CHAPTER V

SUMMARY OF THAILAND POWER DEVELOPMENT

5.1 SUMMARY OF THAILAND POWER DEVELOPMENT PLAN 2010-2030 (PDP 2010)

5.1.1 Introduction

The last Thailand Power Development Plan 2007–2021 (PDP 2007 Revision 2) was an update of the PDP 2007 Revision 1. The original PDP 2007 was issued in June 2007 followed by a revised PDP 2007 (PDP 2007 Revision 1) in December 2008. Since December 2008, the electricity demand has decreased significantly due to depressed economic conditions. To portray a clear picture of power sector development, the Ministry of Energy appointed a subcommittee to prepare a new Thailand PDP and a working group to work on the relevant assumptions on 16 September 2009 and 3 November 2009, respectively.

5.1.2 Summary of PDP2010

5.1.2.1 Current Status

The peak power demand of 2009 occurred on 24 April 2009 of which the maximum power generation of the country reached 22,315.4 MW which was 78.4 MW or 0.35% higher than the record of 2008.

Power Plants: As of December 2009, the total contract capacity was 29,212 MW comprising 14,328.1 MW (49.0%) of EGAT's power plants, 14,243.9 MW (48.8%) of domestic private power producers (IPPs and SPPs) and 640 MW (2.2%) of neighboring country power purchase. The details of contract capacity of Thailand power system.

Transmission System: The standard voltage levels of EGAT transmission system are 500 kV, 230 kV, 132 kV, 115 kV, and 69 kV at operating frequency of 50 Hz. The total length of high voltage transmission line as of December 2009 was 30,446 circuit-kilometers. The total number of high voltage substations was 209 with total transformer capacity of 72,787 MVA. The summary of transmission line length and number of EGAT's substations classified by voltage level.

5.1.2.2 Key Assumptions in PDP 2010

- The new Thailand's Load Forecast was calculated upon energy consumption at end users' level projected by the Metropolitan Electricity Authority (MEA) and the Provincial Electricity Authority (PEA). The figures were derived from regression analysis based on recorded electricity retail and the GDP growth in the base case of NESDB's preliminary study result. The reason to employ this initial outcome was to establish PDP 2010 in due course to cope with present situations and to ascertain work plans of the obliged projects.

- Information about energy conservation from ongoing DSM programs was acquired from EPPO and already included in regression analysis, whereas that from new programs was subtracted from the forecast demand afterward.

-Power generation using renewable energy in 2010-2022 was estimated as per AED (2008-2022) of the Ministry of Energy, while that in 2023-2030 was done with the annual estimation.

- The minimum annual reserve margin was constraint to 15% or sufficient to handle the western gas shortage which is equivalent to 6,961 MW. Hence, the system's reserve margin in the early years is greater than 20%.

- Candidate power plants considered in PDP 2010 were 800 MW clean coal power plant, 800 MW combined cycle power plant, 1,000 MW nuclear power plant, 250 MW gas turbine power plant and 500 MW Lam Takhong pumped storage hydro power plant (additional units).

- In order to maintain the natural gas consumption in power sector, the gas fired power plants to be retired would be replaced with their succeeding combined cycle generating units.

- Greenhouse gas emission per unit of generated electricity in 2030 was set to be lower than that of PDP 2007 Revision 2.

- The proportion of fuel use and energy resources was allocated as below:

- Renewable energy as per the 15 Years AEDP; Cogeneration SPP took first priority and was followed by other alternative technologies.

- Nuclear power plant was limited to 1 unit/year and allowed only 2 years in a row with a pause of 2 years to comfort the investment plan.

- Power purchase from neighboring countries must not exceed 25% of the total generating capacity.

- Other generating capacity was a well considered mix of replacing gas fired combined cycle power plants and clean coal thermal power plants.

5.1.2.3 Thailand Power Development Plan (PDP 2010)

With the aforementioned assumptions about future electrical supplies, power Import from neighboring countries, load forecast and others, EGAT and the Ministry of Energy cooperated in performing Thailand Power Development Plan 2007–2021 (PDP 2010) which can be summarized as followings.

Projects during 2010-2020

- EGAT owned power plants	4,821 MW
- IPP	4,400 MW
- SPP	3,539 MW
- VSPP	2,335 MW
- New combine cycle power plant	800 MW
- Purchase from neighboring countries	5,669 MW

Projects during 2021-2030

- New EGAT power plant (Renewable)	97 MW
- New EGAT power plant (Natural Gas)	13x800 MW
- New EGAT power plant (Clean Coal)	8x800 MW
- New EGAT power plant (Nuclear)	4x1,000 MW
- Power purchase from SPP	3,800 MW
- Power purchase from VSPP	1,745 MW
- Power purchase from neighboring countries	6,000 MW

Power Purchase from Neighboring Countries,SPP and VSPP Using Renewable Energy

Power import projects stated in PDP 2010 are merely a long term indicative guideline. The actual purchase depends on definite capacity and completion date of each project as well as the appropriate timing and power demand. Above all, it must follow the MOU(s) between the governments.

In the same manner, power purchase projects from SPP and VSPP using renewable energy specified in PDP 2010 are only a guideline for long term outlook based on the purchase status as of 31 December 2009 and the 15 Years AEDP. The exact purchase varies upon the potential of different resources and technologies, and must be corresponding with the Government's policies.

Thailand Power Development Plan 2010-2020 (PDP 2010)

Year 2009 Peak Demand 22,044.9 Total Capacity as of December 2009 Contract Capacity 29,212 MW Minimum Reserve Margin 27.6 %

Year 2010 Peak Demand 23,249 MW:

VSPP (Jan)	367 MW
SPP (Renewables) (Jun)	90 MW
Lao PDR (Nam Theun 2) (Mar)	920 MW
North Bangkok CC #1 (May)	670 MW
SPP (Cogeneration) (Nov)	90 MW

Contract Capacity 31,349 MW Minimum Reserve Margin 28.1%

Year 2011 Peak Demand 24,568 MW :

Retirement of Khanom TH #1 (Jul)	-70 MW
VSPP (Jan)	258 MW
EGAT Renewables (Jan)	18 MW
Lao PDR (Nam Ngum 2) (Jan)	597 MW
Chao Phraya Dam #1-2 (Jan)	2x6 MW
SPP (Renewables) (Jun)	160 MW
Naresuan Dam (Oct)	8 MW

GHECO-ONE Co., Ltd. (Nov) 660 MW

Contract Capacity 32,992 MW Minimum Reserve Margin 27.1%

Year 2012 Peak Demand 25,913 MW :

VSPP (Jan)	162 MW
Mae Klong Dam #1-2 (Jan)	2x6 MW
Khun Dan Prakarnchon Dam (Apr)	10 MW
Pasak Jolasid Dam (May)	7 MW
SPP (Renewables) (Jun)	65 MW
SPP (Cogeneration) (Jun-Dec)	704 MW
Lao PDR (Theun Hinboun Ext.) (Jul)	220 MW

Contract Capacity 34,172 MW Minimum Reserve Margin 23.7 %

Year 2013 Peak Demand 27,188 MW :

VSPP (Jan)	187 MW
Kwae Noi Dam #1-2 (Jan)	2x15 MW
EGAT Renewables (Jan)	24 MW
SPP (Cogeneration) (Mar-Sep)	720 MW
Siam Energy Co., Ltd. #1-2 (Mar, Sep)	2x800 MW
National Power Supply Co., Ltd. #	2x135 MW

Contract Capacity 37,003 MW Minimum Reserve Margin 25.4 %

Year 2014 Peak Demand 28,341 MW :

Retirement of Bang Pakong	-1052 MW
VSPP (Jan)	192 MW
EGAT Renewables (Jan)	18 MW
National Power Supply Co., Ltd.	2x135 MW
Wang Noi CC #4 (Jun)	800 MW
SPP (Cogeneration) (Jun)	90 MW
Power Generation Supply Co., Ltd.	2x800 MW
Chana CC #2 (Jul)	800 MW

Contract Capacity 39,720 MW Minimum Reserve Margin 23.4 %

Year 2015 Peak Demand 29,463 MW :

Retirement of Rayong CC #1-4 (Jan)	-1175 MW
VSPP (Jan)	167 MW
EGAT Renewables (Jan)	14 MW
Bang Lang Dam (Renovate) (Jan)	12 MW
Lao PDR (Hongsa TH #1-2) (May, Oct)	2x491 MW
SPP (Cogeneration) (Jun)	270 MW

Contract Capacity 39,990 MW Minimum Reserve Margin 26.0 %

Year 2016 Peak Demand 30,754 MW :

Retirement of Khanom TH #2 (Jul)	-70 MW
Retirement of Khanom CC #1 (Jul)	-678 MW
EGAT Renewables (Jan)	17 MW
Myanmar (Mai Khot TH #1-3)	3x123 MW
Lao PDR (Hongsa TH #3) (Feb)	491 MW
VSPP (Jun)	231 MW
SPP (Cogeneration) (Jun)	270 MW
New Capacity _ South (Jul)	800 MW

Contract Capacity 41,419 MW Minimum Reserve Margin 27.2%

Year 2017 Peak Demand 32,225 MW :

Retirement of Bang Pakong CC #3	-314 MW
End of SPP Contract (Apr-Oct)	-180 MW
VSPP (Jan)	229 MW
EGAT Renewables (Jan)	11 MW
Lao PDR (Nam Ngum 3) (Jan)	440 MW
Lam Takhong #3-4 (Jun)	2x250 MW
SPP (Cogeneration) (Jun)	270 MW

Contract Capacity 42,374 MW Minimum Reserve Margin 23.2 %

Year 2018 Peak Demand 33,688 MW:

Retirement of Bang Pakong CC #4	-314 MW
Retirement of Nam Pong CC #1	-325 MW
End of SPP Contract (Feb-Apr)	-42 MW
VSPP (Jan)	176 MW
EGAT Renewables (Jan)	30 MW
SPP (Cogeneration) (Jan)	270 MW
Neighbouring Countries (Jun)	450 MW

Contract Capacity 42,619 MW Minimum Reserve Margin 17.3 %

Year 2019 Peak Demand 34,988 MW :

End of SPP Contract (Jun-Sep)	-185 MW
VSPP (Jan)	177 MW
EGAT Renewables (Jan)	8 MW
SPP (Cogeneration) (Jan)	270 MW
Neighbouring Countries (Jun)	600 MW
EGAT Clean Coal #1 (Jun)	800 MW

Contract Capacity 44,289 MW Minimum Reserve Margin 15.0 %

Year 2020 Peak Demand 36,336 MW :

Retirement of South Bangkok CC #1 (Jan)	-316 MW
Retirement of Nam Pong CC #2 (Jan)	-325 MW
End of Tri Energy Co., Ltd. (TECO) PPA (Jun)	-700 MW
End of SPP Contract (Feb-Aug)	-188 MW
VSPP (Jan)	190 MW
EGAT Renewables (Jan)	22 MW
SPP (Cogeneration) (Jan)	270 MW
EGAT Nuclear Power Plant #1 (Jan)	1000 MW
Power Purchase from Neighbouring Countries (Jun)	600 MW

Contract Capacity 44,842 MW Minimum Reserve Margin 15.6%

Total Added Capacity 2010-2020 21,564 MW

Total Retired Capacity 2010-2020 - 5,933 MW

Year 2021 Peak Demand 37,856 MW

End of SPP Contract (Feb-Oct)	-200 MW
VSPP (Jan)	135 MW
EGAT Renewables (Jan)	61 MW
SPP (Cogeneration) (Jan)	380 MW
EGAT Nuclear Power Plant #2 (Jan)	1000 MW
Neighbouring Countries (Jan)	600 MW
EGAT Clean Coal #2 (Jun)	800 MW

Contract Capacity 47,618 MW Minimum Reserve Margin 15.4 %

Year 2022 Peak Demand 39,308 MW

Retirement of Bang Pakong TH #3 (Jan)	-576 MW
End of SPP Contract (Aug-Oct)	-150 MW
VSPP (Jan)	294 MW
EGAT Renewables (Jan)	36 MW
SPP (Cogeneration) (Jan)	360 MW
EGAT Gas Fired CC #1 (Jan)	800 MW
Neighbouring Countries (Jan)	600 MW

Contract Capacity 48,982 MW Minimum Reserve Margin 16.0 %

Year 2023 Peak Demand 40,781 MW

Retirement of Wang Noi TH #1-3 (Jan)	-1910 MW
Retirement of South Bangkok CC #2 (Jan)	-562 MW
Retirement of Bang Pakong TH #4 (Jan)	-576 MW
End of Theun Hinboun PPA (Jan)	-214 MW
End of Eastern Power & Electronic PPA (Apr)	-350 MW
End of SPP Contract (Apr)	-41 MW
VSPP (Jan)	146 MW
SPP (Cogeneration) (Jan)	360 MW
EGAT Gas Fired CC #2-6 (Jan)	5x800 MW
EGAT Clean Coal #3 (Jan)	800 MW
Neighbouring Countries (Jan)	600 MW

Contract Capacity 51,235 MW Minimum Reserve Margin 16.7 %

Year 2024 Peak Demand 42,236 MW

End of SPP Contract (Feb-Sep)	-680 MW
Retirement of Mae Moh TH #4 (Jan)	-140 MW
VSPP (Jan)	148 MW
SPP (Cogeneration) (Jan)	360 MW
EGAT Nuclear Power Plant #3 (Jan)	1000 MW
Neighbouring Countries (Jan)	600 MW

Contract Capacity 52,523 MW Minimum Reserve Margin 16.5 %

Year 2025 Peak Demand 43,962 MW

Retirement of Mae Moh TH #5-6 (Jan)	-280 MW
End of SPP Contract (Apr-Oct)	-244 MW
End of Independent Power (Thailand) PPA	-700 MW
Retirement of Ratchaburi TH #1-2 (Nov)	-1440 MW
VSPP (Jan)	163 MW
SPP (Cogeneration) (Jan)	360 MW
EGAT Nuclear Power Plant #4 (Jan)	1000 MW
EGAT Gas Fired CC #7 (Jan)	800 MW
Neighbouring Countries (Jan)	600 MW

Contract Capacity 52,782 MW Minimum Reserve Margin 16.3 %

Year 2026 Peak Demand 45,621 MW

Retirement of Mae Moh TH #7 (Jan)	-140 MW
End of SPP Contract (Sep)	-5 MW
VSPP (Jan)	159 MW
SPP (Cogeneration) (Jan)	360 MW
EGAT Gas Fired CC #8-9 (Jan)	2x800 MW
EGAT Clean Coal #4-5 (Jan)	2x800 MW
Neighbouring Countries (Jan)	600 MW

Contract Capacity 56,956 MW Minimum Reserve Margin 15.9 %

Year 2027 Peak Demand 47,344 MW

End of SPP Contract (Feb)	-15 MW
Retirement of Ratchaburi CC #1-2 (May)	-1360 MW
Retirement of Ratchaburi CC #3 (Nov)	-681 MW
VSPP (Jan)	169 MW
SPP (Cogeneration) (Jan)	360 MW
EGAT Gas Fired CC #10 (Jan)	800 MW
Neighbouring Countries (Jan)	600 MW

Contract Capacity 56,830 MW Minimum Reserve Margin 15.4%

Year 2028 Peak Demand 49,039 MW

End of SPP Contract (Jan-Dec)	-95 MW
End of Glow IPP Co., Ltd. PPA (Feb)	-713 MW
VSPP (Jan)	173 MW
SPP (Cogeneration) (Jan)	360 MW
EGAT Nuclear Power Plant #5 (Jan)	1000 MW
EGAT Gas Fired CC #11-12 (Jan)	2x800 MW
EGAT Clean Coal #6-7 (Jan)	2x800 MW
Neighbouring Countries (Jan)	600 MW

Contract Capacity 61,355 MW Minimum Reserve Margin 16.3 %

Year 2029 Peak Demand 50,959 MW

Retirement of Mae Moh TH #8 (Jan)	-270 MW
VSPP (Jan)	179 MW
SPP (Cogeneration) (Jan)	360 MW
EGAT Gas Fired CC #13 (Jan)	800 MW
EGAT Clean Coal #8 (Jan)	800 MW
Neighbouring Countries (Jan)	600 MW

Contract Capacity 63,824 MW Minimum Reserve Margin 16.3 %

Year 2030 Peak Demand 52,890 MW

Retirement of Mae Moh TH #9 (Jan)	-270 MW
End of Houay Ho PPA (Jan)	-126 MW
VSPP (Jan)	179 MW
SPP (Cogeneration) (Jan)	540 MW
EGAT Clean Coal TH #9 (Jan)	800 MW
Neighbouring Countries (Jan)	600 MW

Contract Capacity 65,547 MW Minimum Reserve Margin 15.0 %

Total Added Capacity 2021-2030	32,442 MW
Total Retired Capacity 2021-2030	- 11,737 MW
Total Installed Capacity as of December 2009	29,212 MW
Total Added Capacity 2010-2030	54,005 MW
Total Retired Capacity 2010-2030	- 17,671 MW
Grand Total Capacity at the end of 2030	**65,547** MW

5.1.3 Assumptions in the Formulation of PDP 2010

The vital assumptions and criteria employed in performing PDP 2010 can be divided into 3 categories as followings:

1. System Reliability
    - Reserve Margin
    - Power Purchase from Neighboring Countries
2. Clean Energy and Efficient Utilization
    - Demand Side Management (DSM)
    - Electricity Generation from Renewable Energy
    - Electricity Generation with Cogeneration System
    - Greenhouse Gas Emission Reduction
3. Load Forecast

5.1.3.1 Reserve Margin

There have been several gas shortage events mostly from western pipeline system, while natural gas is still the major fuel for power generation in Thailand. Considering the risk of such emergency incidents, the suitable reserve margin is probably larger than 20% of the total generating capacity of the system. In addition, fuel diversification is a concerned issue, i.e. balancing the portion of power generation from coal, nuclear, renewable energy and power import.

5.1.3.2 Power Import from Neighboring Countries

Only promising power import projects were identified in PDP 2010 with their contract capacity and commissioning schedule. They must have certain signs of success e.g. Tariff MOU. However, as suggested by the study on power import proportion, maximum share of the power import over the system's generating capacity must not exceed the following percentages:

- Total import from 1 country - 13%

- Total import from 2 countries - 25%
- Total import from 3 countries - 33%
- Total import from 4 countries - 38%

5.1.3.3 Demand Side Management (DSM)

Electrical energy saving at consumption level and peak reduction at the system peak time resulting from existing DSM programs were already integrated in the regression analysis of the "February 2010" Load Forecast. These programs were composed of energy conservation campaigns as well as market mechanisms and consumer behaviors that induced appliances' efficiency improvement e.g. "No.5 Label". Nevertheless, information about the impacts of new programs and innovations, e.g. T5 fluorescent tubes, was unavailable and beyond the capability of regression analysis. Thus, they were later deducted from the load forecast.

5.1.3.4 Electricity Generation from Renewable Energy

At present, the proposed power generation from renewable energy projects are indefinite in aspects of duplicated locations and no robust guarantee of implementation, while their influences on system reliability and the readiness of transmission network are also needed to be studied. Therefore, PDP 2010 contains power generation from renewable energy regarding the 15 Years AEDP to the year 2022 and not less than 5% of energy production referring to the VSPP purchase projected by distribution authorities afterward. The table below shows the cumulative generating capacity from all renewable energy resources

Table 5-1 Renewable energy capacity in Power Development Plan

Unit: MW

Type	Biomass	Biogas	Solar	MSW	Wind	Small Hydro	Total
2009	663.04	49.04	9.23	10.82	3.07	18.33	753.52
2022	2,272.04	152.04	707.23	159.32	1,231.07	281.33	4,803.02
2030	3,032.04	176.04	1,107.23	183.32	1,321.07	281.33	6,101.02

Since renewable technologies are in their early stage and recently commercially introduced, there is insufficient evidence to assure their dependable generating capacity. Most of available data are average values on daily and monthly basis, which cannot reflect the power generation at a certain point of time, particularly that of wind and solar power. Consequently,concerning risk aversion, PDP 2010 recommends deeming their dependable capacity at confident level and later adjusting it when the actual information is available.

5.1.3.5 Electricity Generation with Cogeneration System

Due to the NEPC's resolution on 24 August 2009 to promote cogeneration system, the amount of power purchase from SPP using cogeneration system in PDP 2010 was not only compatible with the purchasing plan during 2009-2015 but also added with another 2,000 MW in 2015-2021 and 360 MW annually during 2022-2030. Cogeneration system is promoted by the Government as it allows more efficient use of steam and power as well as the natural gas utilization.

5.1.3.6 Load Forecast

NESDB in collaboration with NIDA are currently performing a study of Thailand long term economic outlook. The primary outcomes had revealed the long term GDP projection in 3 scenarios namely High GDP Case, Base GDP Case and Low GDP Case. The PDP revising subcommittee then selected the Base Case figures to perform the load forecast for PDP 2010. The peak demand of the year 2021 was estimated at 37,718 MW which is 6,563 MW lower than that

of PDP 2007 Revision 2. Meanwhile, the peak demand at the end of PDP 2010 (the year 2030) was expected to be 52,691 MW.

5.1.3.7 Greenhouse Gas Emission Reduction

In 2009, the power generation sector released 0.546 kg of carbon dioxide for every kWh of electricity production. To respond to clean energy policy and the Green PDP, the concrete plan to cut down greenhouse gas emission in generation system was incorporated into PDP 2010. The goal is to have a lower emission rate than that of PDP 2007 Revision 2 in the year 2020 and then to retain it at not a higher rate, which can be done by apportioning assorted types of low emission power plant.

5.1.3.8 Allocation of New Generating Capacity

The combination of new capacities in PDP 2010 was considered upon the followings.

Renewable Energy and Cogeneration System

Power generation from renewable energy and cogeneration SPPs was the first priority in future planting up. Their capacity and operating schedule of the renewable energy in 2010-2022 was in line with the 15 Years AEDP. Thereafter, their energy generation was set to not less than 5% of total energy requirement as predicted by distribution power utilities. Meanwhile, cogeneration SPPs utilize energy resources and infrastructures more efficiently. Their capacity and commissioning schedule was according to the purchasing progress in 2010- 2014, the NEPC's resolution on 24 August 2009 in 2015-2021 (2,000 MW) and the agreed capacity in 2022-2030 (360 MW annually).

Power Purchase from Neighboring Countries

PDP 2010 has promising power purchase projects from 2 neighboring countries. Hence, their portion was limited to 25% due to the system reliability constraints. However,most of them are hydro electric power plants which do not discharge greenhouse gases, so they can lessen the number of future fossil fuel fired power projects.

Gas Fired Power Plant

Due to the risk of natural gas supply, especially from the western gas pipeline system, PDP 2010 attempted to diminish gas quantity in power generation by diversifying fuel types and resources. Nevertheless, to maximize the profits of existing domestic resources and infrastructures, new gas-fired power plants were assigned to replace the retiring ones.

Nuclear Power Plant

Nuclear power plants were selected by the optimization because of their low production cost. In addition, they can serve base load for a long duration and thus secure the power system. They can also help trimming down the number of fossil fuel fired power plants since they do not release greenhouse gases. However, due to public acceptance, PDP 2010 allowed only 5 units of them with a maximum energy generation share of 10% to the total generation requirement. Besides, they had to come in intervals to ease the investment burdens.

Clean Coal Power Plant

As well as nuclear power plants, coal-fired power plants were picked up by the optimization due to their low production cost. However, there are difficulties with location, greenhouse gas emission and public acceptance, despite Supercritical or Ultra-supercritical technologies with bituminous fuel and FGD equipment. Educating people about facts, knowledge and understanding is therefore very essential. To avoid greenhouse gas emission, clean coal power plants were the last precedence of new planting up in PDP 2010.

5.1.4 Power Demand Forecast

The power demand forecast used for the arrangement of this Thailand Power Development Plan (PDP 2010) is the electricity demand prediction of the Thailand power system, called "The Power Demand Forecast (February 2010)", prepared by the Load Forecast Working Group (LFWG) set up by the Thailand Load Forecast Subcommittee (TLFS). The forecast is based on the following assumptions.

1. The forecast period 2010 – 2030 is defined.

2. The actual peak demand and actual energy generation of 2009 are bases for this forecast.

3. The estimated Thailand Economic Growth or the forecasted Thailand Gross

Domestic Products (GDP), shown in Table 4.1, is a required parameter to predict the future power demand. The forecast GDP figure was agreed by the LFWG for this power demand forecast as the followings:

- For short-term period (2010 – 2011): the estimated GDP as agreed among MEA, PEA, and EGAT for performing their plan their 2011 budgets was used.
- For long-term period (2012 – 2024): the forecasted GDP was applied following the initial result obtained from the Thailand Long-term GDP study by the National Institution of Development Administration (NIDA) under the governance of the National Economic and Social Development Board (NESDB). The final report of the study will be completed by this year 2010.
- For further period (2025 – 2030): the forecasted GDP was fixed as the same rate as that in 2024 in the initial result of the study
- Considering renewable energy in the power demand forecast, the estimated amounts of MEA and PEA renewable energy purchases from Very Small Power Producers (VSPP), which is consistent with the Alternative Energy Development Plan (AEDP) prepared by the Ministry of Energy was taken into account. It is noted that the plan was approved by the Cabinet on 28 January 2009 (more details shown in Chapter 7).
- The Demand Side Management (DSM) project with a clear specification of electricity demand reduction at consumption level was considered. However, DSM projects are classified from electricity conservation plans gathered and estimated by the Energy Planning and Policy Office (EPPO). In addition, the DSM project is considered as new projects which have not been included in the Load Forecast Model

The "February 2010" power demand forecast used in formulating PDP 2010 is shown in Appendix 5. For peak demand, the forecasted peak demand in 2030 is approximately 52,890 MW, 2.37 times higher than that in 2009, (22,315.35 MW). An average growth rate of the forecasted peak demand during 2010 – 2030 is 4.19 percent per year. For energy demand, the forecasted energy demand in 2030 is about 347,947 GWh, 2.38 times higher than that in 2009, (146,182 GWh). An average growth rate of the forecasted energy demand during 2010 – 2030 is 4.22 percent per year. Thus, the long-term load factor is between 74 and 75 percent.

The "February 2010" demand forecast anticipated electricity saving resulting from the new DSM projects by adjusting electricity demand at consumption level. This causes the future energy elasticity1 decrease from 1.36 in 2010 to 0.99 in 2030

Compared with the previous "December 2008" demand forecast, the "February 2010" demand forecast indicates decreasing projection due to the lower long-term economic forecast which was reviewed to be compatible with the global economic recession and Thailand economic downturn.

5.2 SUMMARY OF THAILAND POWER DEVELOPMENT PLAN2012 – 2030 (PDP 2010: REVISION 3)

5.2.1 Introduction

Thailand Power Development Plan 2010 - 2030 (PDP2010) was approved by the Nation Energy Policy Council (NEPC) on 12 March 2011, and then was endorsed by the Cabinet on 23 March 2011. The themes of PDP2010 substantially focused on security and adequacy of power system along with the policies of the Ministry of Energy (MoEN) on the aspects of environment concern, energy efficiency and renewable energy promotion to be in line with the 15-Year Renewable Energy Development Plan (REDP 2008 - 20212). Parenthetically, cogeneration system was recognized to promote as the efficient electricity generation.

In 2010, the recorded actual power demand (peak) of the country increased significantly higher than the forecast and tended to grow continuously. Additionally, the new power plant construction of Independent Power Producers (IPP) as plan has been delayed causing power system security to fall at risk influencing power reserve margin (RM) into the level of lower than the setting criteria or standards. Accordingly, the MoEN set a framework for a short-term urgent relief (2012 – 2019) by revising the power development plan (the PDP 2010) to be the one so called PDP2010: Revision 1 subsequently approved by NEPC on 25 November 2010, and endorsed by the Cabinet on 30 November 2010.

On 11 March 2011, an earthquake and tsunami occurred to strike the east coast of Japan, leading to severe damages on nuclear reactors as well as radiation leak and contamination on the Fukushima Daiichi Nuclear Power Plant. This disaster lessened public acceptance and trust in the Thailand's nuclear power project development,encouraging the MoEN to contemplated the

postponement of scheduled commercial operation date (SCOD) of the first unit on nuclear power project. Consequently, the PDP2010: Revision 2 was prepared and submitted to the NEPC, and accordingly was approved by the NEPC on 27 April 2011, and endorsed by the Cabinet on 3 May 2011 to shift SCOD of the first unit on nuclear power project forward by 3 years from 2020 to 2023 for the reasons of safety measures review, legislation framework, regulatory framework and stakeholder involvement review as well as additional supporting plans.

By the way, on 27 December 2011, the Cabinet approved the resolution of NEPC proposed on 30 November 2011 calling for Alternative Energy Development Plan: AEDP 2012–2021 (by 25 percent instead of fossil fuels within the next 10 years) and also 20-Year Energy Efficiency Development Plan 2011 – 2030 (EE Plan 2011 – 2030).

The scope of the new government policies and the variation of current economic situation induce changes and fluctuation in both power demand and power supply.Therefore, to have clear vision on power supply acquiring, Thailand Power Development Plan 2010 – 2030 (PDP2010: Revision 3) is developed with crucial issues as the following:

1) Forecasted power demand results approved by the Thailand Load Forecast Subcommittee (TLFS) on 30 May 2012 are adopted within frameworks as the following.

- Refer to the projected Thai Gross Domestic Products (GDP) and projected Gross Regional Products (GRP) estimated by the Office of National Economic and Social Development Board (NESDB), and issued on 29 November 2011, covering the economic stimulation policies and flooding effects at the end of 2011

- Refer to the approved 20-Year Energy Efficiency Development Plan 2011 – 2030 (EE Plan 2011 – 2030) proposed by the MoEN

2) Alternative Energy Development is regarded according to Alternative Energy Development Plan: AEDP 2012-2021 to use renewable energy and alternative energy by 25 percent instead of fossil fuels within the next 10 years.

3) Energy supply security is taken into consideration of fuel diversification and suitable power reserve margin level.

5.2.2 Summary

The revised PDP or *"Thailand Power Development Plan 2010 – 2030 (PDP2010: Revision 3)"* is suggested within the scope of the new government's energy policies frameworks as listed below.

1) The 20-Year Energy Efficiency Development Plan 2011 – 2030 (EE Plan 2011 – 2030): this policy is targeting on 25 percent reduction of energy intensity (ratio of energy consumption to GDP) of the country within 20 years (2011 – 2030). resulting in the decrease of country's power demand projection on account of energy saving programs and energy efficiency promotions.

2) The 10-Year Alternative Energy Development Plan 2012 - 2021 (AEDP 2012 –2021): this policy is targeting on increasing the share of renewable energy and alternative energy uses by 25 percent instead of fossil fuels within the next 10 years. resulting in replacement of some planned conventional (fossil fuels as coal-fired or gas-fired based) power plants by renewable power plants.

In addition, the government has set the new policies for economic stimulation , causing trajectory changes in GDP growth rate projection during the year 2012 – 2020.However, power demand forecast in terms of 2030 net peak demand is still stand at about 52,256 Megawatt (MW) lower than that of the previous version of the forecast around 3,494 MW (or 6.27 percent).

The total generating capacities during 2012 – 2030 can be summarized as the following:

- Total capacity (as of December 2011) 32,395 MW
- Total added capacity during 2012 – 2030 55,130 MW
- Total retired capacity during 2012 – 2030 - 16,839 MW
- Grand total capacity (at the end of 2030) 70,686 MW

5.2.3 Thailand Electricity Overview and Power Demand Forecast

5.2.3.1 Electricity Overview

In 2012, the country's electricity demand grew at an a bit accelerating rate in tandem with the hot weather. Net peak generation requirement (on EGAT system) rose up to 26,121.1

MW on 26 April 2012 at 14.30 hours, higher than that of the preceding year (standing at 23,900.2 MW) by 2,220.9 MW or 9.24 percent.

Net energy generation requirement throughout the first five-month of the year 2012 (January – May 2012) grew in line with the peak demand growth rate, amounting to 71,698.4 GWh, higher than that of the prior year, month on month, (standing at 65,552.0 GWh) by 6,146.4 GWh or 9.38 percent.

5.2.3.2 Power Demand Forecast

The latest power demand forecast was approved by the Thailand Load Forecast Subcommittee (TLFS) on 30 May 2012 with considerable assumptions as the following.

1. Set a timeframe of the 20-year power demand forecast of 2012 – 2030

2. Implement the new model of load forecast developed by the Energy for Environmental Foundation (E for E) under the project of Energy Policy and Planning Office (EPPO) on "Thailand Future Load Forecast" submitted by April 2010

3. Refer to the trajectory GDP growth rate projection during 2011 – 2030 estimated by the Office of National Economic and Social Development Board (NESDB), and issued on 29 November 2011, taking into account economic stimulation policies and flooding effects faced at the end of 2011 (shown as Table 3.1)

4. Incorporate energy saving programs and energy efficiency promotions in accordance with the MoEN's 20-Year Energy Efficiency Development Plan 2011 – 2030 (EE Plan 2011 – 2030) approved by the NEPC on 30 November 2011 on intense thrust targeting on 25 percent reduction of the country's energy intensity (ratio of energy consumption to GDP) within 20 years (as the governmental policy statement declaration to the parliament on 23 August 2011 of the Prime Minister: Miss Yingluck Shinawatra)

Table 5-2 Trajectory GDP Growth Rate Projection (2011 – 2030)

Unit: Percent

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
GDP	1.5	5.0	5.1	5.7	6.0	5.1	4.7	4.1	4.2	4.3
Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
GDP	4.2	4.1	4.0	4.0	4.0	4.0	3.9	3.9	3.8	3.8

The two main purposes of Thailand power development plan formulation are to maintain power system security and to provide adequate and reliable electricity supply.Hence, in order to maintain power system security, avoid blackout risk and provide adequate electricity supply for future power demand growth (in line with economic stimulation policy), the Thailand PDP Review Subcommittee (Chaired by the Permanent Secretary of the MoEN) decided, as a risk adverse on EE Plan implementation, to adopt the high case of load forecast expected to achieve 20% of 20-Year EE Plan target called EE20% for PDP formulation.

As net peak generation requirement (on EGAT system) rose up to 26,121.10 MW on 26 April 2012 at 14.30 hours, the Load Forecast Working Group agreed to adjust load forecast by applying the actual power demand of the first 4-month as the starting point in the modeling of load forecast. The revised load forecast was approved by the TLFS on 30 May 2012 within 3 scenarios as the following:

- Base case (EE40%): expected to achieve the 40% of 20-Year EE Plan target
- High case (EE20%): expected to achieve the 20% of 20-Year EE Plan target
- Low case (EE60%): expected to achieve the 60% of 20-Year EE Plan target

As decided by the Thailand PDP Review Subcommittee to use the High case of EE20% for the revised PDP formulation, the High case of load forecast of the year 2030 net peak generation requirement is then adopted about 52,256 MW, higher than that of the year 2011 by 1,483 MW or 4.16 percent per year. In terms of net energy generation requirement, the High case

reveals about 346,767 GWh of net energy generation requirement in 2030, higher than that of the year 2011 by 9,793 GWh or 4.13 percent per year.

By comparison of the latest 30 May 2012 load forecast of PDP2010: Revision 3 and the previous load forecast of PDP2010: Revision 2, it indicates that peak demand of the latest version is lower than that of the previous one by 3,494 MW or 6,27 percent. For the energy demand, the latest version is lower than that of the previous one by 20,497 GWh or 5.58 percent. Decreasing in projection comes from the effect of EE Plan.

5.2.4 Thailand Power Development Plan 2012 – 2030 (PDP2010: Revision 3)

5.2.4.1 Key Assumptions for PDP2010: Revision 3 Formulation

To formulate the revised PDP to be in line with the new government energy policies, several assumptions need to be reviewed and reconsidered. Key assumptions, made for PDP2010: Revision 3 formulation, are listed below.

1) The power demand forecast or load forecast: it is approved by the TLFS on 30 May 2012 to incorporate energy saving programs and energy efficiency promotions in accordance with the 20-Year Energy Efficiency Development Plan 2011 – 2030 (EE Plan 2011 – 2030) formulated by the MoEN, and approved by the NEPC on 30 November 2011.

2) Thailand power system security: Thailand should have the proper level of reserve margin to be not less than 15 percent of peak power demand. Moreover, to avoid the risk of the natural gas acquiring from sources in the western part of Thailand, in case of no natural gas supply, the appropriate level of reserve margin should be higher than 20 percent of the peak demand.

3) The future electricity acquiring: fuel type diversification in appropriate proportion is considered to reduce natural gas dependency in power generation.

4) Electricity acquiring from renewable energy: the MoEN targeted to increase the proportion of renewable energy for Thailand's electricity generation by not less than 5% from that of the previous PDP2010: Revision 2 within 2030 by taking into account the 10-Year Alternative Energy Development Plan 2012 - 2021 (AEDP 2012 – 2021). And then in 2022 – 2030, the generation from renewable energy will be expanded in accordance with its potential and advanced technology development.

5) Electricity acquiring from nuclear power plant: with the scope of the government's policy, a share of nuclear power generation should be not greater than 5 percent of total generating capacity. Additionally, the MoEN suggested shifting the scheduled commercial operation date (SCOD) of the first unit on nuclear power project forward by 3 years from 2020 to 2023.

6) Electricity acquiring from coal-fired power plant: the MoEN suggested considering coal-fired power plant development in an appropriate proportion as the necessity of Thailand power system except for considerations of other fuel types. Incidentally, for greenhouse gas emission reduction, CO_2 in particular, clean coal technologies should be recommended.

7) Foreign power purchase: the suggested proportion of power purchase from neighboring countries should be not greater than 15 percent of total generating capacity by emphasizing only on the projects that having been signed Tariff MOU already.

8) Efficient power generation by cogeneration system: it is suggested to promote cogeneration and to increase the amount of power purchases from cogeneration system as the following:

- During 2010 – 2014: conforming to the projects that have been settled
- During 2014 – 2019: scheduling the power purchases of SPP projects with Firm contract amounting 3,500 MW as the NEPC approval on 24 August 2009 and 25 November 2010.
- After 2020: planning to purchase more electricity from SPP cogeneration with Firm contract totaling 1,350 MW.

9) CO_2 emission from power sector: the target of CO_2 emission reduction (ton CO2/kWh) of PDP2010: Revision 3 is still set to be not higher than that of the previous PDP2010.

5.2.4.2 Thailand Power Development Plan (PDP2010: Revision 3)

With the aforementioned key assumptions for PDP2010: Revision 3 formulation, Thailand Power Development Plan 2012 – 2030 (PDP2010: Revision 3) can be summarized as the following.

At the end of 2030, grand total capacity will be about 70,686 MW comprising total capacity (as of December 2011) amounting 32,395 MW, total added capacity of 55,130 MW and deduction of the retired capacity totaling 16,839 MW.

Total added capacity during 2012 – 2019 composes of all projects planned with commitment and agreement. The total added capacity will be about 23,325 MW detailed as the following:

- Power purchases from renewable energy 8,194 MW (both domestic and neighboring countries)
- Cogeneration 5,107 MW
- Combined cycle power plants 6,551 MW
- Thermal power plants (coal/lignite) 3,473 MW

Total added capacity during 2020 – 2030 comprises all projects planned for serving future power demand increasing annually and also replacement of the retired power plants. The total added capacity during this period will be about 31,805 MW summarized as the following:

- Power purchases from renewable energy 6,387 MW (both domestic and neighboring countries)
- Cogeneration 1,368 MW
- Gas turbine power plant (3 x 250 MW) 750 MW
- Combined cycle power plants (21 x 900 MW) 18,900 MW
- Thermal power plants (coal) (3 x 800 MW) 2,400 MW
- Thermal power plants (nuclear) (2 x 1,000 MW) 2,000 MW

The total capacities during 2012 – 2030 can be concluded as the following:

- Total capacity (as of December 2011) 32,395 MW
- Total added capacity during 2012 – 2030 55,130 MW
- Total retired capacity during 2012 – 2030 -16,839 MW
- Grand total capacity (at the end of 2030) 70,686 MW

The added capacity during 2012 – 2030 can be classified as the following:

1. Renewable energy power plants	**14,580 MW**
- Power purchase from domestic	9,481 MW
- Power purchase from neighboring countries	5,099 MW
2. Cogeneration	**6,476 MW**
3. Combined cycle power plants	**25,451 MW**
4. Thermal power plants	**8,623 MW**
- Coal-fired power plants	4,400 MW
- Nuclear power plants	2,000 MW

- Gas turbine power plants	750 MW
- Power purchase from neighboring countries	1,473 MW
Total	**55,130 MW**

Details of Thailand power development plan 2012 – 2030 (PDP2010: Rev.3) and names of power plants to be completed during the planning period are listed as follows.

The new project in each year along PDP 2010 Revision 3

Year 2012 Peak demand 26,355 MW

SPP-Renewables	498 MW	-
SPP-Cogeneration	254 MW	Gas
VSPP-Renewables	201 MW	-
VSPP-Cogeneration	8 MW	Gas
GHECO-ONE Co.,Ltd.	660 MW	Coal
Chao Phraya Dam #1-2	12 MW	Hydro
Naresuan Dam	8 MW	Hydro

Khun Dan Prakarnchon Dam 10 MW Hydro

Power Purchase from Lao PDR (Theun Hinboun Ext.) (Jul) 220 MW Hydro

Contract Capacity 34,265 MW Reserve Margin 16.0%

Year 2013 Peak demand 27,443 MW

SPP-Renewables	249 MW	-
SPP-Cogeneration	1,170 MW	Gas
VSPP-Renewables	772 MW	-
VSPP-Cogeneration	16 MW	Gas
Mae Klong Dam #1-2	2x6 MW	Hydro
Pasak Jolasid Dam	7 MW	Hydro

Contract Capacity 36,491 MW Reserve Margin 18.4 %

Year 2014 Peak demand 28,790 MW

SPP-Renewables	420 MW	-
SPP-Cogeneration	270 MW	Gas
VSPP-Renewables	181 MW	-

VSPP-Cogeneration	16 MW	Gas
Renewable Energy (Additional)	60 MW	-
Gulf JP NS Co.,Ltd #1 2 (Jan,Ded)	2 x800 MW	Gas
Gulf Co.,Ltd. 1-Jun, Dec)	2x800 MW	Gas
Wang Noi CC #4 (Apr)	769 MW	Gas
Chana CC #2 (Apr)	782 MW	Gas
Thap Sakae Solar Cell	5 MW	Solar
Sirindhorn Dam Solar Cell	0.1 MW	Solar

Contract Capacity 39,542 MW Reserve Margin 17.7 %

Year 2015 Peak demand 30,231 MW

SPP-Renewables	369 MW	-
SPP-Cogeneration	540 MW	Gas
VSPP-Renewables	83 MW	-
VSPP-Cogeneration	17 MW	Gas
Renewable Energy (Additional)	230 MW	-
Gulf JP UT Co.,Ltd. #1-2 (Jun, Dec)	2x800 MW	Gas
North Bangkok CC#2 (Oct)	900 MW	Gas
Bang Lang Dam (Renovated)	12 MW	Hydro
Kwae Noi Dam #1-2	2x15 MW	Hydro
Khao Yai Thiang Wind Turbine (North)	18 MW	Wind
Chulabhorn Hydropower	1 MW	Hydro
Klong Tron Hydropower	3 MW	Hydro
Kiew Kohma Hydropower	6 MW	Hydro
Mae Karm Solar Cell	0.1 MW	Solar
Lao PDR (Hongsa TH #1-2)	2x491 MW	Lignite

Contract Capacity 43,157 MW Reserve Margin 16.5 %

Year 2016 Peak demand 31,808 MW

SPP-Renewables	635 MW	-
SPP-Cogeneration	450 MW	Gas
VSPP-Renewables	79 MW	-

VSPP-Cogeneration	21 MW	Gas
Renewable Energy (Additional)	270 MW	-
National Power Supply Co.,Ltd.	270 MW	Coal
New Power Plant (South) (Jul)	900 MW	Gas
Phayaman Hydropower	2 MW	Hydro
Lam Pao Hydropower	1 MW	Hydro
Lam Ta Khong Hydropower	2 MW	Hydro
Bhumubol Dam Solar Cell	0.1 MW	Solar
Lao PDR (Hongsa TH #3) (Mar)	491 MW	Lignite

Contract Capacity 45,530 MW Reserve Margin 24.3 %

Year 2017 Peak demand 33,263 MW

SPP-Renewables	153 MW	-
SPP-Cogeneration	900 MW	Gas
VSPP-Renewables	77 MW	-
Renewable Energy (Additional)	280 MW	-
National Power Supply Co.,Ltd.	270 MW	Coal
LamTa Khong Pumped Storage	500 MW	Hydro
That Noi Hydropower	2 MW	Hydro
Rawai Stadium Wind Turbine	3 MW	Wind
Rajjaprabha Dam Solar Cell	0.1 MW	Solar
Pha Chuk Hydropower	20 MW	Hydro

Contract Capacity 47,240 MW Reserve Margin 21.4%

Year 2018 Peak demand 34,592 MW

SPP-Cogeneration	720 MW	Gas
VSPP-Renewables	86 MW	-
VSPP-Cogeneration	1 MW	Gas
Renewable Energy (Additional)	280 MW	-
Mae Moh TH #4-7 (Replaced)	(600MW)	-
Yaso Thorn - Phanom Prai Hydropower	4 MW	Hydro
Khao Laem Hydropower # 1-2	2x9 MW	Hydro

Kra Seao Hydropower	2 MW	Hydro
Lao PDR (Nam-Ngiep 1) (Jan)	269 MW	Hydro
Lao PDR (Xe-Pian) (Aug)	390 MW	Hydro

Contract Capacity 48,329 MW Reserve Margin 19.6%

Year 2019 Peak demand 35,869 MW

SPP-Renewables	60 MW	-
SPP-Cogeneration	720 MW	Gas
VSPP-Renewables	72 MW	-
VSPP-Cogeneration	5 MW	Gas
Renewable Energy (Additional)	310 MW	-
EGAT Coal-Fired TH #1 (Jun)	800 MW	Coal
Huai Sataw Hydropower	1 MW	Hydro
Bang Pakong Hydropower	2 MW	Hydro
Sirindhorn Dam Solar Cell	1 MW	Solar
Khao Yai Thiang Wind Turbine (South)	50 MW	Wind
Lao PDR (Xaiyaburi) (Oct)	1,220 MW	Hydro

Contract Capacity 51,386 MW Reserve Margin 18.7%

Year 2020 Peak demand 37,325 MW

SPP-Renewables	45 MW	-
SPP-Cogeneration (Additional # 1)	90 MW	Gas
VSPP-Renewables	81 MW	-
Renewable Energy (Additional)	310 MW	-
Mae Saruay Hydropower	2 MW	Hydro
Thatako Solar Cell #1	1 MW	Solar
Klong See Yud Hydropower	3 MW	Hydro

Contract Capacity 50,389 MW Reserve Margin 18.1%

Year 2021 Peak demand 38,726 MW

SPP-Cogeneration (Additional # 2-3)	180 MW	Gas
VSPP-Renewables	79 MW	-

VSPP-Cogeneration	1 MW	Gas
Renewable Energy (Additional)	360 MW	-
New Gas-fired Power Plant	900 MW	Gas
Bang Pakong CC #1 (Replaced)	900 MW	Gas
Chonnaboat Hydropower	2 MW	Hydro
Thatako Solar Cell #2	1 MW	Solar
Neighbouring Countries	300 MW	–

Contract Capacity 52,912 MW Reserve Margin 17.8%

Year 2022 Peak demand 40,134 MW

SPP-Cogeneration (Additional # 4-5)	180 MW	Gas
VSPP-Renewables	67 MW	-
VSPP-Cogeneration	5 MW	Gas
Renewable Energy (Additional)	220 MW	-
New Gas-Fired Power Plant	900 MW	Gas
Bang Pakong CC #2 (Replaced)	900 MW	Gas
EGAT Coal-Fired TH #2	800 MW	Coal
Mahasarakam Hydropower	1 MW	Hydro
Chulabhorn Dam Solar Cell	0.1 MW	Solar
Neighbouring Countries	300 MW	–

Contract Capacity 56,135 MW Reserve Margin 16.9%

Year 2023 Peak demand 41,567 MW

SPP-Cogeneration (Additional # 6-7)	180 MW	Gas
VSPP Renewable	47 MW	-
Renewable Energy (Additional)	220 MW	-
New Gas-Fired Power Plant	900 MW	Gas
South Bangkok CC #1-2 (Replaced)	2x900 MW	Gas
Low Wind Speed Wind Turbine	10 MW	Wind
Huai Nam Sai Hydropower	2 MW	Hydro
Rasisalai Hydropower	2 MW	Hydro
Ubonrat Dam Solar Cell	0.1 MW	Solar

Neighbouring Countries	300 MW	–

Contract Capacity 56,732 MW Reserve Margin 16.4%

Year 2024 Peak demand 43,049 MW

SPP-Cogeneration (Additional # 8-9)	180 MW	Gas
VSPP-Renewables	53 MW	-
VSPP-Cogeneration	1 MW	Gas
Renewable Energy (Additional)	220 MW	-
New Gas-Fired Power Plant	900 MW	Gas
South Bangkok CC #3 (Replaced)	900 MW	Gas
Bang Pakong CC #3 (Replaced)	900 MW	Gas
Hua Na Hydropower	1 MW	Hydro
Lamtapearn Hydropower	1 MW	Hydro
Sirikit Dam Solar Cell	0.1 MW	Solar
Neighbouring Countries	300 MW	–

Contract Capacity 59,509 MW Reserve Margin 16.3%

Year 2025 Peak demand 44,521 MW

SPP-Cogeneration (Additional # 10-11)	180 MW	Gas
VSPP-Renewables	37 MW	-
VSPP-Cogeneration	5 MW	Gas
Renewable Energy (Additional)	220 MW	-
New Gas-Fired Power Plant	900 MW	Gas
Bang Pakong CC #4 (Replaced)	900 MW	Gas
EGAT Coal-Fired TH #3	800 MW	Coal
Pranburi Hydropower	2 MW	Hydro
Tabsalao Hydropower	2 MW	Hydro
Neighbouring Countries	300 MW	–

Contract Capacity 60,477 MW Reserve Margin 16.5%

Year 2026 Peak demand 46,002 MW

SPP-Cogeneration (Additional # 12-13)	180 MW	Gas

VSPP-Renewables	32 MW	-
Renewable Energy (Additional)	220 MW	-
New Gas-Fired Power Plant	900 MW	Gas
Bang Pakong CC #5 (Replaced)	900 MW	Gas
EGAT Nuclear Power Plant #1	1,000 MW	Uranium
Kamalasai Hydropower	1 MW	Hydro
Numpung Dam Solar Cell	1 MW	Solar
Neighbouring Countries	300 MW	–

Contract Capacity 64,007 MW Reserve Margin 16.5%

Year 2027 Peak demand 47,545 MW

SPP-Cogeneration (Additional # 14-15)	180 MW	Gas
VSPP-Renewables	33 MW	-
VSPP-Cogeneration	1 MW	Gas
Renewable Energy (Additional)	220 MW	-
Wang Noi CC #1 (Replaced)	900 MW	Gas
Bang Pakong CC #6 (Replaced)	900 MW	Gas
EGAT Nuclear Power Plant #2	1,000 MW	Uranium
Mae Wong Hydropower	12 MW	Hydro
Vajiralongkorn Dam Solar Cell	0.1 MW	Solar
Chaiyaphum Wind Turbine	50 MW	Wind
Neighbouring Countries	300 MW	–

Contract Capacity 64,979 MW Reserve Margin 16.2%

Year 2028 Peak demand 49,114 MW

VSPP Renewables	32 MW	-
VSPP-Cogeneration	5 MW	Gas
Renewable Energy (Additional)	220 MW	-
EGAT Coal-Fired TH #4	800 MW	Coal
Wang Noi CC #2-3 (Replaced)	2x900 MW	Gas
Gas Turbine #1	250 MW	Diesel
Mae Khan Hydropower	16 MW	Hydro

Huai Samong Hydropower	1 MW	Hydro
Mae Moh Solar Cell	1 MW	Solar
Neighbouring Countries	300 MW	–

Contract Capacity 67,012 MW Reserve Margin 16.4%

Year 2029 Peak demand 50,624 MW

VSPP-Renewables	32 MW	-
Renewable Energy (Additional)	220 MW	-
South Bangkok CC #4 (Replaced)	900 MW	Gas
EGAT Combined Cycle Power Plant	900 MW	Gas
Gas Turbine #2	250 MW	Diesel
Ao Phai Wind Turbine	10 MW	Wind
Lam Dome Yai Hydropower	1 MW	Hydro
Kamphaeng Phet Solar Cell	3 MW	Solar
Neighbouring Countries	300 MW	–

Contract Capacity 69,358 MW Reserve Margin 16.4%

Year 2030 Peak demand 52,256 MW

VSPP-Renewables	33 MW	-
VSPP-Cogeneration	1 MW	Gas
Renewable Energy (Additional)	220 MW	-
EGAT Combined Cycle Power Plant	900 MW	Gas
Gas Turbine #3	250 MW	Diesel
Solar Cell , Southern Part of Thailand	10 MW	Solar
Samut Sakhon Wind Turbine	30 MW	Wind
Klong Luang Hydropower	1 MW	Hydro
Neighbouring Countries	300 MW	–

Contract Capacity 70,686 MW Reserve Margin 16.2 %

Total Contract Capacity as of December 2011	32,395 MW
Total Added Capacity	55,130 MW
Total Retired Capacity	- 16,839 MW

Grand Total Capacity at the End of 2030 70,686 MW

5.2.5 Renewable Energy Generation

With the government policy targeting on increasing the share of renewable energy and alternative energy uses by 25 percent instead of fossil fuels within the next 10 years, new projects of renewable energy development are initiated into PDP2010:Revision 3. Hence, at the end of 2030, total capacity of renewable energy will be around 20,546.3 MW (or 29 percent of total generating capacity in the power system) comprising total existing capacity amounting 6,340.2 MW, total added capacity of renewable energy of 14,580.4 MW and deduction of the retired capacity of renewable energy totaling 374.3 MW. The 20,546.3 MW capacity of renewable energy can be classified into domestic renewable energy of 13,688 MW and renewable energy from neighboring countries of 6,858 MW as the following.

Renewable Energy Power Projects during 2012 – 2021

In this period, renewable energy power projects should be in line with the 10-Year Alternative Energy Development Plan: AEDP 2012-2021 of the MoEN detailed as the following:

Solar power	1,806.4 MW
Wind power	1,774.3 MW
Hydro power	3,061.4 MW
(both domestic and neighboring countries)	
Biomass	2,378.7 MW
Biogas	22.1 MW
Municipal solid waste (MSW)	334.5 MW
	Total 9,377.4 MW

Renewable Energy Power Projects during 2022 – 2030

Renewable energy power project development during 2022 – 2030 will be considered in accordance with its potential detailed as the following:

Solar power	1,995.7 MW
Wind power	199.4 MW
Hydro power	2,742.5 MW
Biomass	223.5 MW

Biogas	24.1 MW
Municipal solid waste (MSW)	17.8 MW
	Total 5,203.0 M

5.2.5.1 CO_2 Emission from Power Sector

In 2011, an average greenhouse gas (CO_2) emission released from Power sector is about 0.505 kgCO2/kWh. In response to the MoEN policies on clean energy development promotion, the 2030 target of CO_2 emission reduction (ton CO_2/kWh) of PDP2010: Revision 3 is set to be not higher than that of the previous PDP2010: Revision 2 by rearranging generation mix appropriately.

Estimation of CO_2 emission amounts on PDP2010: Revision 3 is calculated with reference to the international principles as the 2006 IPCC Guidelines for National Greenhouse Gas Inventories .

5.3 SUMMARY OF PROPOSED POWER DEVELOPMENT PLAN (PDP 2012)

This PDP is called " Proposed Power Development Plan (PDP) 2012 and a Framework for Improving Accountability and Performance of Power Sector Planning " or " PDP 2012" in this study . This PDP2012 is performed by Chuenchom Sangarasri Greacen and Chris Greacen worked as Non Govermental Oganizations (NGOs) in Thailand.

5.3.1 Introduction (reference PDP 2012)

Thailand's Power Development Plan (PDP), prepared periodically by the state-owned Electricity Generating Authority of Thailand (EGAT), is the master investment plan for power system development. It determines what kind and what quantity of power plants get built, where and when. The PDP has wide-reaching implications, shaping not just the future of Thailand's electricity sector and its social and environmental landscape, but also that of Thailand's neighboring countries.

The official PDP document also reflects a planning process in crisis. By selecting excessive amounts of controversial ,expensive, risky, and polluting power plants over cheaper, cleaner, and safer alternatives, the PDP is at odds with both Thai energy policy as well as the interests of the vast majority of Thai people. The well-documented casualties are predominantly

the rural poor. Afflictions include acute respiratory disease in thousands of villagers from operations of coal mining and power plants (Sukkumnoed, 2007), a number of violent conflicts associated with power plants (Polkla, 2010) ,as well as higher prices because of excessive investment (Sirasoontorn, 2008). Investment in hydropower projects in
Thailand and neighboring countries has led to human rights violations, impaired livelihoods for hundreds of thousands of riverside communities, flooding of high conservation value areas and destruction of river ecosystems upon which millions depend (IRN, 1999; World Commission on Dams, 2000).

This document is a new PDP. We (Chuenchom Sangarasri Greacen and Chris Greacen) do not wish to call it an "Alternative PDP" because we believe a document that makes sense should not be relegated to the marginal title "alternative". We call it simply "PDP 2012", and as such it is more consistent with Thai policy and the interests of Thai people than the the Electricity Generating Authority of Thailand's (EGAT)'s most recent power development plan, the PDP 2010. Our intention is not for the PDP 2012 to be the "only" PDP, but rather one to be considered in comparison to other plans. We would hope that all candidate plans be presented to the public in a way that emphasize the values and assumptions embedded in different future scenarios, and that ultimately an optimum PDP is selected that reflects excellent science, consistency with government policy objectives, and coherence with the desires of the Thai public.

In previous years, "energy security" has been a trump card used to justify official government PDPs and to discount proposed alternatives without serious discussion. But what exactly is energy security? In this paper we propose a set of quantitative energy security indicators and other indicators to measure consistency of PDPs with Thai policy objectives. We employ these indicators in evaluating the PDP 2012 compared with the PDP 2010.

This study concludes with policy recommendations to improve the planning process, as well as reforms to the industry and regulatory structure so that the development and operation of the power sector will move closer towards the government's stated policy objectives.

5.3.2 Methodology for developing PDP 2012

When faced with demands from various groups about the choices of power plants in the official PDP, decision makers often counter, "What are the alternatives?" Often what is assumed in the point of view of policy makers is that we must choose among large-scale gas, nuclear, coal

and big dams. Our PDP2012 analysis challenges the assumption that "we have no other better options". As discussed above, there are cheaper, less impactful energy options sufficient to meet the growing demand for electricity to fuel continued economic development in Thailand. This section is incorporates the resources discussed in the previous section to ensure that the growing need for electricity, as projected by our adjusted forecast in the previous section, can be met. In creating the PDP 2012, our analysis is based on the following key assumptions and guiding principles:

1. The primary objective is to maintain reliability of the power system, using EGAT's criteria of maintaining a minimum reserve margin (generation capacity in excess of peak demand) of 15%.

2. Demand projections are adjusted to be more consistent with historic electricity demand trends as discussed in the Electricity demand projection. Future demand growth is assumed to follow the historical 25-year average trend, in which peak demand increases 830 MW per year. Peak demand is then converted to energy demand (in GWh) using the same load factor as is used in the PDP 2010.

3. To meet growing demand and replace retiring generation capacity, priority is given to energy efficiency, plant-life extension, co-generation, and renewable energy sources. New power plant projects in the PDP 2010 that are controversial in nature or have not begun construction as of 2011 are considered uncommitted plants. Uncommitted plants are postponed or canceled as needed to make way for other resource options that are cleaner, cheaper and more consistent with the policy objectives. The next section discusses the assumptions and justifications in the PDP 2012 model.

5.3.3.Assumptions on Resource options

5.3.3.1 Energy Efficiency (EE) / Demand Side Management (DSM)

In addition to the assumed energy savings in the PDP 2010 from the T5 light replacement measure which is expected to deliver a peak saving of 584 MW, we assumed additional savings from new voluntary and mandatory measures consistent with the government's 20-year Energy Efficiency Development Plan to reduce year 2030 power consumption by 20% or 52,224 GWh. The targets and recommended measures in the plan are realistic, doable and based on well-researched and conservative analysis by a team of energy and policy academics and

practitioners. The budget for the plan has already been approved and disbursed. It is important however to have a good evaluation and monitoring system in place to ensure that the budget is spent effectively and delivers the savings as planned. For details on the suggested EE measures, see Ministry of Energy (2011) and Foong thammasan, Tippichai et al. (2011).

The savings from T5 light replacement which has already been deducted from the official demand forecast used in the PDP 2010 is considered part of the baseline (or business-as-usual) according to the 20-year Energy Efficiency Plan. In ouranalysis of the PDP2012, we only consider additional savings beyond the T5 program. The savings are treated as a resource or investment options. Even though the savings happen on the demand side, in our analysis we follow the Pacific Northwest practice of treating EE/DSM savings as a supply option, competing on a level playing field against other generation options in terms of resource amount, cost, etc.

The energy savings from the T5 light replacement program has an expected load factor of 56%, according to the PDP 2010.Thailand's power system has a load factor of around 75%. For this study, we assumed that additional EE/DSM savings have a load factor of around 60%. Based on this assumption, we convert the GWh savings into MW savings. The savings start off small (0.4% in 2013) and increase progressively toward the target of 20% energy savings compared to the projected demand in 2030. The energy savings in GWh and MW incorporated in the PDP 2012 over the planning period.

Table 5-3 Cumulative energy savings from energy efficiency in PDP2012 and PDP2010.

	EE savings in PDP 2010*		Additional EE savings in PDP 2012		
Year	GWh	MW	% of total energy	GWh	MW
2010	210	43	-	-	-
2011	629	129	-	-	-
2012	1049	215	-	-	-
2013	1678	344	0.4%	672	128
2014	2307	473	1.0%	1,665	317
2015	2852	584	1.7%	3,005	572
2016	2433	498	2.5%	4,571	870
2017	1804	369	3.5%	6,529	1,242
2018	965	198	4.5%	8,591	1,634
2019	1170	240	5.6%	11,079	2,108
2020	1170	240	6.6%	13,525	2,573
2021	1170	240	7.7%	16,253	3,092
2022	1170	240	8.9%	19,104	3,635
2023	1170	240	10.1%	22,255	4,234
2024	1170	240	11.2%	25,537	4,859
2025	1170	240	12.6%	29,324	5,579
2026	1170	240	14.0%	33,451	6,364
2027	1170	240	15.5%	37,734	7,179
2028	1170	240	16.9%	42,175	8,024
2029	1170	240	18.8%	48,113	9,154
2030	1170	240	20.0%	52,155	9,923

*These savings were deducted from the PDP2010 demand forecast.

5.3.3.2 Renewable Energy

The PDP2012 adds the same amount renewable energy generation as in the PDP 2010, as shown below in Table 5.2. Other related assumptions, such as dependable capacity (see Table 5.3) and total energy production are also as specified in the PDP2010.

Table 5-4 Generation from renewable energy in MW in the PDP 2010 and the PDP2012.

	PDP 2010				PDP2012			
Year	EGAT	SPP	VSPP	Cumu. Total	EGAT	SPP	VSPP	Cumu. Total
2010		465	331	796		465	331	796
2011	38	425	236	1495	38	425	236	1495
2012	29	65	162	1751	29		162	1686
2013	54		181	1986	54			1740
2014	18		191	2195	18			1758
2015	14	90	165	2464	14	155	346	2273
2016	17		225	2705	17		415	2705
2017	11		228	2943	11		228	2943
2018	30		173	3146	30		173	3146
2019	8		170	3323	8		170	3323
2020	22		188	3533	22		188	3533
2021	61		133	3727	61		133	3727
2022	36		287	4050	36		287	4050
2023			145	4195			145	4195
2024			146	4341			146	4341
2025			156	4497			156	4497
2026			157	4654			157	4654
2027			168	4822			168	4822
2028			168	4990			168	4990
2029			179	5169			179	5169
2030			179	5348			179	5348

*PDP2012 assumes the same amount of renewable energy capacity addition as PDP2010 except for some adjustments for projects facing delays.

Table 5-5 Dependable capacity assumptions used in PDP2010 and PDP2012. These are used in calculating energy (GWh) output and costs of electricity from renewable energy.

RE	PDP 2010	Dependable	Generation		Purchase price of RE** (B/kWh)		
	MW	capacity	GWh	%	adder	total	weighted price
biomass***	2025	55%	9756.45	78%	0.3	3.00	2.344
biogas	121	21%	222.59	2%	0.3	3.00	0.053
solar	922	21%	1696.11	14%	6	8.70	1.182
wind	672	5%	294.34	2%	3.5	6.20	0.146
small hydro	69.3	40%	242.83	2%	0.8	3.50	0.068
waste	157.5	20%	275.94	2%	2.5	5.20	0.115
							3.908

*Data source: EPPO, http://www eppo.go.th/power/pdp/page-7.html, updated 25 Feb 2010
Cited source for dependable capacity: Study on Dependable Capacity of Renewable Energy Generation (in Thai), 2010.
**assume bulk price = 2.7 B/kWh
***Assume 50% biomass is from rice husks which has assumed plant factor of 70% while that of the rest is 40%

5.3.3.3 Cogeneration

Cogeneration is considered a preferred resource option over centralized power plants due to its high efficiency. The PDP 2010 calls for investments of 16,670 MW of centralized gas-fired combined cycle generation while including only 7,024 MW of more efficient cogeneration. In contrast, the PDP2012 gives priority to cogeneration over gas combined cycle gas turbines (CCGT) or coal-fired power plants if and when new capacity is needed. Typically the size of each cogeneration capacity varies and depends on the steam requirement at the host factor. According to SPP regulations, no more than 90 MW of electricity export is accepted per plant. Here in the PDP2012, we added 300 MW of cogeneration capacity per year in most years and 600 MW in the few years that more new capacity addition is required. Table 5-6 shows the comparison of cogeneration capacity in the PDP2010 vs. the PDP2012.

Table 5-6 Comparison of cogeneration capacity (MW) in the PDP2010 vs the PDP2012.

	PDP 2010		PDP2012		
Year	Firm SPP	Cumu. Total	Firm SPP	Add'l SPP/VSPP	Cumu. Total
2010	90	90	90		90
2011	0	90	0		90
2012	704	794	0		90
2013	720	1514	0		90
2014	90	1604	90		180
2015	270	1874	974		1154
2016	270	2144	990		2144
2017	270	2414	270	300	2714
2018	270	2684	270	300	3284
2019	270	2954	270	300	3854
2020	270	3224	270	300	4424
2021	380	3604	380	300	5104
2022	360	3964	360	300	5764
2023	360	4324	360	300	6424
2024	360	4684	360	300	7084
2025	360	5044	360	600	8044
2026	360	5404	360	300	8704
2027	360	5764	360	300	9364
2028	360	6124	360	600	10324
2029	360	6484	360	300	10984
2030	540	7024	540	300	11824
Total	7024	7024	7024	4800	11824

We expect that most of the cogeneration capacity will use natural gas as fuel while some may use coal. For the purpose of our analysis here, we assume that all cogeneration is gas-based. This improves environmental performance of the PDP2012 generation mix but exacerbates the country's dependency on gas. However, we believe that if we must use fossil fuels, gas is

preferred over coal and efficient utilization of gas in the form of useful cogeneration should be employed to the extent possible before considering inefficient centralized generation.

5.3.3.4 Plant life extension

In the analysis of the PDP2012, five-to-ten year plant life extension is considered only in cases where additional capacity is needed at the time of the plants' planned decommissioning to keep the reserve margin above 15%. Otherwise, plants are retired as scheduled. Table 14 indicates which plants are retired as scheduled in the PDP2010 and which receive life extension.

Note that our criteria for choosing which plant gets extended life are based mainly on the generation requirement and the type of fuel used (coal plants are not considered for life extension out of health and environmental impact concerns).

However, more detailed assessment should be done on a case-by-case basis to ensure resource, technical and economic feasibility of plant life extension. If a plant is highly inefficient, the saved capital investment cost may not be sufficient to outweigh the high fuel cost when compared to a new, efficient plant. In addition, for independent power producer (IPP) plants (privately owned), the option to extend plant life should be presented to the IPPs to consider. Interested IPPs may enter into a negotiation process to extend and adjust the Power Purchase Agreements (PPAs), taking into account system requirement, conditions of the generation facilities and related equipment, etc. The ERC is currently developing a guideline and terms for considering plant life extension for IPPs as some are nearing the expiry of their power purchase agreements.

Table 5-7 List of power plants scheduled to retire during the PDP2010, some of which are considered for life extension in the PDP2012 as an economic investment option to add generation capacity. Data source: (EGAT 2010).

Power plants to be decommissioned in PDP2010	MW	Plant life at decommissioning	Extended life to delay decommissioning and construction of new plants*
EGAT			
Nam Pong CC #1♂	325	25	
Nam Pong CC #2 ♂	325	25	30
Bang Pakong TH #1-2	1,052	30	
Bang Pakong TH #3	576	30	
Bang Pakong TH #4	576	30	
Bang Pakong CC # 3	334	25	
Bang Pakong CC # 4	334	25	30
South Bangkok CC #1	326	25	30
South Bangkok CC #2	562	25	30
Mae Moh TH # 4	140	40	
Mae Moh TH # 5-6	280	40	
Mae Moh TH # 7	140	40	
Mae Moh TH # 8	270	40	
Mae Moh TH #9	270	40	
Wang Noi TH #1-3	1,910	25	30
IPPs			
Khanom TH #1	70	15	
Khanom TH #2	70	20	
Khanom CC #1	678	20	
Eastern Power	350	20	30
Glow IPP	713	25	30
Independent Power (Thailand) (IPT)	700	25	30
[illegible] Energy Co., Ltd	700	20	30
Hausy Ho	126	30	
Theun Hinboun	214	25	
Rayong CC #1-4	1,175	20	
Ratchaburi TH #1-2	1,440	25	30
Ratchaburi CC #1-2	1,360	25	30
Ratchaburi CC # 3	681	25	30

* Only in case where life extension is needed to keep reserve margin above 15%. Otherwise, plants are retired as schedul
Plant life extension may require additional investments and time to maintain and upgrade equipment. The time and resources required to extend plant life are usually significantly less than building a new one. However, more detailed assessment should be done on a case by case basis to ensure technical and economic feasibility of plant life extension.
May negotiate PPA extension with IPPs taking into account system requirement, condition of power plants, and willingness of IPPs

5.3.4 The Power Development Plan 2012 (PDP2012)

Based on the key assumptions and methodology discussed above, the PDP 2012 is very different than EGAT's PDP 2010. The differences in resource mix in these plans leads to significant differences in overall costs, reliance on imports, promotion of renewable energy, greenhouse gas emissions, heath and environmental impacts, and electricity bills paid by consumers. These are explored in detail below.

5.3.4.1 Resource mix: PDP 2012 vs. PDP 2010

PDP2012 calls for a very different resource mix compared to the PDP2010 (Figure 5). Notable differences include the reduction in capacity needed because of forecast correction in the PDP 2012, the lack of nuclear power, reduction in natural gas power plants as they retire, and lack of growth in coal generation. These large-scale fossil fuel sources are replaced with considerable generation expansion in cogeneration and EE/DSM.

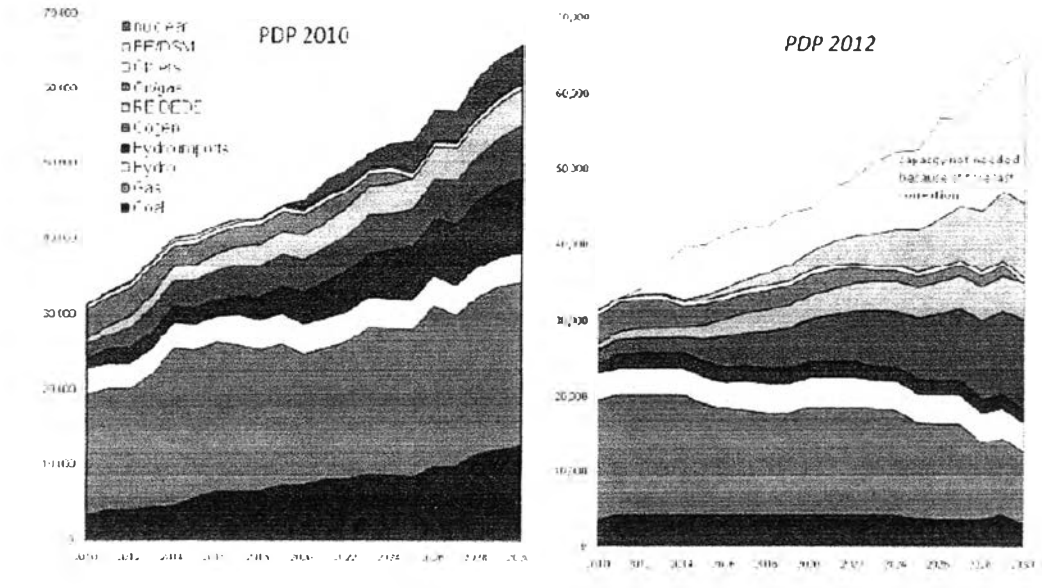

Figure 5.1 Supply resources in the PDP2010 vs PDP2012.

Table 5-8 Comparison of resource additions through year 2030 in PDP 2010 vs. PDP2012

PDP 2010			
Project (MW)		Year	Installed MW
Capacity already online since 2010 (as of Oct 2011)		2009	29,212
Nam Theun 2	920	2010	31,349
North Bangkok CC # 1	670	2011	32,992
Nam Ngum 2	597	2012	34,171
		2013	37,002
Additions of capacity considered "clean" or in the pipeline		2014	39,720
SPP – cogeneration	7,340	2015	39,990
SPP – renewables	1,045	2016	41,419
VSPP	2,567	2017	42,374
EGAT renewables	336	2018	42,619
Gheco One (IPP)	660	2019	44,290
Theun Hinboun Expansion	220	2020	44,843
Wang Noi CC#4 (EGAT)	800	2021	47,618
Bang Lang Dam Expansion	12	2022	48,582
Lam Ta Kong (pump storage)	500	2023	51,235
	13,479	2024	52,533
Other capacity additions		2025	52,738
Gas CC 17 units	15,200	2026	56,957
Coal 13 units	7,740	2027	56,830
Hydro (imports)	8,090	2028	61,355
Lignite (imports)	1,842	2029	63,824
Nuclear 5 units	5,000	2030	65,547
	37,872		
Generation capacity as of December 2009			29,212
Total capacity added during 2010 – 2030			54,005
Total capacity decommissioned during 2010-2030			-17,671
Total capacity at the end of 2030			65,547

PDP 2012				
Project (MW)		Year	Installed MW**	Reserve Margin
Capacity already online since 2010 (as of Oct 2011)		2009	29,212	27.6%
Nam Theun 2	920	2010	31,350	26.7%
North Bangkok CC # 1	670	2011	32,993	33.9%
Nam Ngum 2	597	2012	33,403	31.0%
		2013	33,457	27.6%
Additions of capacity already included in PDP 2010		2014	32,513	20.9%
SPP – cogeneration	7,340	2015	32,757	19.2%
SPP – renewables	1,045	2016	33,438	19.3%
VSPP	2,567	2017	34,253	20.2%
EGAT renewables	336	2018	34,662	19.7%
Gheco One (IPP)	660	2019	35,232	20.2%
Theun Hinboun Expansion	220	2020	36,626	23.3%
Wang Noi CC#4 (EGAT)	800	2021	37,301	24.3%
Bang Lang Dam Expansion	12	2022	37,565	23.9%
Lam Ta Kong (pump storage)	500	2023	37,226	21.6%
	13,479	2024	37,215	20.9%
Other resource additions		2025	36,428	18.0%
EE/DSM	9,923	2026	37,147	20.1%
Cogeneration	4,800	2027	37,961	22.7%
Plant life extension (retiring after 2030)*	3,104	2028	36,527	18.1%
	17,827	2029	37,895	23.7%
		2030	35,579	15.9%
*Additional 12,543 MW was extended but retired by 2030				
**Excluding savings from EE/DSM				
Generation capacity as of December 2009			29,212	
Total capacity added during 2010 – 2030			20,934	
Total capacity decommissioned during 2010-2030			-14,567	
Total capacity at the end of 2030			35,579	
(Excluding 10,158 MW savings from EE/DSM)				

Details of the PDP2012 are summarized in Table 5.6. The PDP2012 analysis finds that 55 power plant projects of various types (nuclear, coal, gas CC, hydro imports and lignite-fired imports) included in the PDP 2010 are unnecessary to maintain the reliability of the system (15% minimum reserve margin). These projects are removed from the lineup in the PDP 2012 (Table 5-8)

Table 5.9 Power projects that were included in the PDP2010 but which are unnecessary and thus not included in the PDP2012.

Generation type by fuel	Unnecessary Projects	MW
Coal	National Power Supply # 1-2	270
Coal	National Power Supply #3-4	270
Coal	EGAT clean Coal #1	800
Coal	EGAT clean Coal #2	800
Coal	EGAT clean Coal #3	800
Coal	EGAT clean Coal #4-5	1,600
Coal	EGAT clean Coal # 6-7	1,600
Coal	EGAT clean Coal # 8	800
Coal	EGAT clean Coal # 9	800
Coal	total	7,740
Gas	Siam Energy Co., Ltd #1-2	1,600
Gas	Power Generation Supply Co., Ltd # 1-2	1,600
Gas	Chana CC #2	800
Gas	New Power Plant South	800
Gas	EGAT Gas Fired CC # 1	800
Gas	EGAT Gas Fired CC #2-6	4,000
Gas	EGAT Gas Fired CC #7	800
Gas	EGAT Gas Fired CC #8-9	1,600
Gas	EGAT Gas Fired CC #10	800
Gas	EGAT Gas Fired CC #11-12	1,600
Gas	EGAT Gas Fired CC #13	800
Gas	total	15,200
Imports (coal)	Power Purchase from Lao PDR (Hong Sa TH #1-2)	982
Imports (coal)	Power Purchase from Myanmar (Mae Khot TH #1-3)	369
Imports (coal)	Power Purchase from Lao PDR (Hong Sa TH # 3)	491
Imports (coal)	total	1,842
Imports (hydro)	Power Purchase from Lao PDR (Nam Ngum3)	440
Imports (hydro)	Power Purchase from Neighbouring Countries	450
Imports (hydro)	Power Purchase from Neighbouring Countries (12 x 600 MW)	7,200
Imports (hydro)	total	8,090
Nuclear	EGAT Nuclear Power Plant #1	1,000
Nuclear	EGAT Nuclear Power Plant # 2	1,000
Nuclear	EGAT Nuclear Power Plant #3	1,000
Nuclear	EGAT Nuclear Power Plant #4	1,000
Nuclear	EGAT Nuclear Power Plant #5	1,000
Nuclear	total	5,000
	Grand Total	**37,872**

5.3.4. 2 Adequacy of energy resource

Here we compare the official PDP 2010 and the PDP2012 in their performance in meeting key government energy policy objectives by applying the evaluation framework of indicators proposed earlier.

Adequacy of energy resource to ensure reliability of the power system is a primary objective of the PDP2012. The planning criteria used in developing the PDP2010 as well as

PDP2012 is a minimum reserve margin of 15%. The PDP2012 is able to achieve a minimum reserve margin of 15% in all the years during the planning period as shown in Table 5.10

Table 5.10 Reserve margin according to PDP2012. The total installed capacity is sufficient to maintain a minimum 15% reserve margin over the peak demand after deducting energy efficiency savings.

Year	Peak demand (revised) (MW)	EE/DSM savings (MW)	Peak demand (after EE savings) (MW)	Installed Capacity (MW)	Reserve margin (%)
2010	24,010	0	24,010	31,350	26.7%
2011	23,900	0	23,900	32,993	33.9%
2012	24,731	0	24,731	33,403	31.0%
2013	25,562	128	25,434	33,457	27.6%
2014	26,393	317	26,077	32,513	20.9%
2015	27,225	572	26,653	32,757	19.2%
2016	28,056	870	27,186	33,438	19.3%
2017	28,887	1,242	27,645	34,253	20.2%
2018	29,718	1,634	28,084	34,662	19.7%
2019	30,549	2,108	28,441	35,232	20.2%
2020	31,380	2,573	28,807	36,626	23.3%
2021	32,211	3,092	29,119	37,301	24.3%
2022	33,043	3,635	29,408	37,565	23.9%
2023	33,874	4,234	29,640	37,226	21.8%
2024	34,705	4,859	29,846	37,215	20.9%
2025	35,536	5,579	29,957	36,428	18.0%
2026	36,367	6,364	30,003	37,147	20.1%
2027	37,198	7,179	30,019	37,961	22.7%
2028	38,029	8,024	30,005	36,527	18.1%
2029	38,861	9,154	29,707	37,896	23.7%
2030	39,692	9,923	29,769	35,579	15.9%

Both PDP 2010 and PDP2012 thus achieve the resource adequacy goal using the 15% reserve margin as the benchmark for having sufficient energy resources to meet growing electricity demand.

Because the PDP 2012 is based on a lower demand projection, one might ask what happens when the demand is higher than expected? Electricity is different from other commodities or services. If the supply is not enough to meet demand, the entire system may be affected (in the form of brownouts or blackouts). Electricity cannot be stored, and moreover it takes a minimum of two years (not including the permitting process) to construct a power plant, or more for larger plants and less for VSPP-scale plants. Will Thailand be caught with power shortage situation?

Because of excessive past investment, Thailand's reserve margin in 2011 is 33.9%, far above the target of 15%. Thailand has sufficient surplus capacity and projects in the pipeline14 to maintain a minimum 15% reserve margin until 2017, without additional investments in EE/DSM, without adding more cogeneration capacity, and without plant life extension. We thus have at

least five years before more capacity is added if the adjusted forecast is accurate. The focus in the PDP2012 is on smaller, more distributed power plants which have shorter lead times, enabling a shorter, faster response time. This provides an additional, but unquantified, benefit of the PDP 2012.

5.4 Summary of three Power Development Plan (PDP)

In this section will summarize the content of Power Development Plan (PDP) in issue of Peak Load Demand, Energy Mix , Import of energy source and Reducing Greenhouse Gas Emissions as followings :

5.4.1 Peak Load Demand

Summary of Peak Load Demand of PDP2010 , PDP 2010 Revision 3 and PDP 2012 is shown as graph Figure 5-2

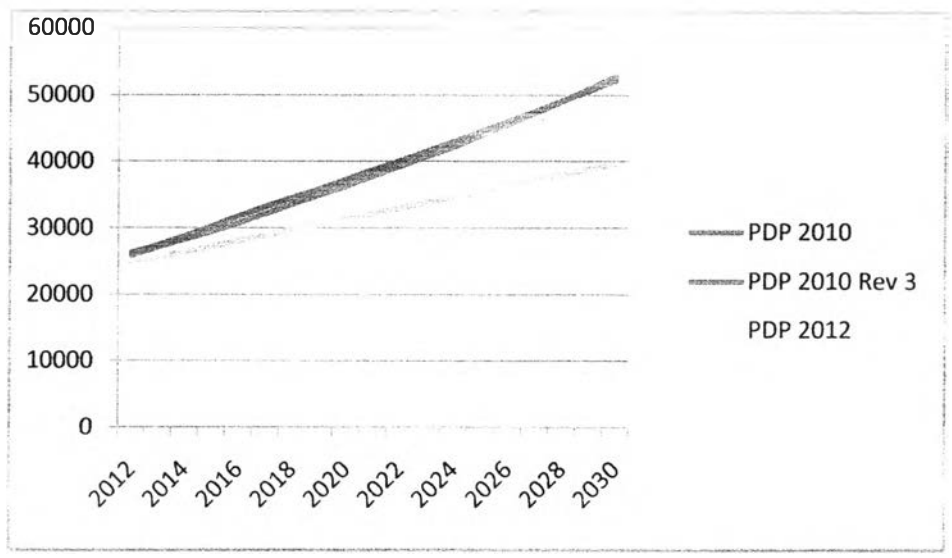

Figure 5-2 show Peak Load Demand of each Power Development Plan (PDP)

5.4.2 Mixture of Energy (Energy Mix)

The government has set a goal to increase the share of renewable energy (RE) in the total energy mix to 25% by 2020. Though there is no specific goal for the power sector, what is planned for the power sector will impact the overall energy mix. Even though the PDP2012 adopts the same renewable energy capacity and energy targets (measured in MW and GWh) as

the PDP 2010, because fewer conventional power plants are needed, the overall share of renewable energy in the PDP2012 is much higher (Table 5-11).

Table 5-11 show the proportion of each energy mix of each PDP in 2030

Energy Source	Year 2010		PDP 2010		PDP 2010 Revision 3		PDP2012	
			Year 2030		Year 2030		Year 2030	
	Capacity (MW)	Proportion	Capacity (MW)	Proportion	Capacity (MW)	Proportion	Capacity (MW)	Proportion
Coal	3,527	11%	12,669	19%	8,860	12.4%	3,087	9%
Gas	16,091	51%	21,668	33%	31,119	44%	9,572	27%
Hydro - EGAT	3,424	11%	3,936	6%	4,325	6.1%	3,936	11%
Hydro - Import	1,260	4%	9,827	15%	6,858	9.7%	1,737	5%
Cogeneration	1,878	6%	7,024	11%	6,793	10%	11,824	33%
Renewables	767	3%	4,804	7%	9,363	13.2%	4,804	13%
Oil / gas	3,784	12%	0	0%	0	0%	0	0%
Nuclear	0	0%	5,000	8%	2,000	2.7%	0	0%
Others (fuel oil , diesel ,Malay)	619	2%	619	1%	1,369	1.9%	619	2%
Total	31,350	100%	65,547	100%	70,686	100%	35,579	100%

5.4.3 Import of energy Source

Energy self-reliance in this context means reliance on energy sources that are locally available. Hence, the more electricity production from imported fuel or generation sources, the less energy self-reliant Thailand is. PDP 2010 calls for investments in energy sources that are not locally sourced such as hydroelectric imports from neighboring countries, imported coal and gas (due to limited domestic resources) and uranium to fuel nuclear reactors. By investing heavily in energy efficiency in the PDP 2012, the need to rely on imported fuel sources is greatly reduced thus reducing the need to depend on energy imports (Table 5-12).

Table 5-12 Reduced dependency on imports: according to PDP 2010, about 65% of electricity would be sourced from foreign sources making Thailand highly dependent on imports. In contrast,the PDP 2012 plans to rely on mostly domestic sources for meeting the electricity demand.

		PDP2010	PDP2012
Sources of electricity	**2010**	**2030**	**2030**
Domestic	**65.4%**	**35.2%**	**59.0%**
Lignite-Mae Moh	10.7%	2.4%	4.1%
Hydro - EGAT	3.9%	1.5%	2.4%
RE	3.1%	6.0%	9.9%
Gas (Gulf of Thailand)	47.8%	25.3%	42.6%
Imports	**34.6%**	**64.8%**	**41.0%**
Coal	8.1%	25.0%	7.3%
Gas (Burma/LNG)	20.5%	13.6%	28.4%
Fuel Oil	0.6%	0.0%	0.0%
Diesel	0.1%	0.0%	0.0%
Hydro imports /Malay	5.4%	15.3%	5.2%
Nuclear	0.0%	11.0%	0.0%
Total	100.0%	100.0%	100.0%

5.4.4 Reducing Greenhouse Gas Emissions

One of the PDP 2010 stated objectives is to reduce GHG or CO_2 emissions contribution from the power sector. The government has often claimed that the PDP2010 will lead to a lower CO_2 emission per kWh produced (-4.4% by our calculation). This is only half the story. The total GHG emission does not go down; in fact it will almost double – increasing 97% in 2030 compared to 2010. This is because total emissions are equal to GHG intensity (CO_2 emission/kWh) times the total number of kWh of expected demand. Projected consumption of electricity (kWh) more than doubles from 2010 to 2030.

In contrast, the total emissions in the case of PDP2012 will increase by only 3.7% while the per capita CO_2 emission is down 7.7% .This is mainly due to a shift away from inefficient lignite-, coal- and gas-fired generation and significant investments in energy efficiency, which are carbon-free, as well as in high-efficiency cogeneration

Table 5-13 Comparison of CO2 emissions between PDP 2010 and PDP2012. (kt = kilotonnes)

Plant type	PDP2010 2010 GHG(kt)	PDP2010 2030 GHG(kt)	PDP2012 2030 GHG(kt)
Lignite – EGAT & Imports	19,631	26,404	10,226
Coal – EGAT & IPPs	9,625	70,433	14,703
Oil	675	0	0
Diesel	73	14	14
Natural gas	48,610	44,113	31,212
Large hydro – EGAT & Imports	208	859	225
Cogeneration-gas	3,234	16,884	29,989
Cogeneration-coal	1,476	0	0
Malaysia	139	416	416
Biomass	745	745	745
Biogas	-12	-12	-12
PV	84	84	84
microhydro	1	1	1
Wind	5	5	5
Municipal solid waste	26	26	26
Nuclear	0	6,497	0
Total	84,520	166,468	87,634
GHG intensity (kg/kWh)	0.50	0.48	0.34
per cap GHG emission (tonnes)	1300.30	2280.39	1200.47
		Change compared to 2010	
Total GHG emissions		97.0%	3.7%
GHG intensity		-4.4%	-32.9%
per cap CO2 emissio		75.4%	-7.7%

The calculations in Table 5-13 are based on pollutant emissions assumptions shown in 5-14 .

Table 5-14 Assumptions used in calculating different types of emissions from power generation. Source: (Sukkumnoed, 2007) p. 183.

Plant type	GHG g/kWh	NOX g/kWh	SO2 g/kWh	TSP g/kWh	Hg mg/kWh
Lignite	1200	5.80	5.27	0.62	0.04
Coal	960	3.79	3.76	0.33	0.36
Oil	770	2.90	4.90	0.25	0.01
Diesel	650	2.90	1.29	0.25	0.01
Natural gas	512	1.25	0.31	0.01	0.00
Large hydro – EGAT & Imports	15	0.02	0.01	0.01	0.00
Cogeneration-gas	343	0.84	0.21	0.01	0.00
Cogeneration-coal	643	2.54	2.52	0.23	0.36
Malaysia	443	1.25	0.31	0.10	0.00
Biomass	46	2.50	0.30	0.20	0.00
Biogas	33	1.94	0.07	0.10	0.00
PV	30	0.01	0.02	0.02	0.00
microhydro	2	0.01	0.00	0.00	0.00
Wind	10	0.00	0.07	0.01	0.00
Municipal solid waste	58	3.13	0.38	0.25	0.00
Nuclear	170	0	0	0	0