAR, 69 kV Capacitor; 5-69 kV PCB
Bani Load-end SS, 4x5 MVAR, 69 kV Capacitor; 5-69 kV PCB
San Fabian Load-end SS, 4x5 MVAR, 69 kV Capacitor; 5-69 kV PCB
Aglipay Load-end SS, 4x5 MVAR, 69 kV Capacitor; 5-69 kV PCB
Cauayan Load-end SS, 4x5 MVAR, 69 kV Capacitor; 5-69 kV PCB
Ilagan Load-end SS, 4x2.5 MVAR, 69 kV Capacitor; 5-69 kV PCB
Project Cost: 2,599 Million Pesos
Location: North Luzon</td><td>Dec 2025</td></tr>
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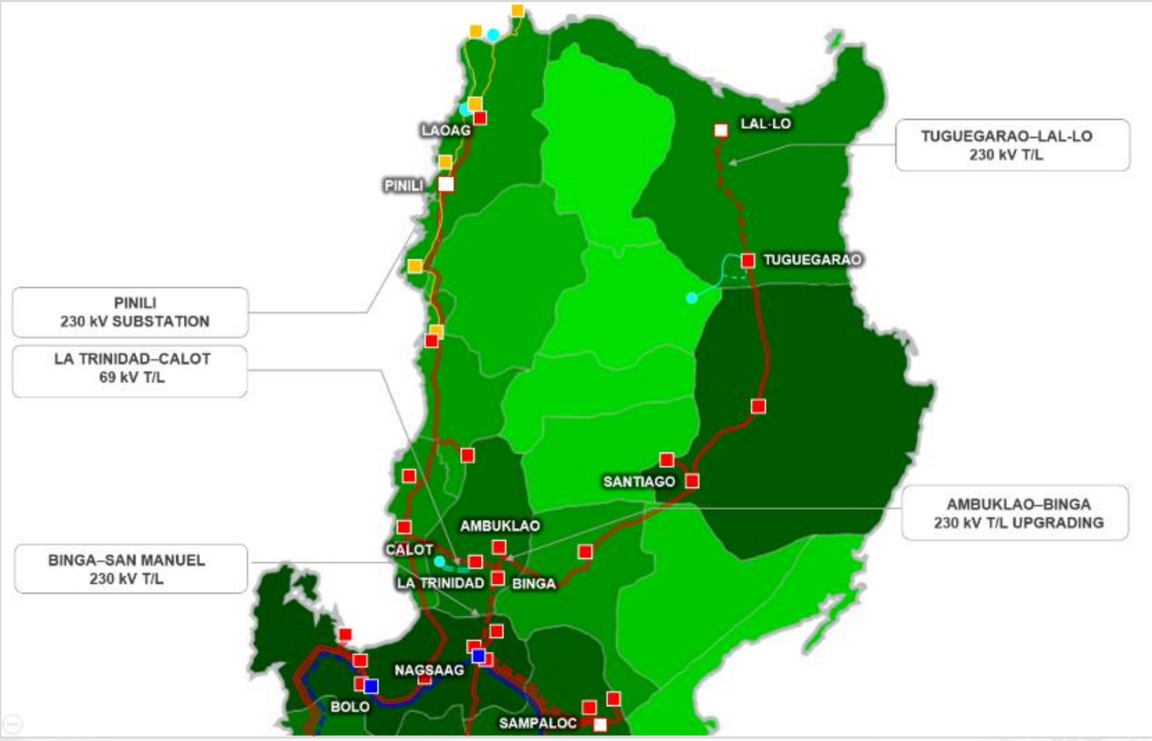


Figure 8.1: North Luzon Transmission Outlook for 2025

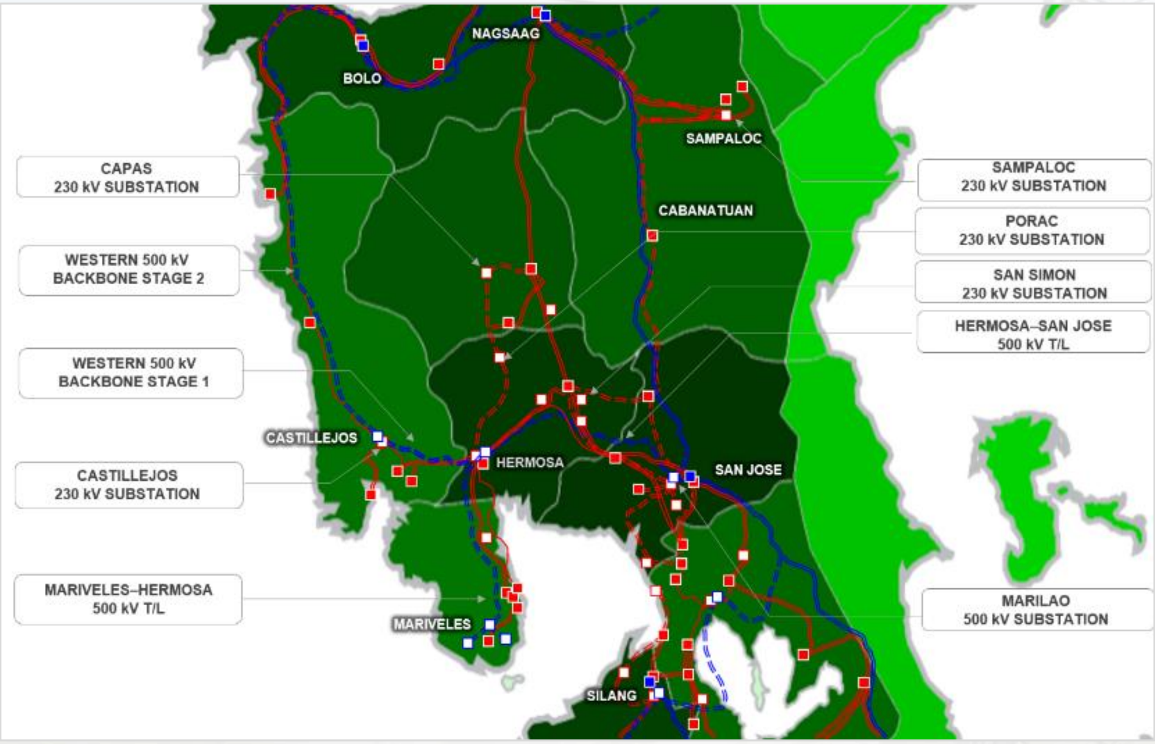


Figure 8.2: Central Luzon Transmission Outlook for 2025

Figure 8.3: Metro Manila Transmission Outlook for 2025

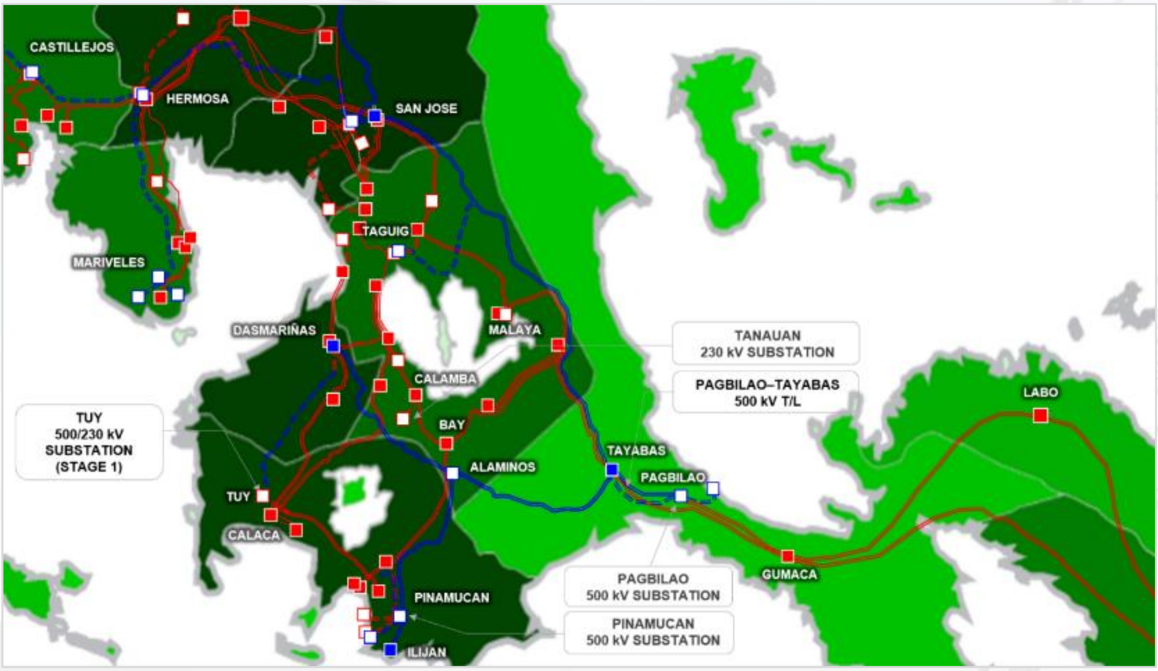


Figure 8.4: South Luzon Transmission Outlook for 2025

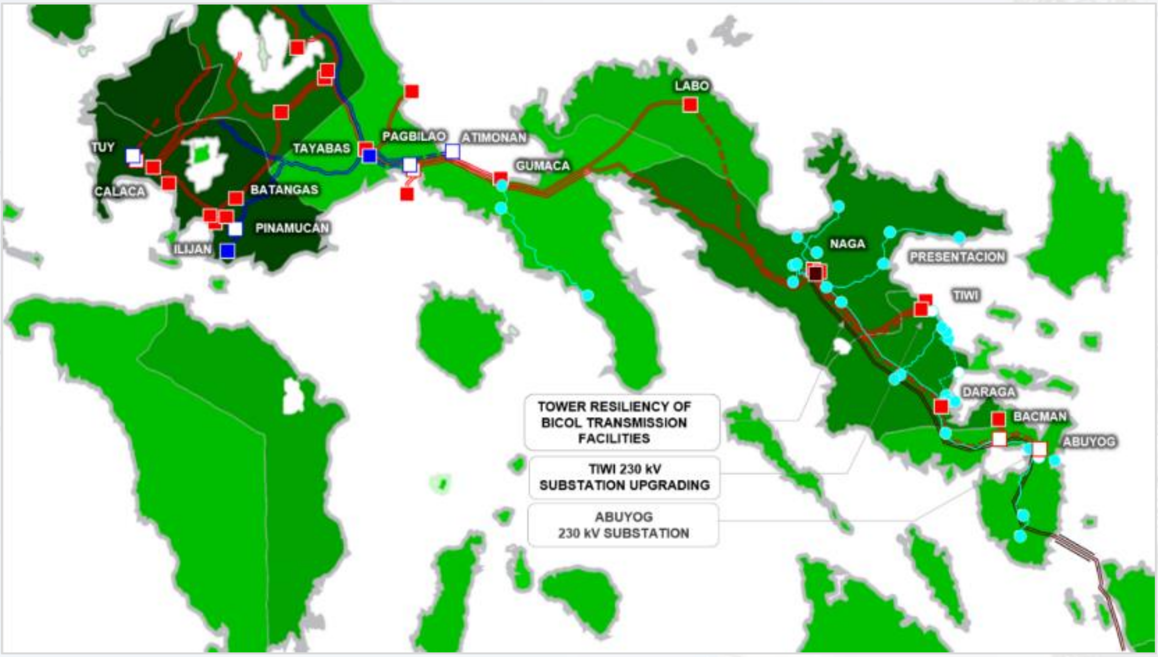
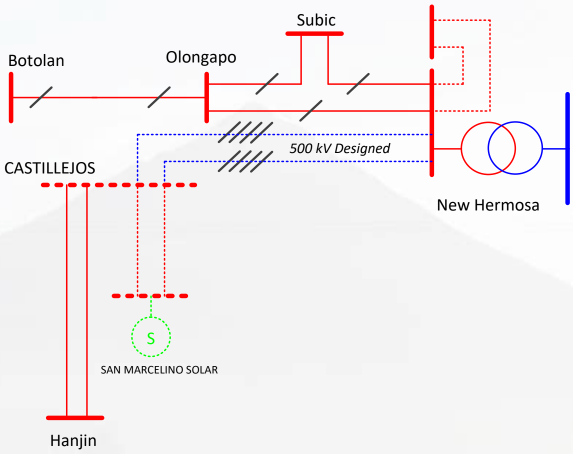


Figure 8.5: Bicol Region Transmission Outlook for 2025

8.1.1 Western Luzon 500 kV Backbone (Stage 1)

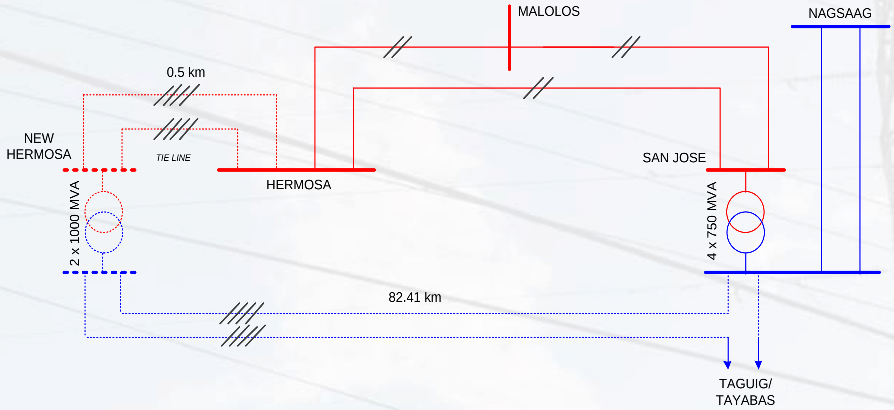
The Western Luzon Backbone (Stage 1: Castillejos–Hermosa 500 kV Transmission Line Project) involves the implementation of a 32 km double circuit 500 kV designed transmission line from Castillejos to Hermosa. This facility will initially be energized at 230 kV voltage level and will connect to the proposed Castillejos 230 kV Substation to accommodate the proposed VRE plants in Zambales Area. This Castillejos–Hermosa 500 kV Line segment is part of the proposed long-term plan for 500 kV backbone loop development from Bolo (Kadampat) down to Hermosa Substation.



8.1.2 Hermosa–San Jose 500 kV Transmission Line

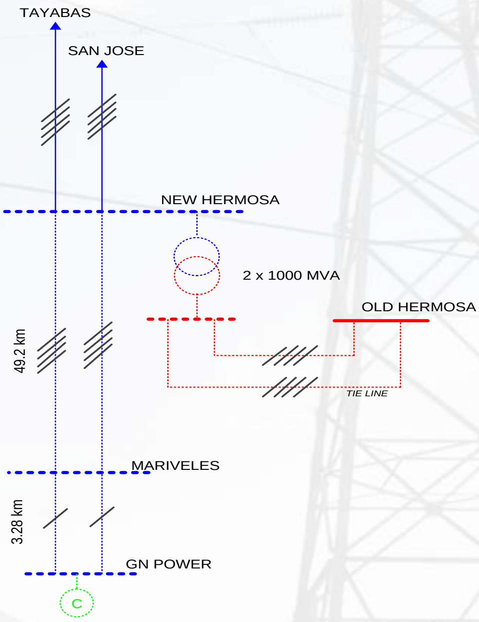
The Hermosa–San Jose 500 kV Transmission Line Project accommodates the generation capacity additions in Bataan and Zambales area. The Project will serve as a new 500 kV corridor for the bulk power generation coming from the existing Limay CCPP, Petron RSFF, Subic Enron DPP, Mariveles CFPP, and the programmed generation capacity additions which include San Marcelino Solar Plant and SMC CFPP. The Project involves the development of a new Hermosa 500 kV Substation and construction of a 500 kV transmission line from the new Hermosa 500 kV Substation up to the San

Jose 500 kV Substation. The old Hermosa 230 kV Substation will transfer power through the construction of a 230 kV Tie Line to the new Hermosa 500 kV Substation. Shunt Reactors, Line Reactor and Capacitor will also be installed for system voltage regulation during off-peak and peak conditions.



8.1.3 Mariveles–Hermosa 500 kV Transmission Line

The Mariveles–Hermosa 500 kV Transmission Line Project allows the connection of incoming generations in Bataan Peninsula which include 2x668 MW GN Power Dinginin CFPP and 8x150 MW SMC Consolidated Power Corporation CFPP. While the Bataan 230 kV Grid Reinforcement Project can increase the capacity of the existing 230 kV corridor in the area, the huge generation capacity addition cannot be accommodated unless a new transmission highway is developed. The Project involves the development of a new Mariveles 500 kV Substation and construction of a 500 kV transmission line backbone from the new Mariveles 500 kV Substation to Hermosa 500 kV Substation. This new backbone will form part of the loop from Hermosa to Mariveles then to Cavite/Metro Manila upon completion of the future submarine cable.

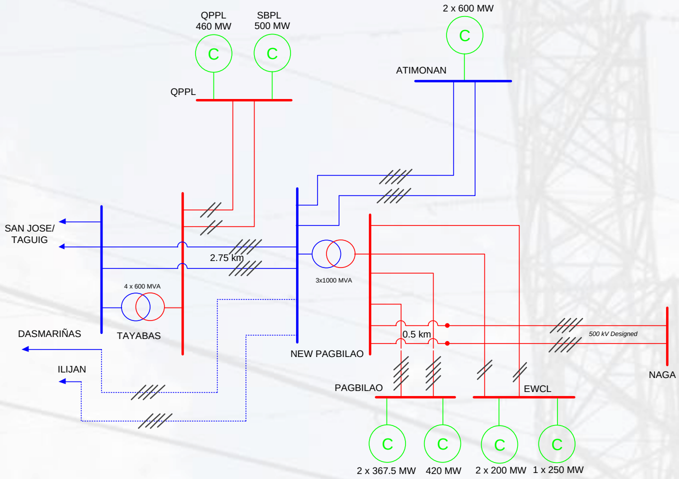


8.1.4 Bataan–Cavite Transmission Line Feasibility Study

The feasibility study for Bataan–Cavite Transmission line aims to establish the most feasible submarine cable link between Bataan and Cavite as part of the long-term plan to form a backbone loop system. This undertaking is in relation to several power plant projects being proposed in the Luzon Grid particularly in the province of Bataan.

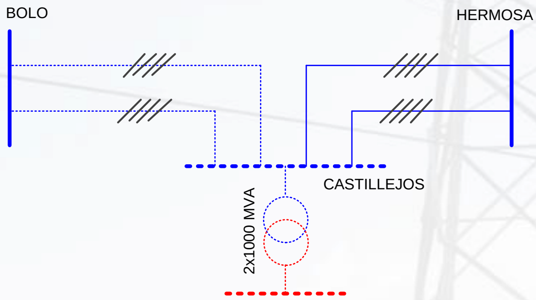
The project involves system studies for the establishment of the appropriate cable capacity based on the available technologies and the conduct of surveys for both submarine and overhead portions of the Bataan–Cavite Transmission Line.

8.1.5 Pagbilao–Tayabas 500 kV Transmission Line



The Pagbilao–Tayabas 500 kV Transmission Line Project accommodates further generation capacity additions in the Quezon province and provides additional reliability in the Luzon 500 kV Grid. The proposed 1,200 MW Atimonan CFPP which will connect to Pagbilao Substation is the next major generation addition in the area that triggered this project. The project is needed to establish a by-pass line to Tayabas Substation such that the Pagbilao 500 kV Substation will already become part of the backbone loop. This will avoid the critical concentration of more than 3,500 MW power generation at Tayabas 500 kV Substation and will address the high fault level issue at Tayabas 230 kV Substation. The project involves the expansion of the Pagbilao 500 kV Substation and construction of the 500 kV Line from Pagbilao Substation to Tayabas Substation.

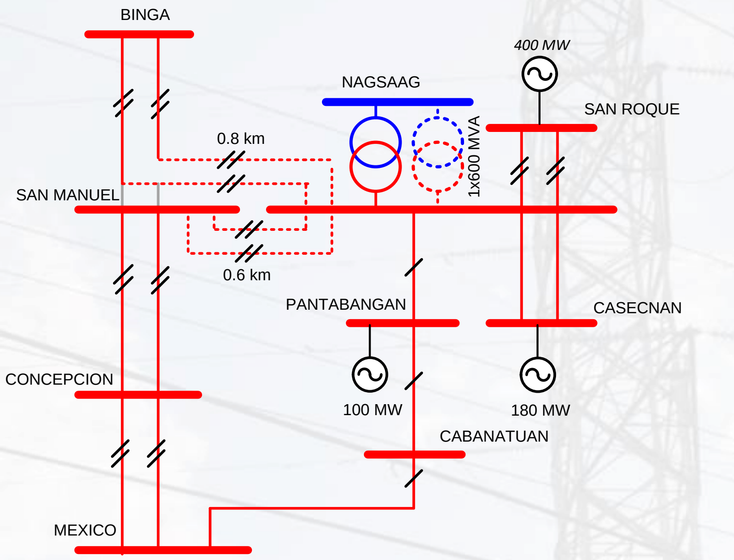
8.1.6 Western Luzon 500 kV Backbone (Stage 2)



This Western 500 kV Backbone (Stage 2) Project will complete the reinforcement of the western transmission corridor presently consisting of a single-circuit line from Labrador down to Botolan to Hanjin then to Olongapo. The long-term development plan considers providing a higher level of reliability up to N-2 contingency for the 500 kV backbone system of the Luzon Grid. It should be noted that the existing double-circuit 500 kV transmission line from Bolo to Nagsaag to San Jose is on common tower structures and that toppling of a tower due to typhoon would result in a simultaneous outage of two circuits, which will completely disrupt the power flow in the 500 kV transmission corridor. Such a scenario results in grid congestion due to the required curtailment to the baseload coal-fired power plants in northern Luzon. The capacity expansion of Masinloc CFPP and the entry of other new plants in the area would further highlight the critical role of the existing 500 kV backbone in ensuring the security of supply, thus, the need to reinforce the transmission network by developing the Western 500 kV transmission backbone. This project involves the construction of a 174 km double circuit 500 kV line from Bolo 500 kV Substation to Castillejos. It involves the implementation of the Castillejos 500 kV Substation which could help support any future bulk generation development in the area. This Stage 2 project involving relatively long transmission lines will be divided into two segments from Castillejos to Masinloc and Masinloc to Bolo.

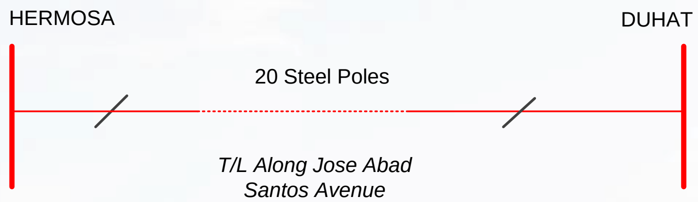
8.1.7 San Manuel–Nagsaag 230 kV Transmission Line Project

The project aims to address the overloading of the San Manuel–Nagsaag 230 kV tie line, Pantabangan–Cabanatuan 230 kV Line, and the Nagsaag 500/230 kV transformer. During Maximum North condition and the hydro plants are maximized, outage of the San Manuel–Nagsaag 230 kV tie line will result in the overloading of the single circuit Pantabangan–Cabanatuan 230 kV line. Conversely, the outage of the Pantabangan–Cabanatuan 230 kV line will result in the overloading of the San Manuel–Nagsaag 230 kV tie line. Furthermore, during Maximum South condition and the hydro plants are minimized or completely not operating, the San Manuel 500/230 kV transformer will serve as a drawdown substation in central Luzon. The outage of one circuit of the Nagsaag–San Jose 500 kV line will result in the overloading of the 1x600 Nagsaag 500/230 kV transformer. The project involves the installation of an additional 600 MVA 500/230-13.8 kV transformer at Nagsaag EHV Substation and construction of the new San Manuel–Nagsaag 230 kV Tie-Line.



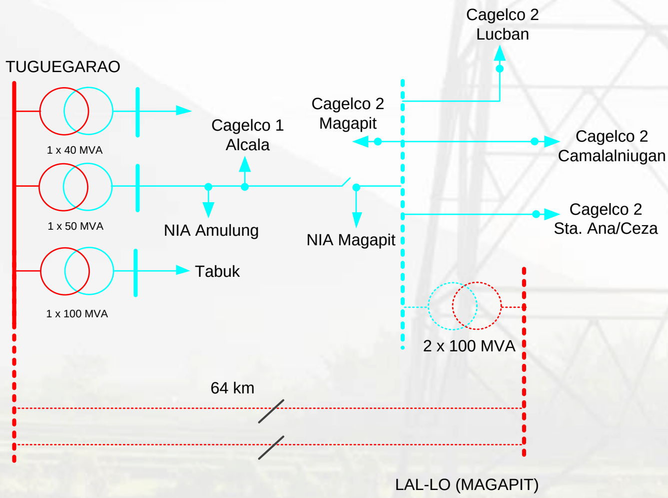
8.1.8 Relocation of Steel Poles along Hermosa–Duhat 230 kV Transmission Line

This undertaking is in connection to the road widening project along Jose Abad Santos Avenue in San Fernando, Pampanga which left several steel poles in the middle of the road. The proposed relocation will eliminate the danger brought about by the remaining steel pole structures as well as to prevent accidents that will cause power interruption to the Hermosa–Duhat 230 kV Line. The project involves the relocation of 18 steel pole structures along the road Right-of-Way (**ROW**) limit of the DPWH in San Fernando–Gapan–Olongapo National Road, San Fernando City. This will be implemented through re-routing of the affected line using new steel pole structures.

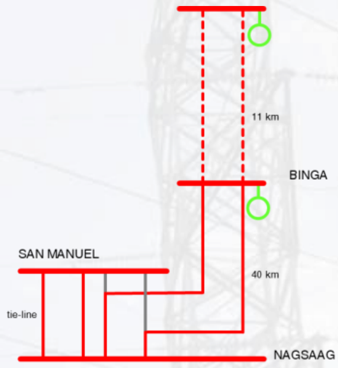


8.1.9 Tuguegarao–Lal-lo 230 kV Transmission Line

The Tuguegarao–Lal-lo 230 kV Transmission Line project addresses the imminent overloading of the Tuguegarao–Magapit 69 kV Line due to the forecasted load growth in the northern part of Cagayan Province. It also aims to improve the power quality and reliability of supply in the area which is presently being served by a very long 69 kV line. This project will also become an integral part of the development of the Northern Luzon 230 kV loop which will link the north-western and north-eastern 230 kV backbone. The project involves the construction of a 64 double-circuit 230 kV transmission line from Tuguegarao to Lal-lo and the development of Lal-lo 230/69 kV Substation with a capacity of 2x100 MVA.



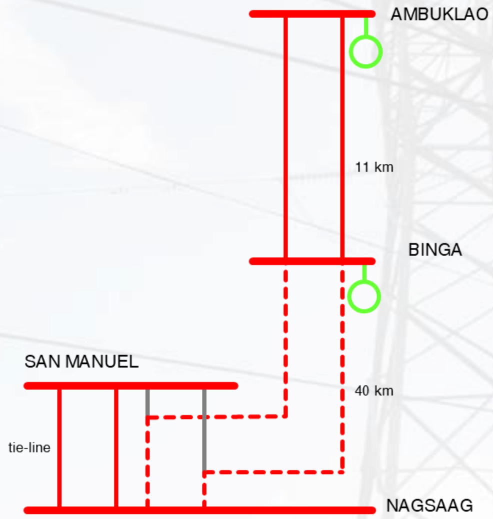
8.1.10 Ambuklao–Binga 230 kV Transmission Line Upgrading



The Ambuklao–Binga 230 kV Transmission Line Upgrading project upgrades the existing line to address its old age condition and also to maintain the N-1 contingency provision taking into consideration the repowering of Ambuklao HEPP and the proposed generation capacity additions in the Cagayan Valley area. Thus, during maximum generation of the power plants, this project will prevent the overloading under N-1 contingency conditions, i.e, outage of one 230 kV circuit. The project involves the construction of 11 km, 230 kV, double-circuit, steel tower transmission line to replace the old Ambuklao–Binga 230 kV line which presently conveys the generated power of Ambuklao and Magat HEPPs to the transmission backbone of the Luzon Grid.

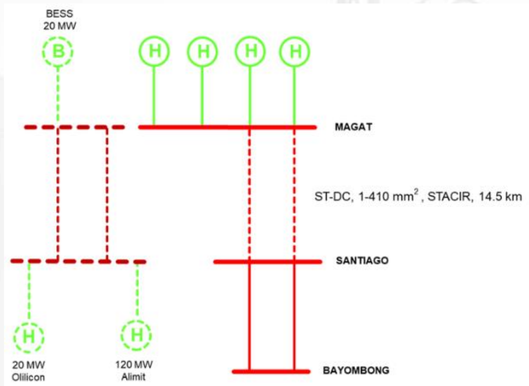
8.1.11 Binga–San Manuel 230 kV Transmission Line Stage 1 & 2

The Binga–San Manuel 230 kV Transmission Line upgrading project aims to provide N-1 contingency during the maximum dispatch of the generating plants, particularly HEPPs, in north Luzon. The existing line, as well as the power circuit breakers at Binga Substation, which were constructed/installed in 1956, have already surpassed the economic life. Moreover, there are developments in the power plants affecting the power flow at Binga–San Manuel 230 kV line. These include the repowering of Ambuklao HEPP to a new capacity of 105 MW (previously at 75 MW capacity) and the completion of Binga HEPP expansion to an additional capacity of 25 MW, and the other generation developments in Cagayan Valley area. This project involves the construction of a new 40 km double circuit Binga–San Manuel 230 kV transmission line using a new right-of-way, including the installation of switching facilities at Binga and San Manuel Substations.



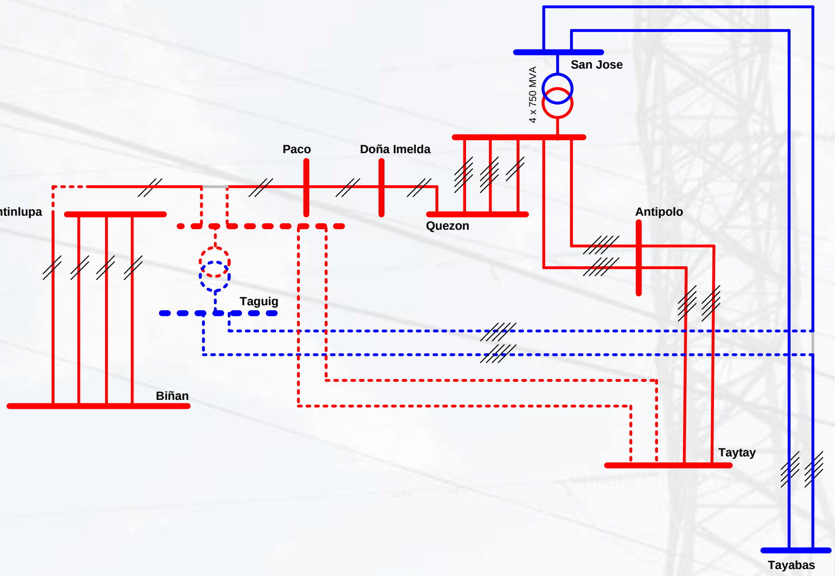
8.1.12 Santiago–Magat 230 kV Transmission Line Reconductoring Project

The Santiago–Magat 230 kV Transmission Line Reconductoring Project aims to upgrade the existing Santiago–Magat 230 kV Transmission Line to accommodate new generation plants that will be connected in Magat such as the ±20 MW Magat BESS, 120 MW Alimit Hydro Plant and the 20 MW Olilicon Hydro Plant.



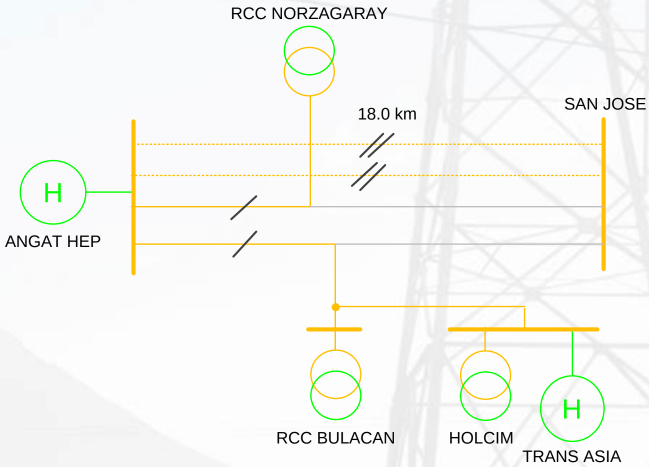
8.1.13 Taguig–Taytay 230 kV Transmission Line

The project will address the overloading of the Taguig–Paco 230 kV Line segment during the N-1 contingency event and under maximum south generation condition specifically with the incoming generating plants in the provinces of Batangas and Quezon. This project will provide additional outgoing circuits from the new Taguig 500/230 kV Substation. With the link from Taguig to Taytay, the decongestion of the San Jose EHV Substation will become more effective and the utilization of the new substation in Taguig will be optimized. This project will form part of the 230 kV transmission loop surrounding Laguna Lake as it involves the construction of a 10 km double circuit 230 kV line from Taguig to Taytay Substation. The Taytay Substation will be expanded for up to two bays to allow the termination of the Taguig–Taytay 230 kV Line.



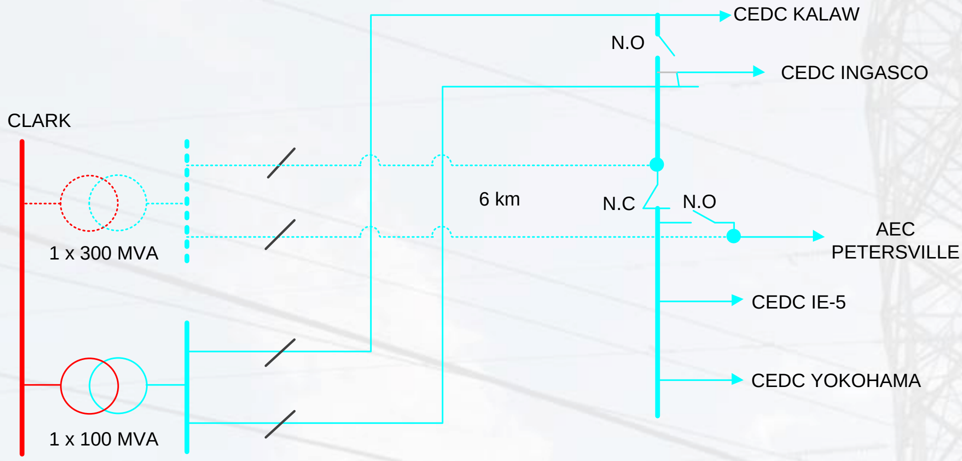
8.1.14 San Jose–Angat 115 kV Line Upgrading

The San Jose–Angat 115 kV Line Upgrading Project ensures the reliability of the existing 115 kV transmission lines connecting Angat HEPP to the Luzon Grid. The San Jose–Angat Lines 1 and 2 were built in 1967 while Line 3 (wood pole) was built in 1960. The 300 MVA capacity per circuit of the project would be sufficient to provide N-1 contingency during the maximum dispatch of the 246 MW Angat HEPP. If not implemented, transmission constraints could be experienced when there is an outage in Line 3. Furthermore, this project will eliminate the T-connection of existing industrial customers along the existing San Jose–Angat 115 kV Lines. The project involves the construction of a new 18 km 115 kV double-circuit line with a higher ampacity. It will utilize the existing right-of-way of San Jose–Angat Line 3. The existing industrial customers that were previously T-connected will utilize the existing Lines 1 and 2 and will radially source its power requirement to San Jose 115 kV Substation.



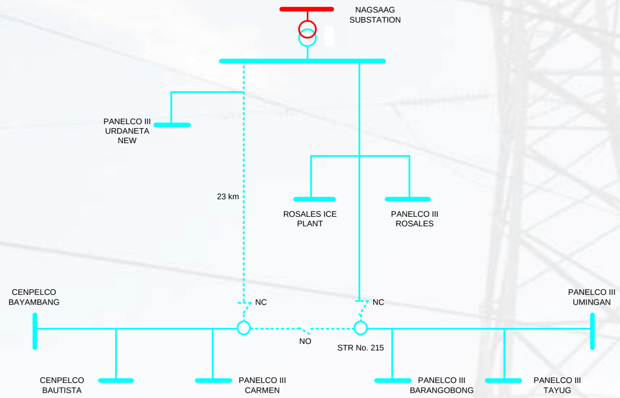
8.1.15 Clark–Mabiga 69 kV Transmission Line

The Clark–Mabiga 69 kV Line Project provides transmission capacity reinforcement to the Mexico–Clark 69 kV Line which is serving PRESCO, PELCO I, PELCO II, Angeles Electric Corporation (AEC), Quanta Paper Corporation, and Clark Electric Development Corporation (CEDC). This will address the load growth in the area of Angeles and Mabalacat together with the new industries in Clark Freeport Zone and improve the power quality of supply in the area. The project involves the installation of a new transformer at Clark 230 Substation and the construction of a 69 kV line from the Clark Substation up to the area of Mabiga in Pampanga.



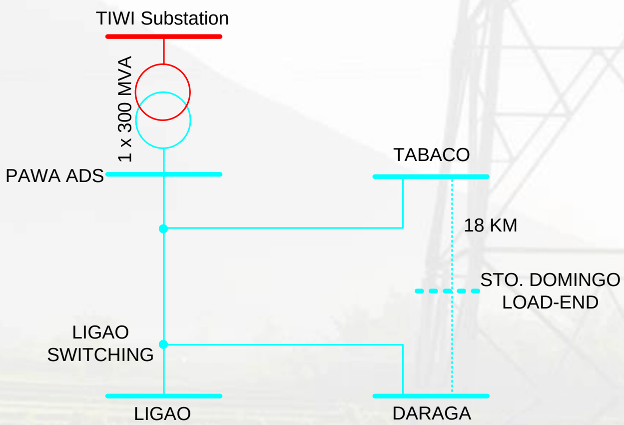
8.1.16 Nagsaag–Tumana 69 kV Transmission Line

The Nagsaag–Tumana 69 kV Transmission Line Project caters to the growing demand in Pangasinan. The existing Nagsaag–Umingan 69 kV Transmission Line which delivers power to the loads of Pangasinan III Electric Cooperative (PANELCO III) and Central Pangasinan Electric Cooperative (CENPELCO) will already be overloaded. The Nagsaag–Tumana 69 kV Transmission Line Project involves the construction of a new 69 kV transmissionline from Nagsaag Substation going to the area of Tumana in Rosales, Pangasinan. The new transmission line will unload the Nagsaag–Umingan 69 kV Transmission Line by catering the loads of PANELCO III Urdaneta and Carmen, and CENPELCO Bautista and Bayambang.



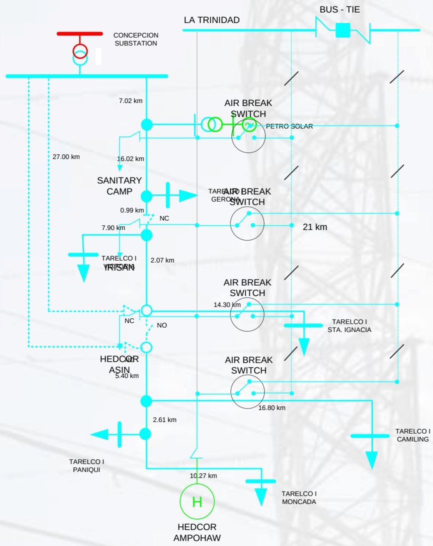
8.1.17 Eastern Albay 69 kV Transmission Line Stage 2

The Eastern Albay 69 kV Line Project provides a more reliable transmission corridor in the eastern coast of Albay to serve the increasing eco-tourism developments in the area which include the Misibis Resort, Estate and Spa in Cagraray Island. The Eastern Albay 69 kV Line Project is divided into two stages. Stage 1 includes the development of the Sto. Domingo Load-End Substation with a 10 MVA, 69/13.8 kV transformer and the single-circuit Daraga–Sto. Domingo 69 kV Transmission Line which will be 21 km long and composed 1-336.4 MCM ACSR/AS conductor. Stage 2 meanwhile includes the development of the single-circuit Sto. Domingo-Tabaco 69 kV Line which will be 18 km long and composed of 1-336.4 MCM ACSR/AS conductor.



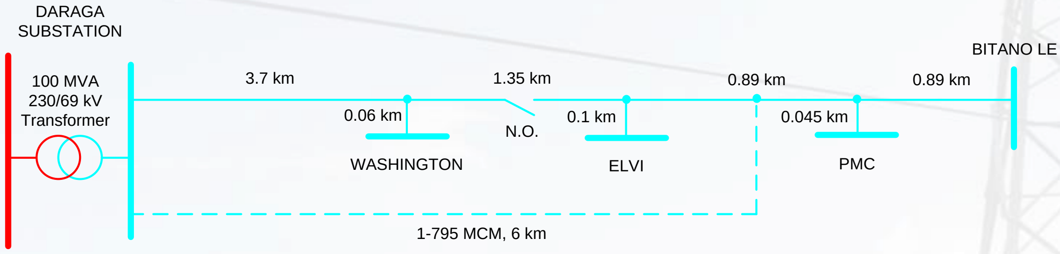
8.1.18 Concepcion–Sta. Ignacia 69 kV Transmission Line

The Concepcion–Sta. Ignacia 69 kV Transmission Line Project caters to the growing demand in Tarlac Area. The existing Concepcion–Camiling 69 kV Transmission Line which delivers power to the loads of Tarlac I Electric Cooperative, Inc. (TARELCO I) will already be overloaded. The Concepcion–Sta. Ignacia 69 kV Transmission Line Project involves the construction of a new double circuit 69 kV transmission line from Concepcion Substation up to Camiling, Tarlac. It will unload the existing Concepcion–Paniqui 69 kV Transmission Line by catering the loads of TARELCO Sta. Ignacia, Camiling, Mayantoc, Paniqui, Anao and Moncada.



8.1.19 Daraga–Bitano 69 kV Transmission Line

The Daraga–Bitano 69 kV Transmission Line Project aims to cater the load growth of Albay Power and Energy Corporation (APEC) and other directly connected industrial and commercial loads in Albay Province. The project will relieve the anticipated overloading of the existing Daraga–Washington 69 kV Transmission Line. The project involves the development of a new single circuit, 6 km 1-795 MCM ACSR 69 kV Transmission Line from Daraga 69 kV Substation to Bitano Load-End (LE) of APEC.

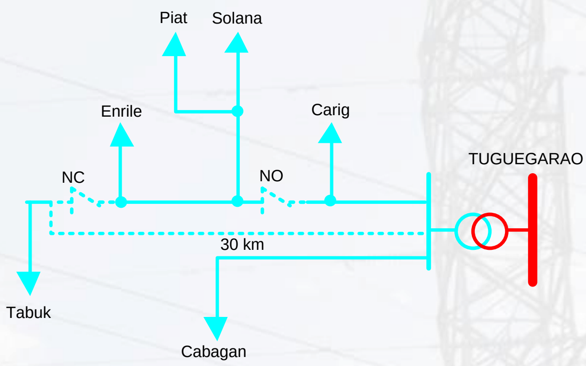


8.1.20 La Trinidad–Calot 69 kV Transmission Line

The La Trinidad–Calot 69 kV Transmission Line Project improves the reliability and increases the transfer capacity of the 69 kV transmission line serving loads of Benguet Electric Cooperative (BENECO) Lamut, BENECO Sanitary Camp, BENECO Irisan, and power generations from HEDCOR Asin and HEDCOR Ampohaw. The project involves the construction of a 21 km, 69 kV, double-circuit, steel tower/steel pole transmission line from La Trinidad Substation to Calot, Sablan, Benguet. It also involves the expansion of the 69 kV switchyard for the termination of the new La Trinidad-Calot 69 kV transmission line.

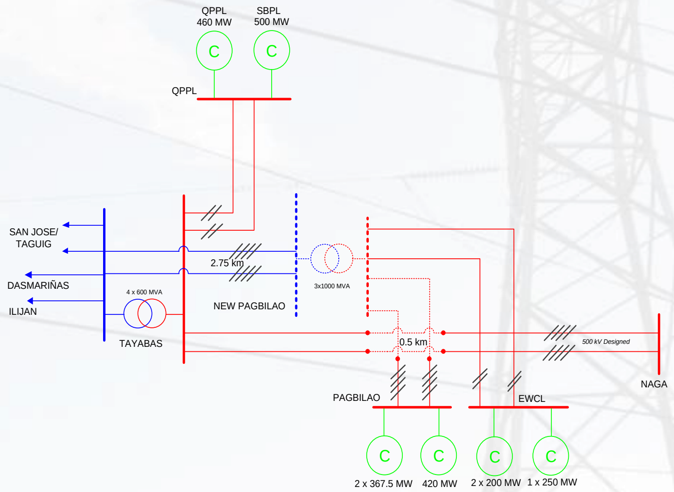
8.1.21 Tuguegarao–Enrile 69 kV Transmission Line

The Tuguegarao–Enrile 69 kV Transmission Line Project provides additional transfer capacity to address the load growth of Cagayan 1 Electric Cooperative, Inc (CAGELCO I) and Kalinga-Apayao Electric Cooperative, Inc. (KAELCO). The project will relieve the anticipated overloading of the existing Tuguegarao–Tabuk 69 kV Line. The project will involve the development of a new single circuit, 15 km 1-795 MCM ACSR 69 kV transmission line that will initially tap to the Tuguegarao–Cabagan 69 kV line. Ultimately, this will be terminated to Tuguegarao 69 kV Substation through the development of an additional 15 km 1-795 MCM ACSR 69 kV transmission line.



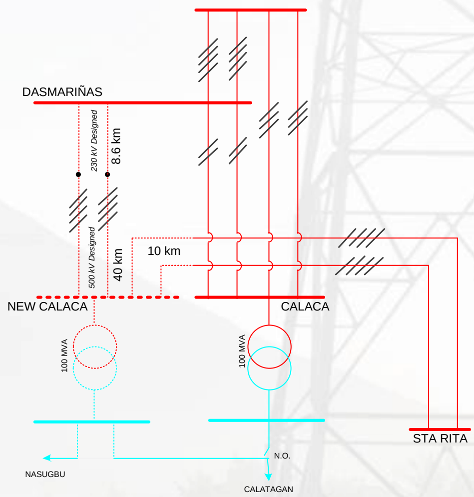
8.1.22 Pagbilao 500 kV Substation

The Pagbilao 500 kV Substation Project accommodates the connection of incoming power plants in Quezon Province which include the 420 MW Pagbilao Coal-Fired Power Plant (CFPP) Expansion, 500 MW San Buenaventura Power Ltd. Co. (SBPL) Coal-Fired Power Plant and 600 MW Energy World Corporation (EWC) Combined-Cycle Power Plant. The Pagbilao EHV Substation Project will address the overloading of Tayabas 500/230 kV transformers and the fault level issue at Tayabas 230 kV Substation. The Project involves the development of Pagbilao 500 kV substation and expansion of the Tayabas 500 kV Substation. It will be connected bus-in to the grid through Naga-Tayabas 230 kV Line. The 17 km segment of the Naga–Tayabas 230 kV Line will be energized at 500 kV level to accommodate the connection of the Project.



8.1.23 Tuy 500/230 kV Substation Project (Stage 1)

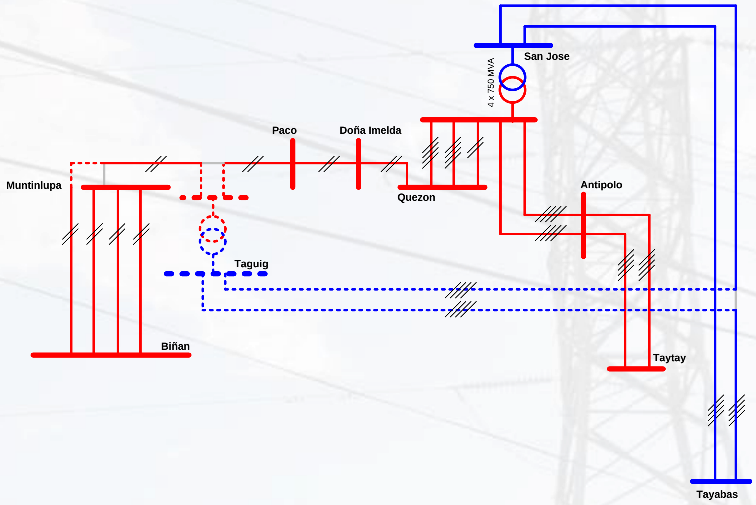
The Tuy 500 kV Substation (Stage 1) accommodates the connection of the 2x350 MW SRPGC Coal Plant and allows full dispatch of bulk generation capacity additions in Batangas. The generation capacity additions will turn Calaca Substation into a merging point of more than 2,000 MW of power generation. The existing outgoing 230 kV lines going to Dasmariñas and Biñan would not be enough to accommodate the full dispatch of the plants considering the single outage contingency criterion.



The Tuy 500 kV Substation (Stage 1) Project involves the development of Tuy 500 kV Substation which will initially involve 230 kV facilities only. The project will also involve the development of Tuy–Dasmariñas 500 kV designed transmission line but will be initially energized at 230 kV. Furthermore, a new 100 MVA, 230/69-13.8 kV Power Transformer will be installed to provide N-1 contingency to the existing 100 MVA Power Transformer at Calaca Substation.

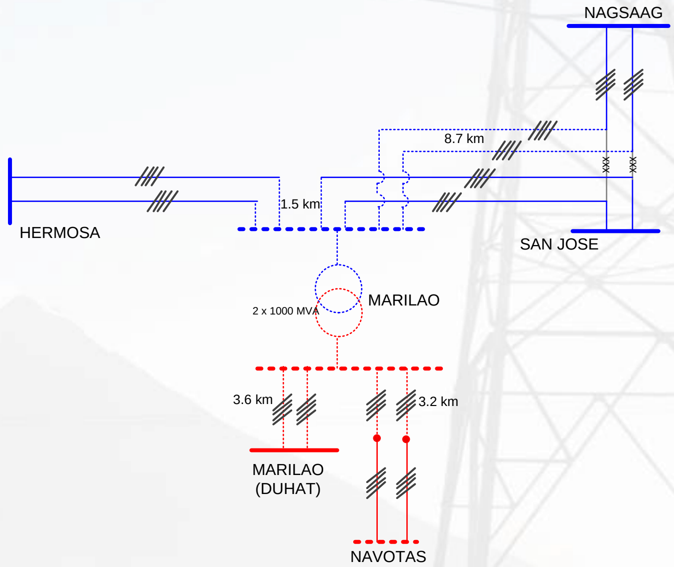
8.1.24 Taguig 500 kV Substation

The Taguig 500 kV Substation provides another 500/230 kV drawdown substation to decongest San Jose EHV Substation and provide a higher level of reliability to the 500 kV system of the Luzon Grid. The Project will also address the criticality of the existing 230 kV single-circuit line from Quezon to Muntinlupa during N-1 contingency and will address the severe low voltage of the Metro Manila 230 kV Substations due to the single-circuit configuration and heavy loading condition of the Quezon–Muntinlupa 230 kV Line. This is one of NGCP's major transmission network developments for Metro Manila to ensure that the power requirements of the country's load center will be adequately and reliably served in the long term. The implementation of the Taguig 500 kV Substation will improve the reliability of the transmission network by providing direct power injection within Metro Manila through the Muntinlupa–Paco 230 kV Transmission Line segment. The Project also involves the construction of a 500 kV supply line that will be connected through cut-in along the existing San Jose–Tayabas 500 kV Line. A 230 kV Line will also be constructed from Taguig Substation and will be connected through a bus-in scheme along Muntinlupa–Paco 230 kV Line.



8.1.25 Marilao 500 kV Substation

The Marilao 500 kV Substation provides another drawdown substation to support the increasing demand in Metro Manila and will also address the further increase in bulk power injection to the 500 kV system coming from the new power plants in the grid. The project will also address the initial line by-pass scheme at San Jose Substation under the project Hermosa–San Jose 500 kV Transmission Line which is brought about by the GIS expansion limitation at San Jose 500 kV Substation. The Project will reduce the criticality of the ring-bus configured San Jose 500 kV Substation as the Marilao Substation will now serve as the main node in the grid. The project involves the construction of Marilao 500 kV Substation to serve as a new corridor of generation supply in the northern region. It includes the bus-in of the new substation along the Hermosa-San Jose 500 kV transmission line, transfer of Nagsaag 500 kV line from San Jose EHV Substation to the new substation, and termination of 230 kV lines going to Duhat, Marilao, Navotas, Quezon, and Hermosa Substations.

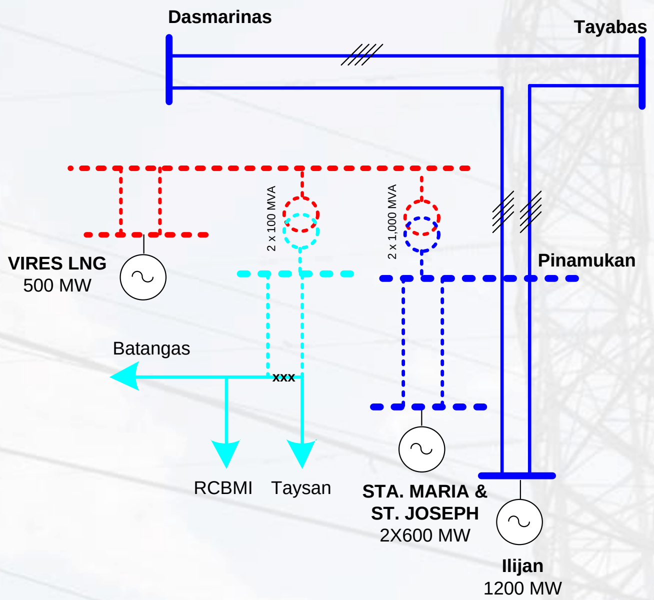


8.1.26 Pinamucan 500 kV Substation

The Pinamucan 500 kV Substation Project allows the connection of incoming bulk generation capacities in Batangas City Area which are mostly LNG-fired power plants. This substation will also serve as a new drawdown 230/69 kV drawdown substation for MERALCO and Batangas Electric

II Cooperative (BATELEC II) loads. The proposed 500 kV Substation will connect to the 500 kV system through bus-in along the Ilijan–Dasmariñas and Ilijan–Tayabas 500 kV Lines.

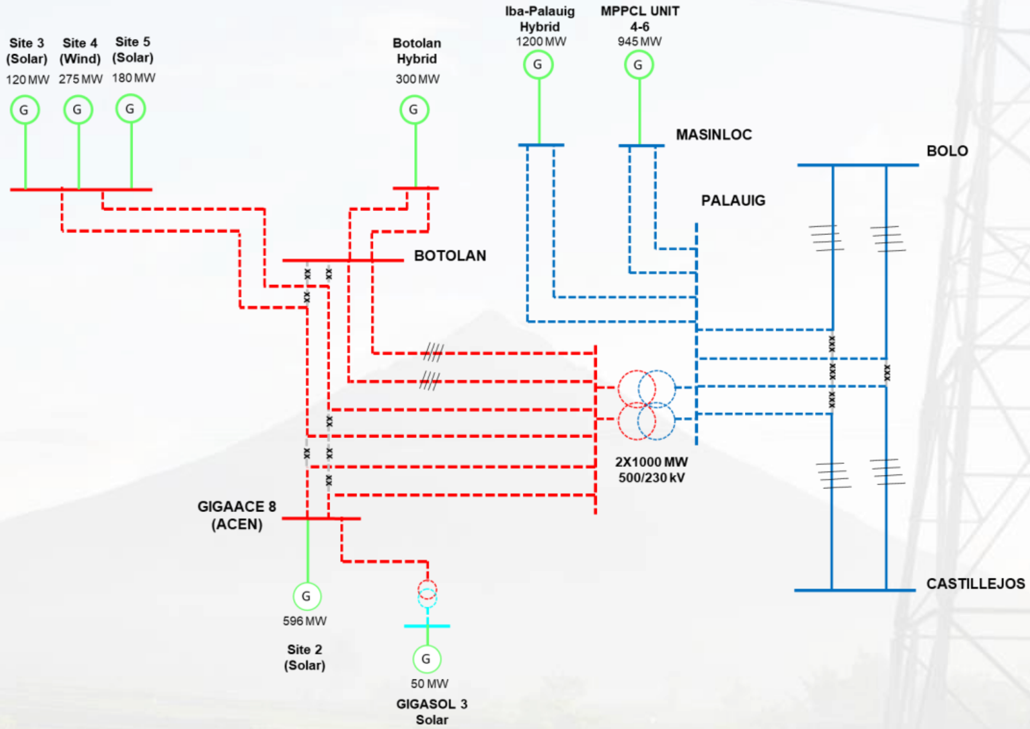
In the long-term, this should be followed by the development of a new 500 kV backbone to Tuy 500 kV to increase the transmission capacity for the outgoing circuits and to form the southern 500 kV loop configuration.



8.1.27 Palauig 500 kV Substation

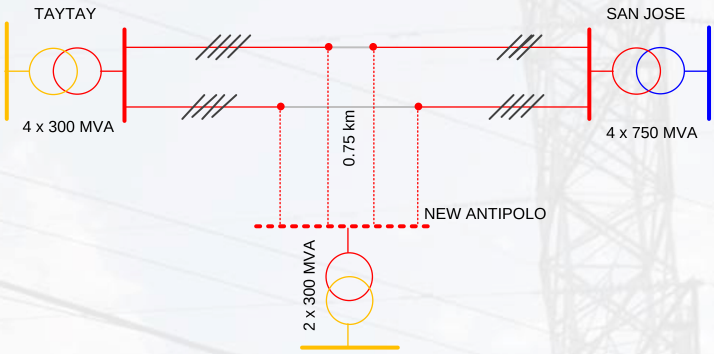
The Palauig 500 kV Substation Project aims to accommodate the connection of various power plants in Western Luzon. Since Western Luzon is part of the identified Competitive Renewable Energy Zone, the Palauig 500 kV Substation will serve as a collector substation and transmit this bulk generation power to the load center. The proposed 500 kV Substation will bus-in along the Castillejos–Bolo 500 kV Transmission Line.

In the long-term, this substation will be part of a new 500 kV backbone from Western Luzon to Eastern Luzon and Metro Manila, thus further strengthening the reliability of the 500 kV backbone of the country.



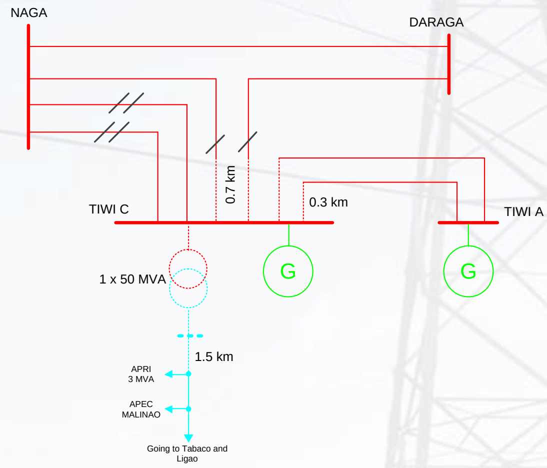
8.1.28 Antipolo 230 kV Substation

The Antipolo 230 kV Substation caters to the load growth in the Sector 2 of MERALCO. With the further increase in load, the existing 230/115 kV substations in Taytay and Doña Imelda become heavily loaded and have been losing already the provision for N-1 contingency and have space constraints for further expansion. This will expose the Metro Manila loads to supply reliability risk as well as power quality concerns during system peak load conditions. The project involves the new 230 kV substation that will bus-in along the existing ST-DC San Jose-Taytay 230 kV line with 4-794 MCM ACSR conductors. Initially, the substation will also be installed with Capacitor for voltage support. To draw supply from Antipolo, MERALCO will be installing 2x300 MVA 230/115 kV transformers and 115 kV Substation. MERALCO will also put up line connections to their existing 115 kV network in the area.



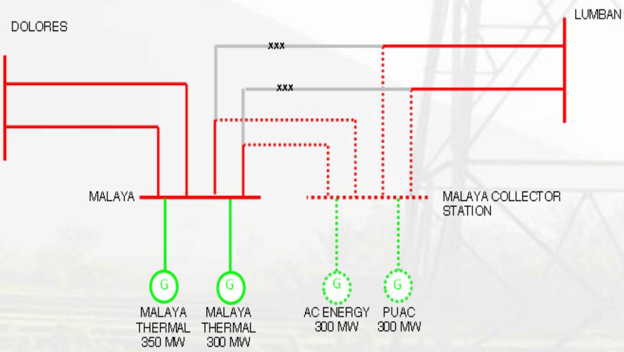
8.1.29 Tiwi Substation Upgrading

The project upgrades the old and deteriorated substation equipment at Tiwi A and C Substations to improve the reliability of the system. It will also augment the power requirement of Malinao/Ligao LES by the installation of additional power transformer at Tiwi C Substation and will clearly identify asset boundaries within the Tiwi Geothermal Power Plant Complex through the construction of NGCP's own control facilities. The project involves the upgrading of equipment at Tiwi A and C Substations and installation of 50 MVA, 230/69-13.8 kV Power Transformer at Tiwi C Substation. It also involves the diversion of the Daraga/Naga 230 kV Line to Tiwi C Substation and extension of the Malinao/Ligao 69 kV Line from Tiwi A to Tiwi C Substation.



8.1.30 Malaya 230 kV Collector Station

The Malaya 230 kV Collector Station Project aims to accommodate the 300 MW Modular Diesel Plant of AC Energy as well as the 300 MW PUAC Laguna Bay 2 Solar Power Plant. Since the existing Malaya 230 kV Substation has insufficient space for expansion, the Malaya 230 kV Collector Station will serve as the connection point for all generation plants in the area. The Malaya 230 kV Collector Station will bus-in along the existing Malaya–Lumban 230 kV Transmission Line.

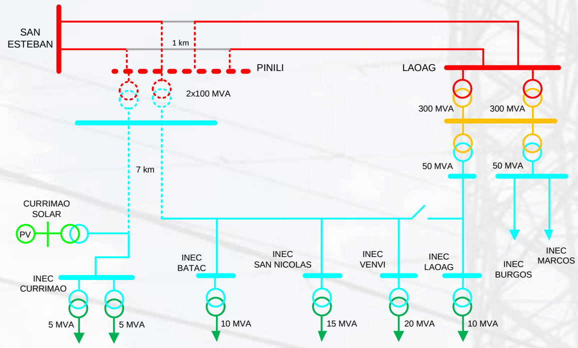


8.1.31 North Luzon 230 kV Substation Upgrading Project

The North Luzon Substation Upgrading Project caters to the load growth and provides N-1 contingency to various substations in NGCP's North Luzon Region, Bauang, Gamu, Bayombong, Hermosa, Doña Imelda, Malaya, San Jose, Quezon, Balingueo, Bacnotan, Labrador, and San

Rafael Substations. The Project involves transformer installations, and replacement and rearrangements of power circuit breakers to ensure reliability and flexibility of operations on the concerned substations.

8.1.32 Pinili 230kV Substation



This Pinili 230 kV Substation will replace the existing Currimao 115 kV Substation as it can no longer be expanded due to space constraints. This project will accommodate the load growth and provide N-1 contingency for the loads of Ilocos Norte Electric Cooperative (INEC), Ilocos Sur Electric Cooperative (ISECO) and Abra Electric Cooperative (ABRECO). This will also serve as a connection point for new renewable energy plants. The Pinili 115 kV Substation Project involves the construction of a new 230/69 kV substation and it will be connected 'bus-in' to the San Esteban–Laoag 230 kV line and will be arranged in a breaker-and-a-half scheme. It involves the installation of 2x100 MVA, 230/69-13.8 kV Power Transformer, 10-230 kV PCBs, 5-69 kV PCBs, and its associated equipment.

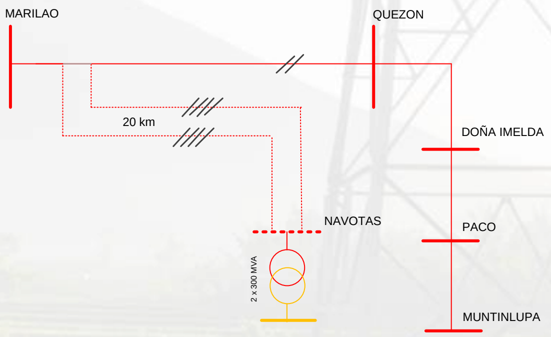
8.1.33 South Luzon 230 kV Substation Upgrading Project

The South Luzon Substation Upgrading Project caters to the load growth and provides N-1 contingency to various substations in NGCP's South Luzon Region which include Las Piñas, Lumban, Labo, Naga, Gumaca, and Daraga Substations. The Project involves transformer installations, and replacement and rearrangements of power circuit breakers to ensure reliability and flexibility of operations on the concerned substations.

8.1.34 South Luzon 230 kV Substation Upgrading Project 2

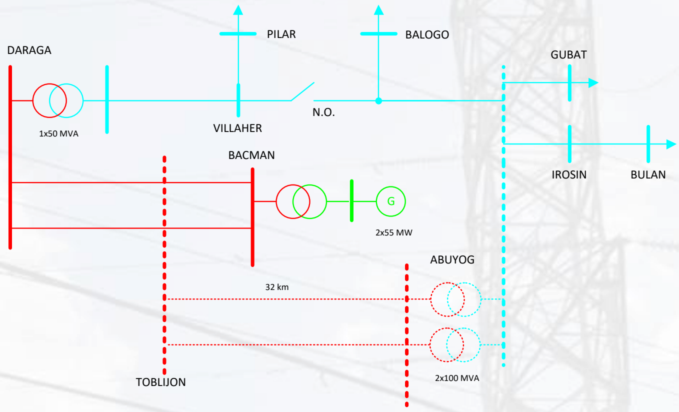
The South Luzon Substation Upgrading Project 2 caters to the load growth and provides N-1 contingency to various substations in NGCP's South Luzon Region in Lumban, Gumaca, Tuy, Labo, and Calaca Substations. The Project involves transformer installations to ensure the adequacy of transformer capacity to serve the loads. Furthermore, capacitor installations in Quezon and Taytay will be implemented to address power quality. Also, the Project involves the replacement and installation of power circuit breakers in areas such as Biñan, Dasmariñas, Naga, and Muntinlupa Substations to ensure reliability and flexibility of operations on the concerned substations.

8.1.35 Navotas 230 kV Substation



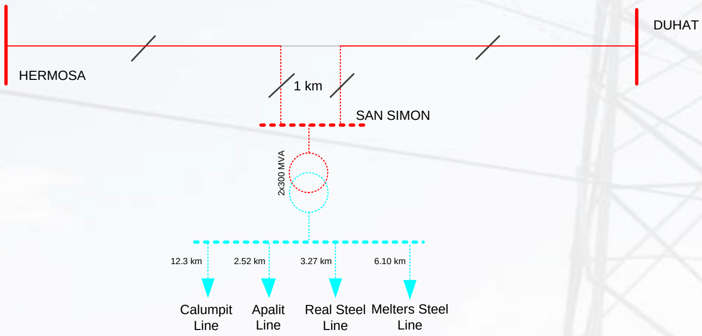
The Navotas 230 kV Substation caters to the load growth in the Sector 1 of MERALCO and serves as a connection point for power plants in the area such as the TMO and Millennium Power Plants. With the further increase in load, the existing 230/115 kV substations in Metro Manila become heavily loaded and have been losing already the provision for N-1 contingency. This will expose the Metro Manila loads to supply reliability risk as well as power quality concerns during system peak load conditions. The proposed Navotas 230 kV Substation will be initially linked to the grid through cut-in connection along the existing Marilao–Quezon 230 kV Transmission Line and will ultimately terminate in the future Marilao 500 kV Substation. The Project will be a Gas Insulated Switchgear (GIS) substation due to the space constraints for an outdoor substation.

8.1.36 Abuyog 230 kV Substation



The Abuyog 230 kV Substation Project establishes a 230 kV drawdown substation closer to the loads in Sorsogon which will address the supply reliability issues, meet the long-term projected demand and address the power quality issues at the load-end substations. Presently, the whole province of Sorsogon is solely relying on a single-circuit 69 kV line being supplied from Daraga Substation which is located in Albay. The proposed Abuyog 230 kV Substation will connect to a new switching station in Toblijon, Sorsogon through a 25.4 km ST-DC, 2-795 MCM ACSR transmission line. The switching station will bus-in along Daraga–Bacman 230 kV Line. The Abuyog Substation involves the installation of a 2x100 MVA, 230/69-13.8 kV Power Transformer.

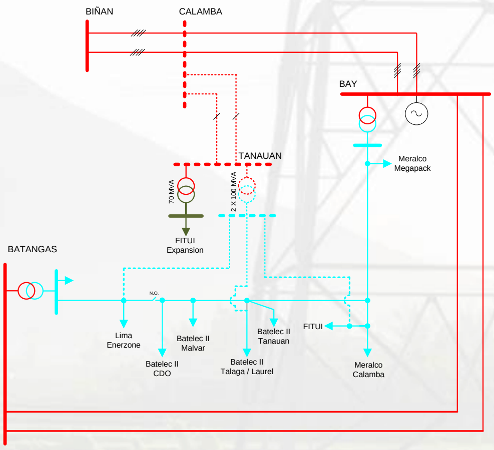
8.1.37 San Simon 230 kV Substation



The San Simon 230 kV Substation Project will accommodate the further load growth of the steel plants and will also support the entry of other new industrial loads in the southeastern part of the province of Pampanga which is presently served by the existing Mexico 230 kV Substation and underlying 69 kV facilities. This will also serve as an alternate source substation for the loads connected at Mexico Substation. The San Simon 230 kV Substation will bus-in along the existing Hermosa–Duhat 230 kV Line and will involve the installation of 2x300 MVA 230/69 kV transformers. A 69 kV switchyard and 69 kV transmission facilities will also be implemented for the connection of the 69 kV loads.

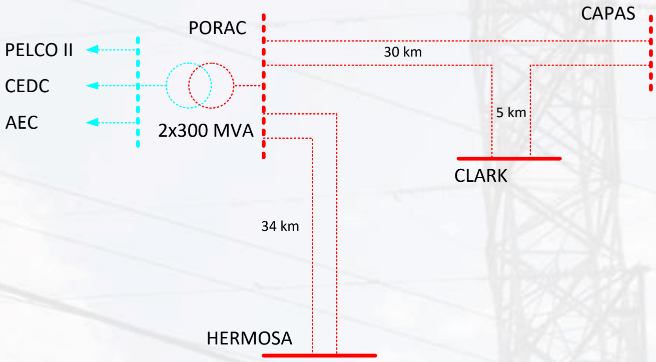
8.1.38 Tanauan 230 kV Substation

The Tanauan 230 kV Substation Project caters to the load growth of Batangas and Laguna Area particularly loads of MERALCO Calamba, BATELEC II, and the industrial loads. The proposed substation will relieve the overloading along the Bay–Calamba 69 kV Line, the Bay 2x100 MVA 230/69 kV transformer, and improve the power quality at the loads. The Project involves the development of Tanauan 230 kV Substation and will be radially connected to the Calamba 230 kV Substation.



8.1.39 Porac 230 kV Substation

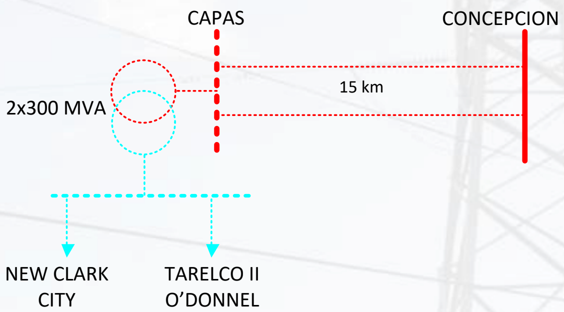
The Porac 230 kV Substation Project supports the load growth in Pampanga specifically the development of major loads such as Alviera. This project also aims to establish the 230 kV backbone loop from Hermosa in Bataan to Concepcion in Tarlac. This will provide more direct access to the generation hub in Bataan. The Porac 230 kV Substation will draw its power from the Hermosa and Capas 230 kV Substations through the proposed Hermosa–Porac–Capas 230 kV Lines.



The project includes the installation of a 230/69 kV switchyard with a transformer capacity of 2x300 MVA. The 230 kV backbone loop from Bataan to Tarlac will be completed with the implementation of the 64 km double circuit Hermosa– Porac–Capas 230 kV Line.

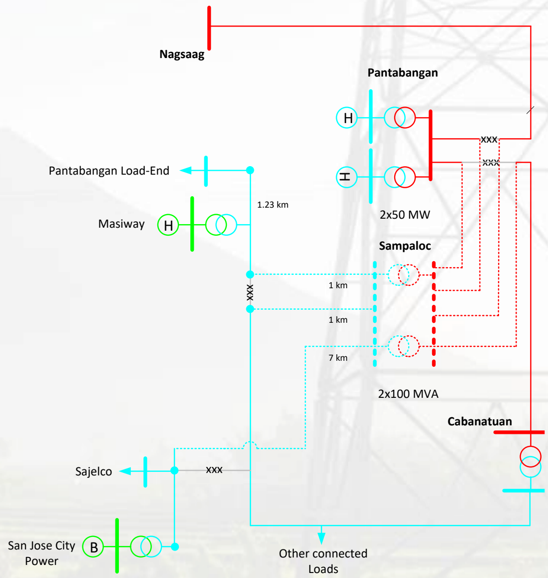
8.1.40 Capas 230 kV Substation

The Capas 230 kV Substation Project supports the load growth in Tarlac specifically the development of major loads such as Clark Green City. The Capas 230 kV Substation will draw its power from the Concepcion 230 kV Substation through the proposed Concepcion–Capas 230 kV Line. The project involves the installation of a 2x300 MVA 230/69 kV transformer and 15 km double circuit 230 kV transmission line from Concepcion to Capas 230 kV Substation.



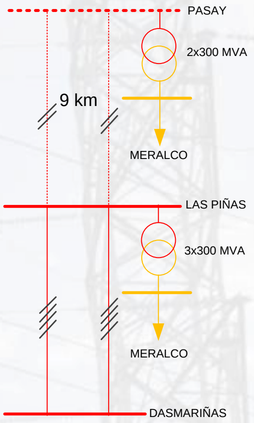
8.1.41 Sampaloc 230 kV Substation

The Sampaloc 230 kV Substation Project establishes an additional 230 kV drawdown substation in Nueva Ecija. This 230 kV drawdown substation will relieve the heavy loading of the existing 69 kV line from Cabanatuan going to Pantabangan LES. This project will address the supply reliability issues, meet the long-term projected demand and address the power quality issues at the load-end substations. The Sampaloc 230 kV Substation will be connected to the Luzon Grid through a 'bus-in' along the Nagsaag–Pantabangan 230 kV Line and the Cabanatuan–Pantabangan 230 kV Line via a 2 km ST-DC 1-795 MCM ACSR/AS 230 kV Transmission Line with 2x100 MVA transformer capacity. Ultimately, this substation will be linked to Nagsaag and Cabanatuan 230 kV Substations through a new double-circuit Sampaloc–Nagsaag–Cabanatuan 230 kV Transmission Line.



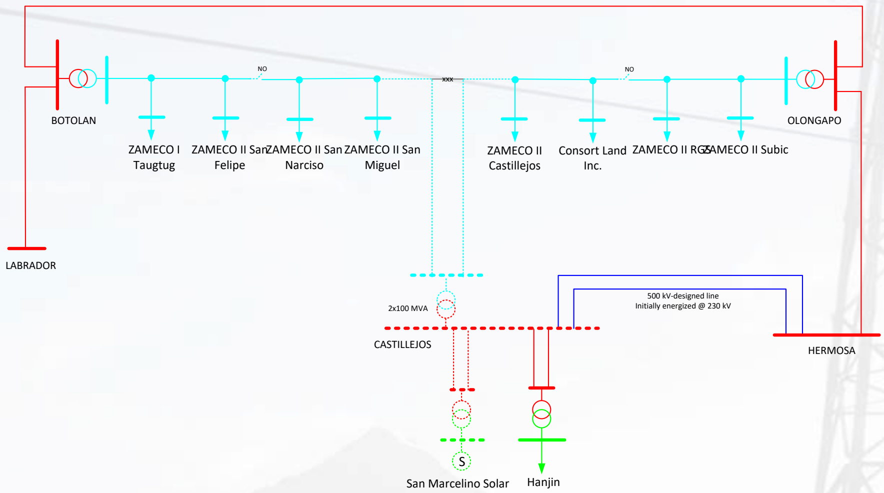
8.1.42 Pasay 230 kV Substation

The Pasay 230 kV Substation Project caters to the load growth of MERALCO's load sector 3 which is presently being served by Las Piñas and Muntinlupa Substations. The Las Piñas and Muntinlupa Substation have a space limitation for expansion, thus the need for a new drawdown substation to cater load growth and provide adequate space for future expansion. The Project will be developed close to the load growth area in the Entertainment City in Pasay and will also support the loads in Makati City. It will be connected radially to the Las Piñas 230 kV Substation.



8.1.43 Castillejos 230 kV Substation

The Castillejos 230 kV Substation Project caters to the load growth in Zambales. The Castillejos Substation will have a transformer capacity of 2x100 MVA and will serve as an alternative source to loads of Botolan and Olongapo 230 kV Substations. The Castillejos 230 kV substation will also serve as the connection point of San Marcelino Solar and any other future bulk generation development in the area. The new substation will connect to the Hermosa 230 kV Substation thru the Castillejos–Hermosa 500 kV Transmission Line (initially energized at 230 kV).



8.1.44 Luzon Voltage Improvement Project 3

The Luzon Voltage Improvement Project 3 addresses the anticipated undervoltage problem during peak load condition and overvoltage problem during off peak load condition at various 500 kV, 230 kV and 69 kV load-end substations in the North Luzon Grid. The Luzon Voltage Improvement Project 3 involves the installation of capacitors and reactors to substations in the North Luzon Region, Baler, Pantabangan, Umingan, Camiling, San Esteban, Botolan, Itogon, Antipolo and Bautista Substations.

8.1.45 Luzon Voltage Improvement Project 4

The Luzon Voltage Improvement Project 4 addresses the anticipated undervoltage problem during peak load condition at various 69 kV load-end substations in the South Luzon Grid. The Luzon Voltage Improvement Project 4 involves the installation of capacitors to substations in the South Luzon Region. The capacitor installation will be implemented in Ligao, Iriga, Irosin, Mabini, Cuenca, Taysan, Tanauan, San Roque, and Lagonoy 69 kV Load End Substations.

8.1.46 Luzon Voltage Improvement Project 5

The Luzon Voltage Improvement Project 5 addresses the anticipated undervoltage problem during peak load condition at various load-end substations in Cagayan, Tarlac, Nueva Ecija, Pampanga, Zambales, Pangasinan, Batangas, Quirino, Isabela, Nueva Viscaya, and Benguet.

8.2 Transmission Outlook for 2030

The province of Batangas is still among the major bulk generation hubs in the Luzon Grid. To accommodate these generation capacities require the development of the Tuy 500 kV Substation (Stage 2). This project also involves the implementation of the 500 kV-designed Tuy–Silang 500 kV Transmission Line. It will also be complemented by the development of a new 500 kV transmission corridor from Pinamucan to Tuy 500 kV Substation. Meanwhile, the proposed hydro and wind farms in the Mountain Province will be connected to the grid through the La Trinidad–Sagada 230 kV Transmission Line Project. On the other hand, Ilocos Norte being within one of the CREZ in Northern Luzon, any additional generation will be accommodated by both Bolo–Balaoan 500 kV Transmission Line and the Balaoan–Laoag 500 kV Transmission Line Projects. Another bulk generation location for Renewable Energy and Coal Plants is the province of Zambales. These generation capacities will be accommodated by the Palauig 500 kV Substation and the development of new 500 kV transmission corridor from Palauig to San Antonio in Nueva Ecijan and eventually to Baras, Rizal.

To meet the forecasted load growth needs the development of new drawdown substations. These include the development of Magalang, Guagua, and Apalit 230 kV Substations in Pampanga, Baler 230 kV Substation in Aurora, San Fabian 230 kV Substation in Pangasinan, Valenzuela 230 kV Substation in Metro Manila, Balanga 230 kV Substation in Bataan, Cabatuan 230 kV Substation in Isabela, San Isidro 230 kV Substation in Nueva Ecija, Malvar 230 kV Substation in Batangas, Iriga 230 kV Substation in Camarines Sur, Nuvali 230 kV Substation in Laguna and San Agustin 230 kV Substation in Tarlac. Furthermore, additional 69 kV transmission lines will be implemented to address the heavy loading of the existing 69 kV transmission lines.

To maintain the reliability of transmission facilities, the old transmission facilities will be upgraded. These include the upgrading of the Cabanatuan–San Rafael–Mexico 230 kV transmission corridor, the Hermosa–Mexico 230 kV Transmission Line, and the Mexico–Clark 69 kV Transmission Line. In North Luzon, the Bauang–La Trinidad 230 kV Transmission Line will also be upgraded. In Metro Manila, additional transmission lines will be implemented such as the Limay–Pasay and Pasay–Taguig 230 kV lines.

Lastly, to effectively regulate the voltage in the grid, additional capacitors will be installed.

Table 8.2: Luzon Transmission Outlook for 2030

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Description	ETC
500 kV	Taguig-Silang 500 kV TL Filed to ERC	▪ The project aims to address the overloading of the San Jose-Tayabas 500 kV TL during N-1 condition and to provide a new transmission corridor that will supply the loads in Metro Manila. ▪ Location: Cavite, Metro Manila	Feb 2027
	Nagsaag-Santiago 500 kV TL Filed to ERC	▪ The project aims to serve as a new transmission backbone to support the generation developments in Cagayan Valley and Cordillera. ▪ Location: Isabela, Pangasinan	May 2027
	Bolo-Balaoan 500 kV TL Filed to ERC	▪ The project aims to accommodate bulk generation capacity addition in the northwestern part of Luzon Grid. The project will enable to allow the entry of the proposed additional wind farms in Ilocos Norte, the 1,200 MW Luna Coal Plant in La Union, and the 500 MW Coheco Badeo in Benguet. ▪ Location: La Union, Pangansinan	Apr 2028
	Balaoan-Laoag 500 kV TL Filed to ERC	▪ The project aims to accommodate the entry of wind farm and solar PV projects in the Province of Ilocos Norte. The existing 230kV transmission facilities in the grid will not be able to accommodate these incoming Renewable Energy (RE) plants.	Apr 2028

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Description	ETC
		▪ Location: La Union, Ilocos Norte	
	Pinamucan-Tuy 500 kV Line Filed to ERC	▪ The project will accommodate additional generation capacity and will also provide reliability in the 500kV Network in Batangas City. ▪ Location: Batangas, Laguna	Jan 2029
	Baras-San Antonio 500 kV TL	▪ To support the delivery of bulk generation going to the loads in Central Luzon, especially during Maximum South Generation Scenario. ▪ Location: Rizal	Dec 2030
	Baras-Pinamucan 500 kV TL	▪ To support the delivery of bulk generation from Batangas City Area going to Metro Manila. ▪ Location: Rizal	Dec 2030
230kV	Marilao-Mexico 230 kV TL Filed to ERC	▪ The project aims to address the overloading of Quezon– Mexico 230 Line during N-1 contingency and maximum north generation dispatch. The congestion of Quezon-Mexico 230 kV Line will result to generation curtailment. ▪ Location: Pampanga, Bulacan	Aug 2027
	Tower Resiliency of Bicol Transmission Facilities Filed to ERC	▪ The project aims to replace the steel tower structure of Naga-Tiwi-Daraga, Naga-Labo and Daraga-Tublijon TL to withstand strong typhoons. ▪ Location: Camarines Sur, Albay, Sorsogon	Sep 2027
	San Jose-San Rafael 230 kV TL Upgrading	▪ The project aims to strengthen the reliability of San Jose—San Rafael 230 kV TL by upgrading the existing single circuit line to double circuit lines. And increasing its transmission capacity from 300 MVA to 1,275 MVA. ▪ Location: Bulacan	Oct 2027
	Bauang-La Trinidad 230 kV TL Upgrading Filed to ERC	▪ The project aims to address the overloading of the old Bauang-La Trinidad 230 kV TL during n-1 contingency and maximum north generation dispatch. ▪ Location: La Union, Benguet	Dec 2027
	Northern Luzon 230 kV Loop Filed to ERC	▪ The Project aims to provide a new transmission corridor to accommodate renewable energy and other power plants in the Northern part of Luzon. Also, it will ensure the system reliability and operational flexibility in the Ilocos Region and Cagayan Valley through the 230 kV looping. ▪ Location: Ilocos Norte, Apayao, Cagayan	Dec 2027
	La Trinidad-Sagada 230 kV TL	▪ The project will be accommodating the upcoming Hydroelectric Power Plants and Wind Farms on Mountain Province ▪ Location: Benguet	Dec 2027
	Bauang-Balaoan 230 kV TL Upgrading	▪ To upgrade the single bundle Bauang-Balaoan 230 kV line to 4-795 CM ACSR to accommodate the generation capacities and increase of demand in La Union. ▪ Location: La Union	Dec 2027
	Navotas-Doña Imelda 230 kV TL ERC-approved	▪ It involves the construction of the 10 km SPDC, 2-410 mm2 TACSR/AS, 230 kV Line from Manila to Doña Imelda 230 kV SS. This project will provide additional transmission corridor that will complement the	Jan 2028

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Description	ETC
		existing single-circuit Quezon (Balintawak)–Doña Imelda (Araneta)–Paco–Muntinlupa (Sucat) 230 kV line. ▪ Location: Navotas, Quezon City	
	Cabanatuan–Sampaloc–Nagsaag 230 kV TL Filed to ERC	▪ The project aims to address the overloading of the existing single circuit, Cabanatuan–Sampaloc and Sampaloc–Nagsaag 230 kV transmission line. Aside from the anticipated overloading, these transmission facilities already reached its 50-year asset life and thus, provides low reliability. ▪ Location: Nueva Ecija, Pangasinan	Feb 2028
	Cabanatuan–San Rafael–Mexico 230 kV TL Upgrading	▪ The project aims to address the low reliability of the existing lines due to the aging of the conductor cable. ▪ Location: Nueva Ecija, Pampanga, Bulacan	Apr 2028
	Hermosa–Mexico 230 kV TL Upgrading	▪ The project aims to address the anticipated overloading of the aforementioned 230 kV line due to increase in the demand of Pampanga Province. ▪ Location: Bataan, Pampanga	Dec 2028
	Calaca–Salong 230 kV TL 2	▪ The project will provide provision for single outage contingency for the existing single circuit Calaca–Salong 230 kV TL. ▪ Location: Batangas	Dec 2028
	Pasay–Taguig 230 kV TL	▪ The project will increase the reliability of 230 kV TL supplying the loads of Metro Manila. ▪ Location: Metro Manila	Dec 2030
	Navotas–Pasay 230 kV TL	▪ The project aims to provide additional reliability of supply in Metro Manila through a new transmission corridor that will connect the northern and southern part of the grid. ▪ Location: Metro Manila	Dec 2030
	Naga–Presentacion 230 kV TL	▪ The project aims to cater the Load Growth the Eastern part of Camarines Sur. It will also complement the proposed Presentacion 230 kV SS Project and future plans to interconnect the Catanduanes Island to the Luzon Grid. ▪ Location: Camarines Sur	Dec 2030
	Pasay–Limay 230 kV TL	▪ The project will increase the reliability of 230 kV TL supplying Meralco Sector 1 and secure the supply of power in the area. ▪ Location: Bataan, Metro Manila	Dec 2030
69kV	North Luzon 69 kV TL Upgrading 1	▪ The project aims to mitigate the impending overloading of various 69 kV TL on North Luzon. and will prevent the undervoltage problem on various points along the 69 kV Transmission. ▪ Location: Ilocos Sur, Benguet, Cagayan, Bataan, Zambales	Mar 2026
	South Luzon 69 kV TL Upgrading 1	▪ The project aims to relieve the overloading of various 69 kV TL in NGCP's South Luzon Region to prevent load dropping and power interruptions during peak loading. ▪ Location: Batangas, Camarines Norte, Camarines Sur, Albay	Jun 2026
	Mexico–Clark 69 kV TL Upgrading	▪ The project aims to cater the growing demands of the loads of PRESCO and PELCO I. ▪ Location: Pampanga	Apr 2027

SUBSTATION PROJECTS			
Voltage	Project Name	Description	ETC
500kV	Tuy 500/230 kV SS (Stage 2) Filed to ERC	▪ The project aims to accommodate the connection of bulk generation capacity additions in Batangas. ▪ Location: Batangas	Oct 2027
	Silang 500 kV SS Filed to ERC	▪ The project aims to address the overloading of the Dasmariñas 4x600 MVA 500/230 kV Transformers. this will provide termination of the new 500 kV transmission line coming from Taguig 500 kV Substation and the receiving 500 kV substation for the new 500 kV TL from the Tuy 500 kV SS complementing and completing the 500 kV loop serving Metro Manila. ▪ Location: Cavite	Feb 2027
	Marilao 500 kV SS Expansion	▪ The project involves the installation of a 3rd 1,000 MVA 500/230 kV transformer bank at Marilao 500 kV SS to serve the load growth in Metro Manila. ▪ Location: Bulacan	Dec 2027
	Taguig EHV SS Expansion	▪ The project involves the installation of a 3rd 1,000 MVA 500/230 kV transformer bank at Taguig 500 kV SS to serve the load growth in Metro Manila. ▪ Location: Metro Manila	Dec 2027
	Bolo 5th Bank	▪ The Bolo 5th Bank Project aims to maintain the N-1 contingency provision of Bolo 500 kV SS. ▪ Location: Pangasinan	Dec 2028
	Tagkawayan 500 kV SS Filed to ERC	▪ The project aims to accommodate entry the 1,200 MW Tagkawayan Coal-Fired Power Plant in Tagkawayan, Quezon and the 700 MW Jose Panganiban Coal-Fired Power Plant in Jose Panganiban, Camarines Norte. ▪ Location: Tagkawayan, Quezon Province	Feb 2029
	Baras 500 kV SS	▪ The project will accommodate the entry of power plants in Rizal to supply the demand load of Metro Manila and swill increase the reliability of the 500 kV backbone of the Luzon Gird. ▪ Location: Rizal	Feb 2029
	Sta. Maria 500 kV SS	▪ To accommodate generation capacities in Rizal and Laguna. ▪ Location: Laguna	Dec 2030
	San Antonio 500 kV SS	▪ To provide a new 500 kV drawdown SS to Central Luzon. ▪ Location: Nueva Ecija	Dec 2030
	Alaminos EHV SS	▪ The project will accommodate the entry of power plants in Batangas and Quezon Province and to supply the demand of South Luzon. This will also increase reliability of the 500 kV backbone of the South Luzon Grid. ▪ Location: Laguna	Dec 2030
230kV	Plaridel 230 kV SS Filed to ERC	▪ The project will serve as an additional drawdown substation to address the continuous load growth in MERALCO's Bulacan Sector. The substation will also provide N-1 contingency provision to the 230/69 kV transformers at San Rafael and Malolos SS. ▪ Location: Bulacan	Feb 2026

SUBSTATION PROJECTS			
Voltage	Project Name	Description	ETC
	Kawit 230 kV SS Filed to ERC	▪ The project involves the development of a new drawdown SS in Kawit, Cavite with a 2x300 MVA transformer capacity to cater the load growth in the Cavite Sector of MERALCO. The project will relieve the overloading of Dasmariñas 3x300 MVA 230/115 kV transformers. ▪ Location: Cavite	May 2026
	North Luzon 230 kV SS Upgrading 2 Filed to ERC	▪ To cater the load growth and provide N-1 contingency to substations in NGCP's North Luzon Region. Without the project, power interruptions will be experienced by customers during failure of existing transformers and power circuit breakers. ▪ Location: La Union, Ilocos Norte, Nueva Vizcaya, Isabela, Ilocos Sur, Pangasinan, Cagayan, Tarlac, Pampanga, Zambales, Nueva Ecija	May 2027
	Dasol 230 kV SS Filed to ERC	▪ The project aims to cater the load growth in PANELCO I and ZAMECO I franchise areas. The project will relieve the projected overloading of the Labrador–Bolinao and Botolan–Candelaria 69 kV Transmission lines along with the overloading of the transformers in Labrador and Botolan 230 kV SS. ▪ Location: Zambales	Dec 2027
	Magalang 230 kV SS	▪ The project aims to provide an additional drawdown SS in the province of Pampanga. This will improve the reliability of the supply of loads in Pampanga to act as another connection point of distribution utilities in the area. ▪ Location: Pampanga	Dec 2027
	San Agustin 230 kV SS	▪ The project aims to provide an additional drawdown SS in the province of Tarlac to address the anticipated overloading of the existing 230/69 kV transformers and associated 69 kV TL both in the province of Tarlac and Pangasinan. The project will also improve the reliability of the supply of loads in Tarlac and Pangasinan acting as another connection point of distribution utilities in the area. ▪ Location: Tarlac	Dec 2027
	Apalit 230 kV SS	▪ The project aims to provide an additional drawdown SS in the province of Pampanga. This project will improve the reliability of the supply of loads in Pampanga acting as another connection point of distribution utilities in the area. ▪ Location: Pampanga	Dec 2027
	Guagua 230 kV SS	▪ The project aims to provide an additional drawdown SS in the province of Pampanga. This project will improve the reliability of the supply of loads in Pampanga acting as another connection point of distribution utilities in the area. ▪ Location: Pampanga	Dec 2027
	San Fabian 230 kV SS Filed to ERC	▪ The project aims to cater the load growth of both provinces of Pangasinan and La Union. ▪ Location: La Union	Mar 2028
	Olongapo 230 kV SS Upgrading Filed to ERC	▪ The project aims to improve the reliability of the SS. This project will allow the continuous source of power to the load even with the failure of one of its breakers, the project will also address overloading of the transformers during normal and N-1 contingency. ▪ Location: Zambales	Mar 2028

SUBSTATION PROJECTS			
Voltage	Project Name	Description	ETC
	Iriga 230 kV SS	▪ The project aims to cater the Load Growth of the Province of Camarines Sur. ▪ Location: Camarines Sur	Dec 2028
	Malvar 230 kV SS	▪ The project aims to cater the Load Growth of the Province of Batangas. ▪ Location: Batangas	Dec 2028
	Balanga 230 kV SS	▪ The project aims to provide an additional drawdown SS in the province of Bataan. This project will improve the reliability of the supply of loads in Bataan since it will act as another connection point of distribution utilities in the area. ▪ Location: Bataan	Dec 2028
	San Isidro 230 kV SS	▪ The project aims to provide an additional drawdown SS in the province of Nueva Ecija. This project will improve the reliability of the supply of loads in Nueva Ecija since it will act as another connection point of distribution utilities in the area. ▪ Location: Nueva Ecija	Dec 2028
	FBGC 230 kV SS	▪ The project will address the anticipated overloading of the existing 230 kV SS serving Sector 3 of the MERALCO Franchise. ▪ Location: Metro Manila	Dec 2028
	Baler 230 kV SS Project Filed to ERC	▪ The project aims to address the forecasted overloading of the Cabanatuan–Baler 69 kV TL ▪ Location: Nueva Ecija, Aurora	Apr 2029
	Valenzuela 230 kV SS	▪ The project will address the anticipated overloading of the existing 230 kV SS serving Sector 1 of the MERALCO Franchise ▪ Location: Metro Manila	Dec 2030
	Nuvali 230 kV SS	▪ The project aims to provide additional drawdown SS in Sta. Rosa, Laguna. This project will improve power quality and the reliability of supply MERLACO's Laguna Sector as another connection point in the area. ▪ Location: Laguna	Dec 2030
	Cabatuan 230 kV SS	▪ The project aims to provide additional drawdown SS in the province of Isabela. This project will improve the reliability of supply of loads in Isabela as another connection point of distribution utilities in the area. ▪ Location: Isabela	Dec 2030
	Masiit 230 kV Collector Station	▪ To accommodate generation capacities in Laguna. ▪ Location: Laguna	Dec 2030
115kV	Minuyan 115 kV Switching Station Filed to ERC	▪ The project aims to provide reliable connection of the industrial loads (cement plants) in the area of BulacanThe switching station will provide flexibility and enables to isolate the fault to prevent power interruption to the other connected customers. ▪ Location: Bulacan	Feb 2026

VOLTAGE IMPROVEMENT PROJECTS			
Voltage	Project Name	Description	ETC
230kV	Luzon Voltage Improvement 6 Filed to ERC	▪ The project addresses the anticipated undervoltage problem during peak load condition at various 69 kV load-end SS in the north and south Luzon Grid. It involves the installation of capacitors to substations in the North and South Luzon Region. ▪ Location: Pangasinan, Cagayan, Tarlac, Zambales, Bulacan, Laguna, Camarines Sur	Mar 2026
	Luzon Voltage Improvement Project 7	▪ To provide additional reactive power support in the network to maintain the system voltage within ±5% of the nominal voltage during normal and single outage contingencies as prescribed under the Philippine Grid Code (PGC). ▪ Location: Metro Manila, Bulacan, Laguna, Pampanga, Cavite	Dec 2027

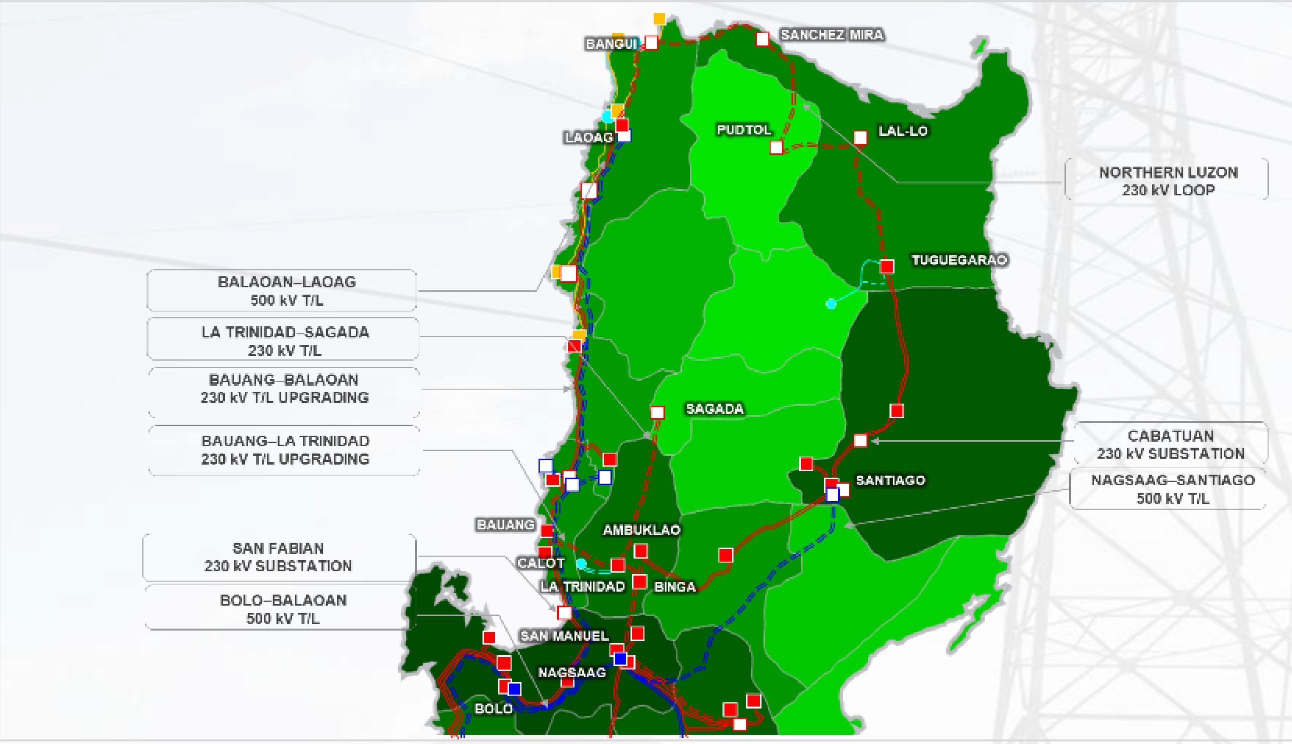


Figure 8.6: North Luzon Transmission Outlook for 2030

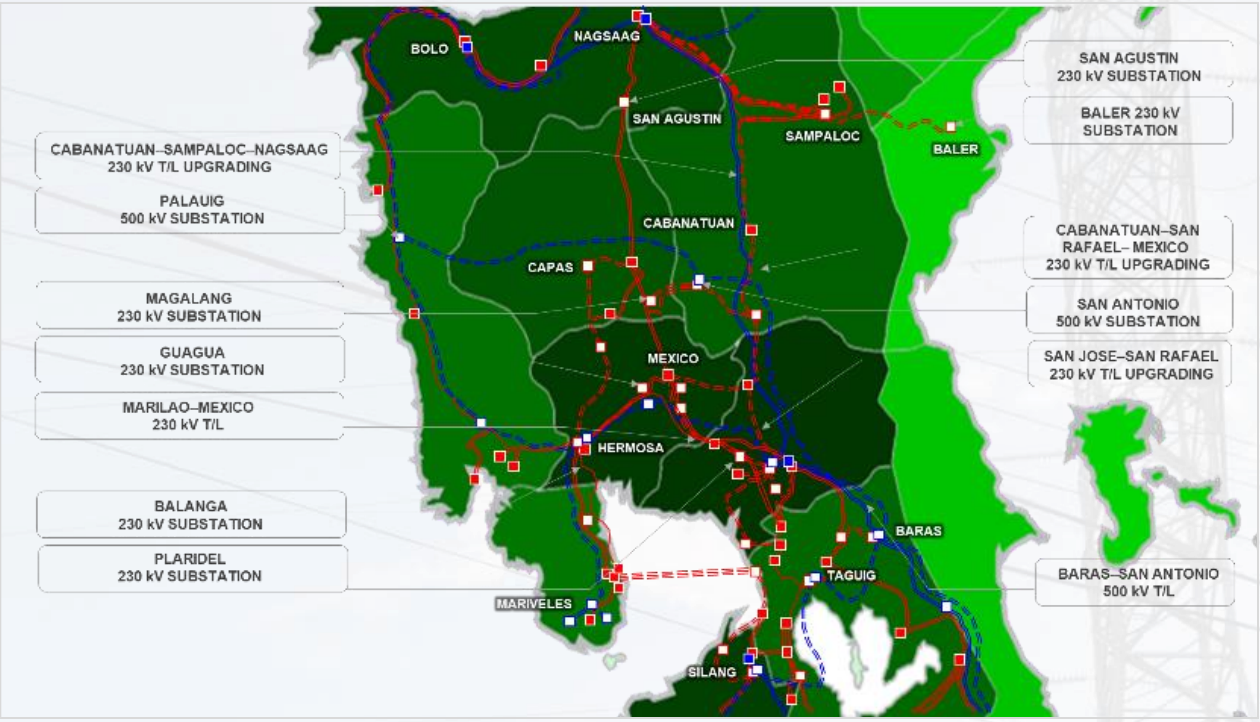


Figure 8.7: Central Luzon Transmission Outlook for 2030

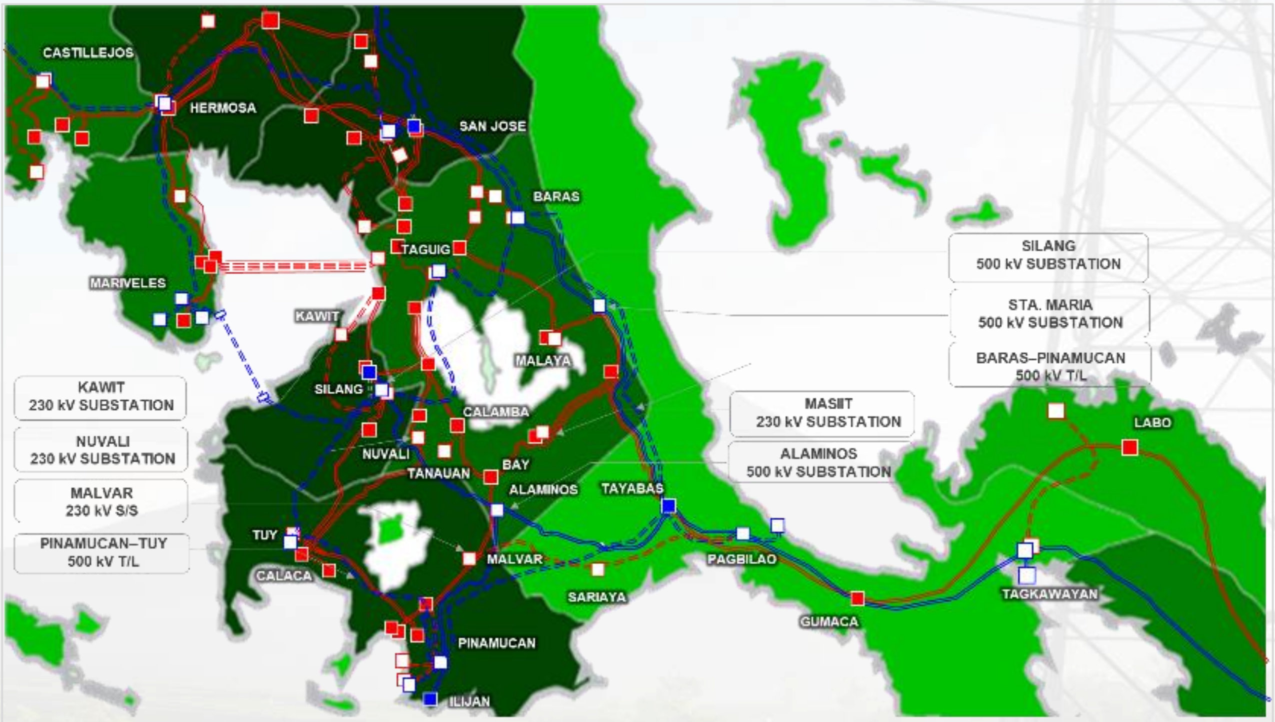


Figure 8.8: Metro Manila Transmission Outlook for 2030

Figure 8.9: South Luzon Transmission Outlook for 2030

Figure 8.10: Bicol Region Transmission Outlook for 2030

8.3 Transmission Outlook for 2035

In the period 2031-2035, the development of new delivery substations is needed to meet the forecasted increase in demand in some provinces. These substations are the Sariaya 230 kV Substation in Quezon, Presentacion 230 kV Substation in Camarines Sur, Bustos 230 kV Substation in Bulacan, and San Mateo 230 kV Substation in Rizal.

The existing transmission line capacity in Metro Manila will be further increased by upgrading the Taguig–Muntinlupa 230 kV Transmission Line from single circuit to double circuit.

Table 8.3
Luzon Transmission Outlook for 2035

TRANSMISSION LINE PROJECTS		
Voltage	Project Name	Description
500 kV	Santiago–Kabugao 500 kV TL	▪ The project will accommodate the entry of power plants in Kabugao to ensure that the power supply will meet the demand load of Luzon Grid and will increase the reliability of the 500 kV backbone. ▪ Location: Apayao, Isabela
230kV	Taguig–Muntinlupa 230 kV TL 2	▪ The proposed Taguig–project aims to strengthen the corridor of the 230 kV TL in Metro Manila due to the continuous increase of loading in Metro Manila. In addition, the proposed additional 230 kV line will improve the reliability of the system as it will provide N-1 contingency ▪ Location: Metro Manila

SUBSTATION PROJECTS		
Voltage	Project Name	Description
500kV	Bacolor 500 kV SS	▪ The proposed project involves the development of a new 500 kV substation in Bacolor, Pampanga to address the load growth in the area. The 500 kV TL of the proposed Bacolor 500 kV SS will bus-in along Marilao–Hermosa 500 kV TL, on the other hand, the 230 kV will bus-in along Mexico–Guagua 230 kV TL. ▪ Location: Pampanga
	Dasmariñas 500 kV SS Upgrading	▪ The proposed project aims to upgrade the existing capacity of Dasmariñas SS to serve the increasing loads of various substations in the area. ▪ Location: Cavite
230kV	North Luzon SS Upgrading 3	▪ The project aims to cater the load growth and provide N-1 contingency to various SS in NGCP's North Luzon Region. Without the project, the customers being served by these substations will experience load dropping and power interruptions during outage and failure of existing transformers and power circuit breakers. ▪ Location: Ilocos Norte, Benguet, Pangasinan, Isabela, Cagayan, Bataan, Zambales, Tarlac, Pampanga, Nueva Ecija
	South Luzon SS Upgrading 3	▪ The project aims to cater the load growth and provide N-1 contingency to various SS in NGCP's South Luzon Region. Without the project, the customers being served by these SS will experience load dropping and power interruptions during outage and failure of existing transformers and power circuit breakers. ▪ Location: Batangas, Albay
	San Mateo 230 kV SS	▪ The proposed project aims to provide an additional drawdown SS in San Mateo, Rizal. This project will also improve power quality and the reliability of supply in MERLACO's Sector 2 since it will act as another connection point in the area. ▪ Location: Metro Manila
	Bustos 230 kV SS	▪ The project will support the load growth in Bulacan and will help unload the San Rafael 230 kV SS. ▪ Location: Bulacan

SUBSTATION PROJECTS		
Voltage	Project Name	Description
	Sariaya 230 kV SS	▪ The project aims to cater the Load Growth of the Province of Quezon and the eastern part of Batangas. ▪ Location: Quezon
	Presentacion 230 kV SS	▪ The project aims to cater the Load Growth in the Eastern part of Camarines Sur. It will utilize the proposed Naga-Presentacion 230 kV TL. The project will also be the connection in the future of the Catanduanes Luzon Island Interconnection. ▪ Location: Camarines Sur

VOLTAGE IMPROVEMENT PROJECTS		
Voltage	Project Name	Description
230kV	Luzon Voltage Improvement Project 8	▪ The proposed project involves the installation of Capacitor on various 230 kV SS in Luzon. ▪ Location: Pampanga, Laguna, Batangas

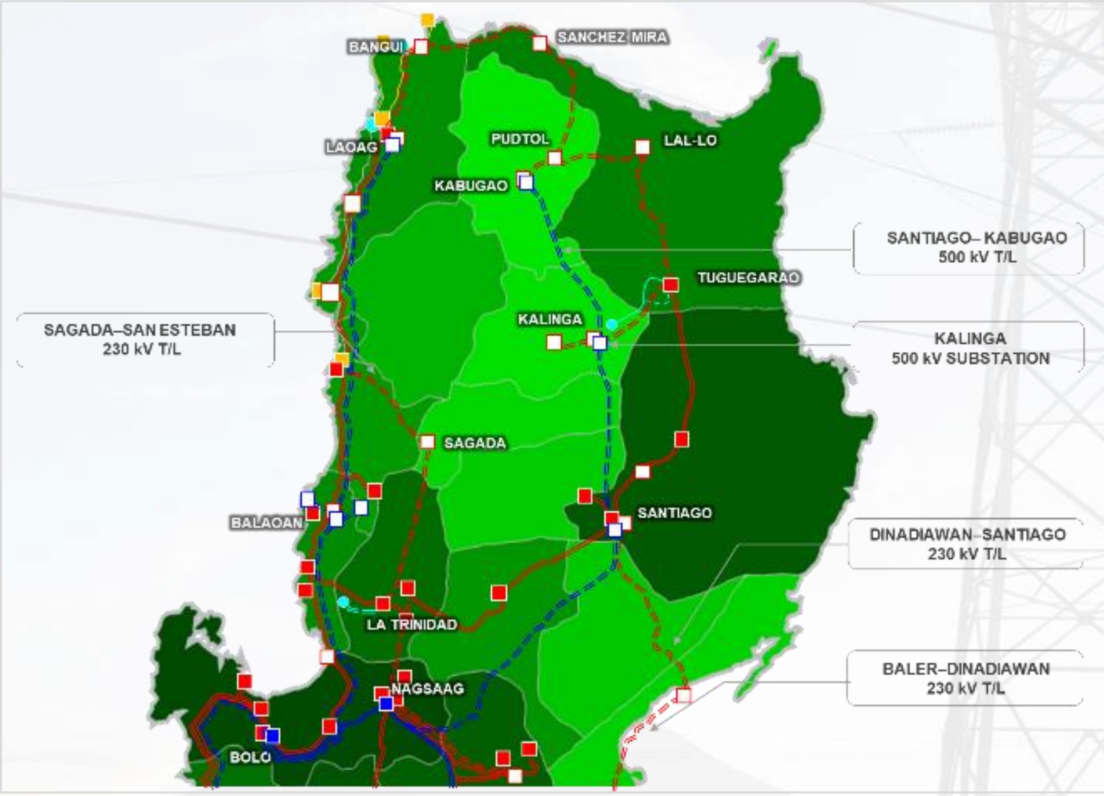


Figure 8.11: North Luzon Transmission Outlook for 2031-2040

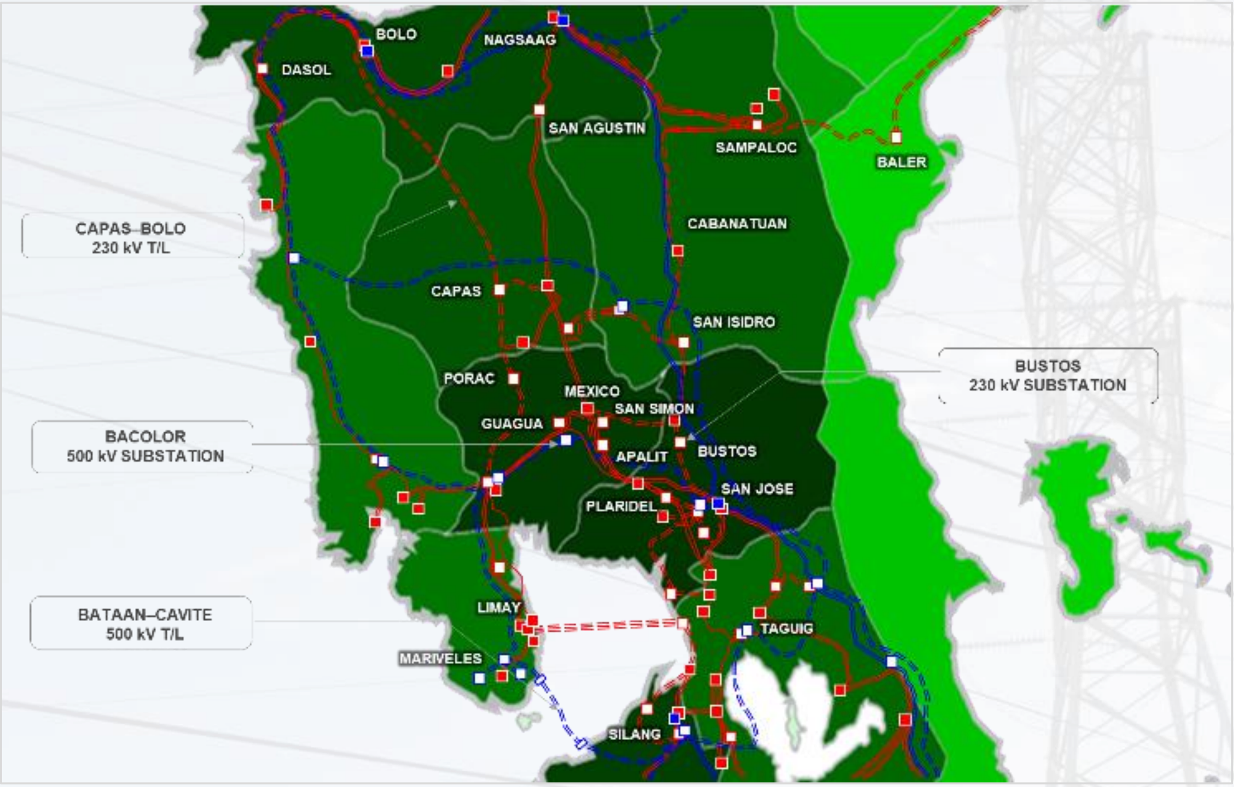


Figure 8.12: Central Luzon Transmission Outlook for 2031-2040

Figure 8.13: Bicol Region Transmission Outlook for 2031-2040

8.4 Transmission Outlook for 2040

From year 2035 to 2040, most of the projects will be focusing on the improvement of system reliability. On the 500 kV network, the Bataan–Cavite 500 kV Transmission Line will be implemented. In the northern part of Luzon Grid, the transmission backbone for the province of Aurora will be developed through the Baler–Dinadiawan–Santiago Transmission Line Project. The Sagada–San Esteban 230 kV Transmission Line will provide transmission corridor in Mountain Province by completing the La Trinidad–Sagada-San Esteban 230 kV transmission loop. Another transmission corridor will also be developed through the proposed Capas–Kadampat 230 kV Line.

To accommodate additional generation capacities, the Kalinga 500 kV Substation will be developed to cater to the proposed Hydropower Plants in the area. In Sorsogon, the Matnog 230 kV Substation will be developed to cater to wind farm projects.

Table 8.4: Luzon Transmission Outlook 2040

TRANSMISSION LINE PROJECTS		
Voltage	Project Name	Description
500kV	Bataan-Cavite 500 kV TL	▪ The project will reinforce the transmission line corridor supplying the loads of Metro Manila ▪ Location: Bataan, Cavite
	Naga-Tublijon 500 kV TL Project	▪ To further strengthen the reliability of the transmission network Bicol Region, the existing 230 kV TL from Naga SS to Bacman SS will be upgraded to 500 kV voltage level. This will also accommodate generation capacity addition in the Southernmost part of the Grid. ▪ Location: Camarines Sur, Albay, Sorsogon
230kV	Sagada–San Esteban 230 kV TL	▪ The project will provide a new 230 kV transmission corridor in Mountain Province Area by completing the La Trinidad-Sagada–San Esteban transmission loop. ▪ Location: Mountain Province, Ilocos Sur
	Dinadiawan–Santiago 230 kV TL	▪ The project will increase the system reliability on the Northeastern side of the Luzon Grid. ▪ Location: Isabela, Aurora
	Baler–Dinadiawan 230 kV TL	▪ The Dinadiawan-Baler 230 TL will increase the system reliability on the Northeastern side of the Luzon Grid. ▪ Location: Isabela, Aurora
	Capas–Bolo 230 kV TL	▪ The project involves the construction of 80 km, ST-DC, 4-795 MCM ACSR 230 kV TL from Capas to Bolo 230 kV SS to provide additional reliability of power supply in Central Luzon. ▪ Location: Tarlac, Pangasinan

SUBSATION PROJECTS		
Voltage	Project Name	Description
500kV	Kalinga 500 kV SS	▪ The project will accommodate the entry of power plants in Kalinga to ensure that the power supply will meet the demand load of Luzon Grid and will increase the reliability of the 500 kV backbone. ▪ Location; Kalinga
	Matnog 230 kV SS	▪ The project will accommodate the entry of power plants in Sorsogon particularly in Matnog to ensure that the power supply will meet the demand load of Luzon Grid. ▪ Location: Sorsogon
	North Luzon SS Upgrading 4	▪ The project aims to cater the load growth and provide N-1 contingency to various SS in NGCP's North Luzon Region. Without the project, the customers being served by these SS will experience load dropping and power interruptions during outage and failure of existing transformers and power circuit breakers. ▪ Location: Pangasinan, Cagayan, Zambales, Pampanga, Nueva Ecija

SUBSATION PROJECTS		
Voltage	Project Name	Description
	South Luzon SS Upgrading 4	▪ The project aims to cater the load growth and provide N-1 contingency to various SS in NGCP's South Luzon Region. Without the project, the customers being served by these SS will experience load dropping and power interruptions during outage and failure of existing transformers and power circuit breakers ▪ Location: Batangas, Camarines Sur, Albay, Sorsogon

9 Visayas Transmission Outlook

This section will provide a list of ERC-approved projects on various stages of implementation and the other identified system requirements in the Visayas Grid but are still subject to regulatory approval prior to implementation. ERC applications for some of the new projects have been made already.

With reference to the DOE list, Cebu and Panay are the main sites for large generation capacity additions specifically for coal-fired power plants. For RE-based plants, on the other hand, it can be observed that the concentration is in Negros and Panay Islands, most of which have already materialized. Such direction of generation development would further emphasize the need to reinforce the 138 kV submarine cable interconnections between Cebu, Negros, and Panay.

Presently, the 230 kV facilities are in Leyte and Cebu only but the development of a 230 kV transmission backbone to reach up to Panay Island has been part of the master plan to support the generation developments and also to avert the criticality of island grid separations due to the present long radial line configuration of the Visayas Grid. The implementation of this project, which is called Cebu-Negros-Panay 230 kV Backbone, is divided into three stages. The first stage is the additional submarine cable between Negros and Panay. This project was already energized in October 2016 and addresses the congestion and market issues being encountered due to the limited capacity of the existing single-circuit 138 kV link. Also, the existing Negros-Cebu 138 kV can only export a maximum of 180 MW of excess generation capacity. This will be insufficient just with the entry of committed power plants only. Thus, the second and third stages of the new 230 kV backbone are the next major requirements in the Visayas Grid.

Within Cebu Island where the load center is located, the development of new 230 kV load substations and implementation of new 230 kV transmission line extensions are required to ensure adequate supply facilities in the long term. Similar to other urbanized areas, securing right-of-way in Cebu is also a major challenge in transmission project implementation.

In Panay, the new developments in the tourism industry in Boracay Island would result in an increase in power supply requirements. It is projected that the existing 69 kV submarine cable serving the island would not be adequate in supporting load growth in the coming years. Thus, this is also one of the areas requiring grid reinforcements through the installation of additional submarine cable under the Nabas–Caticlan–Boracay Transmission Line Project. Large capacities of wind and hydro are also being proposed in Panay that will trigger the installation of the second circuit 230 kV submarine cable between Negros and Panay.

Another major submarine cable project that is for implementation is the Cebu–Bohol 230 kV Interconnection Project. Presently, Bohol Island has a power deficiency issue due to limited power sources on the island. In 2020, the maximum demand in Bohol reached 110 MW. By 2022, even when all diesel power plants are utilized in Bohol Island, the Leyte–Bohol 138 kV submarine cable is expected to be overloaded. The implementation of the Cebu–Bohol 230 kV Interconnection Project would significantly boost the supply reliability to support the load growth in the island as will be brought about by its direct access to the bulk generations located in Cebu. It can be noted also that during Typhoon Yolanda and the recent earthquake incident which affected the transmission facilities in Ormoc, Leyte area, the supply for Bohol Island was also interrupted because there is no alternate source for the island. Such concern will also be addressed by Cebu–Bohol 230 kV Interconnection Project.

9.1 Transmission Projects for 2025

Transmission projects that currently being implemented and planned for Visayas in the period 2021-2025 are listed in Table 9.1 below.

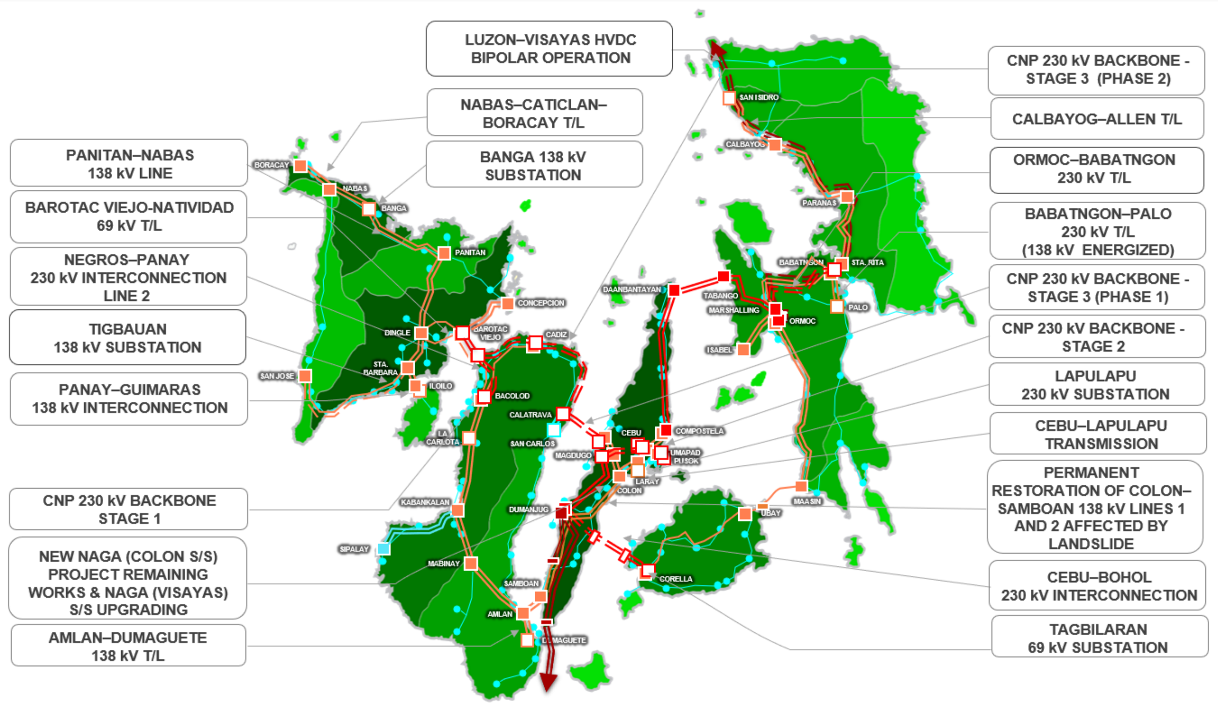


Figure 9.1: Proposed Visayas Transmission Outlook for 2025

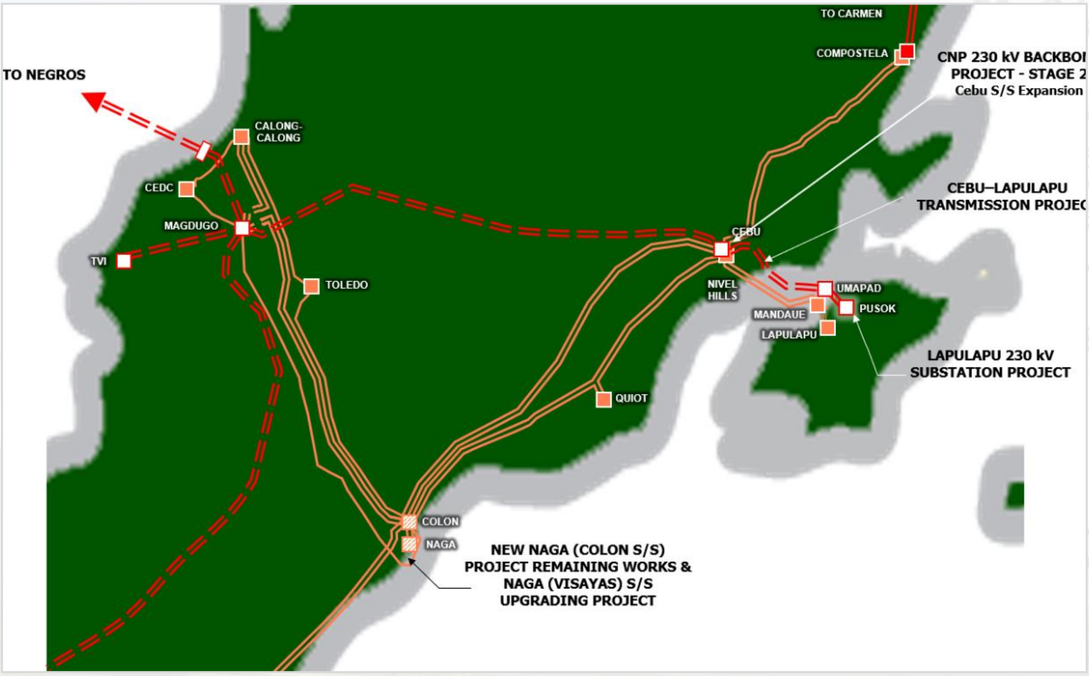


Figure 9.2: Metro Cebu Transmission Outlook for 2025

Table 9.1
Visayas Transmission Outlook for 2025

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Project Driver and Major Components	ETC
500 kV	Luzon–Visayas HVDC Bipolar Operation	Generation Entry *Substation:* ▪ Naga Converter/Inverter Station Upgrading ▪ Naga 500 kV SS: 2x750 MVA 500/230 kV Transformer, 2x90 MVAR 500 kV Line Reactor, 8-500 kV PCB ▪ Naga 230 kV SS: 2x100 MVAR 230 kV Shunt Capacitor, 2-230 kV PCB ▪ Tagkawayan 500 kV SS: 2-500 kV PCB ▪ Ormoc Converter/Inverter Station Upgrading Project Cost: 18,106 million Pesos Location: Cebu, Negros, and Panay	Dec 2025
230 kV	Cebu–Negros–Panay 230 kV Backbone Project – Stage 2 ERC-approved	Generation Entry *Substation:* ▪ Cebu 230 kV SS, 3x300 MVA 230/138 kV Power Transformer 8 230 kV PCB (GIS) and 3-138 kV PCB. ▪ Construction of Warehouse *Transmission Line:* ▪ Extension of Magdugo–Cebu 230 kV TL, ST/SP-DC, 2-610 mm² TACSR OHTL, 0.75 km ▪ Extension of Cebu–Lapulapu 230 kV TL, Underground Cable System, Double Circuit of 1200 MW Capacity, 0.425 km and 2-410 mm² STACIR, ST/SP-DC, 0.150 km ▪ Extension of Colon–Quiot–Cebu 138 kV TL, 138 kV Underground Cables, Double Circuit of 180 MW capacity, 0.250 km. Project Cost: 3,329 million Pesos Location: Cebu, Negros, and Panay	Oct 2022
	Cebu–Negros–Panay 230 kV Backbone - Stage 1 ERC-approved	Generation Entry *Substation:* ▪ Bacolod SS Expansion, 2-138 kV PCB. *Transmission Line:* ▪ Bacolod–E. B. Magalona, 230 kV TL (initially energized at 138 kV), ST-DC, 2-795 MCM ACSR, 39 km. Project Cost: 6,104 million Pesos Location: Cebu, Negros, and Panay	Dec 2022
	Negros–Panay 230 kV Interconnection Line 2 Filed to ERC	Generation Entry *Substation:* ▪ Barotac Viejo SS (Expansion), 1x70 MVAR, 230 kV Line reactor, 2-230 kV PCB associated submarine cable termination equipment ▪ E.B. Magalona SS (Expansion), 1x70 MVAR, 230 kV Line reactor, 3-230 kV PCB. *Submarine Cable:* ▪ Barotac CTS–Barotac Viejo SS, 230 kV, Single Circuit, 1-1,600 mm² XLPE Underground Cable, 0.75 km ▪ Barotac Viejo–E. B. Magalona, 230 kV, Single Circuit, 3-1,600 mm² XLPE Submarine Cable, 22 km. Project Cost: 8,293 million Pesos Location: Negros and Panay	Mar 2023
	Cebu–Negros–Panay 230kV Backbone - Stage 3 ERC-approved	Generation Entry Phase 1 – submarine cable energization Phase 2 – remaining OHTL	Phase 1 - Jun 2022 Phase 2 - Jun 2023

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Project Driver and Major Components	ETC
		Substation: ▪ Magdugo 230 kV SS, 3x300 MVA 230/138-13.8 kV Power Transformer 2x70 MVAR 230 kV Line Reactors, 15-230 kV PCB, 15-138 kV PCB ▪ Calatrava 230 kV SS, 2x100 MVA 230/69-13.8 kV Power Transformer 1x70 MVAR 230 kV Bus Reactor, 1x70 MVAR 230 kV Line Reactor, 12-230 kV PCB, 14-69 kV PCB; ▪ Cadiz 230 kV SS, 2x150 MVA 230/138-13.8 kV Power Transformer 10-230 kV PCB, 6-138 kV PCB ▪ E. B. Magalona Switching Station, 1x70 MVAR 230 kV Line Reactor 9-230 kV PCB ▪ Barotac Viejo 230 kV SS, 3x300 MVA 230/138-13.8 kV Power Transformer 1x70 MVAR 230 kV Line Reactor, 8-230 kV PCB, 6-138 kV PCB ▪ Bacolod 230 kV SS, 2x300 MVA 230/138-13.8 kV Power Transformer 6-230 kV PCB, 1-138 kV PCB ▪ Colon 138 kV SS, 2-138 kV PCB . ▪ San Carlos 69 kV SWS, 11-69 kV PCB . ▪ Quiot 138 kV SS, Uprating of 4-138 kV PCB ▪ Cebu 138 kV SS, Uprating of 6-138 kV PCB *Transmission Line:* ▪ Magdugo–Cebu 230 kV TL, ST-DC, 4-795 MCM ACSR, 33 km ▪ Talavera–Magdugo 230 kV TL, ST-DC, 4-795 MCM ACSR, 8 km ▪ Cadiz–Calatrava 230 kV TL, ST-DC, 4-795 MCM ACSR, 80 km ▪ E. B. Magalona–Cadiz 230 kV TL, ST-DC, 4-795 MCM ACSR, 45 km ▪ Transfer of the CEDC 138 kV Line from AYA SS to Colon SS ▪ Calatrava CTS–Calatrava Substation, ST-DC, 4-795 MCM ACSR, 1.5 km ▪ Reconductoring of the Cebu–Quiot–Colon 138 kV Transmission Corridor, STACIR Conductor for 138 kV Steel Tower, 1 km ▪ Bundling of termination at Cebu-Quiot-Colon 138 kV Transmission Corridor ▪ Calatrava–San Carlos 69 kV TL, ST-DC, 1-795 MCM ACSR, 5.6 km. *Submarine Cable:* ▪ Calatrava–Talavera 230 kV Submarine Cable, Double Circuit, 6-1,600 mm^2 XLPE, 29 km ▪ Talavera CTS, Cable Sealing End ▪ Calatrava CTS, Cable Sealing End. Project Cost: 43,413 million Pesos Location: Cebu, Negros, and Panay	
	Cebu–Bohol 230 kV Interconnection Filed to ERC	Load Growth Phase 1 – submarine cable Phase 2 – OHTL *Substation:* ▪ Dumanjug 230 kV SS, 2x70 MVAR 230 kV line reactors, 4-230 kV PCB ▪ Corella 230 kV SS, 2x300 MVA, 230/138-13.8 kV Power Transformers 2x70 MVAR 230 kV line reactors, 8-230 kV PCB, 5-138 kV PCB ▪ Argao CTS (with provision to be SWS) ▪ Maribojoc CTS (with provision to be SWS) *Transmission Line:* ▪ Dumanjug–Argao TL, 230 kV, ST-DC, 4-795 MCM ACSR, 28 km. ▪ Maribojoc–Corella TL, 230 kV, ST-DC, 4-795 MCM ACSR, 22 km.	Phase 1 – Jun 2023 Phase 2 – Nov 2023

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Project Driver and Major Components	ETC
		<u>*Submarine Cable:*</u> ▪ Argao–Maribojoc 230 kV S/C, Double circuit submarine cable system with a transfer capacity of 600 MW at 230 kV, 30 km. (with provision for 3rd circuit) Project Cost: 19,762 million Pesos Location: Cebu and Bohol	
	Cebu–Lapu-Lapu 230 kV TL ERC-approved	System Reliability <u>*Transmission Line:*</u> ▪ Cebu–Umapad 230 kV TL, ST/SP-DC, 2-410 mm^2 STACIR, 9 km. Project Cost: 1,884 million Pesos Location: Cebu	Dec 2023
	Babatngon–Palo 230 kV TL (Initially energized at 138 kV) Filed to ERC	Load Growth <u>Stage 1 (Dec 2023)</u> <u>*Substation:*</u> ▪ Babatngon 138 kV SS, 4-230 kV PCB <u>Stage 2 (May 2025)</u> <u>*Substation:*</u> ▪ Babatngon 138 kV SS, 3-138 kV PCB ▪ Palo 138 kV SS (New), 3x100 MVA, 138/69-13.8 kV Power Transformer 8-230 kV PCB, 9-69 kV PCB. <u>*Transmission Line:*</u> ▪ Babatngon–Palo 230 kV TL (138 kV energized), ST-DC, 4-795 MCM ACSR, 20 km. ▪ Palo–Campetik & Palo–Tolosa 69 kV TL, SP-DC, 1-336.4 MCM ACSR, 2 km. ▪ Palo–Alang-Alang 69 kV TL, SP-SC, 1-336.4 MCM ACSR, 0.5 km. Project Cost: 2,681 million Pesos Location: Southern Leyte	May 2025
	Ormoc–Babatngon 230 kV TL	Generation Entry <u>*Substation:*</u> ▪ Babatngon SS, 2x300 MVA 230/138-13.8 kV Power Transformer 4-230 kV PCB, 3-138 kV PCB ▪ Palo SS, 2x300 MVA 230/69-13.8 kV Power Transformer <u>*Transmission Line:*</u> ▪ Ormoc–Babatngon TL, ST-DC, 4-795 MCM ACSR, 75 km. ▪ Energization of Babatngon–Palo to 230 kV level Project Cost: 2,783 million Pesos Location: Kananga, Ormoc	Dec 2025
138 kV	Panitan–Nabas 138 kV TL 2 ERC-approved	System Reliability <u>*Substation:*</u> ▪ Panitan 138 kV SS, 1-138 kV PCB. ▪ Nabas 138 kV SS, 3-138 kV PCB. <u>*Transmission Line:*</u> ▪ Panitan–Nabas 138 kV TL, ST-DC (2nd circuit stringing), 1-795 MCM ACSR, 95 km. Project Cost: 463 million Pesos Location: Panitan and Nabas, Panay	Mar 2022
	Permanent Restoration of Colon–Samboan 138kV Lines 1 and 2 affected by Landslide	System Reliability <u>*Transmission Line:*</u> ▪ *Colon-Samboan Line 1,* 1-795 MCM ACSR, 138 kV, ST-DC1, 8km, 26 rerouted towers, 8 km	Aug 2022

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Project Driver and Major Components	ETC
	Filed to ERC	▪ *Colon-Samboan Line 2,* 1-795 MCM ACSR, 138 kV, ST-DC1, 8km, 21 rerouted towers, 8 km ▪ *Colon-Samboan Lines 1 and 2 (Common Tower),* 138 kV, ST-DC, 3 rerouted towers. Project Cost: 538 million Pesos Location: Colon, Cebu	
	Panay–Guimaras 138 kV Interconnection Filed to ERC	Generation Entry *Substation:* ▪ Iloilo SS, 3x100 MVA,138/69-13.8 kV Power Transformers 2-138 kV PCB, 10-69 kV PCB ▪ Buenavista SS, 1x100 MVA,138/69-13.8 kV Power Transformer 6-138 kV PCB, 4-69 kV PCB ▪ Transfer of existing 1x100 MVA 138/69-13.8 kV Power Transformer from Iloilo SS to Buenavista SS *Transmission Line:* ▪ Iloilo SS–Ingore CTS 138 kV TL Portion: ST-DC, 1-795 MCM ACSR, 1.7 km ▪ Iloilo SS–Ingore CTS 138 kV U/G Portion: Single-circuit, XLPE cables of 200 MW capacity per circuit, 0.15 km ▪ Iloilo 138 kV–Iloilo 69 kV U/C: Three circuits, XLPE cables of 100 MW capacity per circuit, 0.25 km ▪ Extension of Sta. Barbara–Iloilo 138 kV Line: Double circuit, XLPE cables of 400 MW capacity per circuit, 0.15 km ▪ Baldoza 69 kV Line Transfer TL Portion: SP-SC, 1-795 MCM ACSR, 0.07 km ▪ Baldoza 69 kV Line Transfer U/G portion: Single circuit, XLPE cable of 100 MW capacity per circuit, 0.38 km ▪ PPC & MORE 69 kV Line Transfer TL Portion: SP-SC, 1-795 MCM ACSR, 0.09 km ▪ PPC & MORE 69 kV Line Transfer U/G portion: Single circuit, XLPE cable of 100 MW capacity per circuit, 0.37 km ▪ Banuyao 69 kV Line Transfer TL Portion: SP-SC, 1-795 MCM ACSR, 1.5 km ▪ Banuyao 69 kV Line Transfer U/G portion: Single circuit, XLPE cable of 100 MW capacity per circuit, 0.36 km ▪ Buenavista 138 kV U/C: Double-circuit, XLPE cables of 200 MW capacity per circuit, 0.15 km ▪ Sawang CTS–Buenavista SS 138 kV TL: ST-DC, 1-795 MCM ACSR, 1 km ▪ Zaldivar 69 kV Bypass Line: SP-SC, 1-336.4 MCM ACSR, 0.7 km Project Cost: 2,253 million Pesos Location: Panay and Guimaras	Dec 2023
	Nabas–Caticlan–Boracay TL Filed to ERC	Load Growth <u>Substation:</u> ▪ Boracay 138 kV GIS SS (New), 2x100 MVA 138/69-13.2 kV Power Transformers 5-138 kV PCB (GIS), 6-69 kV PCB (GIS). ▪ Nabas 138 kV SS (Expansion), 4-138 kV PCB. ▪ Nabas Transition Station. *Submarine Cable:* ▪ Caticlan–Boracay S/C, Submarine Cable System, Double circuit of 100 MW capacity at 138 kV, 2.1 km ▪ Caticlan CTS (New), Cable Sealing End. *Transmission Line:* ▪ Nabas–Unidos 230 kV TL (Initially energized at 138 kV), 230 kV, ST/SP-DC, 4-795 MCM ACSR, 15.7 km.	Mar 2024

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Project Driver and Major Components	ETC
		▪ Unidos–Caticlan 138 kV TL, ST-DC, 138 kV, 1-795 MCM ACSR, 1.9 km ▪ Caticlan 138 kV U/G, Double circuit, 138 kV Underground Cable System of 180 MW capacity per circuit, 4.5 km. ▪ Manocmanoc–Boracay Tie Line, 69 kV, SP-SC, 1-336.4 MCM ACSR, 0.375 km; Project Cost: 5,484 million Pesos Location: Aklan	
	Amlan–Dumaguete 138 kV TL Filed to ERC	Load Growth *Substation:* ▪ Amlan 138 kV SS, 3-138 kV PCB. ▪ Dumaguete 138 kV SS (New), 2x100 MVA, 138/69-13.8 kV Power Transformer 6-138 kV PCB, 6-69 kV PCB. *Transmission Line:* ▪ Amlan–Dumaguete 138 kV TL, ST-DC, 1-795 MCM ACSR, 18 km. Project Cost: 1,838 million Pesos Location: Negros Occidental	Dec 2024
	Calbayog–Allen TL Filed to ERC	System Reliability *Substation:* ▪ Calbayog SS, 4-138kV PCB ▪ San Isidro SS, 2x50 MVA 138/69 kV Power Transformer (2x50 MVA transformer from Paranas SS and Calong-calong SS), 10-138 kV PCB, 4-69 kV PCB *Transmission Line:* ▪ Calbayog–San Isidro 138 kV TL, ST-DC, 1-795 MCM ACSR, 60 km. ▪ San Isidro–Allen 69 kV TL, SP-SC, 1-336.4 MCM ACSR, 22 km. Project Cost: 2,753 million Pesos Location: Samar and Northern Samar	Jun 2025
69kV	Barotac Viejo–Natividad 69 kV TL Filed to ERC	System Reliability *Transmission Line:* ▪ Barotac Viejo–Natividad 69 kV TL, SP-SC, 1-336.4 MCM ACSR, 7km. Project Cost: 36 million Pesos Location: Iloilo	Dec 2024

SUBSTATION PROJECTS			
Voltage	Project Name	Project Driver and Major Components	ETC
230 kV	Visayas SS Upgrading Project 1 Filed to ERC	System Reliability *Substation:* Cebu: ▪ Daanbantayan SS, 150 MVA 230/69-13.8 kV Power Transformer, 1-230 kV PCB, 3-69 kV PCB. Leyte: ▪ Tabango SS, 50 MVA 230/69-13.8 kV Power Transformer, 1-230 kV PCB, 2-69 kV PCB ▪ Maasin SS, 50 MVA 138/69-13.8 kV Power Transformer Samar: ▪ Calbayog SS, 50 MVA 138/69-13.8 kV Power Transformer, 1-138 kV PCB, 2-69 kV PCB. Project Cost: 986 million Pesos Location: Cebu, Leyte, Samar	Dec 2022

SUBSTATION PROJECTS			
Voltage	Project Name	Project Driver and Major Components	ETC
	Lapu-Lapu 230 kV SS Filed to ERC	Load Growth *Substation:* ▪ Pusok 230 kV GIS SS (New), 2x300 MVA 230/69-13.8 kV Power Transformers, 8-230 kV PCB (GIS), 10-69 kV PCB (GIS). *Submarine cable:* ▪ Umapad–Pusok 230 kV S/C, 600 MW per circuit, Double circuit, 2.1 km. Project Cost: 4,356 million Pesos Location: Lapu-Lapu, Cebu	Dec 2023
	Visayas SS Upgrading Project 2 Filed to ERC	System Reliability *Substation:* Leyte: ▪ Isabel SS, 1x50 MVA 138/69-13.8 kV Power Transformer (1x50 MVA transformer transferred from Calong-calong SS), 3-138 kV PCB, 2-69 kV PCB. (Additional), 9-138 kV PCB, 2-69 kV PCB. (Replacement), Centralized Control Building, Full upgrading of secondary devices ▪ Tabango SS, 1x50 MVA 230/69-13.8 kV Power Transformer, 2-230 kV PCB, 4-69 kV PCB, Centralized Control Building, Full upgrading of secondary devices ▪ Maasin SS, 1x50 MVA 138/69-13.8 kV Power Transformer, 5-138 kV PCB, 9-69 kV PCB, Expansion of Control Room Samar: ▪ Paranas SS, 2x100 MVA 138/69-13.8 kV Power Transformer (Replacement of 30 MVA and 50 MVA transformers), 9-69 kV PCB, Centralized Control Building, Full upgrading of secondary devices ▪ Calbayog SS, 1x50 MVA 138/69-13.8 kV Power Transformer, 5-138 kV PCB, 8-69 kV PCB, Full upgrading of secondary devices, Centralized Control Building. Cebu: ▪ Calong-calong SS, 3x100 MVA 138/69-13.8 kV Power Transformer (Replacement of 2x50 MVA transformers), 2-138 kV PCB,11-69 kV PCB, Full upgrading of secondary devices, Centralized control building, Dismantling of existing 69 kV Switchyard, and Calong-calong 69 kV feeder line extensions ▪ Compostela SS, 2x100 MVA 138/69-13.8 kV Power Transformer (Replacement of 2x50 MVA transformers), 2-230 kV PCB, 3-69 kV PCB, and Relocation of Warehouse ▪ Samboan SS, 4-138 kV PCB, 3-69 kV PCB, Centralized Control Building, and Full upgrading of secondary devices ▪ Toledo SS, 3x100 MVA 138/34.5-13.8 kV Power Transformer (Replacement of 3x40 MVA transformers), 1-138 kV PCB (Replacement), Transfer of termination of various transmission lines, and Centralized Control Building ▪ Daanbantayan SS, 1x150 MVA 230/69-13.8 kV Power Transformer, 2-69 kV PCB, Centralized Control Building Bohol: ▪ Ubay SS, 1x100 MVA 138/69-13.8 kV Power Transformer, 10-138 kV PCB, 11-69 kV PCB, Centralized Control Building, and 69 kV line extensions ▪ Corella SS, 1x100 MVA 138/69-13.8 kV Power Transformer, 2-138 kV PCB, 8-69 kV PCB and 69 kV line extensions. Negros: ▪ Kabankalan SS, 2x100 MVA 138/69-13.8 kV Power Transformer (Replacement of 30 and 50 MVA Transformers), 3-138 kV PCB, 4-69 kV PCB, Centralized Control Building and Telecom Shelter, Kabankalan–Overflow 69 kV Line Extension, and Full upgrading of secondary devices	Dec 2025

SUBSTATION PROJECTS			
Voltage	Project Name	Project Driver and Major Components	ETC
		▪ Mabinay SS, 1x50 MVA 138/69-13.8 kV Power Transformer, 4-138 kV PCB, 5-69 kV PCB, Centralized control building and Telecom Shelter, and Full upgrading of secondary devices Panay: ▪ San Jose SS, 2x50 MVA 138/69-13.8 kV Power Transformer, 6-138 kV PCB, 5-69 kV PCB, Expansion of Control Building ▪ Panitan SS, 3x100 MVA 138/69-13.8 kV Power Transformer (Replacement of 2x30 and 50 MVA transformers), 4-138 kV PCB, 13-69 kV PCB, Centralized Control Building and Container Van and Dismantling of existing 69 kV Switchyard ▪ Dingle SS, 2x100 MVA 138/69-13.8 kV Power Transformer (Replacement of 2x50 MVA Transformers), 3-138 kV PCB, 9-69 kV PCB, Centralized Control Building and Telecom Shelter, and Full upgrading of secondary devices ▪ Concepcion SS, 1x100 MVA 138/69-13.8 kV Power Transformer, 1-138 kV PCB ▪ Barotac Viejo SS, 50 MVA 138/69-13.8 kV Power Transformer (50 MVA Transformer transferred from Iloilo SS), 2-138 kV PCB, 2-69 kV PCB, ▪ Sta. Barbara SS, Upgrading of Secondary Equipment. Project Cost: 18,706 million Pesos Location: Cebu, Negros, Panay, Leyte	
138 kV	New Naga (Colon) SS (Remaining Works) ERC-approved	Load Growth *Substation:* ▪ Colon 138 kV SS, 1x100 MVA 138/69-13.8 kV Power Transformer, 2-138 kV PCB, 2-69 kV PCB. *Transmission Line:* ▪ Transfer of Sibonga and VECO Naga 69 kV Feeder from Naga SS to Colon SS, SP-DC, 1-795 MCM ACSR, 1.5 km. Project Cost: 313 million Pesos Location: Colon	Jun 2022
	Naga (Visayas) SS Upgrading Project ERC-approved	System Reliability *Substation:* ▪ Naga 138 kV SS, 6-138 kV PCB, ▪ Construction of New Control Room ▪ Dismantling of Primary and Secondary Equipment at Naga SS Project Cost: 499 million Pesos Location: Naga	Jun 2022
	Tigbauan 138 kV SS Filed to ERC	Load Growth Stage 1 (Dec 2022) *Transmission Line:* ▪ Stringing of Sta. Barbara–San Jose 138 kV Line 2, ST-DC2, 1-795 MCM ACSR, 93 km Stage 2 (Sep 2027) *Substation:* ▪ Tigbauan 138 kV SS, 2x100 MVA 138/69-13.8 kV Power Transformer, 10-138 kV PCB, and 4-69 kV PCB ▪ Sta. Barbara SS, 1-138 kV PCB, and 2-69 kV PCB ▪ San Jose SS, 2-138 kV PCB *Transmission Line:* ▪ Reconductoring of portion of Sta. Barbara–San Jose 69 kV Line, 1-160 mm2 STACIR, 30 km ▪ Tigbauan 138 kV Bus-in Line, ST-DC, 1-795 MCM ACSR, 2x0.50 km	Stage 1 - Dec 2022 Stage 2 - Sep 2027

SUBSTATION PROJECTS			
Voltage	Project Name	Project Driver and Major Components	ETC
		▪ Tigbauan 69 kV Cut-in Line, SP-DC, 1-160 mm2 STACIR/1-336.4 MCM ACSR, 0.5 km ▪ Sta. Barbara 69 kV Tie Line, SP-SC, 1-336.4 MCM ACSR, 0.4km Project Cost: 1,537 million Pesos Location: Iloilo	
	Visayas SS Reliability Project II ERC-approved	System Reliability *Substation:* ▪ Mandaue 138 kV SS Expansion, 1x100 MVA 138/69-13.8 kV Power Transformer, 1-138 kV GIS Switch Bay, 1-69 kV GIS Switch Bay ▪ Lapu-Lapu 138 kV SS Expansion, 1x100 MVA 138/69-13.8 kV Power Transformer, 1-138 kV GIS Switch Bay, 1-69 kV GIS Switch Bay ▪ Bacolod 138 kV SS Expansion, 1-69 kV PCB, ▪ Sta. Barbara 69 kV SS Expansion, 2-69 kV PCB. Project Cost: 727 million Pesos Location: Cebu and Negros	Dec 2022
	Upgrading of acquired Transmission Assets	System Reliability *Substation:* ▪ CEDC 138kV SS, new separate control building, upgrading of various disconnect switches, telecom requirements, automation system, and other accessories ▪ TPC CARCON 34.5 kV SS, new separate control building, upgrading of various protective devices and other accessories ▪ TPC 2nd Lift 34.5 kV SS, new separate control building, upgrading of various protective devices, telecom requirements, and other accessories ▪ TPC SANGI 34.5 kV Switchyard, new separate control building, upgrading of various protective devices, telecom requirements, and other accessories Location: Cebu and Panay	Dec 2023
	Banga 138 kV SS	Load Growth *Substation:* ▪ Banga 138 kV SS, 2x100 MVA, 138/69-13.8 kV Power Transformer, 10-138 kV PCB, 5-69 kV PCB *Transmission Line:* ▪ Bus-in of Banga SS to Panitan–Nabas TL, 138 kV TL, ST-DC, 1-795 MCM ACSR, 1 km. ▪ Banga Cut-in 69 kV Cut-in Line, SP-DC, 1-336.4 MCM ACSR, 2x1 km Project Cost: 982 million Pesos Location: Panay	Dec 2025
69 kV	Tagbilaran 69 kV SS ERC-approved	System Reliability *Substation:* ▪ Tagbilaran 69 kV SS (New), 1x10 MVA 69/13.8 kV power transformer and 1-69 kV PCB ▪ Construction of New Control Room. Project Cost: 487 million Pesos Location: Bohol	Sep 2022
	Visayas Mobile Capacitor	Power Quality *Substation:* ▪ DUCOMI 69 kV LES, 3x5 MVAR 69 kV Mobile Capacitor, 3-69 kV PCB ▪ Boracay 69 kV LES, 2x5 MVAR 69 kV Mobile Capacitor, 2-69 kV PCB ▪ Altavas 69 kV LES, 2x5 MVAR 69 kV Mobile Capacitor, 2-69 kV PCB ▪ Miagao 69 kV LES, 5 MVAR 69 kV Mobile Capacitor, 1-69 kV PCB	Dec 2023

SUBSTATION PROJECTS			
Voltage	Project Name	Project Driver and Major Components	ETC
		Project Cost: 506 million Pesos Location: Panay and Negros	

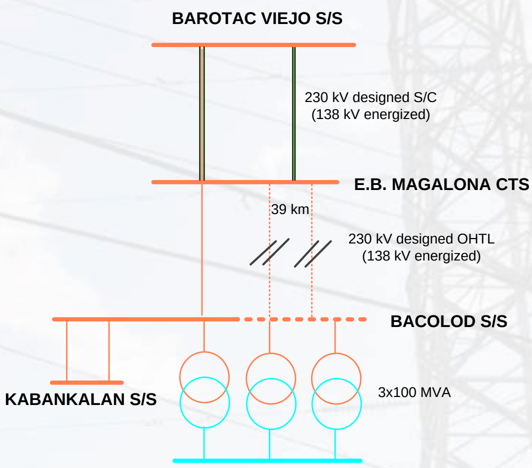
VOLTAGE IMPROVEMENT PROJECTS			
Voltage	Project Name	Project Driver and Major Components	ETC
138 kV	Visayas Voltage Improvement ERC-approved	Power Quality *Substation:* Stage 1 ▪ Compostela 138 kV SS, 2x20 MVAR, 138 kV Capacitor, 2-138 kV PCB, ▪ Cebu 138 kV SS, 2x20 MVAR, 138 kV Capacitor, 2-138 kV PCB, ▪ Corella 69 kV SS, 3x5 MVAR, 69 kV Capacitor, 3-69 kV PCB. Stage 2 ▪ Himayangan LES, 1x5 MVAR, 69 kV Capacitor, 1-69 kV PCB, ▪ Bobolosan LES, 1x5 MVAR, 69 kV Capacitor, 1-69 kV PCB, ▪ Tolosa LES, 1-5 MVAR, 69 kV Capacitor, 1-69 kV PCB. Project Cost: 735 million Pesos Location: Cebu, Bohol, Leyte, and Samar	Dec 2022
	Visayas Voltage Improvement 2 Filed to ERC	Power Quality *Substation:* STATCOM: ▪ Calbayog 138 kV SS, ±20 MVAR 138 kV STATCOM, 2-138 kV PCB ▪ Naga 138 kV SS, ±40 MVAR 138 kV STATCOM, 2x20 MVAR Capacitor, 5-138 kV PCB ▪ Panitan 138 kV SS, ±20 MVAR 138 kV STATCOM, 2-138 kV PCB Capacitor: ▪ Quinapondan 69 kV LES, 5 MVAR 69 kV Capacitor, 1-69 kV PCB ▪ Baybay 69 kV LES, 2x5 MVAR 69 kV Capacitor, 2-69 kV PCB ▪ Asturias 69 kV LES, 2x5 MVAR 69 kV Capacitor, 2-69 kV PCB ▪ Garcia Hernandez 69 kV LES, 2x5 MVAR 69 kV Capacitor, 2-69 kV PCB ▪ Carmen 69 kV LES, 2x5 MVAR 69 kV Capacitor, 2-69 kV PCB ▪ Sipalay 69 kV LES, 2x5 MVAR 69 kV Capacitor, 2-69 kV PCB ▪ Valladolid 69 kV LES, 5x5 MVAR 69 kV Capacitor, 5-69 kV PCB ▪ Bayawan 69 kV LES, 5 MVAR 69 kV Capacitor, 1-69 kV PCB ▪ Roxas 69 kV LES, 2x5 MVAR 69 kV Capacitor, 2-69 kV PCB ▪ San Jose 69 kV LES, 3x5 MVAR 69 kV Capacitor, 3-69 kV PCB ▪ Estancia 69 kV LES, 2x5 MVAR 69 kV Capacitor, 2-69 kV PCB Project Cost: 2,265 million Pesos Location: Samar, Leyte, Cebu, Negros, Panay	Dec 2025

9.1.1 Luzon–Visayas HVDC Bipolar Operation

The development of new power plants in Luzon will result in increased excess generation in the island. Currently, the transfer capacity of the HVDC from Luzon to Visayas is only 440 MW. In order to utilize the excess generation from each island, there is a need to upgrade the existing HVDC system between Luzon and Visayas. The Luzon–Visayas High Voltage Direct Current (HVDC) Bipolar Operation aims to accommodate additional generation, import and export to the Visayas Grid. The upgrade of Luzon-Visayas HVDC will also help in the maximum utilization of the Mindanao-Visayas Interconnection enabling more efficient sharing of reserves among Luzon, Visayas and Mindanao.

The Luzon–Visayas HVDC Bipolar Operation Project involves the development of the Naga 500/230 kV Substation, as well as upgrading of the Naga and Ormoc Converter/Inverter Stations in order to provide an additional transfer capacity between Luzon and Visayas. There will be an additional 450 MW transfer capacity between Luzon and Visayas upon completion of the project. It aims to accommodate additional excess generation, import and export to the Visayas Grid and vice versa.

9.1.2 Cebu–Negros–Panay 230 kV Backbone Project - Stage 1

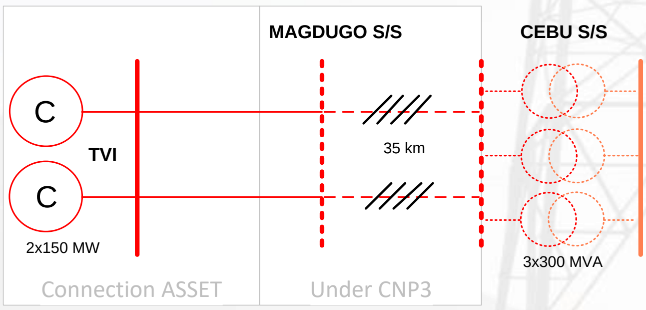


The development of new power plants, particularly in the Panay and Negros Islands will result in an increase in power exchange between the islands of Panay, Negros, and Cebu. However, the existing Negros-Panay interconnection system has limited capacity to cater the excess power generation from Panay towards Negros which could result in power curtailment.

To ensure the effective transmission of excess power generation from Panay towards Negros, a high-capacity transmission corridor is being proposed. Strategically, the project will be designed consistent with the long-term transmission master plan of having a 230 kV transmission backbone in the Visayas by establishing a 230 kV interconnection from Panay to Cebu.

The project involves the development of a transmission corridor from Barotac Viejo Substation to Bacolod Substation and will be composed of the submarine cable system and overhead transmission lines. It is designed at 230 kV voltage level but will be initially energized and operated at 138 kV. The submarine cable component was already completed in October 2016. The project will also involve associated expansion works at Barotac Viejo and Bacolod Substations.

9.1.3 Cebu–Negros–Panay 230 kV Backbone Project - Stage 2

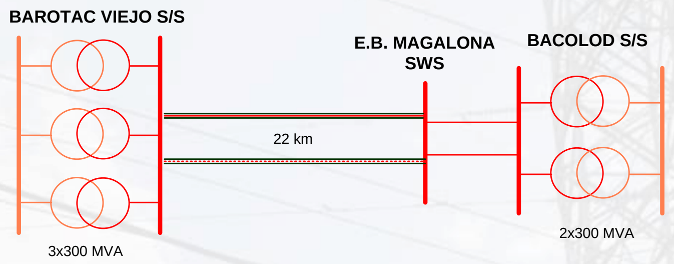


Therma Visayas, Inc. is developing a 300 MW coal-fired power plant in Toledo City, Cebu, and is intended to supply additional power to the load centers in Metro Cebu. However, the existing transmission system between the area of Toledo and the major drawdown substations in Metro Cebu has limited capacity to effectively accommodate the entire generation capacity of the new power plant. Hence, there will be power curtailment.

To ensure the effective full generation dispatch of the new power plant, a new transmission corridor, which includes a high-capacity transmission line and new substation facilities, is being proposed towards Metro Cebu. The transmission line portion was previously classified as connection assets and will be implemented by the power plant proponent. On the other hand, the substation portion is classified as a transmission asset, hence, the object of this project. It can be noted also that the transmission line which will be developed from Magdugo to Cebu will serve as an integral part of the 230 kV backbone in the Visayas.

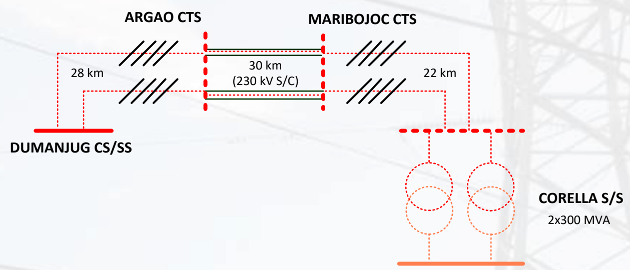
The project involves the construction of 230 kV facilities in the existing Cebu 138 kV Substation to facilitate the connection of the proposed transmission line from Toledo.

9.1.4 Negros–Panay 230 kV Interconnection Line 2 Project



The project aims to address the need to increase the interconnection capacity between Negros and Panay to cater the incoming large generators in Panay, particularly the 300 MW Aklan Pump Storage Hydro Power Plant. This entails an additional circuit of 230 kV submarine cable between Negros and Panay to allow for the full dispatch of the power plants in the island of Panay.

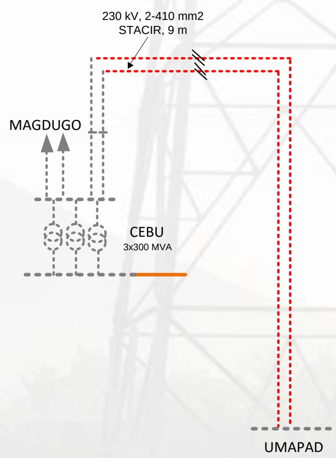
9.1.5 Cebu–Bohol 230 kV Interconnection Project



Currently, Cebu, Leyte, and Bohol are connected radially which are prone to isolations. By 2021, even when all the diesel power plants in Bohol are dispatched at full capacity, the Leyte–Bohol 138 kV submarine cable will be overloaded which could result in load curtailment in the said island. With the outage of the Leyte–Bohol 138 kV Interconnection, power delivery towards the entire Bohol Island will be interrupted. Since the existing power plants in Bohol do not have sufficient generation capacity to cater the power demand in the island during N-1 contingency conditions, there is a need to provide additional transmission backbone towards Bohol.

The project involves laying of outright double circuit 230 kV submarine cable with 600 MW capacity per circuit with provision for the 3rd circuit between Cebu and Bohol, construction of 230 kV double circuit overhead transmission line, development of a 230 kV switchyard in the existing Corella Substation and the expansion of the proposed Dumanjug 230 kV Substation under the Mindanao–Visayas Interconnection Project (MVIP).

9.1.6 Cebu–Lapu-Lapu 230 kV Transmission Line Project



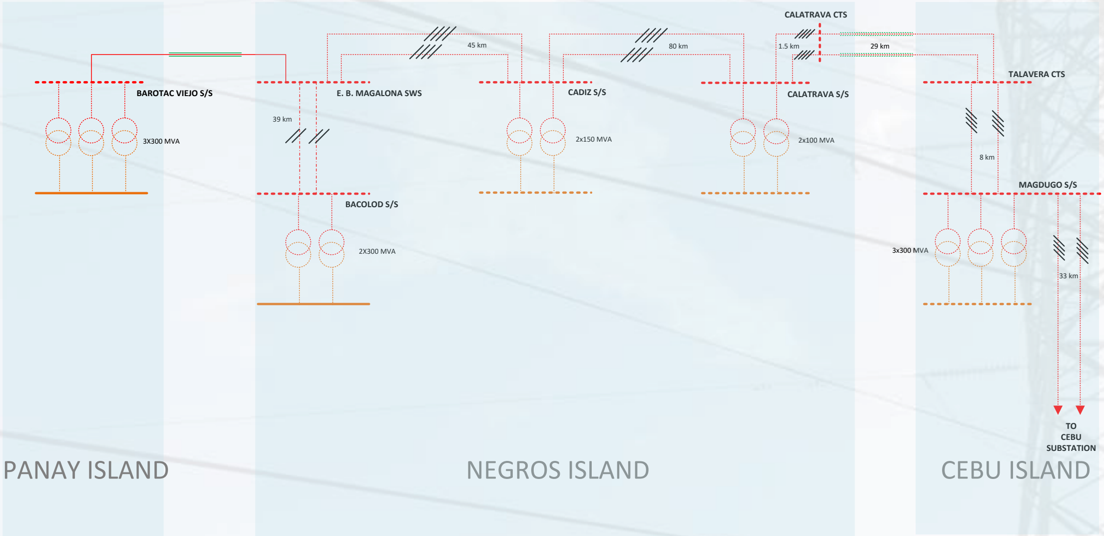
The existing transmission corridors serving the major load centers in Mandaue and Mactan in Cebu do not have N-1 contingency provisions. During the outage of one of the two 138 kV circuits of the Cebu–Mandaue–Lapu-Lapu Transmission Corridor, the remaining circuit will be overloaded, therefore, to prevent damage to the equipment, power will be curtailed.

To maintain the continuous transmission of power towards the major load centers in Mandaue and Mactan even during N-1 condition, a new transmission corridor, composed of overhead transmission lines and submarine/underground cable system, is proposed between Cebu Substation and Lapu-Lapu Substation.

9.1.7 Cebu–Negros–Panay 230 kV Backbone Project - Stage 3

The development of new power plants, including baseload and renewable, in Panay and Negros Islands will result in an increase in power exchange between the islands of Panay, Negros, and Cebu. Currently, the existing Negros–Panay interconnection system has limited capacity to accommodate the transmission of excess power from Panay towards Negros. Similarly, the existing Cebu–Negros interconnection system has limited capacity to cater the excess power generation from Panay and Negros towards Cebu. Hence, there will be power curtailment.

To ensure the effective transmission of excess power generation from Panay and Negros towards Cebu, a high capacity transmission corridor is being proposed and this will serve as stage 3 or the final stage for the Cebu–Negros–Panay 230 kV Backbone Project. The project involves the construction of 230 kV facilities that will extend from Barotac Viejo Substation in Panay to a new Magdugo Substation in Cebu. It will be primarily composed of overhead transmission lines, submarine cable interconnections, and corresponding new substation facilities.

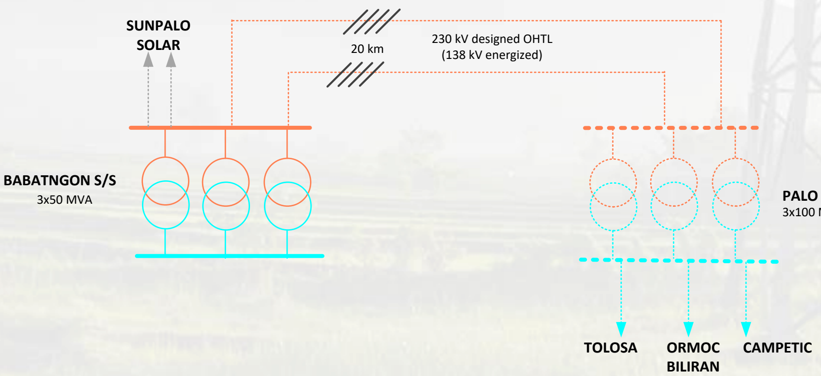


9.1.8 Babatngon–Palo 230 kV Transmission Line Project (Initially energized at 138 kV)

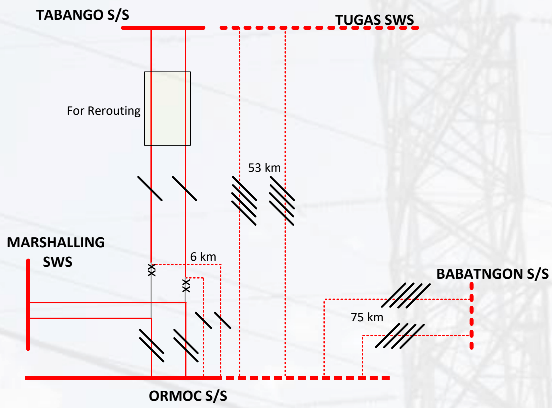
A large part of the power customers in the eastern Leyte area is being served through 69 kV lines which draw power from Babatngon Substation and Ormoc Substation in the north and Maasin Substation in the south. However, due to long distances and mountainous terrain, the quality and reliability of transmitting power along the 69 kV transmission lines cannot be ensured.

To improve the quality of power and enhance the reliability of the transmission backbone in Leyte, it is proposed to construct a transmission corridor along the eastern part of Leyte. The project will involve the construction of a new drawdown substation in Palo which will be linked to Babatngon Substation via 230 kV designed transmission lines energized at 138 kV. The proposed substation will serve Don Orestes Romualdez Electric Cooperative, Inc. (DORELCO) and Leyte Electric Cooperative II (LEYECO II) and provide alternate power supply source during N-1 contingency event.

The project will form part of the planned 230 kV transmission loop in Leyte, complementary to the proposed Ormoc–Babatngon and Palo–Javier 230 kV Transmission Lines.



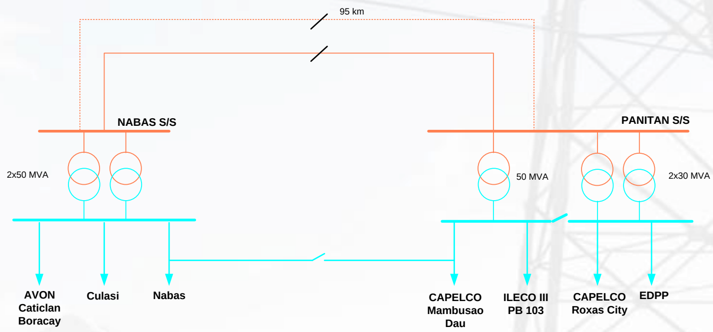
9.1.9 Ormoc–Babatngon 230 kV Transmission Line Project



There is a need to provide reliable power transmission to Leyte and Samar customers. In 2017, a magnitude-6.5 earthquake shook Ormoc, Leyte which left the region without electricity. The Leyte-Samar grid is primarily dependent in Ormoc Substation as it houses the High Voltage Direct Current (HVDC) connection to the Luzon Grid and it is where the 230 kV transmission system from Cebu ends. Ormoc Substation also serves as the major drawdown substation in Leyte and Samar, large generators injecting power in the Ormoc–Tabango 230 kV Transmission Corridor are absorbed through the 138 kV transmission system that connects Ormoc Substation and other 138 kV substations in Leyte and Samar. The excess power is either transmitted to Cebu via 230 kV transmission backbone or to Luzon Grid via 350 kV HVDC transmission corridor.

The project aims to provide a reliable and resilient grid in Leyte and Samar Island. The new Babatngon 230 kV Substation can also accommodate incoming power plants in Leyte and Samar Island. It involves the construction of a 75 km 230 kV Transmission Line from Babatngon going to Ormoc 230 kV Substation. Providing a new 230 kV backbone in Leyte aside from Ormoc–Marshalling–Tabango 230 kV Transmission Backbone.

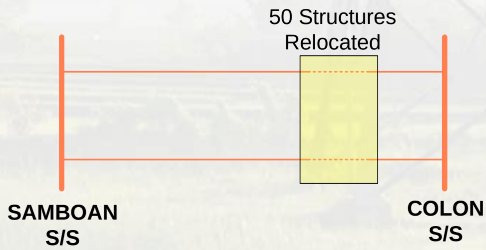
9.1.10 Panitan–Nabas 138 kV Transmission Line 2 Project



The northwestern part of Panay, which includes the Boracay Island, is served by Nabas Substation which normally draws power from the grid through the existing Panitan–Nabas 138 kV Transmission Line. The Nabas Substation is also linked to San Jose Substation by a 69 kV transmission line. However, during the outage of the 138 kV line, the 69 kV line will have a limited transmission capacity to cater the entire load of the area, hence, will result in power curtailment.

To cater the entire power requirement of Nabas Substation even during N-1 condition, a new 138 kV circuit will be installed from Panitan Substation and Nabas Substation. The project will involve the second circuit stringing of the existing Panitan–Nabas 138 kV Line, which is already designed to support two circuits. It will also include associated substation expansion works.

9.1.11 Permanent Restoration of Colon–Samboan 138 kV Lines 1 and 2 Affected by Landslide Project



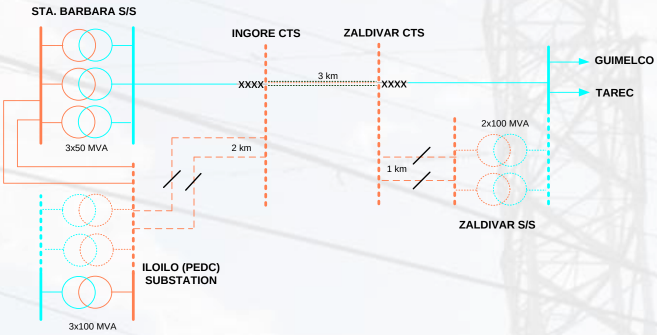
The fatal landslide that struck Brgy. Tina-an, City of Naga, Cebu on 20 September 2018 was a result of a natural phenomenon and man-made actions.The portion of mountainous areas of the Tina-an, City of Naga, Cebu, where located the Colon-Samboan 138 kV Lines 1 and 2 are within the declared danger zone of Mines and Geosciences Bureau

(MGB) of the Department of Environmental and Natural Resources (DENR) hindering maintenance and construction activities in the affected transmission line. Moreover, in the event of the recurrence of landslide and ground movements, the toppling of the structures will affect the stability of the grid.

The project includes the rerouting of the portion of Colon-Samboan 138 kV Line 1 and 2 affected by the landslide. This will avoid the 1 km danger zone declared by MGB.

9.1.12 Panay–Guimaras 138 kV Interconnection Project

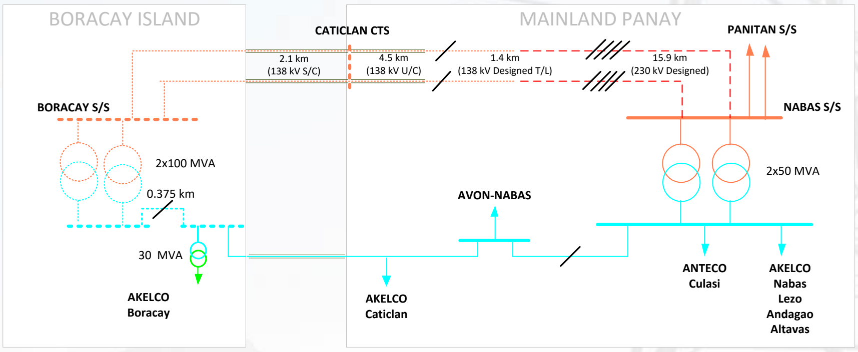
The development of new power plants in Guimaras Island will result in increased power transmission towards Panay. Currently, the existing submarine cable interconnection between Panay and Guimaras is only energized at 69 kV and has limited capacity to accommodate the transmission of excess power from Guimaras.



To ensure the full dispatch of the San Lorenzo Wind Plant and other prospective generators in the area, it is proposed to energize the Panay–Guimaras Interconnection at 138 kV. The project will also involve the construction of a 2 km overhead transmission line from the cable terminal station in Ingore towards Iloilo Substation, as well as the expansion and upgrading works at Zaldivar Substation and Iloilo Substation.

9.1.13 Nabas–Caticlan–Boracay Transmission Line Project

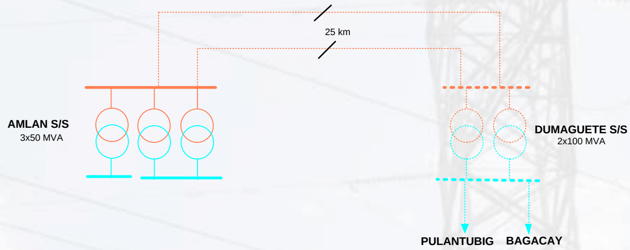
In line with the developments in the tourism industry in Boracay Island, the power requirement is expected to increase. The power requirement of Caticlan and Boracay Island is currently supplied by Nabas Substation via a single circuit 69 kV overhead transmission line and submarine cable. These 69 kV transmission facilities are not enough to cater the forecasted demand of the island.



The project will upgrade the existing 69 kV system into a 138 kV system that will provide the required transmission and substation capacity. The project will be implemented in two stages, stage 1 will be the construction of Boracay Substation, Manocmanoc–Boracay 69 kV overhead transmission line and laying of the new double-circuit Caticlan–Boracay 138 kV submarine cable (initially energized at 69 kV) to be connected to the existing Caticlan 69 kV CTS. Stage 2 will be the construction of the Nabas–Caticlan 230 kV OHTL which will be initially energized at 138 kV, 138 kV underground cable in Caticlan, and installation of 2x100 MVA 138/69 kV power transformer in Boracay Substation.

The submarine cable from Boracay to Caticlan was changed from single to double-circuit submarine cable for outright compliance with the N-1 provision. The 69/13.8 kV Transformers are removed from the project components since it will now be implemented by Aklan Electric Cooperative (AKELCO).

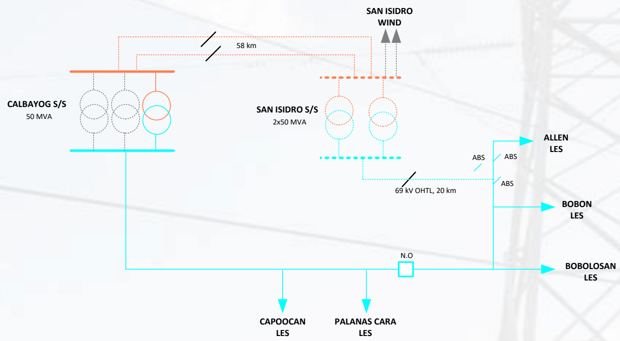
9.1.14 Amlan–Dumaguete 138 kV Transmission Project



The power requirement in the southern part of Negros Oriental is being served by a 69 kV line which draws power from Amlan Substation. However, the 69 kV line will not be sufficient to cater the projected increase in the power demand in the area.

To accommodate the future power requirement in the southern part of Negros Oriental, a new drawdown substation is proposed near Dumaguete City. The project will provide an alternative source of power to Negros Oriental Electric Cooperative II (NORECO II), thereby, unloading Amlan Substation and the Amlan–Siaton 69 kV Line. The proposed implementation scheme will also minimize transmission loss and improve the power quality to the customers served by the 69 kV line. The new substation will be linked to Amlan Substation via a 138 kV transmission line.

9.1.15 Calbayog–Allen Transmission Line Project



The power consumers in the northern part of Samar draws power from Calbayog Substation via the existing Calbayog-Palanas Cara and Palanas Cara-Catarman-Allen-Bobolosan 69 kV transmission lines, which traverse the mountainous area of Calbayog and Catarman. Such terrain poses frequent and extended outage of the 69 kV lines in Northern Samar which result in power curtailment.

To improve the reliability of power delivery and accommodate the load growth and power plant in the northern part of Samar, a 138 kV transmission line traversing northern Samar up to the new substation which is located in San Isidro which will cater the loads in Northern Samar. The project aims to form a loop, thus, will provide single outage contingency to the transmission lines serving Northern Samar.

9.1.16 Barotac Viejo–Natividad 69 kV Transmission Line Project

This project extends the 69 kV line serving Natividad to Barotac Viejo and forms a 69 kV loop between Dingle and Barotac Viejo Substations. This provides N-1 to the 69 kV feeder serving Iloilo II Electric Cooperative (ILECO II) and Iloilo III Electric Cooperative (ILECO III) and allows for the operational flexibility and reliability for both cooperatives.

9.1.17 Visayas Substation Upgrading Project 1

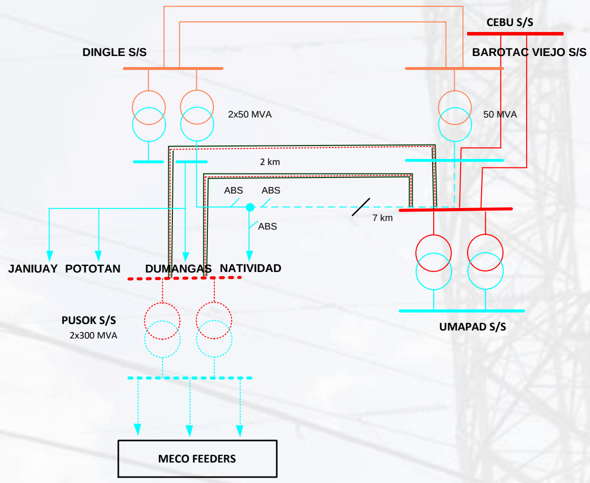
To accommodate the projected demand and avoid overloading of the transformer, there is a need to upgrade the substation capacity of Tabango Substation to 1x50 MVA. This will provide an N-1 provision on the said substation.

To accommodate the proposed 100 MW CEKO Solar Power Plant and the increase in demand in the area, there is a need to upgrade the substation capacity in Daanbantayan Substation to 1x150 MVA.

To comply with the N-1 contingency criterion of the PGC, an additional 1x50 MVA transformer needs to be installed at Maasin and Calbayog Substations.

9.1.18 Lapu-Lapu 230 kV Substation Project

Power consumers in Mactan Island currently draw power from Lapu-Lapu 138 kV Substation. With the continuing economic and infrastructure developments within the area, the projected power requirement will not be adequately served by the existing substation capacity.



The project provides an alternative connection point to power consumers particularly for Mactan Island, thus, will accommodate the projected increase in the power demand.

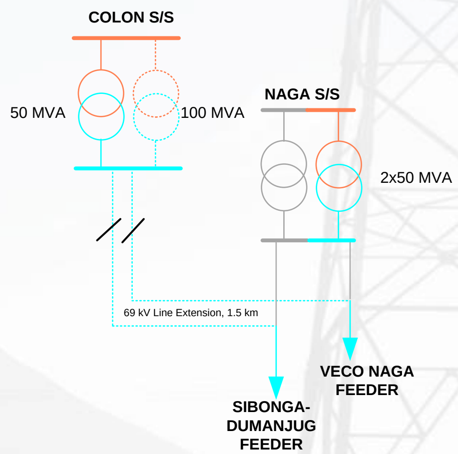
The new substation will be connected to Umapad 230 kV Substation and will be located in Lapu-Lapu, Cebu.

9.1.19 Visayas Substation Upgrading Project 2

The project involves the upgrading of 20 substations in the Visayas by installing an additional 850 MVA transformer capacity and replacing the existing transformers with a total of 1,600 MVA higher capacity transformers to cater the load growth in the area and to provide N-1 contingency to the substations. Replaced transformers will be either redeployed to other substations or refurbished.

9.1.20 New Naga (Colon) Substation Project (Remaining Works)

The Naga Substation was commissioned in 1977, hence, most of the equipment is already antiquated and is difficult to maintain. In line with the plan to improve the reliability of the power delivery in the area, the Naga–Sibonga–Dumanjug and VECO Naga 69 kV feeders which draw power from Naga Substation are proposed to be transferred to Colon Substation. However, the existing Colon Substation does not have sufficient capacity to cater the projected power demand upon the connection of new loads. Hence, there will be power curtailment.



To accommodate the projected demand for Colon Substation, there is a need to increase the substation capacity. The project involves the installation of 100 MVA transformer at Colon Substation and the transfer of the Naga–Sibonga–Dumanjug and VECO Naga 69 kV feeders from Naga Substation to Colon Substation, which were originally part of the formerly known and ERC-approved New Naga (Cebu) Substation Project, however, were not implemented as proposed during the 3rd Regulatory Period since the projected load to be catered by the transformer did not materialize.

The implementation of the remaining works under the New Naga (Colon) Substation Project will be pursued in the 4th Regulatory Period in consideration of the renewed need to address, among others, the increase in power demand along the Naga–Sibonga–Dumanjug and VECO Naga 69 kV feeders.

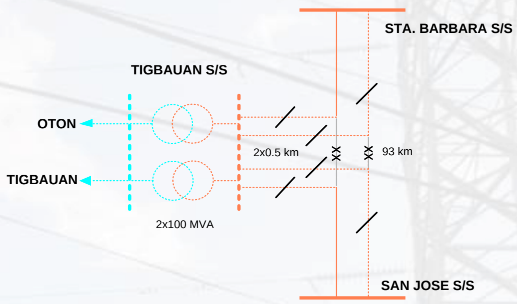
9.1.21 Naga (Visayas) Substation Upgrading Project

The equipment at Naga Substation, which was commissioned in 1977, is already antiquated and is difficult to maintain. Thus, outages due to equipment failure, maintenance, and repair works are expected to occur more frequently and at a longer duration. Accordingly, these outages may result in power curtailment.

To improve the reliability of the substation, equipment shall be replaced. The project involves the construction of new steel tower structures and the installation of associated overhead line components. It also involves the use of steel tower structures with higher wind design capability. This project was formerly named as Naga Substation Rehabilitation Project.

9.1.22 Tigbauan 138 kV Substation Project

Power consumers in Southern Panay draws power from Sta. Barbara and San Jose Substation. With the continuing economic and infrastructure developments within the area, the projected power requirement will not be adequately served by the existing substation capacity.



The project aims to provide alternative connection point to power consumers particularly for Southern Panay, thus, will accommodate the projected increase in the power demand.

The new substation will bus-in to the Sta. Barbara–San Jose 138 kV Transmission Line and will be located in Tigbauan, Panay.

9.1.23 Visayas Substation Reliability Project II

Various substations in the Visayas Grid have limited transformation capacity to provide continuous power delivery towards the load customers during single transformer outages, which will result in power curtailment.

The project aims to cater the load growth and provide N-1 contingency and accommodate additional generation capacity to various substations in Panay, Leyte, and Cebu. The project will involve upgrading Ormoc, Babatngon, Sta. Barbara, Mandaue, Sta. Rita, Bacolod and Lapu-Lapu Substations. Expansions in Lapu-Lapu, Bacolod, Sta. Barbara and Mandaue are still ongoing while the expansions on the other substations are already completed.

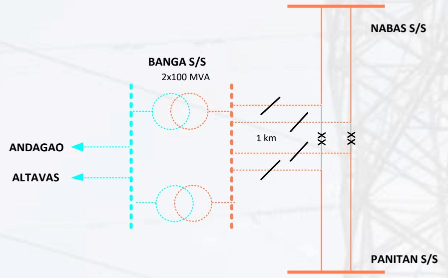
The project involves the installation of the power transformer and power circuit breakers, including the associated substation expansion required to ensure reliability and flexibility of operations on the substations.

9.1.24 Upgrading of Acquired Transmission Assets

Assets of generating companies that are classified by the ERC as transmission assets shall be maintained and operated by the TNP. The project involves the replacement and upgrading of acquired primary and secondary equipment, which are already old, obsolete, and not compliant with the TNP standards. A new separate control building will be constructed to ensure safety and improved operational efficiency.

9.1.25 Banga 138 kV Substation Project

Power consumers in Northern Panay draw power from Nabas and some from Panitan Substation. With the continuing economic and infrastructure developments within the area, the projected power requirement will not be adequately served by the existing substation capacity.

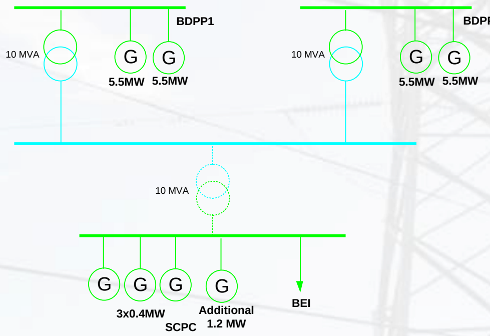


The project provides an alternative connection point to power consumers particularly for Northern Panay, thus, will accommodate the projected increase in the power demand.

The new substation will bus-in to the Panitan–Nabas 138 kV Transmission Line and will be located in Banga, Aklan.

9.1.26 Tagbilaran 69 kV Substation Project

This project involves the installation of a 10 MVA transformer for Tagbilaran Substation that will allow a continuous reliable supply of power for Bohol Electric Incorporated (BEI) and for the Sta. Clara Power Corp. (SCPC). Presently, these customers are just relying on the 2x10 MVA transformers at Bohol DPP Switchyard, thus, any outage or maintenance works in the BDPP-owned transformers, the grid connection of BEI and SCPC is being disrupted. With the project, BEI and SCPC will have a dedicated connection to Tagbilaran Substation, and the expansion of SCPC's Hydro Electric Power Plant will be catered.



9.1.27 Visayas Mobile Capacitor Project

The project involves the installation of voltage compensation devices in four (4) different areas in the Visayas with a total of 40 MVAR capacity. It entails the installation of mobile Capacitor in the 69 kV load end substations (DUCOMI 69 kV LES, Boracay 69 kV LES, Altavas 69 kV LES, and Miagao 69 kV LES) to provide sufficient voltage regulation in the load center, load end substations and its adjacent areas until the completion of the needed transmission project on each area.

9.1.28 Visayas Voltage Improvement Project

Various areas in Samar and Leyte are experiencing low voltage occurrences due to long 69 kV transmission lines. Likewise, areas in Cebu and Bohol are also experiencing low voltage occurrences due to high concentrations of load. These low voltages may result in power curtailment.

To address the low voltage problems in these areas, Capacitor are proposed to be strategically installed at identified substations and load-ends.

9.1.29 Visayas Voltage Improvement Project 2

This project aims to improve voltage regulation in different areas in the Visayas. These voltage issues are primarily due to the load growth in the area and load end substations that are currently served by long 69 kV transmission lines. Without any transmission reinforcements, these substations will be experiencing low voltage occurrences. As the demand grows, these occurrences will worsen which may lead to load shedding and possible voltage collapse in the area.

The project involves the installation of voltage compensation devices in different areas in Visayas with a total 240 MVAR capacity. It entails the installation of Capacitor in the 69 kV load end substations and network substation (Quinapondan, Baybay, Naga, Asturias, Garcia Hernandez, Carmen, Sipalay, Bayawan, Valladolid, Roxas, San Jose, and Estancia) and installation of STATCOM in the 138 kV network substations (Calbayog, Naga, and Panitan) and is seen to provide sufficient voltage regulation in the load center, load end substations and its adjacent areas.

9.2 Transmission Outlook for 2030

With the implementation of projects that will strengthen the Visayas Backbone, future developments in terms of the commercial and industrial sector in the Visayas that would increase the power supply requirements are being expected. To anticipate these developments, the main backbone will be extended towards Western Panay and Northern Samar. The interconnection of the 230 kV Backbone from Panay to Leyte will be unified by linking the CNP 230 kV Backbone to the Cebu–Ormoc 230 kV Line. This will be realized upon completion of the Daanbantayan–Bobon 230 kV Transmission Line under Cebu–Leyte 230 kV Interconnection Line 3 and 4 Project. More generations are expected to come to Panay that will need major reinforcements of the 230 kV lines. While the extension of the 138 kV line from Calbayog to Catarman will provide reliability as the demand in the Northern Samar increases.

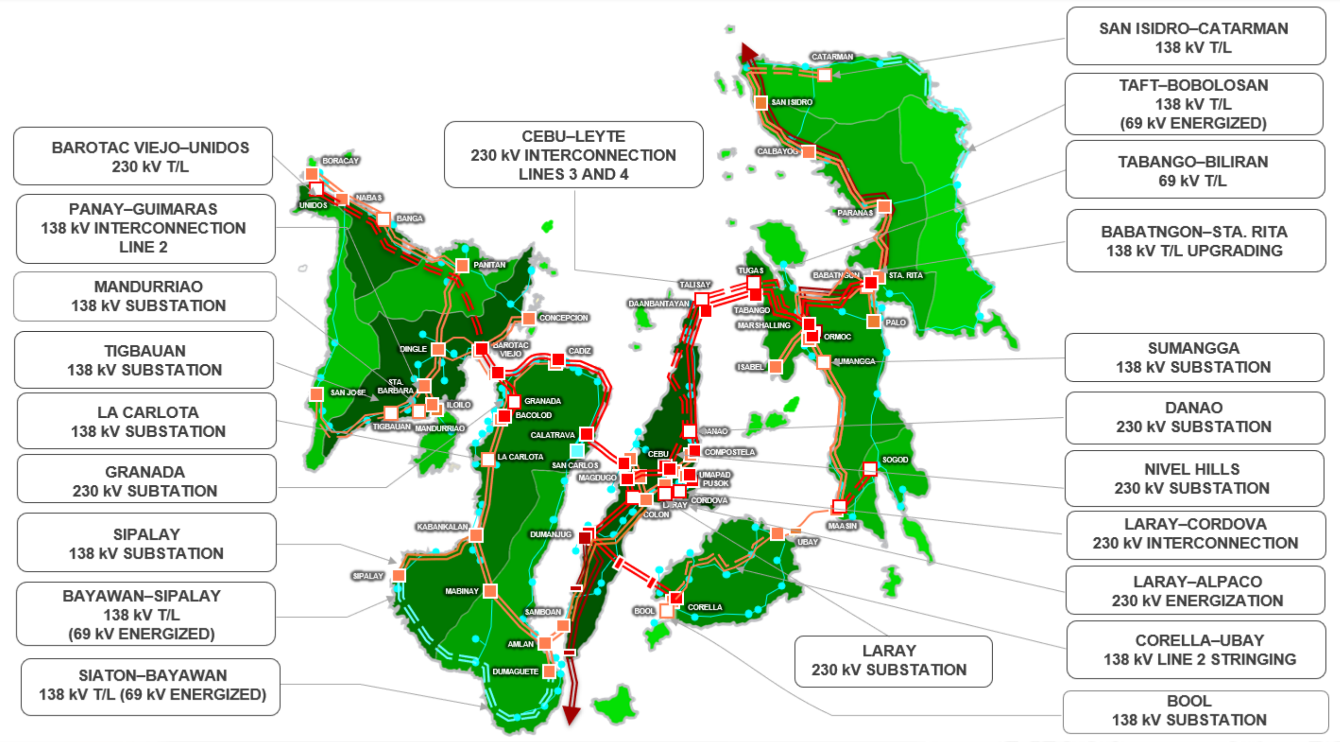


Figure 9.3: Visayas Transmission Outlook for 2030

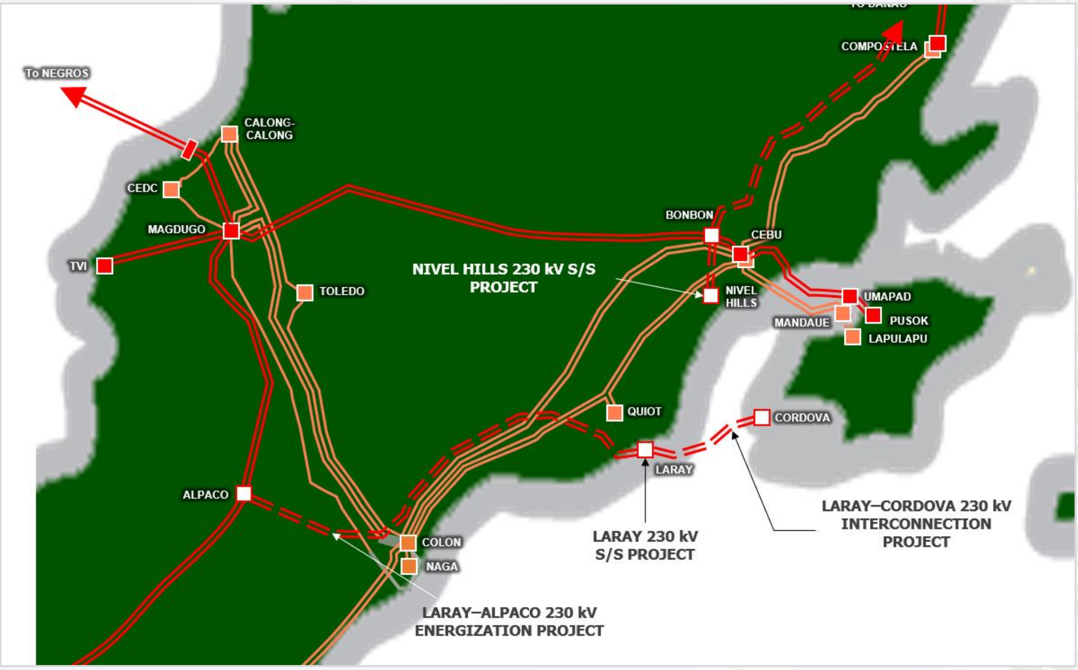


Figure 9.4: Metro Cebu Transmission Outlook for 2030

Table 9.2: Visayas Transmission Outlook for 2030

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Description	ETC
230 kV	Barotac Viejo–Unidos 230 kV TL	▪ The Project involves the construction of a new drawdown SS in Unidos, Aklan with a 2x300 MVA 230/138-13.8kV transformer capacity. It will bus-in along the proposed Nabas-Caticlan TL which is under the Nabas-Caticlan-Boracay Transmission Project. Termination of the 230 kV designed transmission line from Nabas SS will be disconnected and will be extended going to Barotac Viejo SS thus, connecting Unidos SS to Barotac Viejo SS. The project will accommodate the incoming power plants in Northern Panay. ▪ Location: Iloilo, Aklan	May 2026
	Cebu-Leyte 230 kV Interconnection Lines 3 and 4	▪ The Cebu-Leyte 230 kV Interconnection Line 3 and 4 Project involves the construction of a 120-km double-circuit 230 kV overhead line from Bobon SWS to the Talisay SWS. From there, 33-km double circuit submarine cables will be laid toward Tugas SWS. Another 53-km double-circuit 230 kV overhead line will be constructed from the Tugas SWS to Ormoc SS. Lastly, Marshalling SWS will be directly connected to Ormoc SS thru the existing Marshalling-Ormoc 230 kV TL and the existing Tabango-Marshalling 230 kV TL will be extended going to Ormoc SS. Installation of series reactors will be done in Tabango SS to control the amount of power flow in the existing Cebu-Leyte 230 kV Interconnection. These series reactors will be placed along Ormoc-Tabango 230 kV line. ▪ Location: Cebu and Leyte	Dec 2026
	Laray-Cordova 230 kV Interconnection	▪ The project involves the construction of a new drawdown SS within the area of Cordova in Visayas. It will be connected to Laray 230 kV SS in Mainland Cebu crossing to Cordova Island via double circuit 230 kV submarine cables with a transfer capacity of 600 MW per circuit. ▪ Location: Cebu	Dec 2030
	Laray-Alpaco 230 kV Energization	▪ The project involves the construction of a new switching station within the area of Alpaco in Metro Cebu. It will bus-in to the proposed Magdugo-Dumanjug 230 kV TL which is part of the Mindanao-Visayas Interconnection Project. The proposed overhead TL coming from Laray GIS SS, which is	Dec 2030

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Description	ETC
		connected to Magdugo-Colon 138 kV TL will be extended and will be connected to the new Alpaco Switching Station. Additionally, with this energization of Laray 230 kV SS will be done. ▪ Location: Cebu	
138 kV	Panay-Guimaras 138 kV Interconnection Line 2	▪ The proposed project involves the laying of the second submarine cable from Panay to Guimaras Island. This will provide reliability to the existing and future power plants in Guimaras Island. ▪ Location: Panay and Guimaras	Jul 2026
	Babatngon-Sta. Rita 138 kV TL Upgrading	▪ The project involves the upgrading of a portion of the existing Babatngon-Paranas 138 kV line along San Juanico Strait and the construction of Sta. Rita SS, with 2x50 MVA 138/69-13.8 kV transformers, which will bus-in to the said transmission corridor. ▪ Location: Leyte and Samar	Dec 2026
	Siaton-Bayawan 138 kV TL (Initially energized at 69 kV)	▪ The Siaton-Bayawan 138 kV TL Project involves the construction of 138 kV-designed TL, energized at 69 kV, that will connect Siaton and Bayawan Load End SS. The project is part of the ultimate plan of establishing 138 kV loop in southern Negros. ▪ Location: Negros Occidental and Negros Oriental	Dec 2027
	Corella-Ubay 138 kV Line 2 Stringing Project	▪ The proposed project involves the installation of the second circuit from Corella to Ubay SS. This will provide reliability to the existing and future power plants connected in Ubay SS. ▪ Location: Bohol	Sep 2028
	Taft-Bobolosan 138 kV TL (Initially energized at 69 kV)	▪ The Taft-Bobolosan 138 kV TL Project involves the construction of 138 kV-designed TL, energized at 69 kV, that will connect Taft and Bobolosan load End SS. These structures, to be found in northeastern Samar, will be part of the ultimate plan of establishing a 138 kV loop around Samar Island. ▪ Location: Northern and Eastern Samar	Dec 2028
	San Isidro-Catarman 138 kV TL	▪ The proposed project involves the development of a new double circuit 138 kV TL from Calbayog SS going to San Isidro and Catarman in Northern Samar. This transmission facility will improve the reliability in the area. ▪ Location: Samar	Dec 2028
	Bayawan-Sipalay 138 kV TL (Initially energized at 69 kV)	▪ The Bayawan-Sipalay 138 kV TL Project involves the construction of 138 kV-designed TL, energized at 69 kV, that will connect Bayawan and Sipalay Load End SS. The project is part of the ultimate plan of establishing 138 kV loop in southern Negros. ▪ Location: Negros Occidental and Negros Oriental	Dec 2030
69 kV	Tabango-Biliran 69 kV TL	▪ The Tabango-Biliran 69 kV TL Project involves the extension of 69 kV line from Tabango SS to the Biliran (LES) to form a loop and provide single outage contingency (N-1) capability to the TL serving northern Leyte and Biliran Island. ▪ Location: Leyte	Sep 2027

SUBSTATION PROJECTS			
Voltage	Project Name	Description	ETC
230 kV	Laray 230 kV SS (Initially energized at 138 kV)	▪ The project involves the construction of a new drawdown Gas Insulated Switchgear (GIS) SS within the area of Metro Cebu, which is a major load center in the Visayas. It will be tapped to the Magdugo-Colon 138 kV Line	Nov 2026

SUBSTATION PROJECTS			
Voltage	Project Name	Description	ETC
	Filed to ERC	via 230 kV TL that will be initially energized at 138 kV. The Magdugo-Colon 138 kV TL shall be disconnected from Colon SS, hence, Laray SS will be directly linked to Magdugo SS, bypassing Colon SS. ▪ Location: Cebu	
	Granada 230 kV SS Filed to ERC	▪ The project aims to provide alternative connection point to power consumers in Northern Negros, thus, will accommodate the projected increase in the power demand. The new substation will bus-in to the existing 230 kV transmission lines from E.B Magalona to Bacolod and will be located in the area of Granada. ▪ Location: Granada, Negros Occidental	Dec 2026
	Nivel Hills 230 kV SS Filed to ERC	▪ The project involves the construction of a new drawdown Gas Insulated Switchgear (GIS) SS with 3x300 MVA 230/69 kV transformers within the area of Metro Cebu, which is a major load center in the Visayas. It will bus-in to Cebu–Magdugo 230 kV TL via 230 kV transmission line which is approximately 5 km in length and will be connected through the230 kV switching station that will be located in the area of Bonbon, Cebu. ▪ Location: Cebu	Dec 2026
	Danao 230 kV SS	▪ The project involves putting up a new 230 kV drawdown SS in Danao, Cebu with 2x300 MVA 230/69 kV Power Transformers. The new Danao 230 kV SS will bus-in along Compostela SS–Talisay SWS 230 kV TL proposed under Cebu–Leyte 230 kV Interconnection Lines 3&4 Project. ▪ Location: Cebu	Aug 2028
138 kV	Sumangga 138 kV SS Filed to ERC	▪ The Sumangga 138 kV SS Project involves putting up a new 138 kV SS in Sumangga, Ormoc City, Leyte with 2x100 MVA 138/69 kV Power Transformers. The new Sumangga 138 kV SS will bus-in along Ormoc-Maasin 138 kV TL. ▪ Location: Leyte	Apr 2027
	Bool 138 kV SS Filed to ERC	▪ The project aims to provide alternative connection point to power consumers particularly for Southern Bohol, thus, will accommodate the projected increase in the power demand. The project involves the construction of the overhead transmission line from Corella to Bool that will be energized at 69 kV and the additional 100 MVA transformer in Corella Substation and the construction of the substation in Bool. Loads served by BOHECO I and II are the primary beneficiaries of the project. ▪ Location: Bohol	Dec 2026
	La Carlota 138 kV SS Filed to ERC	▪ The La Carlota 138 kV SS Project involves the construction of a new 138 kV SS in La Carlota, Negros Occidental with 2x100 MVA 138/69 kV power transformers. The project also includes the reconductoring of 42-km Bacolod–San Enrique–La Carlota 69 kV Line. ▪ Location: Negros	Oct 2026
	Mandurriao 138 kV SS	▪ The project involves the extension of the 138 kV transmission backbone towards southern part of Panay. This includes the construction of 52 km Barotac Viejo–Mandurriao 138 kV overhead TL and a new SS in Mandurriao, Iloilo City. This new SS will bus-in along Sta. Barbara–PEDC 138 kV TL. ▪ Location: Panay	Oct 2028
	Sipalay 138 kV SS	▪ The proposed project involves the upgrading of the existing Sipalay 69 kV SWS to a 138 kV SS. This substation facility will serve as a new drawdown	Dec 2029

SUBSTATION PROJECTS			
Voltage	Project Name	Description	ETC
		substation in preparation for the looping configuration in the southern part of Negros Island. ▪ Location: Negros	
230 kV	Visayas SS Upgrading 3	▪ The proposed project involves the expansion of the Boracay and Umapad SS to increase the SS capacity due to the forecasted load growth and to sustain the N-1 contingency provision prescribed by the Philippine Grid Code (PGC). ▪ Location: Cebu, Panay, and Negros	Dec 2027
138 kV	Visayas Regional PCB Replacement Project 1	▪ The projects involve the replacement of the existing PCB in various NGCP SS in the Visayas due to the following: ▪ Underrated capacity – short circuit current and/or continuous current capacity is less than the actual current that will flow into the circuit breaker. ▪ Old age - These PCBs are more or less 40 years old in the service, hence they are becoming less and less reliable every passing year. Although these PCBs can still operate, the reliability of the system is endangered due to their unpredictable operation. These PCBs are bound to fail to operate that will result in widespread system disturbance which should be avoided. ▪ Location: Cebu, Negros, Panay, Bohol, Leyte, Samar	Dec 2026
	Visayas Regional PCB Replacement 2	▪ The projects involve the replacement of the existing PCB in various NGCP SS in the Visayas due to the following: ▪ Underrated capacity – short circuit current and/or continuous current capacity is less than the actual current that will flow into the circuit breaker. ▪ Old age - These PCBs are more or less 40 years old in the service, hence they are becoming less and less reliable every passing year. Although these PCBs can still operate, the reliability of the system is endangered due to their unpredictable operation. These PCBs are bound to fail to operate that will result in widespread system disturbance which should be avoided. ▪ Location: Cebu, Negros, Panay, Bohol, Leyte, Samar	Dec 2030

VOLTAGE IMPROVEMENT PROJECTS			
Voltage	Project Name	Description	ETC
138 kV	Visayas Voltage Improvement 3	▪ The Visayas Voltage Improvement Project 3 aims to provide reactive power support to address undervoltage problems in Visayas. ▪ Location: Cebu	Dec 2027

9.3 Transmission Outlook for 2035

To further improve the reliability of power supply to the Visayas grid, looping projects will be constructed, the San Jose–Nabas 138 kV Transmission Line Project aims to loop the 138 kV system in Panay, on the other hand the Bohol–Leyte 230 kV Interconnection Project and the Palo–Javier 138 kV Transmission Line Project aims to form a 230 kV loop among Cebu, Bohol and Leyte sub-grids.

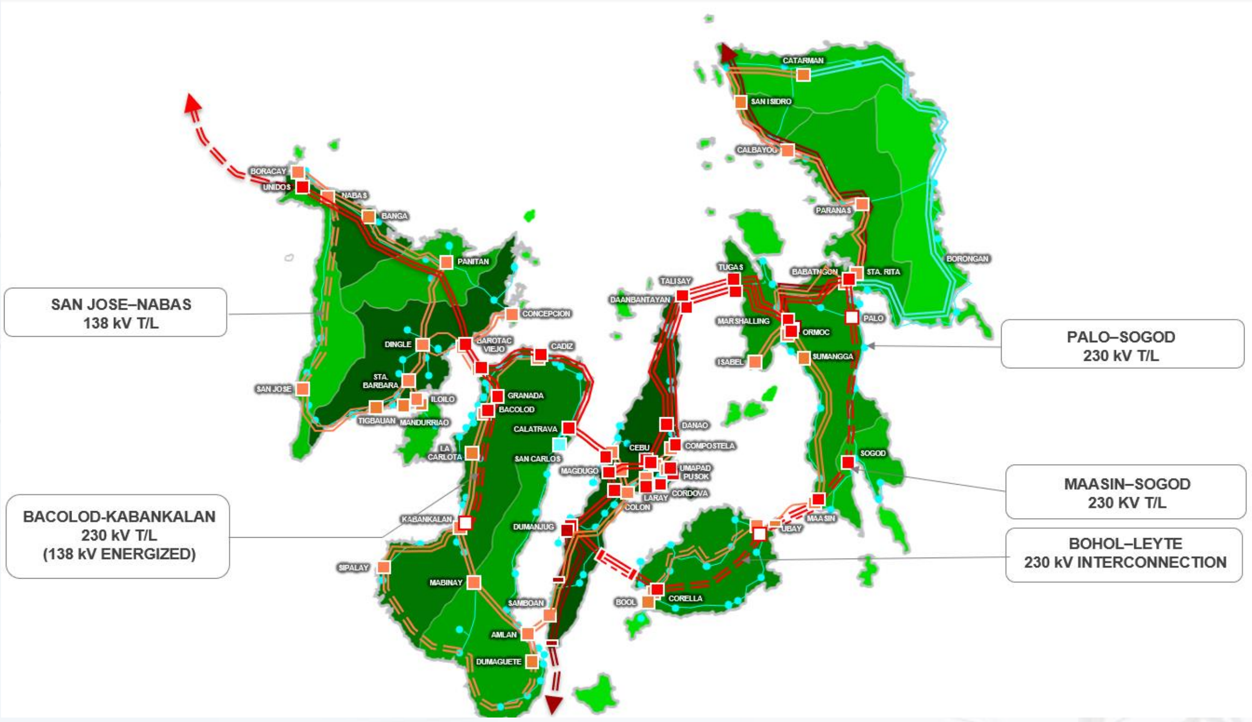


Figure 9.5: Visayas Transmission Outlook for 2035

Table: 9.3 Visayas Transmission Outlook for 2035

TRANSMISSION LINE PROJECTS		
Voltage	Project Name	Description
230 kV	Bacolod–Kabankalan 230 kV TL (Initially energized at 138kV)	▪ The Bacolod–Kabankalan 138 kV TL connects the northern and southern part of Negros Island. It enables the exchange of power between the two areas. With the long-term plan of putting up a 138 kV backbone loop in the southern portion of Negros, the capacity of Bacolod–Kabankalan 138 kV TL will be no longer sufficient. The project aims to increase the capacity of Bacolod–La Carlota–Kabankalan 138 kV TL by constructing a double circuit overhead transmission line from Bacolod SS toward Kabankalan SS. ▪ Location: Negros Occidental
	Bohol–Leyte 230 kV Interconnection	▪ The Bohol–Leyte 230 kV Interconnection Project involves the development of a 230 kV Backbone from Bohol to Leyte. The completion of the project will complete the 230 kV transmission loop between Cebu, Bohol, and Leyte Island. It involves the construction of 230 kV TL that will traverse from Corella–Ubay–Tugas and from Guadalupe–Maasin–Sogod. Moreover, a double circuit 230 kV Submarine Cable will be laid from Tugas to Guadalupe SWS with a transfer capacity of 600 MW per circuit. ▪ Location: Bohol and Leyte
	Maasin–Sogod 230 kV TL (Initially 138 kV Energized)	▪ The projects involve the construction of a new drawdown substation in the area of Sogod. This will accommodate the customers in Southern Leyte thus giving reliability and addressing the undervoltage issues in the area. A 230 kV designed transmission line that will be energized at 138 kV will be constructed from Maasin going to the new Sogod SS. ▪ Location: Leyte
	Palo–Sogod 230 kV TL	▪ The project aims to complete the ultimate plan of creating a 230 kV loop between Cebu, Bohol, and Leyte Islands by the construction of 90-km Palo–Sogod 230 kV TL thereby ensuring the reliable and resilient transmission of power between Cebu, Bohol, and Leyte Island. ▪ Location: Leyte

TRANSMISSION LINE PROJECTS		
Voltage	Project Name	Description
138 kV	San Jose–Nabas 138 kV TL	▪ The project aims to complete the ultimate plan of creating a 138 kV loop in Panay Island by the construction of 125-km San Jose–Nabas 138 kV TL thereby ensuring the reliable and resilient transmission of power in Panay Island. ▪ Location: Panay

SUBSTATION PROJECTS		
Voltage	Project Name	Description
138 kV	Visayas SS Upgrading 4	▪ The proposed project involves the expansion of the various Visayas SS to increase the SS capacity due to the forecasted load growth and to sustain the N-1 contingency provision prescribed by the Philippine Grid Code (PGC). ▪ Location: Cebu, Panay, Leyte, Negros and Bohol

	Visayas PCB Replacement 3	▪ The projects involve the replacement of the existing PCB in various NGCP SS in the Visayas due to the following:
		  ▪ Underrated capacity – short circuit current and/or continuous current capacity is less than the actual current that will flow into the circuit breaker.
		  ▪ Old age - These PCBs are more or less 40 years old in the service, hence they are becoming less and less reliable every passing year. Although these PCBs can still operate, the reliability of the system is endangered due to their unpredictable operation. These PCBs are bound to fail to operate that will result in widespread system disturbance which should be avoided.
		▪ Location: Cebu, Negros, Panay, Bohol, Leyte, Samar

VOLTAGE IMPROVEMENT PROJECTS		
Voltage	Project Name	Description
230 kV	Visayas Voltage Improvement 4	▪ The Visayas Voltage Improvement Project 4 will address the undervoltage problems in Cebu and Negros Islands. The installation of Capacitor in Granada, La Carlota, and Cordova SS will address the projected undervoltage in each area. ▪ Location: Cebu and Negros

9.4 Transmission Outlook for 2040

By 2040, a more secure, more robust, and stronger transmission system is expected. A looped transmission system with sufficient redundancy is the key to a more robust and resilient grid. With the gradual expansion of the 230 kV backbone in the Visayas, the looping of the 230 kV system will further ensure system security and reliability of the Visayas Grid. This will also provide grid resiliency during natural calamities by providing alternative transmission corridors. Furthermore, Samar's 138 kV system will also be further extended and looped to improve supply, power quality, security, and reliability.

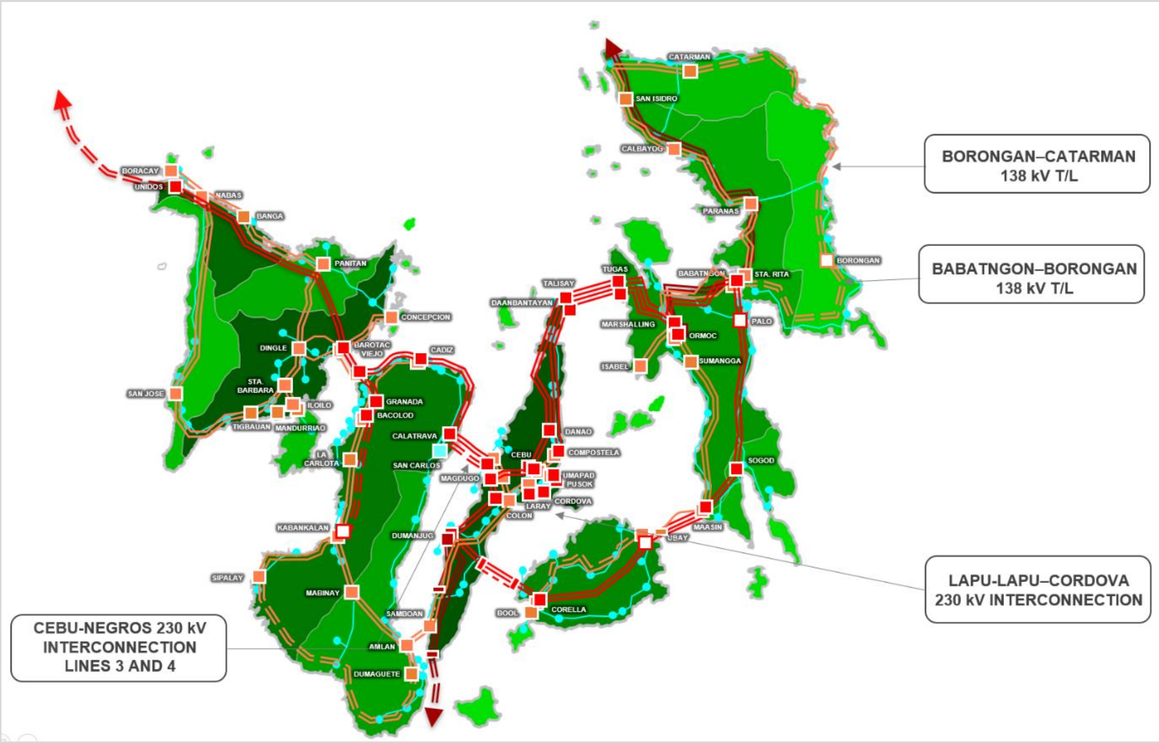


Figure 9.6: Visayas Transmission Outlook 2040

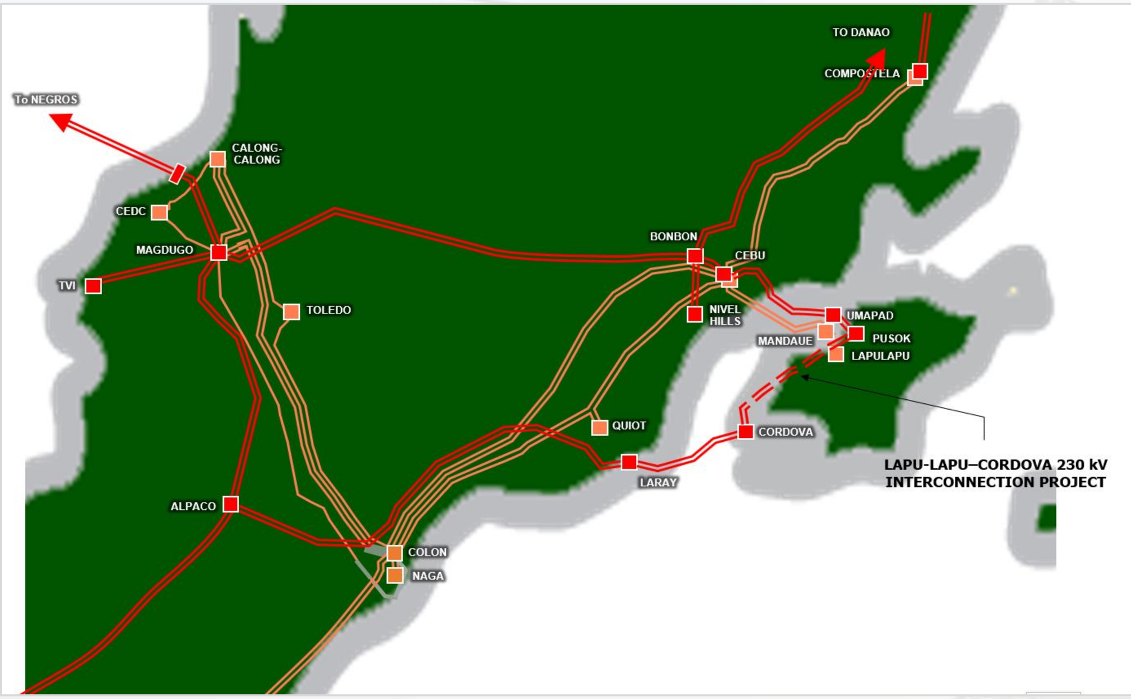


Figure 9.7: Proposed Metro Cebu Transmission Outlook 2040

Table 9.4 Visayas Transmission Outlook for 2040

TRANSMISSION LINE PROJECTS		
Voltage	Project Name	Description
230 kV	Cebu–Negros 230 kV Interconnection Line 3 and 4	▪ The Cebu–Negros 230 kV Interconnection Line 3 and 4 Project involves the construction of a Cebu–Negros 230 kV Submarine Cable Line 3 and 4. The proposed facility will accommodate the excess generation from Panay and Negros going to Cebu. This project will also pave way for the construction of the new Calatrava SWS in Negros and Talavera SWS in Cebu. ▪ Location: Cebu and Negros

TRANSMISSION LINE PROJECTS		
Voltage	Project Name	Description
	Lapu-Lapu–Cordova 230 kV Interconnection	▪ The 230 kV transmission corridor in Cebu and Mactan Island is a double circuit 230 kV TL and submarine cable that traverses from Lapu-Lapu–Umapad–Cebu–Magdugo–Alpaco–Laray–Cordova. Double Outage of the transmission line from Umapad to Lapu-Lapu will result to the isolation of Lapu-Lapu Substation from the grid. The Lapu-Lapu–Cordova 230 kV Interconnection Project will complete the 230 kV transmission loop in Metro Cebu. This will provide a reliable and resilient power grid in Cebu and Mactan Island. ▪ Location: Cebu
138 kV	Babatngon-Borongan 138 kV TL	▪ The Paranas-Borongan-Quinapondan 69 kV Line serves loads of the Eastern Samar through ESAMELCO's Load-End Substations (LES). The existing 69 kV line serving the said area is having a length of more than 190 km which is prone to long outages and tedious to maintain. The proposed Babatngon-Borongan 138 kV TL Project aims to provide a transmission backbone corridor along the eastern part of Samar Island. The project will also drastically improve the reliability of the power supply in the area. This project will also construct a new drawdown 138 kV SS in Borongan. ▪ Location: Samar and Leyte
	Borongan–Catarman 138 kV TL	▪ Samar Island is located in eastern part of Visayas. Samar is frequently impacted by typhoons from Pacific Ocean which makes its transmission system very susceptible to interruption. There is a need to strengthen the reliability of transmission backbone in Samar Island by creating 138 kV transmission loop system within the Island. The Borongan–Catarman 138 kV TL Project will address the generation and load curtailment in the event of outage of the entire Babatngon–Sta Rita 138 kV TL. Sta. Rita, Paranas, Calbayog, San Isidro and Catarman SS are no longer solely dependent on Babatngon–Sta Rita 138 kV TL. Moreover, the proposed project completes the 138 kV backbone loop and thereby ensures reliable transmission of power within Samar Island. ▪ Location: Samar

10 Mindanao Transmission Outlook

The power supply deficiency being experienced in Mindanao for the past years especially during the dry season has been averted by the entry of bulk generation capacity additions from several coal-fired power plant projects. In the integration of these power plant projects to the Mindanao Grid, new transmission backbones were developed.

Further, the proponents of the coal-fired power plant projects have plans to expand their capacity in the future which could reach a total of 600 MW to 1,200 MW of power generation capacity in each site. With such aggressive plans for the expansion of power plants on the island and with the implementation of the interconnection between Mindanao and Visayas, there would be more opportunities for power exchange. This major interconnection project, which is the final link to interconnect the Philippine Grid, is further discussed in this Chapter.

In terms of transmission system configuration, Mindanao is relatively a robust grid. However, security issues in the island remains a serious concern, thus NGCP is still facing major challenges in implementing its operations and construction of key transmission projects. Notably, another vital issue in the Mindanao grid is the looming low voltage issue in Zamboanga City. Due to a long distance and radial configuration of transmission line supplying power to the area relative to the continuous increase in demand, there will be an impending low voltage in the area which cannot be resolved by power mitigating transmission facility. In this case, a power plant should be constructed in the area to balance the essential reactive requirement of the system.

Meanwhile, to cater the other requirements of the Mindanao Grid, reinforcements of the existing 138 kV substations, the extension of some of the existing 230 kV and 138 kV transmission lines and looping of some of 69 kV transmission systems as well as power quality projects are necessary for load growth and system reliability improvement.

10.1 Transmission Outlook for 2025

Shown in Table 10.1 is the list of transmission projects planned for Mindanao Grid for the period 2021-2025 in addition to the projects already approved by the ERC.

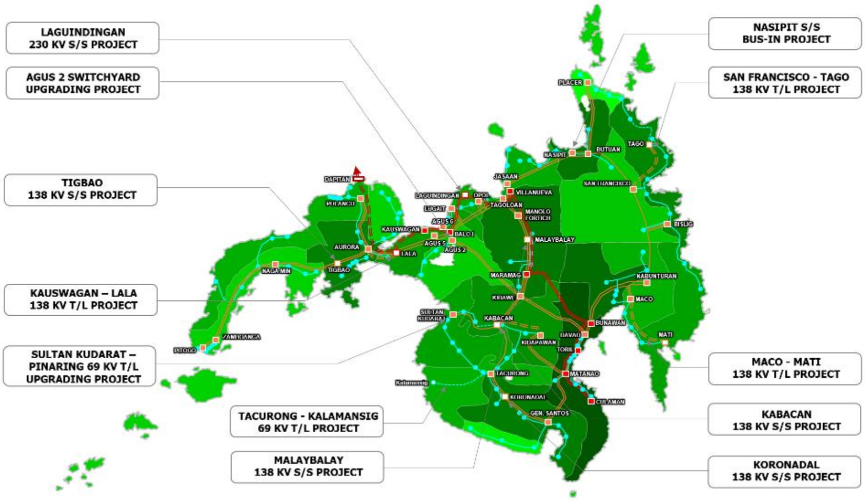


Figure 10.1: Proposed Mindanao Transmission Outlook for 2025

Table 10.1
Mindanao Transmission Outlook for 2025

TRANSMISSION LINE PROJECTS			
Voltage	**Project Name**	**Project Driver and Components**	**ETC**
230 kV	Kauswagan–Lala 230 kV TL ERC-approved	Generation Entry, System Reliability *Substation:* ▪ Lala 230 kV SS, 2x300 MVA 230/138 kV Power Transformers, 6-230 kV PCB, 6-138 kV PCB ▪ Aurora 138 kV SS, 3-138 kV PCB *Transmission Line:* ▪ Kauswagan-Lala 230 kV TL, ST-DC, 4-795 MCM ACSR, 56 km. ▪ Lala-Aurora 138 kV TL, ST-DC, 2-795 MCM ACSR, 27.17 km. Project Cost: 5,040 Million Pesos Location: Lanao del Norte, Zamboanga del Sur	Mar 2022
138 kV	Maco–Mati 138 kV TL Filed to ERC	Load Growth, System Reliability *Substation:* ▪ Maco 138 kV SS, 4-138 kV PCB ▪ Mati 138 kV SS, 1x50 MVA 138/69 kV Power Transformer, 6-138 kV PCB, 5-69 kV PCB *Transmission Line:* ▪ Maco–Mati 138 kV TL, ST-DC, 1-795 MCM ACSR/AS, 72.3 km. Project Cost: 2,764 Million Pesos Location: Davao de Oro, Davao Oriental	Feb 2025
	San Francisco– Tago 138 kV TL Filed to ERC	Load Growth, System Reliability *Substation:* ▪ San Francisco 138 kV SS, 4-138 kV PCB ▪ Tago 138 kV SS, 1x50 MVA 138/69 kV Power Transformer, 6-138 kV PCB, 8-69 kV PCB *Transmission Line:* ▪ San Francisco–Tago 138 kV TL, ST-DC, 1-795 MCM ACSR/AS, 91 km. ▪ Madrid–Tago 69 kV TL, SP-SC, 1-795 MCM ACSR/AS, 59.4 km. ▪ Tago SS Cut-in to Cagwait–Tandag 69 kV TL, SP-SC, 1-795 MCM ACSR/AS, 2 x 1 km Project Cost: 4,199 Million Pesos Location: Agusan del Sur, Surigao del Sur	May 2025
69 kV	Tacurong–Kalamansig 69 kV TL Filed to ERC	System Reliability *Substation:* ▪ Tacurong 138 kV SS, 1-69 kV PCB ▪ Kalamansig 69 kV SwS, 1x7.5 MVAR 69 kV Capacitor, 3-69 kV PCB *Transmission Line:* ▪ Tacurong-Kalamansig 69 kV TL, ST/SP-SC, 1-336.4 MCM ACSR, 100 km. Project Cost: 1,939 Million Pesos Location: Sultan Kudarat	Dec 2023
	Sultan Kudarat–Pinaring 69 kV TL Upgrading Filed to ERC	System Reliability *Substation:* ▪ *Sultan Kudarat 138 kV SS,* 3-69 kV PCB *Transmission Line:* ▪ *Sultan Kudarat – Pinaring 69 kV TL (New),* SP-DC, 1-795 MCM ACSR/AS, 6.67 km. ▪ *Sultan Kudarat – Pinaring 69 kV TL Upgrading,* SP-SC, 1-795 MCM ACSR/AS, 6.67 km. Project Cost: 541 Million Pesos Locaton: Maguindanao	Jun 2025

SUBSTATION PROJECTS			
Voltage	Project Name	Project Driver and Components	ETC
230 kV	Laguindingan 230 kV SS Filed to ERC	Load Growth *Substation:* ▪ Laguindingan 230 kV SS, 2x300 MVA 230/138 kV and 1x100 138/69 kV Power Transformers, 10-230 kV PCB, 6-138 kV PCB, 3-69 kV PCB equipment ▪ Tagoloan 138 kV SS, 5-138 kV PCB *Transmission Line:* ▪ Laguindingan SS Bus-in to Balo-i–Laguindingan 230 kV TL, ST-DC, 2-795 MCM ACSR/AS, 2 x 5.75 km Project Cost: 2,354 Million Pesos Location: Misamis Oriental	Jan 2024
138 kV	Agus 2 Switchyard Upgrading ERC-approved	System Reliability *Substation:* ▪ Agus 2 SY, 10-138 kV PCB Project Cost: 741 Million Pesos Location: Lanao del Sur	Oct 2022
	Mindanao Substation Expansion 3 Project (MSE3P) Filed to ERC	Load Growth *Substation:* ▪ Pitogo 138 kV SS, 1x100 MVA 138/69 kV Power Transformer, 2-138 kV PCB, 1-69 kV PCB ▪ Placer 138 kV SS, 1x100 MVA 138/69 kV Power Transformer ▪ San Francisco 138 kV SS, 1x100 MVA 138/69 kV Power Transformer, 2-138 kV PCB, 1-69 kV PCB ▪ Matanao 138 kV SS, 1x100 MVA 138/69 kV Power Transformer, 2-138 kV PCB, 1-69 kV PCB Project Cost: 1,465 Million Pesos Location: Zamboanga del Sur, Surigao del Norte, Agusan del Sur, Davao del Sur	Dec 2023
	Mindanao Substation Upgrading Project (MSUP) ERC-approved	Load Growth *Substation:* Stage 1: ▪ Bislig 138 kV SS, 1x50 MVA 138/69 kV Power Transformer, 3-138 kV PCB, ▪ 6-69 kV PCB ▪ Butuan 138 kV SS, 3x7.5 MVAR 69 kV Capacitors, 5-138 kV PCB, 3-69 kV PCB ▪ Kidapawan 138 kV SS, 1x50 MVA 138/69 kV Power Transformer (from Culaman SS), 1-69 kV PCB ▪ Pitogo 138 kV SS, 1x100 MVA 138/69 kV Power Transformer, 2x7.5 MVAR 69 kV Capacitors, 1-138 kV CAIS, 1-69 kV CAIS, 2-69 kV PCB ▪ Placer 138 kV SS, 1x100 MVA 138/69 kV Power Transformer, 2x7.5 MVAR 69 kV Capacitors, 2-138 kV PCB, 5-69 kV PCB ▪ San Francisco 138 kV SS, 1x50 MVA 138/69 kV Power Transformer, 3x7.5 MVAR 69 kV Capacitors, 4-138 kV PCB, 1-69 kV PCB ▪ Gen. Santos 138 kV SS, 1x100 MVA 138/69 kV Power Transformer, 1x7.5 MVAR 69 Capacitor, 1-138 kV PCB, 9-69 kV PCB ▪ Tacurong 138 kV SS, 1x7.5 MVAR 69 kV Capacitor, 9-69 kV PCB ▪ Agus 6 138 kV SS, 1x100 MVA 138/69 kV Power Transformer, 2-138 kV PCB, 3-69 kV PCB ▪ Maramag 138 kV SS, 1x75 MVA 138/69 kV Power Transformer, 3-138 kV PCB, 1-69 kV PCB ▪ Naga Min 138 kV SS, 1x100 MVA 138/69 kV Power Transformer, 2-69 kV PCB ▪ Opol 138 kV SS, 1x100 MVA 138/69 kV Power Transformer, 2-69 kV PCB	Feb 2024

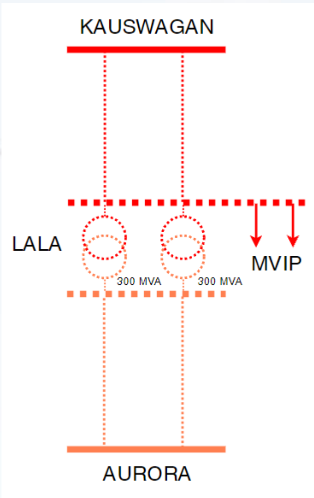
SUBSTATION PROJECTS			
Voltage	Project Name	Project Driver and Components	ETC
		▪ Polanco 138 kV SS, 1x75 MVA 138/69 kV Power Transformer, 3-138 kV PCB, 1-69 kV PCB Project Cost: 5,016 Million Pesos Location: Surigao del Sur, Agusan del Norte, North Cotabato, Zamboanga del Sur, Surigao del Norte, Agusan del Sur, South Cotabato, Sultan Kudarat, Lanao del Norte, Bukidnon, Zamboanga Sibugay, Misamis Oriental and Zamboanga del Norte	
	Mindanao Substation Expansion 4 Project (MSE4P) Filed to ERC	Load Growth *<u>Substation:</u>* ▪ Naga Min 138 kV SS, 1x100 MVA 138/69 kV Power Transformer, 2-138 kV PCB, 2-69 kV PCB ▪ Polanco 138 kV SS, 1x100 MVA 138/69 kV Power Transformer, 2-138 kV PCB, 2-69 kV PCB ▪ Agus 6 138 kV SY: 1x100 MVA 138/69 kV Power Transformer, 2-138 kV PCB, 2-69 kV PCB ▪ Maramag 138 kV SS: 1x100 MVA 138/69 kV Power Transformer, 2-138 kV PCB, 2-69 kV PCB ▪ Maco 138 kV SS, 1x100 MVA 138/69 kV Power Transformer, 2-138 kV PCB, 2-69 kV PCB ▪ Culaman 230 kV SS, 1x50 MVA 230/69 kV Power Transformer, 2-230 kV PCB, 2-69 kV PCB ▪ Sultan Kudarat 138 kV SS, 2x100 MVA 138/69 kV Power Transformers, 4-138 kV PCB, 4-69 kV PCB ▪ Nasipit 138 kV SS, 1x100 MVA 138/69 kV Power Transformer, 2-138 kV PCB, 2-69 kV PCB Project Cost: 3,525 Million Pesos Location: Zamboanga Sibugay, Zamboanga del Norte, Lanao del Norte, Bukidnon, Davao de Oro, Davao Occidental, Maguindanao, Agusan del Norte	Feb 2024
	Mindanao Substation Rehabilitation Project (MSRP) ERC-approved	System Reliability *<u>Substation:</u>* ▪ Bunawan 138 kV SS, 5-138 kV PCB ▪ Davao 138 kV SS, 4-138 kV PCB, 2-69 kV PCB ▪ Maco 138 kV Substation, 1x7.5 MVAR 69 kV Capacitor, 1-69 kV PCB ▪ Nabunturan 138 kV SS, 1x7.5 MVAR 69 kV Capacitor, 3- 138 kV PCB, 5-69 kV PCB ▪ Nasipit 138 kV SS, 2-138 kV PCB ▪ Sultan Kudarat 138 kV SS, 6-69 kV PCB ▪ Tagoloan 138 kV SS, 3-138 kV PCB, 1-69 kV PCB ▪ Maramag 138 kV SS, 11-138 kV PCB, 1-69 kV PCB ▪ Agus 5 SY, 6-138 kV PCB ▪ Balo-i 138 kV SS, 13-138 kV PCB ▪ Lugait 138 kV SS, 5-138 kV PCB, 1-69 kV PCB ▪ Aurora 138 kV SS, 1-138 kV PCB, 3-69 kV PCB ▪ Zamboanga 138 kV SS, 3-138 kV PCB, 2-69 kV PCB Project Cost: 3,418 Million Pesos Location: Davao del Sur, Davao de Oro, Agusan del Norte, Maguindanao, Misamis Oriental, Bukidnon, Lanao del Norte, Zamboanga del Sur	Jun 2024
	Tigbao 138 kV SS For Filing	Load Growth *<u>Substation:</u>* ▪ Tigbao 138 kV SS, 2x100 MVA 138/69 kV Power Transformers, 10-138 kV PCB, 5-69 kV PCB *<u>Transmission Line:</u>* ▪ Tigbao-Dumalinao 69 kV TL, SP-SC, 1-795 MCM ACSR/AS 15 km. Location: Zamboanga Del Sur	Sep 2024

SUBSTATION PROJECTS			
Voltage	Project Name	Project Driver and Components	ETC
	Kabacan 138 kV SS Filed to ERC	System Reliability Phase 1 – Substation Phase 2 – Remaining TL *Substation:* ▪ Kabacan 138 kV Substation, 1x50 MVA 138/69 kV Power Transformer, 11-138 kV PCB, 1-69 kV PCB ▪ Kidapawan 138 kV SS, 2-138 kV PCB ▪ Gen. Santos 138 kV SS, 4-138 kV PCB *Transmission Line:* ▪ Kabacan-Kidapawan 138 kV TL, ST-DC, 1-795 MCM ACSR/AS, 50.6 km ▪ Kabacan-Villarica 69 kV TL, SP-SC, 1-336.4 MCM ACSR/AS, 37.2 km ▪ Kibawe 138 kV Line Extension, ST-DC, 1-795 MCM ACSR/AS, 0.5 km ▪ Tacurong 138 kV Line Extension, ST-SC, 1-795 MCM ACSR/AS, 1.86 km ▪ Sultan Kudarat 138 kV Line Extension, ST-SC, 1-795 MCM ACSR/AS, 1.88 km Project Cost: 4,168 Million Pesos Location: North Cotabato, South Cotabato, Sultan Kudarat, Maguindanao	Phase 1 – Dec 2023 Phase 2 – Dec 2025
	Koronadal 138 kV SS	Load Growth *Substation:* ▪ Koronadal 138 kV SS, 2x150 MVA 138/69 Power Transformers, 14-138 kV PCB, 6-69 kV PCB *Transmission Line:* ▪ Koronadal SS Bus-in to Tacurong–General Santos 138 kV TL, ST-DC, 1-795 MCM ACSR, 0.5 km. Location: South Cotabato	Dec 2025
	Malaybalay 138 kV SS Filed to ERC	Load Growth, System Reliability *Substation:* ▪ Malaybalay 138 kV SS, 2x100 MVA Power Transformers, 10-138 kV PCB, 4-69 kV PCB *Transmission Line:* ▪ Malaybalay SS Bus-in to Manolo Fortich–Tagoloan 138 kV TL, ST-DC, 1-795 MCM ACSR/AS, 0.5 km Project Cost: 1,936 Million Pesos Location: Bukidnon	Dec 2025

VOLTAGE IMPROVEMENT PROJECTS			
Voltage	Project Name	Project Driver and Components	ETC
138 kV	Zamboanga Peninsula Voltage Improvement Project (ZPVIP) Filed to ERC	Power Quality *Substation:* ▪ Zamboanga 138 kV SS, 200 MVAR STATCOM, 2-138 kV PCB, 1-69 kV PCB ▪ Naga Min 138 kV SS, 4x10 MVAR 138 kV Capacitors, 4-138 kV PCB ▪ Pitogo 138 kV SS, 2x10 MVAR 138 kV Capacitors, 6-138 kV PCB ▪ Tacurong 138 kV SS, 2x30 MVAR 138 kV Capacitors, 2-138 kV PCB ▪ Gen. Santos 138 kV SS, 4x30 MVAR 138 kV Capacitors, 4-138 kV PCB Project Cost: 1,878 Million Pesos Location: Zamboanga del Sur, Zamboanga Sibugay, Sultan Kudarat, South Cotabato	Dec 2023
	Nasipit SS Bus-in Filed to ERC	Power Quality, System Reliability *Substation:* ▪ Nasipit 138 kV SS, 1x100 MVA 138/69 kV Power Transformer, 7-138 kV PCB, 1-69 kV PCB *Transmission Line:*	Apr 2024

VOLTAGE IMPROVEMENT PROJECTS			
Voltage	Project Name	Project Driver and Components	ETC
		▪ Nasipit SS Bus-in to Jasaan – Butuan 138 kV TL: ST-DC, 1-795 MCM ACSR/AS, 4 km ▪ Swinging of TM 2 138 kV TL: 1-795 MCM ACSR/AS, 0.5 km Project Cost: 1,172 Million Pesos Location: Agusan del Norte	
	Eastern Mindanao Voltage Improvement Project (EMVIP) Filed to ERC	Power Quality *Substation:* ▪ Butuan 138 kV SS, 3x10 MVAR 138 kV Capacitors, 3-138 kV PCB ▪ San Francisco 138 kV SS, 3x10 MVAR 138 kV Capacitors,3-138 kV PCB ▪ Nabunturan 138 kV SS, 3x10 MVAR 138 kV Capacitors, 6-138 kV PCB ▪ Maco 138 kV SS, 3x10 MVAR 138 kV Capacitors, 3-138 kV PCB Project Cost: 868 Million Pesos Location: Agusan del Norte, Agusan del Sur, Davao de Oro	Oct 2024

10.1.1 Kauswagan – Lala 230 kV Transmission Line Project



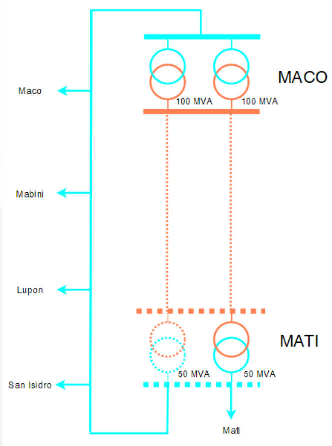
Formerly Balo-i – Kauswagan –Aurora 230 kV TL Phase 2, the project connects the Kauswagan Substation to Lala Substation utilizing a double-circuit transmission line in a bundle-of-two power conductor configuration at 230 kV voltage level. The project includes the installation of two power transformers in the Lala Substation to be linked to the existing Aurora Substation through a 138 kV transmission line.

The majority of power consumption in the Zamboanga Peninsula is supplied through Balo-i – Agus 5 – Aurora 138 kV lines. These transmission lines are critically loaded during the N-1 condition. The project provides a reliable transmission network for the Zamboanga Peninsula to achieve continuous normal grid operation. It is the extension of the planned Mindanao 230 kV transmission backbone facility which complements the MVIP.

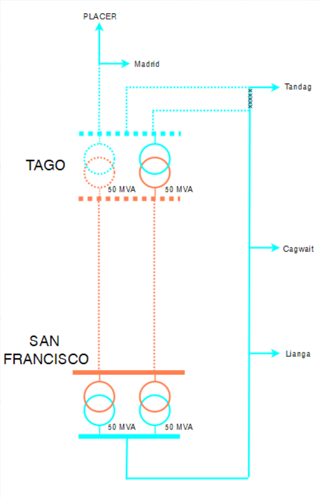
10.1.2 Maco – Mati 138 kV Transmission Line Project

Presently, the existing Maco – Mati 69 kV Line has a radial configuration. There is no alternate line to deliver power when the line is shut down during outage or maintenance. Also, a low voltage problem is anticipated due to the development and increasing power requirement of Mati City.

The project consists of the extension of the 138 kV corridor from the existing Maco Substation to the new Mati Substation and the installation of a 50 MVA power transformer in the new substation. This addresses the anticipated low voltage in the area and offers continuous and reliable power delivery during normal and N-1 conditions.



10.1.3 San Francisco – Tago 138 kV Transmission Line Project



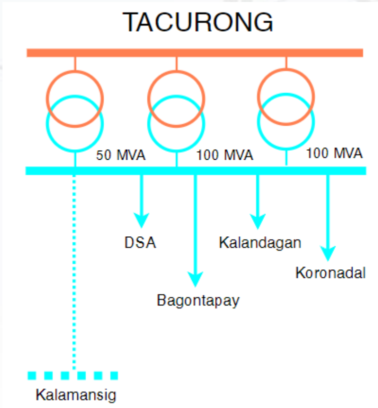
An outage of either San Francisco – Tandag 69 kV Line or Placer – Madrid 69 kV Line shuts down the connected loads in Surigao provinces due to the absence of an alternative transmission facility.

The project is comprised of the 138 kV line extension from San Francisco Substation to the new Tago Substation and the looping of the 69 kV lines in Surigao del Sur. This project allows the switching of loads during line outages and solves the power quality and reliability problems being experienced in the area.

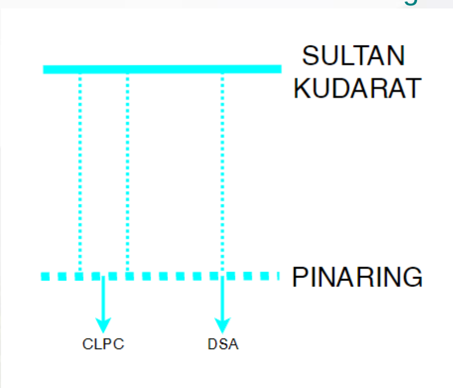
10.1.4 Tacurong – Kalamansig 69 kV Transmission Line Project

This project allows the towns of Lebak, Kalamansig, Bagumbayan, and Senator Ninoy Aquino to enjoy cheaper and reliable electricity from the grid. These areas located in the Province of Sultan Kudarat in the SOCCSKSARGEN Region are considered off-grid loads and are currently being served by a limited and costly power.

The project involves the implementation of a new 69 kV single-circuit line, expansion of Tacurong Substation, and construction of a switching station in Kalamansig. The completion of the project ends the dependency of power consumers from SPUG as they start enjoying the reliable and cheaper power supply from the grid.

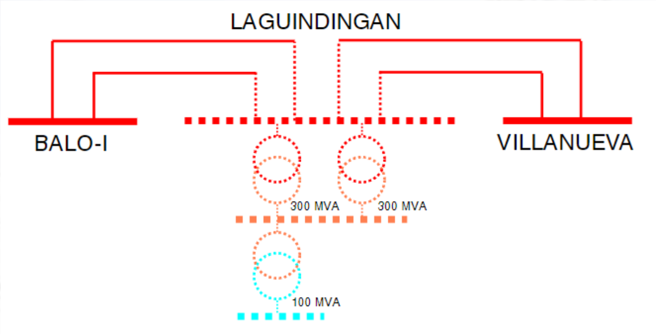


10.1.5 Sultan Kudarat – Pinaring 69 kV Transmission Line Upgrading Project



The Sultan Kudarat – Datu Saudi Ampatuan – Tacurong 69 kV Line is experiencing frequent load shifting, which is followed by low voltage and rotational power interruptions in the area. This impedes the economic development of the Maguindanao province, especially Cotabato City. To prevent this, the almost 7 km Sultan Kudarat – Pinaring line section is upgraded from 1-336.4 MCM ACSR to 1-795 MCM ACSR conductor. Also, a double circuit of the same length as the mentioned section is implemented to effectively separate the feeder serving Cotabato City with N-1 contingency.

10.1.6 Laguindingan 230 kV Substation Project



The abrupt industrial and commercial developments in the area of Laguindingan requires substantial power supply requirement, which exceeds the existing capacity of nearby transmission facilities.

The project involves the implementation of a new 230 kV substation within Laguindingan that will bus-in to the existing Balo-i – Villanueva 230 kV line. This provides a stable supply and efficient delivery of bulk power to the loads in the vicinity through the 230 kV backbone of the Mindanao Grid. The continuous power supply is essential for the operation of the Laguindingan Economic Zone.

10.1.7 Agus 2 Switchyard Upgrading Project

The Agus 2 Switchyard is an old transmission facility experiencing difficulties in operation and maintenance. The obsolete equipment in the switchyard and the scarcity of spare parts make maintenance an utmost concern.

Agus 2 Switchyard Upgrading Project involves the replacement of obsolete power circuit breakers, capacitive potential transformers, telecom equipment, and secondary devices. It also involves expansion and renovation of the control building with installation of new monitoring, switching, metering, annunciation, and control equipment. The project improves the operational capability of the substation to efficiently respond to any system disturbance and enhances the operational stability of the grid by ensuring the continuous service of the power plant's transmission corridor.

10.1.8 Mindanao Substation Rehabilitation Project (MSRP)

MSRP involves the rehabilitation of various Mindanao substations by replacing old, defective, obsolete, and underrated power circuit breakers with new ones for improved system reliability of the grid.

Additional power circuit breakers are intended for Bunawan Substation to connect the feeders of Davao Light and Power Company (DLPC) while definite purpose power circuit breakers are for the connection of Capacitor in Sultan Kudarat Substation.

10.1.9 Mindanao Substation Upgrading Project (MSUP)

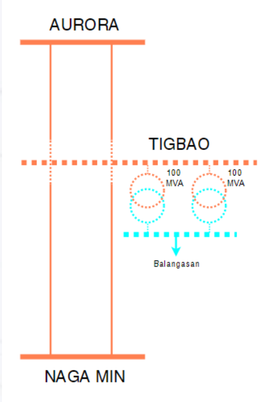
The existing transformer capacities in various substations in Mindanao are not sufficient to further accommodate the projected demand load while some substations are yet to comply with the single-outage (N-1) contingency requirement of the PGC. Additionally, voltage violation and breaker failures frequently occur in some areas in the Mindanao Grid.

MSUP involves the installation of additional power transformers and Capacitor, and the replacement of old, defective, obsolete, and underrated power circuit breakers to ensure adequate and reliable transmission system in Mindanao.

10.1.10 Tigbao 138 kV Substation Project

With the further increase of demand load in the area, the existing Aurora Substation becomes overloaded during N-1 condition. Due to space restrictions, a further development inside the said substation is infeasible. The project caters to the continuously growing demand load in Zamboanga del Sur. It also resolves power quality concerns in the area that occurred during system peak load conditions.

The project involves the construction of Tigbao Substation, bus-in to the existing Aurora-Naga Min 138 kV transmission line. Also involved is a new single-circuit 69 kV from the new substation to ZAMSURECO I's Balangasan Load End Station.



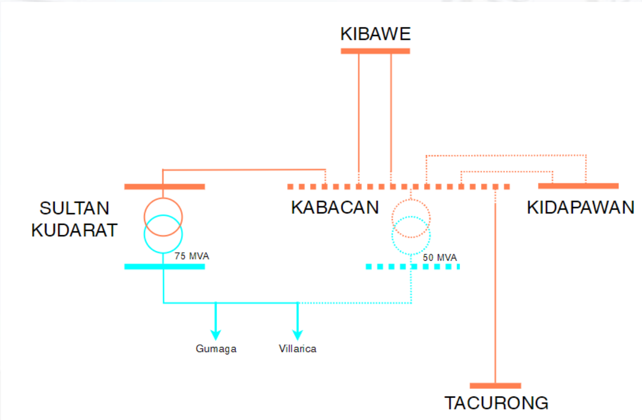
10.1.11 Mindanao Substation Expansion 3 Project (MSE3P)

Starting 2023, the existing transformers in Pitogo, Placer, San Francisco, and Matanao Substations will exceed their thermal capacity during N-1 conditions. The installation of an additional transformer in each of these substations maintains the continuous operation even during the outage of one of the transformers. This development also complies with the N-1 contingency criterion of the Philippine Grid Code.

10.1.12 Mindanao Substation Expansion 4 Project (MSE4P)

Several substations in Mindanao are expected to become overloaded based on the demand forecast. Thus, transmission facilities should be developed in which substation capacity must be upgraded.

10.1.13 Kabacan 138 kV Substation Project



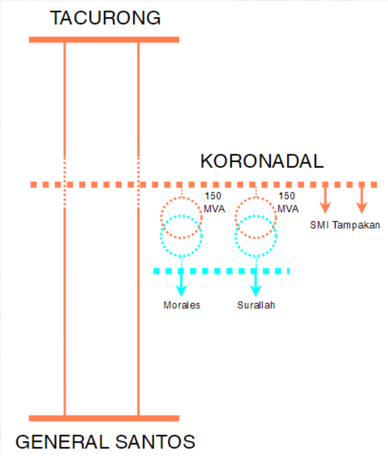
The Kibawe – Sultan Kudarat and Kabacan – Tacurong 138 kV lines traverse areas with the prevalent presence of militant groups and lawless elements. Thus, transmission facilities are exposed to a high risk of sabotage. An outage of any of these lines will result in large-scale power interruptions in Sultan Kudarat, Maguindanao, North Cotabato, and South Cotabato provinces.

The project involves the bus-in connection of the mentioned lines to the proposed new Kabacan Substation, construction of a new 53 km Kabacan – Kidapawan 138 kV line, and construction of a new 40 km Kabacan – Villarica 69 kV line. These new developments provide flexibility and additional reliability to the transmission system and ensure the continuity of power supply in the concerned areas. Additionally, the project includes the installation of new PCBs in General Santos Substation, allowing the entry of the 105 MW Coal-Fired Power Plant Phase 2 of Sarangani Energy Corporation (SEC).

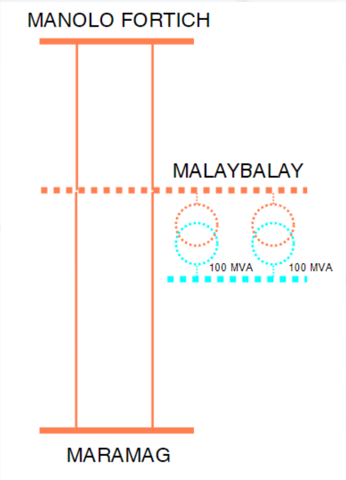
10.1.14 Koronadal 138 kV Substation Project

Power is being supplied to Koronadal City from a substation in its neighboring city, Tacurong. The demand for South Cotabato's capital and the nearby municipalities is rapidly increasing, whose amount is already equivalent to a loading of an existing substation in Mindanao. Also, there is a planned operation of mining in the municipality of Tampakan that will require a 138 kV direct connection to the grid and will draw a significant amount of power.

This new substation is to be linked to the grid via bus-in connection along the Tacurong–General Santos 138 kV Transmission Line. It also includes the installation of a 2x150 MVA, 138/69-13.8 kV power transformers. The 69 kV switchyard is intended to serve nearby if not all load requirements of South Cotabato Electric Cooperative, Inc. (SOCOTECO I).



10.1.15 Malaybalay 138 kV Substation Project



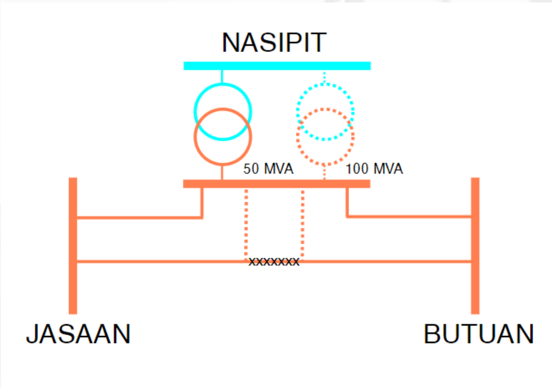
The Malaybalay 138 kV Substation intends to address the overloading and undervoltage issues in the cities of Malaybalay and Valencia resolving power interruptions being experienced by connected customers and other stakeholders in the province of Bukidnon. The project complements the Malaybalay-Aglayan 69 kV Line of Bukidnon Subtransmission Corporation (BSTC).

This new substation is to be linked to the grid via bus-in connection along the Manolo Fortich–Maramag 138 kV Transmission Line. It also includes the installation of a 2x100 MVA, 138/69-13.8 kV transformer. On the other hand, BSTC has to implement a 5 km, 69 kV, SP-SC line from the proposed Malaybalay 138 kV Substation of NGCP to Aglayan LES of BSTC.

10.1.16 Nasipit Substation Bus-In Project

The outage of the existing Nasipit – Butuan 138 kV line results in a low voltage in the following substations: Butuan, Placer, and San Francisco.

The project improves the reliability and power quality of the transmission system in the northeastern Mindanao area. It is comprised of the 4 km bus-in of the existing Jasaan – Butuan 138 kV line to Nasipit Substation, installation of a new 50 MVA power transformer, and replacement of defective PCBs.



10.1.17 Zamboanga Peninsula Voltage Improvement Project (ZPVIP)

The main problem in the Zamboanga Peninsula is the absence of a local baseload generator, which triggers voltage difficulties in the northwestern Mindanao area. Under the circumstance, voltage levels should be managed to maintain the normal operation of the grid.

While waiting for the needed power plant in the area, ZPVIP provides voltage support in the peninsula by installing 200 MVAR Static VAR Compensator (STATCOM) in Zamboanga Substation, 4x10 MVAR 138 kV Capacitor in Naga Min Substation, and 2x10 MVAR Capacitor in Pitogo Substation. STATCOM offers a fast response in the control of reactive power flow, thereby increasing the stability of the network.

10.1.18 Eastern Mindanao Voltage Improvement Project (EMVIP)

The substations in eastern Mindanao experience undervoltage due to increasing demand. The installation of Capacitor in the substations ensures the voltage level within the prescribed limits of PGC even during contingency scenarios. It also maintains the nominal voltage level in the area until the completion of the Eastern Mindanao 230 kV Transmission Line Project.

10.2 Transmission Outlook for 2030

The Lala– Malabang–Sultan Kudarat 230 kV Transmission Line Project, which creates a looped system through a high voltage power line emanating from Lanao del Norte, further improves the reliability of transmitted power towards southwestern Mindanao. Likewise, the various 69 kV transmission line projects such as the Siom – Sindangan – Salug 69 kV line in Zamboanga Del Norte and upgrading of Placer – Madrid 69 kV line in CARAGA Region provide flexibility in supplying power to the customers in that part of Mindanao. Two new substations namely the Salug and Midsayap Substation are to be constructed for the growing demand load in the provinces of Zamboanga del Norte and Cotabato, respectively.

In the long term, the installation of transformers in the Matanao 230 kV facility ensures adequate substation and improve voltage profile for the customers in Davao del Sur.

Finally, the implementation of Zamboanga-Basilan and Davao-Samal Interconnection projects significantly boost the supply reliability supporting the load requirements of Basilan and Samal islands.

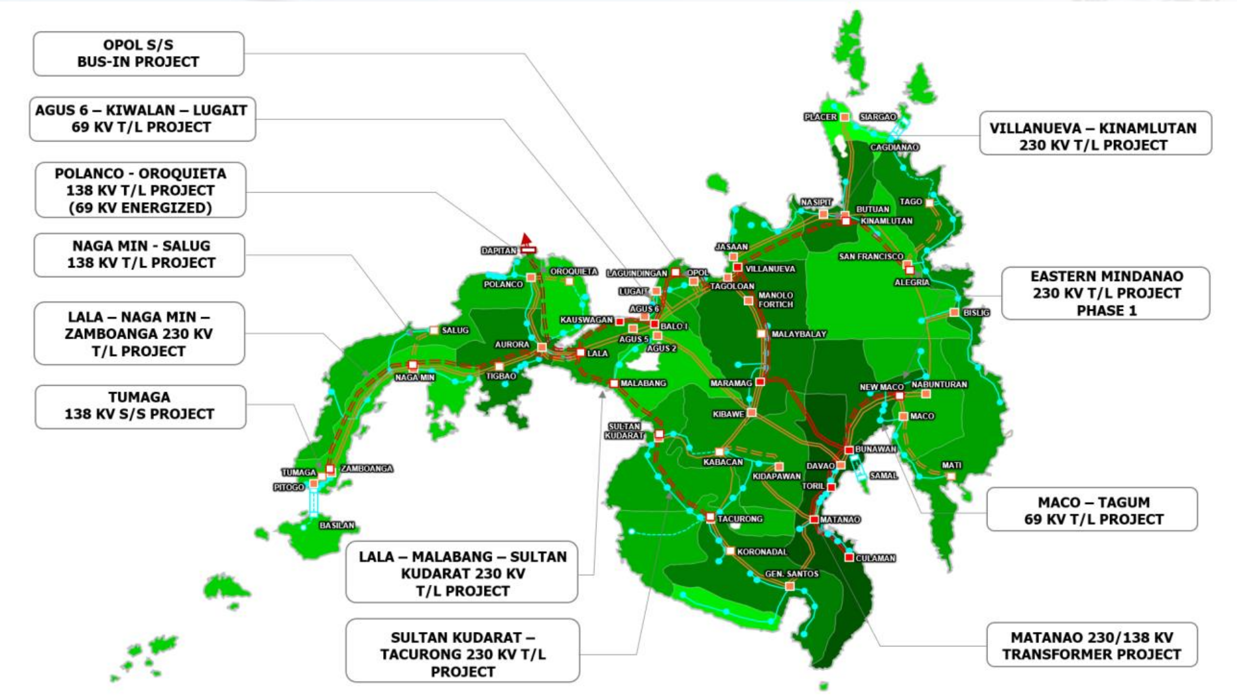


Figure 10.2: Proposed Mindanao Transmission Outlook for 2030

Table 10.2
Mindanao Transmission Outlook for 2030

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Project Description	ETC
230 kV	Sultan Kudarat–Tacurong 230 kV TL (Initially energized at 138 kV) Filed to ERC	▪ The Sultan Kudarat–Tacurong 230 kV TL Project provides the immediate need for a reliable power delivery service for the southwestern Mindanao area through a looped transmission network. The project improves system reliability as the new line creates a robust transmission network towards southern Mindanao by integrating it to the Lala-Malabang-Sultan Kudarat 230 kV TL traversing Lanao del Norte towards Sultan Kudarat in Maguindanao. These complementing projects further strengthen the Mindanao 230 kV Transmission Backbone that provides a reliable power supply for the customers in the southwestern area. ▪ Location: Maguindanao, Sultan Kudarat	Oct 2026
	Villanueva–Kinamlutan 230 kV TL Filed to ERC	▪ The Villanueva-Kinamlutan 230 kV TL Project increases the power transfer capacity and provides a reliable transmission corridor serving the Northeastern Mindanao. The new 230 kV line accommodates the anticipated load demand due to the progressive development triggered by the mining industries in Caraga Region. This project is complementary to the Eastern Mindanao 230 kV TL Project. ▪ Location: Misamis Oriental, Agusan del Norte	Jan 2027
	Eastern Mindanao 230 kV Transmission Line Project Phase 1	▪ The project extends the 230 kV backbone from Agusan del Norte to Agusan del Sur and from Davao del Sur to Davao de Oro to strengthen the transmission corridor in Eastern Mindanao that is currently in single-circuit 138 kV configuration. Also, this project anticipates the Competitive RE Zone in Agusan del Sur. ▪ Location: Agusan del Norte. Agusan del Sur, Davao del Sur, Davao de Oro	Aug 2027
	Lala–Naga Min–Zamboanga 230 kV TL Filed to ERC	▪ The extension of the Mindanao 230 kV transmission backbone towards the Zamboanga Peninsula offers operation stability by having another transmission corridor with a higher power transfer capacity. The development of the 230 kV TL in combination with the Zamboanga Peninsula Voltage Improvement Project (ZPVIP) will improve the overall power quality in NWMA. ▪ Location: Lanao del Norte, Zamboanga Sibugay, Zamboanga del Sur	Jul 2029
	Lala–Malabang–Sultan Kudarat 230 kV TL	▪ The project aims to provide a new transmission corridor that will complete the 230 kV loop in the western part of the Mindanao island. Also, it will ensure system reliability and operational flexibility in the province of Lanao del Sur and Maguindanao. ▪ Location: Lanao Del Norte, Lanao del Sur, Maguindanao	Dec 2030
138 kV	Polanco–Oroquieta 138 kV TL (Initially energized at 69 kV)	▪ The project aims to address the low voltage is being experienced by customer load end stations and low voltage problem suppress the progress of the municipalities in Misamis Occidental. ▪ Location: Zamboanga del Sur, Zamboanga del Norte, Misamis Occidental	Oct 2026
	Naga Min–Salug 138 kV TL	▪ The project aims to provide a high voltage transmission corridor towards the Municipality of Salug, Zamboanga del Norte for a more reliable and efficient energy supply. ▪ Location: Zamboanga Sibugay, Zamboanga del Norte	Jul 2028
69 kV	Nasipit–Butuan 69 kV TL	▪ The project aims to relieve the overloading of the existing TL to prevent load dropping and power interruptions during peak loading. ▪ Location: Agusan del Norte	Dec 2026
	Placer–Luna 69 kV TL	▪ The project aims to relieve the overloading of the existing TL to prevent load dropping and power interruptions during peak loading. ▪ Location: Surigao del Norte	Dec 2026

TRANSMISSION LINE PROJECTS			
Voltage	Project Name	Project Description	ETC
	Opol–Carmen 69 kV TL	▪ The project aims to relieve the overloading of the existing TL to prevent load dropping and power interruptions during peak loading. ▪ Location: Misamis Oriental	Dec 2026
	Davao–Toril 69 kV TL	▪ The project aims to relieve the overloading of the existing TL to prevent load dropping and power interruptions during peak loading. ▪ Location: Davao del Sur	Dec 2026
	Agus 6–Kiwalan–Lugait 69 kV TL Filed to ERC	▪ The existing Agus 6–Kiwalan–Lugait 69 kV TL, serving a rapidly increasing demand, has already reaching its full thermal capacity. The project aims to prevent imminent overloading which might entail load curtailment. Also, the additional load due to the possible outage of Agus 6–Mapalad–Lugait 69 kV TL cannot be catered by Agus 6–Kiwalan–Lugait due to capacity constraints. ▪ Location: Lanao del Norte, Misamis Oriental	Oct 2027
	Maco–Tagum 69 kV TL Filed to ERC	▪ Due to rapid economic development in the area of Tagum City, the capacity of the existing 69 kV single-circuit line is insufficient to cater to the load demand. Likewise, the line lacks alternative reinforcement needed during a single-outage-contingency condition which is critical for the reliable transmission of power supply in the city. The project consists of two stages: Stage 1 is the construction of the new Maco–Tagum 69 kV TL whereas Stage 2 is the reconductoring of the Maco–Tagum–Magdum 69 kV TL ▪ Location: Davao de Oro, Davao del Norte	Dec 2027
	Naga Min–Ipil 69 kV TL	▪ The project aims to relieve the overloading of the existing TL to prevent load dropping and power interruptions during peak loading. ▪ Location: Zamboanga Sibugay	Dec 2027
	Marawi–Malabang 69 kV TL	▪ The project aims to relieve the overloading of the existing TL to prevent load dropping and power interruptions during peak loading. ▪ Location: Lanao del Sur	Dec 2027
	Nabunturan–Monkayo 69 kV TL	▪ The project aims to relieve the overloading of the existing TL to prevent load dropping and power interruptions during peak loading. ▪ Location: Davao de Oro	Dec 2030
	Placer–Madrid 69 kV TL	▪ The project aims to relieve the overloading of the existing TL to prevent load dropping and power interruptions during peak loading. ▪ Location: Surigao Del Norte	Dec 2030

SUBSTATION PROJECTS			
Voltage	Project Name	Project Description	ETC
138 kV	Tumaga 138 kV Substation Filed to ERC	▪ The project aims to relieve the overloading of the Zamboanga-Pitogo 69 kV line due to the increase in demand in the area. ▪ Location: Zamboanga del Sur	Jan 2026
	Mindanao Substation Upgrading 2 Project (MSU2P) Filed to ERC	▪ The projects aim to accommodates the growing demand in the area ▪ Location: Lanao del Norte, Misamis Oriental, Bukidnon, Agusan del Norte, Davao del Sur, North Cotabato, South Cotabato	May 2026

SUBSTATION PROJECTS			
Voltage	Project Name	Project Description	ETC
230 kV	Matanao 230/138 kV Transformer	▪ The project aims to interconnect the 230 kV and 138 kV switchyards of Matanao SS to avoid possible overloading of the existing transmission corridors towards the north of the Davao Region ▪ Location: Davao Del Sur	Dec 2030
138 kV	Mindanao Substation Expansion 5 Project (MSE5P)	▪ The project aims to cater the load growth and provide N-1 contingency to various SS in Mindanao. Without the project, the customers being served by these SS will experience load dropping and power interruptions during outage and failure of existing transformers and power circuit breakers. ▪ Location: various substations in Mindanao	Dec 2030

VOLTAGE IMPROVEMENT PROJECTS			
Voltage	Project Name	Project Description	ETC
230 kV	Opol SS Bus-in Filed to ERC	▪ The Opol SS Bus-in Project is a grid expansion and reliability project which also improves the system voltage within the franchise area of Misamis Oriental I Electric Cooperative (MORESCO I) and other nearby facilities of CEPALCO. The project involves the bus-in of Opol SS to the existing Balo-i-Tagoloan 138 kV Single Circuit TL, and installation of a new 100 MVA power transformer and associated power circuit breakers. ▪ Location: Misamis Oriental	Sept 2027

10.3 Transmission Outlook for 2035

The development in eastern Mindanao is expected to escalate within this period which requires a new 138 kV transmission corridor to support such progress. Further, the upgrading of the existing 69 kV transmission lines is needed to prevent thermal overloading of the existing lines through a looped network that provides adequate line capacity to sustain the growing mining operations in CARAGA Region.

Within this period, the expansion of various facilities through the installation of additional transformers in each of the affected substation supports the expected load growth in Mindanao.

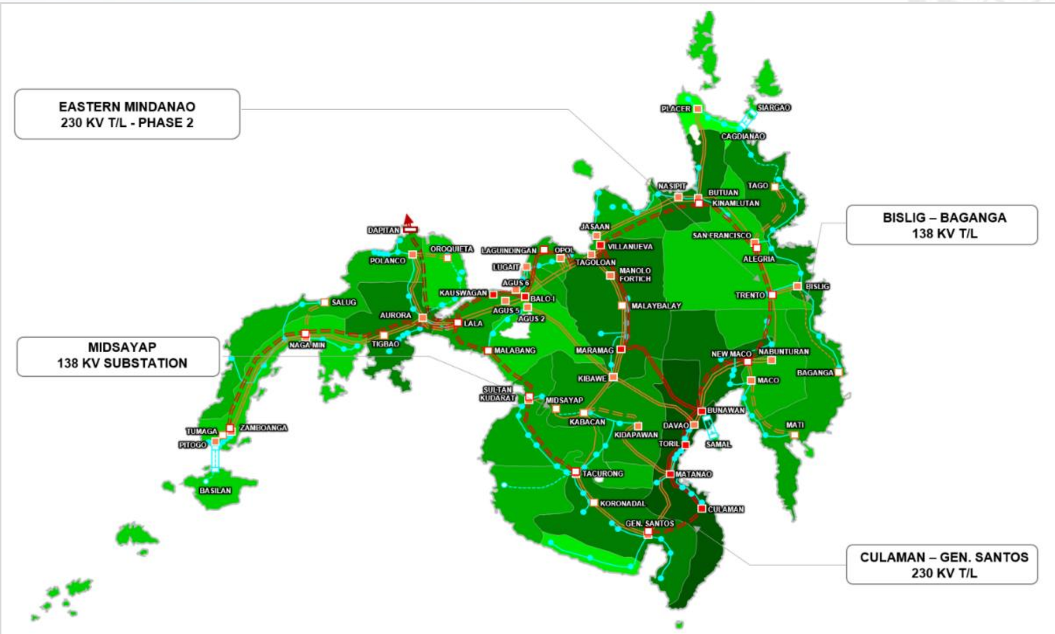


Figure 10.3: Proposed Mindanao Transmission Outlook for 2035

Table 10.3
Mindanao Transmission Outlook for 2035

TRANSMISSION LINE PROJECTS		
Voltage	Project Name	Project Description
230 kV	Eastern Mindanao 230 kV TL Phase 2	▪ The project aims to loop completely the 230 kV backbone on the eastern side of Mindanao from the 230 kV SS in Agusan del Sur and Davao de Oro towards a new 230 kV SS in the municipality of Trento. ▪ Location: Agusan del Sur, Davao de Oro
	Culaman-Gen. Santos 230 kV TL	▪ The project aims to provide a 230 kV transmission corridor towards General Santos City, South Cotabato. General Santos City is one of the major load centers in Mindanao and its demand will exceed the MW capacity of the embedded coal plants and the power flowing thru Matanao – General Santos 138 kV TL. ▪ Location: Davao Occidental, South Cotabato
138 kV	Bislig-Baganga 138 kV TL	▪ The project aims to provide a high voltage transmission corridor towards the Municipality of Baganga, Davao Oriental for a more reliable and efficient energy supply ▪ Location: Surigao del Sur, Davao Oriental
69 kV	San Francisco – Barobo 69 kV TL 2	▪ The project aims to relieve the overloading of the existing TL to prevent load dropping and power interruptions during peak loading. ▪ Location: Agusan del Sur, Surigao del Sur

SUBSTATION PROJECTS		
Voltage	Project Name	Project Description
138 kV	Midsayap 138 kV SS	▪ The project will support the load growth in North Cotabato and will help unload the Sultan Kudarat SS. ▪ Location: North Cotabato
	Mindanao Substation Expansion 6 Project (MSE6P)	▪ The project aims to cater the load growth and provide N-1 contingency to various SS in Mindanao. Without the project, the customers being served by these SS will experience load dropping and power interruptions during outage and failure of existing transformers and power circuit breakers. ▪ Location: various SS in Mindanao

10.4 Transmission Outlook for 2040

The identified grid expansion projects in Mindanao by 2040 mainly consider the anticipated demand load. The Mindanao Grid 230 kV transmission backbone network is extended towards Zamboanga Sibugay, Davao de Oro, and Southwestern areas to improve power reliability. The high-voltage network expansion projects are the Matanao – Tacurong 230 kV Transmission Line, Culaman-Gen. Santos 230 kV Transmission Line, and Nabunturan – Bunawan 230 kV Transmission Line. These transmission corridors complete the envisioned 230 kV loop system of the Mindanao Grid.

Expected development in new areas in Mindanao requires additional reinforcement of existing 69 kV transmission lines that provide more sustainable and reliable power supply delivery to their service areas. The reinforcement consists of upgrading the existing transmission facilities to a higher capacity which can be energized to a higher voltage level in the future.

Figure 10.4: Proposed Mindanao Transmission Outlook for 2040

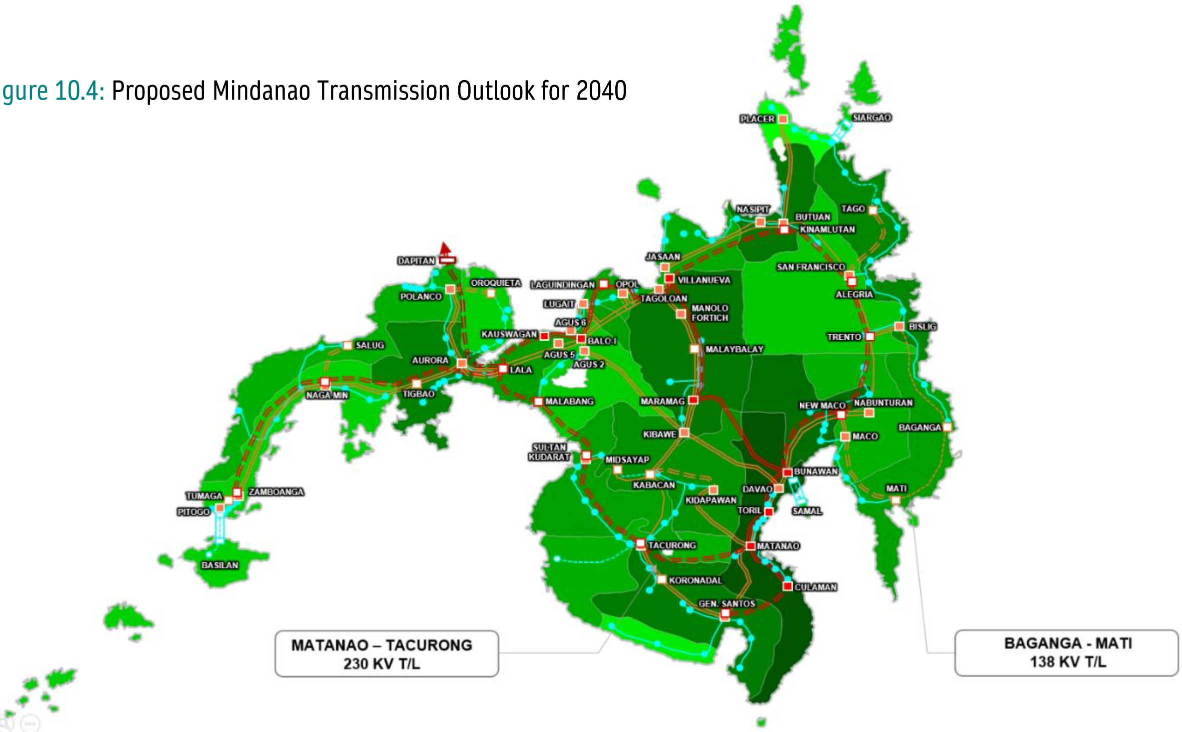


Table 10.4
Mindanao Transmission Outlook for 2040

TRANSMISSION LINE PROJECTS		
Voltage	Project Name	Project Description
230 kV	Matanao– Tacurong 230 kV TL	▪ The project aims to directly connect the bulk generation of the Davao Region to the SS in southwestern Mindanao thru a new 230 kV corridor. ▪ Location: Davao del Sur, Sultan Kudarat
138 kV	Baganga–Mati 138 kV TL	▪ The project aims to loop the 138 kV backbone from the municipality of Baganga to the city of Mati, Davao Oriental. This will provide a stable and reliable power supply of loads in Davao Oriental. ▪ Location: Davao Oriental
69 kV	Maco–Mati 69 kV TL	▪ The project aims to relieve the overloading of the existing TL to prevent load dropping and power interruptions during peak loading. ▪ Location: Davao de Oro, Davao Oriental
	San Francisco–Tandag 69 kV TL	▪ The project aims to relieve the overloading of the existing TL to prevent load dropping and power interruptions during peak loading. ▪ Location: Agusan del Sur, Surigao del Sur
	Naga Min–Malangas 69 kV TL	▪ The project aims to relieve the overloading of the existing TL to prevent load dropping and power interruptions during peak loading. ▪ Location: Zamboanga Sibugay
	Aurora– Kapatagan 69 kV TL	▪ The project aims to relieve the overloading of the existing TL to prevent load dropping and power interruptions during peak loading. ▪ Location: Zamboanga del Sur, Lanao del Norte
	Bislig–Barobo 69 kV TL	▪ The project aims to relieve the overloading of the existing TL to prevent load dropping and power interruptions during peak loading. ▪ Location: Surigao del Sur

TRANSMISSION LINE PROJECTS		
Voltage	Project Name	Project Description
	Tumaga–Pitogo 69 kV TL	▪ The project aims to relieve the overloading of the existing TL to prevent load dropping and power interruptions during peak loading. ▪ Location: Zamboanga del Sur

SUBSTATION PROJECTS		
Voltage	Project Name	Project Description
138 kV	Mindanao Substation Expansion 7 Project (MSE7P)	▪ The project aims to cater the load growth and provide N-1 contingency to various SS in Mindanao. Without the project, the customers being served by these SS will experience load dropping and power interruptions during outage and failure of existing transformers and power circuit breakers. ▪ Location: various substations in Mindanao

11 Island Interconnection

11.1 Island / Off-grid Interconnection

One of the challenges in improving the system reliability and reducing the reserve requirements without adding a new generation is the interconnection of two or more islands using an undersea cable. Major considerations in the implementation of such kind of project yield high reliability and long life of more than 30 years with minimal maintenance are the required investment. The Philippine archipelago with more than 7,100 islands, NGCP's concession is challenged and confronted to energize and interconnect its islands to the main grid. Equipped with vision of a fully interconnected and integrated power grid, and access to state-of-the-art technology, NGCP is well on its way towards this goal.

In pursuit of its goal of building One Grid, NGCP continues to embark on major interconnection projects to realize this vision. Upon completion of its goal, this will prepare the entire Philippine grid to integrate to the proposed ASEAN Power Grid, an era when the country can already share its power resources with the rest of Southeast Asian neighbors because of interconnected power transmission system.

These are some of the salient benefits of island/off-grid interconnections:

- Provide additional power supply like a generator having the ability to import power when required.
- More efficient dispatch to meet demands across different grids while optimizing the most efficient generator.
- Reduce power curtailment by means of exporting power when there is surplus from one island to another: and
- Renewable and indigenous energy sources, such as wind, hydro and geothermal potential sites suitable for energy generation can be optimized, while providing clean and sustainable sources of energy that may become attractive for development by generation proponents.

Detailed studies should be undertaken to quantify the overall benefits to the receiving island. In the long run, considering these salient and many intangibles, benefits the island/off-grid interconnections will become more economically attractive

11.1.1 Existing Island Interconnections

As of December 2020, the Philippines has seven major undersea island interconnection systems: six High Voltage Alternating Current (HVAC) and one High Voltage Direct Current (HVDC). These are the

- Leyte-Luzon ± 350 kV HVDC
- Leyte-Cebu 230 kV Interconnection
- Negros–Panay 138 kV and 230 kV Interconnection
- Cebu–Negros 138 kV Interconnection
- Cebu–Lapu-Lapu 138 kV HVAC Interconnection
- Panay–Boracay 69 kV AC Interconnection facilities

The 432-km Leyte-Luzon ± 350 kV HVDC, with a 23-km connecting Leyte Island (via Samar Island) to the Luzon Grid has been in operation since 1998. Its maximum transmission capacity is 440 MW with provision for upgrade to 880 MW through the implementation of Luzon-Visayas HVDC Bipolar Operation Project.

The Leyte-Cebu interconnection is a 33-km double circuit 230 kV submarine cable, with a transfer capacity of nearly 400 MW. The first and second circuits were energized in 1997 and 2005, respectively. The double circuit Cebu-Negros Interconnection enables power-sharing of the maximum of 180 MW between Cebu and Negros Islands. Its first circuit of 18-km, 138 kV submarine cable was energized in 1993 while its second circuit was energized in 2007. From Negros Island, connected is the 18-km 138 kV Negros-Panay Interconnection, energized in 1990 with a rated capacity of 85 MW. In 2016, an additional 230 kV-designed submarine cable was installed between Negros and Panay.

Connecting the island of Mactan to mainland Cebu is the 8.5-km 200 MW capacity cable that was energized in 2005. It was laid underneath the Cebu-Mactan Bridge. Another island interconnection is the Leyte-Bohol Interconnection, a submarine cable that allows a maximum power flow of 90 MW to the island of Bohol since 2004.

11.2 Transmission Backbone and Major Island Interconnection Projects

To ensure a transmission network that can support growth and competitive electricity prices, NGCP envisioned its goal of One Grid through the implementation of the Transmission Backbone and Major Island Interconnections. Guided by NGCP's vision to build the strongest power grid in Southeast Asia and contribute to the social and economic development of the country and to satisfy its stakeholders' needs. NGCP programmed a significant upgrade in its facilities to expand the transmission backbone in order to meet the forecasted demand, entry of new and various generating facilities that will allow market competition.

The creation of an interconnected Philippine Grid among the considerations, would create more open, liberalized and competitive market. As the Luzon and the Visayas Grids are already interconnected, connecting the Visayas and Mindanao, Mindanao-based industry players can participate freely in Wholesale Electricity Spot Market.

Figure 11.1 and Figure 11.2 respectively show the development of transmission backbones and island interconnections as well as the existing and future Philippine network topology of an interconnected grid. While some segments of the transmission backbones are already programmed for implementation within the Fourth Regulatory Period (2016-2020), as discussed in Chapters 8, 9, and 10, other segments will still be subjected to a more thorough system analyses or even Feasibility Study for some big and more complicated backbone projects.

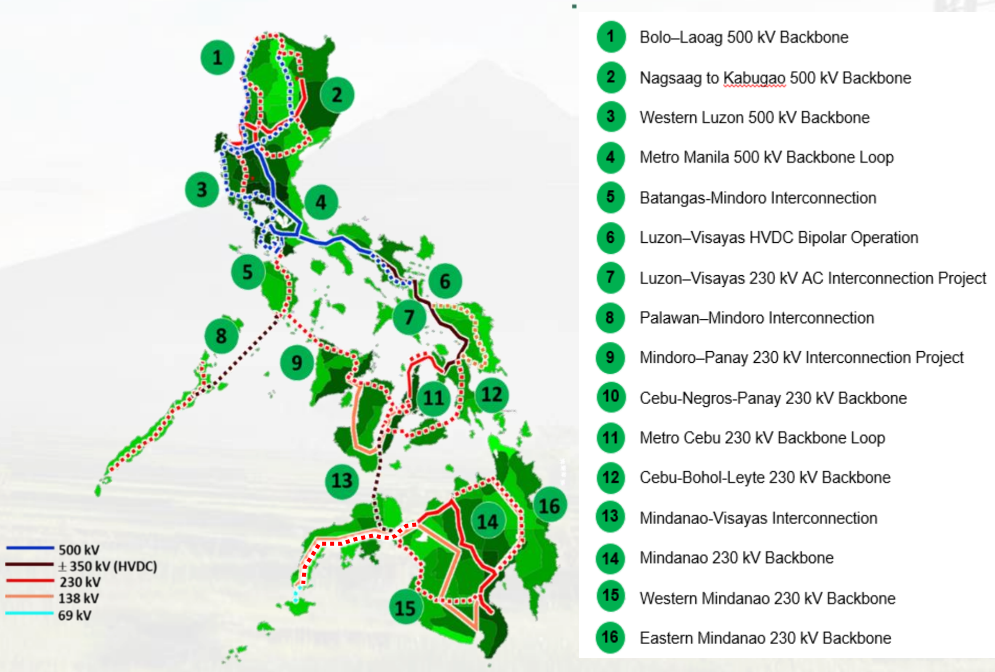


Figure 11.1: Transmission Master Plan

Table 11.1
Transmission Backbone and Major Island Interconnections

	Project Name	Description	ETC
1.	Bolo to Laoag 500 kV Backbone	Composed of Bolo–Balaoan and Balaoan–Laoag 500 kV Transmission Lines that will traverse the provinces of Pangasinan, La Union, Ilocos Sur, and Ilocos Norte. This 500 kV Backbone is intended to support the entry of large generation capacities in La Union, Mountain Province, and Ilocos area. It also aims to address the anticipated overloading of the San Esteban–Laoag and San Esteban–Bakun/Bacnotan–Bauang 230 kV Transmission Lines during N-1 contingency event.	Apr 2028
2.	Nagsaag to Kabugao 500 kV Backbone	Composed of Nagsaag–Santiago and Santiago–Kabugao 500 kV Transmission Lines that will traverse the provinces of Pangasinan, Isabela, Kalinga, and Apayao. This is to support the generation developments in Cagayan Valley and the Cordilleras. Furthermore, it also intends to augment and relieve the overloading of the Santiago–Bayombong and Bayombong–Ambuklao 230 kV Transmission Lines.	2031-2035
3.	Western Luzon 500 kV Backbone	Subdivided in two stages: (a) Stage 1 is the construction of Castillejos–Hermosa 500 kV Transmission Line (initially energized at 230 kV), which provides a transmission facility to connect the Renewable Energy plants [MFL1] to the Luzon Grid through Hermosa Substation; and (b) Stage 2 is the construction of a 174 km double circuit 500 kV line from Bolo 500 kV Substation to Castillejos. It will also involve the implementation of the Castillejos 500 kV Substation to accommodate bulk generation capacities. The Western Luzon 500 kV Backbone will traverse the provinces of Pangasinan and Zambales.	Dec 2025
4.	Metro Manila 500 kV Backbone Loop	The development of Metro Manila 500 kV Backbone Loop involves the implementation of the Silang 500 kV Substation, which will bus-in to the existing Dasmariñas–Tayabas 500 kV Transmission Line; the implementation of Taguig 500 kV Substation, which will initially cut-in to the existing San Jose–Tayabas 500 kV Transmission Line; the construction of the Silang–Taguig 500 kV Transmission Line; and the development of the Baras 500 kV Substation, which will bus-in to the existing San Jose–Taguig–Tayabas 500 kV Transmission Line. This forms the Silang–Taguig–Baras–Tayabas 500 kV Backbone Loop for Metro Manila. Another 500 kV Backbone Loop within Metro Manila will be developed through the Bataan–Cavite 500 kV Transmission Line Project.	Feb 2029
5.	Batangas–Mindoro Interconnection	The proposed interconnection of Mindoro Island with the Luzon Grid was envisioned to provide access to bulk generation sources in the main grid, while at the same time providing the means to export possible excess power once the generation potentials, including RE-based plants, within the island have been developed. The nearest connection point in the Luzon Grid for the planned island interconnection project is the proposed Pinamucan 500 kV Substation, while Calapan would serve as the interconnection point in Mindoro Island.	Feb 2026
6.	Luzon–Visayas HVDC Bipolar Operation	The project will provide an additional 440 MW transfer capacity between Luzon and Visayas. It involves the construction of Naga 500 kV Substation with 2x750 MVA, 500/230-13.8 kV Power Transformers as	Dec 2025

Project Name	Description	ETC
	well as upgrading of the Naga and Ormoc Converter/Inverter Stations in order to provide an additional transfer capacity between Luzon and Visayas. Upgrading of the 230 kV network between Cebu and Leyte is a requirement in order to fully utilize the transfer capacity of the Luzon–Visayas HVDC System.	
7. Luzon–Visayas 230 kV AC Interconnection Project	The Samar-Sorsogon AC Interconnection Project will provide Samar Island an alternate power source. The creates a new interconnection between Luzon and Visayas Grids via extension of 230 kV backbone in Sorsogon towards Northern Samar.	2036-2040
8. Palawan–Mindoro Interconnection	Subdivided in 2 stages: (a) Stage 1 will include the Desktop, System and Feasibility Studies, and Hydrographic Survey of the submarine cable route of the Palawan–Mindoro Interconnection Project (PMIP). It will also include the preparation of the Mindoro Backbone through the development of Calapan–San Jose 230 kV Transmission Line Backbone and San Jose 230 kV Substation in Occidental Mindoro; and (b) Stage 2 will involve the implementation of the PMIP. It will utilize HVDC transmission system from San Jose Converter Station in Occidental Mindoro to Roxas Converter Station in Palawan. The power supply from the Luzon Grid will then be delivered to the proposed drawdown substations in Roxas, El Nido, and Irawan through the 230 kV High Voltage Alternating Current (HVAC) system. This interconnection project aims to provide the Mainland Palawan with a more reliable supply of power and to address the power quality issues, which result to frequent power interruptions.	Feb 2028
9. Mindoro–Panay 230 kV Interconnection Project	The Mindoro–Panay 230 kV Interconnection Project creates a new interconnection between Luzon and Visayas Grids via Mindoro Island in the western region of the Philippines. It increases the power transfer capability of the system as this new transmission corridor accommodates the power generation in Luzon and Visayas especially power plants that are located within Competitive Renewable Energy Zones.	2036-2040
10. Cebu–Negros–Panay 230 kV Backbone	The Cebu–Negros–Panay 230 kV Backbone involves the construction of a 230 kV transmission backbone between the Cebu, Negros and Panay Islands. It will augment the transfer capacity of the existing corridor which will support the transmission of excess power generation in Negros and Panay Islands toward the rest of the Philippine Grid. The project is subdivided into three (3) stages: (a) Stage 1 involves the development of transmission corridor composed of submarine cable system and overhead transmission lines from Barotac Viejo Substation in Panay to Bacolod Substation in Negros; (b) Stage 2 involves the construction of 230 kV facilities in the existing Cebu 138 kV Substation and harmonize its capacity with the 230 kV transmission backbone; and (c) Stage 3 involves the construction of 230 kV facilities from Barotac Viejo Substation to Cebu Substation.	Jun 2023
11. Metro Cebu 230 kV Backbone Loop	The Metro Cebu 230 kV Backbone Loop aims to pool the excess power resources from Negros, Panay and Mindanao and transmit it to the	2036-2040

Project Name	Description	ETC
	main load center in Metro Cebu. It involves the construction of several 230 kV transmission corridors and 230 kV drawdown substations with adequate capacities to facilitate the power absorption by the load-end customers. This long-term plan is the basis of the transmission projects in Metro Cebu spread within the 2040 planning horizon namely: 1. Cebu–Lapu-Lapu Transmission Project 2. Cebu–Negros–Panay 230 kV Backbone Project Stages 2 and 3 3. Mindanao–Visayas Interconnection Project (MVIP) 4. Laray 230 kV Substation Project (Initially energized at 138 kV) 5. Lapu-Lapu 230 kV Substation Project 6. Laray–Alpaco 230 kV Energization Project 7. Laray–Cordova 230 kV Interconnection Project 8. Lapu-Lapu–Cordova 230 kV Interconnection Project	
12. Cebu–Bohol–Leyte 230 kV Backbone	The Cebu–Bohol–Leyte 230 kV Backbone involves the construction of a 230 kV transmission backbone between the Cebu, Bohol and Leyte Islands. It increases the reliability the current transmission system by constructing several 230 kV facilities and to distribute the excess power generation from Negros, Panay and Mindanao toward power customers in Bohol, Leyte and Samar. This long-term plan is the basis of the transmission projects in Cebu, Bohol and Leyte spread within the 2040 planning horizon namely: 1. Cebu–Bohol 230 kV Interconnection Project 2. Babatngon–Palo 230 kV Transmission Line Project 3. Ormoc–Babatngon 230 kV Transmission Line Project 4. Cebu–Leyte 230 kV Interconnection Lines 3 and 4 Project 5. Maasin–Sogod 230 kV Transmission Line Project (Initially Energized at 138 kV) 6. Palo–Sogod 230 kV Transmission Line Project 7. Bohol-Leyte 230 kV Interconnection Project	2031-2035
13. Mindanao–Visayas Interconnection	As part of the government's vision to interconnect the major grids into a single national grid, this interconnection project is intended to help improve the overall power supply security in the country by optimizing the use of available energy resources and additional generation capacities of the major grids through sharing of reserves from one grid to another. For more detailed information, please refer to sub-section 11.1.3.	Oct 2022
14. Mindanao 230 kV Transmission Backbone	This project mainly concentrates on strengthening the existing transmission backbone in Mindanao. As a major transmission highway that delivers both renewable and conventional energies to load centers, it ensures the stability, reliability, and efficiency of power supply in the island. While the existing 138 kV transmission backbone is already inadequate to accommodate the increasing capacity from the new power plants, the energization of the project to 230 kV level increases the	Completed

Project Name	Description	ETC
	thermal capacity of the existing line allowing the transfer of huge power capacity coming from north or south of the island.	
15. Western Mindanao 230 kV Backbone	The Western Mindanao 230 kV Backbone Project completes the envisioned 230 kV transmission extension and looping at the western side of the island. It provides an alternate transmission corridor to far-flung and radially connected areas for much reliable power supply.	Dec 2030
16. Eastern Mindanao 230 kV Backbone	The Eastern Mindanao 230 kV Backbone loops 230 kV transmission corridor in the eastern side of Mindanao. It increases the power transfer capacity of the grid between CARAGA and Davao Region. In addition, its new transmission corridor serves as reinforcement to the existing Butuan – San Francisco – Bislig – Nabunturan 138 kV single circuit line.	Dec 2035

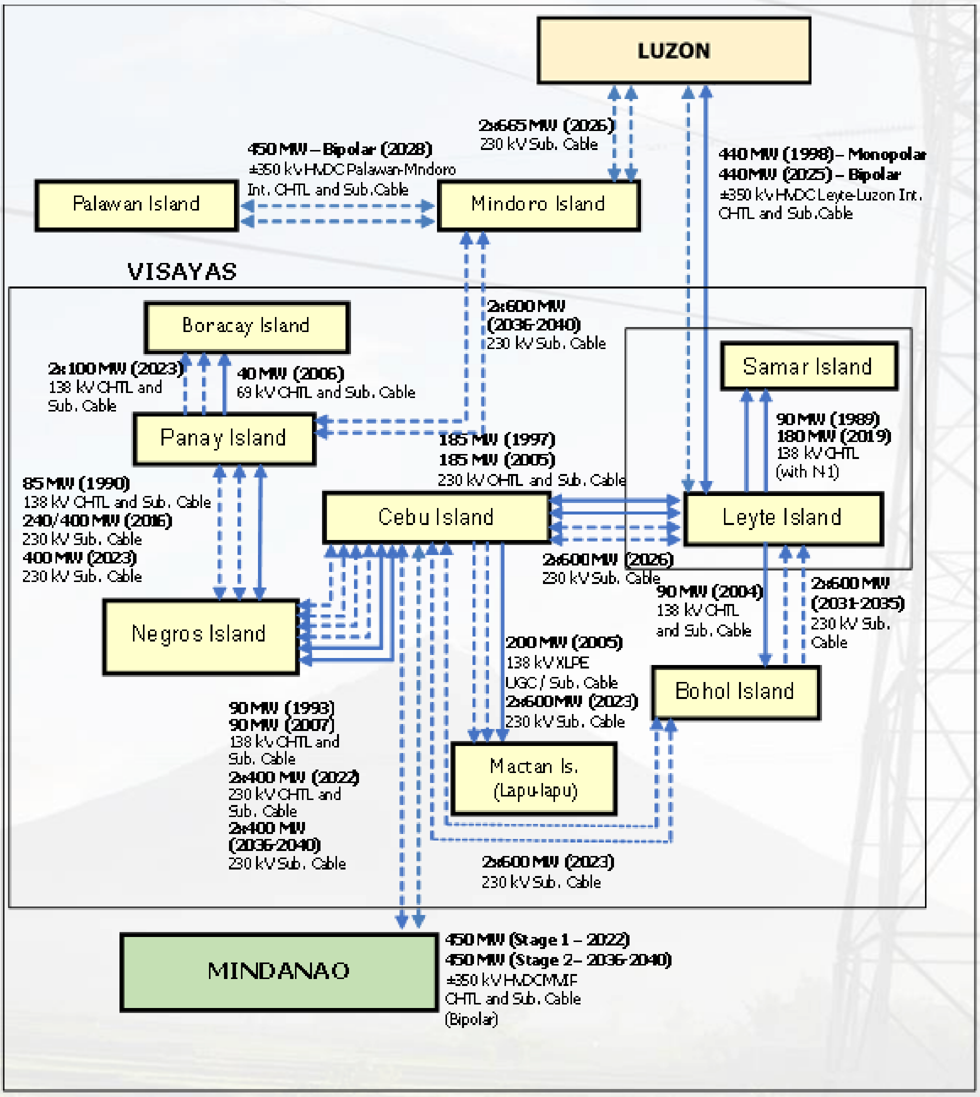


Figure 11.2: Existing and Future Philippine Network Topology

The projects in the Transmission Master Plan with active developments are as follows:

11.1.1 Batangas–Mindoro Interconnection Project

The power system of Mindoro Island, which is composed of 69 kV lines connected to several power plants and various load-end substations, is presently being operated by Small Power Utilities Group (SPUG) of the National Power Corporation (NPC). Power distribution to the consumers is handled by Oriental Mindoro Electric Cooperative (ORMECO) and Occidental Mindoro Electric Cooperative (OMECO). The major load center is in Calapan City in Oriental Mindoro and the total peak demand of the island in 2020 was more than 81.56 MW already, based on the combined total load of ORMECO and OMECO.

Figure 11.3: Batangas–Mindoro Interconnection Project

As the implementation of an interconnection project may take some time, further generation capacity additions within Mindoro Island would still be required to be able to sustain the short-term and medium-term power supply requirements of its increasing load. The interconnection of the island with the main Luzon Grid was envisioned to provide the island the access to bulk generation sources in the main grid while at the same time providing the means to export possible excess power once the generation potentials, including RE-based plants, within the island have been developed. The improvement in reliability of supply is expected to result in better economic growth as the island could attract more investors for industrial, commercial loads and for the tourism industry.

Transmission line route investigation has been already conducted including the identification of the possible cable terminal stations (CTS) at Batangas and Mindoro side. The nearest connection substation in the Luzon Grid for the planned interconnection is the proposed Pinamukan 500 kV Substation. This new 500 kV Substation, located further down south of Batangas City, could serve as the interconnection substation of Mindoro Island aside from the generation connection hub of proposed bulk generations.

The interconnection of Mindoro would only serve as the initial stage in the development of the power system in the island. Calapan would serve as the interconnection point but given the configuration of the island involving long 69 kV lines, in-land generators will still have to operate to provide voltage regulation support. In the long term, a 230 kV backbone system within the island could be developed as well as the future establishment of a loop to Panay Island thereby providing another corridor for the Luzon and Visayas link.

Major Project Components:

- Pinamukan–Lobo CTS 230 kV Transmission Line, ST-DC 2-795 MCM ACSR, 37 km
- Lobo CTS-Mahal na Pangalan CTS 230 kV Submarine Cable, DC, 1-2,500 mm^2 XLPE, 25 km
- Mahal na Pangalan CTS–Calapan 230 kV Transmission Line, ST-DC 2-795 MCM ACSR, 6 km
- Pinamukan 230 kV Switchyard: 2-230 kV PCB, 2-30 MVAR 230 kV Line Reactors and associated equipment

- Calapan 230 kV Substation: 2-100 MVA, 230/69-13.8 kV Power Transformers, 9-230 kV PCB, 3-25 MVAR 230 kV Shunt Reactor, 2-30 MVAR 230 kV Line Reactor and associated equipment

11.1.2 Palawan–Mindoro Interconnection Project

With the envisioned interconnection of Mindoro Island to the Luzon Grid, the province of Palawan will be the next big island to be interconnected in terms of land area and energy demand. Presently, the power system of Palawan Island is composed of a 69 kV transmission corridor which stretches from Roxas in the north and extending down to Brooke's Point in the south with an estimated length of about 305 circuit-km. Based from 2018 record of the National Power Corporation (NAPOCOR), the main power grid of Palawan registered a peak load of 54 MW and being served by combination of bunker and diesel power plants with a dependable capacity of 73.7 MW.

The Palawan-Mindoro Interconnection Project (PMIP) will provide the Mainland Palawan a more reliable supply of power and to address the power quality issues which result to frequent blackouts experienced by customers. The project is also in support to the government's direction of interconnecting off-grid areas into the main grid.

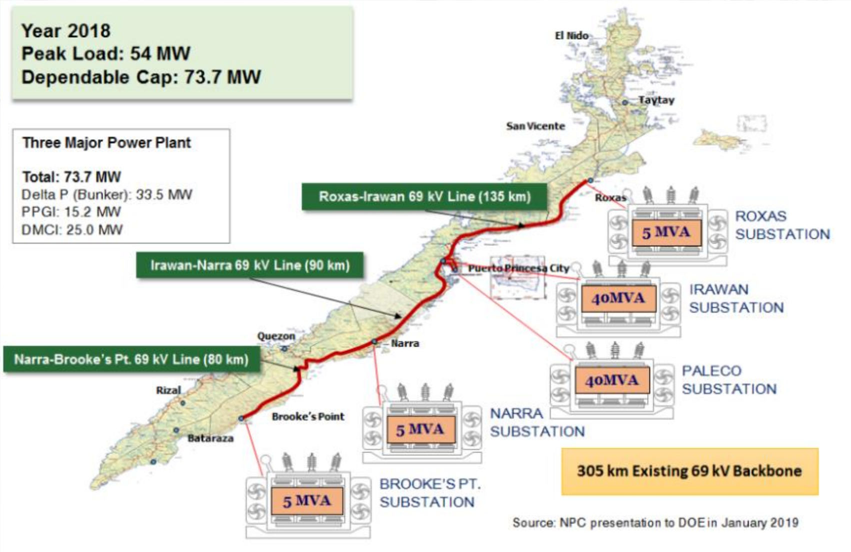


Figure 11.4: Palawan-Mindoro Interconnection Project

By interconnecting the existing Palawan grid into the Luzon grid via Mindoro Island, the current energy mix of the province, which is mainly oil-based, is seen to deviate from conventional sources in the forthcoming years. This is due to the projected entry of renewable energy power plants in which Palawan has high potential. A reliable transmission backbone and an opportunity to export power to the main grid will encourage the development of more renewable power plants in the province.

To interconnect Palawan to the Luzon Grid, NGCP will be implementing a stage-by-stage project development. Stage 1 will include the Desktop, System and Feasibility Studies and Hydrographic Survey of the submarine cable route of the Palawan–Mindoro Interconnection. Furthermore, Stage 1 will include the preparation of the Mindoro Backbone through the development of Calapan–San Jose 230 kV Transmission Line Backbone and San Jose 230 kV Substation in Occidental Mindoro. On the other hand, Stage 2 of the project will involve the physical implementation of the PMIP. Due to the significant distance from Palawan to Mindoro, it will utilize High Voltage Direct Current (HVDC) transmission system from San Jose Converter Station in Occidental Mindoro to Roxas Converter Station in Palawan. The power supply from the Luzon Grid will then be delivered to the proposed drawdown substations in Roxas, El Nido, and Irawan through the 230 kV High Voltage Alternating Current (HVAC) system.

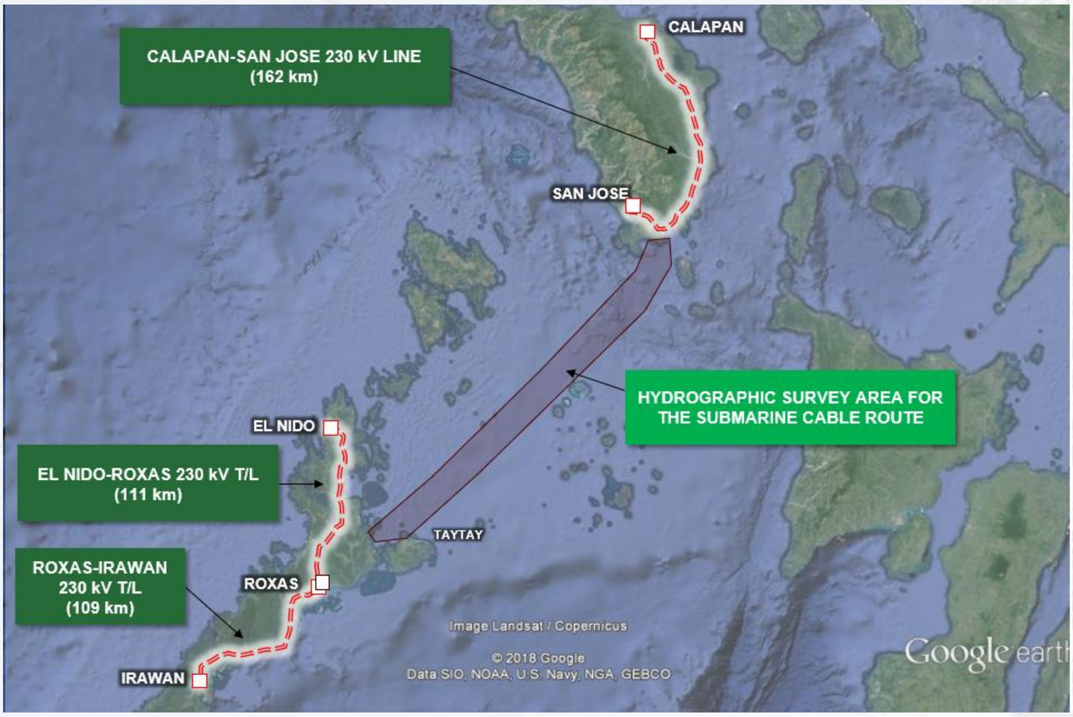


Figure 11.5: Hydrographic Survey Area for the Submarine Cable Route (PMIP)

Major Project Components:

- Desktop, System and Feasibility Studies and Hydrographic Survey of the Palawan–Mindoro Interconnection
- Calapan–San Jose 230 kV Transmission Line, ST-DC 2-795 MCM ACSR, 154 km
- Calapan 230 kV Substation: 4-230 kV PCBs and associated equipment
- San Jose 230 kV Substation: 2x100 MVA 230/69 kV Power Transformer, 6-230 kV PCBs and associated equipment, 6-69 kV PCBs and associated equipment, 2x25 MVAR 230 kV Shunt Reactor and associated equipment

This Palawan-Mindoro Interconnection Project will also prepare the country for interconnection with other ASEAN member states as envisaged in the ASEAN Power Grid under the Heads of ASEAN Power Utilities/Authorities or the regional initiatives for power grid interconnection being done by the Brunei Darussalam-Indonesia-Malaysia-Philippines East ASEAN Growth Area.

11.1.3 Mindanao-Visayas Interconnection Project

The Mindanao-Visayas Interconnection Project was previously known as Visayas-Mindanao Interconnection Project (VMIP). The change to MVIP indicates the importance and priority given to Mindanao Grid which has long been isolated. Luzon and the Visayas Grids have already been interconnected since 1998 and with the electricity market in operation since 2006 and 2008, respectively. The name MVIP indicates further support to boost the development of the country's electricity market to include the Mindanao Grid.

The tangible benefits in terms of reduced investments in power generation due to the implementation of MVIP are due to the following:

- Sharing of system reserve
- Lesser investment in power generation in either the Visayas or Mindanao to maintain the one-day Loss of Load Probability (LOLP)
- Reduction of operating cost due to economic dispatch of generators

The intangible benefits in the implementation of MVIP:

- Attractiveness of MVIP to power generation investments due to the bigger market through an interconnected power network
- From a technical standpoint, MVIP will provide benefits to the system in terms of added supply security, improved system reliability and improvement in the quality of power supply
- Optimized utilization of indigenous energy sources, such as natural gas in Luzon, geothermal in the Visayas and hydro in Mindanao as well as, this will reduce the overall generation of pollution and dependency on the importation of fossils fuel, where its availability and price are sensitive to the price in the world market.

Major Project Components:

- Submarine Cable
  Santander CTS–Dapitan CTS, 92 km, ±350 kV HVDC, Bipolar, 1,500 mm^2 HVDC Mass Impregnated (MI) submarine cable.
- Overhead DC Transmission Lines:
  - Dumanjug CS–Santander CTS (Visayas Side): 73 km, ±350 kV HVDC OHTL, Bipolar, 3-795 MCM ACSR Condor
  - Dapitan CTS (Mindanao Side)–Lala CS: 131 km, ±350 kV HVDC OHTL, Bipolar, 3-795 MCM ACSR Condor.
- Overhead AC Transmission Lines:
  - Dumanjug CS–Magdugo Substation: 61 km, 230 kV, ST-DC, 4-795 MCM ACSR
  - Bus-in of Dumanjug to Colon–Samboan 138 kV OHTL, 138 kV, ST-DC, 1-795 MCM ACSR, 2x8 km
- Electrode Line Stations:
  - Lala CS–Kolambugan ES: 20 kV OHTL (2 lines), 20 km, 2-795 MCM ACSR Condor
  - Dumanjug CS–Alegria ES: 20 kV OHTL (2 lines), 30 km, 2-795 MCM ACSR Condor.
- Converter Stations (Conventional Bipolar):
  Dumanjug Converter Station:
  - Thyristor Valves: 2x225 MW, 350 kV, 750 A, water cooled, air insulated, suspended, indoor 12-pulse single phase quadruple
  - Converter Transformers: 2x225 MW, 230 kV AC/350 kV DC, single phase and three -winding
  - Power Transformer: 2x150 MVA, 230/138-13.8 kV Power Transformers, 2x100 MVA 230/138-13.8 kV Power Transformers and accessories, 2x100 MVA, 138/69-13.8 kV Power Transformers and accessories
  - Power Circuit Breakers: 14-230 kV PCB and associated equipment, 12-138 kV PCB and associated equipment, 5-69 kV PCB and associated equipment

  Lala Converter Station:
  - Thyristor Valves: 2x225 MW, 350 kV, 750 A, water cooled, air insulated, suspended, indoor 12-pulse single phase quadruple
  - Converter Transformers: 2x225 MW, 230 kV AC/350 kV DC, single phase and three-winding
  - Power Transformer: 3x150 MVA, 230/138-13.8 kV Power Transformer and accessories
  - Power Circuit Breakers: 8-230 kV PCB and associated equipment

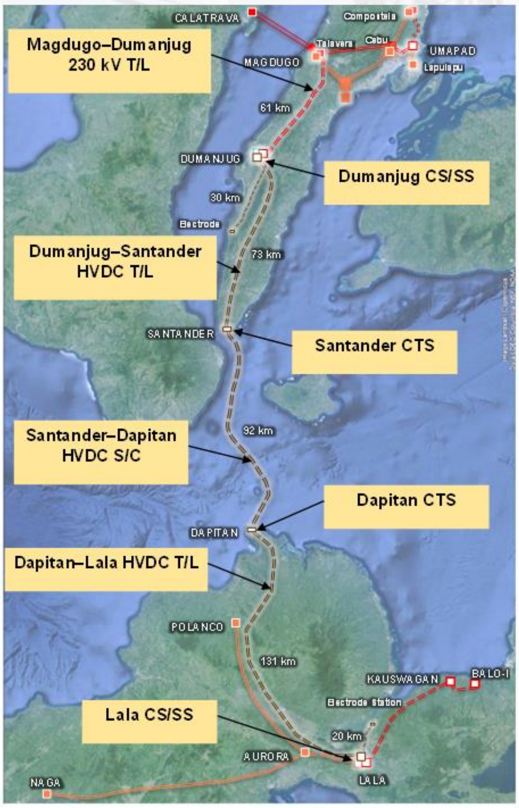


Figure 11.6: Connection Configuration of MVIP

- Substations:
  - Umapad GIS Substation (New): 2x300 MVA, 230/69-13.8 kV Power Transformers and accessories, 9-230 kV PCBs (GIS), 9-69 kV PCBs (GIS) and associated equipment. This substation component will be completed by December 2023 but the HVDC system of MVIP will be completed already by October 2022.
  - Magdugo Substation (Expansion): 2-230 kV PCB and associated equipment
  - Other Equipment/Facilities identified based on the result of GIS, e.g., power compensating equipment, etc.

11.1.4 Luzon–Visayas 230 kV AC Interconnection Project

Currently, Samar Island is highly dependent to Leyte due to the absence of generating power plants in the Island and since the existing Luzon-Visayas HVDC transmission system is terminated in Ormoc in Leyte. Isolation of Samar Island is possible in case of troubles that occur in Leyte thus, resulting to power interruption in the island.

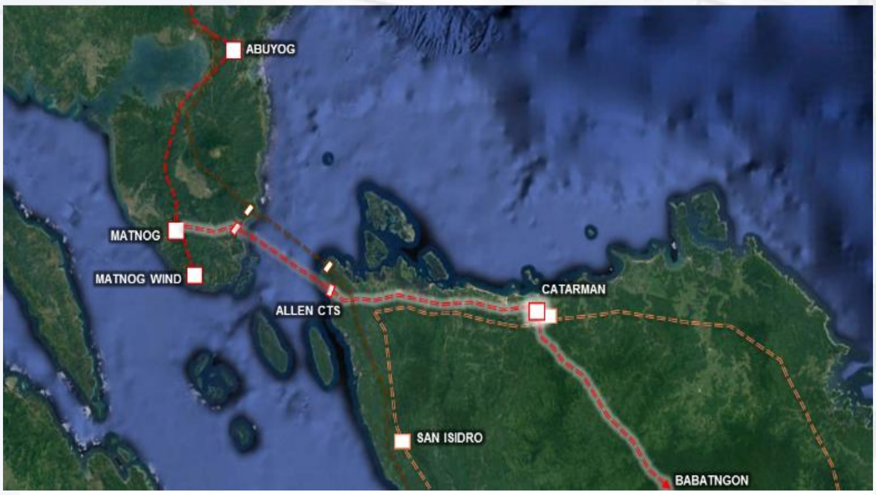


Figure 11.7: Leyte-Luzon Interconnection Project

The Samar–Sorsogon AC Interconnection Project aims to provide Samar Island an alternate power source. This will address the high dependency of Samar to Leyte. Two circuits of 230 kV submarine cable with a transfer capacity of 400 MW per circuit will be laid connecting Sorsogon to Samar. Shown below are the major components of the project. This project will be pursued when the Luzon 230 kV backbone is already extended to the southern part of Sorsogon. This will provide operational flexibility for the loads in Samar. Operationally, some substations in Samar will normally draw supply from Sorsogon.

Major Project Components:

- Substation:
  - Catarman 230 kV Substation: 2x300 MVA, 230/138-13.8 kV Power Transformers, 2x70 MVAR 230 kV Line Reactor, 6-230 kV PCB and 4-138 kV PCB and associated equipment
  - Matnog 230 kV Substation (Expansion): 2x70 MVAR 230 kV Line Reactor, 4-230 kV PCB and associated equipment
- Transmission Line:
  - Allen CTS–Catarman 230 kV Transmission Line, ST-DC, 2-795 MCM ACSR, 27 km
  - Catarman–Babatngon 230 kV Transmission Line, ST-DC, 2-795 MCM ACSR, 150 km
  - Matnog–Sta. Magdalena CTS 230 kV Transmission Line, ST-DC, 2-795 MCM ACSR, 18 km
- Submarince Cable:
  - Sta. Magdalena CTS–Allen CTS 230 kV XLPE Submarine Cable, Double circuit with 400 MW transfer capacity per ckt, 23 km
  - Allen CTS: Cable Sealing End
  - Sta. Magdalena CTS: Cable Sealing End.

11.1.5 Mindoro–Panay 230 kV Interconnection Project

The Mindoro–Panay 230 kV Interconnection Project creates a new interconnection between Luzon and Visayas Grids via Mindoro Island in the western region of the Philippines. It increases the power transfer capability of the system as this new transmission corridor accommodates the power generation in Luzon and Visayas especially power plants that are located within Competitive Renewable Energy Zones.

Major Project Components:

- Substation:
  - San Jose 230 kV Substation: 2x70 MVAR 230 kV Line Reactors,6-230 kV PCBs and associated equipment
  - Unidos 230 kV Substation: 2x70 MVAR 230 kV Line Reactors,6-230 kV PCBs and associated equipment

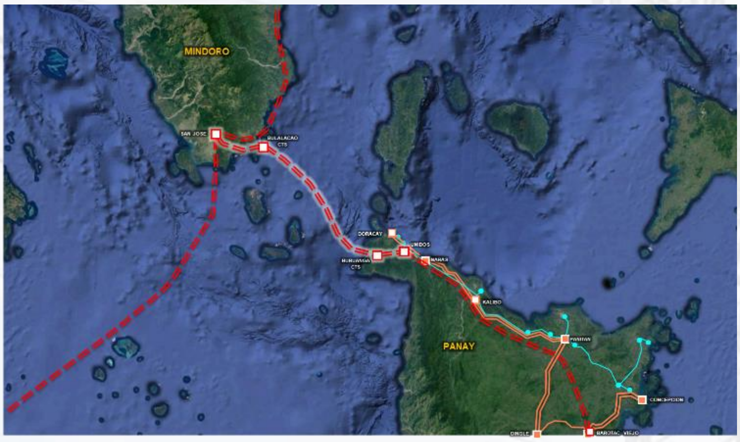


Figure 11.8: Mindoro-Panay 230kV Interconnection Project

- Transmission Line:
  - San Jose SS–Bulalacao CTS 230 kV Transmission Line, ST-DC, 4-795 MCM ACSR, 15 km
  - Buruanga CTS–Unidos SS 230 kV Transmission Line, ST-DC, 4-795 MCM ACSR, 22.5 km
- Submarince Cable:
  - Bulalacao CTS–Buruanga CTS 230 kV XLPE Submarine Cable, Double circuit with 600 MW transfer capacity per ckt, 75 km
  - Bulalacao CTS: Cable Sealing End
  - Buruanga CTS: Cable Sealing End

11.3 Small Island/Off-Grid Interconnection

As part of the country's power transmission infrastructure development, the DOE published in February 2019 the Department Circular No. DC2019-01-001 entitled, "Prescribing the Omnibus Guidelines on Enhancement of Off-Grid Power Development and Operation" with the following objectives:

- Improve the reliability and adequacy of power supply
- Reduce power rates
- Lead to the graduation of UC-ME subsidy

NGCP through its endeavor will undertake the conduct and overall due diligence to shortlist island/off-grid areas to be interconnected to the grid and document a Techno-Economic Feasibility Study (Techno-Eco FS) for the shortlisted island/off-grid areas. Further, NGCP will submit an annual program for the interconnection of off-grid areas to the network that will be included in project prioritization and annual updating of the TDP in compliance to Rule 9 of the said DOE Circular.

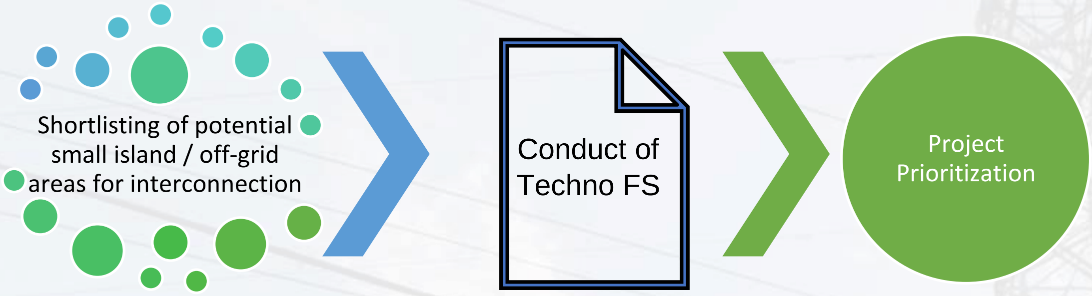


Figure 11.9: Small Island / Off-Grid Prioritization Process

Indicated in the table below is the list of Small Island / Off-grid interconnection projects:

Table 11.2 Small Island / off-grid Interconnection Projects

Project Name	Description	ETC
1. Quezon – Marinduque 69kV Interconnection Filed to ERC	The proposed Quezon-Marinduque Interconnection Project (QMIP) aims to address the expected long-term development in the island province of Marinduque. This project enables the province to have access to a more reliable and competitive generation sources in the Luzon Grid. In addition, the current energy mix in the province, which is mainly oil-based, is seen to improve due to the access of power supply from various generation sources in the Luzon Grid.	Dec 2025
2. Camarines Sur – Catanduanes 69kV Interconnection	The Camarines Sur–Catanduanes Interconnection Project (CCIP) aims to link the Catanduanes Island to the Luzon Grid and provide Catanduanes access to a more reliable and competitive generation sources.	Dec 2025
3. Claver - Siargao 69kV Interconnection	Siargao Electric Cooperative (SIARELCO) is currently connected to the Mindanao Grid thru tap connection of their 20 MVA Cagdianao Substation to NGCP Placer – Madrid 69 kV line. Then, 34.5 kV energized submarine cables and overhead line link the island of Bucas Grande and Siargao. As tourism is booming in Siargao, the capacity of the existing power transformer in Cagdianao and 34.5 kV lines will not be sufficient to accommodate the increasing demand. This project aims to provide a 69 kV interconnection facility that increases the power transfer towards the islands and improve the voltage within the franchise area of SIARELCO.	Dec 2025
4. Zamboanga-Basilan 69kV Interconnection	The power requirement of Basilan is being served by NPC-SPUG through missionary electrification. NPC-SPUG utilizes Basilan Diesel Power Plant and Power Barge 119. The Zamboanga – Basilan interconnection is envisioned to give the province a reliable and efficient power service. Also, this project counts out Basilan from the subsidy recipients of Universal Charge – Missionary Electrification.	Dec 2030

11.3.1 Quezon-Marinduque Interconnection Project

The proposed Quezon-Marinduque Interconnection Project (QMIP) involves interconnecting the island of Marinduque to the Luzon Grid thru a submarine cable from General Luna, Quezon to Sta. Cruz, Marinduque. It aims to address the expected long-term development in the island province of Marinduque. This project enables the province to have access to a more reliable and competitive generation sources in the Luzon Grid. In addition, the current energy mix in the province, which is mainly oil-based, is seen to improve due to the access of power supply from various generation sources in the Luzon Grid.

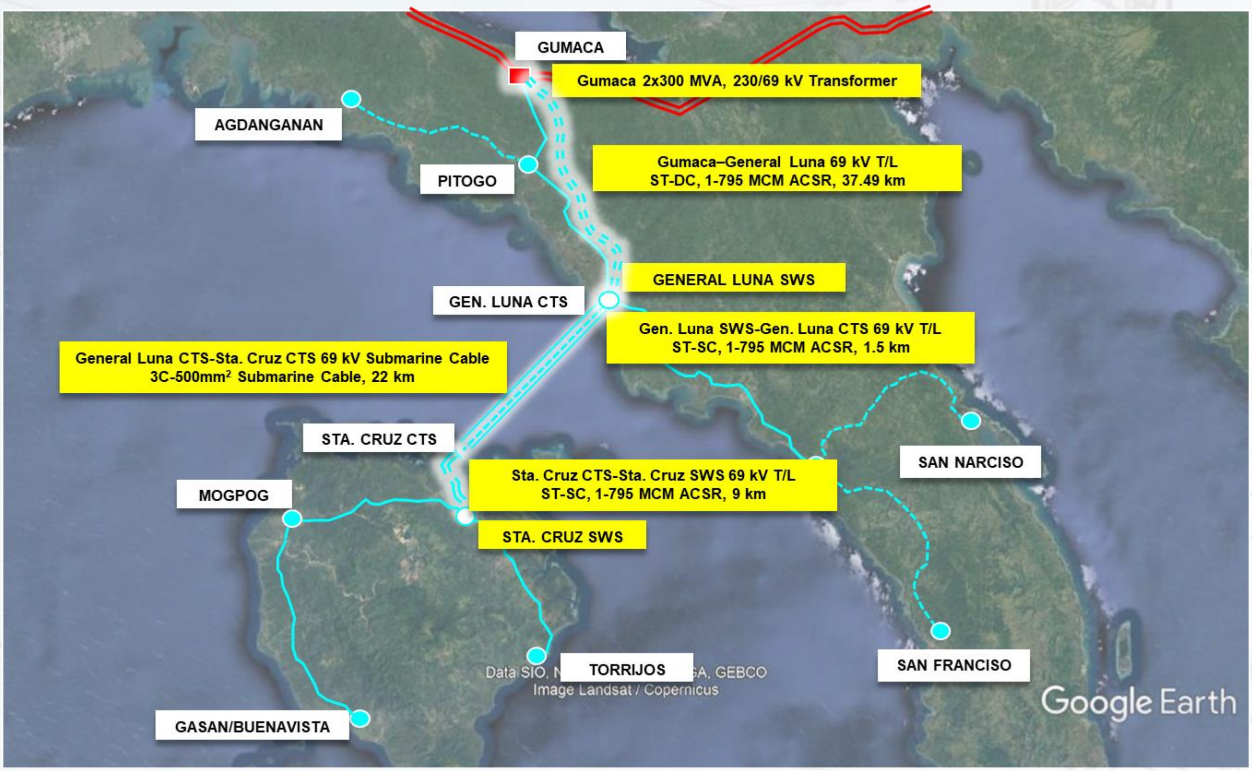


Figure 11.10: Quezon-Marinduque Interconnection Project

Major Project Components:

- Substation:
  - Gumaca 230 kV Substation: 2x300 MVA Power Transformers and 13-69 kV PCBs and associated equipment
  - General Luna Switching Station: 11-69 kV PCBs and associated equipment
  - Sta. Cruz Switching Station: 2x2.5 MVAR Line Reactors and 7-69 kV PCBs and associated equipment
  - Gasan 69 kV Load End Substation: 4x2.5 MVAR Shunt Capacitors and 4-69 kV PCBs and associated equipment
- Transmission Line:
  - General Luna-General Luna CTS 69 kV Transmission Line, ST-SC, 1-795 MCM ACSR, 1.5 km
  - Sta. Cruz-Sta. Cruz CTS 69 kV Transmission Line, ST-SC, 1-795 MCM ACSR, 9 km
  - Gumaca-General Luna 69 kV Transmission Line, ST-DC, 1-795 MCM ACSR, 37.5 km
- Submarine Cable:
  - General Luna CTS-Sta. Cruz CTS 69 kV XLPE Submarine Cable, 3-Core 500 mm^2, 22 km

11.3.2 Camarines Sur-Catanduanes Interconnection Project

The Camarines Sur–Catanduanes Interconnection Project (CCIP) aims to link the Catanduanes Island to the Luzon Grid and provide Catanduanes access to more reliable and competitive generation sources.

Presently, the island of Catanduanes is being served by the First Catanduanes Electric Cooperative, Inc. (FICELCO). On the other hand, the transmission system is being supervised by the NPC. The island's transmission system has a total existing line length of 47.0 circuit-kilometers and an existing substation capacity of 20 MVA.

Major Project Components:

- Substation:
  - Naga 69 kV S/S, 2-69 kV PCB
  - Presentacion 69 kV Switching Station, 3x2.5 MVAR 69 kV Capacitor, 3x2.5 MVAR 69 kV Shunt Reactor, 12-69 kV PCB
  - San Andres 69 kV Switching Station, 1x5 MVAR 69 kV Line Reactor, 6-69 kV PCB
  - Marinawa 69 kV Substation, 3x5 MVAR 69 kV Capacitor, 3-69 kV PCB
- Transmission Line:
  - Naga–Presentacion 230 kV Line, ST-DC, 1-795 MCM ACSR, 70 km
  - Presentacion–Bitaogan CTS 69 kV Line, ST-SC, 1-795 MCM ACSR, 12 km
  - Asgad CTS–San Andres 69 kV Line, ST-SC, 1-795 MCM ACSR, 1 km
- Submarine Cable:
  - Bitaogan CTS–Asgad CTS 69 kV Line, SC, 3 Core 500 mm2 XLPE Submarine Cable, 23 km

Figure 11.11: Camarines Sur – Catanduanes Interconnection Project

11.3.3 Potential Small Island Interconnections

A significant number of islands and far-flung areas in the country remain isolated from the main grids. These are classified as off-grid areas and the power systems in these areas are being operated and managed by NPC-SPUG. Some of these small islands were initially considered for further assessment. Shown in Table 11.3 below are the potential small island interconnections indicating the length of the required facilities. Further details for the potential small island interconnection and other small island and off-grid areas will be discussed on the succeeding TDP issuance:

Table 11.3
Potential Small Island Interconnections

Island	Interconnection Point	Length (km) Submarine	Length (km) Overhead	Length (km) Total
LUZON				
Ticao	Abuyog	20	35	55
Masbate	San Jacinto	16	16	32
Tablas	San Jose	61	36	97
Lubang	Calaca	54	20	74
Busuanga	San Jose	84	52	136

Island	Interconnection Point	Length (km)		
		Submarine	Overhead	Total
VISAYAS				
Bantayan	Medellin	21	24	45
Siquijor	Bacong	20	24	44
Camotes	Isabel	18	8	26
Semirara	San Jose	33	0	33
MINDANAO				
Dinagat	Canlanipa	30	15	45
Camiguin	Esperanza	30	37	67
Siasi	Parang	43	32	75
Sulu	Taberlongan	100	34	134
Tawi-Tawi	Pagatpat	84	60	144

12 Operations and Maintenance Program

NGCP has the mandate to maintain, operate, expand, and improve the high voltage backbone transmission system and facilities throughout the Philippines. This chapter contains the operation and maintenance Capital Expenditures (CAPEX) programs for the years 2022 to 2040 with the objective of increasing the reliability of the Grid and improving the transmission system and facilities throughout the country for reliable, adequate, secure, and stable service for all users of the nationwide electricity transmission system.

NGCP has an estimated total of around 159,596 operational assets[6]. These assets vary from substation primary equipment, protection relays, secondary devices to transmission line towers and other structures. To evaluate the condition of these assets, proper asset management must be observed.

The 19-year operation and maintenance program cover the major categories of expenditures enumerated below:

- Installation, replacement, rehabilitation, and relocation of High Voltage Equipment.
- Acquisition, Installation, and replacement of Protection and Secondary Devices.
- Rehabilitation of Transmission Lines and Sub-transmission Lines which were not divested.
- Acquisition and replacement of Test & Measuring Equipment, Maintenance Tools and Maintenance Vehicles
- Acquisition of Spares for High Voltage Equipment, Transmission Lines, and Secondary Device.
- Construction and rehabilitation of Substation and Support Facilities that include projects to:
  - Control and mitigate the effects of Fire and Flood
  - Preserve and Protect the Environment
  - Resiliency Projects

12.1 CAPEX Program

With the goal of meeting the Performance Incentive Scheme (PIS) targets set forth by ERC, several O&M projects will be implemented through CAPEX programs. These programs will also be filed to ERC for each regulatory period:

12.1.1 Substation Reliability Program

This program covers acquisition, installation, and replacement works for high voltage equipment, protection, and secondary devices, substation upgrading/automation, and operation resiliency plans to ensure the reliable operation of the power grid. The prioritization of every equipment is dependent on planning criteria on Asset health index, as well as its risk assessment of the equipment discussed in Chapter 4.

In addition, with the DOE's initiative on the adoption of Resiliency Planning and Program in the Energy Industry, NGCP has identified and proposed risk reduction programs to ensure the reliable operation of the grid during times of disastrous events. Furthermore, the foreseen adverse effects to be brought by disasters will be addressed in the most timely and efficient manner.

[6] as of August 2021

Program Scope

Ensuring the reliability of substation based on the planning criteria requires specific programs that will facilitate the replacement/installation/acquiring of the following equipment:

a. Replacement of Substation High Voltage Equipment

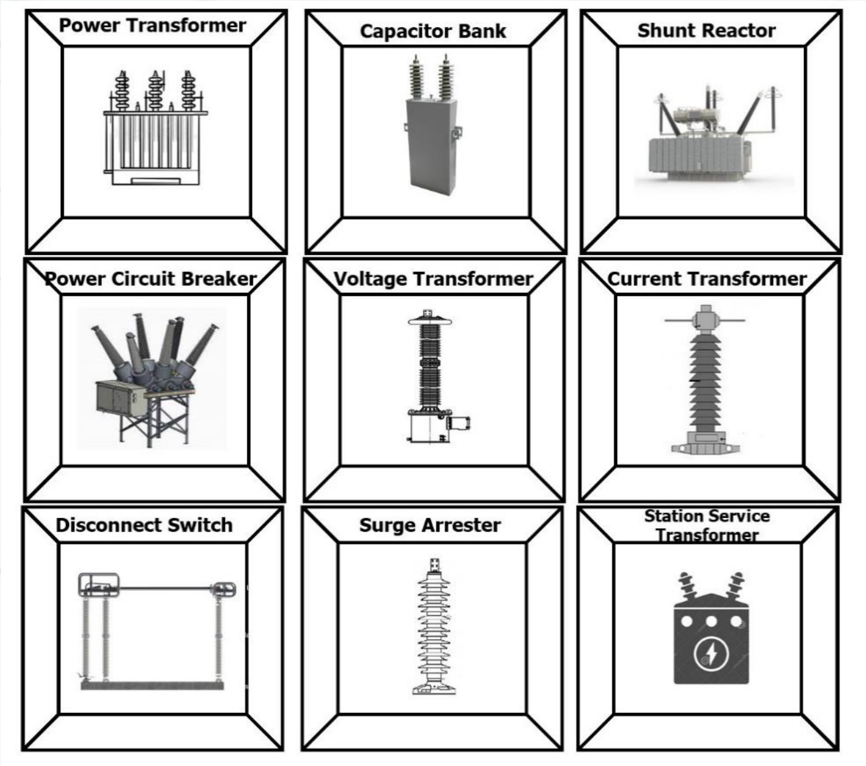


Figure 12.1 High Voltage Equipment Components

b. Replacement of Protection and Secondary Devices

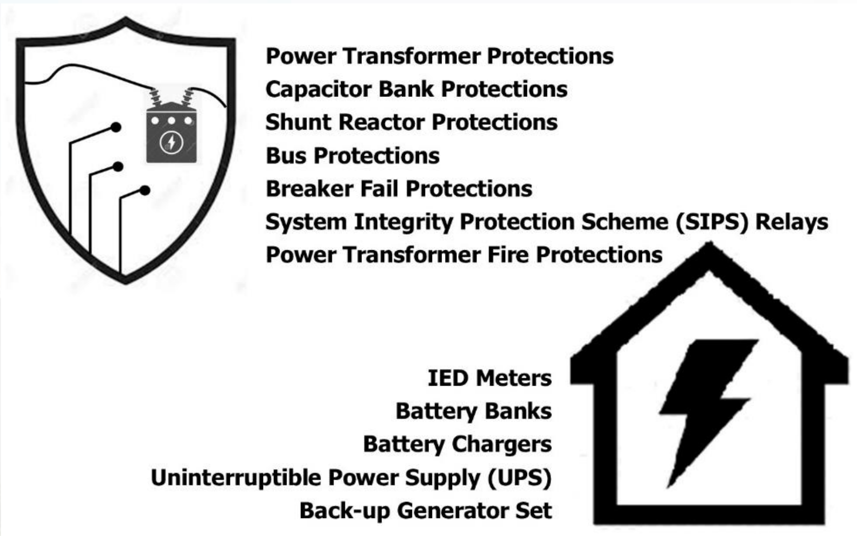


Figure 12.2 Protection and Secondary Devices Components

c. Substation Automation Program

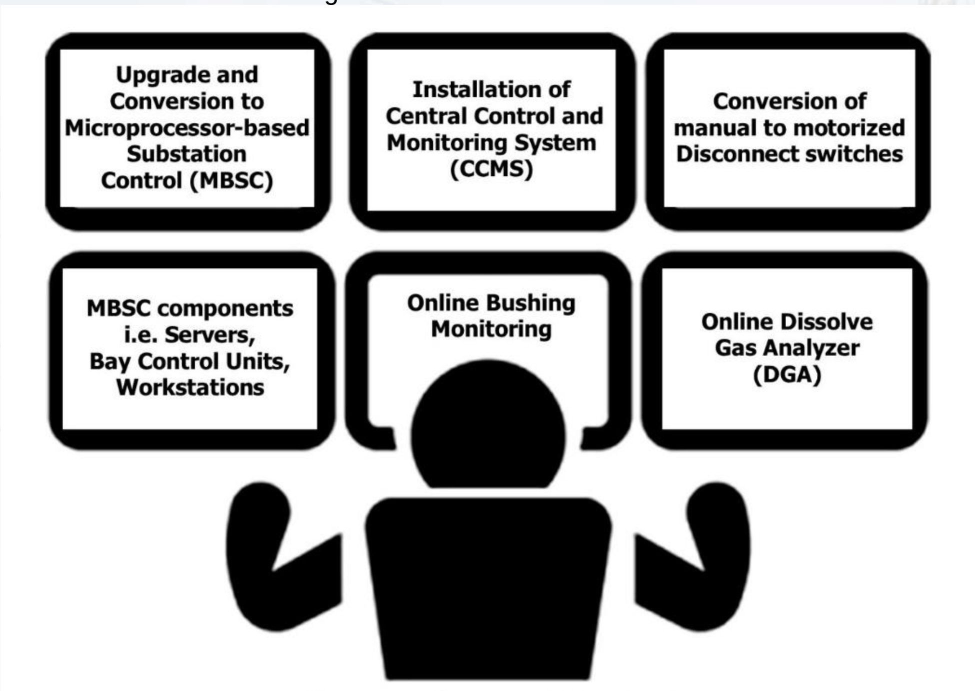


Figure 12.3 Substation Automation Program Components

d. Resilient Operation

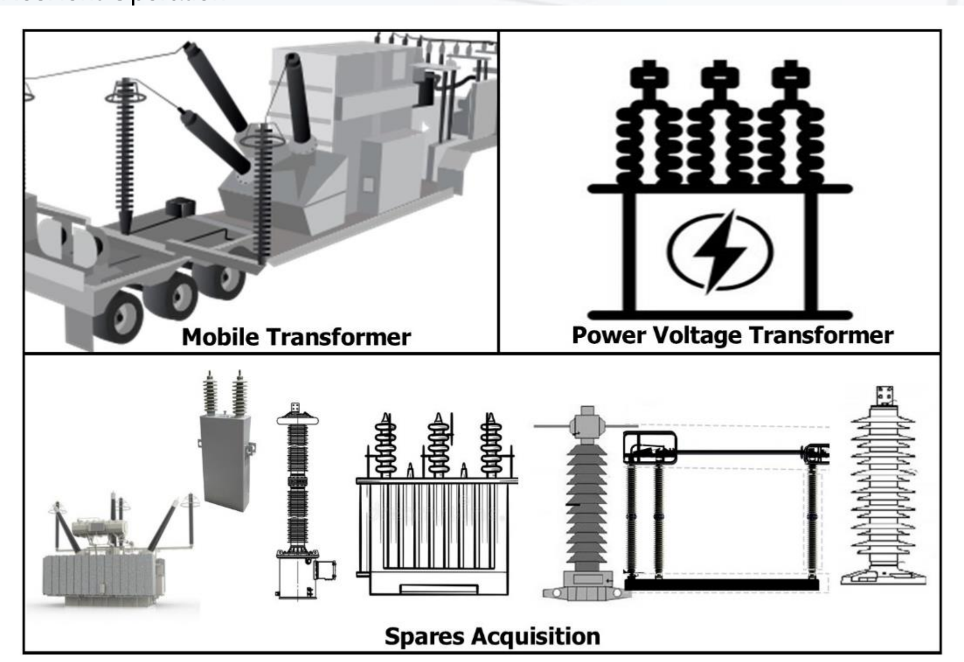


Figure 12.4 Resilient Operation Components

Program Disbursement
These projects will extend within the next 19 years. The project has a total estimated cost of 34.019 Bn.

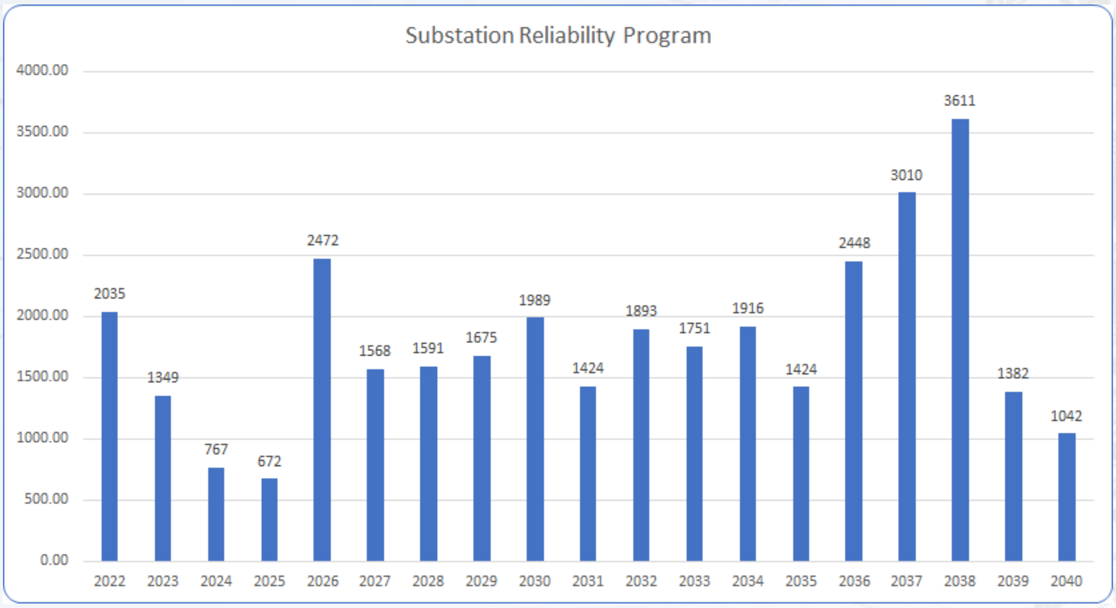


Figure 12.5 Substation Reliability Program Disbursement (in Mn Php)

12.1.2 Transmission Line Reliability Program

These projects include replacement of line-associated high voltage equipment, secondary devices and other accessories that are classified as transmission assets. All Transmission Lines which are subject to maintenance will require shutdown schedule, and materials dependent on the type of projects.

NGCP has identified transmission lines assets that needs necessary and requiring rehabilitation works to include major works such as replacement of steel pole, cross-arms, insulator, conductor and OHGW, etc. due to period of service, natural wear and tear and exposure to harsh environment.

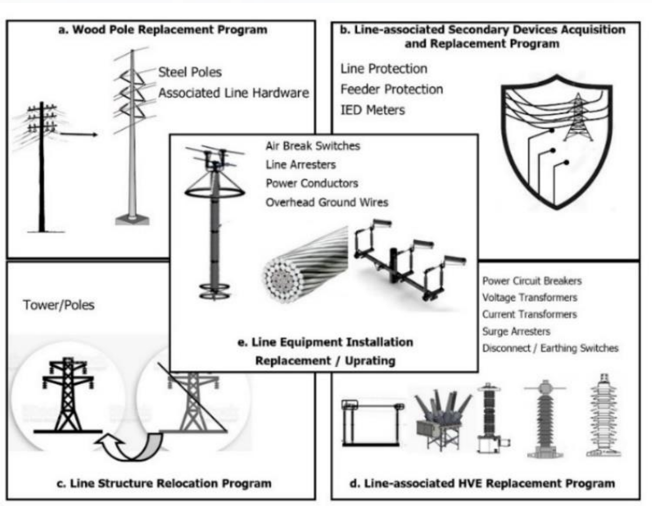


Figure 12.6 Transmission Line Reliability Program Components

Program Disbursement
These projects will extend within the next 19 years. The project has a total estimated cost of 17.223 Bn.

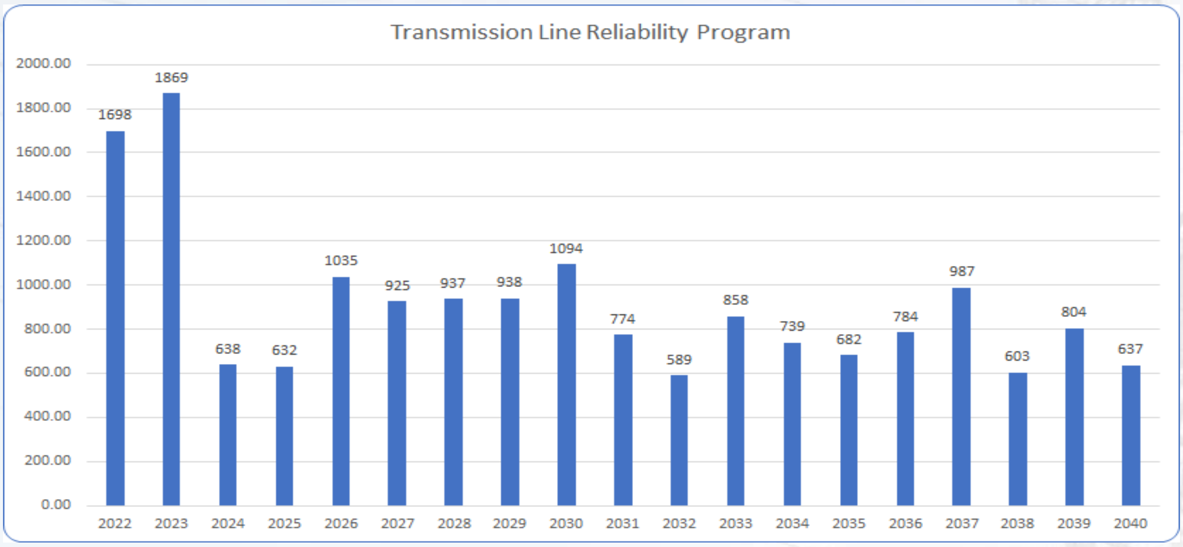


Figure 12.7 Transmission Line Reliability Program Disbursement (in Mn Php)

12.1.3 Sub-transmission Line Reliability Program

These projects include acquisition, installation and replacement of associated high voltage equipment, secondary devices and other accessories that are classified as sub-transmission assets. Sub-transmission Assets which are subject to maintenance will require shutdown schedule, and materials dependent on the type of projects.

NGCP has identified sub-transmission assets that requires installation / replacement plans due to prolonged period of service, natural wear and tear and exposure to harsh environment and compliance to safety and environmental mandate.

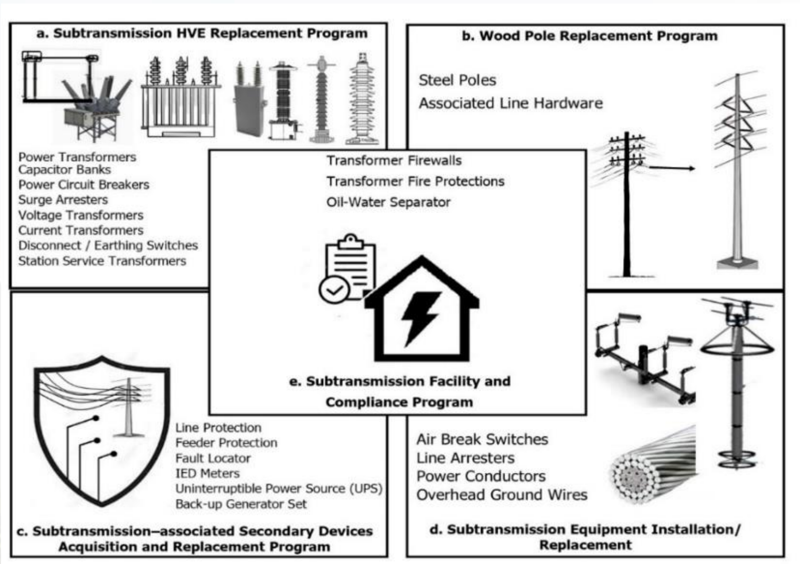


Figure 12.8: Sub-transmission Line Reliability Program Components

Program Disbursement
These projects will extend within the next 19 years. The project has a total estimated cost of 7.433 Bn.

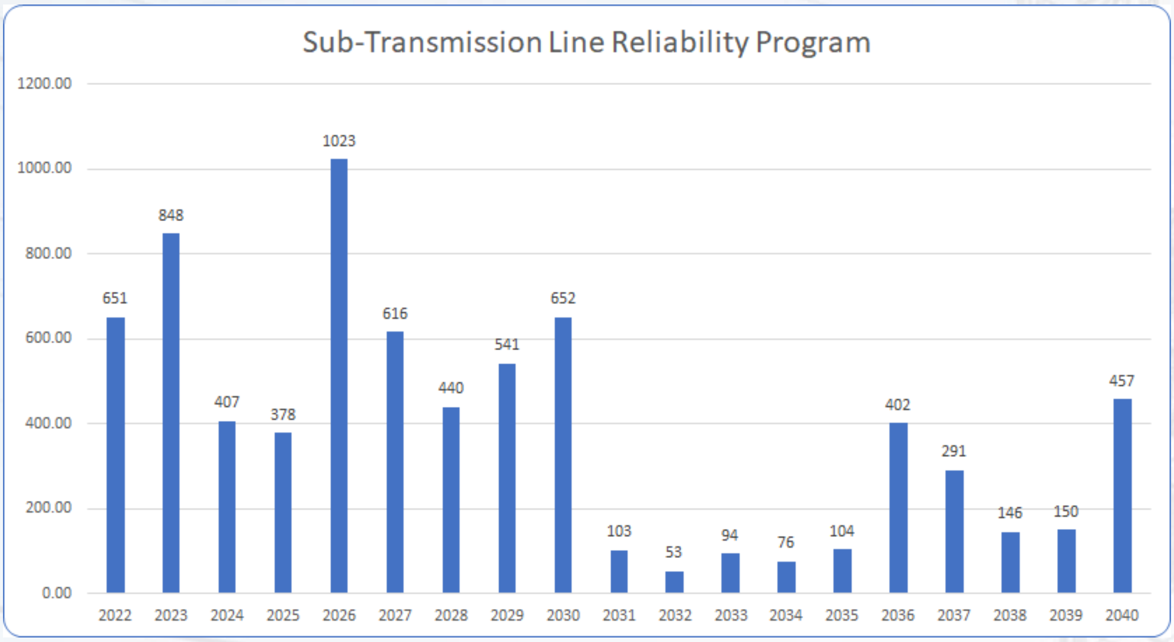


Figure 12.9: Sub-transmission Line Reliability Program Disbursement (in Mn Php)

12.1.4 Tools and Equipment Program

In accordance with the standard test for all equipment, the following group of test equipment are being replaced & augmented:

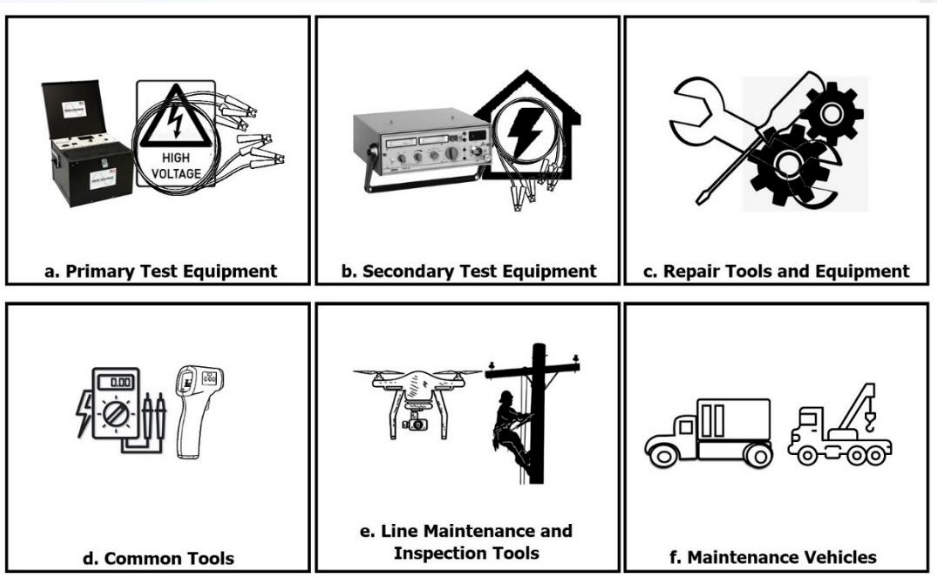


Figure 12.10 Tools and Equipment Program Components

Program Disbursement
These projects will extend within the next 19 years. The project has a total estimated cost of 7.151 Bn.

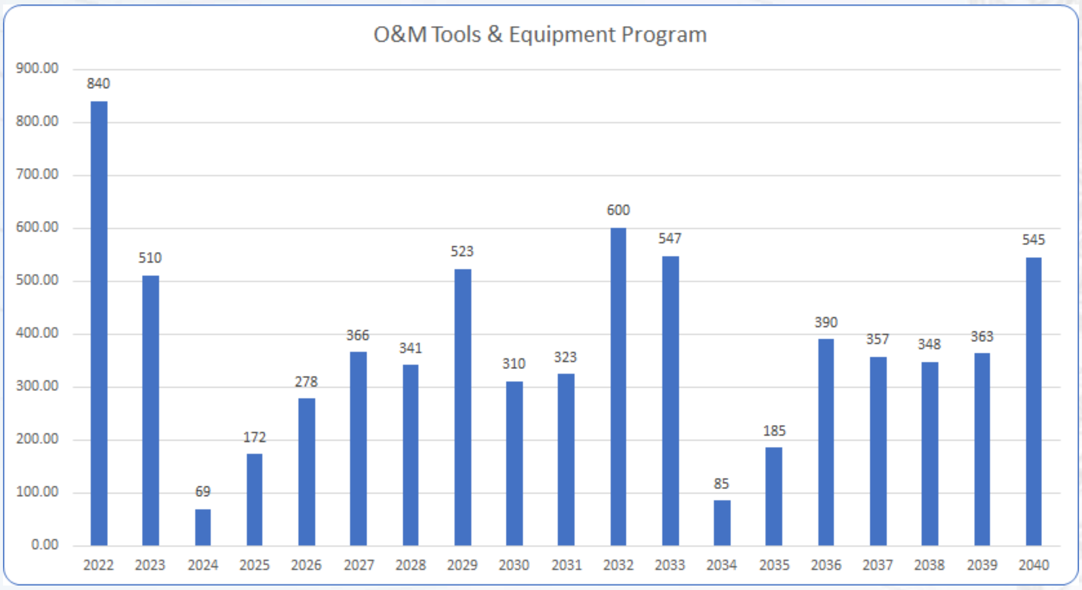


Figure 12.11 Tools and Equipment Program Disbursement (in Mn Php)

12.1.5 Network Facility Improvement Program

Most of the NGCP facilities and buildings were constructed several decades ago. Security and safety standards were different back then. To comply with the IMS Certification, additional security and safety standards must be implemented.

Also, from the time that NGCP took over the operation of the transmission network, additional equipment are utilized to cope up with the fast-technological advancements in the field which require additional facilities or extension of existing buildings for proper storage and also to provide the personnel with good working environment.

In addition to these improvements, NGCP must construct facilities to comply with environmental standards, regulations and practices under Philippine Environmental Laws and Regulations, and NGCP's Integrated Management System (IMS) such as oil catch basin, water separator for generator set, transformers, station service and shunt reactors, hazardous waste storage facilities, etc.

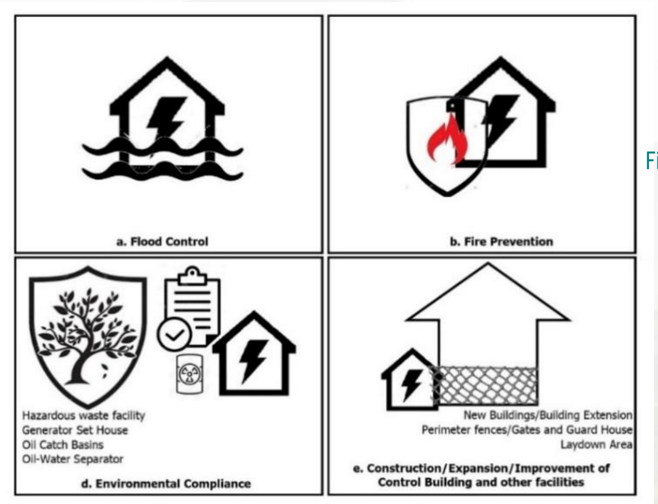


Figure 12.12 Network Facility Improvement Program Components

Program Disbursement

These projects will extend within the next 19 years. The project has a total estimated cost of 0.818 Bn.

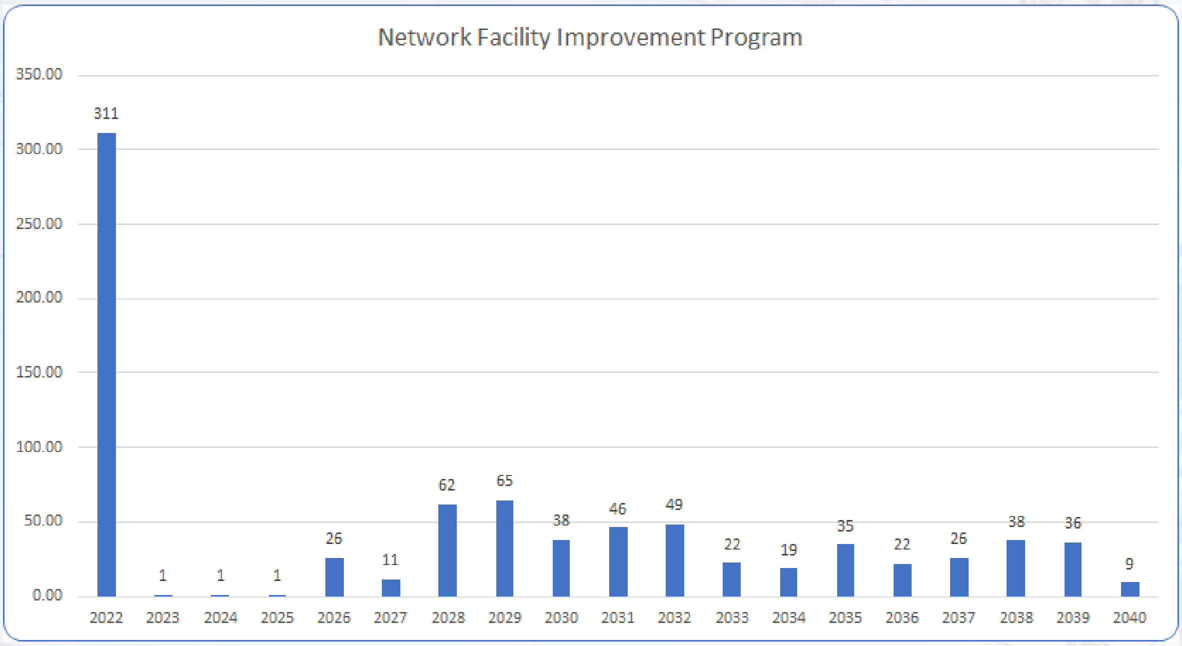


Figure 12.13 Network Facility Improvement Program Disbursement (in Mn Php)

12.1.6 Summary of 2022 - 2040 CAPEX Budget Requirements

The estimated CAPEX Budget for the TDP 2022-2040 is shown in Table 12.1.

Table 12.1: Summary of CAPEX Cost 2022-2040 (in Million (PhP)

TDP 2022-2040 O&M PROJECTS	Asset Replacement	Compliance to Standards	Technology Installation	Maintenance Equipment	Resilient Operation	TOTAL
Substation Reliability Projects	23,154.44	2,050.18	3,601.19	-	5,213.08	34,018.89
Transmission Line Reliability Projects	12,280.72	2,469.11	126.61	-	2,346.96	17,223.40
Sub-transmission Line Reliability Projects	6,017.00	1,394.79	21.06	-	-	7,432.85
O&M Tools & Equipment	-	-	86.16	7,065.33	-	7,151.48
Network Facility Improvement	-	818.33	-	-	-	818.33
TOTAL	41,452.16	6,732.40	3,835.01	7,065.33	7,560.05	66,644.95

The O&M CAPEX Program will also include the Grid Protection Relay Replacement Project (Priority 1, 2 and 3) or GPRRP. The project involves the replacement of protection relays in Luzon, the Visayas and Mindanao Grids to ensure the safe, secure, and reliable system operations.

The protection relay replacements also include other protection associated equipment, such as control system, auxiliary system, teleprotection system, construction of control buildings, which are necessary to efficiently and properly operate the protection relays.

The implementation of GPRRP commenced in 2019 and targeted to be completed in 2025. The bulk cost estimate of the project is Php 8,893.80 Million.

12.2 Metering Facilities

12.2.1 Obligations of Metering Service Provider for the Wholesale Electricity Spot Market

NGCP, the entity granted by the ERC with the Certificate of Authority as WESM Metering Service Provider (WMSP), is responsible for ensuring compliance of Grid-connected Facilities to the metering requirements prescribed by the OATS Rules, WESM Rules and Metering Manual, PGC, PEC, other applicable laws and supplemental guidelines issued by the ERC and the DOE. This responsibility is defined under Article III of ERC Resolution 28 Series of 2006.

According to the ERC Resolution, only an ERC-licensed WMSP shall be allowed to enter into a contract with a WESM Trading Participant for the provision of metering services which include in its scopes the installation, operation and maintenance of metering facilities.

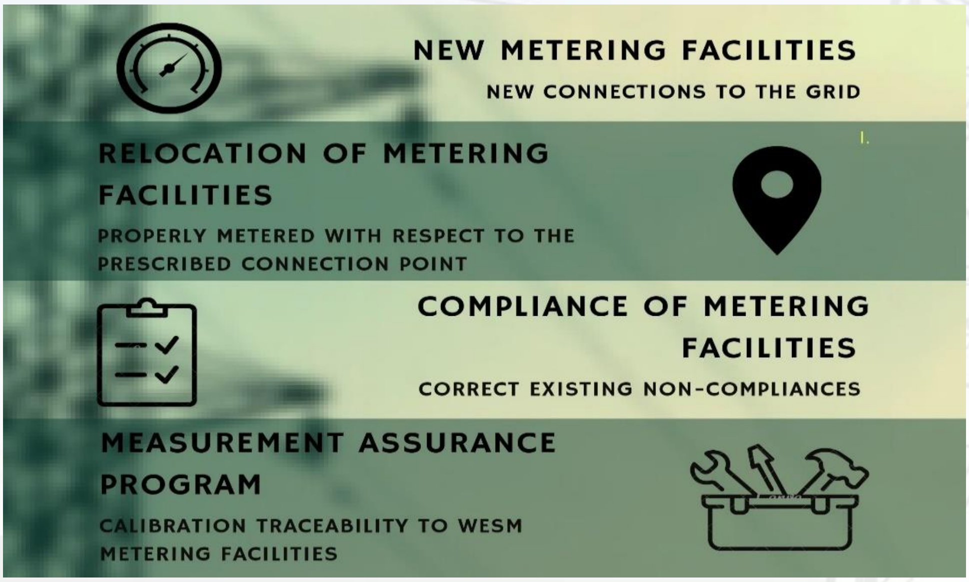
The PGC 2016 Edition also states that a metering facility may only be declared as ready for revenue metering service when regulatory conditions are satisfied as certified by the WMSP.

a. **Revenue Metering Capital Projects**

To satisfy these obligations, NGCP is required to continuously undertake metering capital projects classified into two major categories, namely:

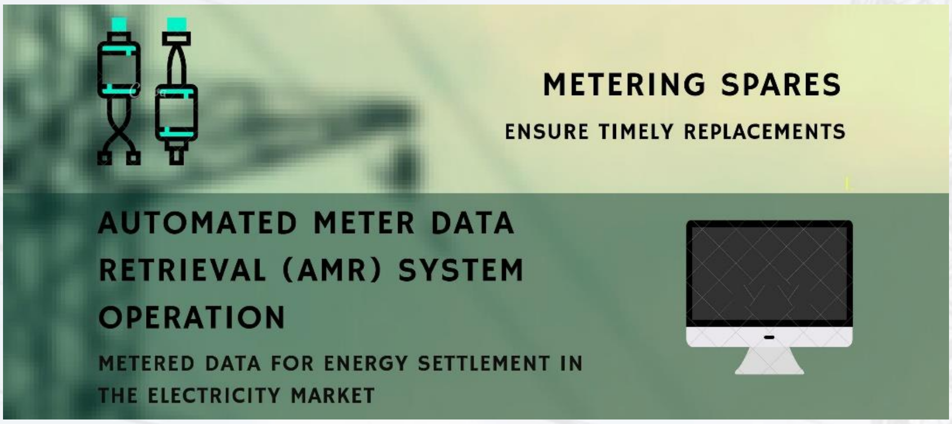
- Regulatory Requirements Compliance Projects

  The main driver for this project category is compliance to the metering requirements prescribed by the applicable rules governing the WESM. This project group is classified into four sub-categories:



- Metering Systems Reliability Projects

  The main drivers for this project category are security and reliability of metering facilities to maintain state of compliance to regulatory requirements. This project group is classified into two sub-categories:



b. Revenue Metering Capital Assets

The following table provides the rationale for the NGCP metering Capital Projects and the necessary revenue metering Capital Assets required to implement the projects:

Table 12.2
Metering Capital Asset Requirements

Project Sub-Categories	Capital Asset Requirements	Governing Rules
New Metering Facilities a. Generators b. Load Customers	Meters Current Transformers Voltage Transformers Lightning Arresters Communication Devices Meter Enclosure Test Switches Cablings Grounding System Conduit System Mounting Structures Concrete Foundations Metering Perimeter	OATS Rules ▪ E3 ▪ E11.1 ▪ E11.3 ▪ E11.4 ▪ F(AIII) 3 WESM Metering Manual ▪ 2.3.1 PGC 2016 Edition ▪ GRM 9.2.2.3 ▪ GRM 9.2.4.3 ERC Resolution 23 S2016 ▪ 6.0
Relocation of Metering Facilities a. Transmission Customers b. NGCP Station Services	Meters Current Transformers Voltage Transformers Lightning Arresters Communication Devices Meter Enclosure Test Switches Cablings Grounding System Conduit System Mounting Structures Concrete Foundations Metering Perimeter	OATS Rules ▪ E2.1 ▪ E11.8 ▪ F(AIII) 3 WESM Metering Manual ▪ 2.2-2.3 PGC 2016 Edition ▪ GRM 9.2.1 ▪ GRM 9.2.2.3 ERC Resolution 23 S2016 ▪ 6.0 DOE DC 2018-05-0015 (c) Clause 3.2.2.2 DOE DC2016-05-0007 ▪ Section 2

Project Sub-Categories	Capital Asset Requirements	Governing Rules
Compliance of Metering Facilities	Meters Current Transformers Voltage Transformers Lightning Arresters	WESM Metering Manual ▪ 2.4-2.11 PGC 2016 Edition ▪ GRM 9.2.2 ▪ GRM 9.2.3 DOE DC2016-05-0007 ▪ Section 1
Measurement Assurance Program a. Laboratory Standards b. Field Test Instruments c. Other O&M Tools	CMCL Standards Multi-meters Clamp Meters CT/PT Test Sets Meter Test Sets Insulation Testers Earth Testers Thermal Scanners	PGC 2016 Edition ▪ GRM 9.2.4.1 ▪ GRM 9.2.4.2 ▪ GRM 9.2.5 ERC Resolution 28 S2006 ▪ 2.2.2.3 ▪ 2.2.2.4 DOE DC2016-05-0007 Section 1
Metering Spares a. Equipment Failure b. Ageing Assets	Meters Current Transformers Voltage Transformers Lightning Arresters Communication Devices	OATS Rules ▪ E3 ▪ E11.3 PGC 2016 Edition ▪ GRM 9.2.4.1 (f) (g) ▪ GRM 9.2.4.3 ▪ GRM 9.2.8.4 ERC Resolution 23 S2016 ▪ 6.0 ERC Resolution 28 S2006 ▪ 3.4.5
AMR System Operation	Meter Data Retrieval and Validation System Communication Devices	OATS Rules ▪ F(AIII) 3 WESM Metering Manual ▪ 2.9.2 PGC 2016 Edition ▪ GRM 9.3 ERC Resolution 28 S2006 2.2.2.3.4

12.2.2 Requirement Analysis

The metering capital project requirements, which translate into revenue metering capital assets, were derived from the technical and commercial obligations of a Metering Service Provider as defined by the authorities that govern WESM Metering through the OATS Rules, WESM Metering Manual, PGC and guidelines issued by ERC or DOE.

a. New Metering Facilities

This project covers the installation of Metering Facilities for new Generator and/or Load Customer connections to the Grid.

Transmission Customer may provide the metering equipment installed at the connection point except for the revenue meters, which shall be provided by the Metering Service Provider. This requirement serves as the basis for the following project classifications for

New Metering Facilities and the corresponding metering tariffs applied to the Transmission Customers:

However, in line with the issuance of ERC Resolution 23 Series of 2016, all Grid-connected metering facilities included in this TDP 2022-2040 will be classified under Full Metering Projects.

The list of new metering facilities will be determined based on the following considerations:

- Requirements for new metering facilities for Transmission Customers which have already been communicated to NGCP through requests for facility studies et. al.
- Private Sector Initiated Power Projects as published at the DOE Website
- Growth forecast for new load customer connections

b. Relocation of Metering Facilities

This project covers the relocation of Metering Facilities to the prescribed connection point.

According to PGC and WESM Metering Manual, the Metering Point shall be located at the Connection Point or Market Trading Node. DOE DC2018-05-0015 further clarified that the metering equipment for the market trading node shall be installed no more than 500 meters from the connection point. ERC Resolution 23 Series of 2016, on the other hand, redefined the connection point based on the functionality of assets, regardless of its ownership.

These requirements and new definition of connection point serve as the basis for the following project classifications under Relocation of Metering Facilities:

- **Transmission Customer Metering** – existing transmission customer metering point/s not located at the prescribed connection point will be transferred or totalized at the prescribed connection point
- **NGCP Station Service Metering** – permanent metering facilities will be installed at the prescribed connection points using WESM compliant metering equipment

The list of metering facilities for relocation will be determined based on the following considerations:

- Connection point/s as defined by ERC Resolution 23 Series of 2016
- Metering points located more than 500 meters from the connection points
- Existing NGCP Station Service Transformers and corresponding locations of temporary metering points

c. Compliance of Metering Facilities

This project will address non-compliances of installed metering equipment against the standards prescribed by PGC and WESM Metering Manual such as, but not limited to, the following:

- Metering Equipment or Facilities not meeting required specifications

- Metering Equipment not used exclusively for WESM revenue metering purpose

According to WESM Metering Manual, continued non-compliance of metering installations shall be subject to sanctions or penalties. To ensure full compliance to this requirement, NGCP will undertake the procurement of replacement assets regardless of the ownership of the existing equipment. The list of metering facilities for compliance will be determined based on the following audit results:
- NGCP Internal audit results
- External audit results by PEMC, ERC and others

d. Measurement Assurance Program
This project covers the procurement of Tools and Equipment to support compliance to the Measurement Assurance System requirements:
- Laboratory Standards
- Field Test Instruments
- Other Operations and Maintenance (O&M) Tools

The WMSP is required by ERC to operate and maintain a measurement assurance system consisting of procedures, meter calibration standards and testing equipment and a central meter calibration laboratory. The purpose is to ensure the traceability of measurements of metering equipment to National Institute of Standards or to any reputable international standard body.

The list of Laboratory Standards and Field Test Instruments will be determined based on the following Considerations:
- Calibration traceability requirements for field test instruments and installed metering equipment
- Operational requirements per field metering offices (existing vs. required test instruments and O&M tools)
- Triggers such as end of asset life, obsolescence, asset condition and failures

e. Metering Spares
This project covers the procurement of spares for metering equipment to handle the following scenarios:
- Equipment Failure
- End of Asset Life

A metering equipment which failed the accuracy test or malfunctioned is required to be replaced immediately. NGCP shall undertake the procurement of metering spares including the requirements for transmission customer owned equipment to ensure immediate replacements of failed metering assets. Consequently, meter only metering facilities will be converted to full metering upon replacement of their equipment with NGCP owned assets. This is consistent with the ERC Resolution 23 Series of 2016 requirements.

Also, since the likelihood of failure of older equipment is higher due to natural deterioration process, NGCP shall incorporate its asset management system for ageing assets to this project category.

The metering spares level will be determined based on the following considerations:
- Age of metering assets
- Present asset conditions
- Historical failure rates
- Procurement lead time
- Geographic locations of spares storage facilities

- Installed equipment specifications

f. AMR System Operations

This project covers the operation, maintenance, and upgrade of Automatic Meter Reading (AMR) which is composed of hardware, software and communication infrastructures necessary for the delivery of settlement-ready meter data to WESM at the prescribed delivery schedules. Also included in the project is the establishment of an integrated meter data validation system to aid NGCP in the validation process.

The timelines and activities will be determined based on the following considerations:

- Age and conditions of AMR system hardware
- Maintenance contract with the AMR system provider
- Availability of alternative AMR system in the market
- Availability of new communication technologies in the market
- Management decision, driven by business considerations

12.2.3 Project Development

a. New Metering Facilities

The accuracy of the list of proposed projects under new metering facilities relies heavily on the correctness and timeliness of information received by NGCP about incoming connections to the grid.

For incoming generators, the list of committed and indicative Private Sector Initiated Power Projects sourced from the DOE website and the received requests for facility studies and operational assessments by NGCP provide useful references for the proposed projects.

Recently, NGCP has also started receiving load growth forecast from Trading Participant for incoming load customer connections; however, the quantity of planned connections submitted for reference are still relatively few. Thus, it is still necessary to make an estimated forecast of annual requirements for new load customer metering facilities. Table 12.3 provides the estimated new load customer connections per year to the transmission grids based on the historical average numbers of Metering Facilities commissioned annually. These estimates will serve as reference for the anticipated metering points for load customers proposed in this TDP 2022-2040.

Table 12.3:
Annual Growth Forecast for new Load Customer Connections

Metering Points/ Year	Luzon	Visayas	Mindanao
138kV	0	1	1
115kV	1	0	0
69kV	10	5	5
Total	11	6	6

b. Relocation of Metering Facilities

Transmission Customers: Table 12.4 provides the status of compliance of existing metering points to the DOE DC2018-05-0015 and ERC Resolution 23 Series of 2016's definition of connection points. These figures will serve as reference for the relocation projects for the TDP 2022-2040. Unless there will be space and security constraints at the proper connection points, NGCP will undertake and complete the relocation projects by 2025.

Table 12.4
Status of Compliance to ERC Resolution 23 Series of 2016

Region	Total Metering Points	Compliant	Non-compliant	Percentage (Compliant/ Total)	Required Relocation	Total MP after Relocation
Luzon	623	369	254	59.23%	142	511
Visayas	287	188	99	65.51%	83	271
Mindanao	252	162	90	64.29%	53	215
Total	1,162	704	445	61.88%	278	997

NGCP Station Service: The station service consumptions of NGCP Substations are presently being metered using temporary WESM meters installed in series with the statistical meters of the substations at the 480Vac distribution system. This project intends to relocate the metering to the proper connection points which is at the 13.8kV tertiary winding of the main transformer. Table 12.5 provides the list of Station Service Transformers requiring proper metering. These figures will serve as reference for the NGCP Station Service Permanent Metering proposed in this TDP 2022-2040. Unless there will be space constraints at the proper connection points, NGCP will undertake and complete the relocation projects by 2025.

Table 12.5
Metering Facilities for NGCP Station Service

Region	Existing Temporary Metering Points	Compliant	For Relocation
Luzon	93	5	88
Visayas	49	7	42
Mindanao	50	11	39
Total	192	23	169

c. Compliance of Metering Facilities

The PEMC of WESM conducts Review of Metering Installation Arrangements once every two years covering around 30% of Metering Points in Luzon and Visayas. The audit aims to determine the compliance of NGCP as MSP to the standards set by WESM.

Metering Facilities which were found non-compliant to the WESM standards demands corrections by MSP. Some of the audit findings for the year 2016 were already corrected and others already have compliance plans which includes replacement of non-compliant metering equipment, rearrangement of metering equipment in accordance with the WESM requirements and others.

In anticipation of the Metering Arrangement Review, it has become a regular practice of NGCP to perform internal audits to be able to come up with compliance plans. Table 12.6 provides the statistics of Metering Points with Non-compliances based on the audit reports. These figures will serve as reference for the compliance projects for the TDP 2022-2040. NGCP will undertake and complete the compliance projects for both Full and Meter Only Metering Facilities by 2025.

Table 12.6
Remaining Metering Facilities for Compliance

Region	Full Metering	Meter Only	Total
Luzon	22	17	39
Visayas	7	14	21
Mindanao	1	3	4
Total	30	34	64

d. Measurement Assurance Program

The majority of existing laboratory standards and field test instruments were bought during the 4th regulatory period. By the 6th and 7th Regulatory Periods, most of these instruments will reach the end of their asset life:

- Laboratory Standards – asset life of 12 years
- Field Test Instruments – asset life of 10 years

Metering Assets are expected to go through natural wear-and-tear. Our record shows that the established asset life accurately defines the economic and technical performance of this asset category. Majority of the test instruments procured during the 2nd Regulatory Period have shown signs of deterioration around the time they have reached their assigned regulatory life including, but not limited to, the following:

- Accuracy and Performance Issue
- Power Supply and Component Failure
- Firm Ware Error

Existing instruments will be programmed for replacement as soon as they reach their asset life and have also exhibited signs of decline in performance. The proactive asset management system that NGCP implements is consistent with the policies of the ERC, which continuously monitors the age and conditions of the assets to come up with a reasonable replacement program. While NGCP considers both as important triggers, the actual asset conditions are given more importance than the age of the assets. The run-to-failure approach will be implemented for fully aged serviceable instruments. These assets will be utilized for redundancy purposes.

Other instruments included in this proposal are intended to address operational, maintenance, and automation requirements which are also based on regulatory obligations of the MSP such as testing, calibration, and maintenance of metering installations as defined by PGC 2016 and further clarified by DOE DC2016-05-0007.

e. Metering Spares

Maintaining an optimal level of metering spares is critical for ensuring the continuous and reliable operation of the metering systems. The standard quantity of 3% of installed metering equipment, previously used to determine the spares requirements, failed to completely provide the operational requirements of NGCP due to the following scenarios:

- Unexpected failure of some metering equipment (meters and modems) prior to assigned asset life
- Transmission customers' failure to provide spares for customer-owned metering facility in case of equipment defect.
- Unplanned metering requirements e.g., new grid connections, new regulatory guidelines

NGCP was forced to utilize not only its limited spares, but also other metering equipment originally intended for different projects to partially address the above-mentioned scenarios. For other requirements which can no longer be provided, the following measures were temporarily implemented:

For failed CT, VT and Meters: Manual estimation or application of correction factors to the metered data is applied.

To address this, NGCP has implemented some improvements in the spares program to better support the operational requirements of NGCP.

Fully Aged Metering Assets

Metering Assets are expected to go through normal wear-and-tear. Our statistics show that the established asset life for the following metering equipment accurately defines their economic and technical performance:

- Voltage Transformers – asset life of 30 years
- Current Transformers – asset life of 30 years
- Combined Instrument Transformers – asset life of 30 years
- Lightning Arresters – asset life of 30 years

However, the meters, with assigned asset life of 10 years, has the tendency to fail earlier than their expected lifespan. Obsolescence is also an added consideration for these types of assets.

These items are to be replaced towards the end of their assigned Asset Life and when they exhibit impending failure. Information on asset age and condition shall serve as primary reference for the replacement program for installed metering equipment included in this TDP 2022-2040.

f. AMR System Operations

The proposal for this TDP 2022-2040 project sub-category will include:

- **AMR System communication infrastructure**: which presently utilizes GSM Modems, will be upgraded to IP-based 3G modems. The project will replace the existing modems at the remote metering facilities. This project is now being implemented.
  On the other hand, for facilities installed inside NGCP premises, NGCP will utilize its existing IP network in lieu of the TelCo VPN. This will entail the procurement of IP Telephony accessories such as routers and serial to Ethernet converters.
- **AMR System Hardware:** will be replaced as they reach their assigned Asset Life or when they become obsolete or fail in service.
- **AMR System Software (currently the MV-90 System):** will be replaced or upgraded as they reach their assigned Asset Life (5-years) or when they become obsolete or fail in service.
- **Integrated Meter Data Validation System:** has started full operation in 2019 and system enhancement will be done in 2023. This software and database system have partially automated the validation process to minimize human intervention in handling the metered data for billing settlement.

12.2.4 Summary of 2022- 2040 CAPEX Budget Requirements

The estimated CAPEX Budget for the TDP 2022-2040 is shown in Table 12.7.

Table 12.7
2022-2040
CAPEX Budget

Project Sub-Category	Estimated Cost in Millions (PhP) 2022-2040
New Metering	2,501.78
Relocation	617.29
Compliance	99.81
MAP	438.04
Replacement	240.04
Spares Program	237.68
AMR System	145.64
Total	4,280.27

13 System Operations

13.1 Developmental Objectives

The development plan for the SCADA, telecommunication and protection components of the Power Grid is characterized by the need to cope with the market-driven demand for consolidation of enterprise and operations applications in the energy management systems (EMS), subsequent necessity for bandwidth and interoperability in the communications network and indispensability of redundancy, i.e., N-1 in the protection systems. The importance of integrating embedded variable renewable sources of energy into the Grid has also made it a point to provision readiness in both the SCADA-EMS and telecommunication systems for addressing connectivity and data organization and for the protection system to be able to handle the peculiar power quality management issues.

The following are the objectives of the developmental program for the 2022–2040 planning horizon and the respective major CAPEX issues of interest.

- Migration to Efficient Technologies
    - Shift to IP-based transport/network
    - Completion of optical telecom backbone
    - Adoption of Smart Grid model; implementation of IEC 61850 standard
    - Use of hybrid power supplies
    - Supervision/monitoring functions employing public infra
- Sustenance of Systems to Maximize Economic Lives
    - Stagger the retirement/replacement of systems running through obsolescence
    - Technological prudence: specified functions and upgradability should be realized within expected service life
    - Manage maintenance and replenishment of battery banks
    - Employ remote fiber monitoring systems for quick detection of damaging factors
- Prioritization of Infra Expansion/Upgrade to Areas of Most Benefits at Least Cost
    - Enhanced EMS applications, with emphasis on VRE management
    - OPGW retrofitting to enable access to bandwidth
    - Upgrade of power supply systems and other support infra
    - Compliance with data center standards
    - Cyber security
- Address Deficiencies that Prevent Optimized Network Performance
    - Completion of network synchronization system
    - Integration of telecom network management systems
    - Securing RCC interfacing to HVDC control system
    - Equipping RTUs with IP interfaces
- Compliance with Grid Code and Regulatory Directions
    - Monitoring and control of embedded generators
    - VRE forecasting
    - Consistency with Protection, SCADA and Telecommunication Philosophies
    - Meeting power quality and system availability requirements
    - Grid resiliency measures
    - Real-time monitoring and control at connection points

13.2 Situational Analysis

13.2.1 Telecommunications

As the pace of development vis-à-vis geographic peculiarities of the electricity grids in Luzon, Visayas and Mindanao varies significantly, the characteristics of the respective telecommunication systems and facilities differ appreciably among each other. On a nationwide scale, backbone infrastructure is dependent on the continuity of transmission-line-embedded fibers—for this matter, relatively-recent transmission line segments without OPGW have to be retrofitted to interconnect the already-fiber-embedded lines in the new installations.

From the register of our existing telecom facilities, we define:

- The need to replace part of the installed base already without spare parts support as well as the program for replenishments of equipment upon obsolescence
- Required upgrades or replacements to address capacity/bandwidth issues resulting from a particular element's deficiency
- Additional facilities that will provide element and path redundancy in compliance with our N-1 philosophy
- Additional network management components to consolidate remote control capability over telecom network elements.

On the network level, as the open market integrates, the respective characteristics of the telecommunication networks in Luzon, Visayas and Mindanao become more similar as common performance parameters are adopted and the same operating philosophies are shared. Further, the requirement for more backbone bandwidth (and the subsequent need to reinforce synchronization of the high-speed transport network) is nonetheless increasingly and universally felt, catering to the demands of the now-mainly-IP-based applications. The 2022–2040 CAPEX projects identified in this volume reflect this trend as an integrated NGCP telecommunication network develops over the course of the planning horizon.

Following is an illustration of the geographic extent of the optical infrastructure on which basis the collective performance of NGCP's operations and business applications are founded on:

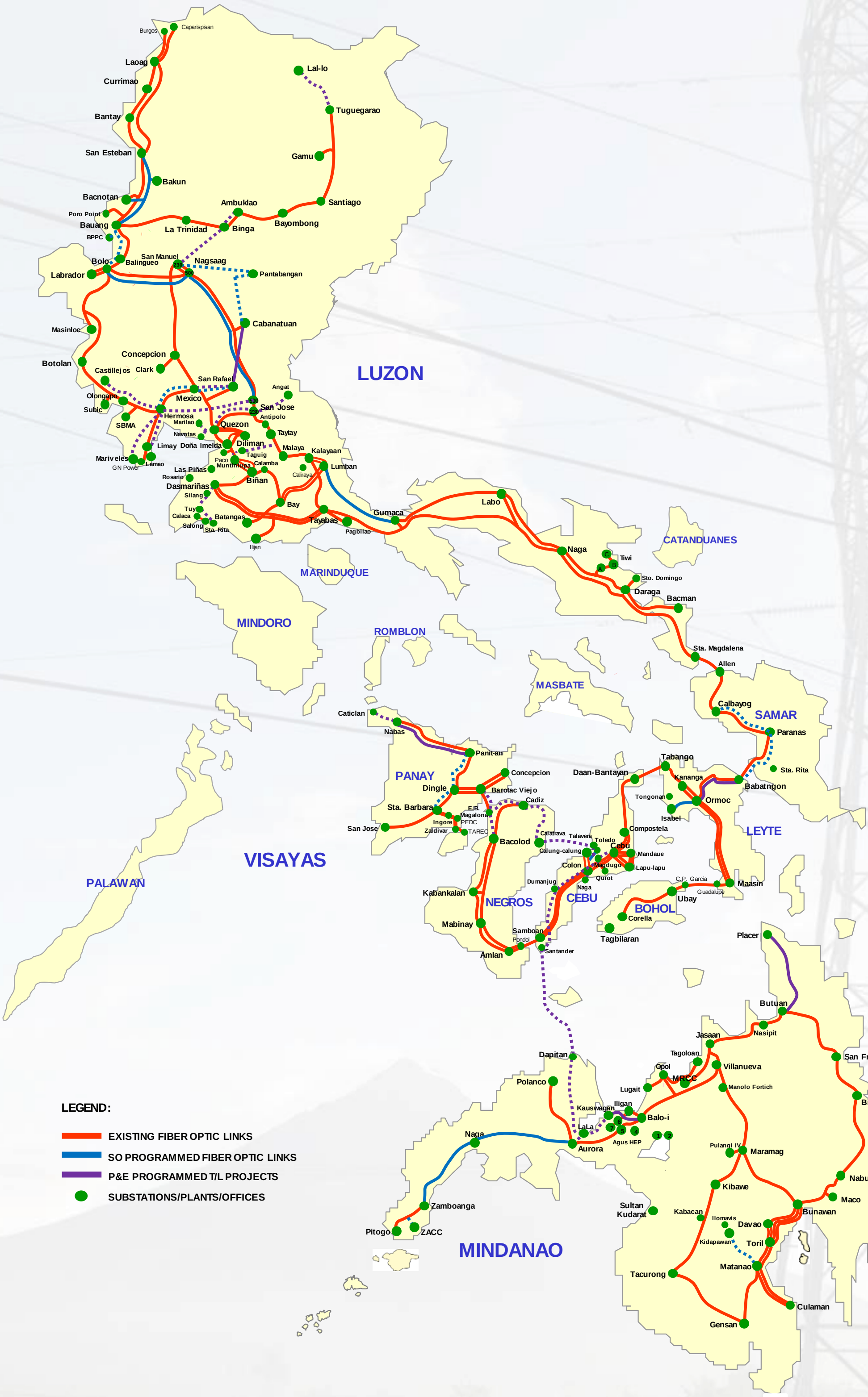


Figure 13.1: Fiber Optic network

13.2.2 SCADA-EMS

NGCP's Regional Control Centers (RCCs) are responsible for monitoring and control of the transmission systems in each of the three power grids: Luzon, Visayas and Mindanao. Backup RCCs were also established to take over the functionalities of RCCs during contingency events. Several Area Control Centers (ACCs) are situated in each Region to supervise other parts of the transmission network not directly managed by the RCCs and to coordinate with the customers in their respective areas of responsibility.

The entry into the Electricity Market of Visayas and Mindanao has resulted in significantly more complex operations in the regions. The need for comprehensive SCADA/EMS coverage has also been made more difficult by the rapid changes in Grid configuration brought about by the integration of new players.

The major issues for improvement of the existing SCADA/EMS arrangement are characterized below:

- The responsiveness of the existing SCADA system to the requirements of VRE integration as well as to the 5-minute real-time dispatch mechanism depends on enhanced computing resources as well as improved accuracy of the telemetry system
- Inadequacies in auxiliary support facilities for some of the control centers should be addressed to avoid unreliable SCADA operations and accelerated equipment ageing and failure
- Exposure of the SCADA-EMS system to cyber security risks has become more prominent as threats grow alongside technology-driven commerce
- There is limited infrastructure reach to readily address supervision of embedded generators.

The development of the Grid in response to Market demand in terms of capacity growth, geographic expansion and challenges in dispatching generators of renewable energy has manifested itself in the SCADA-EMS system through the consolidation and standardization of data collection and management processes and the employment of specialized modeling and analytical applications as part of EMS. The 2022–2040 CAPEX projects are in line with this development trend.

Figure 13.2 is an illustration of the pertinent SO-MO process flow involving NGCP's SCADA-EMS and its interface to the Market.

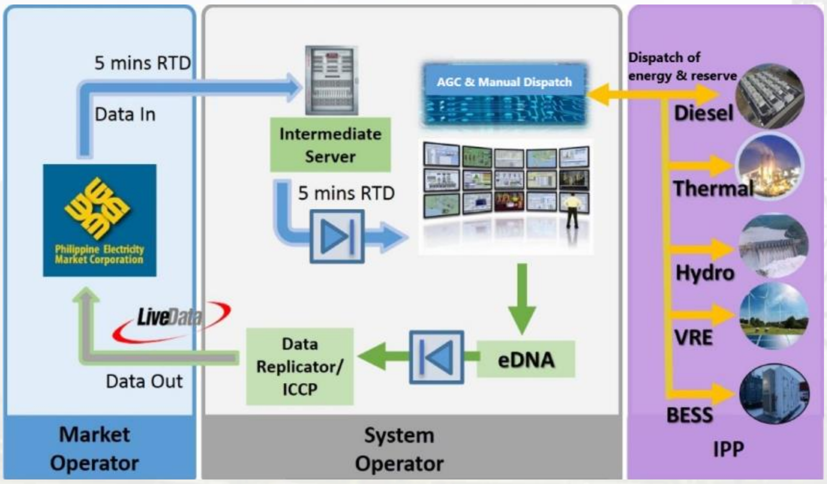


Figure 13.2: SO-MO Process Flow

13.2.3 Protection Systems

A resilient Power Grid made possible through an effective protection system is a requisite for the realization of the Smart Grid environment. However, the existing protection facilities are significantly lagging in terms of compliance with the Network Protection Philosophy, especially in Mindanao where complementary telecommunication facilities to support path redundancy requirements are still under development.

The challenges presently faced by the existing protection system are described by the following needs:

- Replacement of obsolete protection equipment—which has no more manufacturer support and lacks modern communication features—has to be accelerated to minimize equipment failures as well as to consolidate (remote) management and maintenance.
- Redundancy requirements to meet the N-1 objective necessitate the addition of relay equipment where no Main 2's are present and upgrade of existing relays where the required philosophies governing Main 1 and Main 2 modes have not yet been realized.
- Strategic deployment of NDME and PQA to ensure quick and accurate diagnostics of network disturbances and power quality issues in compliance with PGC requirements.
- The present state of stability still requires continued employment of SIPS in strategic areas of the Grid.

While programmed substation upgrades address the above needs through the accompanying upgrading of the secondary equipment attributed to the transmission lines (radiating from the substation), such substation upgrades would not significantly cover the deficiencies in due time given the respective implementation schedules. Thus, the 2022–2040 CAPEX for protection builds up on relay, NDME, and PQA equipment—the lack of which compromises NGCP's performance objectives.

13.3 Summary of CAPEX Costs

CAPEX Costs 2021–2040 (In Million Pesos)

Table 13.1 CAPEX Proportion by Function

Function	Replenishments	Rehab/Upgrades	Expansions	Total
Telecoms	7,870	794	4,015	12,679
SCADA	5,510	807	3,361	9,678
Protection (NDME/PQA)	1,189	35	244	1,469
Connection Point Monitoring/Control	0	0	3,736	3,736
TOTAL	14,569	1,636	11,356	27,561

Table 13.2 CAPEX Proportion by Region

Function	Replenishments	Rehab/Upgrades	Expansions	Total
Luzon	5,404	492	4,183	10,078
Visayas	4,325	836	2,909	8,069
Mindanao	4,841	308	4,265	9,414
TOTAL	14,569	1,636	11,356	27,561

Table 13.3: Telecom Projects According to Nature of Facilities

Telecom Facilities	Luzon	Visayas	Mindanao	Total
Fiber Optics and OPGW	2,080	896	2,278	5,255
Microwave Radio	321	234	316	871
Network Management and Synchronization	499	857	617	1,973
Teleprotection Equipment	124	129	118	371
WAN and Access Equipment	540	377	711	1,628
Power Supply and Auxiliary	854	442	823	2,119
Cyber Security	3	45	17	64
Mobile Radio Network	64	31	72	167
Test Equipment	72	61	98	231
TOTAL	4,555	3,073	5,051	12,679

Table 13.4: SCADA/EMS Projects Categorized by Component Function

SCADA/EMS Components	Luzon	Visayas	Mindanao	Total
SCADA	2,814	2,638	2,139	7,591
EMS Applications	95	32	84	211
Cyber Security	188	90	182	459
WAMS	429	439	548	1,416
TOTAL	3,526	3,199	2,953	9,678

13.4 Strategies

- **Sustenance of Assets Against Technology Shifts.** System Operations' primary asset management objective—and the main CAPEX driver—is to optimize the serviceability of its existing facilities, i.e., maximizing service lives up to the extent that the costs of ownership vis-à-vis strategic benefits justify continued maintenance. Therefore, given SO's dependence on software and electronics, rapid technological advances in either field increases the need for frequent reassessment of the relevance of such assets to SO's functional objectives. Technologies and applications approaching obsolescence should be retired—albeit on an optimized schedule—and replaced with the more efficient ones for the sake of improved performance and economics. Thus, we are reducing and eventually ending acquisition of spares and maintenance support for the assets due for retirement and investing on their replacements, as follows:

Table 13.5 CAPEX Proportion by Function

Decreasing Functionality	Current Paradigm
▪ Power Line Carriers (PLCs) cannot be used to provide *differential* line protection and cannot be used as a redundant backbone access channel given the bandwidth requirements of current business and operations applications. PLC is also quite expensive for stations which have ready access to fiber-embedded transmission lines.	Fiber is the preferred media for line protection offering both the best bandwidth and reliability. All new transmission lines are already embedded with fiber and existing lines continue to be retrofitted with OPGW. Optical terminals are cheaper to acquire and maintain and protection relays can be outfitted with optical transceivers enabling "direct fiber" line protection setups.
▪ Microwave radio shall be limited to spur link applications and backup routes where no transmission lines can be used to establish optical transport.	Retrofitted fiber is much cheaper in addressing backbone needs given the exponential bandwidth growth.

Decreasing Functionality	Current Paradigm
▪ There would be less use of TDM channel multiplexers as service access is shifted to IP.	Routers and Ethernet switches shall begin to displace TDM multiplexers along the service access points as applications migrate towards IP communication.
▪ SDH transport facilities are already being migrated to packet-switched networks.	IP-based transport facilities shall gradually replace SDH networks that are now reaching obsolescence.
▪ PABX equipment shall be totally phased out as circuit-switched arrangements become obsolete.	Telephony and other multimedia services shall run through the IP network not unlike other applications using networked servers.
▪ RTUs for Power Grid SCADA shall become less relevant as automation and data communication is integrated into substation and power plant design.	Remote data collection requirements shall be reduced to compliance with supervisory and communication protocol and hardware limited to intermediary access terminal for security purpose.
▪ User owned telecommunication facilities to reach remote IPPs will be less favored especially when no teleprotection complement is required.	Less CAPEX-involved public infrastructure to establish access among IPPs (especially embedded ones) shall be taken advantage of but cyber security arrangements shall be given due attention.
▪ Use of Distance Relays shall be limited only to areas where differential protection cannot be applied on account of bandwidth limitation.	Differential Relays (with direct-fiber interfaces) shall displace more and more Distance Relays as fast communication interfaces through fiber and radio become pervasive.

- **Timing of Projects**. Given the interdependence of technology and infrastructure—as well as the role of organizational evolution adapting to market trend—in defining developmental direction, outlined below are the implementation sequence of major projects for the purpose of validation and prioritization. It is also the purpose of this development plan to make rescheduling of projects convenient when faced with limited budget or0020implementation resources. Optimization demands that just enough infrastructure is ready to accommodate the applications as they come and that right applications are chosen to take advantage of the minimum infrastructure components in place at the time of need.

- **CAPEX Priorities**. As shown in the above schedule, 58% of projected CAPEX is allocated for sustenance of existing facilities and the rest for programs to address current deficiencies and new requirements. This does not mean that the same apportionment would be observed in case of budget constraints. While sustenance would ideally be the priority, the new facilities are also meant to address deficiencies in existing service areas. Should CAPEX limits be apparent as a result of transmission regulation, prevailing demand for pertinent applications shall be prioritized.

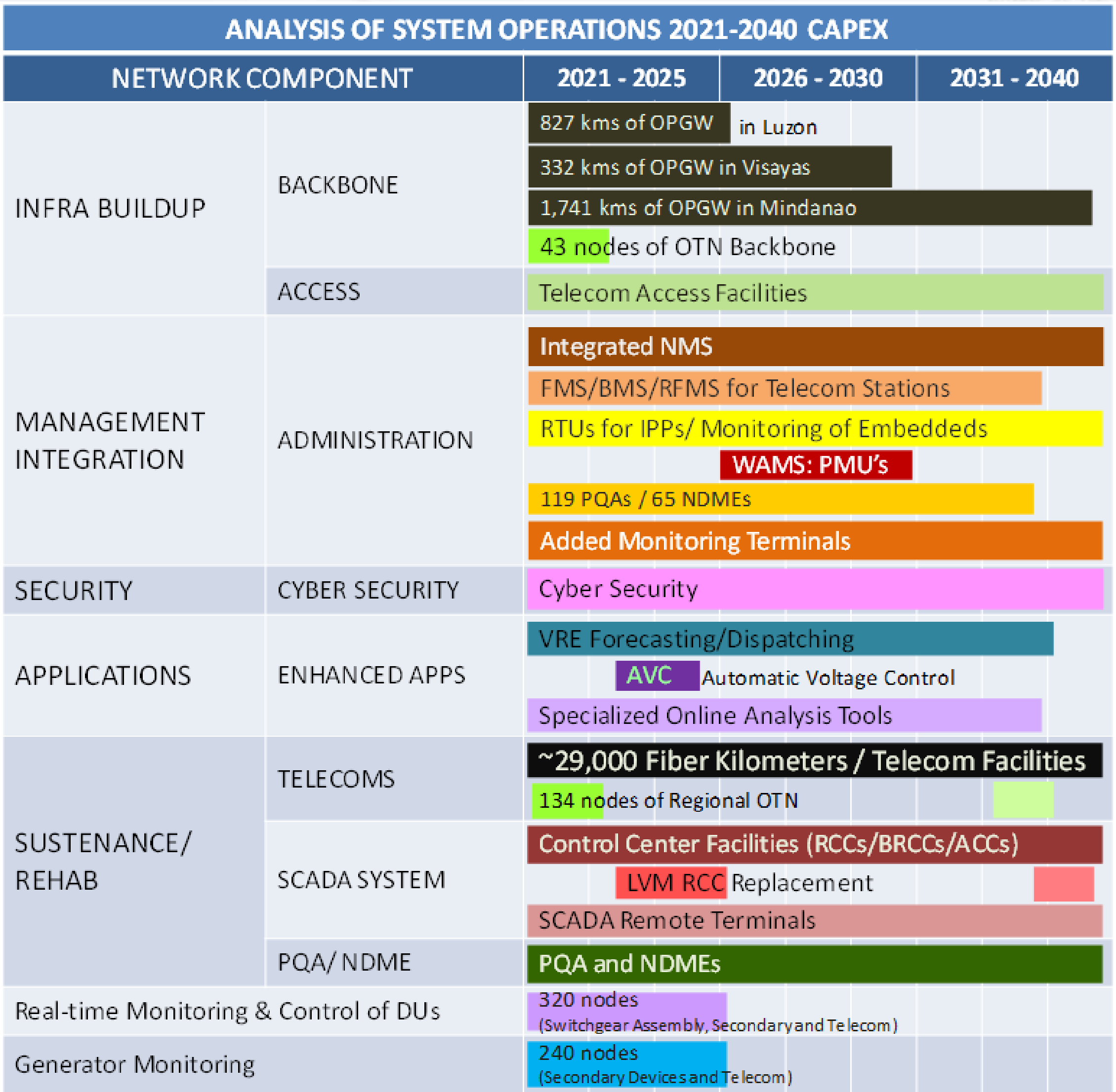


Figure 13.3: Analysis of SO 2021-2040 CAPEX

As an example, EMS enhancements for the purpose of improving SO response to Grid dynamics and maximizing access to energy sources according to market conduct are lined up for implementation through the 4th and 5th regulatory periods. Projects for either infrastructure reinforcement or sustenance/upgrade programs would hence depend on the relative significance of the affected network elements or sections in support of said EMS applications. Prominent in this respect are the VRE forecasting and modeling applications.

Imperative also during the early years is putting in place the pertinent synchronization mechanisms and enforcing communication protocols which govern the building blocks of our automation and control systems.

Finally, given the increasing dependence of SO on IT and communications systems—amid the growing pervasiveness of the internet in the business environment—the need to protect System Operations against cyber threats has manifested itself as an indispensable determinant in development planning and engineering design.

Table 13.6
CAPEX Summary

PROJECT LIST	5th REG					6th REG	7th REG	8th REG	TOTAL 2021-2040
	2021	2022	2023	2024	2025	2026-2030	2031-2035	2036-2040	
Fiber Optic and Microwave Radio Equipment Replacement	29	45	62	361	397	456	1,351	172	2,873
Teleprotection Equipment Replacement	20	22	26	17	15	77	122	73	371
Telecom Access and Remote Management Component Replacement	72	51	93	100	53	973	654	945	2,940
Power Supply and Auxiliary Equipment Replenishment	98	52	74	175	157	618	495	620	2,289
Infra and IT Support Facilities Replacement	127	59	77	78	118	861	399	444	2,163
SCADA/EMS Facilities Replacement	140	301	299	862	44	1,445	295	959	4,345
NDME and PQA Replacement	58	78	38	15	18	216	574	227	1,225
SCADA Expansion—Added RTUs and Monitoring Points	116	30	43	31	42	220	214	191	887
Telecom Access for Added Locations, Subscribers and Application Points	57	26	36	58	47	61	66	60	411
Fiber Optic and Microwave Radio Expansion	516	511	145	218	96	824	453	402	3,165
Cyber Security	158	11	101	81	22	87	30	35	524
Network and Facilities Management System and IT Support Facilities	92	177	70	43	121	90	90	80	762
EMS Enhancements	2	-	15	10	20	47	100	17	211
Wide Area Measurement System (WAMS)	-	-	-	-	-	1,416	-	-	1,416
NDME and PQA Expansion Program	58	28	43	24	18	46	25	4	244
Monitoring and Control of DUs	1,074	1,127	361	361	393	-	-	-	3,317
Generator Monitoring	164	166	28	30	31	-	-	-	419
TOTAL	2,781	2,684	1,509	2,463	1,592	7,436	4,868	4,228	27,561
	11,030								

13.5 Telecommunications

13.5.1 Fiber Optic Network Expansion

The following are diagrams for the 2022–2040 programmed additions for the Fiber Optic network. The expansions include optical fiber links resulting from new transmission line projects as well as OPGW retrofitting on existing TL programmed in this section:

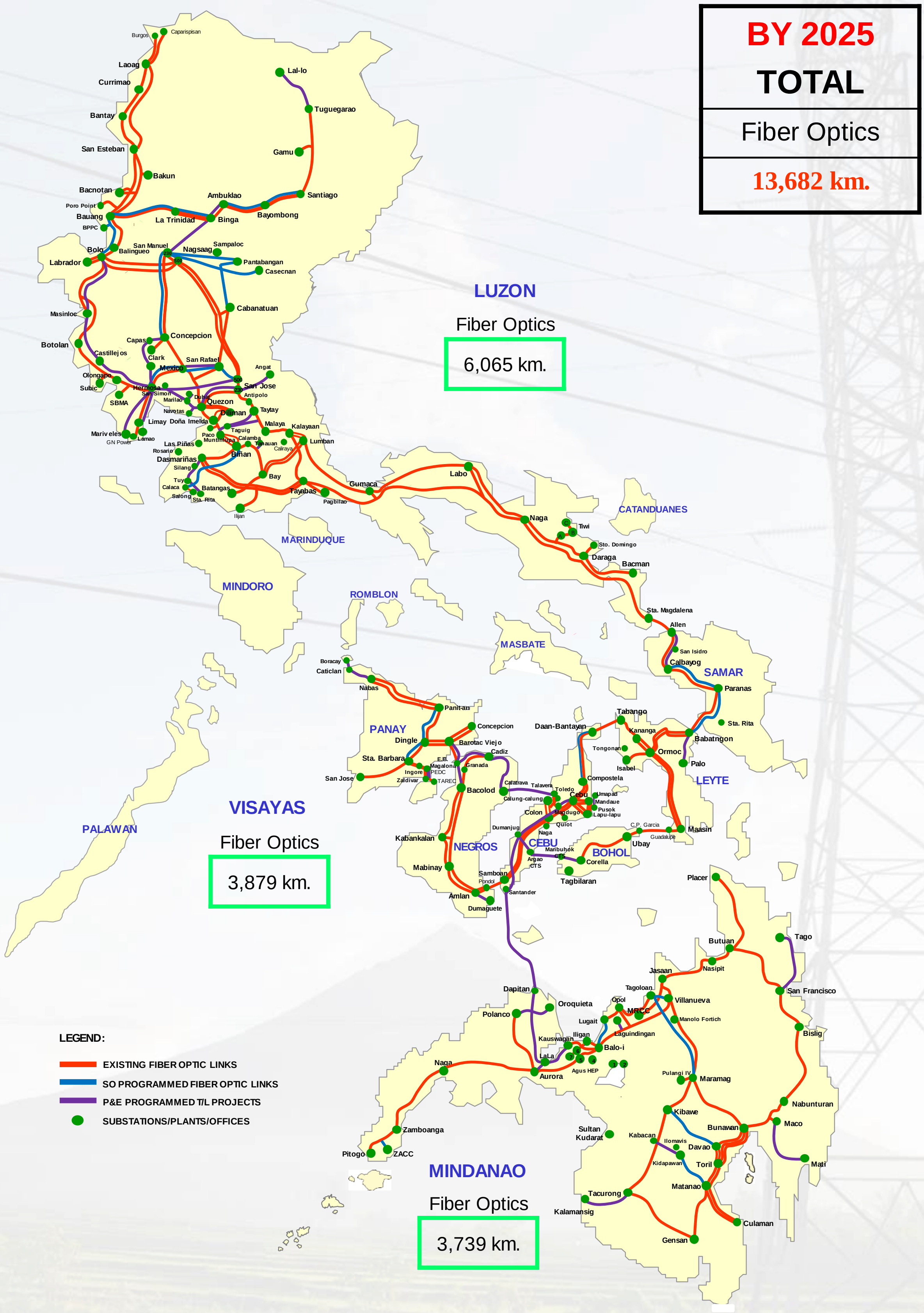


Figure 13.4: FO Network by 2025

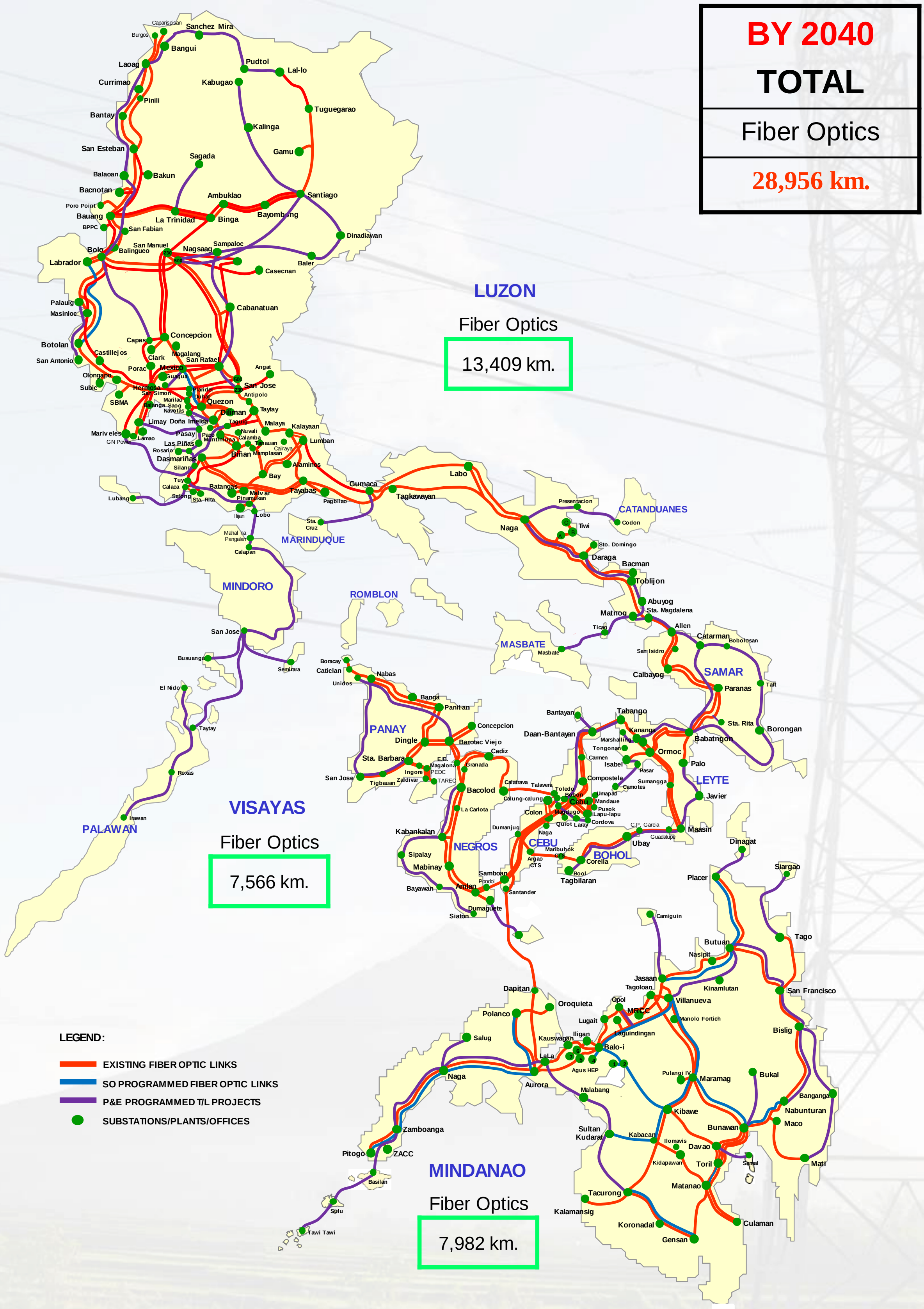


Figure 13.5: FO Network by 2040

13.5.2 IP Transport Network Implementation

The need to adopt a high capacity and purely-IP-based telecommunication infrastructure calls for a phased implementation of the telecommunication transport system migration to optimize the life of existing TDM/SDH equipment. The cost for migration has been outweighed by the cost of sustaining and provisioning for legacy equipment whose respective O&M efficiencies have been surpassed by modern technology. Thus, the current SDH transport network would be sustained only up to the elements' economic lives where feasible and legacy TDM applications would be run on emulated mode (over IP) until such time that the applications themselves have migrated into their respective IP modes. New application requirements which demand for high bandwidth and secure telecommunication network render SDH transport system obsolete for obvious capacity limitation. The fairly mature Optical Transport Network (OTN) technology is preferred to address the new mission-critical network requirements. It offers the advantages of being flexible, open technology, scalable, and cost-effective long-term infrastructure solution. It is aimed to increase network performance by lowering latency, increasing network manageability, and paving the way for the network to embrace purely IP-based networks and Software-Defined Networking as planned.

The acquisition of new IP-based transport appliances, therefore, should be complemented by the choice of the adequate transport protocols, reinforcement of the network management centers and putting in place of appropriate out-of-band network probes to ensure that performance thresholds are met.

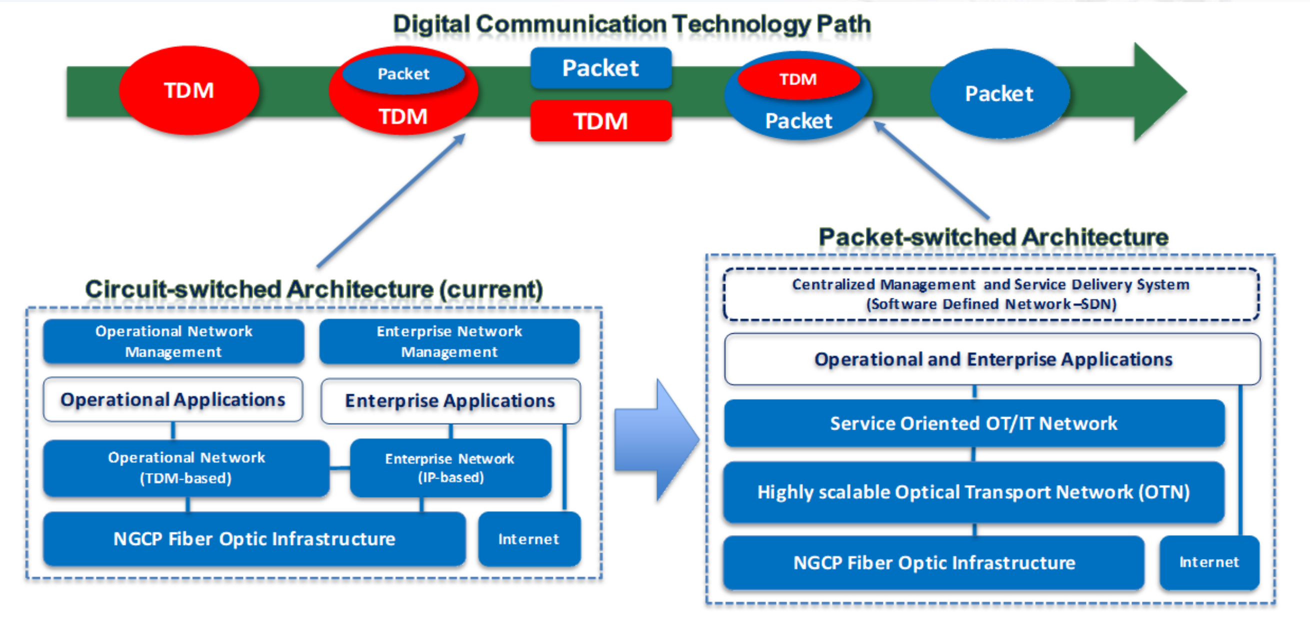


Figure 13.6: NGCP ICT Infrastructure Migration Path

13.5.3 Network Synchronization

The following NGCP network elements require a common reference clock—i.e., they need to be synchronized—for reasons peculiar to their respective functions and nature of operations:

- **Telecommunications**—High-speed digital transmission technology requires synchronous telecommunication nodes
- **SCADA/EMS**—Data monitoring/recording especially those from synchrophasor measurements, for purpose of power flow analysis and eventual automated control, must be synchronized
- **Grid Protection**—Protection relays and event/waveform recorders require accurate time stamps for network performance analysis and post-event diagnostics
- **Metering**—Accurate billing information requires standard time reference

On a national scale, a synchronized timing system is also necessary to coordinate events and activities among the various collaborating government agencies and public utilities. Republic Act No. 10535, also known as The Philippine Standard Time Act of 2013, orders the synchronization of all clocks in the country under the Philippine Standard Time (PST).

Such need for synchronization is especially relevant as NGCP prepares for Smart Grid. Precise timing is necessary if coordinated supervisory control and quick reaction to fast changes in real-time data would be realized to meet Smart Grid standards.

A unified synchronization system with stratum 1 traceability to a primary reference clock source has been established for NGCP to provide synchronization requirements to all the installed based network elements. This shall cover all telecommunications, SCADA, protection, metering, enterprise data network and other substation devices. The sync system shall continue to provide legacy timing protocols such as IRIG-B, 1PPS and 1PPM to old but functional network elements requiring such.

The installation of synchronization clocks at 138kV, 230kV and 500kV substations has been completed (refer to Appendix 7) and all network elements are currently being integrated for unified clock reference.

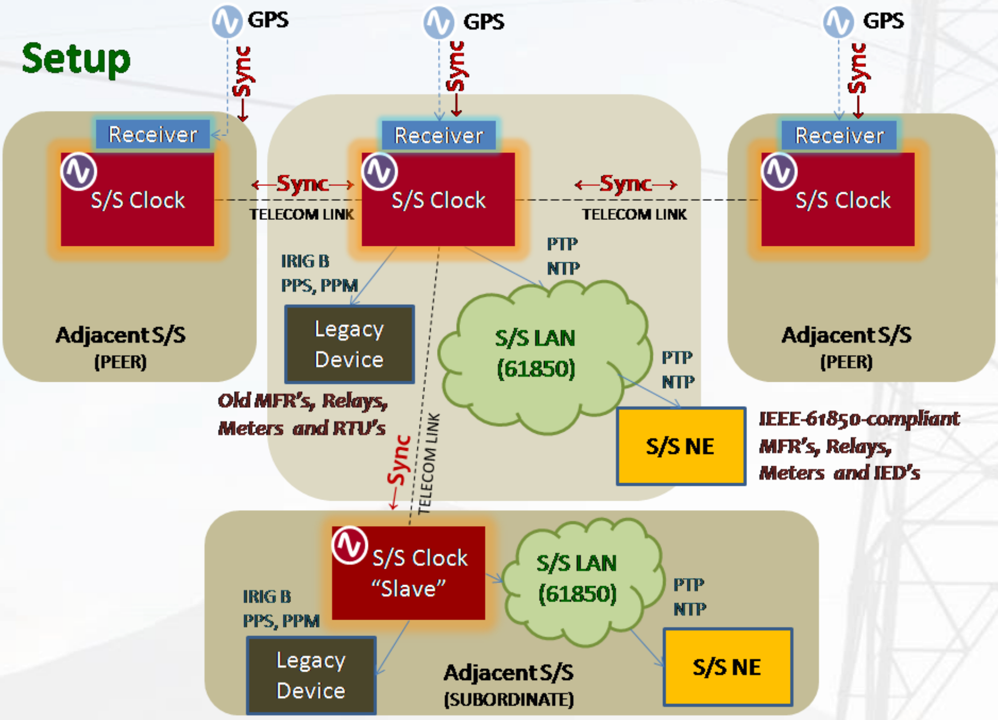


Figure 13.7: Synchronization Arrangement

13.6 SCADA Programs

13.6.1 National System Operations

The Visayas and Mindanao Grids will soon be interconnected via HVDC transmission system. As such, there should be a holistic view of the Philippine Grid as a single interconnected network. In consonance with this concept, a centralized monitoring and control is envisioned to be established to support the integrated operation of the transmission system and dispatch of all generation in the Philippines. The National System Operations (NSO) would be responsible for the whole grid operations once the Luzon, Visayas and Mindanao interconnection is complete.

The replacement of the near obsolete SCADA/EMS System should be timely in anticipation of the integration of the WESM operation among Luzon, Visayas and Mindanao to ensure continuous exchange of information between a unified SO and the Market Operator. The replacement/upgrade of SCADA/EMS for the three RCCs will realize the implementation of a National SO – the control center of which would be co-located with Luzon's. These replacement programs are harmonized with the implementation timeline of the MVIP towards the planned unification of the Philippine Grid against a nationwide resource-optimization objective.

The National System Operations (NSO) would be responsible to carry out the following Grid-management lookouts:

- Supervise, monitor and control all interconnection of the three Regions (Luzon, Visayas and Mindanao)
- Monitor and control HVDC interconnection system during normal and emergency conditions
- Manage the respective transmission backbones of the three regions (i.e. 500kV of Luzon, Visayas interconnection and 230kV of Mindanao
- Conduct of simulation studies for the whole grid necessary for decision making
- Supervise the implementation of Planned Activity Notice (PAN) of HVDC interconnection and the transmission backbone
- Supervise the operations of the three Regional Control Centers
- Coordinate with the Market Operator for the implementation of the RTD schedules of the three Regions
- Forecast week ahead and day ahead of the three Regions

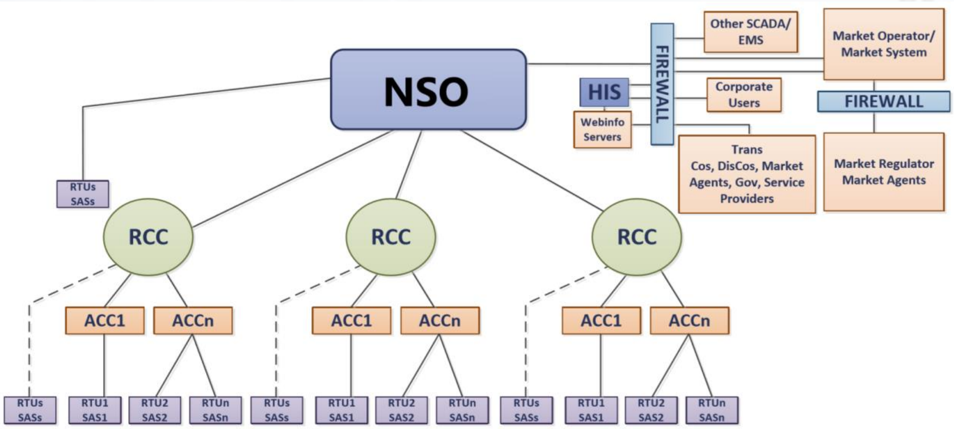


Figure 13.8: National System Operations Conceptual Framework

The backup RCC's would continue to operate using the existing platform in parallel operation with the upgraded SCADA-EMS systems to serve as redundant control center facilities for the purpose of business continuity.

13.6.2 EMS Advanced Applications

Computer-aided EMS technology has been around since the 1980s and works in conjunction with SCADA systems to optimize generation and transmission resources. EMS advanced applications (software) are automation tools employed by electric power utilities designed for specialized tasks at hand within the realm of such resource optimization. NGCP EMS enhancement project involves the acquisition of preferred EMS advanced applications intended to:

- Meet Current Market Demands
  - The rapidly growing number of network elements—especially by the integration of embedded generators into the Market—requires more management attention and faster reaction; the 5-minute dispatch interval is expected to be implemented soon
  - Integration of more VRE into the supply pool requires quicker anticipation and more automated control
  - Efficient dispatch means less cost of electricity
- Adapt to and Take Advantage of New Technology
  - Lower cost of electronics means faster processing—an opportunity to pack more intelligence and automation into EMS
  - Greater bandwidth and less latency in IP communications afford access to more network elements, thereby facilitating greater control
- Improve Performance
  - We should tap all available tools within the bounds of economics which will allow us to ensure that service availability and power quality are within performance thresholds
  - EMS is the brain behind an automated Grid management system—there is always room for more intelligence

NGCP's EMS enhancement program was started during the 3rd Regulatory Period driven by the above considerations—following is the development road map:

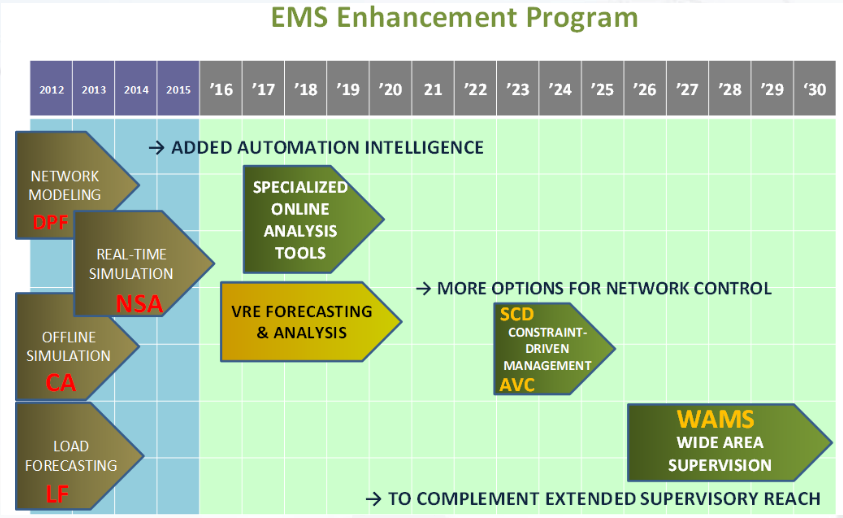


Figure 13.9: EMS Development Road Map

The project is aligned with the overall network development plan aimed to support Market growth and optimization of energy sources, especially the VREs.

13.6.3 Cyber Security

As SCADA and substation automation systems increasingly play a vital role in NGCP as it works towards efficient operations, the need to protect these network elements from unauthorized access and threats becomes an increasingly significant task. The risks of security breaches are great if not attended to properly. Securing these systems, however, is not so simple: these systems are exposed at all times to access by a multitude of personnel and the need for data exchange with other systems requires interconnection to external networks. A comprehensive cyber-security system should be employed to address all possible threats to the system and cyber-security principles shall be considered in all aspects from planning and design to operations and maintenance.

The continuous cyber security implementation and improvement aims to enhance protection of NGCP's facilities from internal and external cyber threats and to prevent unauthorized access of SCADA facilities to ensure utmost degree of security for a more reliable power grid. This is also in compliance with the Department of Information and Communications Technology (DICT) National Cyber Security Plan 2022 wherein Critical Infostructure (CII), including the energy sector, should assure continuous operation and implement cyber resiliency measures to enhance the ability to respond to threats before, during, and after attacks.

Figure 13.10 illustrates the SO ICS network in relation to external domains, while Figure 13.11 shows the typical Cyber Security layers of protection:

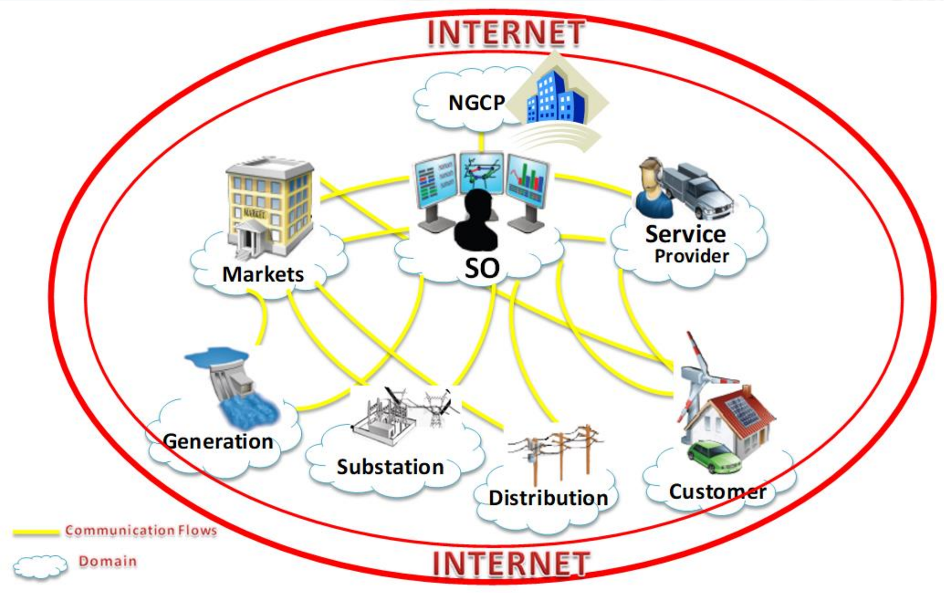


Figure 13.10: SO ICS Network Model

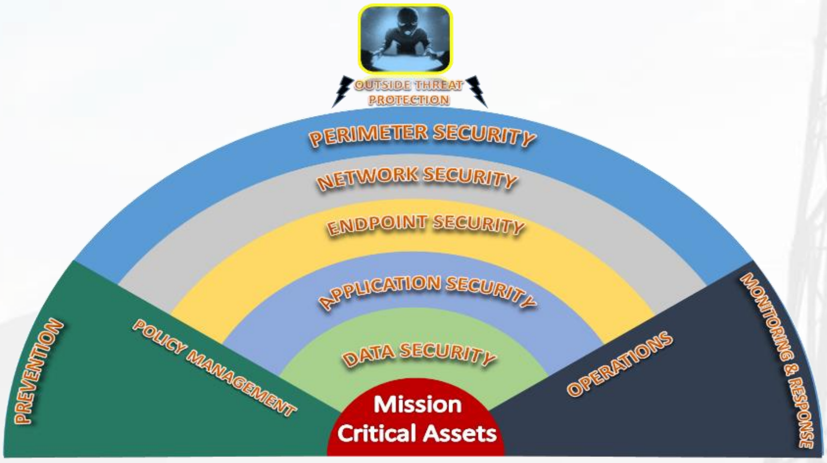


Figure 13.11: Cyber-Security Protection Layers

13.6.4 Real-time Monitoring and Control for Distribution Utilities

The project to install Real-Time Monitoring and Control Equipment for DUs is in compliance with DOE's request for its inclusion in NGCP's 4th Regulatory Period CAPEX program. This is in compliance with the implementation of DOE's Circular No. DC2012-030994 and DC No.2010-08-0010, entitled, "Addressing Power Supply Situation including rationalization of Available Capacities in Mindanao Grid" and "Prescribing the Implementing Rules and Procedures for Department Circular No. DC2010-05-006, entitled, Terminating the Default

Wholesale Supplier Arrangement for Philippine Wholesale Electricity Spot Market (WESM) and Declaring a Disconnection Policy", respectively.

At present, control of NGCP's load customers is up to the substation level only which—while adequate for managing load limits to sustain system stability and power quality—would not allow SO's selective control over the customers connected to one feeder.

Following is an illustration of the proposed installation at each DU's connection point.

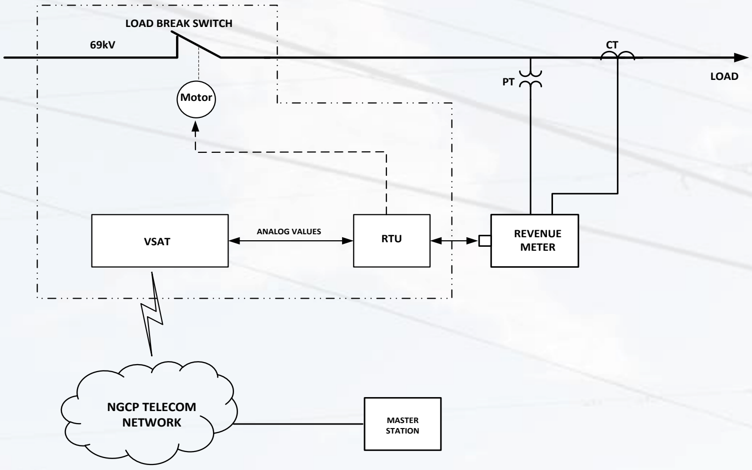


Figure 13.12: Connection Diagram for DUs

The connection diagram shows the wiring linkages of the new system facility including the telecommunication component. These will be remotely monitored and controlled by the master station located in NGCP's control center.

The figure below is an illustration of the physical setup at the customer side.

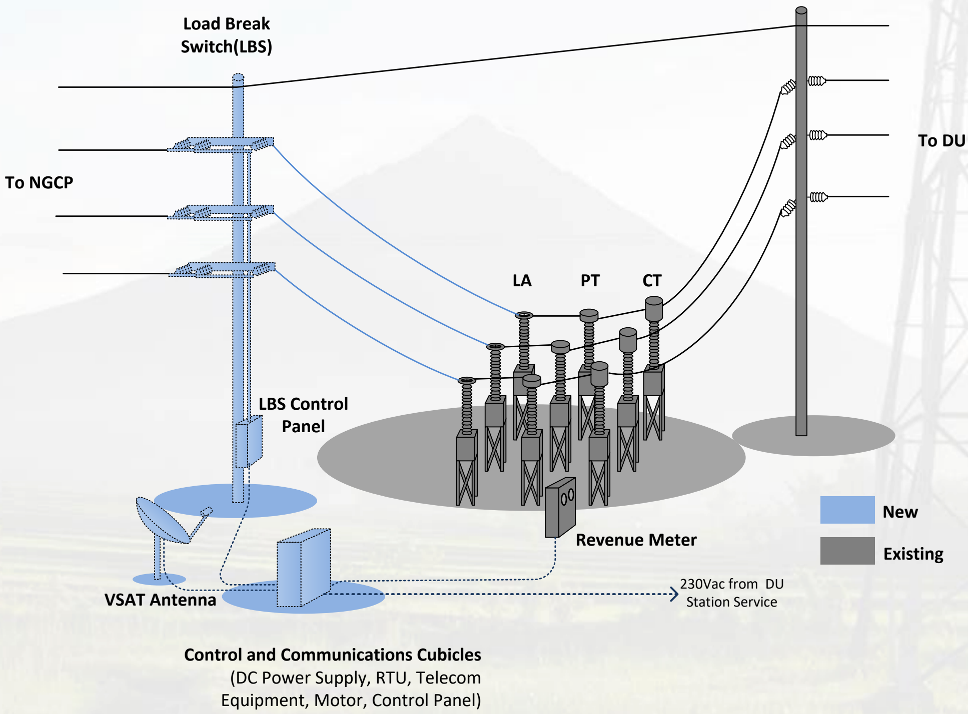


Figure 13.13: Physical Setup for DU Monitoring and Control

13.7 Network Protection and Power Quality

13.7.1 Network Disturbance Monitoring Equipment and Power Quality Analyzer Program

The undesired tripping of transmission lines and high voltage equipment in the grid are sometimes caused by non-operation or malfunction of the fault clearance system. The delay in the resolution of the cause of network failure and subsequent correction of network deficiencies is on account of the non-availability of fault data due to the lack of functional NDME's. Obsolescence and degradation because of age have also lessened the effectiveness of existing NDME's. Sustenance of NDME effectiveness should therefore be addressed through a replenishment program meant to meet outstanding deficiencies in this respect.

Power quality issues are prevalent in connection points along long multi-tap feeders, those subjected to significant supply-demand incongruence between peak and off-peak periods, lines with dynamic power flows, areas with connected inverters such as those used by VRE's and battery energy storage systems as well as nodes which are connected to large non-linear time-varying loads (e.g., steel mills).

NGCP's previous plan was to install PQAs at all NGCP customer connection points. However, an alternate less-costly compliance plan was formulated where PQAs will be installed at the secondary side of transformer which would cover the monitoring of all the connected feeders—reducing the total PQAs for installation. The proposed monitoring scheme is shown in Figure 13.14. The use of portable PQAs for deeper investigation into the customer side would complement this arrangement.

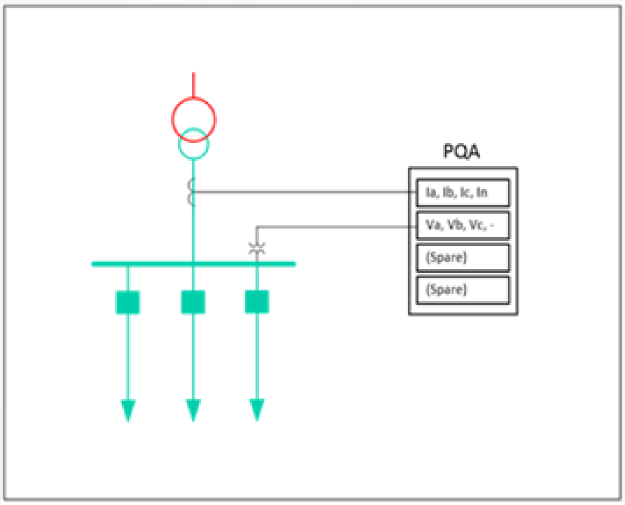


Figure 13.14: PQA installation at the secondary side of transformer

Hand-in-hand with the installation of PQAs is the establishment of a centralized Power Quality Management System (PQMS). With the growing number of installed PQAs, manual processing of PQ data will require extensive effort and become time-consuming. To address this, the proposed PQMS shall be able to manage bulk, raw data coming from different brands of PQAs and will automate report generation in accordance with PGC PQ parameters.

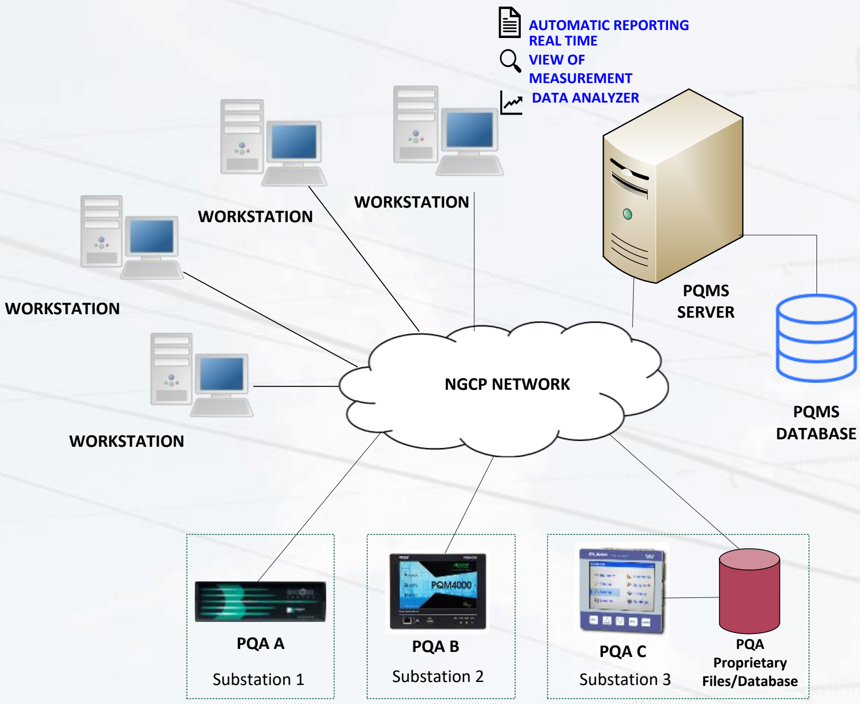


Figure 13.15: Proposed System Architecture

13.7.2 Protection Relay Replacement Program

To meet PGC security and reliability objectives, the fault clearance system needs to be enhanced through the replacement/upgrading of obsolete and defective protective devices and equipment as well as the installation of new protection systems. Aligned with the Smart Grid model, protective relays with enhanced communication systems and more interfacing options shall be incorporated to cover protection of all network elements which include transmission line, transformer, bus, and breaker-fail components. A relay replacement program prioritized according to results of risk assessment is as follows.

Table 13.7
Overall Priority Table for Replay Replacement Program

Category of Replacement	Line Protection	Transformer Protection	Bus Protection	Breaker Fail Protection	Feeder Protection	Reactor Protection	Total
No Main 1	0	0	4	17	0	0	21
No Main 2	0	28	31	n/a	0	0	59
Non-Compliant	169	33	32	39	0	0	273
Obsolete	361	78	52	384	2	10	887
Defective	7	0	0	0	0	0	7
Total	537	139	119	440	2	10	1,247

Appendices

Appendix 1 – NGCP Plans for Procurement of Ancillary Services

a. Background: State of Ancillary Services in the Grid

As System Operator, NGCP determines the levels of Ancillary Services required for each grid based on the results of assessment and simulation studies. These reserve levels which are variable according to network dynamics are meant to meet PGC-prescribed grid reliability and security requirements.

To qualify as provider of Ancillary Services the prospective provider should undergo the certification process defined by the PGC. Subsequently, a certified AS provider would be subject to verification testing no more than once (1) every two (2) years except when there are reasonable grounds to surmise that the prevailing characteristics of the generating unit departs from the as-tested-and-certified values.

Table 1 lists the plants with existing Ancillary Service Procurement Agreement (ASPA); Table 2 lists prospective AS providers not yet certified by NGCP.

Table 1: Plants with existing ASPA

Regulating Reserve		
AS Provider	Firm (MW)	Non-Firm (MW)
Luzon Grid	237	525
PANASIA	60	300
SNAP - Ambuklao	22	
SNAP - Magat	90	90
PSALM/NPC - KPSPP		90
MPPCL AES BESS	20	
PMPC	45	45
Visayas Grid	40	50
GCGI - Palinpinon II		30
EDC - Nasulo		20
SPESCL-Kabankalan BESS	40	
Mindanao Grid	0	165
PSALM/NPC - Agus 1		30
PSALM/NPC - Agus 2		30
PSALM/NPC - Agus 4		40
PSALM/NPC - Pulangui 4		65

Contingency Reserve		
AS Provider	Firm (MW)	Non-Firm (MW)
Luzon Grid	180	395
Panasia - Limay		60
SNAP - Ambuklao	60	
SNAP - Binga		136
SNAP - Magat	60	60
PSALM/NPC - KPSPP		85
Therma Luzon - Pagbilao	60	
First Gen - Pantabangan		54
Visayas Grid	56	86
SIPC - PDPP3		30
CEDC	30	30
PEDC	26	26
Mindanao Grid	0	297
PSALM/NPC - Agus 1		30
PSALM/NPC - Agus 2		30
PSALM/NPC - Agus 4		30
PSALM/NPC - Agus 5		35
PSALM/NPC - Agus 6		30
PSALM/NPC - Agus 7		16
PSALM/NPC - Agus 7		PSALM/NPC - Pulangui 4
TMI (PB107)		48
TMI (PB108)		48

Dispatchable Reserve		
AS Provider	Firm (MW)	Non-Firm (MW)
Luzon Grid	145	901
PANASIA		80
SNAP - Magat		95
TAOEDC - One Subic		108
TAPGC - Bulacan DPP		48
PSALM/NPC - KPSPP		360

Reactive Power Support
AS Provider
Luzon Grid
PANASIA
SNAP - Ambuklao
SNAP - Binga
SNAP - Magat
PSALM/NPC - KPSPP

Black Start Provider
AS Provider
Luzon Grid
PSALM/NPC – KPSPP
First Gen – Pantabangan
SNAP – Ambuklao
SNAP – Binga
SNAP – Magat

1590 EC		190
CIP II		20
Therma Mobile, Inc.	145	
Visayas Grid	83.8	120.4
SIPC - PDPP1		5
SIPC - PDPP3		50
SIPC - BDPP	16	
PHINMA (PB101)		32
PPC - Nabas	6.8	
TPC - Carmen	40	
SIPC - PB104	21	7
CENPRI		26.4
Mindanao Grid	7.5	327.8
TMI (PB107)		98
TMI (PB108)		98
WMPC		100
KEGI 2 - Panaon		15.6
KEGI 3 - Jimenez		16.2

First Gen - Pantabangan
APRI - MakBan A
APRI - MakBan B
Therma Luzon - Pagbilao
Therma Mobile, Inc.
Pagbilao Energy Corp.
Visayas Grid
SIPC - PDPP1
SIPC - PDPP3
PPC - Nabas
TPC - Carmen
CENPRI
Mindanao Grid
PSALM/NPC - Agus 1
PSALM/NPC - Agus 2
PSALM/NPC - Agus 4
PSALM/NPC - Agus 5
PSALM/NPC - Pulangui 4
WMPC
KEGI 2 - Panaon
KEGI 3 - Jimenez

PMPC – Avion
Visayas Grid
SIPC – BDPP
TPC – Carmen
PB104
Mindanao Grid
PSALM/NPC - Pulangui 4
WMPC

Table 2: List of Prospective Ancillary Service Providers not yet certified by NGCP

Company	Power Plant	Remarks
Luzon Grid		
CE Casecnan Water & Energy Co.,Inc	Casecnan Units 1 and 2	For AS testing.
Team Pagbilao Corporation	Pagbilao Unit 3	Certified for CR and RPS; With ASPA for RPS only.
GNPower Mariveles Co. Ltd.	Mariveles CFPP	Certified for CR.
Ingrid Power Holdings Inc.	Malaya Modular Diesel PP	For AS testing.
Bac-Man Geothermal Inc. (BGI)	Bac-Man Units 1, 2 and 3	Certified for BSS.
Visayas Grid		
Therma Visayas, Inc. (TVI)	TVI	Certified for CR and RPS.
Therma Power Visayas, Inc. (TPVI)	TPVI	Certified for DR, RPS, and BSS.
East Asia Utilities Corporation (EAUC)	EAUC	AS Accreditation is pending upon the completion of GCT.
Cebu Private Power Corporation (CPPC)	CPPC	For AS testing.
Green Core Geothermal Inc. (GCGI)	PGPP1	AS Accreditation is pending upon the completion of GCT.
Green Core Geothermal Inc. (GCGI)	TGPP	For AS testing.
Panay Power Corporation	PPC 1 and 2	AS Accreditation is pending upon the completion of GCT.
Isabel Ancillary Services Co. Ltd.	Isabel Modular Diesel PP	Certified for RR and RPS.
Mindanao Grid		
Therma Marine Inc. (TMI)	TMI Mobile 1 and 2	With ASPA for CR and DR. Certified for RPS (M1 & M2); Certified for BSS (M2).
GNPower Kauswagan Ltd. Co	Kauswagan PP	Certified for CR.
Therma South Inc. (TSI)	TSI CFPP	Certified for CR.
King Energy Generation Inc. (KEGI)	KEGI Tandag	ASPA for DR pending issuance of PA by ERC.
Universal Power Solutions, Inc. (UPSI)	Malita BESS	Certified for RR and CR.

b. Plans for the Procurement of Ancillary Services

Because of the limited number of qualified AS providers, as well as restrictions from available generator capacities and response times of these providers, the Grid's reserve level requirements to sustain reliability objectives are not being met. In NGCP's view, if the existing non-firm contracts are supplemented with committed capacities through enough firm contracts, the reserve capacities would be raised to more comfortable levels.

Consistent with the Department of Energy's instruction to NGCP to fully contract all AS capacities with Firm Contracts, NGCP plans to convert all existing non-firm contracts to firm contracts through a public bidding and subsequent procurement will be through DOE's Competitive Selection Process (CSP). In the event that the reserve market will be operational, NGCP will procure all additional capacitites required to fulfill all the required levels of AS in case the contracted capacities are insufficient.

Also, NGCP as the System Operator, conscious of its mandate, ensures that procurement of Ancillary Service is carried out in the least-cost manner. While co-optimization of offered reserves in the energy market would make for efficient energy dispatch, a secondary price cap for reserves—approved by the ERC—would be a welcome cost-control measure.

Appendix 2 – Generation and Load Distribution Per Area

Generation and Load Distribution in the Luzon Grid

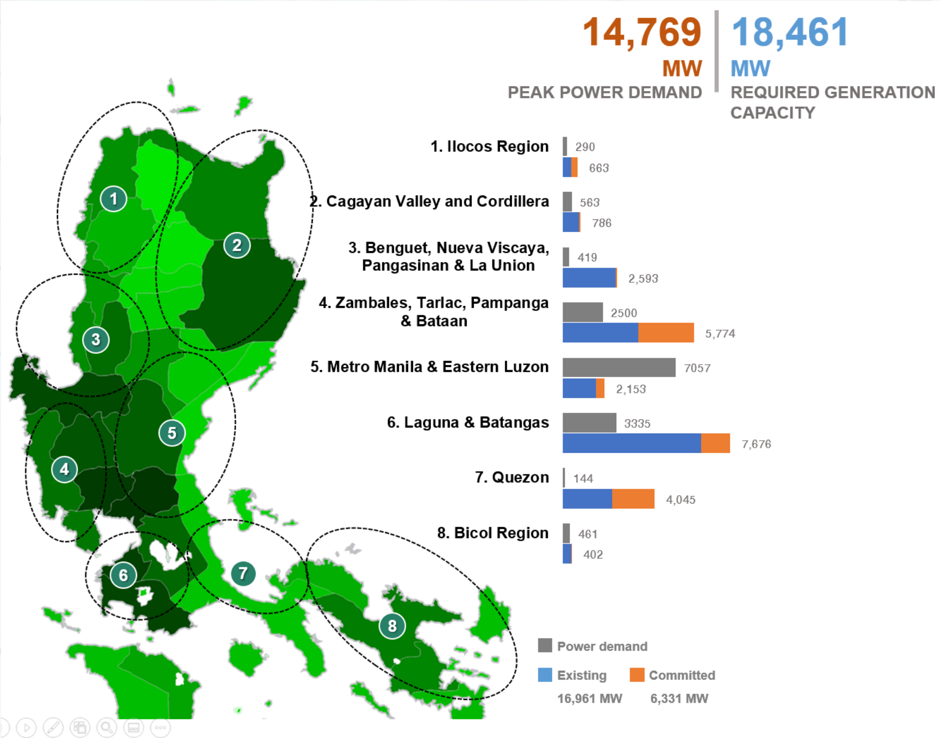


Figure 1 – Projected Luzon Grid Generation and Load Distribution in 2025

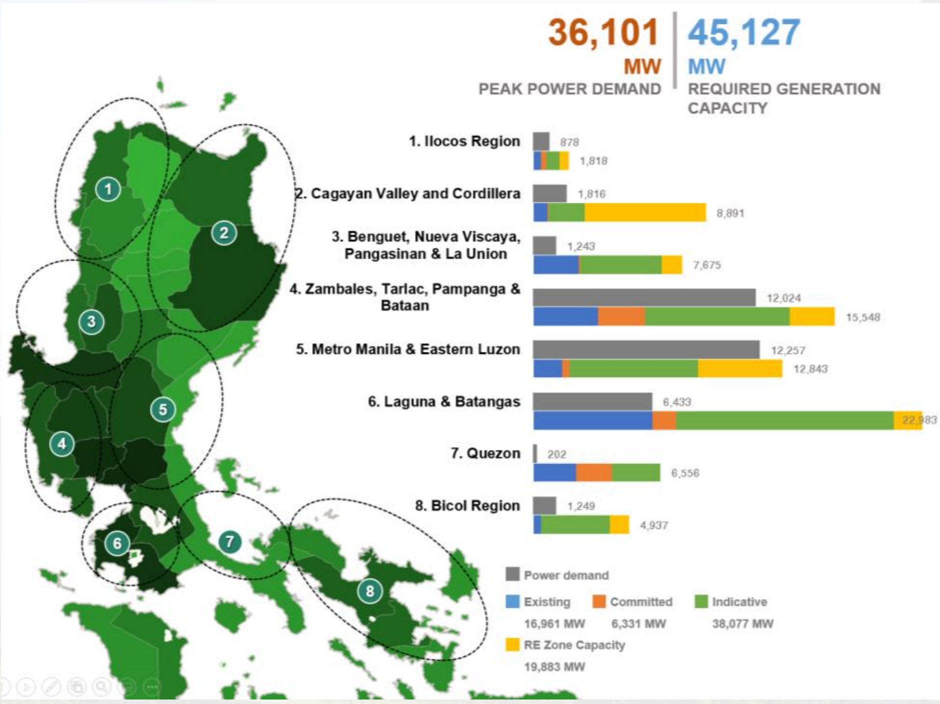


Figure 2 – Projected Luzon Grid Generation and Load Distribution in 2040

Generation and Load Distribution in the Visayas Grid

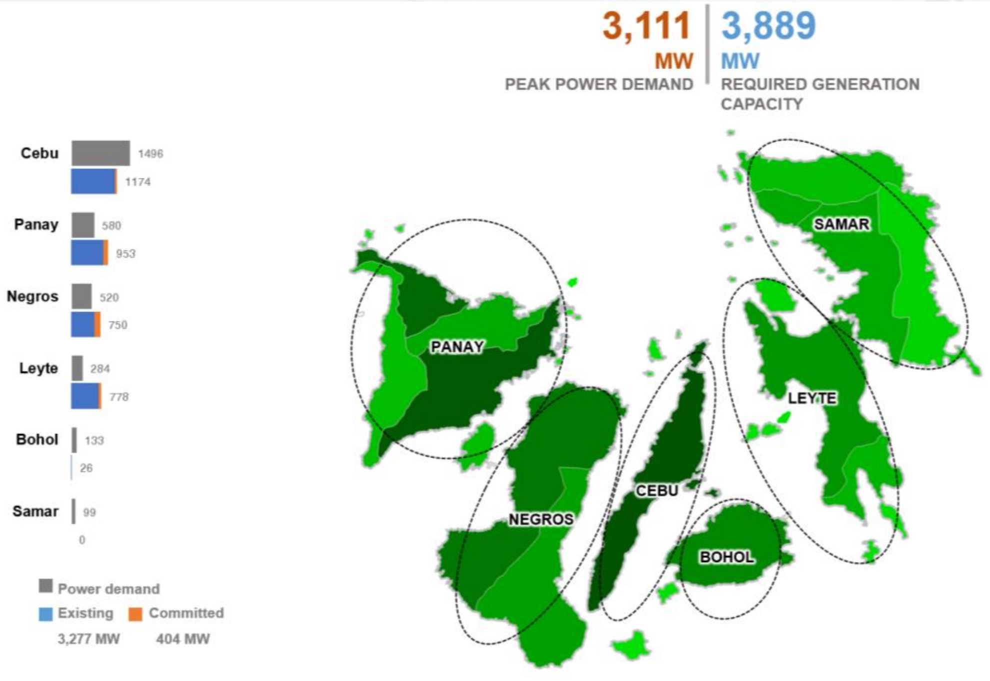


Figure 3 – Projected Visayas Grid Generation and Load Distribution in 2025

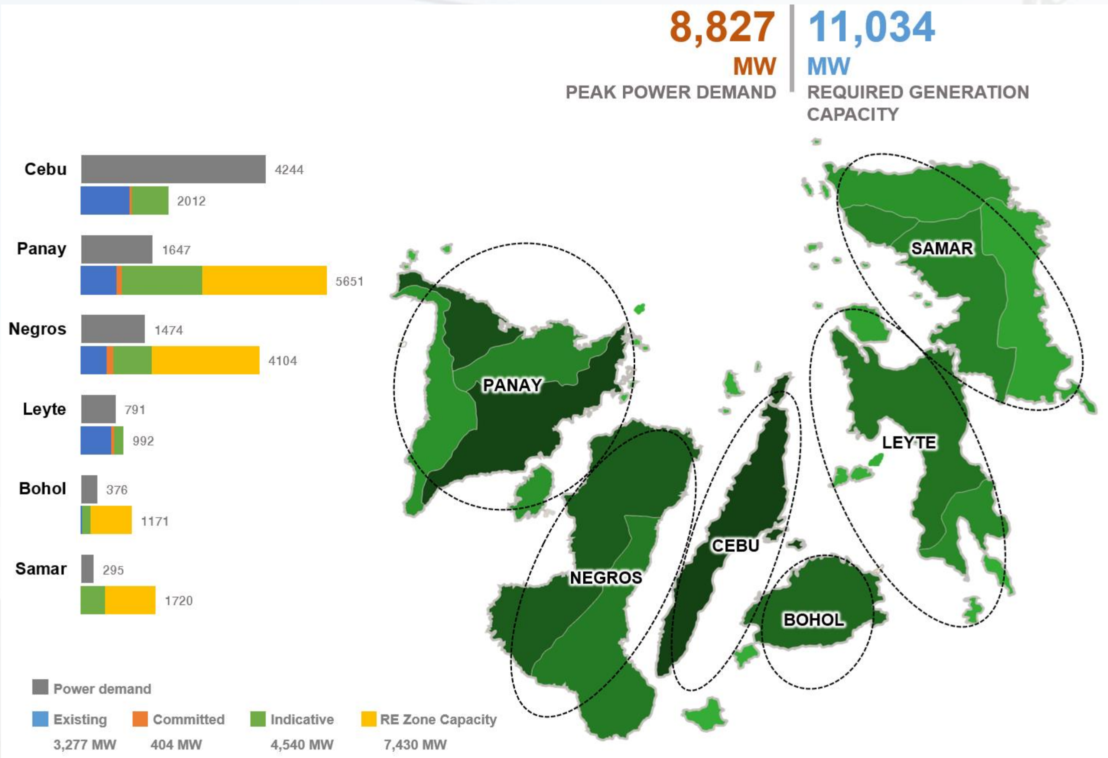


Figure 4 – Projected Visayas Grid Generation and Load Distribution in 2040

Generation and Load Distribution in the Mindanao Grid

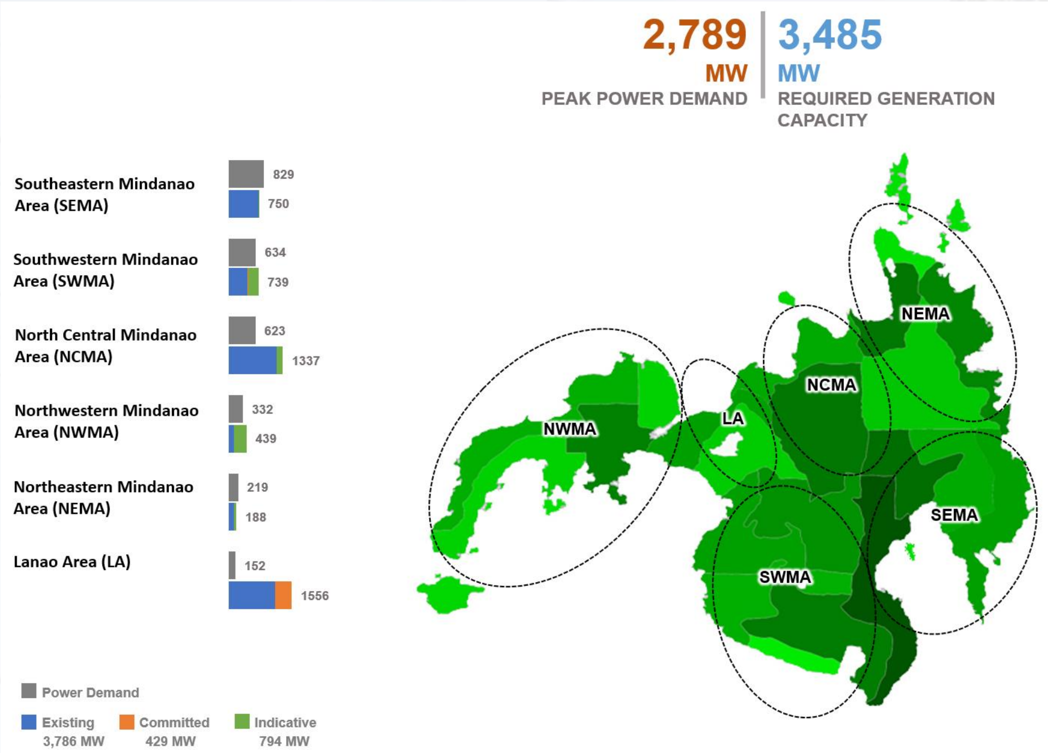


Figure 5 – Projected Mindanao Grid Generation and Load Distribution in 2025

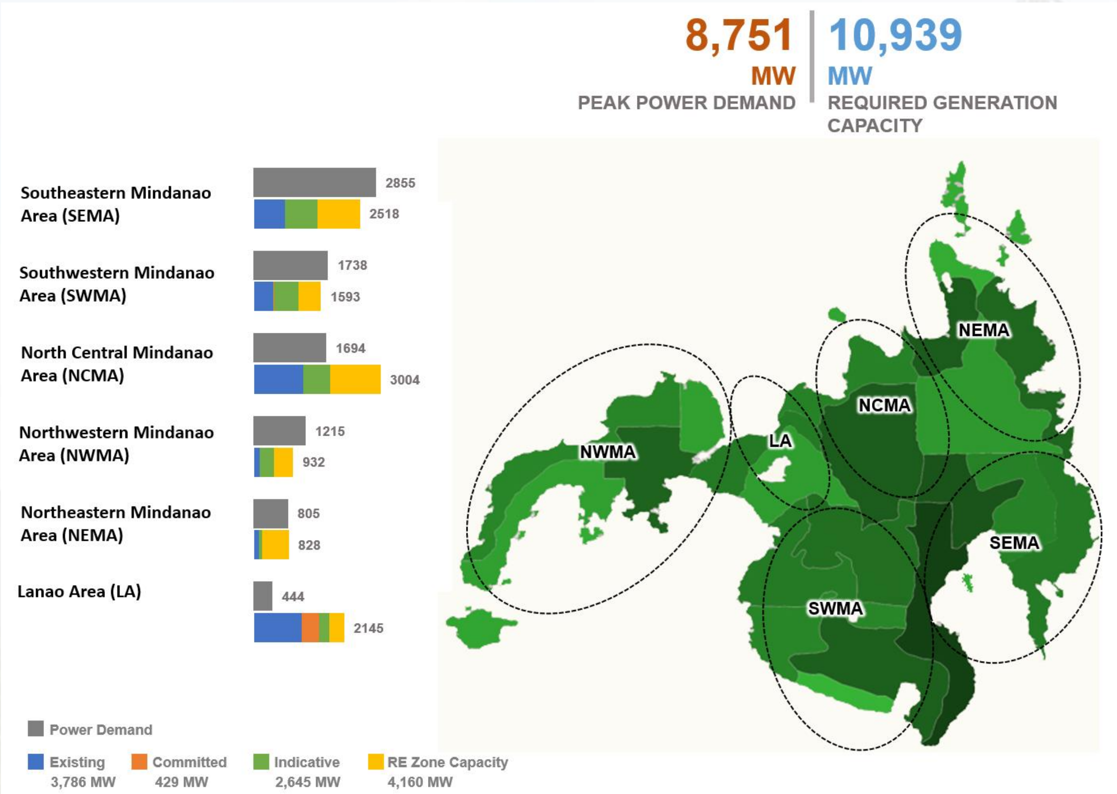


Figure 6 – Projected Mindanao Grid Generation and Load Distribution in 2040

Appendix 3 – Prospective Power Plants

Proponent	Projects	Installed Capacity (MW)	Location
Luzon			
Matuno River Development	Matuno River Hydroelectric Power Plant	8.661	Bambang, Nueva Vizcaya
JBD Management and Consulting Services, Inc	Pakil Pumped Storage Hydroelectric Power Plant	350	Pakil, Laguna
Solar Philippines Tanauan	Maragondon 1 Solar Power Project	1200	Maragondon, Cavite
3 Barracuda Energy Corp	Currimao Energy Storage Project	50	Currimao, Ilocos Norte
Solar Philippines Commercial	SM City Tuguegarao Solar Power Project	5	Tuguegarao, Cagayan
Universal Power Solutions, Inc.	Bacnotan R- HUB	40	Brgy. Cabugao, Bacnotan, La Union
Universal Power Solutions, Inc.	Subic R-HUB	40	Sitio Agusuhin, Cawag, Subic, Zambales
Universal Power Solutions, Inc.	Concepcion	40	Brgy. Sta. Rosa, Concepcion, Tarlac
Universal Power Solutions, Inc.	San Jose R-HUB	40	Brgy. San Jose del Monte City, Bulacan
Universal Power Solutions, Inc.	Bolo R-HUB	40	Brgy. Bolo, Labrador, Pangasinan
Universal Power Solutions, Inc.	Tuguegarao R-HUB	40	Brgy. Libag Norte, Tuguegarao City, Cagayan
Universal Power Solutions, Inc.	Bayombong R-HUB	40	Brgy. Busilac, Bayombong, Nueva Vizcaya
Universal Power Solutions, Inc.	Calamba	40	Brgy. Prinza, Calamba, Laguna
Universal Power Solutions, Inc.	Gumaca R-HUB	40	Brgy. Progreso, Gumaca, Quezon
Universal Power Solutions, Inc.	Labo R-HUB	40	Brgy. Mahawan-hawan, Labo, Camarines Norte
Universal Power Solutions, Inc.	Naga R-HUB	40	Brgy. Del Rosario, Naga, Camarines Sur
Universal Power Solutions, Inc.	Calbayog R-HUB	20	Brgy. Carayman, Calbayog, Samar
Solar Philippines Commercial Rooftop Projects, Inc.	Sta. Rosa Nueva Ecija 3 Solar Power Project	1200	Sta. Rosa and Cabanatuan City, Nueva Ecija
Solar Philippines Commercial Rooftop Projects, Inc.	General Santos Solar Power Project	1200	General Santos, South Cotabato
Solar Philippines Commercial Rooftop Projects, Inc.	Padre Garcia Solar Power Project	1200	Lipa and Padre Garcia Batangas
Sunwest Water and Electric Co.	Daraga Ancillary Reserve Diesel Power Plant	50	Daraga, Albay
Sunwest Water and Electric Co.	Kiwalo Diesel Power Plant	100	Kiwalo, Daraga, Albay
Sunwest Water and Electric Co.	Namantao Diesel Power Plant	50	Daraga, Albay
Excellent Energy Resources Inc.	Ilijan Natural Gas Fired Plant Project	1,200	Brgy. Dela Paz Proper, Batangas City
Greencore Power Solutions 3, Inc.	Arayat Solar Power Plant Project	60 MWp (50 MWac)	Arayat and Mexico, Pampanga
VISAYAS			
SMCGP Philippines Energy Storage Co. Ltd.	Kabankalan Integrated Renewable Power Hub Facility (R-Hub)	20	Kabankalan, Negros Occidental
Triconti Southwind Corporation	Guimaras Strait Wind Power Project	600	Guimaras
Universal Power Solutions, Inc.	Calbayog R-Hub	20	Brgy. Carayman, Calbayog, Samar

Proponent	Projects	Installed Capacity (MW)	Location
MINDANAO			
Villanueva BESS	SMC Global Power Corporation (SMGPC)	20	Villanueva, Misamis Oriental
Malita BESS	SMC Global Power Corporation (SMGPC)	20	Malita, Davao Occidental

Appendix 4 – Private Sector Initiated Power Projects

Table 1: Private Sector Initiated Power Projects in Luzon as of 30 June 2021

Proposed Generation Facility / Name of the Project	Capacity (MW)	Location	Commissioning Year
COMMITTED POWER PLANTS			
COAL			
GNPower Dinginin Supercritical CFPP - Unit 1*	668	Mariveles, Bataan	Ongoing
GNPower Dinginin Supercritical CFPP - Unit 2*	668	Mariveles, Bataan	TBD
Masinloc Power Plant - Unit 4*	350	Masinloc, Zambales	Mar 2024
Masinloc Power Plant - Unit 5*	350	Masinloc, Zambales	Mar 2024
AOE CFPP - Unit 1*	668	Atimonan, Quezon	Jun 2025
AOE CFPP - Unit 2*	668	Atimonan, Quezon	TBD
Refinery Solid Fuel-Fired Boiler Project - Phase 3*	44.4	Brgy. Alangan, Limay, Bataan	May 2022
Sub-Total Coal	**3,416.4**		
OIL-BASED			
11.04 MW Capas Bunker C-Fired DPP*	11.04	Brgy. Sto. Rosario, Capas, Tarlac	Mar 2022
Ingrid Pillila DPP Project - Phase 1*	179.82	Brgy. Malaya, Pililia, Rizal	Jun 2021
Ingrid Pillila DPP Project - Phase 2*	150	Brgy. Malaya, Pililia, Rizal	Jun 2024
Sub-Total Oil-based	**340.86**		
NATURAL GAS			
Energy World Corporation 650 MW Gas Fired CCPP*	650	Brgy. Ibabang Polo, Grande Island, Pagbilao, Quezon	Dec 2022
Batangas CCPP - Phase 1, Unit 1*	437.5	Brgy. Dela Paz Proper, Batangas City	Sep 2023
Batangas CCPP - Phase 1, Unit 2*	437.5	Brgy. Dela Paz Proper, Batangas City	Mar 2024
Batangas CCPP - Phase 1, Unit 3*	437.5	Brgy. Dela Paz Proper, Batangas City	Jun 2024
Batangas CCPP - Phase 2	437.5	Brgy. Dela Paz Proper, Batangas City	TBD
Sub-Total Natural Gas	**2,400**		
GEOTHERMAL			
Montelago GPP Project - Phase 1	3	Naujan, Oriental Mindoro	Sep 2021
Montelago GPP Project - Phase 2	10	Naujan, Oriental Mindoro	Dec 2023
Palayan Binary Power Plant*	29	Brgy. Nagotgot, Manito, Albay	Dec 2022
Tanawon GPP*	20	Sorsogon Province	Dec 2023
Sub-Total Geothermal	**62**		
HYDRO			
Man-Asok HEPP*	3	Buguias, Benguet	Dec 2021
Colasi HEPP	4	Mercedes, Camarines Norte	Dec 2021
Labayat River (Upper Cascade) HEPP*	3.46	Real, Quezon	Dec 2021
Butao Irrigation Drop HEPP	1.3	San Manuel, Pangasinan	Dec 2021
Matuno HEPP*	8	Bambang, Nueva Vizcaya	Dec 2021
Lalawinan HEPP*	3	Real, Quezon	Dec 2021
Biyao HEPP	0.8	Balbalan, Kalinga	Dec 2021
Laguio (Laginbayan) Malaki 1 HEPP	1.6	Mauban, Quezon	Dec 2021
Tubao HEPP	1.5	Tubao, La Union	Dec 2022
Labayat River (Lower Cascade) HEPP*	1.4	Real, Quezon	Dec 2022
Tibag HEPP*	4.4	Real, Quezon	Dec 2022
Rangas HEPP	1.5	Goa & Tigaon, Camarines Sur	Dec 2022
Ibulao HEPP*	4.5	Lagawe, Ifugao	Dec 2022
Dupinga HEPP	4.8	Gabaldon, Nueva Ecija	Dec 2023
Kapangan HEPP*	60	Kapangan and Kibungan, Benguet	Dec 2023
Piapi HEPP*	3.3	Real, Quezon	Dec 2023
Daet HEPP	5	Daet, Camarines Norte	Dec 2024
Tignoan River (Upper Cascade) HEPP*	1.5	Real, Quezon	Dec 2025
Sub-Total Hydro	**113.06**		
BIOMASS			
Isabela Rice Husk-Fired Biomass Power Plant Project	5	Isabela	Sep 2021
2.4 MW Biogas Power Plant Project	2.4	Apalit, Pampanga	Dec 2021
12 MW Rice Husk-Fired Biomass Power Plant Project	12	Bocaue, Bulacan	Dec 2021

Proposed Generation Facility / Name of the Project	Capacity (MW)	Location	Commissioning Year
1.2 MW Biogas Power Plant Project	1.2	Candelaria, Quezon	Dec 2021
3.5 MW Biomass Power Plant Project	3.5	Brooke's Point, Palawan	Dec 2022
8 MW Biomass Power Plant Project	8	Pinamalayan, Oriental Mindoro	Dec 2025
Sub-Total Biomass	**32.1**		
SOLAR			
Bataan Solar Power Project Phases 1, 2, 3a, and 3b	100.459	Hermosa, Bataan	Feb 2022
Concepcion 1 Solar Power Project	115	Concepcion, Tarlac	Oct 2022
Ilocos Norte Solar Power Project*	100.099	Burgos, Ilocos Norte	Aug 2021
Gigasol3 Solar Power Project*	63.01	Barrio Salaza, Palauig, Zambales	Nov 2022
Sta. Barbara Solar Power Project	20	Mapandan and Santa Barbara, Pangasinan	Jan 2022
SIAEP Rooftop Solar Project	0.5	Mabalacat City, Pampanga	Dec 2021
Bataan Solar Power Project	4.377	Mariveles, Bataan	Dec 2021
Bulacan 2 Solar Power Project*	22.004	Brgy. Casalat and Brgy. Pasong Bangkal, San Ildefonso, Bulacan	Sep 2021
Tarlac Solar Power Project Phase 2*	20	Tarlac City	Dec 2022
Alaminos Solar Power Plant	120.32	Alaminos, Laguna	May 2021
Sub-Total Solar	**565.76**		
BATTERY			
San Manuel BESS*	20	San Manuel, Pangasinan	Aug 2021
San Manuel BESS Phase 2*	40	San Manuel, Pangasinan	Aug 2021
Bauang BESS*	40	Bauang, La Union	Sep 2022
Labrador BESS Project	40	Labrador, Pangasinan	Sep 2022
San Rafael BESS*	20	San Rafael, Bulacan	Sep 2022
San Rafael BESS Phase 2	20	San Rafael, Bulacan	Sep 2023
Gamu BESS*	20	Gamu, Isabela	Aug 2021
Gamu BESS Phase 2*	40	Gamu, Isabela	Aug 2021
Magapit BESS*	20	Magapit, Cagayan	Aug 2021
Magapit BESS Phase 2*	20	Magapit, Cagayan	Aug 2021
Concepcion BESS*	20	Concepcion, Tarlac	Aug 2021
Concepcion BESS Phase 2*	40	Concepcion, Tarlac	Aug 2021
Lumban BESS*	40	Lumban, Laguna	Nov 2021
Lumban BESS Phase 2*	20	Lumban, Laguna	Nov 2021
Pampanga BESS*	40	Mexico, Pampanga	Mar 2022
Pampanga BESS Phase 2*	20	Mexico, Pampanga	Mar 2022
Pagbilao BESS	40	Pagbilao, Quezon	Sep 2023
Sual BESS	60	Sual, Pangasinan	Sep 2023
Cabanatuan BESS	40	Cabanatuan, Nueva Ecija	Sep 2022
Urdaneta BESS	40	Urdaneta, Pangasinan	Sep 2023
Mahabang Parang BESS	40	Mahabang Parang, Batangas	Apr 2022
Dasmarinas BESS	40	Dasmarinas, Cavite	Sep 2023
Ilijan BESS Project	40	Ilijan, Batangas	Sep 2023
Hermosa BESS Project	40	Hermosa, Bataan	Sep 2023
Bacnotan BESS Project	40	Brgy. Cabugao, Bacnotan, La Union	Sep 2023
Subic BESS Project	40	Sitio Agusuhin, Cawag, Subic, Zambales	Sep 2023
San Jose BESS Project	40	Brgy. San Jose del Monte City, Bulacan	Sep 2023
Bolo BESS Project	40	Brgy. Bolo, Labrador, Pangasinan	Sep 2023
Tuguegarao BESS Project	40	Brgy. Libag Norte, Tuguegarao City, Cagayan	Sep 2023
Bayombong BESS Project	40	Brgy. Busilac, Bayombong, Nueva Vizcaya	Sep 2023
Calamba BESS Project	40	Brgy. Prinza, Calamba, Laguna	Sep 2023
Gumaca BESS Project	40	Brgy. Progreso, Gumaca, Quezon	Sep 2023
Labo BESS Project	40	Brgy. Mahawan-hawan, Labo, Camarines Norte	Sep 2023
Naga BESS Project	40	Brgy. Del Rosario, Naga, Camarines Sur	Sep 2023
La Trinidad BESS Project	40	Beckel, La Trinidad, Benguet	Sep 2023
Limay BESS Project*	20	Brgy. Lamao, Limay, Bataan	Jul 2021
Limay BESS Project Phase 2	40	Brgy. Lamao, Limay, Bataan	Jul 2021
BCCP Limay BESS Project	40	BCCPP, Limay, Bataan	Jul 2021
BCCP Limay BESS Project Phase 2	20	BCCPP, Limay, Bataan	Sep 2023

Proposed Generation Facility / Name of the Project	Capacity (MW)	Location	Commissioning Year
Albay BESS Project	40	Daraga, Albay	Jun 2022
Laoag BESS Project*	40	Laoag, Ilocos Norte	Sep 2022
Navotas BESS Project*	40	Navotas, Metro Manila	Sep 2022
Angat BESS Project*	20	Angat, Bulacan	Sep 2022
Alaminos BESS*	40	Brgy. San Andres, Alaminos, Laguna	Sep 2021
Sub-Total BESS	**1,540**		
TOTAL COMMITTED	8470.18		
TOTAL COMMITTED W/O BESS	6,930.18		

* with SIS

INDICATIVE POWER PLANTS			
COAL			
SMC Mariveles CFPP - Unit 1*	150	Mariveles, Bataan	Mar 2022
SMC Mariveles CFPP - Unit 2*	150	Mariveles, Bataan	Sep 2022
SMC Mariveles CFPP - Unit 3*	150	Mariveles, Bataan	Dec 2022
SMC Mariveles CFPP - Unit 4*	150	Mariveles, Bataan	Mar 2023
H & WB PCB Supercritical CFPP - Unit 1*	350	Jose Panganiban, Camarines Norte	2028
H & WB PCB Supercritical CFPP - Unit 2*	350	Jose Panganiban, Camarines Norte	TBD
KEPCO Pangasinan CFPP - Unit 1*	500	Sual, Pangasinan	Mar 2025
KEPCO Pangasinan CFPP - Unit 2*	500	Sual, Pangasinan	Dec 2025
SRPGC CFPP Project*	350	Brgy. San Rafael, Calaca, Batangas	Jun 2025
SRPGC CFPP Project*	350	Brgy. San Rafael, Calaca, Batangas	Jun 2025
Global Luzon CFPP*	670	Brgys. Carisquis and Nalvo Sur, Luna, La Union	TBD
Sub-Total Coal	**3,670**		
OIL-BASED			
Kiwalo Ancillary Reserve DPP*	100	Brgy. Kiwalo, Daraga, Albay	Aug 2021
Namantao Ancillary Reserve DPP*	50	Brgy. Namantao , Daraga, Albay	Aug 2021
Ingrid2 Dual-Fired Power Plant Project*	300	Brgy, Batangas II, Mariveles, Bataan	Jun 2024
Sub-Total Oil-Based	**450**		
NATURAL GAS			
Lloyds Energy Philippines Inc. Floating Power Plant	1,200	San Pascual, Batangas Bay	Jan 2022
GNPower Sisiman LNG CCPP	1,200	Barangays Alas-asin and Sisiman, Mariveles, Bataan	Jun 2027
Natural Gas-Fired Power Plant	1,100	Pinamucan Ibaba, Batangas City	Mar 2025
Mariveles Gas to Power Project (Mariveles LNG)	1,200	Brgy. Biaan, Mariveles, Bataan	Mar 2026
Stellar Dual-Fired Power Plant Project	1,250	Brgy. Libjo and Malitam, Batangas City	Sep 2024
Sub-Total Natural Gas	**5,950**		
GEOTHERMAL			
Kalinga GPP - Phase 1*	40	Lubuagan, Pasil and Tinglayan, Kalinga	2027
Kalinga GPP - Phase 2*	40	Lubuagan, Pasil and Tinglayan, Kalinga	2029
Kalinga GPP - Phase 3*	40	Lubuagan, Pasil and Tinglayan, Kalinga	2031
Maibarara3 GPP	20	Laguna/Batangas	2025
Bacman 4 Botong - Rangas GPP	20	Bacon District, Sorsogon, Sorsogon City	2026
Kayabon GPP	30	Manito, Albay	2026
Sub-Total Geothermal	**190**		
HYDRO			
Lamut HEPP*	6.8	Asipulo, Ifugao	Dec 2022
Mariveles HEPP	0.52	Mariveles, Bataan	Dec 2022
Talubin HEPP	5.4	Bontoc, Mountain Province	Dec 2022
Camiling 1 HEPP	7	Mayantoc, Tarlac	Dec 2023
Matibuey HEPP	16	San Emilio, Ilocos Sur	Dec 2023
Pinacanauan River HEPP	6	Peñablanca, Cagayan	Dec 2023
Pasil C HEPP	9.75	Pasil, Kalinga	Dec 2024
Chico River HEPP*	52	Tabuk, Kalinga	Dec 2024
Coto 1 HEPP*	9	Masinloc, Zambales	Dec 2024
Ibulao 2 HEPP*	7.4	Lagawe, Ifugao	Dec 2024
Lower Siffu HEPP	3	Natonin, Mt. Province	Dec 2024
Matuno 1 HEPP*	7.4	Ambaguio, Nueva Vizcaya	Dec 2024

Proposed Generation Facility / Name of the Project	Capacity (MW)	Location	Commissioning Year
Matuno 2 HEPP*	15	Ambaguio, Nueva Vizcaya	Dec 2024
Olilicon HEPP*	20	Ilagan, Ifugao	Dec 2024
Pampang HEPP*	26	Sta. Fe Nueva Vizcaya	Dec 2024
Pasil B HEPP	15.68	Pasil, Kalinga	Dec 2024
Tignoan (Lower) HEPP*	8	Real, Quezon	Dec 2024
Upper Siffu HEPP	2.75	Natonin, Mt. Province	Dec 2024
ARIIS 1 (NIA Station 4+283) HEPP	0.67	San Manuel, Pangasinan	Dec 2025
ARIIS 2 (NIA Stn 5+437.50) HEPP	0.48	San Manuel, Pangasinan	Dec 2025
ARIIS 3 (NIA Stn 5+898.50) HEPP	0.48	San Manuel, Pangasinan	Dec 2025
ARIIS 4 (Stn 4+808) HEPP	0.68	San Manuel, Pangasinan	Dec 2025
Bacolan HEPP	3	San Clemente, Tarlac & Mangatarem, Pangasinan	Dec 2025
Boga HEPP	1	Bauko, Mt. Province	Dec 2025
Calanan HEPP*	60	Tabuk, Kalinga	Dec 2025
Camiling 3 HEPP	4.2	Mayantoc, Tarlac	Dec 2025
Coto 2 HEPP	3.5	Masinloc, Zambales	Dec 2025
Dalimuno HEPP*	58	Tabuk, Kalinga	Dec 2025
Ilaguen HEPP*	19	Echague, Isabela	Dec 2025
Kabayan 2 HEPP*	52	Kabayan, Benguet	Dec 2025
Lower Chico HEPP	2.1	Bauko, Mountain Province	Dec 2025
Sablan 1 HEPP*	20	Sablan and La Trinidad Benguet	Dec 2025
Tinoc 1 HEPP	3	Tinoc, Ifugao	Dec 2025
Tumauini (Upper Cascade) HEPP	14	Tumauini, Isabela	Dec 2025
Upper Chico HEPP	2	Bauko, Mountain Province	Dec 2025
Alimit HEPP	120	Lagawe, Ifugao	Dec 2026
Asin HEPP	7.04	Kiangan, Ifugao	Dec 2026
Baua 1 HEPP	4.44	Gonzaga, Cagayan	Dec 2026
Hungduan HEPP	4.04	Kiangan, Ifugao	Dec 2026
Ibulao 1 HEPP	6.75	Lagawe, Ifugao	Dec 2026
Ilaguen 2 HEPP*	14	Echague, Isabela	Dec 2026
Ilaguen 3 HEPP*	25.7	Echague, Isabela	Dec 2026
Nabuangan Run-of-River HEP	10	Conner, Apayao	Dec 2026
Rizal Run-of-River HEPP	10	San Guillermo, Isabela	Dec 2026
Santol-Sugpon HEPP	52	Sugpon, Ilocos Sur	Dec 2028
Tinglayan HEPP	4.8	Tinglayan, Kalinga	Dec 2026
Upper Nabuangan HEPP	10	Conner, Apayao	Dec 2026
Wawa Pumped Storage 1 HEPP*	500	Rodriguez, Rizal	Dec 2026
Wawa Pumped Storage 2 HEPP	100	Rodriguez, Rizal	Dec 2026
Wawa Pumped Storage 3 HEPP	50	Rodriguez, Rizal	Dec 2026
Camiling 2 HEPP	4	Mayantoc, Tarlac	Dec 2027
Alimit-Pumped Storage HEPP	250	Lagawe & Mayoyao, Ifugao	Dec 2028
Gened - 2 HEPP	50	Kabugao, Apayao	Dec 2028
Pantabangan (Pump Storage) HEPP	600	Pantabangan, Nueva Ecija	Dec 2029
Aoan HEPP	50	Calanasan, Apayao	Dec 2030
Kibungan HEPP*	1,000	Kibungan, Benguet	Dec 2030
Pakil Pump Storage HEPP	350	Pakil and Paete Laguna	Dec 2030
San Roque Upper East Pump Storage HEPP	600	Itogon, Benguet	Dec 2030
San Roque West Pump Storage HEPP	400	Itogon, Benguet	Dec 2030
Dingalan Pumped Storage HEPP	500	Dingalan, Aurora	Dec 2032
Sub-Total Hydro	**5,184.59**		
BIOMASS			
Santa Biomass Power Project*	10	Brgy. Nagpanaoan, Santa, Ilocos Sur	Dec 2024
Polillo Biomass Power Plant Project	1.5	Quezon	Feb 2022
Green Atom Pampanga Waste to Energy Project	12	Mabalacat City, Pampanga	Jun 2022
Green Atom Pangasinan Waste to Energy Project	6	Laoac, Pangasinan	Mar 2023
3.78 MW Biomass Power Plant Project	3.78	Bacnotan, La Union	Dec 2024
6 MW Biomass Power Plant Project	6	San Jose, Occidental Mindoro	Dec 2022
11.1 MW Waste-to-Energy Power Plant Project	11.1	Angeles City, Pampanga	Dec 2022

Proposed Generation Facility / Name of the Project	Capacity (MW)	Location	Commissioning Year
6.957 MW Baguio Waste-to-Energy Plant Project	6.6	Baguio City, Benguet	Feb 2026
Sub-Total Biomass	**56.98**		
SOLAR			
San Jose Solar Power Project*	10	San Jose City, Nueva Ecija	2022
San Manuel 1 Solar Power Project	70	San Manuel, Pangasinan	2024
San Ildefonso Solar Power Project	140	San Ildefonso, Bulacan	2024
Iba-Palauig 2 Solar Power Project	1,200	Iba-Palauig, Zambales	2024
Santa Solar Power Project*	20	Santa, Ilocos Sur	Aug 2023
Malvar Solar Power Project	3	Malvar, Batangas	2024
Bugallon Solar Power Plant	1.03	Bugallon & San Carlos City, Pangasinan	2024
San Manuel 2 Solar Power Project	70	San Manuel, Pangasinan	2024
Raslag III Solar PV Power Project*	18.01	Mabalacat, Pampanga	2027
Balayan Solar Power Project	600	Balayan & Calaca, Batangas	2024
San Rafael 1 Solar Power Project*	140	San Rafael, Bulacan	2025
Cabanatuan Solar Power Plant	6.25	Cabanatuan City and Laur, Nueva Ecija	2025
Labrador Solar Power Project	5	Labrador, Pangasinan	2025
Limbauan Solar Power Project	25	San Pablo and Cabagan, Isabela	2024
Sta. Maria Solar Power Project*	30	Sta. Maria, Isabela	2023
Talugtug Solar PV Power Project	125	Muñoz and Lupao, Nueva Ecija	2023
Capas Solar PV Power Project*	27.56	Clark Green City, Capas, Tarlac	Jan 2022
Calamba - Tanauan Solar Power Project	100	Calamba, Laguna and Tanauan, Batangas	2024
Bato (formerly applied as Bulawen) Solar Power Project	35.5	Palauig, Zambales	2022
San Pablo Solar Power Project	130	San Pablo, Isabela	2024
1 MWp Anda Solar Power Project	1	Brgy Poblacion, Anda, Pangasinan	2026
74.131 MWp / 51.555 MW Calabanga Solar Power Project*	74.131	Calabanga, Camarines Sur	Apr 2023
Rizal Floating Solar Project	150	Laguna de Bay and Pililla, Rizal	Dec 2026
Arayat Solar Power Project	60	Arayat, Pampanga	Dec 2026
64.260 MWp/48.118 MW Currimao Solar Power Project	48.118	Currimao, Ilocos Norte	Aug 2023
Palauig Solar Power Project*	50	Iba-Palauig, Zambales	Oct 2026
SM City Tuguegarao Solar Power Project	5	Tuguegarao City, Cagayan	Dec 2026
98.136 MWp/81.780MW Laoag Solar Power Project	98.136	Laoag,Aguilar, Pangasinan	Jun 2025
Palawan Solar Power Project	25.02	Roxas and San Vicente, Palawan	Dec 2021
Santa Rosa Nueva Ecija 2 Solar Power Project	150	Santa Rosa, Peñaranda and San Leonardo, Nueva Ecija	2024
Currimao Solar Power Project	1	Currimao, Ilocos Norte	2026
San Pedro Floating Solar Power Project	250	Muntinlupa City, Manila	Dec 2026
Naga Solar Power Project	TBD	Pili and Naga City, Camarines Sur	Dec 2026
Lal-lo Solar Power Project	110.703	Brgy. Maxingal, Lal-lo, Cagayan	Jan 2028
Subic New PV Solar Power Plant Project	100.034	Morong and Hermosa, Bataan	Feb 2028
Sulvec Solar Power Plant	20	Narvacan, Ilocos Sur	2024
Padre Garcia Solar Power Project (formerly Bawi Solar Power Project)*	45	Lipa City & Padre Garcia, Batangas	2024
Maragondon-Naic-Tanza 2 Solar Power Project	200	Naic and Tanza, Cavite	2024
Luntal-Bayudbod Solar Power Project	62.5	Tuy, Batangas	2027
Cagayan Valley Solar Power Project	50	Cauayan City, Alicia, Angadanan, Isabela	Nov 2026
Central Luzon State University Rooftop Solar Power Project	0.977	Munoz City and San Jose, Nueva Ecija	Dec 2026
Binalonan Solar Power Project	46.09	Sison and Binalonan, Pangasinan	Nov 2026
Padre Garcia Solar Power Project	1,68	Padre Garcia, Batangas	Dec 2026
Calamba-Tanauan 2 Solar Power Project	1,68	Calamba City, Laguna and Tanauan City, Batangas	Dec 2026
San Jose Solar Power Project*	10	San Jose City & Lupao, Nueva Ecija	Aug 2022
Taguig Floating Solar Power Project	TBD	Taguig City, Taguig	2026
Cordon Solar PV Power Project*	50	Cordon, Isabela	Dec 2022
Ilagan City Solar Power Project	100	Ilagan City, Isabela	May 2023

Proposed Generation Facility / Name of the Project	Capacity (MW)	Location	Commissioning Year
Bongabon Solar Power Project	22	Bongabon, Nueva Ecija	Nov 2021
Laguna Bay 2 Solar Power Project	TBD	Pililla and Laguna de Bay, Rizal	Oct 2024
Sta Rosa Nueva Ecija 1 Solar Power Project	100	Santa Rosa and Peñaranda, Laguna	Apr 2026
Ramon Solar Power Project	6.496	Ramon & Santiago, Isabela	May 2022
Isabela Solar Power Project	18	Reina Mercedes and Luna, Isabela	Jul 2021
Sabang Solar Power Project	50.47	Naic and Tanza, Cavite	2025
Botolan Solar Power Project*	39.27	Botolan, Zambales	Mar 2022
Clark Solar Power Project*	35	Clark International Airport, Mabalacat, Pampanga	2024
San Jose del Monte Solar Power Project*	80	San Jose del Monte, Bulacan	2023
Lal-lo Hybrid Solar Power Project	100	Lal-lo and Gattaran, Cagayan	2023
Iba Palauig 1 Solar Power Project	1,200	Iba and Palauig, Zambales	2024
Cabatang Tiaong Solar Power Project	600	Cabatang, Taiong, Quezon	2026
Maragondon 1 Solar Power Project	60.01	Maragondon and General Emilio Aguinaldo, Cavite	2026
San Ildefonso Solar Power Project*	55	San Ildefonso, Bulacan	2026
Kananga-Ormoc Solar Power Project	1,200	Kananga and Ormoc City, Leyte	2026
Victorias Solar Power Project	30.63	Brgy. XII, Victorias City, Negros Occidental	2022
Sub-Total Solar	**11,420.94**		
WIND			
Matnog 1 Wind Power Project*	153	Matnog, Sorsogon	2022
Matnog 2 Wind Power Project	206	Matnog, Sorsogon	2022
Matnog 3 Wind Power Project	206	Matnog, Sorsogon	2022
Tanay Wind Power Project	96	Antipolo and Tanay, Rizal	2025
Pagudpud Wind Power Project*	84	Brgy. Balaoi and Caunayan, Pagudpud, Ilocos Norte	2024
Burgos 2 Wind Power Project	183	Burgos, Ilocos Norte	2021
Sembrano Wind Power Project (Formerly: Phase 2: Mabitac Wind Power Project)	80.4	Mt. Sembrano, Mabitac, Laguna	Dec 2021
Balaoi Wind Power Project	45	Brgy. Balaoi, Pagudpud, Ilocos Norte	Oct 2021
Talim Wind Power Project	198	Rizal	2023
Rizal Wind Power Project	603	Antipolo and Tanay, Rizal	2027
Camarines Sur Wind Power Project	71.4	Mt. Bernacci, Libmanan, Camarines Sur	Nov 2023
Presentacion Wind Power Plant	42	Presentacion and Garchitorena	2029
Sanchez Mira Wind Power Project	50	Sanchez Mira, Cagayan	Dec 2022
Real Wind Power Project	250	Real, Quezon	2022
Calatagan Wind Power Project	200	Calatagan and Balayan, Batangas	2022
Frontera Bay (Offshore) Wind Power Project	450	Offshore of Cavite Province	2029
San Miguel Bay (Offshore) Wind Power Project	600	Offshore of Camarines Norte/Sur Provinces	2029
Real Ace Wind Power Project	175	Province of Quezon	2029
Quezon II Plaridel Wind Power Project	50	Plaridel and Atimonan, Quezon	2026
Aguilar Wind Power Project	99	Bugallon and Aguilar Pangasinan	Dec 2027
Presentacion 2 Wind Power Project	54	Presentacion, Camarines Sur	Dec 2027
Kalayaan 2 Wind Power Project*	100	Pakil, Paete and Kalayaan, Laguna and Mauban, Quezon	Dec 2027
Sub-Total Wind	**3,995.8**		
BATTERY			
Magat BESS*	20	Ramon, Isabela	Sep 2022
Ambuklao BESS	20	Brgy. Ambuklao, Bokod, Benguet	Dec 2022
Nagsaag BESS	20	Nagsaag, Pangasinan	TBD
Lumban BESS*	20	Lumban, Laguna	TBD
Laoag BESS*	20	Laoag, Ilocos Norte	TBD
Concepcion BESS*	20	Concepcion, Tarlac	TBD
Labrador BESS	20	Labrador, Pangasinan	TBD
Pililla BESS Project	50	Pililia, Rizal	TBD
Currimao BESS Project	50	Currimao, Ilocos Norte	TBD
Currimao BESS Project	50	Currimao, Ilocos Norte	TBD
Bay BESS Project	20	Bay, Laguna	Dec 2022
Bay BESS Project	50	Bay, Laguna	TBD
Lumban BESS*	20	Lumban, Laguna	TBD

Proposed Generation Facility / Name of the Project	Capacity (MW)	Location	Commissioning Year
Labo BESS Project	20	Labo, Camarines Norte	Mar 2024
Sub-Total Battery	**400**		
TOTAL INDICATIVE	32,308.295		
TOTAL INDICATIVE W/O BATTERY	31,908.295		

* with SIS

Table 2: Private Sector Initiated Power Projects in Visayas as of 30 June 2021

Proposed Generation Facility / Name of the Project	Capacity (MW)	Location	Commissioning Year
COMMITTED POWER PLANTS			
COAL			
Palm Concepcion CFPP Unit II*	135	Brgy. Nipa, Concepcion, Iloilo	Mar 2024
Sub-Total Coal	**135**		
OIL-BASED			
Isabel Modular Diesel Ancillary Service Power Plant	86.32	Isabel, Leyte	Ongoing
Sub-Total Oil-Based	**86.32**		
GEOTHERMAL			
Biliran GPP Unit 1	3.5	Biliran, Biliran	2022
Biliran GPP Unit 2	4.5	Biliran, Biliran	2024
Biliran GPP Unit 3	10	Biliran, Biliran	2025
Biliran GPP Unit 4	10	Biliran, Biliran	2026
Biliran GPP Unit 5	22	Biliran, Biliran	2027
Sub-Total Geothermal	**50**		
HYDRO			
Timbaban HEPP	18	Madalag, Aklan	Dec 2021
Igbulo (Bais) HEPP	5.1	Igbaras, Iloilo	Dec 2021
Tubig HEPP	16	Taft, Eastern Samar & Hinabangan, Samar	Dec 2021
Sub-Total Hydro	**39.1**		
BIOMASS			
HDJ Biomass Power Plant Project*	3	Bayawan City, Negros Oriental	Dec 2021
Sub-Total Biomass	**3**		
SOLAR			
Mandaue Solar Power Project	1.5	Brgy. Tipolo, Mandaue City , Cebu	Feb 2023
Sub-Total Biomass	**1.5**		
BATTERY			
Ormoc BESS Project	20	Ormoc, Leyte	Nov 2021
Ormoc BESS Project Phase 2	20	Ormoc, Leyte	Nov 2021
Tabango BESS Project	20	Tabango, Leyte	Oct 2021
Tabango BESS Project Phase 2	20	Tabango, Leyte	Sep 2023
Toledo BESS Project	40	Toledo City, Cebu	Jul 2021
Toledo BESS Project Phase 2	20	Toledo City, Cebu	Sep 2023
San Carlos BESS Project	20	San Carlos City, Negros Occidental	Sep 2023
Nabas BESS Project	20	Nabas, Antique	Sep 2023
Mactan BESS Project	20	Mactan, Cebu	Sep 2023
Calbayog BESS Project	20	Brgy. Carayman, Calbayog, Samar	Sep 2023
Samboan BESS Project	20	Samboan, Cebu	Sep 2022
Cebu BESS Project	20	Compostela, Cebu	Sep 2022
Iloilo BESS Project	20	Dingle, Iloilo	Mar 2022

Proposed Generation Facility / Name of the Project	Capacity (MW)	Location	Commissioning Year
Bohol BESS Project	20	Ubay, Bohol	Jul 2021
Bohol BESS Project Phase 2	20	Ubay, Bohol	Sep 2023
Kabankalan Integrated Renewable Power Hub Facility (R-Hub)	20	Kabankalan, Negros Occidental	TBD
Bais BESS	10	Negros Oriental	TBD
Sub-Total BESS	**350**		
TOTAL COMMITTED	661.92		
TOTAL COMMITTED W/O BESS	311.92		

* with SIS

INDICATIVE POWER PLANTS			
COAL			
SMC Global Negros CFPP Project	300	San Carlos, Negros Occidental	TBD
Sub-Total Coal	**300**		
OIL			
Bohol DPP Capacity Expansion*	30	Brgy. Dampas, Tagbilaran City, Bohol	TBD
SPC DPP*	7.2	Brgy. Imelda, Ubay, Bohol	Oct 2022
Sub-Total Oil	**37.2**		
GEOTHERMAL			
Dauin GPP	40	Dauin, Negros Oriental	2025
Mahanagdong Geothermal Brine Optimization Plant*	36	Barangay Tongonan, Ormoc City, Leyte	2024
Sub-Total Geothermal	**76**		
HYDRO			
Main Aklan River HEPP	15	Libacao, Aklan	Dec 2025
Maslog HEPP*	40	Maslog, Eastern Samar	Dec 2025
Malugo HEPP	6	Silay City, Negros Occidental	Dec 2025
Casapa HEPP	10	Maslog, Eastern Samar	Dec 2026
Lower Himogaan HEPP	4	Sagay, Negros Occidental	Dec 2026
Ilog HEPP*	21.6	Mabinay, Negros Occidental	Dec 2029
Aklan Pumped-Storage HEPP	300	Malay, Aklan	Dec 2030
Sub-Total Hydro	**396.6**		
SOLAR			
Medellin Solar Power Plant*	300	Medellin, Cebu	2024
Cadiz City Solar Power Plant*	70	Cadiz City, Negros Occidental	2024
Bacolod City Solar Power Project II	50	Bacolod City, Negros Occidental	2022
Biliran Solar Power Project	25	Biliran, Biliran	2022
Vista Alegre Solar Power Project	52	Bacolod City, Negros Occidental	2022
San Miguel Solar Power Project	100	San Miguel, Leyte	2023
Tigbauan Solar Power Project	34.3	Brgy. Cordova Norte and Bantud, Tigbauan, Iloilo	Jul 2022
Sub-Total Solar	**631.3**		
WIND			
Iloilo 1 Wind Power Project	213	Batad & San Dionisio, Iloilo	2022
Nabas Wind Power Project Phase II*	14	Brgy. Pawa, Nabas, Aklan	Aug 2021
Pulupandan Wind Power Project*	50	Pulupandan, Negros Occidental	2023
Aklan I Wind Power Project Phase 1-3*	75	Nabas-Malay, Aklan	2025
Bohol I (Ubay) Wind Power Project	100	Ubay, Alicia, Mabini, Bohol	2025
Batan Wind Power Project	50	Batan, Aklan	2024
Tanjay Wind Power Project*	50	Bais, Negros Oriental	2022

Proposed Generation Facility / Name of the Project	Capacity (MW)	Location	Commissioning Year
Guimaras Strait Wind Power Project	600	Offshore of Negros Occidental and Iloilo Provinces	2029
Sub-Total Wind	**1,152**		
BATTERY			
Toledo BESS	7.5	Toledo City, Cebu	TBD
Tabango BESS	7.5	Tabango City, Leyte	TBD
Compostela BESS	7.5	Compostela, Cebu	TBD
Dingle BESS	7.5	Dingle City, Iloilo	TBD
Ubay BESS	7.5	Ubay City, Bohol	TBD
Sta. Barbara BESS Project	20	Sta. Barbara, Iloilo	TBD
Panay BESS Power Plant	40	Brgy. Tinocuan, Iloilo City	Dec 2022
Calbayog BESS Power Plant	30	Calbayog, Samar	TBD
Daanbantayan BESS Power Plant	30	Daanbantayan, Cebu	TBD
Ormoc BESS Project	50	Ormoc, Leyte	TBD
Cadiz BESS Project	50	Cadiz City, Negros Occidental	TBD
Naga (Pandora) BESS	20	Naga City, Cebu	Mar 2023
Padayon BESS Project	20	Brgy. Ermita, Cebu City	Jun 2023
Santa Rita BESS Project	30	Santa Rita, Samar	TBD
Santander BESS Project	30	Santander Cebu	TBD
Tabango BESS Project	30	Tabango, Leyte	TBD
Pandora 2 Integrated BESS Project	42	Barangay Colon, Naga City, Cebu	Jun 2023
3 Barracuda Energy Corp. Tinampa-an BESS	49	Cadiz City, Negros Occidental	TBD
Horus Solar Energy Corp. Tinampa-an BESS	50	Brgy. Tinampa-an, Cadiz City, Negros Occidental	TBD
Sub-Total Battery	**528.5**		
TOTAL INDICATIVE	3,121.6		
TOTAL INDICATIVE W/O BATTERY	2,593.1		

* with SIS

Table 3: Private Sector Initiated Power Projects in Mindanao as of 30 June 2021

Proposed Generation Facility / Name of the Project	Capacity (MW)	Location	Commissioning Year
COMMITTED POWER PLANTS			
COAL			
Misamis Oriental 2 x 135 MW Circulating Fluidized Bed CFPP Thermal*	270	PHIVIDEC Industrial Estate, Villanueva, Misamis Oriental	Dec 2024
Sub-Total Coal	**270**		
OIL-BASED			
SPC DPP	11.04	Libudon Road, Lower Dawan, Mati City, Davao Oriental	Jun 2021
Sub-Total Oil-Based	**11.04**		
GEOTHERMAL			
Mindanao 3 Binary GPP	3.6	Kidapawan, North Cotabato	Jan 2022
Sub-Total Oil-Based	**3.6**		
HYDRO			
Lake Mainit HEPP	25	Jabonga, Agusan del Norte	Dec 2021
Marbel 1 HEPP	0.79	Koronadal & Tampakan, South Cotabato	Dec 2021
Alamada HEPP	2.84	Alamada, North Cotabato	Dec 2021
Sipangpang HEPP	1	Cantilan, Surigao del Sur	Dec 2021
Siguil HEPP	15.1	Maasim, Sarangani	Dec 2022
Maladugao (Upper Cascade) HEPP	8.4	Kalilangan, Bukidnon	Dec 2023

Proposed Generation Facility / Name of the Project	Capacity (MW)	Location	Commissioning Year
Maramag HEPP	4.4	Maramag, Bukidnon	Dec 2025
Liangan HEPP	11.9	Bacolod, Lanao del Norte	Dec 2025
Sub-Total Hydro	**69.43**		
BIOMASS			
PTCI Rice Husk-Fired Biomass Cogeneration Facility	3	Sultan Kudarat,Maguindanao	Dec 2021
10 MW Biomass Cogeneration Plant	10	Matalam, North Cotabato	Dec 2021
10 MW Biomass Cogeneration Plant	10	Hagonoy, Davao del Sur	Dec 2021
6 MW Biomass Power Plant Project	6	Aurora, Zamboanga del Sur	Jun 2023
Sub-Total Biomass	**29**		
BESS			
Tagoloan BESS	40	Tagoloan, Misamis Oriental	Aug 2021
Tagoloan BESS Project Phase 2	20	Tagoloan, Misamis Oriental	Sep 2023
Placer BESS Project	20	Placer, Surigao del Norte	Sep 2023
Maramag BESS Project	20	Maramag, Bukidnon	Sep 2023
General Santos BESS Project	20	General Santos, South Cotabato	Sep 2023
Malita BESS Project	20	Malita, Davao	Apr 2021
Maco BESS Project	20	Maco, Davao	Aug 2021
Jasaan BESS Project	20	Jasaan, Misamis Oriental	Nov 2021
Tagum BESS Project	20	Tagum, Davao del Norte	Mar 2022
Surigao / Butuan BESS	20	Surigao / Butuan	Nov 2021
Sub-Total BESS	**220**		
TOTAL COMMITTED	603.07		
TOTAL COMMITTED W/O BESS	383.07		

* with SIS

INDICATIVE POWER PLANTS			
COAL			
San Ramon Power, Inc. CFPP Station	120	ZamboEcozone, Brgy. Talisayan, Zambanga City	Dec 2023
Sub-Total Coal	**120**		
NATURAL GAS			
GNPower Kauswagan LNG CCPP	600	Barangay Tacub, Kauswagan, Lanao del Norte	Jun 2027
Sub-Total Natural Gas	**600**		
HYDRO			
Katipunan River Mini HEPP	6.2	Cabanglasan, Bukidnon	Dec 2022
Pulanai River HEPP	10.6	Valencia, Bukidnon	Dec 2022
Maladugao River (Lower Cascade) HEPP	15.7	Kalilangan and Wao, Bukidnon	Dec 2023
Cateel HEPP	16	Baganga, Davao Oriental	Dec 2024
Malitbog HEPP*	3.4	Malitbog, Bukidnon	Dec 2024
Sawaga River Mini Hydro Power Project	4.5	Malaybalay, Bukidnon	Dec 2024
Bubunawan HEPP	32	Baungon, Bukidnon	Dec 2025
Culaman HEPP*	10	Manolo Fortich, Bukidnon	Dec 2025
Limbatangon HEPP	9	Cagayan de Oro City, Misamis Occidental	Dec 2025
Casauman HEPP	34	Manay, Davao Oriental	Dec 2026
Silo-o HEPP*	3.29	Malitbog, Bukidnon	Dec 2026
Davao HEPP	140	Davao City	Dec 2027
Cabadbaran HEPP*	9.75	Cabadbaran, Agusan del Norte	Dec 2028
South Pulangi HEPP*	250	Damulos, Bukidnon	Dec 2031
Sub-Total Hydro	**544.44**		
BIOMASS			
23.5 MW Woody Biomass Power Plant Project	23.5	Agusan del Norte	Dec 2022
10MW Biomass Power Plant Project	10	Kalilangan, Bukidnon	Dec 2022
12 MW Biomass Power Plant Project	12	Manolo Fortich, Bukidnon	Dec 2022
Sub-Total Biomass	**45.5**		

Proposed Generation Facility / Name of the Project	Capacity (MW)	Location	Commissioning Year
SOLAR			
Bukidnon Solar Power Project	2	San Vicente, Sumilao, Bukidnon	Jul 2023
San Francisco Solar Power Project	10	San Francisco, Agusan del Sur	Aug 2021
Maasim Hybrid Solar Power Project	100	Maasim, Sarangani	2023
Hayes Solar Power Project*	27	Villanueva, Misamis Oriental	2024
Zamboanga del Norte Solar Power Project	7	La Libertad and Dapitan, Zamboanga del Norte	Jun 2025
General Santos Solar Power Project	120	General Santos, South Cotabato	2026
Sub-Total Solar	**266**		
BESS			
TMI Hybrid Diesel-BESS	49	Maco, Davao de Oro	Oct 2021
Kibawe BESS Project	50	Kibawe, Bukidnon	TBD
Toril BESS	20	Toril, Davao	Jun 2023
Sub-Total Battery	**119**		
TOTAL INDICATIVE	1,694.94		
TOTAL INDICATIVE W/O BESS	1,575.94		

* with SIS

Appendix 5 – Summary of Asset Lives

Category	Description	Life (Years)	Notes
Transmission Lines	Lattice steel tower line	50	
	Wood pole line	25	
	Concrete pole line	50	
	Steel pole line	50	
Power Cables	Submarine HVDC	50	
	Submarine HVAC	50	
	Underground HVAC	50	
Outdoor Substations – MEAs	Transformers 500 kV	45	N-1 Security
	Transformers 230 kV	35	Without N-1 Security
		45	With N-1 Security
	Transformers 115 kV	35	Without N-1 Security
		45	With N-1 Security
	Reactors	35	
	Capacitor	40	
	Outdoor switch bays	40	500 kV, 230 kV, 138/115 kV, 69 kV outdoor assemblies (see Note 1)
Outdoor Substations – Individual equipment	Circuit breakers	40	500 kV, 230 kV, 138/115 kV, 69 kV
Indoor GIS Substations	500 kV GIS switch bay	45	
	230 kV GIS switch bay	45	
	115 kV GIS switch bay	45	
Substations Secondary	Protective relays and controls	15	
	Metering equipment	30	
	RTUs, SCADA systems	15	
Communications	OPGW links	50	
	PLC links	35	
System Control		15	

Notes: 1. A switchgear bay includes the primary equipment, bus works, foundations, equipment supports and other structures, protective and control equipment and cabling directly associated with the bay.

Appendix 6 – Power Restoration Project

POWER RESTORATION HIGHWAY

System blackout occurred when all generation in the grid has ceased and the entire power system has shutdown. The process of recovery from total system blackout using a generating unit with the capability to start and synchronize with the power system without an external power supply is called Black Start. Power plants that serve as Black Start Provider must have a black start capability or the ability to go from a shutdown condition to an operating condition within a specified period without feedback power from the grid and to start delivering power to the sections of the grid such as generating plants and critical loads.

Black start generators must be capable of starting themselves quickly without the need for external power supply from the grid, with sufficient real (MW) and reactive power (MVAR) to energize transmission lines and restart other generators. They must also be able to control frequency as well as a voltage which can sustain a self-reliant operation for at least 12 hours and extend power within 30 minutes.

There are four (4) sub-grids in Luzon including Metro Manila sub-grid (LRCC), Northern Luzon sub-grid (NLACC), Central Luzon sub-grid (CLACC), and Southern Tagalog sub-grid (STACC). Both Visayas and Mindanao have five (5) sub-grids. In Visayas, these includes Panay, Negros, Cebu, Bohol, Leyte-Samar, while in Mindanao, these are Zamboanga ACC, Iligan Cagayan ACC, Butuan ACC, Davao ACC and General Santos ACC. Each sub-grid has its own designated power restoration highway and must have at least two black start service providers, in case the other fails to operate. However, at present there are sub-grids that have a deficiency in Black Start Providers, hence, NGCP continuously encourages other generating units to participate as Black Start Providers for the improvement of the restoration time.

It is also crucial to monitor and ensure the health of the breakers as well as protective relays which are connected to all restoration highway (substation/power plant). Similarly, setting and proper coordination of power plant protection relays and grid protection relays could prevent any undesired tripping during occurrence of system disturbance.

Furthermore, installation of NDMEs are also necessary for real-time monitoring, recording of system disturbance and retrieving of fault data remotely particularly in these critical substations as part of the restoration highway. Similarly, installation of PQAs could be used effectively for online monitoring of power quality problems such as generating current/voltage harmonics beyond power system network limits, voltage imbalance and fluctuation and harmonic resonance in the substations and power plant which are part of the power restoration highway.

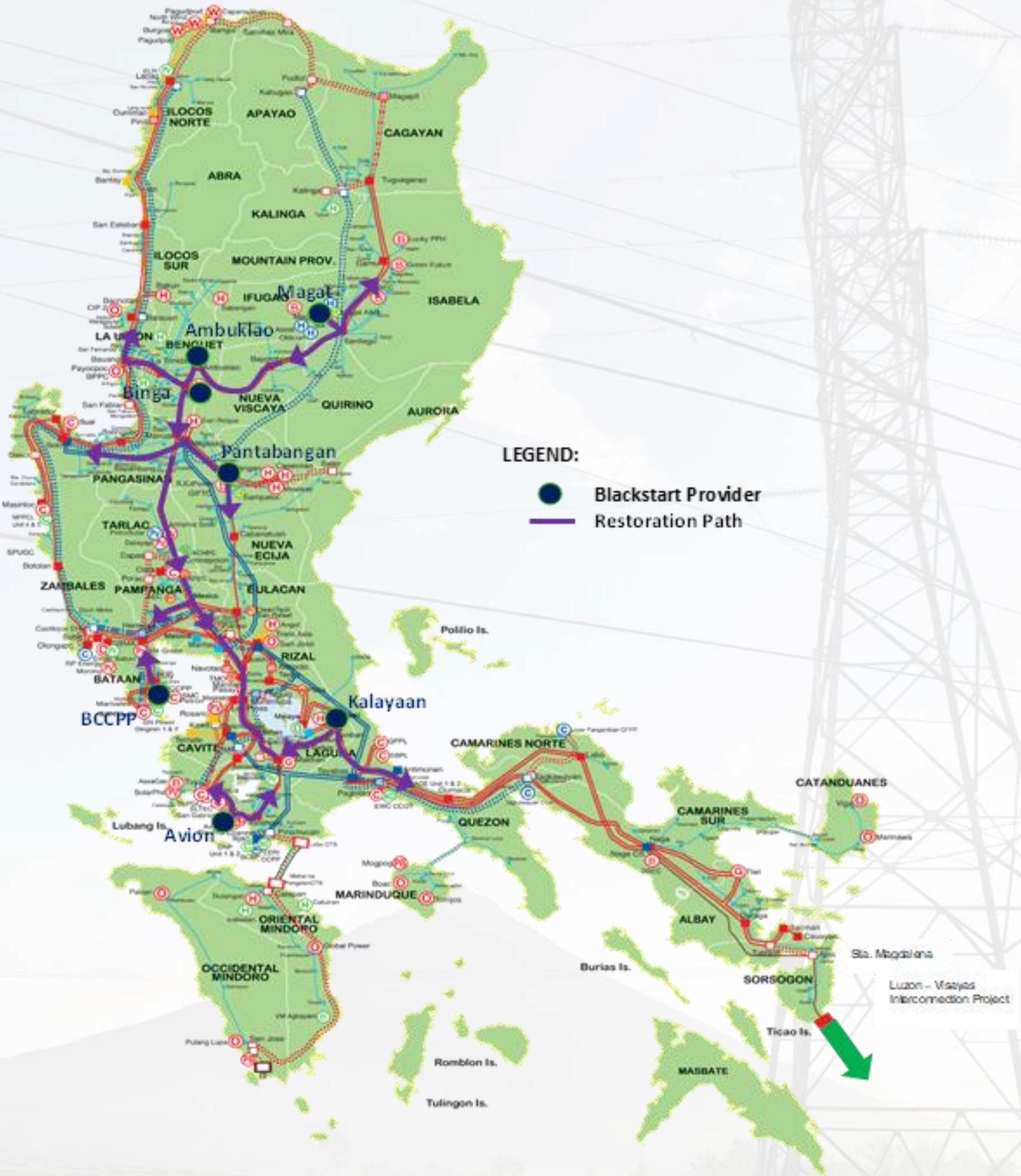


Figure 1: Luzon Power Restoration Highway

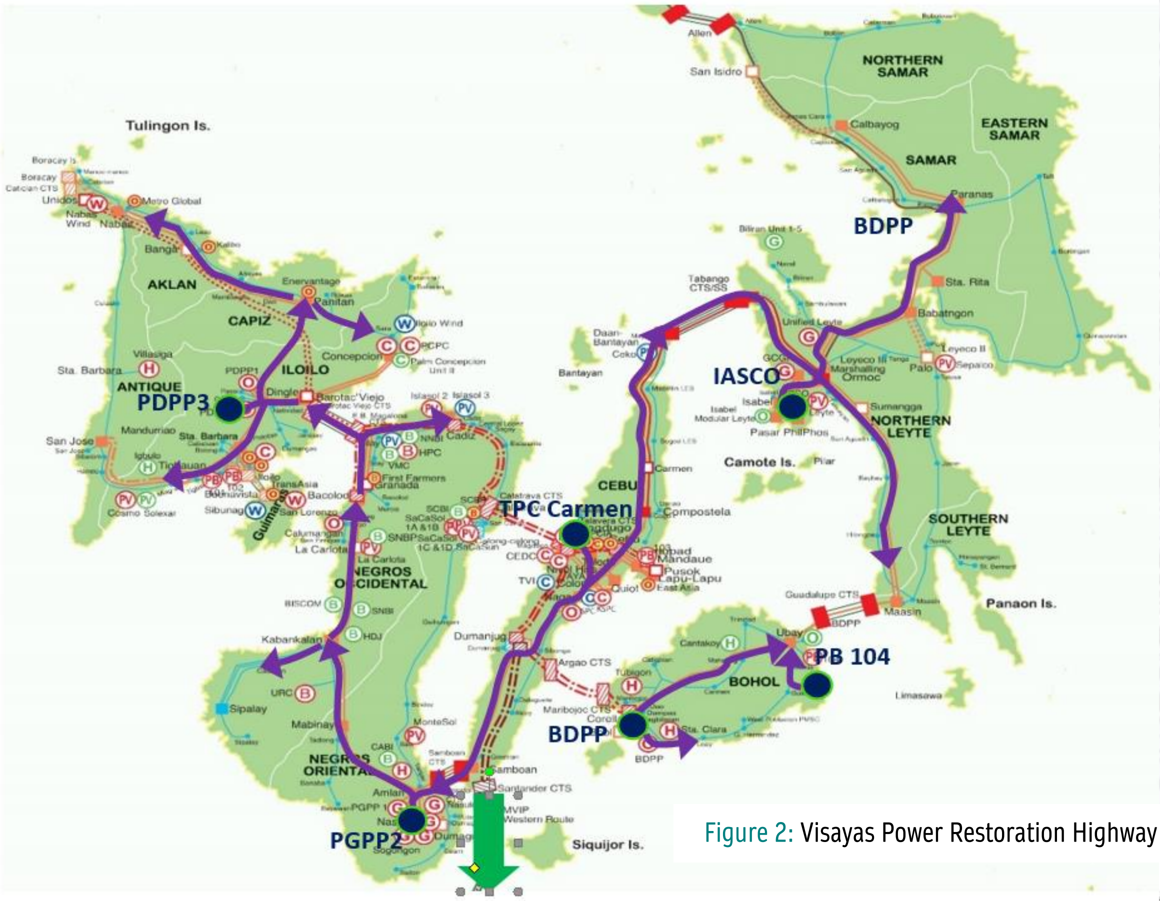


Figure 2: Visayas Power Restoration Highway

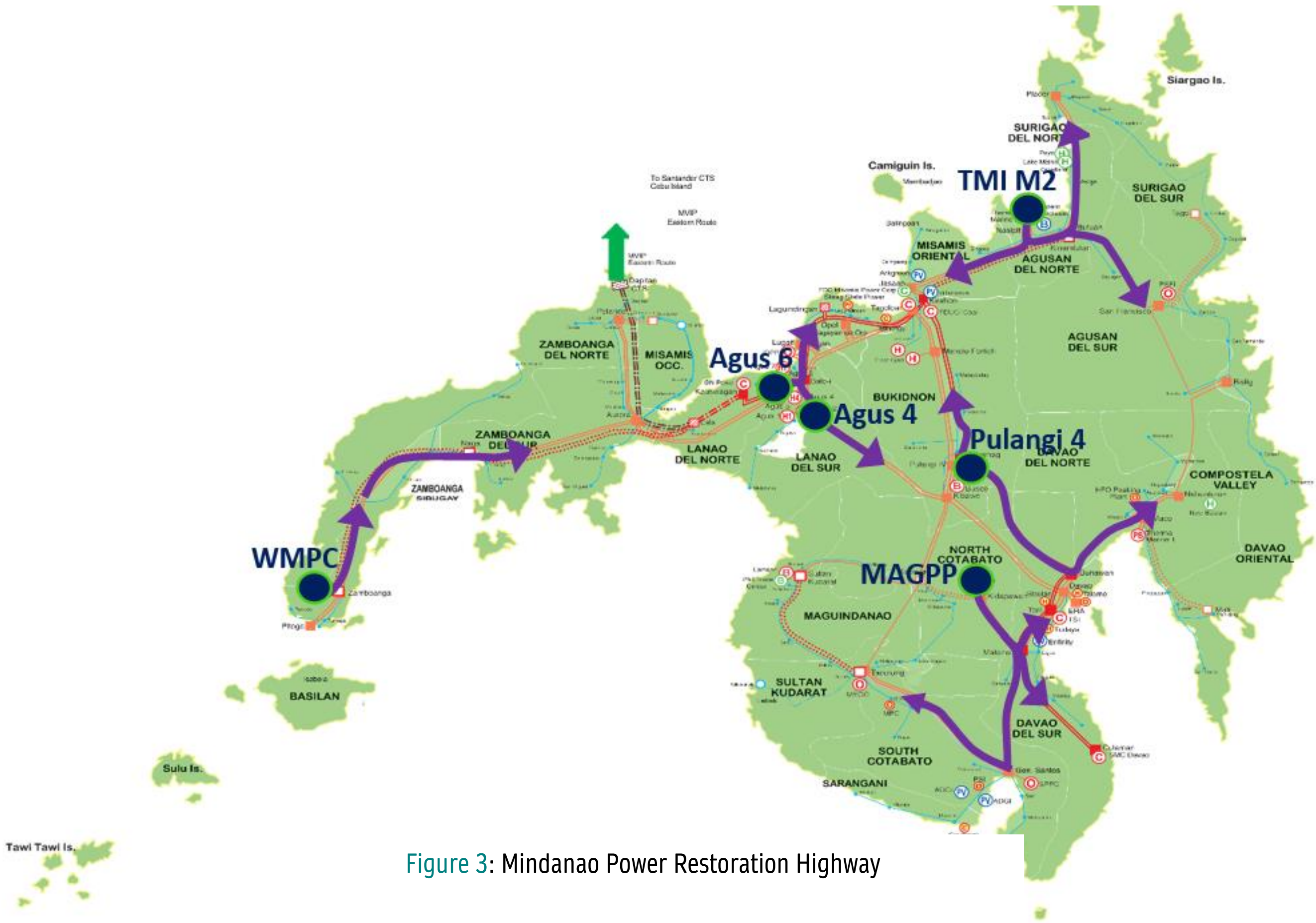


Figure 3: Mindanao Power Restoration Highway

Appendix 7 – Network Synchronization Program Installation Status

Table 1: List of Substations Installed with Sync Units

Luzon	With Clock Installed
San Jose 500KV SS	Installed
Mexico SS	Installed
Nagsaag SS	Installed
Bolo SS	Installed
La Trinidad SS	Installed
Biñan SS	Installed
Dasmariñas SS	Installed
Tayabas SS	Installed
Naga SS	Installed
Bay SS	Installed
Malaya SS	Installed
Cabanatuan SS	Installed
San Manuel 230kV SS	Installed
Currimao SS	Installed
SBMA SS	Installed
Botolan SS	Installed
Olongapo SS	Installed
Subic SS	Installed
Gamu SS	Installed
Hermosa SS	Installed
San Jose 230kV SS	Installed
Bauang SS	Installed
San Esteban SS	Installed
Lumban SS	Installed
Batangas SS	Installed
Gumaca SS	Installed
Labo SS	Installed
Taytay SS	Installed
Quezon SS	Installed
Doña Imelda SS	Installed
Muntinlupa SS	Installed
Las Piñas SS	Installed
Calaca SS	Installed
Tuguegarao SS	Installed
Santiago SS	Installed
Bayombong SS	Installed
Bacnotan SS	Installed
Naga HVDC SS	Installed
Daraga SS	Installed
Labrador SS	Installed
Lamao SS	Installed
Navotas SS	Installed
Laoag SS	Installed
Bantay SS	Installed
San Rafael SS	Installed
Limay SS	Installed
Concepcion SS	Installed
Clark SS	Installed
Rosario SS	Installed
Pagbilao SS	Installed
Ambuklao SS	Installed
Binga SS	Installed
Balingueo SS	Installed
Salong SS	Installed

Visayas	With Clock Installed
Bacolod SS	Installed
Sta Barbara SS	Installed
Ormoc SS	Installed
Cebu SS	Installed
Quiot SS	Installed
Daan Bantayan SS	Installed
Colon SS	Installed
Calong-Calong SS	Installed
Tabango SS	Installed
Kabankalan SS	Installed
Mabinay SS	Installed
Cadiz SS	Installed
Ubay SS	Installed
Dingle SS	Installed
Kananga SS	Installed
Isabel SS	Installed
Panit-an SS	Installed
Compostela SS	Installed
Toledo SS	Installed
Samboan SS	Installed
Amlan SS	Installed
Corella SS	Installed
Barotac Viejo SS	Installed
San Jose SS	Installed
Nabas SS	Installed
Maasin SS	Installed
Babatngon SS	Installed
Paranas SS	Installed
Calbayog SS	Installed
Mandaue SS	Installed
Lapu-Lapu SS	Installed
Magdugo SS	Installed

Mindanao	With Clock Installed
General Santos SS	Installed
Butuan SS	Installed
Balo-i SS	Installed
Jasaan SS	Installed
Villanueva SS	Installed
Maramag SS	Installed
Bunawan SS	Installed
San Francisco SS	Installed
Kibawe SS	Installed
Davao SS	Installed
Tagoloan SS	Installed
Aurora SS	Installed
Nasipit SS	Installed
Bislig SS	Installed
Nabunturan SS	Installed
Maco SS	Installed
Tacurong SS	Installed
Matanao SS	Installed
Toril SS	Installed
Zamboanga SS	Installed
Tumaga SS	Installed
Sultan Kudarat SS	Installed
Kidapawan SS	Installed
Iligan SS	Installed
Polanco SS	Installed
Lugait SS	Installed
Cagayan de Oro SS	Installed
Naga Mindanao SS	Installed
Pitogo SS	Installed
Placer SS	Installed
Culaman SS	Installed
Manolo Fortich SS	Installed
Opol SS	Installed

Appendix 8 – Abbreviations and Acronyms

Development Plans	
DDP	Distribution Development Plan
NREP	National Renewable Energy Program
PDP	Power Development Program
PEP	Philippine Energy Plan
TDP	Transmission Development Plan

Electricity Market	
IEMOP	Independent Electricity Market Operator of the Philippines
PEMC	Philippine Electricity Market Corporation
WESM	Wholesale Electricity Spot Market

Government Agencies	
ERC	Energy Regulatory Commission
DOE	Department of Energy
NEDA	National Economic & Development Authority

Government-owned and Controlled Corporation and other Government Agencies	
NPC	National Power Corporation
PSALM	Power Sector Assets & Liabilities Management
TransCo	National Transmission Corporation
SPUG	Small Power Utilities Group

Legal, Environmental and Other Requirements	
BCMS	Business Continuity Management System
EPIRA	Electric Power Industry Reform Act
IMS	Integrated Management System
ISO	International Organization for Standardization
OHSAS	Occupational Health and Safety Assessment Series
PGC	Philippine Grid Code
QMS	Quality Management System
RE Law	Renewable Energy Law

Other Companies	
BEI	Bohol Enterprises, Inc.
BSTC	Bukidnon Subtransmission Corporation
NREL	National Renewable Energy Laboratory
USAID	United States Agency for International Development

Power Generating Companies	
CEDC	Cebu Energy Development Corporation
EWC	Energy World Corporation
FGHPC	First Gen Hydro Power Corporation
GN Power	General Nakar Power
KEPCO	Korea Electric Power Corporation
KSPC	KEPCO SPC Power Corporation
MAEC	Mirae Asia Power Corporation
PCPC	Palm Concepcion Power Corporation
PEDC	Panay Energy Development Corporation
QPPL	Quezon Power Philippines Limited
RP Energy	Redondo Peninsula Energy
SEC	Sarangani Energy Corporation
SBPL	San Buenaventura Power Ltd. Company
SMCPC	San Miguel Consolidated Power Corporation
TAREC	Trans-Asia Renewable Energy Corporation

Power Plants	
CCPP	Combined Cycle Power Plant
CFPP	Coal-Fired Power Plant
DPP	Diesel Power Plant
GPP	Geothermal Power Plant
HEPP	Hydro Electric Power Plant
LNG	Liquified Natural Gas
NGPP	Natural Gas Power Plant
RE	Renewable Energy
Solar PV	Solar Photovoltaic

Private Distribution Utilities	
APEC	Albay Power and Energy Corporation
AEC	Angeles Electric Corporation
CEPALCO	Cagayan Electric Power & Light Company
CEDC	Clark Electric Distribution Corporation
DLPC	Davao Light and Power Company
MERALCO	Manila Electric Company
VECO	Visayan Electric Company, Inc.

Regions/Areas	
CBD	Central Business District
LA	Lanao Area
NCR	National Capital Region
NCMA	North Central Mindanao Area
NEMA	North Eastern Mindanao Area
NWMA	North Western Mindanao Area
SEMA	South Eastern Mindanao Area
SOCCSKSARGEN	South Cotabato, Cotabato, Sultan Kudarat, Sarangani & General Santos
SRP	South Road Properties
SWMA	South Western Mindanao Area

Regulatory	
ASAI	Ancillary Services Availability Indicator
CA	Connection Assets
CC/RSTC	Connection Charges/Residual Subtransmission Charges
ConA	Congestion Availability
CSI	Customer Satisfaction Indicator
FD	Final Determination
FIT	Feed-in-Tariff
FLC	Frequency Limit Compliance
FOT/100 Ckt-km	Frequency of Tripping per 100 circuit-km
OATS	Open Access Transmission Service
PA	Provisional Authority
PBR	Performance-Based Ratemaking
RAB	Regulatory Asset Base
RSTA	Residual Subtransmission Assets
RTWR	Rules for Setting Transmission Wheeling Rate
SA	System Availability
SEIL	Std. Equipment Identification and Labeling
SISI	System Interruption Severity Index
VLC	Voltage Limit Compliance VLC

Supply-Demand and Investment	
AAGCR	Annual Average Compounded Growth Rate
CAPEX	Capital Expenditures
CR	Contingency Reserve
DR	Dispatchable Reserve
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
IMF	International Monetary Fund
LoLp	Loss of Load Probability
SPD	System Peak Demand

Transmission Service Provider	
NGCP	National Grid Corporation of the Philippines

Unit of Measure	
ckt-km	Circuit-kilometer

km	kilometer
kV	kilo-Volt
MVA	Mega-Volt Ampere
MVAR	Mega-Volt Ampere Reactive
MW	Mega-Watt
UTS	Ultimate Tensile Strength
Electric Cooperatives	
ABRECO	Abra Electric Cooperative, Inc.
AKELCO	Aklan Electric Cooperative, Inc.
BATELEC II	Batangas II Electric Cooperative, Inc.
BENECO	Benguet Electric Cooperative, Inc.
CAGELCO I	Cagayan 1 Electric Cooperative, Inc.
CASURECO IV	Camarines Sur IV Electric Cooperative, Inc.
CENPELCO	Central Pangasinan Electric Cooperative, Inc.
DORELCO	Don Orestes Romuladez Elect Cooperative, Inc.
ESAMELCO	Eastern Samar Electric Cooperative, Inc.
FICELCO	First Catanduanes Electric Cooperative, Inc.
ILECO II	Iloilo II Electric Cooperative, Inc.
ILECO III	Iloilo III Electric Cooperative, Inc.
INEC	Ilocos Norte Electric Cooperative, Inc.
ISECO	Ilocos Sur Electric Cooperative, Inc.
KAELCO	Kalinga-Apayao Electric Cooperative, Inc.
LEYECO II	Leyte II Electric Cooperative, Inc.
LUELCO	La Union Electric Cooperative, Inc.
MOELCI I	Misamis Occidental I Electric Cooperative, Inc.
MORESCO I	Misamis Oriental I Electric Cooperative, Inc.
NEECO II A2	Nueva Ecija II Electric Cooperative, Inc. – Area 2
NORECO II	Negros Oriental II Electric Cooperative, Inc.
OMECO	Occidental Mindoro Electric Cooperative, Inc.
ORMECO	Oriental Mindoro Electric Cooperative, Inc.
PANELCO III	Pangasinan III Electric Cooperative, Inc.
PELCO I	Pampanga I Electric Cooperative, Inc.
PELCO II	Pampanga II Electric Cooperative, Inc.
PRESCO	Pampanga Rural Electric Service Cooperative, Inc.
SAJELCO	San Jose City Electric Cooperative, Inc.
SIARELCO	Siargao Electric Cooperative, Inc.
SOCOTECO I	South Cotabato I Electric Cooperative, Inc.
TARELCO I	Tarlac I Electric Cooperative, Inc.
Transmission System/Projects	
ACC	Area Control Center
ACSR	Aluminum Cable Steel Reinforced
ACSR/AS	Aluminum Cable Steel Reinforced/ Aluminum-clad Steel
AIS	Air Insulated Switchgear
APG	ASEAN Power Grid
AS	Ancillary Service
ASPA	Ancillary Service Procurement Agreement
ASPP	Ancillary Service Procurement Plan
AVC	Automatic Voltage Control
BESS	Battery Energy Storage System
BMS	Battery Monitoring System
BRCC	Backup Regional Control Center
CAES	Compressed Air Energy Storage
CCMS	Central Control and Monitoring System
CREZ	Competitive Renewable Energy Zone
CTS	Cable Terminal Station
CS	Converter Station
DC1	Double Circuit Transmission Line First Stringing
DC2	Double Circuit Transmission Line Second Stringing
DER	Distribution Energy Resources
DS/ES	Disconnecting/Earthing Switches

DU	Distribution Utility
EAM	Enterprise Asset Management
EHV	Extra High Voltage
EMS	Energy Management System
ERS	Emergency Restoration System
ES	Electrode Station
ESS	Energy Storage System
ETC	Expected Target Completion
ICT	Information and Communications Technology
FACTS	Flexible AC Transmission System
FESS	Flywheel Energy Storage System
FMS	Facilities Management System
GEOP	Green Energy Option
GIS	Gas Insulated Switchgear
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
ICT	Information and Communications Technology
IP	Internet Protocol
IPP	Independent Power Producer
MBSC	Microprocessor-Based Substation Control
MCM	Thousand Circular Mills
NDME	Network Disturbance Monitoring Equipment
NMS	Network Management System
OHTL	Overhead Transmission Line
O & M	Operation and Maintenance
OPGW	Optical Power Ground Wire
OTN	Optical Transport Network
PABX	Private Automatic Branch Exchange
PAN	Planned Activity Notice
PCB	Power Circuit Breaker
PGC	Philippine Grid Code
PLC	Powerline Carrier
PMU	Phasor Measurement Unit
PQA	Power Quality Analyzer
PQMS	Power Quality Management System
PSH	Pumped-Storage Hydropower
PST	Philippine Standard Time
RCC	Regional Control Center
RCOA	Retail Competition and Open Access
RFMS	Remote Fiber Monitoring System
ROW	Right-of-Way
RPS	Renewable Portfolio Standards
RTD	Real-time Dispatch
RTU	Remote Terminal Unit
SACS	Substation Automation Control System
SCADA	Supervisory Control and Data Acquisition
SDH	Synchronous Digital Hierarchy
SIPS	Systems Integrity Protection Scheme
SIS	System Impact Study
SO	System Operations
SO-MO	System Operator-Market Operator
SPD	System Peak Demand
SPS	Special Protection System
SP-SC	Steel Pole Single Circuit
SP-DC	Steel Pole Double Circuit
ST-SC	Steel Tower Single Circuit
ST-DC	Steel Tower Double Circuit
WSD	Wind Speed Design
ZWG	Zone Working Group

Appendix 9 – Contact Details

For all inquiries regarding the TDP, you may contact any of the following

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