Power Development Plan, 2009-2030

Energy and Peak Demand Forecast

Electricity demand is the basic component of development planning as it integrates different electric power subsectors: distribution, transmission and generation. It also indicates the minimum required capacity and production in terms of watt (w) and watt-hour (Wh), respectively.

The energy and demand forecasts for the Luzon grid is more comprehensive compared to Visayas and Mindanao grids as it comprised about 74.0 percent of the nationwide demand vis-à-vis its contribution to the major economic structural changes, being the center of industry and commerce.

Demand Forecasting Methodology and Assumptions

Following are the steps in the coming up with the peak demand forecasts for the major grids.

1. *Determine the Energy Sales Forecasts*

Initial step in determining the energy sales forecasts is to identify the scenarios and corresponding assumptions. The growth rates of the energy sales of the DUs based on their consolidated 2009 DDPshave been used to come up with the peak demand forecast. The growth rates are applied to the actual data of the reference year for each grid, which in this case is 2008. From the baseline energy sales data, the non-utility sales are added and compared to the Power Delivery Services (PDS) data sourced from the System Operations of the transmission company. This is to synchronize the consolidated distribution utilities' data with that of the actual energy that has been transmitted in the high voltage lines to the distribution utilities and non-utility customers. Furthermore, embedded generation of the distribution utilities and non-utility customers are then added as they are not captured in the PDS**.**

2. *Convert energy sales forecasts to peak demand forecasts*

The peak demand forecasts for each grid are derived using the load factor approach. From the forecasted energy sales that have been established above, the station use (SU) and transmission losses (TL) are then added to come up with the gross generation. These are the figures converted to peak demand in MW using the assumed load factor for each grid based on historical performance. The 2008 actual SU/TL of 2.6 percent (Luzon), 4.3 percent (Visayas) and 4.4 percent (Mindanao) were used. Meanwhile, the load factor assumptions for the planning horizon are: 73.0 percent for Luzon; 67.0 percent for Visayas; and 70.0 percent for Mindanao.

Resulting Energy and Peak Demand Forecasts, 2009-2030

Electricity demand growth slowed down over the years, from an average rate of 6.0 percent in Luzon, 7.6 percent in Visayas and 4.4 percent in Mindanao during the 90's to an average of 2.6 percent in Luzon, 6.0 percent in Visayas and 3.3 percent in Mindanao for the period 2000-2008. This can be attributed to factors like structural changes of the country's economy, from an industry-led to services-driven growth. In the cases of Visayas and Mindanao, the other contributing reasons are due to suppressed demand considering the tight power supply and peace and order situations, respectively, which hinder the potential for growth. Henceforth, it is assumed that the economic structure of the country remain the same. In addition, we are looking forward to greater efficiency gains in response to rising energy prices and aggressive promotion of energy conservation and energy efficiency programs for lighting system and other electricity-consuming appliances, and other modes of demand-side management.

By 2030, the country's energy sale is projected to increase from 55,417 GWh in 2008 to 86,809 GWh by 2018, up to 149,067 GWh by 2030. These are translated to peak demand from 9,226 MW in 2008 to 14,311 MW by 2018, to about 24,534 MW by 2030. .

Following are the summary by major grids:

Luzon

Table 1 shows the Luzon grid's 2008 actual energy sales and peak demand and 2009-2030 projected growth levels. These results to increases in energy levels from 41,275 GWh in 2008 to 64,303 GWh in 2018 and 109,477 Gwh in 2030. The corresponding peak demand of 6,822 MW in 2008 is projected to inch up to 10,393 MW by 2018. Based on the average growth rates indicated in the table, this is expected to further move up to 17,636 MW by 2030.

Table 1: Luzon Energy Sales and Peak Demand Average Annual Growth Rate, 2009-2030

Period	Energy Sales, GWH	Peak Demand, MW
Base year 2008 (Actual Level)	**41,275**	**6,822**
2009	42,768	7,036
2018	64,303	10,393
2030	109,477	17,636
AAGR	**%**	**%**
2009-2018	4.53	4.3
2019-2030	4.53	4.51
2009-2030	4.53	4.41

Visayas

Visayas energy sales and peak demand are expected to grow much faster than Luzon as shown in Table 2. Based on the growth rate indicated in the table, the grid's energy sales of 6,565 Gwh in 2008 is expected to increase to 10,601 GWh by 2018, and will reach 19,121 GWh by 2030. Correspondingly, the peak demand will expand from 1,176 MW in 2008 to 1,887 MW by 2018, and increase to 3,404 MW by 2030.

Table 2: Visayas Energy Sales and Peak Demand Average Annual Growth Rate, 2009-2030

Period	Energy Sales, GWH	Peak Demand, MW
Base year 2008 (Actual Level)	**6,565**	**1,176**
2009	6,857	1,331
2018	10,601	1,887
2030	19,121	3,404
AAGR	**%**	**%**
2009-2018	4.91	4.89
2019-2030	5.04	5.04
2009-2030	4.98	4.97

Mindanao

Mindanao had higher actual 2008 energy sales of 7,578 GWh and is expected to expand to 11,904 GWh by 2018, and will reach 20,470 GWh by 2030 (Table 3). These are translated into peak demand increases from 1,228 MW level in 2008 to 2,031 MW by 2018, and 3,493 MW by 2030.

Table 3: Mindanao Energy Sales and Peak Demand Average Annual Growth Rate, 2009-2030

Period	Energy Sales, GWH	Peak Demand, MW
Base year 2008 (Actual Level)	**7,578**	**1,228**
2009	7,966	1,359
2018	11,904	2,031
2030	20,470	3,493
AAGR	**%**	**%**
2009-2018	4.62	5.18
2019-2030	4.62	4.62
2009-2030	4.62	4.86

Capacity Additions, 2009-2030

In power development planning analysis, identification of additional capacity is dependent on the following factors: the projections of electricity demand, amount of required reserve margin needed in the system, and the schedule retirement of existing capacity. The DOE used the WASP IV simulation software to determine the least-cost generating system for the future electricity requirements of the country. For the 2009-2030, around 17 GW of new capacities are needed to meet the demand and reserve requirements for electrical power. Of these, 1,338 MW will come from committed power projects as shown in Table 4, and the remaining capacity requirements are still open for private sector participation.

Table 4. LIST OF COMMITTED PROJECTS

Grid	Project Name	Capacity (MW)	Target Completion	Location	Proponent
Luzon	2x300MW Coal-Fired Power Plant	600	4th Qtr. Of 2012	Mariveles, Bataan	GN Power
	Sub-total Luzon	**600**			
Visayas	3x80MW CFB Power Plant Expansion Project	240	Unit I-March2010 Unit II-June 2010 Unit III-Jan 2011	Brgy. Daanlungsod, Toledo City, Cebu	Cebu Energy Development Corporation (Global Business Power Corp.)
	2x100MW Cebu Coal-Fired Power Plant	200	Unit 1-Feb 2011 Unit 2-May 2011	Naga, Cebu	KEPCO SPC Power Corporation (KSPC)
	17.5MW Panay Biomass Power project	17.5	2011	Brgy. Cabalabaguan, Mina, Iloilo	Green Power Panay Phils., Inc.
	Nasulo Geothermal Plant	20	2011	Nasuji, Valencia, Negros oriental	Energy development Corporation
	2x80MW CFB Power Plant	160	Unit I-Sep 2010 Unit II-Dec 2010	Brgy. Ingore, La Paz, Iloilo	Panay Energy Development Corporation (Global Business Power Corp.)
	Sub-total Visayas	**638**			
Mindanao	Sibulan Hydroelectric Power (Unit I-16.5MW) (Unit II-26MW)	43	Unit I-Feb2010 Unit II-Apr 2010	Sta. Cruz, Davao del Sur	Hedcor Sibulan, Inc.
	Cabulig Mini-Hydro Power Plant	8	June 2011	Plaridel, Jasaan, Misamis oriental	Mindanao Energy Systems,Inc. (MINRGY)
	Mindanao 3 Geothermal	50	July 2014	Kidapawan, North Cotabato	Energy Development Corporation
	Sub-total Mindanao	**101**			
Total Philippines		**1,338**			

Note: Mindanao 3 Geothermal Plant was moved to 2014 from its original target year of 2010

Committed Power Projects

Private sector initiated committed power projects totaled 1,338 MW. In Luzon, the 600 MW coal-fired plant from GN Power will come on-stream before the end of 2012. In Visayas, of the 638 MW total committed power projects, 600 MW will come from coal-fired power plant and the remaining 38 MW is from renewable energy. In Mindanao, the 100.5 MW total committed projects are all renewables. The first Unit of 42.5 MW Sibulan hydro went online at 16.5 MW on April 2010, the operation of this power plant was delayed compared to its original target date of February 2010. The 50 MW Mindanao III geothermal plant was moved to 2014 from its original target of 2010.

Additional capacities are needed on top of the committed capacities to meet the increasing electricity requirement of the country broken down into the following grid requirements: (i) 72.0 percent or 11,900 MW for the Luzon grid; (ii) 13.0 percent or 2,150 MW for the Visayas grid; and (iii) 15.0 percent or 2,500 MW for the Mindanao grid as shown in Table 5.

Table 5: Capacity Additions Requirement, 2009-2030

Year	Luzon Grid				Visayas Grid				Mndanao Grid			
	Plant Type			Total	Plant Type			Total	Plant Type			Total
	Baseload	Midrange	Peaking		Baseload	Midrange	Peaking		Baseload	Midrange	Peaking	
2009							150	150				
2010											50	50
2011			300	300							50	50
2012		300		300					200			200
2013									100			100
2014		300	150	450					100			100
2015			450	450					100			100
2016		300	150	450					100			100
2017	500			500								
2018		300	300	600			100	100	100			100
2019	500		150	650	100		50	150	100			100
2020	500			500	100			100	100			100
2021	500		150	650	100		50	150			100	100
2022	500		150	650	100			100	100			100
2023	500		150	650	100		50	150	100		50	150
2024	500		300	800	100		50	150	100		50	150
2025	500		150	650	100		50	150	100		50	150
2026	500	300		800	100		100	200	100		50	150
2027		600	300	900	100		50	150	100		50	150
2028	500	300		800	100		100	200	200			200
2029		600	300	900	200			200	100		50	150
2030		900		900	200			200	200			200
Total	5,000	3,900	3,000	11,900	1,400		750	2,150	2,000		500	2,500

Luzon Grid

With the scheduled retirement of the 650- MW Malaya Oil Thermal plant, dependable capacity of existing power plants in the Luzon grid will decrease to 9.380 MW in 2011 from the 10,030 MW in 2009. However, with the completion of Bacman Plant Unit I-2 and Unit II rehabilitation in 2011 and 2013, an additional 74.3 MW will be added in the system.

With the projected 4.5 percent annual average growth rate on the peak demand, the critical period in Luzon grid, (where the capacity will not be able to meet the demand and the reserve margin requirement), is projected in 2011. On the same year, the system needs an additional peaking capacity of 300 MW (Figure 1). Within the next 20 years, Luzon grid will require an additional capacity of 12,500

MW, 600 MW of which are already committed leaving the balance of 11,900 MW to be filled-in from the list of indicative power projects. Based on these capacity requirements, Luzon grid will require the following generic capacities: (i) 5,000 MW base-load plant; (ii) 3,900 MW mid-range plant; and (iii) 3,000 MW peaking plant.

Visayas Grid

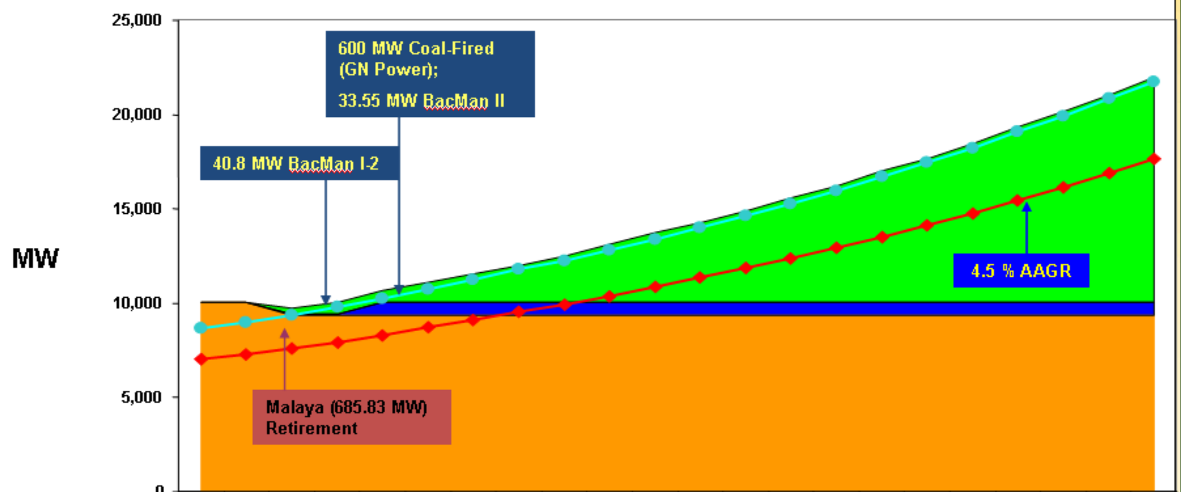
The supply of power in the Visayas grid remains tight between 2010-2011 (Figure 2). With the coming-in of the following committed capacities, supply situation in the Visayas is expected to normalize within the short-term: (i) 3 x 80 MW coal-fired plant from Cebu Energy Development Corporation in March 2010 for Unit I, June 2010 for Unit II and January 2011 for Unit III; (ii) 200 MW Cebu coal-fired plant from Kepco; (iii) 160 MW Panay coal-fired plant from Global Green Power; (iii) 20 MW geothermal plant from Energy Development Corporation; and (iv) 17.5 MW biomass-fed plant from Global Green Power.

However, based on the results of 2009-2030 demand forecast exercises, Visayas grid is projected to increase its annual electricity requirement by 4.6 percent until 2030. With this projection, the system needs a total of 2,150 MW additional capacities on top of the committed power projects thereby assuming 2018 as the grid's new critical period.

Mindanao Grid

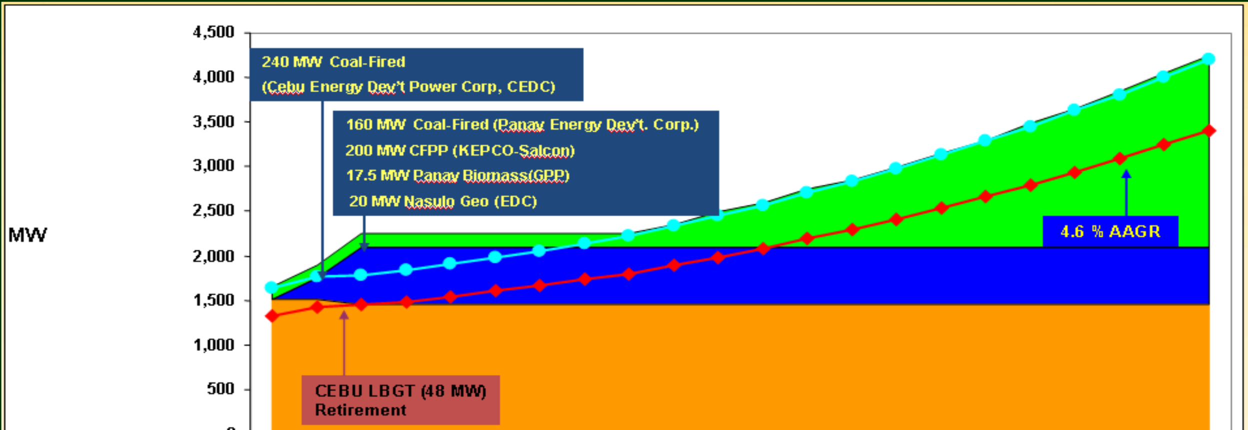
Mindanao grid is heavily dependent on hydroelectric power plant. In fact, 53.0 percent of the 1,682 MW total dependable capacities in 2009 is from hydro. With the coming in of the existing committed capacities and with the assumption that hydro facilities in the grid will run on its normal condition, supply requirement in Mindanao will satisfy the projected annual increase of 4.6 percent in peak demand. However, to prevent the recurrence of another round of supply deficit in Mindanao, the grid will need an additional capacity of 2,500 MW starting in 2010. This is on top of the following 100 MW committed capacities: (i) 42 MW Sibulan Hydro by mid 2010; (ii) 8 MW Cabulig hydro in 2011; and (iii) 50 MW Mt. Apo III geothermal plant in 2014. The additional supply requirement can be broken down into the following generic capacities: 2,000 MW for base-load plant and 500 MW for peaking plant. A 50 MW in 2010 and another 50 MW in 2011, both peaking power plants, are needed to augment the supply of capacity in the system (Figure 3).

Figure 1. LUZON SUPPLY-DEMAND OUTLOOK



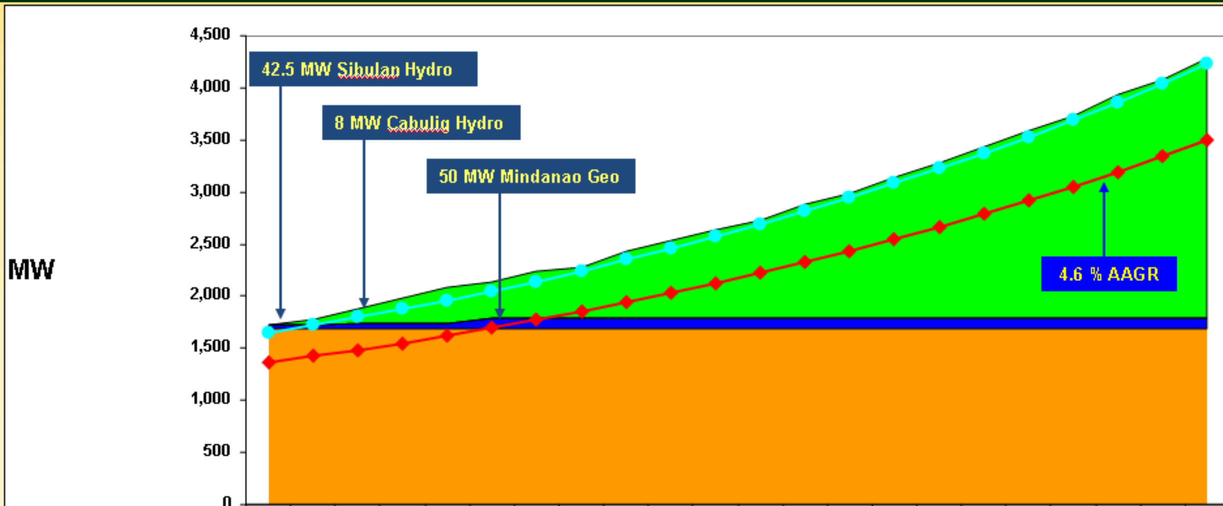
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Required Additional Cap			300	300		450	450	450	500	600	650	500	650	650	650	800	650	800	900	800	900	900
Committed			41		634																	
Existing Capacity	10,030	10,030	9,384	9,384	9,384	9,384	9,384	9,384	9,384	9,384	9,384	9,384	9,384	9,384	9,384	9,384	9,384	9,384	9,384	9,384	9,384	9,384
Required Reserve Margin	1,646	1,701	1,774	1,865	1,944	2,038	2,135	2,235	2,327	2,432	2,541	2,656	2,775	2,900	3,031	3,167	3,310	3,459	3,615	3,778	3,949	4,127
Peak Demand	7,036	7,270	7,582	7,934	8,309	8,710	9,123	9,553	9,945	10,393	10,860	11,349	11,860	12,394	12,952	13,535	14,145	14,783	15,450	16,147	16,875	17,636

Figure 2. VISAYAS SUPPLY-DEMAND OUTLOOK



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Required Additional Cap	150									100	150	100	150	100	150	150	150	200	150	200	200	200
Committed		240	398																			
Existing Capacity	1,505	1,505	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457	1,457
Required Reserve Margin	311	335	339	348	361	375	390	406	420	442	464	487	512	538	565	593	623	654	687	722	758	797
Peak Demand	1,331	1,430	1,448	1,486	1,545	1,603	1,666	1,733	1,797	1,887	1,983	2,082	2,187	2,297	2,413	2,535	2,663	2,797	2,938	3,086	3,241	3,404

Figure 3. MINDANAO SUPPLY-DEMAND OUTLOOK



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Required Additional Cap		50	50	200	100	100	100	100		100	100	100	100	100	150	150	150	150	150	200	150	200
Committed	42		8			50																
Existing Capacity	1,682	1,682	1,682	1,682	1,682	1,682	1,682	1,682	1,682	1,682	1,682	1,682	1,682	1,682	1,682	1,682	1,682	1,682	1,682	1,682	1,682	1,682
Required Reserve Margin	318	333	347	362	379	396	414	433	454	475	497	520	544	569	596	623	652	682	714	747	781	817
Peak Demand	1,359	1,421	1,483	1,549	1,620	1,692	1,769	1,852	1,942	2,031	2,125	2,223	2,326	2,434	2,546	2,664	2,787	2,916	3,050	3,191	3,339	3,493

Transmission Development Plan

The 2009 TDP has been prepared by the energy sector's newest entity, the NGCP. On 15 January 2009, NGCP has officially taken over the nationwide transmission grid operations of the National Transmission Corporation as envisioned by the Electric Power Industry Reform Act of 2001.

The 2009 TDP is the first plan released under the auspices of NGCP. It reflects NGCP's vision of building the strongest power grid and maintains the best power utility practice in Southeast Asia. This ten-year plan is also NGCP's roadmap for transmission development required to meet demand growth, support incoming generation facilities and sustain its transmission business operations while ensuring compliance with technical and regulatory framework of the electric industry. The plan will guarantee the upgrading and expansion of NGCP's transmission facilities thus contributing to social and economic development of the nation and at the same time satisfying the stakeholders' needs. As a commitment for ensuring a reliable transmission system today and in the future, NGCP will be investing billions to roll out new transmission infrastructures. These transmission network upgrade and expansion initiatives are expected to bring positive and far-reaching changes, not only in the reliability and quality of transmission service, but also in helping improve the economy of the country.

Assessment of Transmission System

As of 31 December 2008, NGCP's managed transmission assets comprised of 19,778 ckt-km (Table 6). About half of these assets or 9,527 ckt-km are in Luzon. 4,745 ckt-km form part of the Visayas Grid and the remaining 5,506 ckt-km are in Mindanao. Roughly 78.0 percent (18,861 MVA) of the total 24,214 MVA substation installed capacities are in Luzon. The Visayas account for 3,154 MVA and Mindanao 2,200 MVA. These figures exclude transmission lines and transformer assets which had already been decommissioned.

Table 6. SUMMARY OF EXISTING FACILITIES

	2004	2005	2006	2007	2008
Substation Capacity (in MVA)					
Philippines	24,309	24,607	24,489	24,732	24,814
Luzon	20,041	19,236	19,121	19,411	18,861
Visayas	2,571	3,371	3,268	3,171	3,154
Mindanao	1,697	2,000	2,099	2,150	2,200
Transmission Line Length (in ckt-km)					
Philippines	21,319	20,236	20,236	20,129	19,778
Luzon	10,494	9,881	9,840	9,712	9,567
Visayas	5,072	4,807	4,844	4,856	4,745
Mindanao	5,753	5,547	5,552	5,561	5,506

To ensure that voltages across the network are within the levels prescribed in the Philippine Grid Code (the "Grid Code"), capacitors and reactors have been installed in appropriate locations in the different parts of the region. Currently, there are a total of 1,081.45 mega volts ampere reactive (MVAR) capacitors distributed as follows: 600 MVAR in Luzon, 226.45 MVAR in the Visayas, and 255 MVAR in Mindanao. These exclude the capacitors at the Naga HVDC converter station, which provides the MVAR requirements thereat. The total reactors are 620 MVAR for Luzon and 555 MVAR for Visayas, or a total of 1,175 MVAR. A new 90 MVAR reactor has been installed at the Kadampat Substation in Labrador, Pangasinan to prevent the occurrence of high system voltage in northern Luzon.

The increasing load in the country would necessitate either expanding the existing substations or developing new ones. In Metro Manila, the existing 230-kV substations have space limitations already in accommodating future capacity expansion. As a common problem in an urbanized area, acquiring right-of-way for new transmission lines and area for new substations would be difficult. Further, the capital region is geographically unique as the land area between the Manila Bay and Laguna Lake is rather narrow. Developing power generating power plants within Metro Manila is actually ideal in order to reduce power imports. However, the environmental concerns, area congestion, and high cost of development would make the implementation difficult.

In South Luzon, the Biñan-Sucat 230 kV corridor is posing constraints to the maximum allowable dispatch of the associated power plants due to its limited capacity in maintaining the provision for N-1 contingency. The Kalayaan- Makban corridor is another 230 kV line in the area that is due for upgrading to allow all possible generation dispatch scenarios. The reinforcements of these two important corridors would be necessary upon entry of new power plants and expansion of existing plants in South Luzon. The transmission facilities serving the northeastern and north-western regions of Luzon Island have no provisions for N-1 contingency. Moreover, there are generation expansion projects that will require the upgrading or reinforcement of dedicated lines for the power plants.

In Visayas, Panay has been dependent on the submarine cable to meet its power requirements. The increase in the demand in each of the Visayas sub-grid must be met with corresponding installation of additional capacity within the island; otherwise, the upgrade of existing submarine cables may be considered an option. However, the Visayas grid cannot rely entirely on the submarine linkages to source power from one island to the other. Economics would dictate that higher system losses and lack of voltage support are important considerations in deciding which option to take. In many respect, distributed generation in the islands can better address these issues. On the part of NGCP, it will propose the required transmission infrastructures in case no new generation capacity will come in. Additional transformers will be proposed for the Third Regulatory Period to provide redundancy to a number of substations and also to avert overloading during N-1.

Unless new generating facilities are installed in the island, Bohol will continue to rely heavily on Leyte for its power requirements. The island has few inland generating plants - Bohol diesel, Janopol hydro and Loboc hydro. The combined 23-MW capacity would not be sufficient to supply the entire demand in the island. For this reason, the outage of the Leyte-Bohol interconnection will result in huge power interruptions in Bohol. For the interconnection with Leyte, initial results of the studies indicate that a second submarine cable must be in place by 2018, assuming that no new generators will be installed in Bohol. The ongoing Bohol Backbone Project (Ubay- Corella 138 kV line) will provide the island a reliable transmission backbone. Currently, the island relies on single circuit 69 kV woodpole backbone.

In Cebu, with the coming on stream of a total of 440-MW committed capacity addition, the expansion of New Naga-Banilad 138 kV transmission line is necessary. This will allow the power flow from these new plants to the load centers in Cebu, which are the Banilad, Mandaue and Mactan substations.

Unless upgraded, the New Naga-Banilad and New Naga-Quiot lines will be overloaded by 2014. This is based on a scenario where the Cebu coal plants are maximized, and that Panay and Negros are self-sufficient. The Talavera-Sigpit-New Naga 138 kV corridor must also be reinforced due to the entry of the new Toledo plant.

In Negros, the overhead lines that are linked to the Cebu-Negros submarine cable must be upgraded by installing additional 1-795 MCM circuit; otherwise, the lines will be overloaded by 2011 during N-1 assuming that there is minimum generation in Panay. This corridor consists of the Amlan-Mabinay, Mabinay-Kabankalan and Kabankalan-Bacolod 138 kV lines. Low voltage problems are being experienced in northern Negros, particularly in Bacolod, which is the load center. This is due to the lack of inland generating plants, and that the generators are located in the southern part far from the load center.

Panay island at present remains dependent on the submarine cable to augment its power deficiency. However, the need for the second submarine cable, as forecasted, has been delayed due to the lower actual demand of the island. The latest forecast indicates that it will be needed beyond 2010. In determining the appropriate timing for the implementation of the submarine component of the Negros-Panay Interconnection Uprating Project within the Third Regulatory Period, some assumptions have to be made: (1) The provision of the renewable energy act on must dispatch of renewable energy plants will be strictly observed; (2) The WESM in Visayas will already be in place in 2011; and (3) The 160-MW coal plant in Iloilo by the Panay Energy Development Corporation (PEDC) as well as the 240-MW coal plant in Toledo City, Cebu by Cebu Energy Development Corporation (CEDC) and 200-MW KEPCO coal plants in Cebu will be on stream as scheduled in 2011. The worst case would be if the coal plants in Cebu will have priority dispatch over the coal plant in Panay. With this scenario, the second submarine cable will be needed by 2013.

In Mindanao, currently, the main corridors connecting the Agus complex to the grid are the Agus 2-Kibawe and Abaga-Tagoloan 138 kV lines. The tripping of the Agus 2-Kibawe line in the past had resulted in huge power swing to the other corridors, one of which is the Maramag-Kibawe line, which resulted in N-1 loading violation. The ongoing Abaga-Kirahon-Maramag-Bunawan transmission line projects will address this problem. With this 230-kV designed corridor, which extends from the Agus hydro complex in the north to the Bunawan substation in the southeast, the huge hydro capacity of Agus (about 38 percent of the total grid) will have a reliable backbone to allow the delivery of its output to the major load centers located in southern Mindanao (about half of the island’s total demand).