PDP2015

กระทรวงพลังงาน
MINISTRY OF ENERGY

Thailand Power Development Plan 2015-2036 (PDP2015)

Energy Policy and Planning Office

June 30, 2015

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Endorsed by the National Energy Policy Council (NEPC) on May 14, 2015

Acknowledged by the Cabinet on June 30, 2015

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1. Introduction

In 2012, the Ministry of Energy (Thailand) together with the Electricity Generating Authority of Thailand (EGAT) prepared the Thailand Power Development Plan 2012-2030 (PDP2010 Revision 3) to formulate power system development framework. The PDP2010 Revision 3 was endorsed by the National Energy Policy Council (NEPC) on June 8, 2012 and acknowledged by the Cabinet on June 19, 2012.

Since the end of year 2014, Sub-committee on Load Forecast and Power Development Plan Formulation considered developing a new PDP to respond to changes in economic and infrastructure development and ASEAN Economic Community (AEC). Therefore, the Ministry of Energy (Thailand) developed 5 integration master plans as follows: (1) Thailand Power Development Plan: PDP, (2) Energy Efficiency Development Plan: EEDP, (3) Alternative Energy Development Plan: AEDP, (4) Natural Gas Supply Plan, and (5) Petroleum Management Plan. The new PDP called "Thailand Power Development Plan 2015-2036 (PDP2015)" focuses on (1) Energy Security: coping with the increasing power demand to correspond to National Economic and Social Development Plan and taking into account fuel diversification (2) Economy: maintaining an appropriate cost of power generation for long-term economic competitiveness (3) Ecology: lessening carbon dioxide intensity of power generation.

The themes of the PDP2015 emphasize on improving power system reliability by reducing dependence on natural gas power generation, increasing a share of coal power generation via clean coal technology, importing power from neighboring countries, and developing renewable energy. In addition, the plan aims on transmission and distribution system development in order to support for renewable energy development and ASEAN Economic Community.

Throughout the PDP2015 development process, useful comments and options obtained from all stakeholders were taken into account. Besides, public hearings for the draft of the PDP2015 were conducted on April 8 and 28, 2015 at Rama Garden Hotel, Bangkok, Thailand. Consequently, the Thailand Power Development Plan 2015-2036 (PDP2015) was considered and commented by the Energy Regulatory Commission (ERC) on May 6, 2015. The PDP2015 was endorsed by the National Energy Policy Council (NEPC) on May 14, 2015 and acknowledged by the Cabinet on June 30, 2015.

2. Summary

According to the government policies of electricity, the framework of the Thailand Power Development Plan 2015-2036 (PDP2015) formulated in line with the Energy Efficiency Development Plan (EEDP) and the Alternative Energy Development Plan (AEDP) was approved by the National Energy Policy Council (NEPC) on December 17, 2014 as the following:

1. Energy Security: dealing with an increase in power demand taking into account fuel diversification to lessen the dependency of one particular fuel
2. Economy: maintaining an appropriate cost of power generation and implementing energy efficiency
3. Ecology: reducing environmental and social impacts by lessening carbon dioxide intensity of power generation

The PDP2015 was formulated in line with social and economic development direction addressed by the office of National Economic and Social Development Board (NESDB). The average growth of projected long-term Thai Gross Domestic Products (GDP) estimated by the NESDB was 3.94 percent. With the integration of the PDP2015 and the EEDP to foster energy efficiency, the expected energy saving would be 89,672 GWh in year 2036. Moreover, renewable energy, for instance, municipal waste, biomass, biogas, wind and solar power generation will be encouraged according to the AEDP. Investments in transmission and distribution system will accommodate renewable energy and smart-grid development. Consequently, estimated fuel requirements for the PDP2015 are shown in the following table:

Fuel	Percentage in 2014	Percentage in 2026	Percentage in 2036
Imported hydro power	7	10 - 15	15 – 20
Clean coal including lignite	20	20 - 25	20 – 25
Renewable energy including hydro	8	10 - 20	15 – 20
Natural gas	64	45 - 50	30 – 40
Nuclear	-	-	0 – 5
Diesel/Fuel oil	1	-	-

2.1 Current Status

Power requirement:

The peak power demand of year 2014 occurred on April 23, 2014 at 2.26 p.m. with the temperature of 37.5 Degree Celsius, and the maximum power generation of EGAT system reached 26,942.1 MW relating to 344.0 MW or 1.29 percent higher than the record of year 2013.

Generating capacity:

As of December 2014, the total contract capacity was 37,612 MW comprising 34,668 MW from firmed power plants - EGAT, IPPs and firmed-SPPs, 915 MW from non-firmed SPPs, and 2,029 MW from VSPPs. The details of contract capacity of Thailand power system are shown as the following:

Classified by technology				
- Combined cycle	21,145	MW	56.2	Percent
- Thermal	7,538	MW	20.0	Percent
- Renewable	8,476	MW	22.5	Percent
- Gas turbine/Diesel generator	153	MW	0.5	Percent
- EGAT-TNB linkage	300	MW	0.8	Percent
Total	**37,612**	**MW**		
Classified by power producer				
- EGAT	15,482	MW	41.2	Percent
- Independent Power Producers (IPPs)	13,167	MW	35.0	Percent
- Small Power Producers (SPPs)	4,530	MW	12.0	Percent
- Very Small Power Producers (VSPPs)	2,029	MW	5.4	Percent
- Power imports	2,404	MW	6.4	Percent
Total	**37,612**	**MW**		

Transmission System:

The standard voltage levels of EGAT transmission system are 500 kV, 230 kV, 132 kV, 115 kV, and 69 kV at operation frequency of 50 Hz. The total length of high voltage transmission line as of December 2014 was 32,526.99 circuit-kilometers comprising 4,167.17 circuit-kilometers of 500 kV, 14,605.12 circuit-kilometers of 230 kV, 8.70 circuit-kilometers of 132 kV, 13,703.93 circuit-kilometers of 115 kV, and 19.00 circuit-kilometers of 69 kV. Besides,

the 300 MW HVDC linked between EGAT and TNB system was 23.07 circuit-kilometers. The total number of high voltage substations was 213 comprising 11 of 500 kV substations, 71 of 230 kV substations, and 131 of 115 kV substations, with total transformer capacity of 88,461.44 MVA.

2.2 Power Demand Forecast

Thailand's new Power Demand Forecast was calculated upon the average long-term GDP growth during year 2014-2036 estimated by the NESDB of 3.94 percent and the average population growth of 0.03 percent. In addition, the energy saving target from the EEDP accounts for 89,672 GWh, and the renewable energy development target from the AEDP was set at 19,634.4 MW in year 2036.

The Thailand's new Power Demand Forecast would grow 2.67 percent annually from year 2014 to 2036. In year 2036, the expected energy and power demand would be 326,119 GWh and 49,655 MW respectively. The Power Demand Forecast of the PDP2010 Revision 3 and the PDP2015 are compared as shown in the table below:

Year	PDP2010 Rev3		PDP2015		Change (%)	
	Peak (MW)	Energy (GWh)	Peak (MW)	Energy (GWh)	Peak (MW)	Energy (GWh)
2016	31,809	210,619	30,218	197,891	-1,591	-12,728
2026	46,003	304,548	40,791	267,629	-5,212	-36,919
2030	52,256	346,767	44,424	291,519	-7,832	-55,248
2036	-	-	49,655	326,119	-	-

2.3 Key Assumptions and Frameworks of PDP2015

On August 15, 2014, the National Energy Policy Council (NEPC) approved assumptions and frameworks to formulate the PDP2015 as the following:

1. Ensuring power system reliability of subsystem areas in terms of generation, transmission and distribution
2. Focusing on fuel diversification in order to lessen the dependence of one particular fuel
   - Reducing natural gas power generation
   - Increasing coal power generation by clean coal technology

- Purchasing power from neighboring countries not larger than 20 percent of the total capacity
- Encouraging renewable power generation
- Maintaining nuclear power plants at the end of plan

3. Ensuring an appropriate level of reserve margin not less than 15 percent of the peak power demand
4. Maintaining committed IPPs and SPPs according to power purchase agreements (PPAs)

2.4 Thailand Power Development Plan 2015-2036 (PDP2015)

With the mentioned assumptions and frameworks, the PDP2015 can be summarized as follows: In 2036, the total capacity would be 70,335 MW comprising existing capacity of 37,612 MW (as of December 2014), new capacity of 57,459 MW, and retired capacity during 2015-2036 of 24,736 MW as shown below:

Generating capacity during 2015 - 2036

- Existing capacity as of December 2014	37,612	MW
- New capacity during 2015-2036	57,459	MW
- Retired capacity during 2015-2036	-24,736	MW
- Total capacity in 2036	70,335	MW

New capacity added during 2015-2036 of 57,459 MW can be classified as follows:

Renewable power plant	**21,648**	**MW**
- Domestic	12,105	MW
- Power purchase from neighboring countries	9,543	MW
Pump-storage hydro power plant	**2,101**	**MW**
Cogeneration power plant	**4,119**	**MW**
Combined cycle power plant	**17,478**	**MW**
Thermal power plant	**12,113**	**MW**
- Coal/Lignite power plant	7,390	MW
- Nuclear power plant	2,000	MW
- Gas turbine power plant	1,250	MW
- Power purchase from neighboring countries	1,473	MW
Total	**57,459**	**MW**

To ensure power system reliability of subsystem areas in terms of generation, transmission, and distribution, 2 areas which have high possibilities of power shortages were considered thoroughly.

Ensuring power system reliability in Southern of Thailand

Power demand in southern of Thailand would grow 3 percent annually; therefore, 3 power plants will be added during 2019-2024 as the followings:

- In 2019, Krabi Coal-fired Power Plant 800 MW
- In 2021, Thepa Coal-fired Power Plant unit 1 1,000 MW
- In 2024, Thepa Coal-fired Power Plant unit 2 1,000 MW

Ensuring power system reliability in Metropolitan area and central of Thailand

Electricity consumption of metropolitan area - the country's largest economy area - acquired the largest portion accounting for 30 percent of the total electricity consumption. However, relying on power from other areas, and lacking its own capacity, the area has been confronted with the challenge of the continuously growing power demand. Therefore, power plants are needed to be developed to maintain power system reliability in the area during 2019-2025 as the following:

- In 2019, replacement of South Bangkok Thermal Power Plant unit 1-5 1,300 MW
- In 2019, replacement of Bang Pakong Thermal Power Plant unit 1-2 1,300 MW
- In 2022, replacement of South Bangkok Combined Cycle Power Plant unit 1-2 1,300 MW
- In 2023, replacement of Wang Noi Combined Cycle Power Plant unit 1-2 1,300 MW
- In 2025, replacement of Wang Noi Combined Cycle Power Plant unit 3 1,300 MW

2.5 Transmission System Development Plan

Transmission system development has been one of EGAT's main responsibilities conducted in order to cope with continuously growing power demand, and to reinforce power system reliability. Major transmission system development plans according to the timeframe of the PDP2015 are as follows:

- 9 transmission system development projects to cope with the rising power demand
- 7 transmission system development projects to reinforce power system reliability
- 5 renovation and expansion projects of retired transmission systems
- 9 transmission system development projects for power purchases from IPPs, SPPs and power import from neighboring countries
- Transmission interconnection project (Grid to Grid)
- Smart grid system development

Currently, 13 transmission system development projects are under construction and other 19 projects are in studying processes.

3. Thailand Energy Policies

On September 12, 2014, Prime Minister General Prayut Chan-o-cha issued 11 policies in different perspectives to the legislature. The electricity policies were stated in the topic number 6 focusing on transparency, environmental concerns, cooperation among neighboring countries and long-term economic competitiveness by encouraging public and private sector investments on power generating capacity, for instance, fossil fuel power plant and renewable energy. Besides, the topic number 8 focuses on the exploration of technologies and sciences on R&D and innovation, investments and infrastructure development, for instance, clean energy, rail transport system, electric vehicle, and waste and water management.

Therefore, Sub-committee on Load Forecast and Power Development Plan Formulation considered revising The Thailand Power Development Plan 2012-2030 (PDP2010 revision 3) in order to conform to the policies, including infrastructure development, changes in economic, and ASEAN Economic Community.

The Thailand Power Development Plan 2015-2036 (PDP2015) was formulated according to the frameworks and the assumptions approved by the National Energy Policy Council (NEPC) on August 15, 2014. Thus, the timeframe of the Thailand Power Development Plan 2015-2036 (PDP2015), the Energy Efficiency Development Plan (EEDP), and the Alternative Energy Development Plan (AEDP) were harmonized with the National Economic and Social Development Plan (NESDP).

The Ministry of Energy (Thailand) intended to harmonize 5 integration master plans – (1) the PDP2015, (2) the EEDP, (3) the AEDP, (4) the Natural Gas Supply Plan, and (5) the Petroleum Management Plan - in order to systemize the country's energy management.

The Energy Efficiency Development Plan (EEDP) and the Alternative Energy Development Plan (AEDP) were described as follows:

3.1 Energy Efficiency Development Plan (EEDP)

Government anticipated that energy prices would be one of key concerns due to limited energy resources, environmental issues, global warming and climate change challenges which affect people's quality of life and the country's competitiveness. Therefore, the 20-year Energy Efficiency Development Plan 2015-2036 (EEDP) was developed by the Energy Policy and Planning Office, Ministry of Energy (Thailand) to address the issues. The objectives of the EEDP are as follows:

1. To establish the energy conservation targets (heat and electricity) in short term 5 years and long term 20 years where the aim is to reduce energy intensity (EI) by 30 percent in year 2036 compared with that in year 2010 for overall country and energy intensive sectors such as industrial, business, and residential as shown in figure 3.1.
2. To define strategies and guidelines in the energy conservation promotion to achieve the aforementioned targets and to formulate operation plans of the relevant organizations.

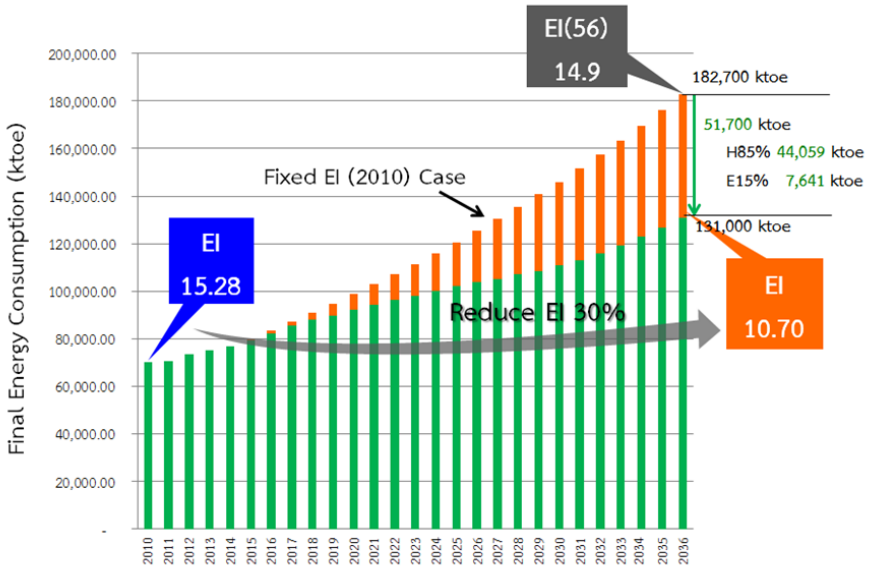


Figure 3.1 the energy conservation target during year 2010-2036

In order to formulate the 20-year Energy Efficiency Development Plan 2015-2036, the Ministry of Energy (Thailand) revised the 20-year Energy Efficiency Development Plan 2011-2030 by adjusting the baseline data and assumptions. Therefore, the target of the EEDP

2015-2036 becomes to reduce energy intensity by 30 percent in year 2036 compared with that in year 2010 or accounting for 56,142 kilo tons of oil equivalent (ktoe). However, energy savings estimated by an energy intensity reduction during year 2010-2013 was 4,442 ktoe. Thus, the energy conservation target would be achieved by measures and projects during year 2015-2036 accounting for 51,700 ktoe where around 15 percent or 7,641 ktoe (89,672 GWh) would be in electricity sectors and around 85 percent or 44,059 ktoe would be in thermal sectors as shown in Figure 3.2.

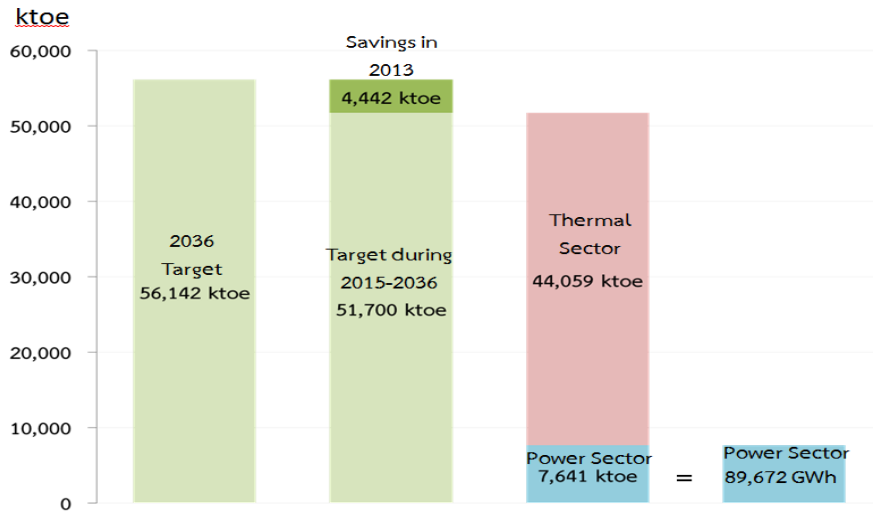


Figure 3.2 the energy conservation target according to EEDP in year 2036

Moreover, the energy conservation plans of 4 economic sectors - residential, industrial, business, and transportation – were revised. Therefore, 6 guidelines were stated to encourage energy conservation as follows:

1. Removing / Revising energy price subsidies to create the market price
2. Introducing tax incentives / ESCO fund to encourage the use of efficient appliances
3. Introducing monetary incentives / grants or soft loan along with energy management consulting to encourage the use of high efficiency appliances
4. Defining Industrial Factory and Building Energy Code to be under obligations
5. Building public awareness of energy conservation
6. Defining Energy Efficiency Resources Standard (EERS) for power producers and distributors

According to the EEDP, 6 of the most feasible measures from 34 energy conservation measures would be implemented in electricity sectors accounting for 89,672 GWh of energy savings in year 2036 as shown in Table 3.1

Table 3.1 the energy conservation targets in year 2036 classified by measure (GWh)

Measures	Residential	Industrial	Building		Total (GWh)
			Business	Government	
1.Specific Energy Consumption (SEC)	-	10,814	5,654	3,180	19,648
2. Building Energy Code (BEC)	-	-	11,975	1,711	13,686
3. High Energy Performance Standard (HEPs) & Minimum Energy Performance Standard (MEPs)	8,936	6,226	7,609	989	23,760
4. Monetary incentives	-	9,133	5,941	-	15,074
5. LED promotion	3,354	3,303	3,711	1,264	11,632
6. Energy Efficiency Resource Standard (EERS)	1,343	2,367	2,162	-	5,872
Total	**13,633**	**31,843**	**37,052**	**7,144**	**89,672**

The aforementioned energy conservation targets can be shown in table 3.2 and the targets classified by economic sectors can be shown in Table 3.3.

Table 3.2 the energy conservation targets classified by measure (GWh)

Measures	Energy Conservation Targets				
	2016	2021	2026	2031	2036
1. Specific Energy Consumption (SEC)	1,802	6,992	11,669	14,738	19,648
2. Building Energy Code (BEC)	-	770	2,719	6,402	13,686
3. High Energy Performance Standard (HEPs) & Minimum Energy Performance Standard (MEPs)	857	3,446	8,163	14,776	23,760
4. Monetary incentives	905	5,133	9,691	11,564	15,074
5. LED promotion	160	1,862	4,909	8,129	11,632
6. Energy Efficiency Resource Standard (EERS)	-	-	870	3,085	5,872
Total	**3,724**	**18,203**	**38,021**	**58,694**	**89,672**

Table 3.3 the energy conservation targets classified by economic sector (GWh)

Economic sectors	Energy Conservation Targets				
	2016	2021	2026	2031	2036
Industrial	2,174	9,420	17,497	22,845	31,843
Business	853	5,156	12,687	22,406	36,052
Residential and Agricultural	395	1,914	4,877	8,760	13,633
Government	302	1,713	2,960	4,683	7,144
Total	**3,724**	**18,203**	**38,021**	**58,694**	**89,672**

3.2 Alternative Energy Development Plan (AEDP)

The words - “Alternative Energy” and “Renewable Energy” – started to play a great role in power system. However, the power generation costs from some renewable energy resources have still been higher than those of conventional energy resources such as coal, natural gas, and hydro while renewable energy has been promoted to address global warming and climate change issues causing by greenhouse gases (GHGs). The most well known GHG is Carbon Dioxide (CO_2) mostly emitted from combustion of fossil fuels in industrial sectors and electricity power generation. Therefore, the government has been making an effort to push forward the Alternative Energy Development Plan (AEDP) in order to become a Low Carbon Society. In the past, to attract investors, the Adder System was used to encourage renewable power generation, while nowadays Feed-in Tariff (FIT) has been planned to be implemented in order to reflect the real cost of renewable power generation and to specify the timeframe of purchasing.

Previously, the timeframe of renewable energy promotion according to the PDP2010 revision 3 and the previous ADEP was during year 2012-2021. The target was to substitute fossil fuel consumption by 25 percent in 10 years, and to analyze the effects of the AEDP on energy prices according to NEPC’s guidance. However, there was a great interest on renewable power generation investments in some areas due to their high incentives causing challenges on the power system and purchasing scheme.

In the new AEDP, the renewable energy promotion schemes were designed to strengthen the community, lessen the dependence on fossil fuels and address social problems such as municipal solid waste and agricultural waste. Therefore, the plan intended to encourage waste, biomass, and biogas power generation as the first priority. According to the plan, the potential of power generation from waste would be 500 MW and the potential

of power generation from biomass would be 2,500 MW. In line with the policies of the Ministry of Agriculture and Cooperatives (Thailand), to increase the plantation area of sugar cane and palm, as well as to raise productivity of cassava from 3.5 to 7 tons per Rai per year could increase the potential of 1,500 MW. In addition, area by area zoning and power generation capacity limitation measures were adopted to prevent challenges from the previous plan. It is expected that technology improvement would build up the competitiveness of renewable energy over that of conventional energy especially LNG. The main target of the new AEDP is to increase the portion of renewable energy generation from currently 8 percent to 20 percent of the total power requirement in 2036 which accounts for 19,634.4 MW as shown in Table 3.4

Table 3.4 the Alternative Energy Development Plan in year 2036 (MW)

Year	Solar	Wind	Hydro	Waste	Biomass	Biogas	Energy crops	Total
2014	1,298.5	224.5	3,048.4	65.7	2,541.8	311.5	-	**7,490.4** 1/
2036	6,000.0	3,002.0	3,282.4	500.0	5,570.0	600.0	680.0	**19,634.4** 1/

Remark: 1/ Installed capacity

The portion of renewable energy for power generation has been increasing; therefore, the development of the PDP2015 must be in line with the AEDP. Power system theories should be adopted to prevent the reverse power and to balance supply and demand so that power system reliability will be reinforced. Frameworks adopted in order to address the mentioned issues are as follows:

1. Department of Alternative Energy Development and Efficiency (DEDE) being the organization responsible for considering potential of each renewable energy resource by area in order to define purchase amount and the timeframe
2. Considering transmission system availability by calculating the existing power demand and quantity of the power purchase from renewable energy of each high voltage substation in order to reduce losses in the transmission system and to define purchase amount
3. Considering distribution system availability by calculating the existing power demand and quantity of power purchase from renewable energy of each

distribution substation in order to define purchase amount, and to prevent reverse power from the distribution system into the transmission system which would cause power losses. Therefore, to prevent such a problem, power generation from renewable energy sources must be managed by the distribution operators - Metropolitan Electricity Authority (MEA) and Provincial Electricity Authority (PEA) -

In the future, the renewable purchase schemes would play a vital role in implementing the AEDP, thus, the Energy Regulatory Commission (ERC) will be responsible for monitoring the country's renewable energy status, and revising the AEDP by situation. As a result, private investors would have a clear picture of the country's renewable energy development.

3.3 Principles and Directions for Firmed Cogeneration SPPs with PPAs expiration date during year 2017-2025

The National Energy Policy Council (NEPC) approved principles and directions for firmed cogeneration SPPs with PPAs expiration date during year 2017-2025, the details are as follows:

1. Criteria for Firmed Cogeneration SPPs with PPAs expiration date during year 2017-2025

Cogeneration power plants could generate both electricity power and useful heat in the form of steam. Therefore, it is advantageous for industrial estates not to invest on unnecessary own boilers. Moreover, Replacement of expired Cogeneration SPPs and construction of the news are ease because of community acceptance and the existing infrastructure exploitation. Thus, the criteria for Firmed Cogeneration SPPs with PPAs expiration date during year 2017-2025 are as follows:

1.1 In case of PPA renewal for old technology cogeneration SPPs, the tariff structure will be renegotiated because the investor has already recovered construction costs.

1.2 In case of construction of new cogeneration SPPs, it is necessary to promote cogeneration SPPs as Distributed Generation (DG) in order to lessen losses in transmission and distribution system by the following measures:

(1) Site of cogeneration SPPs must be located in the industrial estates or the manufacturing zones which have high demand of electricity power and steam or cold water.

(2) Capacity of cogeneration SPPs should be defined at the least possible amount according to demand of the customers in the industrial estates.

(3) Solid regulation should be adopted to maintain primary fuel efficiency and the cogeneration SPP objectives which are to generate both electricity power and steam.

2. Directions for Firmed Cogeneration SPPs with PPAs expiration date during year 2017-2025

2.1 Group 1: In case of cogeneration SPPs with PPAs expiration date during year 2017-2018, the term of the PPAs will be extended for 3 to 5 years where EGAT would purchase electricity in excess of the electricity demand of SPPs' customer at the minimum amount. In addition, the tariff structures will be renegotiated to reflect the real operation costs.

2.2 Group 2: In case of cogeneration SPPs with PPAs expiration date during year 2019-2025, construction of new plants required to be located in the former existing SPP sites or adjacent to where the demand of electricity and heat or cold water are intensive. Moreover, the size of power plant would be properly defined to conform to the power and heat demand of customers in the industrial zones. PPAs will last for 20 years. Purchase price will not be set higher than the rate of IPPs. And EGAT would purchase electricity in excess of the electricity demand of SPPs' customer which is not more than 20 percent of the capacity signed in the previous PPAs. Moreover, solid regulation would also be adopted to maintain the primary fuel efficiency and the cogeneration SPP objectives.

4. Power Demand Forecast

4.1 Current Status of Thailand Power Sector

The peak power demand of year 2014 occurred on April 23, 2014 at 2.26 p.m. with the temperature of 37.5 Degree Celsius where the maximum power generation of EGAT system reached 26,942.1 MW relating to 344.0 MW or 1.29 percent higher than the record of 2013. The energy requirement of EGAT system was 177,580 GWh relating to 4,045 GWh or 2.33 percent higher than the record of the previous year.

The country's peak power demand occurring at the same time of EGAT system's reached 27,663.5 MW relating to 549.0 MW or 2.03 percent higher than that of year 2013. The energy requirement increased 5,338.8 GWh or 3.01 percent from the record of year 2013.

4.2 Thailand Power Demand Forecast

The National Energy Policy Council (NEPC) approved assumptions and frameworks to formulate the Thailand Power Development Plan 2015-2036 (PDP2015) on August 15, 2015. In addition, the Alternative Energy Development Plan (AEDP) and the Energy Efficiency Development Plan (EEDP) were also formulated along the timeframe between year 2015 and 2036.

The new Thailand's Load Forecast was formulated in line with the potential and target of the AEDP and the EEDP, economic growth, changes in economic structure, infrastructure development projects, the performance of the EEDP measures, and VSPP power purchase plan. The Thailand's new Load Forecast was proposed to Thailand Load Forecast and Power Development Subcommittee and approved on January 9, 2015.

The power demand forecast was formulated as the business as usual case (BAU) according to the average forecasted GDP growth during year 2014-2036 (Base case) published by the NESDB on September 2, 2014 of 3.94 percent - the previous plan of 4.49 percent. In addition, population growth, urbanization, and growth rate of electricity customers by economic sectors were also considered. Consequently, End-Use model and Econometrics model developed by Thammasat University were used for the formulation on the power demand forecast development with the assumptions as follows:

Assumptions of the Power Demand Forecast

1) The power demand forecast models for long-term energy efficiency developed by Faculty of Economics, Thammasat University (February 2014) were used to estimate the power demand of the Provincial Electricity Authority (PEA) distribution system and the Metropolitan Electricity Authority (MEA) distribution system. Assumptions required for the models are growth rates of Residential, Business, Industrial, and Other Customer in the distribution system which changes according to economic and population growth.

2) The actual data from January to October 2014 and the estimated data from November to December of 2014 were used to estimate the power demand of year 2014.

3) The estimated GDP growth during year 2014-2036 was published by NESDB on September 2, 2014 in which the outcomes from the infrastructure development projects excluding high speed train projects were included in the estimation. The estimated GDP growth during year 2014-2036 expected to grow on the average of 3.94 percent annually was used in the power demand forecast models. The details of the estimated GDP growth during year 2014-2036 are shown in the following table:

Table 4.1 the estimated long-term GDP growth by NESDB (September 2, 2014)

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
GDP	2.0	4.0	4.4	4.7	4.3	4.1	4.2	4.2	4.1	4.0	4.1	4.0

Year	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
GDP	4.0	4.0	3.9	3.8	3.8	3.9	3.8	3.8	3.8	3.8	3.8

4) The maximum power demand of each electricity customer was estimated from load profiles of year 2013.

5) The power demand from BTS sky train, MRT train, and 10 mass rapid transit projects in Bangkok was counted in the model except those of the unclear high speed train projects.

6) The target of the EEDP is to reduce the energy intensity of year 2036 by 30 percent from that of year 2010. Thus, the measures of the EEDP on electricity focus mainly on industrial, building, residential, and government sector as shown in the table below:

Table 4.2 the energy conservation targets of the EEDP on electricity in year 2036 classified by economic sectors (GWh)

Measures	Residential	Industrial	Building		Total (GWh)
			Business	Government	
1.Specific Energy Consumption (SEC)	-	10,814	5,654	3,180	19,648
2. Building Energy Code (BEC)	-	-	11,975	1,711	13,686
3. High Energy Performance Standard (HEPs) & Minimum Energy Performance Standard (MEPs)	8,936	6,226	7,609	989	23,760
4. Monetary incentives	-	9,133	5,941	-	15,074
5. LED promotion	3,354	3,303	3,711	1,264	11,632
6. Energy Efficiency Resource Standard (EERS)	1,343	2,367	2,162	-	5,872
Total	**13,633**	**31,843**	**37,052**	**7,144**	**89,672**

7) The target of the AEDP is to increase a portion of renewable and alternative energy uses to 30 percent of the total final energy consumption. Thus, the measures of the AEDP on electricity generation are shown as follows:

7.1) Power generation from municipal waste, biomass, and biogas will be promoted according to the potential in order to create benefits for society and agricultural sectors as the following:

- Municipal waste power plants installed capacity of 500 MW
- Biomass power plants
  - Installed capacity of 2,500 MW from current potential
  - Installed capacity of 1,500 MW from agricultural zoning policy (Ministry of Agriculture and Cooperatives)

7.2) Renewable energy targets were defined region by region according to the power demand and renewable energy potential of the region.

7.3) Solar and wind energy will be promoted as soon as they become competitive to LNG.

7.4) Competitive Bidding measures would be adopted to promote the AEDP.

The AEDP would be integrated with the power demand forecasting in order to formulate the PDP2015. However, many limitations should be considered, for instance, the renewable energy potential and power demand of each region. Transmission and distribution system have not been planned for the large amount of power generated from Very Small Power Producers (VSPPs); therefore, there would be a possibility of reverse power flow problems which would increase losses in the power system.

The AEDP developed by Department of Alternative Energy Development and Efficiency (DEDE) was approved by the National Energy Policy Council (NEPC) on December 15, 2014 with the target on power generated from renewable energy in year 2036 of 19,634.4 MW as show in Table 4.3.

Table 4.3 the renewable and alternative energy targets of AEDP in 2036 (MW)

Type	Plant Factor (%)	Target[1/]
Solar		6,000.0
- Ground Mount	16	
- Rooftop	15	
Wind	18	3,002.0
Hydro		3,282.4
- ≤ 10 MW	44	*376.0*
- > *10* MW	-	*2,906.4*
Municipal Waste	70	500.0
Biomass	70	5,570.0
Biogas (Waste water/Waste)	70	600.0
Biogas (Energy crops)	78	680.0
Total		**19,634.4**

Remark: 1/ installed capacity

The information required on the estimation of power demand is as follows: power consumption, distribution power requirement, EGAT sales, power requirement of EGAT system, and power requirement of the country. However, data collection of power plants linked outside EGAT system such as renewable power generation from VSPPs and DEDE as well as diesel generation from PEA has been facing challenges due to their large numbers of sites. Therefore, the installed capacity of VSPPs which would be used in the calculation on energy requirement of EGAT system and the country was estimated from the AEDP as shown in Table 4.4.

Table 4.4 the accumulated installed capacity of renewable energy (VSPPs/DEDE/PEA) (MW)

Year	Solar	Wind	Hydro	Waste	Biomass	Biogas	Energy Crops	Total
2016	3,390	66	70	100	337	1,842	-	5,805
2021	3,816	118	80	141	411	2,956	24	7,547
2026	4,237	224	115	264	491	3,687	259	9,279
2031	4,741	401	137	311	552	4,347	363	10,852
2036	5,262	1,069	168	321	600	5,050	630	13,100

The long-term power demand forecast was developed into 2 cases as the following:

1) BAU (Business as Usual) Case: the statistical data of year 2013 was used in the model where the energy conservation measures were already implemented. Therefore, in 2036, the estimated energy saving would be 27,282 GWh, as a result, the maximum power demand would reach 59,300 MW or grow on the average of 3.5 percent.

2) Base Case: the measures of energy conservation from the EEDP were integrated in the model. Therefore, in year 2036, the energy intensity would be reduced from that of year 2010 by 24 percent accounting for 89,672 GWh of the energy saving. The maximum power demand would reach 49,655 MW or grows on the average of 2.7 percent with the power demand saving of 9,543 MW as shown in Table 4.5 to 4.9.

Table 4.5 comparison of power demand forecast between BAU case and Base case

Year	(1) BAU case		(2) Base case		Difference (2) – (1)	
	MW	GWh	MW	GWh	MW	GWh
2016	30,304	198,439	30,218	197,891	-86	-548
2021	36,993	242,623	35,775	234,654	-1,218	-7,969
2026	43,755	287,748	40,791	267,629	-2,964	-20,119
2031	50,991	336,680	45,438	298,234	-5,554	-38,446
2036	59,300	393,335	49,655	326,119	-9,645	-67,216

Table 4.6 TOTAL GENERATION REQUIREMENT

(PDP2015:Base case)

Year	Peak			Energy			Load Factor	Intensity kWh
	MW	Increase		GWh	Increase			
		MW	%		GWh	%	%	1000 bahts
Actual : NET Generation								
2012 (2555)	26,418.3	2,310	9.58	175,925.1	15,108.8	9.40	75.81	33.34
2013 (2556)	27,084.5	666	2.52	177,543.8	1,618.7	0.92	74.63	32.88
2014 (2557)	27,633.5	549	2.03	182,882.6	5,338.8	3.01	75.34	33.17
Forecast : NET Generation								
2015 (2558)	**29,051**	1,418	5.13	**190,285**	7,403	4.05	74.77	33.11
2016 (2559)	**30,218**	1,167	4.02	**197,891**	7,605	4.00	74.76	32.98
2017 (2560)	**31,385**	1,167	3.86	**205,649**	7,758	3.92	74.80	32.75
2018 (2561)	**32,429**	1,045	3.33	**212,515**	6,867	3.34	74.81	32.46
2019 (2562)	**33,635**	1,206	3.72	**220,503**	7,987	3.76	74.84	32.35
2020 (2563)	**34,808**	1,173	3.49	**228,238**	7,736	3.51	74.85	32.09
2021 (2564)	**35,775**	967	2.78	**234,654**	6,416	2.81	74.88	31.67
2022 (2565)	**36,776**	1,001	2.80	**241,273**	6,619	2.82	74.89	31.29
2023 (2566)	**37,740**	964	2.62	**247,671**	6,398	2.65	74.92	30.88
2024 (2567)	**38,750**	1,010	2.68	**254,334**	6,663	2.69	74.93	30.48
2025 (2568)	**39,752**	1,002	2.59	**260,764**	6,430	2.53	74.88	30.04
2026 (2569)	**40,791**	1,039	2.61	**267,629**	6,865	2.63	74.90	29.67
2027 (2570)	**41,693**	903	2.21	**273,440**	5,812	2.17	74.87	29.16
2028 (2571)	**42,681**	988	2.37	**279,939**	6,499	2.38	74.87	28.74
2029 (2572)	**43,489**	807	1.89	**285,384**	5,445	1.95	74.91	28.26
2030 (2573)	**44,424**	935	2.15	**291,519**	6,135	2.15	74.91	27.82
2031 (2574)	**45,438**	1,013	2.28	**298,234**	6,715	2.30	74.93	27.41
2032 (2575)	**46,296**	858	1.89	**303,856**	5,622	1.89	74.92	26.90
2033 (2576)	**47,025**	729	1.58	**309,021**	5,164	1.70	75.02	26.36
2034 (2577)	**47,854**	829	1.76	**314,465**	5,444	1.76	75.02	25.84
2035 (2578)	**48,713**	859	1.79	**320,114**	5,649	1.80	75.02	25.35
2036 (2579)	**49,655**	942	1.93	**326,119**	6,005	1.88	74.97	24.88
Average Growth								
2007 -2011	-	511	2.24	-	4,211	2.80	-	32.05
2012-2016	-	1,390	4.62	-	7,934	4.24	-	33.09
2017-2021	-	1,111	3.43	-	7,353	3.47	-	32.24
2022-2026	-	1,003	2.66	-	6,595	2.66	-	30.44
2027-2031	-	929	2.18	-	6,121	2.19	-	28.24
2032-2033	-	843	1.79	-	5,577	1.80	-	25.83
2014-2036	-	1,001	2.67	-	6,511	2.68	-	29.04

Remark Purchasing power from VSPP is included. **9 Jan 15**

Table 4.7 EGAT GENERATION REQUIREMENT

9 Jan 2015 : Base Case

Year	Peak			Energy			Load Factor
	MW	Increase		GWh	Increase		
		MW	%		GWh	%	%
Actual : NET Generation							
2012 (2555)	26,121.1	2,221	9.29	173,205.1	14,335	9.02	75.69
2013 (2556)	26,598.1	477	1.83	173,535.4	330	0.19	74.48
2014 (2557)	26,942.1	344	1.29	177,580.5	4,045	2.33	75.24
Forecast : NET Generation							
2015 (2558)	**28,271**	1,329	4.93	**182,575**	4,995	2.81	73.72
2016 (2559)	**29,219**	948	3.35	**187,080**	4,505	2.47	73.09
2017 (2560)	**30,303**	1,084	3.71	**191,697**	4,617	2.47	72.21
2018 (2561)	**31,269**	966	3.19	**193,771**	2,074	1.08	70.74
2019 (2562)	**32,408**	1,139	3.64	**197,335**	3,564	1.84	69.51
2020 (2563)	**33,459**	1,051	3.24	**203,321**	5,986	3.03	69.37
2021 (2564)	**34,382**	923	2.76	**208,385**	5,064	2.49	69.19
2022 (2565)	**35,336**	954	2.77	**213,640**	5,255	2.52	69.02
2023 (2566)	**36,294**	958	2.71	**218,846**	5,206	2.44	68.83
2024 (2567)	**37,097**	803	2.21	**224,018**	5,172	2.36	68.94
2025 (2568)	**37,931**	834	2.25	**228,767**	4,749	2.12	68.85
2026 (2569)	**38,894**	963	2.54	**233,887**	5,120	2.24	68.65
2027 (2570)	**39,729**	835	2.15	**237,859**	3,972	1.70	68.35
2028 (2571)	**40,652**	923	2.32	**242,373**	4,514	1.90	68.06
2029 (2572)	**41,385**	733	1.80	**245,990**	3,617	1.49	67.85
2030 (2573)	**42,239**	854	2.06	**250,824**	4,834	1.97	67.79
2031 (2574)	**43,161**	922	2.18	**256,091**	5,267	2.10	67.73
2032 (2575)	**43,917**	756	1.75	**260,160**	4,069	1.59	67.62
2033 (2576)	**44,543**	626	1.43	**263,700**	3,540	1.36	67.58
2034 (2577)	**45,253**	710	1.59	**267,296**	3,596	1.36	67.43
2035 (2578)	**46,030**	777	1.72	**271,204**	3,908	1.46	67.26
2036 (2579)	**46,891**	861	1.87	**275,325**	4,121	1.52	67.03
Average Growth							
2007 -2011	-	473	-	-	3,782	-	75.43
2012-2016	-	1,244	4.10	-	6,041	3.32	74.25
2017-2021	-	1,033	3.31	-	4,261	2.18	70.20
2022-2026	-	902	2.50	-	5,100	2.34	68.86
2027-2031	-	853	2.10	-	4,441	1.83	67.96
2032-2036	-	746	1.67	-	3,847	1.46	67.38
2014-2036	-	907	2.50	-	4,443	2.03	69.04

9 Jan 15

Table 4.8 Power Demand Forecast

(PDP2015 : Base case)

Year	Total Generation (Include VSPP)		EGAT Generation		EGAT Sales							
					MEA		PEA		Direct customers		Total	
	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW	GWh	MW [1/]	GWh
2012	26,418	175,925	26,121	173,205	8,424	49,992	16,682	116,025	685	3,353	25,791	169,370
2013	27,084	177,544	26,598	173,535	8,638	49,624	17,294	116,793	761	3,113	26,693	169,530
2014	27,633	182,883	26,942	177,580	8,646	50,044	17,724	120,200	986	3,360	27,357	173,604
2015	29,051	190,285	28,271	182,575	8,973	51,504	18,778	123,167	767	3,192	28,518	177,862
2016	30,218	197,891	29,219	187,080	9,225	53,145	19,378	125,872	768	3,232	29,371	182,249
2017	31,385	205,649	30,303	191,697	9,493	54,815	20,134	128,635	783	3,283	30,410	186,733
2018	32,429	212,515	31,269	193,771	9,753	56,411	20,780	128,964	804	3,386	31,336	188,762
2019	33,635	220,503	32,408	197,335	10,021	58,094	21,564	130,685	822	3,459	32,407	192,238
2020	34,808	228,238	33,459	203,321	10,256	59,744	22,232	134,592	837	3,522	33,325	197,859
2021	35,775	234,654	34,382	208,385	10,453	60,959	22,884	138,259	852	3,586	34,189	202,804
2022	36,776	241,273	35,336	213,640	10,654	62,175	23,567	142,091	865	3,651	35,085	207,917
2023	37,740	247,671	36,294	218,846	10,856	63,409	24,251	145,880	879	3,716	35,987	213,005
2024	38,750	254,334	37,097	224,018	11,093	64,687	24,798	149,592	894	3,790	36,785	218,069
2025	39,752	260,764	37,931	228,767	11,323	65,971	25,369	152,871	909	3,839	37,601	222,681
2026	40,791	267,629	38,894	233,887	11,537	67,280	26,102	156,708	923	3,884	38,561	227,872
2027	41,693	273,440	39,729	237,859	11,746	68,502	26,690	159,321	937	3,932	39,373	231,755
2028	42,681	279,939	40,652	242,373	11,945	69,635	27,382	162,547	950	3,979	40,277	236,161
2029	43,489	285,384	41,385	245,990	12,137	70,708	27,993	165,377	963	4,025	41,093	240,110
2030	44,424	291,519	42,239	250,824	12,297	71,641	28,659	169,137	976	4,071	41,932	244,849
2031	45,438	298,234	43,161	256,091	12,467	72,617	29,387	173,280	989	4,115	42,844	250,012
2032	46,296	303,856	43,917	260,160	12,616	73,455	29,979	176,387	1,002	4,160	43,596	254,002
2033	47,025	309,021	44,543	263,700	12,765	74,294	30,516	178,974	1,014	4,205	44,296	257,473
2034	47,854	314,465	45,253	267,296	12,915	75,139	31,080	181,610	1,027	4,249	45,021	260,998
2035	48,713	320,114	46,030	271,204	13,066	75,994	31,688	184,543	1,039	4,293	45,794	264,830
2036	49,655	326,119	46,891	275,325	13,230	76,915	32,358	187,618	1,051	4,337	46,639	268,869
Average Growth												
2012 - 2016	4.62	4.24	4.10	3.32	3.20	3.03	3.91	3.42	-1.83	1.17	3.51	3.26
2017 - 2021	3.43	3.47	3.31	2.18	2.53	2.78	3.38	1.90	2.09	2.10	3.08	2.16
2022 - 2026	2.66	2.66	2.50	2.34	1.99	1.99	2.67	2.54	1.62	1.61	2.44	2.36
2027 - 2031	2.18	2.19	2.10	1.83	1.56	1.54	2.40	2.03	1.40	1.16	2.13	1.87
2032 - 2036	1.79	1.80	1.67	1.46	1.20	1.16	1.94	1.60	1.22	1.06	1.71	1.46

Remark 1/ Maximum Power Demand (Non-coincident) **9 January 2015**

TABLE 4.9

COMPARISON OF TOTAL GENERATION REQUIREMENT

Year	(1) PDP2010 Rev.3 (May 2013)		(2) PDP2015 (9January 2015)		Difference (2)-(1)			
	MW	GWh	MW	GWh	MW	%	GWh	%
2015	30,231	200,726	29,051	190,285	-1,180	-3.90	-10,441	-5.20
2016	31,809	210,619	30,218	197,891	-1,590	-5.00	-12,728	-6.04
2017	33,264	219,616	31,385	205,649	-1,879	-5.65	-13,967	-6.36
2018	34,593	227,760	32,429	212,515	-2,164	-6.25	-15,244	-6.69
2019	35,869	236,408	33,635	220,503	-2,234	-6.23	-15,905	-6.73
2020	37,326	246,164	34,808	228,238	-2,518	-6.74	-17,925	-7.28
2021	38,726	255,591	35,775	234,654	-2,951	-7.62	-20,937	-8.19
2022	40,134	265,039	36,776	241,273	-3,358	-8.37	-23,766	-8.97
2023	41,567	274,672	37,740	247,671	-3,827	-9.21	-27,001	-9.83
2024	43,049	284,640	38,750	254,334	-4,300	-9.99	-30,305	-10.65
2025	44,521	294,508	39,752	260,764	-4,768	-10.71	-33,744	-11.46
2016	46,003	304,548	40,791	267,629	-5,212	-11.33	-36,919	-12.12
2027	47,545	314,925	41,693	273,440	-5,852	-12.31	-41,485	-13.17
2028	49,115	325,470	42,681	279,939	-6,433	-13.10	-45,530	-13.99
2029	50,624	335,787	43,489	285,384	-7,135	-14.09	-50,403	-15.01
2030	52,256	346,767	44,424	291,519	-7,832	-14.99	-55,247	-15.93
2031			45,438	298,234	-	-	-	-
2032			46,296	303,856	-	-	-	-
2033			47,025	309,021	-	-	-	-
2034			47,854	314,465	-	-	-	-
2035			48,713	320,114	-	-	-	-
2036			49,655	326,119	-	-	-	-

9 January 2015

5. Thailand Power Development Plan 2015-2036 (PDP2015)

5.1 Current Status

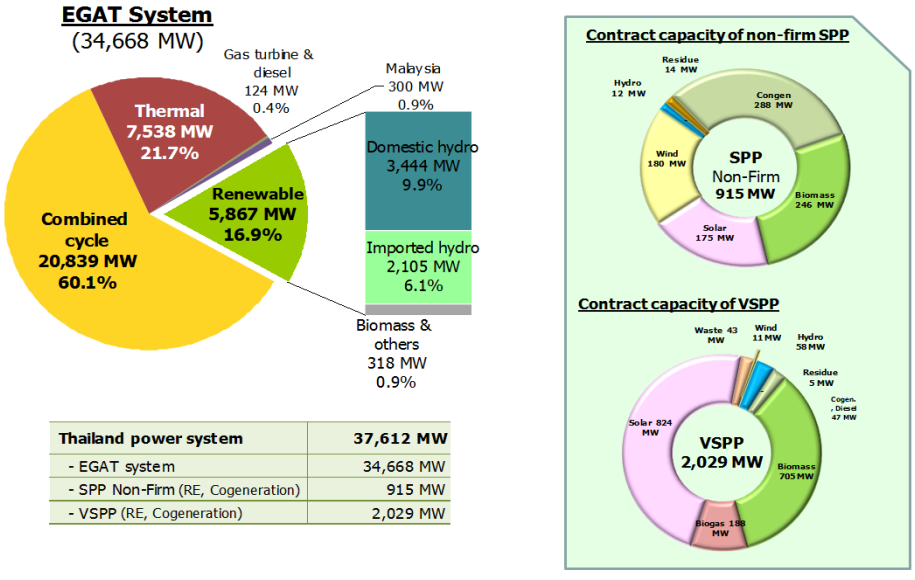
As of December 2014, the total contract capacity was 37,612 MW comprising 34,668 MW from firmed power plants - EGAT, IPPs and firmed-SPPs, 915 MW from non-firmed SPPs, and 2,029 MW from VSPPs. The details of the contract capacity of Thailand power system are shown as following:

Classified by technology

- Combined cycle	21,145	MW	56.2	Percent
- Thermal	7,538	MW	20.0	Percent
- Renewable	8,476	MW	22.5	Percent
- Gas turbine/Diesel generator	153	MW	0.5	Percent
- EGAT-TNB linkage	300	MW	0.8	Percent
Total	**37,612**	**MW**		

Classified by power producer

- EGAT	15,482	MW	41.2	Percent
- IPPs	13,167	MW	35.0	Percent
- SPPs	4,530	MW	12.0	Percent
- VSPPs	2,029	MW	5.4	Percent
- Power imports	2,404	MW	6.4	Percent
Total	**37,612**	**MW**		



Picture 5.1 Thailand's generating capacity as of December 2014

5.2 Development of Thailand Power Development Plan 2015-2036 (PDP2015)

According to the 1/2014 resolution of the National Energy Policy Council (NEPC) on August 15, 2014, the timeframe of the Thailand Power Development Plan 2015-2036 (PDP2015), the Energy Efficiency Development Plan (EEDP) and the Alternative Energy Development Plan (AEDP) would be harmonized to the timeframe of the National Economic and Social Development Plan (NESDP). The NEPC approved the themes of the PDP2015 as the following:

1. Energy Security: coping with an increase in power demand for economic growth taking into account fuel diversification to lessen dependence of one particular fuel
2. Economy: maintaining an appropriate cost of power generation, implementing energy efficiency for the country's long-term economic competitiveness
3. Ecology: reducing environmental and social impacts by lessening carbon dioxide intensity of power generation

5.3 Frameworks and Directions of Thailand Power Development Plan 2015-2036 (PDP2015)

1. The power demand forecast was estimated according to the Base Case GDP growth during year 2014-2036 on the average of 3.94 percent published on September 2, 2014 from the NESDB (GDP growth of the previous plan was on the average of 4.49 percent).
2. Energy savings from the EEDP (30 percent reduction of energy intensity of year 2036 compared to that of year 2010 or 89,672 GWh for power sector) would be integrated to the PDP2015.
3. The AEDP target which is to increase the portion of renewable generation from 8 percent at present to 20 percent of the country's electricity requirement in year 2036 of 19,634.4 MW would be integrated to the PDP2015.
4. Frameworks for new generating capacity allocation and fuel diversification of the PDP2015 are as follows:

4.1 Ensuring power system reliability of subsystem areas in terms of generation, transmission and distribution

4.2 Focusing on fuel diversification in order to lessen dependence of one particular fuel, and maintaining an appropriate cost of power generation for the country's long-term economic competitiveness by the following measures:

- Reducing natural gas power generation
- Increasing coal power generation via clean coal technology due to its relatively low fuel cost, and high reserves of coal
- Purchasing power from neighboring countries not larger than 20 percent of the total capacity by considering development potential and prices
- Encouraging renewable power generation with consideration to transmission system capability
- Maintaining nuclear power plants at the end of plan due to its cleanliness and relatively low fuel cost. Encouraging the study on nuclear technology and safety. And, building public awareness on nuclear power plant

4.3 Maintaining the level of reserve margin from the previous plan (the PDP2010 revision 3) not less than 15 percent of the peak power demand

4.4 Committed IPPs and SPPs would be maintained according to PPAs. And, for SPPs with anticipated expiration of PPA term locating in the high electricity and stream demand industrial zones would be encouraged to continue the operation.

According to the 2/2014 resolution of the National Energy Policy Council (NEPC) on December 15, 2014, frameworks and directions for the development of the PDP2015 were approved as follows: In year 2036, the estimated fuel requirement of the PDP2015 would be hydro power purchases from neighboring countries of 15-20 percent, clean coal of 20-25 percent, renewable energy of 15-20 percent, natural gas of 30-40 percent, and nuclear of not more than 5 percent as shown in Table 5.1.

Table 5.1 the estimated fuel requirement for the PDP2015

Fuel	Percentage in 2014	Percentage in 2026	Percentage in 2036
Imported hydro power	7	10 - 15	15 – 20
Clean coal including lignite	20	20 - 25	20 – 25
Renewable energy including hydro	8	10 - 20	15 – 20
Natural gas	64	45 - 50	30 – 40
Nuclear	-	-	0 – 5
Diesel/Fuel oil	1	-	-

5.4 Power System Reliability

One of the main objectives of the PDP2015 is to ensure power system reliability of subsystem areas in terms of generation, transmission, and distribution. Therefore, 2 areas which have high possibilities of power shortages were considered as follows:

5.4.1 Ensuring power system reliability in Southern of Thailand

Power demand in southern of Thailand would grow on the average of 3 percent; therefore, 3 power plants would be added during 2019-2024 as the following:

— **Krabi Coal-fired Power Plant**

Krabi coal-fired power plant is the 800 MW coal-fired power plant listed in the PDP2010 revision 3. At present, the project has passed public hearing process – public scoping, public screening, and public review (EIA and EHIA have been carried out for the coal unloading terminal unit and the power plant unit respectively). The project is planned to be online in December, 2019.

— **Thepa Coal-fired Power Plant**

Clean coal technology is one of the alternatives to reduce natural gas power generation which was accounting for 64 percent of the total power generation. Moreover, clean coal technology could reduce the country's cost of power generation. Therefore, feasibility study of the Thepa coal-fired power plant 2x1000 MW project was carried out and the project was listed in the PDP2015. At present, the project has passed public hearing process – public scoping and public screening. And, the public hearing of the project will be held on July 27, 2015. Consequently, the Thepa coal-fired power plant unit 1 and unit 2 is planned to be online in year 2021 and year 2024 respectively.

5.4.2 Ensuring power system reliability in Metropolitan area and central of Thailand

Electricity consumption of metropolitan area - the country's largest economy area - held the largest portion accounting for 30 percent of the total electricity consumption. However, relying on power from other areas and lacking of generating capacity, the area has been confronted with the challenge of the continuously growing power demand. Therefore, more new power plants are needed to be added during year 2019-2025 to maintain power system reliability in the area as the followings:

- **South Bangkok area**

To ensure power system reliability in metropolitan, western, and eastern area, a 1,300 MW combined cycle power plant using natural gas as a primary fuel and diesel as a secondary fuel was listed in the plan to replace the South Bangkok thermal power plant unit 1-5, and the project is planned to be online on April, 2019. Moreover, another 1,300 MW combined cycle power plant was also listed in the plan to replace the South Bangkok combined cycle power plant unit 1-2 - EHIA of the project was already done and the project is planned to be online on January, 2022.

- **Bang Pakong area**

To ensure power system reliability in metropolitan and eastern area, a 1,300 MW combined cycle power plant using natural gas as a primary fuel and diesel as a secondary fuel was listed in the plan to replace a Bang Pakong thermal power plant unit 1-2 - EHIA of the project was already done, and the project is planned to be online on April, 2019.

- **Wang Noi area**

To ensure power system reliability of upper metropolitan area, a 1,300 MW combined cycle power plant using natural gas as a primary fuel and diesel as a secondary fuel was listed in the plan to replace the Wang Noi combined cycle power plant unit 1-2, and the project is planned to be online in year 2023. Moreover, another 1,300 MW combined cycle power plant was also listed in the plan to replace the Wang Noi combined cycle power plant unit 3 and the project is planned to be online in year 2025.

5.5 Roles of Private Sector in Power Generation

In the PDP2015, Power purchases from committed and contracted generating capacity of IPPs, SPPs, VSPPs, and neighboring countries during year 2015-2025 are as the followings:

Independent Power Producer (IPP)

There are 7 IPPs signed PPAs with EGAT. The projects are planned to be online during year 2015-2024 with the total capacity of 8,070 MW. The details of the projects are shown in the table below:

Table 5.2 IPPs during year 2015-2024

Project	**Contract Capacity** (MW)	**SCOD** (year)
Gulf JP UT CC #1-2	1,600	2015
Khanom Replacement CC #1	930	2016
National Power Supply TH #1-4	540	2016-2017
Gulf SRC CC #1	1,250	2021
Gulf SRC CC #2	1,250	2022
Gulf PD CC #1	1,250	2023
Gulf PD CC #2	1,250	2024
Total	**8,070**	

Small Power Producer (SPP)

There are 97 SPPs with the total capacity of 5,922 MW which already have PPAs with EGAT to be online during year 2015-2025. The details are as follows: 1) 41 projects of cogeneration power plant with the total capacity of 3,660 MW, 2) 25 Extension projects of cogeneration power plant with the total capacity of 424 MW, 3) 31 projects of renewable energy generation with the total capacity of 1,838 MW.

Very Small Power Producer (VSPP)

The total capacity of VSPP power purchase to be online during year 2015-2036 according to the AEDP would be 9,735.6 MW. The details are as follows: 1) renewable power plant with the capacity of 9,701 MW, 2) Cogeneration power plants with the capacity of 34.6 MW.

Neighboring country power purchases

There are 4 projects of neighboring country power purchases with the total capacity of 3,316 MW which already have PPAs with EGAT to be online during year 2015-2019. The details are shown in Table 5.3.

Table 5.3 neighboring country power purchases during year 2015-2019

Projects	Capacity (MW)	SCOD (year)
Lao PDR (Hong Sa Lignite) #1-3	3x491	2015 - 2016
Lao PDR (Xaiyaburi Hydro)	1,220	2019
Lao PDR (Xe-Pian Hydro)	354	2019
Lao PDR (Nam-Ngiep 1 Hydro)	269	2019
Total	**3,316**	

5.6 Thailand Power Development Plan 2015-2036 (PDP2015)

According to the aforementioned frameworks, the Thailand Power Development Plan 2015-2036 (PDP2015) can be summarized as follows: the total capacity at the end plan (year 2036) would be 70,335 MW comprising the existing capacity (as of year 2014) of 37,612 MW, the new capacity added during year 2015-2036 of 57,459 MW, and the capacity of 24,736 MW which would be retired during year 2015-2036.

Generating capacity during year 2015-2036

- Generating capacity as of December, 2014 37,612 MW
- New generating capacity during year 2015-2036 57,459 MW
- Generating capacity to be retired during year 2015-2036 -24,736 MW
- Total generating capacity in year 2036 70,335 MW

New generating capacity during year 2015-2036

57,459 MW of new generating capacity during year 2015-2036 can be described as follows:

Renewable power plant	**21,648**	**MW**
— Domestic	12,105	MW
— Neighboring country power purchases	9,543	MW
Pump-storage hydro power plant	**2,101**	**MW**
Cogeneration power plant	**4,119**	**MW**
Combined cycle power plant	**17,478**	**MW**
Thermal power plant	**12,113**	**MW**
— Coal/Lignite power plant	7,390	MW
— Nuclear power plant	2,000	MW
— Gas turbine power plant	1,250	MW
— Neighboring country power purchases	1,473	MW
Total	**57,459**	**MW**

New generating capacity during year 2015-2026

Power plant projects during the first 10 years according to the PDP2015 would be the committed power plants which were planned to improve power system reliability of the sensitive areas. The total capacity of the projects during 2015-2026 would be 36,804 MW as follows:

Renewable power plant	**10,644**	**MW**
— Domestic	8,101	MW
— Neighboring country power purchases	2,543	MW
Pump-storage hydro power plant	**1,300**	**MW**
Cogeneration power plant	**4,119**	**MW**
Combined cycle power plant	**14,878**	**MW**
Thermal power plant	**5,863**	**MW**
— Coal/Lignite power plant	4,390	MW
— Neighboring country power purchases	1,473	MW
Total	**36,804**	**MW**

New generating capacity during year 2027-2036

Power plant projects during the last 10 years according to the PDP2015 would be domestic power plants and neighboring country power purchases. The projects were planned to cope with an increase in power demand and to replace the capacities which would be retired during year 2027-2036. The total capacity of the projects during year 2027-2036 would be 20,655 MW as follows:

Renewable power plant	**11,004**	**MW**
— Domestic	4,004	MW
— Neighboring country power purchases	7,000	MW
Pump-storage hydro power plant	**801**	**MW**
Cogeneration power plant (2x1,300)	**2,600**	**MW**
Thermal power plant	**6,250**	**MW**
— Coal/Lignite power plant(3x1,000)	3,000	MW
— Nuclear power plant (2x1,000)	2,000	MW
— Gas turbine power plant (5x250)	1,250	MW
Total	**20,655**	**MW**

Details of projects in the PDP2015 are shown in Table 5.4.

Table 5.4
Thailand Power Development Plan (2015-2036)

Year	Peak Demand (MW)	Projects			Fuel Types	Contract Capacity (MW)	Minimum Reserve Margin (%)
2014	**27,633**	**Total Contract Capacity as of December 2014**				**37,612**	**16.6%**
2015	**29,051**	VSPP	2,377	MW	-		
		SPP	988	MW	-		
		Gulf JP UT CC #1-2 (Jun, Dec)	2x800	MW	Gas		
		Kwae Noi Dam #1-2	2x15	MW	Hydro		
		Thap Sakae Solar Cell	5	MW	Solar		
		Khun Dan Prakarnchon Dam	10	MW	Hydro		
		Pasak Jolasid Dam	6.7	MW	Hydro		
		Mae Klong Dam #1-2	2x6	MW	Hydro		
		Lao PDR (Hong Sa) TH #1-2 (Jun, Nov)	2x491	MW	Lignite	**43,623**	**24.7**
2016	**30,218**	Retirement of Khanom TH #2 (Jun)	-70.2	MW	Gas/Oil		
		Retirement of Khanom CC #1 (Jul)	-678	MW	Gas		
		VSPP	271	MW	-		
		SPP	1,240	MW	-		
		North Bangkok CC #2 (Jan)	848.3	MW	Gas		
		Khanom Replacement CC #1 (Jul)	930	MW	Gas		
		National Power Supply TH #1-2 (Nov)	270	MW	Coal		
		Bang Lang Dam (Refurbish)	12	MW	Hydro		
		Sirindhorn Dam Solar Cell	0.3	MW	Solar		
		EGAT Solar Cell	10	MW	Solar		
		Lao PDR (Hong Sa) TH #3 (Mar)	491	MW	Lignite	**46,947**	**35.2**
2017	**31,385**	Retirement of Bang Pakong CC #3 (Jan)	-314	MW	Gas		
		Retirement of SPP	-180	MW	-		
		VSPP	283	MW	-		
		SPP	1,929	MW	-		
		National Power Supply TH #3-4 (Mar)	270	MW	Coal		
		Kiew Kormah Dam	5.5	MW	Hydro		
		Lam Ta Khong Wind Turbine Phase2	24.0	MW	Wind	**48,965**	**33.9**
2018	**32,429**	Retirement of Bang Pakong CC #4 (Jan)	-314	MW	Gas		
		Retirement of Mae Moh TH #4-7 (Nov)	-560	MW	Lignite		
		Retirement of SPP	-42	MW	-		
		VSPP	288	MW	-		
		SPP	733	MW	-		
		Lam Ta Khong Pumped Storage #3-4 (Feb)	2x250	MW	Hydro		
		Replacement of Mae Moh TH #4-7 (Nov)	600	MW	Lignite		
		Klong Tron Dam	2.5	MW	Hydro		
		Chulabhorn Dam Hydropower	1.3	MW	Hydro		
		EGAT Biomass	4	MW	Biomass		
		EGAT Biogas	5	MW	Energy Crop		
		EGAT Solar Cell	10	MW	Solar		
		Mae Moh Solar Cell	1	MW	Solar		
		Krabi Power Plant Solar Cell	2	MW	Solar	**50,196**	**33.8**

Table 5.4 (Continued)
Thailand Power Development Plan (2015-2036)

Year	Peak Demand (MW)	Projects			Fuel Types	Contract Capacity (MW)	Minimum Reserve Margin (%)
2019	**33,635**	Retirement of Wang Noi CC #1-2 (Jan)	-1,224	MW	Gas		
		Retirement of SPP	-185	MW	-		
		VSPP	330	MW	-		
		SPP	532	MW	-		
		Replacement of Bang Pakong TH #1-2 (Apr)	1,300	MW	Gas		
		Replacement of South Bangkok TH #1-5 (Apr)	1,300	MW	Gas		
		Krabi Coal-Fired TH #1 (Dec)	800	MW	Coal		
		Huai Ped Solar Cell	2	MW	Solar		
		Ban Chan Day Hydropower	18	MW	Hydro		
		Napier Grass (Prachuabkirikhan)	4	MW	Energy Crop		
		Phuket Wind Turbine	4	MW	Wind		
		Lao PDR (Xe-Pian) (Feb)	354	MW	Hydro		
		Lao PDR (Nam-Ngiep 1) (Jul)	269	MW	Hydro		
		Lao PDR (Xaiyaburi) (Oct)	1,220	MW	Hydro	**54,921**	**36.6**
2020	**34,808**	Retirement of South Bangkok CC #1 (Jan)	-316	MW	Gas		
		Retirement of Tri Energy Power Plant (Jun)	-700	MW	Gas		
		Retirement of SPP	-242	MW	-		
		VSPP	358	MW	-		
		SPP	72	MW	-		
		Pha Chuk Dam	14	MW	Hydro		
		Nam Phung Dam Solar Cell	2	MW	Solar		
		EGAT Biogas	5	MW	Energy Crop		
		EGAT Solar Cell	10	MW	Solar		
		Huai Sai Solar Cell	2	MW	Solar		
		Mukdahan2 Substation Solar Cell	10	MW	Solar		
		EGAT Wind Turbine	5	MW	Wind	**54,141**	**36.3**
2021	**35,775**	Retirement of SPP	-213	MW	-		
		VSPP	280	MW	-		
		SPP	228	MW	-		
		Gulf SRC CC #1-2 (Mar, Oct)	1,250	MW	Gas		
		Thepa Coal-Fired TH #1	1,000	MW	Coal		
		Lam Ta Khong Hydropower	1.5	MW	Hydro		
		Chaiyaphum2 Substation Solar Cell	10	MW	Solar		
		Sirindhorn Dam Solar Cell	2	MW	Solar		
		EGAT Wind Turbine	2	MW	Wind	**56,701**	**35.1**
2022	**36,776**	Retirement of Mae Moh TH #8-9 (Jan)	-540	MW	Lignite		
		Retirement of South Bangkok CC #2 (Jan)	-562	MW	Gas		
		Retirement of SPP	-150	MW	-		
		VAPP	277	MW	-		
		SPP	30	MW	-		
		Gulf SRC CC #3-4 (Mar, Oct)	1,250	MW	Gas		
		Replacement of Mae Moh TH #8-9	450	MW	Lignite		
		Replacement of South Bangkok CC #1-2	1,300	MW	Gas		
		Lam Pao Dam	1	MW	Hydro		
		Yaso Thorn - Phanom Prai Hydropower	4	MW	Hydro		
		EGAT Solar Cell	10	MW	Solar		
		Nam Pong Power Plant Solar Cell	2	MW	Solar		
		Sirindhorn Dam Solar Cell	10	MW	Solar		
		EGAT Wind Turbine	5	MW	Wind	**58,788**	**37.1**

Table 5.4 (Continued)
Thailand Power Development Plan (2015-2036)

Year	Peak Demand (MW)	Projects			Fuel Types	Contract Capacity (MW)	Minimum Reserve Margin (%)
2023	**37,740**	Retirement of Wang Noi CC #3 (Jan)	-686	MW	Gas		
		Retirement of EPEC (Mar)	-350	MW	Gas		
		Retirement of SPP	-41	MW	-		
		VSPP	208	MW	-		
		SPP	8	MW	-		
		Gulf PD CC #1-2 (Mar, Oct)	1,250	MW	Gas		
		Replacement of Wang Noi CC #1-2	1,300	MW	Gas		
		Pranburi Dam	1.5	MW	Hydro		
		Mahasarakam Hydropower	3	MW	Hydro		
		Buriram Substation Solar Cell	2	MW	Solar		
		South Khao Yai Thiang Wind Turbine	50	MW	Wind	**60,533**	**37.4**
2024	**38,750**	Retirement of SPP	-680	MW	-		
		VSPP	420	MW	-		
		SPP	126	MW	-		
		Gulf PD CC #3-4 (Mar, Oct)	1,250	MW	Gas		
		Thepa Coal-Fired TH #2	1,000	MW	Coal		
		Praya Man Hydropower	2	MW	Hydro		
		Thart Noi Hydropower	2	MW	Hydro		
		EGAT Biogas	5	MW	Energy Crop		
		Lam Ta Plern Dam	1.2	MW	Hydro		
		Thatako Solar Cell	2	MW	Solar	**62,661**	**39.4**
2025	**39,752**	Retirement of Mae Moh TH #10-13 (Jan)	-1,080	MW	Lignite		
		Retirement of Nam Pong CC #1-2 (Jan)	-650	MW	Gas		
		Retirement of Global Power Energy (Aug)	-700	MW	Gas		
		Retirement of Ratchaburi TH #1-2 (Oct)	-1,440	MW	Gas/Oil		
		Retirement of SPP	-236	MW	-		
		VSPP	490	MW	-		
		SPP	36	MW	-		
		Replacement of Wang Noi CC #3	1,300	MW	Gas		
		Chonnabot Hydropower	1.5	MW	Hydro		
		Ubonrat Dam Solar Cell	2	MW	Solar		
		Bangpakong Hydropower	2	MW	Hydro		
		EGAT Solar Cell	10	MW	Solar		
		Nam Phung Dam Solar Cell	2	MW	Solar		
		EGAT Wind Turbine	5	MW	Wind	**60,403**	**36.1**
2026	**40,791**	Retirement of SPP	-5	MW	-		
		VSPP	333	MW	-		
		Chulabhorn Pumped Storage #1-2	2x400	MW	Hydro		
		Tabsalao Dam	1.5	MW	Hydro		
		EGAT Biogas	5	MW	Energy Crop		
		Klong See Yud Dam	1.5	MW	Hydro		
		EGAT Solar Cell	10	MW	Solar		
		Ao Phai Wind Turbine	10	MW	Wind		
		Power Purchase from Neighbouring Countries	700	MW	Hydro	**62,260**	**30.4**

Table 5.4 (Continued)
Thailand Power Development Plan (2015-2036)

Year	Peak Demand (MW)	Projects			Fuel Types	Contract Capacity (MW)	Minimum Reserve Margin (%)
2027	**41,693**	Retirement of Bang Pakong CC #3 (Jan)	-576	MW	Gas/Heavy Oil		
		Retirement of Ratchaburi CC #1-2 (Apr)	-1,360	MW	Gas		
		Retirement of Ratchaburi CC #3 (Oct)	-681	MW	Gas		
		Retirement of SPP	-7	MW	-		
		VSPP	303	MW	-		
		Hua Na Hydropower	1	MW	Hydro		
		EGAT Wind Turbine	5	MW	Wind		
		Power Purchase from Neighbouring Countries	700	MW	Hydro	**60,645**	**24.6**
2028	**42,681**	Retirement of Bang Pakong TH #4 (Jan)	-576	MW	Gas/Heavy Oil		
		Retirement of Glow IPP (Feb)	-713	MW	Gas		
		Retirement of SPP	-103	MW	-		
		VSPP	295	MW	-		
		Srinagarind Pumped Storage #1-3	3x267	MW	Hydro		
		Lam Dome Yai Hydropower	2	MW	Hydro		
		EGAT Biogas	5	MW	Energy Crop		
		Kamalasai Hydropower	1	MW	Hydro		
		EGAT Solar Cell	10	MW	Solar		
		Samutsakhon Wind Turbine	30	MW	Wind		
		Power Purchase from Neighbouring Countries	700	MW	Hydro	**61,097**	**20.5**
2029	**43,489**	Retirement of Lao PDR (Huay Ho) (Sep)	-126	MW	Hydro		
		VSPP	313	MW	-		
		Huai Samong Dam	1	MW	Hydro		
		Kamphaeng Phet Substation Solar Cell	3	MW	Solar		
		EGAT Wind Turbine	5	MW	Wind		
		Power Purchase from Neighbouring Countries	700	MW	Hydro	**61,993**	**19.7**
2030	**44,424**	VSPP	313	MW	-		
		Mae Khan Dam	16	MW	Hydro		
		EGAT Biogas	5	MW	Energy Crop		
		EGAT Solar Cell	10	MW	Solar		
		Power Purchase from Neighbouring Countries	700	MW	Hydro	**63,037**	**18.4**
2031	**45,438**	Retirement of SPP	-40	MW	-		
		VSPP	349	MW	-		
		Klong Luang Dam	1	MW	Hydro		
		EGAT Wind Turbine	5	MW	Wind		
		Power Purchase from Neighbouring Countries	700	MW	Hydro	**64,052**	**17.3**
2032	**46,296**	Retirement of BLCP TH #1 (Jan)	-673	MW	Coal		
		Retirement of BLCP TH #2 (Feb)	-673	MW	Coal		
		Retirement of GPG CC #1 (May)	-734	MW	Gas		
		Retirement of SPP	-9	MW	-		
		VSPP	356	MW	-		
		Replacement of Bang Pakong CC #3-4	1,300	MW	Gas		
		Mae Wong Dam	12	MW	Hydro		
		EGAT Biogas	5	MW	Energy Crop		
		EGAT Solar Cell	10	MW	Solar		
		Power Purchase from Neighbouring Countries	700	MW	Hydro	**64,345**	**15.0**

Table 5.4 (Continued)
Thailand Power Development Plan (2015-2036)

Year	Peak Demand (MW)	Projects			Fuel Types	Contract Capacity (MW)	Minimum Reserve Margin (%)
2033	**47,025**	Retirement of GPG CC #2 (Feb)	-734	MW	Gas		
		Retirement of Ratchaburi Power CC #1 (Feb)	-700	MW	Gas		
		Retirement of Ratchaburi Power CC #2 (May)	-700	MW	Gas		
		VSPP	371	MW	-		
		Replacement of Bang Pakong TH #3-4	1,300	MW	Gas		
		Coal-Fired Power Plant #4	1,000	MW	Coal		
		EGAT Wind Turbine	5	MW	Wind		
		EGAT Wind Turbine	5	MW	Wind		
		Power Purchase from Neighbouring Countries	700	MW	Hydro	**65,592**	**15.0**
2034	**47,854**	Retirement of Krabi TH #1 (Jan)	-315	MW	Heavy Oil		
		Retirement of Chana CC #1 (Jan)	-710	MW	Gas		
		Retirement of SPP	-21	MW	-		
		VSPP	453	MW	-		
		Gas Turbine #1	250	MW	Diesel		
		Coal-Fired Power Plant #5 (South)	1,000	MW	Coal		
		EGAT Biogas	5	MW	Energy Crop		
		EGAT Solar Cell	10	MW	Solar		
		Power Purchase from Neighbouring Countries	700	MW	Hydro	**66,965**	**15.0**
2035	**48,713**	Retirement of South Bangkok CC #3 (Jan)	-710	MW	Gas		
		Retirement of Bang Pakong CC #5 (Jan)	-710	MW	Gas		
		Retirement of Lao PDR (Nam Theun2) (Mar)	-948	MW	Hydro		
		Retirement of SPP	-90	MW	-		
		VSPP	489	MW	-		
		Gas Turbine #2-4	750	MW	Diesel		
		Coal-Fired Power Plant #6	1,000	MW	Coal		
		Nuclear Power Plant #1	1,000	MW	Uranium		
		EGAT Wind Turbine	10	MW	Wind		
		Power Purchase from Neighbouring Countries	700	MW	Hydro	**68,456**	**15.3**
2036	**49,655**	Retirement of North Bangkok CC #1 (Jan)	-670	MW	Gas		
		VSPP	580	MW	-		
		Gas Turbine #5	250	MW	Diesel		
		Nuclear Power Plant #2	1,000	MW	Uranium		
		EGAT Biogas	10	MW	Energy Crop		
		EGAT Solar Cell	10	MW	Solar		
		Power Purchase from Neighbouring Countries	700	MW	Hydro	**70,335**	**15.3**

Total Contract Capacity as of December 2014	37,612	MW
Total Added Capacity	57,459	MW
Total Retired Capacity	-24,736	MW
Grand Total Capacity at the End of 2036	**70,335**	**MW**

5.7 Generating capacity from renewable sources

According to the government's policies, the target of the Alternative Energy Development Plan (AEDP) is to substitute fossil fuel consumption by 30 percent by year 2036. Therefore, in power sector, the renewable power projects were planned in the Thailand Power Development Plan 2015-2036 (PDP2015) with the total installed capacity of 19,634.4 MW or the total contract capacity of 17,678.9 MW. The details of the renewable projects are as follows: the existing contract capacity as of December 2014 was 5,872.1 MW. The capacity of 298.1 MW would be retired, and the new capacity of 12,104.9 MW would be added during year 2015-2036. Consequently, the renewable contract capacity during year 2015-2026 and year 2027-2036 would be 8,101.2 MW and 4,003.7 MW respectively as shown below:

Renewable power projects year during 2015-2026

— Solar power	3,292.5	MW
— Wind power	1,643.7	MW
— Hydro power	191.0	MW
— Biomass	2,122.6	MW
— Biogas	199.1	MW
— Municipal Solid Waste	373.2	MW
— Energy crops	279.1	MW
Total	**8,101.2**	**MW**

Renewable power projects during year 2027-2036

— Solar power	1,107.6	MW
— Wind power	910.2	MW
— Hydro power	86.9	MW
— Biomass	1,363.9	MW
— Biogas	108.2	MW
— Municipal Solid Waste	56.0	MW
— Energy crops	400.9	MW
Total	**4,003.7**	**MW**

5.8 Fuel Requirement

Fuel diversification will lessen dependence on one particular fuel. In the PDP2015, the share of natural gas power generation would be reduced by increasing the portion of renewable and coal power generation. Therefore, the share of power generation in year 2036 would be as follows: 15 percent from hydro power generation from neighboring countries, 23 percent from coal power generation, 20 percent from renewable power generation, 37 percent from natural gas power generation, and 5 percent from nuclear power generation as shown in Table 5.5.

Table 5.5 the share of fuel requirement (Unit: Percent)

Year	Plant Type					
	Hydro power purchases of neighboring countries	Coal/Lignite	Renewable	Natural Gas	Nuclear	Others[1/]
2015	6	20	9	64	-	0.8
2016	6	24	11	59	-	0.5
2017	6	22	13	59	-	0.2
2018	6	21	15	58	-	0.2
2019	9	21	16	54	-	0.2
2020	9	24	17	50	-	0.1
2021	8	27	18	47	-	0.1
2022	8	26	18	48	-	0.1
2023	8	26	18	48	-	0.1
2024	8	27	18	47	-	0.1
2025	8	23	18	51	-	0.1
2026	8	23	18	51	-	0.1
2027	10	22	18	50	-	0.1
2028	11	22	19	48	-	0.1
2029	12	21	19	48	-	0.1
2030	12	21	19	48	-	0.1
2031	13	20	19	48	-	0.1
2032	14	17	19	50	-	0.1
2033	15	19	19	47	-	0.1
2034	16	21	20	43	-	0.1
2035	15	23	20	39	3	0.1
2036	15	23	20	37	5	0.1

Remark: 1/ Including EGAT-TNB Tie line, Fuel oil, Diesel

5.9 Carbon dioxide Gas Emission in Power Sector

In 2013, carbon dioxide (CO_2) emitted from power sector accounted for 0.506 $kgCO_2/kWh$. Therefore, to promote renewable energy, the target of CO_2 emission reduction was set in the PDP2015 to be more aggressive than that of the PDP2010 revision 3.

In the PDP2015, the expected CO_2 emission from power sector would be less than that of the previous plan because of fuel diversification and renewable energy promotion. In year 2030, the estimated CO_2 intensity would be 0.342 $kgCO_2/kWh$ or 0.043 $kgCO_2/kWh$ less than that of the previous plan. Moreover, the estimated CO_2 intensity at the end of the plan (year 2036) would reach 0.319 $kgCO_2/kWh$.

Carbon dioxide emission per annum in the PDP2015 would be less than that of the PDP2010 revision 3 due to less power demand compared with that of the previous plan. In year 2030, Carbon dioxide emission is estimated to reach 99,822 thousand tons of CO_2 which is 33,717 thousand tons of CO_2 less than that of the previous plan. In addition, the estimated CO_2 emission at the end of the plan would reach 104,075 thousand tons of CO_2.

The amount of carbon dioxide emission was calculated according to the IPCC Guidelines for National Greenhouse Gas Inventories.

Table 5.6 the amount of carbon dioxide emission per unit ($kgCO_2/kWh$)

Carbon dioxide intensity	2021	2026	2030	2036
PDP2010 Rev.3	0.407	0.403	0.385	-
PDP2015	0.399	0.370	0.342	0.319

Table 5.7 the amount of carbon dioxide emission per annum (thousand tons of CO_2)

CO_2 emission per annum	2021	2026	2030	2036
PDP2010 Rev.3	103,982	122,885	133,539	-
PDP2015	93,689	98,950	99,822	104,075

6 Transmission System Development Plan

Transmission System Development Projects in PDP 2015 during 2015 – 2036 consist of:

6.1 Transmission System Development Projects to Cope with the Growing Electricity Demand

6.1.1 Bulk Power Supply for the Greater Bangkok Area Project Phase 3 (BSB3)

The Bulk Power Supply for the Greater Bangkok Area Project Phase 3 (BSB3) is the successive project of BSB2 and was approved by the Cabinet on October 15, 2013. The project consists of many subprojects such as the voltage upgrade of the existing 500 kV transmission lines from 230 kV to 500 kV, the reconstruction of 230 kV transmission lines, the construction of 230 kV new substations and renovation of existing substations to cope with increasing demand, to solve the problem of shutting down for gas field maintenance in Myanmar and to support the long term distribution system expansion plan of the Metropolitan Electricity Authority (MEA). It is planned to be completed during 2016 - 2018.

6.1.2 Bulk Power Supply for the Greater Bangkok Area Project (Future Phases)

The next phases of Bulk Power Supply for the Greater Bangkok Project Area will be the successive project of BSB3 to cope with the increasing demand in the Greater Bangkok Area in the future. In addition, EGAT has planned to implement the underground cable or underground substation for serving increasing demand, avoiding the new Right – Of – Way (ROW) of transmission system and reducing public impact in the future. Nevertheless, these technologies will take long time for consideration and need to use technical experts. The future phases of Bulk Power Supply for the Greater Bangkok Area Project and its implementation period are as follows:

	Period
Bulk Power Supply for the Greater Bangkok Area Project, Phase 4	2019 - 2025
Bulk Power Supply for the Greater Bangkok Area Project, Phase 5	2026 - 2032
Bulk Power Supply for the Greater Bangkok Area Project, Phase 6	2033 – 2039

6.1.3 Transmission System Expansion Project No. 12 (TS.12)

The project was approved by the National Council for Peace and Order (NCPO) on August 19, 2014. It aims to handle the increasing demand and support the power system security except Bangkok area and its vicinity. The TS.12 is the successive project of TS.11 and to support Provincial Electricity Authority (PEA)'s distribution

expansion plan to other areas efficiently. It is planned to be completed during 2016 - 2020.

6.1.4 Transmission System Expansion Projects (the future Phases)

The successive phases of Transmission System Expansion Projects of TS.12 are also aimed to cope with the increasing demand in the Provincial Area except Bangkok area and its vicinity in the future. The next phases of Transmission System Expansion Projects and its implementation period are as follows:

	Period
Transmission System Expansion Project No. 13	2019 - 2025
Transmission System Expansion Project No. 14	2026 - 2032
Transmission System Expansion Project No. 15	2033 - 2039

6.2 Transmission System Improvement Project in Thailand to Enhance System Security

6.2.1 Transmission System Improvement Project in Eastern Region to Enhance System Security

This transmission system project aims to improve the system security in the eastern region of Thailand to continuously cope with the growing electricity demand and to receive the electric power from new power plants. This project consists of the constructions of 500 kV and 230 kV transmission systems. It was approved by the Cabinet on April 23, 2013 and planned to be completed within two phases: by year 2017 and 2019.

6.2.2 Transmission System Improvement Project in Western and Southern Regions to Enhance System Security

The transmission system improvement project comprises the construction of the 500 kV transmission system lines and the renovation of 230 kV transmission systems to cope with the growing electricity demand in the southern part of Thailand in the long term and to increase the capability of the transmission system from the West/Central of Thailand to the South in order to promote the growth of business, industry and tourism sectors in the southern region especially in Phuket Province including remedy in the power outage problem in the South. It was approved by the National Council for Peace and Order (NCPO) on August 19, 2014 and planned to be completed within two phases: by year 2019 and 2022.

6.2.3 Transmission System Improvement Project in Southern Region to Enhance System Security

The transmission system improvement project comprises the construction of 500 kV transmission system lines and the renovation of 230 kV transmission system in the area of Surat Thani Province through Songkhla Province to cope with the growing electricity demand in the southern part of Thailand in the long term and to increase the transmission system security in the lower southern region in order to promote the growth of business, industry, and tourism sectors in the southern region and to accommodate renewable energy and ASEAN Power Grid (APG). It is planned to be implemented during 2016 - 2023.

6.2.4 Transmission System Improvement Project in Northeastern, Lower Northern, Central Regions and Bangkok Area to Enhance System Security

The transmission system project aims to improve the system security in Northeastern, Lower Northern, and Central parts of Thailand including Bangkok area to continuously cope with the growing electricity demand in the long term and receive the electric power from renewable energy according to the new Alternative Energy Development Plan, AEDP. The project also accommodates ASEAN Power Grid (APG) and power purchase from neighboring countries. The project involves the construction of new 500 kV and 230 kV main grid to increase the capability of the transmission system from the northeastern/lower northern/central regions of Thailand to Bangkok area. It is planned to be completed within three phases: by year 2019, 2021, and 2023.

6.2.5 Transmission System Improvement Project in Upper Northern Region to Enhance System Security

This transmission system project aims to improve the system security in Upper Northern part of Thailand especially Chiang Mai and Lamphun Provinces to continuously cope with the growing electricity demand. The project involves the construction of new 500 kV and 230 kV main grid from Lampang to Chiang Mai to increase the capability of the transmission system and to promote the growth of business, industry, and tourism sectors in the upper northern region in the future especially Chiang Mai and Lamphun Provinces. It is planned to be completed within two phases: by year 2019 and 2021.

6.2.6 Submarine Cable Development Project to Enhance System Security of Koh Samui, Surat Thani Province,

This development project aims to increase the capability of the transmission system and to improve the security and reliability of the power system in

Koh Samui and its vicinity in the long run. Currently, PEA has operated one 33 kV and three 115 kV Submarine Cables of which the capacity will be able to cope with the growing electricity demand in the areas of Koh Samui, Koh Pha-Ngan, and Koh Tao for only 4-5 years. The project involves the construction of 230 kV submarine cable from EGAT's substation to the new 230 kV Koh Samui substation (new EGAT substation). It is planned to be completed in 2019.

6.2.7 Transmission System Improvement Project in Upper Northern Region to Enhance System Security, Phase 2

The Transmission System Improvement Project in Upper Northern Region to Enhance System Security, Phase 2 is the successive project of Transmission System Improvement Project in Upper Northern Region to Enhance System Security. The project involves the construction of the 500 kV and 230 kV transmission system lines to increase the security of transmission system in Phayao and Chiang Rai Provinces to cope with the growing electricity demand in the long term and to accommodate ASEAN Power Grid (APG) and power purchase from neighboring countries. It is planned to be completed during 2024 - 2029.

6.3 Transmission System Expansion and Renovation Project

6.3.1 Transmission System Expansion and Renovation Project, Phase 1: Substation

The Transmission System Expansion and Renovation Project, Phase 1: Substation involves the improvement or replacement of aging equipment in substations which consist of 15 subprojects and miscellaneous system improvement. The project aims to increase the availability, reliability and security of the transmission system. It was approved by the cabinet on January 18, 2011 and planned to be completed in 2017.

6.3.2 Transmission System Expansion and Renovation Project, Phase 1: Transmission Line

The Transmission System Expansion and Renovation Project, Phase 1: Transmission Line involves the improvement or replacement of aging equipment in transmission line routes which consist of 15 subprojects and miscellaneous system improvement. The project aims to reduce the power outage caused by the aging transmission lines, to increase the continuity and efficiency in power supply and to enhance the reliability of the power system and the performance index of the transmission system. It was approved by the cabinet on May 20, 2012 and planned to be completed in 2019.

6.3.3 Transmission System Expansion and Renovation Project, Phase 2

The Transmission System Expansion and Renovation Project, Phase 2, a successive scheme of Phase 1 involves the renovation and expansion of the existing 19 substations and 11 transmission lines and miscellaneous improvement related to the transmission system. It was approved by the cabinet on January 15, 2013 and planned to be completed in 2020.

6.3.4 Transmission System Expansion and Renovation Project (Future Phases)

The successive phases of Transmission System Expansion and Renovation Projects involve the renovation and expansion of the existing substations and transmission lines as well as miscellaneous works related to the transmission system in the future to prevent the power outage and improve the reliability of the transmission system. The other phases of Transmission System Expansion and Renovation Projects are as follows:

	Period
Transmission System Expansion and Renovation Project, Phase 3	2017 - 2021
Transmission System Expansion and Renovation Project, Phase 4	2022 - 2026

6.4 Transmission System Development for Power Purchase

6.4.1 Transmission System Development for Power Purchase from Hongsa Lignite-Fired Thermal Power Plant Project

The transmission system project aims to accommodate the power purchase from Hongsa Lignite - Fired Thermal Power Plant Project in Lao PDR which is the first lignite-fired power plant of the capacity of 3x626 MW for supplying 1,473 MW of power to Thailand. The transmission system project consists of the construction of new 500 kV transmission lines from Thai/Lao border (Nan Province) to 500/230/115 kV Nan Substation to be connected with 500 kV transmission line to the main system at Mae Moh 3 Substation. It was approved by the cabinet on July 13, 2010 and planned to be completed in year 2015.

6.4.2 Transmission System Development Project for Power Purchase from IPPs (IPP 2007)

The transmission system project aims to accommodate power purchase from four IPPs according to the Power Development Plan 2007 – 2021 (PDP 2007), which was approved by the National Energy Policy Council (NEPC) and the cabinet in June 2007. The project was approved by the cabinet on June 9, 2009 and it comprises four transmission system sub-projects as follows:

1) The transmission system for the Gheco-One Power Plant Project was completed and connected to the grid system since February 11, 2013.

2) The transmission system for the Gulf JP UT Co., Ltd. was completed and connected to the grid system since August 28, 2014.

3) The transmission system for the Gulf JP NS Co., Ltd. will be completed in June 2015.

4) The transmission system for the National Power Supply Co., Ltd. is currently not commenced.

6.4.3 Main Transmission System Expansion Project for Power Purchase from SPP Cogeneration Power Plant, based on Request for Proposal 2010

The transmission system project aims to accommodate the increasing power purchase of 3,500 MW from SPP's cogeneration power plants with the resolution of the National Energy Policy Council (NEPC) on November 25, 2010 to strengthen the stability of the power system and reduce the system losses of both transmission and distribution network. The project involves the construction of new 230 kV transmission lines between Ayutthaya 4 and Si Khiu 2 Substations, the renovation of related transmission lines with the distance of 507.85 circuit-kilometers, a new substation, the installation of 2,900 MVA transformers, and the improvement of relevant transmission systems. It was approved by the cabinet on October 18, 2011 and planned to be completed in December 2017.

6.4.4 Transmission System Development for Power Purchase from Nam Ngum 3 and Nam Theun 1 Hydropower Plant Project

The transmission system project aims to accommodate the power purchase from Nam Ngum 3 and Nam Theun 1 Hydropower Plant Projects and/or other potential projects in Lao PDR such as Nam Ngiep 1 Hydropower Project and Xayaburi Hydropower Project. The project comprises: 1) The construction of new 500 kV transmission lines Nam Phong 2 – Chaiyaphum 2 - Tha Tako connected with the existing Ban Na Bong (Lao PDR) – Udon Thani 3 – Nam Phong 2 lines (currently operating at 230 kV) to become the 500 kV Ban Na Bong – Udon Thani 3 – Chaiyaphum 2 – Tha Tako line, 2) The construction of the 230 kV Chaiyaphum 2 – Chaiyaphum line with a total length of approximately 1,492 circuit-kilometers, a new substation and the installation of transformers of 4,000 MVA. It was approved by the cabinet on December 18, 2007 and planned to be completed in June 2017.

6.4.5 Transmission System Development in the Area of Ubon Ratchathani, Yasothon and Amnat Charoen Provinces for Power Purchase from Lao PDR Project

The transmission system project aims to accommodate the power purchase from Xepian-Xenamnoy Hydropower Plant Project which has the generating capacity of 3x130 MW and to receive more electric power from other potential projects in the southern part of Lao PDR. The project comprises: 1) the construction of new 500 kV transmission lines from Thai/Laos Border at Ubon Ratchathani Province to the new Ubon Ratchathani 3 Substation with the distance of 90 km, initially energized at 230 kV, and 2) the improvement of other transmission lines (in Thai territory only) with a total of 440 circuit-kilometers, 3) a new substation and 4) the installation of transformers of 400 MVA. It was approved by the cabinet on March 19, 2013 and planned to be completed in 2018.

6.4.6 Transmission System Development in the Area of Loei, Nongbua Lamphu and Khon Kaen Provinces for Power Purchase from Lao PDR Project

The transmission system project aims to accommodate the power purchase from the Xayaburi Hydroelectric Power Plant Project in Lao PDR which will supply power of 1,220 MW to Thailand. It is scheduled that all units will supply power commercially in October 2019. The project comprises: 1) the construction of 500 kV double-circuit transmission lines from Thai/Lao Border in Loei Province to the new Tha Li Substation (the distance of approximately 5 kilometers) and from Tha Li Substation to the new Khon Kaen 4 Substation (the distance of approximately 225 kilometers) with a total of 460 circuit-kilometers of transmission lines (only in Thai territory), 2) two new substations and 3) the installation of transformer of 1,000 MVA. It was approved by the cabinet on November 12, 2012 and planned to be completed in 2018.

6.4.7 Transmission System Development Project for Power Purchase from IPPs, Phase 3 (IPP 2012)

The transmission system project will accommodate the power purchase from Independent Power Producers (IPPs) to connect to the main grid of EGAT according to Power Development Plan 2010 – 2030 (PDP 2010: Revision 3). The Scheduled Commercial Operation Date (SCOD) of this IPPs is between 2021 and 2026.

6.4.8 Transmission System Development Projects for Power Purchase from New Domestic Power Plants

The transmission system projects will accommodate the power purchase from new domestic power plants such as combined-cycle power plants, coal-fired power plants, nuclear power plants, hydropower plants and other types of power

plants which will be connected to EGAT's main grid according to the updated PDP to ensure an adequate electricity generation and maintain both security and reliability of the power system based on EGAT's criteria.

6.4.9 Transmission System Development Projects for Power Purchase from Neighboring Countries

The transmission system projects will accommodate the power purchase from neighboring countries such as Lao PDR, Myanmar, Cambodia and Malaysia to reduce the dependence on natural gas for electricity generation and to prepare for the ASEAN Power Grid (APG) in the future.

6.5 Transmission System Interconnection Project (Grid to Grid)

The transmission system project aims to interconnect as Grid to Grid between Thailand and Neighboring Countries at the new and existing interconnection points. The interconnection points are expected to be expanded or renovated in the future for accommodating ASEAN Power Grid (APG) and improving the stability and reliability of the power system. Currently, EGAT has planned to connect a new interconnection point between Su-Ngai Kolok Substation of EGAT and Rantau Panjang Substation of Tenaga Nasional Berhad (TNB). The 132 kV transmission line from Su-Ngai Kolok Substation to Rantau Panjang Substation with distance of 12.5 kilometers will be constructed after the Interconnection Agreement between EGAT and TNB is concluded.

6.6 Smart Grid Development Project

The Thailand Smart Grid Development Master Plan 2015 – 2036, approved by the National Energy Policy Committee (NEPC) on February 16, 2015, has set policies, directions and frameworks for the overall development of smart grid in Thailand. Hence, all sectors, who plan to invest in smart grid development by their own budget, both government sector i.e. EGAT, MEA and PEA and private sector i.e. entrepreneur, industry, educational institution and consumers, should set their direction and investment plan according to the Thailand Smart Grid Development Master Plan. The rapid increasing of renewable energy into the main grid at present and in the near future, the system security and the environmental impact will be the main concerned issues in the system. The smart grid development in Thailand has been initiated by the government policy, global trends on smart grid and the technology improvement towards ICT-base. These initiatives will enhance the security and efficiency of power system also increase the capability of the system to accommodate the power from renewable energy sources and reduce the environmental impact. The Thailand Smart Grid Development Master Plan 2015 – 2036, issued by the Ministry of Energy, has divided into four phases which are Phase I: preparation (2015 – 2016), Phase II: short-term (2017 - 2021), Phase III: medium-

term (2022 – 2031) and Phase IV: long-term (2032 - 2036). The five strategic areas of the Master Plan which will be a mechanism for the power system improvement to be more secured, sufficient, environment-friendly and effectively manageable, are as follows:

Strategy 1: Power Reliability and Quality

The power reliability and quality using as an indicator of the power system operation are the main concerned issues for three power utilities in Thailand. This strategy will be considered on the technical aspect which covers the capacity, reliability and quality of the power system. The smart grid development shall improve the power system in generation adequacy and continuity, and reduce the power quality problems in both voltage and current levels which may cause damage to equipment in the power system.

Strategy 2: Energy Sustainability and Efficiency

The consideration on sustainability and efficiency of energy generation and consumption is an issue which many countries worldwide are focusing on. The main reason is the need for new energy resources to replace the limited fossil-fueled and effective approaches for energy management to reduce fuel consumption and emission of greenhouse gases which is the global major issue at present. The smart grid development shall improve the energy generation and consumption to reduce the cost, to relieve the fuel resource procurement problem, to minimize the environmental impact and to accommodate the bulk renewable energy generation in the future.

Strategy 3: Utility Operation and Service

The consideration on utility operation and service has to be evaluated together with the development of technologies or innovation of smart grid since the application of smart grid system can imply that the performance of power system and utility itself have to be improved. Therefore, the performance indices shall be provided. Moreover, the smart grid development requires both operation and service performances of power utility to be more effective and more accurate which will help minimizing the operation time and improving services directly to customers.

Strategy 4: Integration and Interoperability

The consideration on integration and interoperability is a major issue which has to be carefully considered since smart grid development will involve a large amount of innovative equipments which will have information exchange and communication among them all the time. The integration of all equipments to accommodate a harmonized and standardized control system must be well organized. Moreover, the accessibility of renewable energy or end-user generation to the system and the grid-to-

grid connection period will be taken into account as well. The smart grid development shall improve the interoperability of all equipments by using ICT technology which will also bring the new services to customers.

Strategy 5: Economic and Industrial Competitiveness

The consideration on economic and industrial competitiveness is necessary since smart grid development will directly affect both economic and industrial aspects such as higher domestic investment, more employment and industrial investment in new technologies, e.g. smart appliances and electric vehicles (EV). If smart grid development depends only on importing technologies from others, it will be non-sustainable and may cause some negative impacts to the country economic system. Accordingly, the human resource development and domestic industry promotion in smart grid technology is extremely essential. Additionally, the smart grid development shall stimulate both economic and industrial growth of country simultaneously.

Table 6.1

Details of Transmission System Expansion Projects during 2015 – 2036
PDP2015

	Name of Project	Commission Date (Year)
<u>Ongoing Projects</u>		
1.	Bulk Power Supply for the Greater Bangkok Area, Phase 3 (BSB3)	2016 - 2018
2.	Transmission System Expansion Project No. 12 (TS.12)	2016 – 2020
3.	Transmission System Improvement Project in Eastern Region for System Security Enhancement	2017 / 2019
4.	Transmission System Improvement Project in Western and Southern Regions to Enhance System Security	2019 / 2022
5.	Transmission System Expansion and Renovation Project, Phase 1: Substation	2017
6.	Transmission System Expansion and Renovation Project, Phase 1: Transmission Line	2019
7.	Transmission System Expansion and Renovation Project, Phase 2	2020
8.	Transmission System Development for Power Purchase from Hongsa Lignite-Fired Thermal Power Plant Project	2015
9.	Transmission System Development Project for Power Purchase from IPPs (IPP 2007)	2013 – 2020
10.	Main Transmission System Expansion Project for Power Purchase from SPP Cogeneration Power Plant, based on Request for Proposal 2010	2017
11.	Transmission System Development for Power Purchase from Nam Ngum 3 and Nam Theun 1 Hydropower Plant Project	2017
12.	Transmission System Development in the Area of Ubon Ratchathani, Yasothon and Amnat Charoen Provinces for Power Purchase from Lao PDR Project	2018
13.	Transmission System Development in the Area of Loei, Nongbua Lamphu and Khon Kaen Provinces for Power Purchase from Lao PDR Project	2018

Table 6.1 (continuous)
Details of Transmission System Expansion Projects during 2015 – 2036
PDP2015

Name of Project	Commission Date (Year)
<u>Future Projects</u>	
1. Transmission System Improvement Project in Northeastern, Lower Northern, Central Regions and Bangkok Area to Enhance System Security	2019 / 2021 / 2023
2. Transmission System Improvement Project in Upper Northern Region to Enhance System Security	2019 / 2021
3. Bulk Power Supply for the Greater Bangkok Area, Phase 4 (BSB4)	2019 – 2025
4. Bulk Power Supply for the Greater Bangkok Area, Phase 5 (BSB5)	2026 – 2032
5. Bulk Power Supply for the Greater Bangkok Area, Phase 6 (BSB6)	2033 – 2039
6. Transmission System Expansion Project No. 13 (TS.13)	2019 – 2025
7. Transmission System Expansion Project No. 14 (TS.14)	2026 – 2032
8. Transmission System Expansion Project No. 15 (TS.15)	2033 – 2039
9. Transmission System Improvement Project in Southern Region to Enhance System Security, Phase 1	2022
10. Transmission System Improvement Project in Southern Region to Enhance System Security, Phase 2	2027
11. Submarine Cable Development Project in Koh Samui, Surat Thani Province, to Enhance System Security	2019
12. Transmission System Improvement Project in Upper Northern Region to Enhance System Security, Phase 2	2024 – 2029
13. Transmission System Expansion and Renovation Project, Phase 3	2017 – 2021
14. Transmission System Expansion and Renovation Project, Phase 4	2022 – 2026
15. Transmission System Development Project for Power Purchase from IPPs, Phase 3 (IPP 2012)	2021 – 2026

Appendix

Appendix 1

Comparison of

Thailand Power Development Plans

Comparison of Thailand Power Development Plans

Year	PDP2010 : Revision 3				PDP2015			
	Peak Demand (MW)	Projects		Reseve Margin (%)/ Contract Capacity (MW)	Peak Demand (MW)	Projects		Reseve Margin (%)/ Contract Capacity (MW)
2015	**30,231**	Renewables	751	**16.4%**	**29,051**	Renewables	2,979	**24.7%**
		Cogeneration	557			Cogeneration	449	
		North Bangkok CC #2 (Oct)	900					
		Gulf JP UT CC #1-2 (Jun, Dec)	2x800			Gulf JP UT CC #1-2 (Jun, Dec)	2x800	
		Lao PDR (Hong Sa) TH #1-2 (Jun, Nov)	2x491	**43,157**		Lao PDR (Hong Sa) TH #1-2 (Jun, Nov)	2x491	**43,623**
2016	**31,809**	Renewables	989	**24.3%**	**30,218**	Renewables	723	**35.2%**
		Cogeneration	471			Cogeneration	810	
						North Bangkok CC #2 (Jan)	848	
		Lao PDR (Hong Sa) TH #3 (Mar)	491			Lao PDR (Hong Sa) TH #3 (Mar)	491	
		Khanom Replacement CC #1 (Jul)	900			Khanom Replacement CC #1 (Jul)	2x465	
		National Power Supply TH #1-2 (Nov)	2x135	**45,530**		National Power Supply TH #1-2 (Nov)	2x135	**46,947**
2017	**33,264**	Renewables	535	**21.4%**	**31,385**	Renewables	1,102	**33.9%**
		Cogeneration	900			Cogeneration	1,139	
		National Power Supply TH #3-4 (Mar)	2x135			National Power Supply TH #3-4 (Mar)	2x135	
		Lam Ta Khong Pumped Storage #3-4 (Jun)	500	**47,240**				**48,965**
2018	**34,593**	Renewables	390	**19.6%**	**32,429**	Renewables	314	**33.8%**
		Cogeneration	721			Cogeneration	733	
						Lam Ta Khong Pumped Storage #3-4 (Feb)	500	
		Replacement of Mae Moh TH #4-7				Replacement of Mae Moh TH #4-7 (Nov)	600	
		Lao PDR (Nam-Ngiep 1) (Jan)	269					
		Lao PDR (Xe-Pian) (Aug)	390	**48,329**				**50,196**
2019	**35,869**	Renewables	496	**18.7%**	**33,635**	Renewables	403	**36.6%**
		Cogeneration	725			Cogeneration	487	
						Replacement of Bang Pakong TH #1-2 (Apr)	1,300	
						Replacement of South Bangkok TH #1-5 (Apr)	1,300	
		EGAT Coal-Fired TH #1 (Jun)	800			Krabi Coal-Fired TH #1 (Dec)	800	
						Lao PDR (Xe-Pian) (Feb)	354	
						Lao PDR (Nam-Ngiep 1) (Jul)	269	
		Lao PDR (Xaiyaburi) (Oct)	1,220	**51,386**		Lao PDR (Xaiyaburi) (Oct)	1,220	**54,921**
2020	**37,326**	Renewables	442	**18.1%**	**34,808**	Renewables	406	**36.3%**
		Cogeneration	90	**50,389**		Cogeneration	72	**54,141**
2021	**38,726**	Renewables	442	**17.8%**	**35,775**	Renewables	296	**35.1%**
		Cogeneration	181			Cogeneration	228	
		IPP Gas-Fired Power Plant #1	900			Gulf SRC CC #1-2 (Mar, Oct)	1,250	
		Bang Pakong CC #1 (Replaced)	900			Thepa Coal-Fired TH #1	1,000	
		Power Purchase from Neighbouring Countries	300	**52,912**				**56,701**
2022	**40,134**	Renewables	289	**16.9%**	**36,776**	Renewables	309	**37.1%**
		Cogeneration	185			Cogeneration	30	
		IPP Gas-Fired Power Plant #2	900			Gulf SRC CC #3-4 (Mar, Oct)	1,250	
		Bang Pakong CC #2 (Replaced)	900			Replacement of South Bangkok CC #1-2	1,300	
		EGAT Coal-Fired TH #2	800			Replacement of Mae Moh TH #8-9	450	
		Power Purchase from Neighbouring Countries	300	**56,135**				**58,788**
2023	**41,567**	Renewables	280	**16.4%**	**37,740**	Renewables	264	**37.4%**
		Cogeneration	180			Cogeneration	8	
		IPP Gas-Fired Power Plant #3	900			Gulf PD CC #1-2 (Mar, Oct)	1,250	
		South Bangkok CC #1-2 (Replaced)	2x900			Replacement of Wang Noi CC #1-2	1,300	
		Power Purchase from Neighbouring Countries	300	**56,732**				**60,533**
2024	**43,049**	Renewables	275	**16.3%**	**38,750**	Renewables	432	**39.4%**
		Cogeneration	181			Cogeneration	126	
		IPP Gas-Fired Power Plant #4	900			Gulf PD CC #3-4 (Mar, Oct)	1,250	
		South Bangkok CC #3 (Replaced)	900			Thepa Coal-Fired TH #2	1,000	
		Bang Pakong CC #3 (Replaced)	900					
		Power Purchase from Neighbouring Countries	300	**59,509**				**62,661**
2025	**44,521**	Renewables	260	**16.5%**	**39,752**	Renewables	512	**36.1%**
		Cogeneration	185			Cogeneration	36	
		EGAT Coal-Fired TH #3	800					
		IPP Gas-Fired Power Plant #5	900			Replacement of Wang Noi CC #3	1,300	
		Bang Pakong CC #4 (Replaced)	900					
		Power Purchase from Neighbouring Countries	300	**60,477**				**60,403**

Comparison of Thailand Power Development Plans

Year	PDP2010 : Revision 3				PDP2015			
	Peak Demand (MW)	Projects		Reseve Margin (%)/ Contract Capacity (MW)	Peak Demand (MW)	Projects		Reseve Margin (%)/ Contract Capacity (MW)
2026	**46,003**	Renewables	254	**16.5%**	**40,791**	Renewables	361	**30.4%**
		Cogeneration	180					
		IPP Gas-Fired Power Plant #6	900					
		EGAT Nuclear Power Plant #1	1,000					
		Bang Pakong CC #5 (Replaced)	900			Chulabhorn Pumped Storage #1-2	800	
		Power Purchase from Neighbouring Countries	300	**64,007**		Power Purchase from Neighbouring Countries	700	**62,260**
2027	**47,545**	Renewables	315	**16.2%**	**41,693**	Renewables	309	**24.6%**
		Cogeneration	181					
		EGAT Nuclear Power Plant #2	1,000					
		Wang Noi CC #1 (Replaced)	900					
		Bang Pakong CC #6 (Replaced)	900					
		Power Purchase from Neighbouring Countries	300	**64,979**		Power Purchase from Neighbouring Countries	700	**60,645**
2028	**49,115**	Renewables	270	**16.4%**	**42,681**	Renewables	343	**20.5%**
		Cogeneration	5					
		EGAT Coal-Fired TH #4	800					
		Wang Noi CC #2-3 (Replaced)	2x900					
		Gas Turbine #1	250			Srinagarind Pumped Storage #1-3	801	
		Power Purchase from Neighbouring Countries	300	**67,012**		Power Purchase from Neighbouring Countries	700	**61,097**
2029	**50,624**	Renewables	266	**16.4%**	**43,489**	Renewables	322	**19.7%**
		South Bangkok CC #4 (Replaced)	900					
		EGAT Gas-Fired Power Plant #1	900					
		Gas Turbine #2	250					
		Power Purchase from Neighbouring Countries	300	**69,358**		Power Purchase from Neighbouring Countries	700	**61,993**
2030	**52,256**	Renewables	294	**16.2%**	**44,424**	Renewables	344	**18.4%**
		Cogeneration	1					
		EGAT Gas-Fired Power Plant #2	900					
		Gas Turbine #3	250					
		Power Purchase from Neighbouring Countries	300	**70,686**		Power Purchase from Neighbouring Countries	700	**63,037**
2031					**45,438**	Renewables	355	**17.3%**
						Power Purchase from Neighbouring Countries	700	**64,052**
2032					**46,296**	Renewables	383	**15.0%**
						Replacement of Bang Pakong TH #3-4	1,300	
						Power Purchase from Neighbouring Countries	700	**64,345**
2033					**47,025**	Renewables	381	**15.0%**
						Replacement of Bang Pakong TH #3-4	1,300	
						Coal-Fired Power Plant #4	1,000	
						Power Purchase from Neighbouring Countries	700	**65,592**
2034					**47,854**	Renewables	468	**15.0%**
						Gas Turbine #1	250	
						Coal-Fired Power Plant #5 (South)	1,000	
						Power Purchase from Neighbouring Countries	700	**66,965**
2035					**48,713**	Renewables	499	**15.3%**
						Gas Turbine #2-4	750	
						Coal-Fired Power Plant #6	1,000	
						Nuclear Power Plant #1	1,000	
						Power Purchase from Neighbouring Countries	700	**68,456**
2036					**49,655**	Renewables	600	**15.3%**
						Gas Turbine #5	250	
						Nuclear Power Plant #2	1,000	
						Power Purchase from Neighbouring Countries	700	**70,335**

Total Contract Capacity as of December 2011	32,395	MW	Total Contract Capacity as of December 2014	37,612	MW
Total Added Capacity	55,130	MW	Total Added Capacity	57,459	MW
Total Retired Capacity	-16,839	MW	Total Retired Capacity	-24,736	MW
Grand Total Capacity at the End of 2030	**70,686**	**MW**	**Grand Total Capacity at the End of 2036**	**70,335**	**MW**

Appendix 2

Thailand's generating capacity

CAPACITY OF THAILAND AND POWER SYSTEM

(as of December 2014)

Plant Name		Fuel Type	Contract Capacity (MW)
Power Plant			
South Bangkok	Block 1	Gas	316.0
	Block 2	Gas	562.0
	Block 3	Gas	710.0
Bang Pakong	Unit 3	Gas/Heavy Oil	576.0
	Unit 4	Gas/Heavy Oil	576.0
Bang Pakong	Block 3	Gas	314.0
	Block 4	Gas	314.0
	Block 5	Gas	710.0
Mae Moh	Unit 4-7	Lignite	560.0
	Unit 8-13	Lignite	1,620.0
Krabi	Unit 1	Heavy Oil	315.0
Nam Pong	Block 1	Gas	325.0
	Block 2	Gas	325.0
Wang Noi	Block 1	Gas	612.0
	Block 2	Gas	612.0
	Block 3	Gas	686.0
	Block 4	Gas	750.0
Chana	Block 1	Gas	710.0
	Block 2	Gas	766.0
North Bangkok	Block 1	Gas	670.0
Subtotal			**12,029.0**
Diesel Power Plant			
Mae Hong Sorn		Diesel	4.4
Subtotal			**4.4**
Renewable Energy			
Bhumibol Dam		Hydro	779.2
Sirikit Dam		Hydro	500.0
Sirindhorn Dam		Hydro	36.0
Chulabhorn Dam		Hydro	40.0
Ubolratana Dam		Hydro	25.2
Srinagarind Dam		Hydro	720.0
Vajiralongkorn Dam		Hydro	300.0
Tha Thung Na Dam		Hydro	39.0
Kang Hrachan Dam		Hydro	19.0
Bang Lang Dam		Hydro	72.0
Rajaprabha Dam		Hydro	240.0
Pak Mun Dam		Hydro	136.0
Lam Ta Khong Pumped Storage		Hydro	500.0
Small Hydro Power Plants		Hydro	37.8
Geothermal		Geothermal	0.3
Solar Cell		Solar	1.6
Wind Turbine		Wind	2.69
Subtotal			**3,448.7**
Total Capacity of EGAT			**15,482.1**

CAPACITY OF THAILAND AND POWER SYSTEM (Continued)

(as of December 2014)

Plant Name		Fuel Type	Contract Capacity (MW)
Purchased Power			
Power Plant			
Khanom	Unit 2	Gas/Heavy Oil	70.2
	Block 1	Gas	678.0
Ratchaburi	Unit 1	Gas/Heavy Oil	720.0
	Unit 1	Gas/Heavy Oil	720.0
	Block 1	Gas	685.0
	Block 2	Gas	675.0
	Block 3	Gas	681.0
BLCP Power Co., Ltd.	Unit 1	Coal	673.3
	Unit 2	Coal	673.3
Gheco-One Co., Ltd.	Block 1	Coal	660.0
Tri Energy Co., Ltd.	Block 1	Gas	700.0
Global Power Synergy Co., Ltd.	Block 1	Gas	700.0
Glow IPP Co., Ltd.	Block 1	Gas	356.5
	Block 2	Gas	356.5
Eastern Power and Electric Co., ltd.	Block 1	Gas	350.0
Gulf Power Generation Co., Ltd.	Block 1	Gas	734.0
	Block 2	Gas	734.0
Ratchaburi Power Co., Ltd	Block 1	Gas	700.0
	Block 2	Gas	700.0
Gulf JP NS Co., Ltd	Block 1	Gas	800.0
	Block 2	Gas	800.0
SPP		Coal	369.5
		Heavy Oil	4.5
		Gas	2,807.0
	Subtotal		**3,181.0**
Subtotal			**16,347.7**
Renewables			
Theun Hinboun		Hydro	434.0
Houay Ho		Hydro	126.0
Nam Theun2		Hydro	948.0
Nam Ngum2		Hydro	596.6
SPP		Biomass	313.6
Gas Turbine			
SPP		Gas	120.0
Others			
EGAT - TNB		-	300.0
Total Capacity of the purchased			**19,185.9**
Grand Total Capacity			**34,668.0**

Small Power Producer (SPP) Firm Contract

(as of 31 December 2014)

No.	Name	Fuel Types	Contract Capacity (MW)
	SPP Firm (Cogeneration)		
1.	Glow Energy PCL (Project 1)	Natural Gas	90
2.	Glow Energy PCL (Project 2)	Natural Gas	90
3.	TPT Petrochemicals PCL	Coal	10
4.	PTT Global Chemical PCL (Project 1)	Natural Gas/Off Gas	32
5.	Glow SPP 1 Co., Ltd. (Project 1)	Natural Gas	55
6.	Thaioil Power Co., Ltd.	Natural Gas	41
7.	Defence Energy Department	Bunker Oil	5
8.	Gulf Cogeneration Co., Ltd.	Natural Gas	90
9.	Amata B. Grimm Power 1 Limited	Natural Gas	90
10.	Glow SPP 1 Co., Ltd. (Project 2)	Natural Gas	55
11.	Bangkok Cogeneration Co., Ltd.	Natural Gas	90
12.	National Power Supply PCL (Project 1)	Coal, Wood Chips	90
13.	Glow SPP 2 Co., Ltd. (Project 1)	Natural Gas	60
14.	Sahacogen (Chonburi) PCL	Natural Gas	90
15.	Glow SPP 2 Co., Ltd. (Project 2)	Natural Gas	60
16.	Rojana Power Co., Ltd. (Project 1)	Natural Gas	90
17.	National Power Supply PCL (Project 2)	Coal, Wood Chips	90
18.	Samutprakarn Cogeneration Co., Ltd.	Natural Gas	90
19.	Glow SPP 3 Co., Ltd. (Project 1)	Coal	90
20.	Glow SPP 3 Co., Ltd. (Project 2)	Coal	90
21.	Glow SPP 11 Co., Ltd. (Project 1)	Natural Gas	90
22.	Nong Khae Cogeneration Co., Ltd.	Natural Gas	90
23.	B.Grimm Power (Laemchabang) 1 Co., Ltd.	Natural Gas	60
24.	Amata B. Grimm Power 2 Limited	Natural Gas	90
25.	EGCO Cogeneration Co., Ltd.	Natural Gas	60
26.	Siam Power Generation PCL (Project 1)	Natural Gas	90
27.	Glow Energy PCL (Project 3)	Natural Gas	74
28.	Amata B. Grimm Power 3 Limited	Natural Gas	90
29.	Glow SPP 11 Co., Ltd. (Project 2)	Natural Gas	90
30.	Gulf JP KP 1 Co., Ltd.	Natural Gas	90
31.	Gulf JP KP 2 Co., Ltd.	Natural Gas	90
32.	Gulf JP TLC Co., Ltd.	Natural Gas	90
33.	Gulf JP NNK Co., Ltd.	Natural Gas	90
34.	Gulf JP NLL Co., Ltd	Natural Gas	90
35.	Amata B. Grimm Power (Rayong) 2 Limited	Natural Gas	90
36.	Bangpa-in Cogeneration Co., Ltd.	Natural Gas	90
37.	Gulf JP CRN Co., Ltd.	Natural Gas	90
38.	Gulf JP NK 2 Co., Ltd.	Natural Gas	90
39.	Rojana Power Co., Ltd. (Project 2)	Natural Gas	90
40.	Nawanakhon Electricity Co., Ltd.	Natural Gas	90
41.	Amata B. Grimm Power (Rayong) 1 Limited	Natural Gas	90
42.	Ratchaburi World Cogeneration Co., Ltd. (Project 1)	Natural Gas	90
	Total		**3,301**

Small Power Producer (SPP) Firm Contract

(as of 31 December 2014)

No.	Name	Fuel Types	Contract Capacity (MW)
	SPP Firm (Renewable)		
1.	National Power Plant 3 Co., Ltd.	Paddy Husk, Wood Chips	41
2.	National Power Plant 2 Co., Ltd.	Paddy Husk, Wood Chips	8
3.	Biomass Power Co., Ltd.	Paddy Husk	5
4.	Roi-Et Green Co., Ltd.	Paddy Husk	8.8
5.	National Power Plant 5 Co., Ltd.	Bark, Wood Chips, Black Liquor	50
6.	National Power Plant 11 Co., Ltd.	Black Liquor	25
7.	Mitr Phol Bio-power (Danchang) Co.,Ltd. (Project 1)	Bagasse, Bark, Paddy Husk	27
8.	Mitr Phol Bio-power Co.,Ltd. (Project 1)	Bagasse, Bark, Paddy Husk	29
9.	A.T. Biopower Co., Ltd.	Paddy Husk	20
10.	Satuk Biomass Co., Ltd.	Paddy Husk, Other biomass	6.5
11.	Gulf Yala Green Co., Ltd.	Rubber Wood Chips	20.2
12.	Khon Kaen Sugar Power Plant Co., Ltd (Project 1)	Bagasse, Other Biomass	20
13.	Mungcharoen Green Power Co.,Ltd	Paddy Husk	8
14.	Surat Thani Green Energy Co., Ltd.	Fruit Bunch (EFB) of Palm Oil	8.8
15.	Mitr Phol Bio-power (Danchang) Co.,Ltd. (Project 2)	Bagasse	10.8
16.	Mitr Phol Bio-power Co.,Ltd. (Project 2)	Bagasse	10
17.	Mungcharoen Biomass Co.,Ltd	Paddy Husk, Wood chips, Raw Bark	15.5
	Total		**313.6**

Small Power Producer (SPP) Non-Firm

(as of 31 December 2014)

No.	Name	Fuel Types	Contract Capacity (MW)
	SPP Non-Firm Cogeneration		
1.	IRPC Public Co., Ltd. (Project 1)	Natural Gas, Coal Heavy Oil	45
2.	Panjapol Pulp Industry Public Co., Ltd..	Coal	8
3.	District Cooling System and Power Plant Co., Ltd.	Natural Gas	65
4.	Global Power Synergy Co., Ltd. (Project 1)	Natural Gas	60
5.	Global Power Synergy Co., Ltd. (Project 2)	Natural Gas	40
6.	Rojana Power Co., Ltd. (Project 4)	Natural Gas	70
	Subtotal		**288**
	SPP Non-Firm Renewable		
1.	Mitr Phol Bio-Power (Phu Viang) Co., Ltd.	Bagasse	8
2.	Chaimongkol Refined Sugar Co., Ltd.	Bagasse	7
3.	Saraburi Sugar Co., Ltd.	Bagasse	8
4.	Thai Roong Ruang Industry Co., Ltd.	Bagasse	8
5.	Angvian Industry Co., Ltd.	Bagasse	30
6.	Kumphawapi Sugar Co., Ltd.	Bagasse	6
7.	Thai Carbon Blank Public Co., Ltd.	Waste Gas	12
8.	Ratchaburi Energy Co. Ltd.	Waste Gas	1.723
9.	Khon Kaen Sugar Power Plant Co., Ltd (Project 2)	Bagasse	30
10.	Department of Alternative Energy Development and Efficienc	Hydro	12.2
11.	Natural Energy Development Co., Ltd.	Solar	55
12.	Mitr Phol Bio-Power (Dan Chang) Co., Ltd. (Project 3)	Bagasse, Paddy Husk	25
13.	Bangchak Petroleum Public Co., Ltd	Solar	30
14.	First Korat Wind Co., Ltd.	Wind	90
15.	Mitr Phol Bio-Power (Kalasin) Co., Ltd.	Bagasse	28
16.	K.R. Two Co., Ltd.	Wind	90
17.	Kaset Thai Bio Power Co., Ltd.	Bagasse	60
18.	Ea Solar Nakornsawan Co., Ltd.	Solar	90
19.	ES Energy Co., Ltd.	Bagasse	20
20.	Uthaithani Bio Energy Co.,Ltd.	Bagasse	16
	Subtotal		**626.923**
	Grand Total		**914.923**

Very Small Power Producer (VSPP)

DEDE and PEA

(as of 31 December 2014)

No.	Fuel Types	Contract Capacity (MW)
1.	Cogeneration	**25**
2.	Diesel	**22**
3.	Renewable Energy	**1,983**
	Biomass	705
	Biogas	188
	Solar	973
	Municipal Solid Waste	43
	Wind	11
	Hydro	58
	Residues	5
	Total	**2,029**

Appendix 3

Map of transmission system

MAP OF EGAT ELECTRIC POWER SYSTEM

MAE CHAN
CHIANG RAI
MEKONG RIVER
MAE KUM LUANG DAM 2x1.6 MW
THOENG
HONG SA THERMAL 3x626 MW
MAE SA–NGA DAM 2x2.5 MW
MAE NGAT DAM 2x4.5 MW
MAE TAENG
MAE HONG SON DIESEL 6.0 MW
PHAYAO
XAYABURI 8x160 MW
MAE HONG SON DAM 0.85 MW
CHIANG MAI 2
CHIANG MAI 1
CHIANG MAI 3
LAMPHUN 2
MAE MOH THERMAL 2,400 MW UNITS 4–7 4x150 MW UNITS 8–13 6x300 MW
NAN
NAM NGUM 2 DAM 3x205 MW
NAM LEUK DAM 2x30 MW
NAM NGIEP 1 DAM 2x130.5 MW
MAE SARIANG DAM 2x0.625 MW
HANG CHAT
MAE MOH 2
LAMPHUN 1
NAM NGUM 1 DAM ULTIMATE CAPACITY 150 MW 2x15+3x40 MW
BAN NA BONG
PAKXAN
CHOM THONG
LAMPANG 2
MAE MOH 3
THEUN – HINBOUN DAM 2x15 MW
THEUN – HINBOUN EXPANSION 1x220 MW
LAMPHUN 3
MAE MOH 4
LAMPANG 1
PHRAE
VIENTIANE
THA NALANG
BUENG KAN
SIRIKIT DAM 4x125 MW
NONG KHAI 1
NAM THEUN 2 DAM 4x252 MW
BAN DUNG
THAKHEK
THOEN
UTTARADIT
THA LI
LOEI
NAKHON PHANOM 2
UDON THANI 1
BHUMIBOL DAM 6x76.3+1x115+1x171 MW
NONG HAN
SAKON NAKHON 2
NAKHON PHANOM 115 KV THA KHEK
UDON THANI 2
SAWANKHALOK
NONG BUA LAM PHU
PHROM PHIRAM
NAC
NAM PHONG 2 COMBINED–CYCLE 2x355 MW
UDON THANI 3
PHANG KHON
SAKON NAKHON
SUKHOTHAI
PHITSANULOK 2
NAM PUNG
NAM PUNG DAM 2x3 MW
THAT PHANOM
TAK 1
LOM SAK
UBOLRATANA DAM 3x8.4 MW
NAM PHONG 1
MUKDAHAN 2
115 KV SAVANNAKHET
PHITSANULOK 1
CHUM PHAE
SOMDET
MAE SOT
TAK 2
LAN KRABU
KHON KAEN 1
KALASIN
ROI ET 2
MUKDAHAN
KHON KAEN 2
KAMPHAENGPHET
PHICHIT
PHETCHABUN
PHON THONG
AKARA MINING
CHULABHORN DAM 2x20 MW
KHON KAEN 4
KHON KAEN 3
ROI ET
NEC
NORTHERN REGION
BAN PHAI
MAHA SARAKHAM
BANG MUN NAK
HUAI KUM DAM 1.06 MW
BUENG SAM PHAN
AMNAT CHAROEN
SALOKBAT
CHAIYAPHUM 2
PHAYAKKHAPHUM PHISAI
YASOTHON
NAKHON SAWAN
PHON
UBON RATCHATHANI 3
XESET DAM 2x3+3x13 MW
THA TAKO
CHAIYAPHUM 1
NONG BUA RAWE
PAK MUN DAM 4x34 MW
XESET 2 DAM 2x38 MW
NORTHEASTERN REGION
HUA WAI
BAMNET NARONG
KHONG
UBON RATCHATHANI 1
HOUAY HO DAM 2x75 MW
MANOROM
CHAI BADAN
SI SA KET
TAKHLI 2
SI KHIU 3
NAKHON RATCHASIMA 1
LAM TAKHONG JOLARHA VADHANA HYDRO POWER PLANT 2x250 MW
LOP BURI 2
SURIN
UBON RATCHATHANI 2
XEPAIN–XENAMNOY DAM 3x130 MW
SING BURI
LOP BURI 1
SARABURI 6
SARABURI 3
BURI RAM
SIRINDHORN DAM 3x12 MW
DOEMBANG NANGBUAT
SI KHIU 2
NAKHON RATCHASIMA 2
SURIN 2
THA WUNG
AYUTTHAYA 4
THALAN 3
KANTHARALAK
PAK XE
VAJIRALONGKORN DAM 3x100 MW
SRINAGARIND DAM 3x120+2x180 MW
PHRA PHUTTHABAT
PAK CHONG
NAKHON RATCHASIMA 3
PRAKHON CHAI
SANGKHA
ANG THONG 2
ANG THONG 1
KAENG KHOI 2 (IPP GULF 2x734 MW)
SARABURI 4
SARABURI 2
SARABURI 1
SUPHANBURI
AYUTTHAYA 3
THALAN 2
PHACHI
SARABURI 5
NAKHON NAYOK
AYUTTHAYA 1
GULF–JP–UT GULF–JP–NS COMBINED CYCLE 2x800+2x800 MW
AYUTTHAYA 2
PRACHIN BURI 1
KABIN BURI
BANG PA–IN 1
PHACHI 2
WANG NOI COMBINED–CYCLE 2x651+1x729+800 MW
BANG PA–IN 2
THA THUNG NA DAM 2x19 MW
KAMPHAENG SAEN
NATIONAL POWER SUPPLY THERMAL 4x135 MW
SINAHA PHOT
WATTHANA NAKHON
KANCHANABURI 2
GREATER BANGKOK AREA AND VICINITY
PHANOM SARAKHAM
PRACHIN BURI 2
KANCHANABURI
THA MUANG
BAN PONG 2
NAKHON CHAISI
CHACHOENGSAO
CHACHOENGSAO 2
CHOM BUENG
BAN PONG
SAM PHRAN 2
RATCHABURI 3
RATCHABURI
SAMUT SAKHON 2
IPP(TRI ENERGY 700 MW)
SAMUT SAKHON 4
BANG PAKONG THERMAL 2x550+2x600 MW COMBINED–CYCLE 2x307+1x700 MW
RATCHABURI 2
SAMUT SONGKHRAM
BANG BO (IPP EPEC 350 MW)
PHAN THONG
(GLOW IPP 713 MW)
CHON BURI
SI RACHA
BAN BUENG
RATCHABURI THERMAL 2x25 MW COMBINED–CYCLE 3x725 MW
RATCHABURI POWER COMBINED–CYCLE 2x700 MW IPP (INDEPENDENT POWER 350 MW)
AO PHAI
PLUAK DAENG
KIRIRATHARN DAM 2x6.4 MW
PHETCHABURI
BO WIN
BANG LAMUNG 2
BAN KHAI
BANG LAMUNG
RAYONG CHOM THEN COMBINED–CYCLE 294.67+287.67+289.78+302.67
RAYONG
CHOENG NOEN
KLAENG
KAENG KRACHAN DAM 1x12.5 MW
CHA–AM
SATTAHIP 1
RAYONG 1
NIKOM MAP TA PHUT (IPP BLCP 2x673.25 MW)
CHANTHABURI
SATTAHIP 2
GHECO–ONE THERMAL 1x660 MW
TRAT
HUA HIN
PRAN BURI
CENTRAL REGION
PRACHUAP KHIRI KHAN
BANG SAPHAN 2
GULF OF THAILAND
BANG SAPHAN
230 KV CENTRAL–SOUTHERN TIE LINE
SOUTHERN REGION
CHUMPHON
LANG SUAN
RANONG
KO SAMUI
SURAT THANI
RAJJAPRABHA DAM 3x80 MW
KHANOM BARGE MOUNTED THERMAL 70.2 MW COMBINED–CYCLE 678 MW
BAN DON
PHUNPHIN
TAKUA PA
SURAT THANI 2
PHANGNGA
NAKHON SI THAMMARAT
PHANGNGA 2
PHUKET 3
KRABI THERMAL 340 MW
THUNG SONG
CHIAN YAI
PHUKET 1
PHUKET 2
LAM POO RA (TRANG)
RANOT
PHATTHALUNG
SAC
SONGKHLA
CHANA COMBINED–CYCLE 710+800 MW
SONGKHLA 2
HAT YAI 1
HAT YAI 2
PATTANI
SATUN
SATAO
KHLONG NGAE
YALA
NARATHIWAT
YALA 2
CHUPING (MALAYSIA)
SUNGAI KOLOK
BANG LANG DAM 3x24 MW
GURUN
BAN SAKTI DAM 1.3 MW
RANTAU PANJANG (MALAYSIA)
MALAYSIA
N
W
E
S
0 40 80 120 KILOMETER

GREATER BANGKOK AREA AND VICINITY

500KV LINES
230KV LINES 3&4
230KV LINES 1&2
NAVA NAKHON
SAM KHOK
RANGSIT
KHLONG LUANG
SAI NOI
500KV LINES
230KV LINES
LAM LUK KA
CHAENG WATTHANA
NIMIT MAI
NORTH BANGKOK COMBINED–CYCLE 1X700 MW
CHATUCHAK
LAT PHRAO
NONG CHOK
NCC&MAC&CAC
RATCHAPHRUK
RATCHADAPHISEK
BANGKOK
BANGKOK NOI
BANG KAPI
ON NUCH
SAM PHRAN 1
SOUTH BANGKOK COMBINED–CYCLE 1x335+1x623+1X700 MW
BANG PHLI
SOUTH THON BURI
ERAWAN
THEPHARAK
SAMUT SAKHON 3
KHLONG DAN
SAMUT SAKHON 1
0 2 4 6 8 10 KILOMETER

MAP OF EGAT ELECTRIC POWER SYSTEM

EXISTING	UNDER CONSTRUCTION	FUTURE PROJECT	
			500 KV TRANSMISSION LINE
			230 KV TRANSMISSION LINE
			115 KV TRANSMISSION LINE
			69 KV TRANSMISSION LINE
			132 KV TRANSMISSION LINE
			500 KV SUBSTATION
			230 KV SUBSTATION
			115 KV SUBSTATION
			132 KV SUBSTATION
			69 KV SUBSTATION
			THERMAL POWER PLANT
			GAS TURBINE
			COMBINE–CYCLE
			HYDRO POWER PLANT
			SITE LOCATIONS FOR COAL–FIRED THERMAL POWER PLANT AND NUCLEAR POWER PLANT ARE UNDER STUDY

ELECTRICITY GENERATING AUTHORITY OF THAILAND

ELECTRIC POWER SYSTEM OF THAILAND

SYSTEM PLANNING DIVISION
TRANSMISSION SYSTEM PLANNING DEPARTMENT

ISSUED DATE : JULY 2015

DWG. NO. EPS 2002

MAP_PDP

Appendix 4

Current status of transmission system

CURRENT STATUS OF TRANSMISSION SYSTEM

(AS OF DECEMBER, 2015)

Voltage Level (KV)	High Voltage Substation		Length of Transmission Line (Circuit-Km)
	Number	Transformer Capacity (MVA)	
Metropolitan			
500	3	8,050.00	459.054
230	12	17,000.00	838.556
115	-	-	-
Total	**15**	**25,050.00**	**1,297.610**
Central			
500	5	7,000.00	2,243.562
230	25	17,793.34	4,256.207
115	42	5,311.00	2,818.168
69	-	-	19.000
Total	**72**	**30,104.34**	**9,336.937**
North Eastern			
500	1	2,000.00	320.793
230	13	5,800.00	2,365.532
115	37	3,918.00	5,940.131
69	-	-	
Total	**51**	**11,718.00**	**8,626.456**
South			
300 (HVDC)	-	388.02	23.066
230	14	6,866.70	3,401.405
115	-	133.40	8.705
69	18	2,429.00	2,050.194
Total	**32**	**9,817.12**	**5,483.370**
North			
500	2	3,799.99	1,143.757
230	7	5,000.00	3,743.424
115	34	2,971.99	2,895.438
69	-	-	-
Total	**43**	**11,771.98**	**7,782.619**
All region			
500	11	20,849.99	4,167.166
230	71	52,460.04	14,605.124
115	113	12,334.39	11,662.442
69	18	2,429.00	2,069.194
300 (HVDC)	-	388.02	23.066
Total	**213**	**88,461.44**	**32,526.992**

Appendix 5

Projection of generating capacity

by power plant types

PROJECTION OF GENERATING CAPACITY BY POWER PLANT TYPES
PDP2015

POWER PLANT TYPE			Capacity	YEAR																				
PLANT	FUEL	OWNER		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Hyro		- EGAT	MW	3,406	3,418	3,418	3,918	3,918	3,918	3,918	3,918	3,918	3,918	3,918	4,718	4,718	5,519	5,519	5,519	5,519	5,519	5,519	5,519	5,519	5,519
			%	7.8	7.3	7.0	7.8	7.1	7.2	6.9	6.7	6.5	6.3	6.5	7.6	7.8	9.0	8.9	8.8	8.6	8.6	8.4	8.2	8.1	7.8
		- Loas	MW	2,105	2,105	2,105	2,105	3,948	3,948	3,948	3,948	3,948	3,948	3,948	4,648	4,648	4,648	4,522	4,522	4,522	4,522	4,522	4,522	3,574	4,274
			%	4.8	4.5	4.3	4.2	7.2	7.3	7.0	6.7	6.5	6.3	6.5	7.5	7.7	7.6	7.3	7.2	7.1	7.0	6.9	6.8	5.2	6.1
		- Myanmar	MW	-	-	-	-	-	-	-	-	-	-	-	-	700	1,400	2,100	2,800	3,500	4,200	4,900	5,600	6,300	6,300
			%	-	-	-	-	-	-	-	-	-	-	-	-	1.2	2.3	3.4	4.4	5.5	6.5	7.5	8.4	9.2	9.0
		Total	MW	**5,511**	**5,523**	**5,523**	**6,023**	**7,866**	**7,866**	**7,866**	**7,866**	**7,866**	**7,866**	**7,866**	**9,366**	**10,066**	**11,567**	**12,141**	**12,841**	**13,541**	**14,241**	**14,941**	**15,641**	**15,393**	**16,093**
			%	**12.6**	**11.8**	**11.3**	**12.0**	**14.3**	**14.5**	**13.9**	**13.4**	**13.0**	**12.6**	**13.0**	**15.0**	**16.6**	**18.9**	**19.6**	**20.4**	**21.1**	**22.1**	**22.8**	**23.4**	**22.5**	**22.9**
Renewable		- EGAT	MW	106	116	146	172	200	248	263	295	352	364	386	414	420	468	477	508	514	541	551	566	576	596
			%	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
		- SPP Firm	MW	336	336	336	336	336	328	328	328	328	278	222	217	210	107	107	107	67	58	58	38	38	38
			%	0.8	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
		- SPP Non-firm	MW	1,173	1,603	2,398	2,398	2,443	2,443	2,443	2,443	2,443	2,443	2,443	2,443	2,443	2,443	2,443	2,443	2,443	2,443	2,443	2,443	2,443	2,443
			%	2.7	3.4	4.9	4.8	4.4	4.5	4.3	4.2	4.0	3.9	4.0	3.9	4.0	4.0	3.9	3.9	3.8	3.8	3.7	3.6	3.6	3.5
		- VSPP/ww./PEA	MW	4,330	4,601	4,879	5,167	5,497	5,855	6,135	6,412	6,620	7,039	7,529	7,862	8,165	8,460	8,773	9,086	9,435	9,791	10,162	10,615	11,104	11,684
			%	9.9	9.8	10.0	10.3	10.0	10.8	10.8	10.9	10.9	11.2	12.5	12.6	13.5	13.8	14.2	14.4	14.7	15.2	15.5	15.9	16.2	16.6
		Total	MW	**5,945**	**6,656**	**7,758**	**8,072**	**8,475**	**8,873**	**9,169**	**9,478**	**9,742**	**10,124**	**10,580**	**10,936**	**11,238**	**11,478**	**11,801**	**12,144**	**12,459**	**12,833**	**13,215**	**13,662**	**14,161**	**14,760**
			%	**13.6**	**14.2**	**15.8**	**16.1**	**15.4**	**16.4**	**16.2**	**16.1**	**16.1**	**16.2**	**17.5**	**17.6**	**18.5**	**18.8**	**19.0**	**19.3**	**19.5**	**19.9**	**20.1**	**20.4**	**20.7**	**21.0**
Combined cycl	Natural gas	- EGAT	MW	8,382	9,230	8,916	8,602	9,978	9,662	9,662	10,400	11,014	11,014	11,664	11,664	11,664	11,664	11,664	11,664	11,664	12,964	14,264	13,554	12,134	11,464
			%	19.2	19.7	18.2	17.1	18.2	17.8	17.0	17.7	18.2	17.6	19.3	18.7	19.2	19.1	18.8	18.5	18.2	20.1	21.7	20.2	17.7	16.3
		- IPP	MW	11,250	11,502	11,502	11,502	11,502	10,802	12,052	13,302	14,202	15,452	14,752	14,752	12,711	11,998	11,998	11,998	11,998	11,264	9,130	9,130	9,130	9,130
			%	25.8	24.5	23.5	22.9	20.9	20.0	21.3	22.6	23.5	24.7	24.4	23.7	21.0	19.6	19.4	19.0	18.7	17.5	13.9	13.6	13.3	13.0
		Total	MW	**19,632**	**20,732**	**20,418**	**20,104**	**21,480**	**20,464**	**21,714**	**23,702**	**25,216**	**26,466**	**26,416**	**26,416**	**24,375**	**23,662**	**23,662**	**23,662**	**23,662**	**24,228**	**23,394**	**22,684**	**21,264**	**20,594**
			%	**45.0**	**44.2**	**41.7**	**40.1**	**39.1**	**37.8**	**38.3**	**40.3**	**41.7**	**42.2**	**43.7**	**42.4**	**40.2**	**38.7**	**38.2**	**37.5**	**36.9**	**37.7**	**35.7**	**33.9**	**31.1**	**29.3**
Cogeneration	Natural gas	- SPP Firm	MW	3,287	4,097	5,051	5,749	6,055	5,893	5,908	5,788	5,755	5,467	5,395	5,395	5,395	5,395	5,395	5,395	5,395	5,395	5,395	5,395	5,305	5,305
			%	7.5	8.7	10.3	11.5	11.0	10.9	10.4	9.8	9.5	8.7	8.9	8.7	8.9	8.8	8.7	8.6	8.4	8.4	8.2	8.1	7.7	7.5
		- SPP Non-firm	MW	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340
			%	0.8	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.5	0.6	0.5	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
		- VSPP/ww./PEA	MW	54	54	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
			%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Coal	- SPP Firm	MW	370	370	370	363	363	363	363	363	363	147	75	75	75	75	75	75	75	75	75	75	75	75
			%	0.8	0.8	0.8	0.7	0.7	0.7	0.6	0.6	0.6	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
		- SPP Non-firm	MW	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
			%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Fuel oil	- SPP Firm	MW	5	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
			%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Total	MW	**4,063**	**4,873**	**5,832**	**6,524**	**6,826**	**6,664**	**6,679**	**6,559**	**6,526**	**6,022**	**5,878**	**5,878**	**5,878**	**5,878**	**5,878**	**5,878**	**5,878**	**5,878**	**5,878**	**5,878**	**5,788**	**5,788**
			%	**9.3**	**10.4**	**11.9**	**13.0**	**12.4**	**12.3**	**11.8**	**11.2**	**10.8**	**9.6**	**9.7**	**9.4**	**9.7**	**9.6**	**9.5**	**9.3**	**9.2**	**9.1**	**9.0**	**8.8**	**8.5**	**8.2**
Thermal	Lignite	- EGAT	MW	2,180	2,180	2,180	2,220	2,220	2,220	2,220	2,130	2,130	2,130	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
			%	5.0	4.6	4.5	4.4	4.0	4.1	3.9	3.6	3.5	3.4	1.7	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.6	1.6	1.5	1.5
		- Loas	MW	982	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473	1,473
			%	2.3	3.1	3.0	2.9	2.7	2.7	2.6	2.5	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.3	2.3	2.3	2.2	2.2	2.2	2.1
	Coal	- EGAT	MW	-	-	-	-	800	800	1,800	1,800	1,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800
			%	-	-	-	-	1.5	1.5	3.2	3.1	3.0	4.5	4.6	4.5	4.6	4.6	4.5	4.4	4.4	4.4	4.3	4.2	4.1	4.0
		- IPP	MW	2,007	2,277	2,547	2,547	2,547	2,547	2,547	2,547	2,547	2,547	2,547	2,547	2,547	2,547	2,547	2,547	2,547	1,200	1,200	1,200	1,200	1,200
			%	4.6	4.8	5.2	5.1	4.6	4.7	4.5	4.3	4.2	4.1	4.2	4.1	4.2	4.2	4.1	4.0	4.0	1.9	1.8	1.8	1.8	1.7
		- New capacity	MW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,000	2,000	3,000	3,000
			%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	3.0	4.4	4.3
	Natural gas / Fuel oil	- EGAT	MW	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	1,152	576	-	-	-	-	-	-	-	-	-
			%	2.6	2.5	2.4	2.3	2.1	2.1	2.0	2.0	1.9	1.8	1.9	1.9	0.9	-	-	-	-	-	-	-	-	-
		- IPP	MW	1,510	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440	-	-	-	-	-	-	-	-	-	-	-	-
			%	3.5	3.1	2.9	2.9	2.6	2.7	2.5	2.4	2.4	2.3	-	-	-	-	-	-	-	-	-	-	-	-
	Fuel oil	- EGAT	MW	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	-	-	-
			%	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	-	-	-
	Nuclear	- EGAT	MW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,000	2,000
			%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	2.8
		Total	MW	**8,146**	**8,837**	**9,107**	**9,147**	**9,947**	**9,947**	**10,947**	**10,857**	**10,857**	**11,857**	**9,337**	**9,337**	**8,761**	**8,185**	**8,185**	**8,185**	**8,185**	**6,838**	**7,838**	**8,523**	**10,523**	**11,523**
			%	**18.7**	**18.8**	**18.6**	**18.2**	**18.1**	**18.4**	**19.3**	**18.5**	**17.9**	**18.9**	**15.5**	**15.0**	**14.4**	**13.4**	**13.2**	**13.0**	**12.8**	**10.6**	**11.9**	**12.7**	**15.4**	**16.4**
Gas turbine	Diesel	- EGAT	MW	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
			%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		- VSPP/DEDE/PEA	MW	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
			%	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		- New capacity	MW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	250	1,000	1,250
			%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4	1.5	1.8
		Total	MW	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**26**	**276**	**1,026**	**1,276**
			%	**0.1**	**0.1**	**0.1**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.4**	**1.5**	**1.8**
Interconnection		Thailand-Malaysia	MW	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300
			%	0.7	0.6	0.6	0.6	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4
Grand total			MW	43,623	46,947	48,965	50,196	54,921	54,141	56,701	58,788	60,533	62,661	60,403	62,260	60,645	61,097	61,993	63,037	64,052	64,345	65,592	66,965	68,456	70,335

Appendix 6

Projection of energy generation by fuel types

PROJECTION OF ENERGY GENERATION BY FUEL TYPES
PDP2015

POWER PLANT		ENERGY	YEAR																				
FUEL	OWNER		2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579
Hydro	- EGAT	GWh	3,794	5,702	5,671	5,741	5,677	5,935	5,935	5,935	5,935	5,935	5,935	6,496	6,496	6,964	6,964	6,964	6,964	6,964	6,964	6,964	6,964	6,964
		%	2.0	2.9	2.8	2.7	2.6	2.6	2.5	2.5	2.4	2.3	2.3	2.4	2.4	2.5	2.4	2.4	2.3	2.3	2.3	2.2	2.2	2.1
	- Loas	GWh	11,976	12,279	12,339	12,758	19,699	19,825	19,825	19,825	19,825	19,825	19,825	22,555	22,555	22,555	22,345	21,940	21,940	21,940	21,940	21,940	17,140	19,034
		%	6.3	6.2	6.0	6.0	8.9	8.7	8.4	8.2	8.0	7.8	7.6	8.4	8.2	8.1	7.8	7.5	7.4	7.2	7.1	7.0	5.4	5.8
	- Myanmar	GWh	-	-	-	-	-	-	-	-	-	-	-	-	3,500	7,000	10,499	13,999	17,499	20,999	24,498	27,998	31,498	31,498
		%	-	-	-	-	-	-	-	-	-	-	-	-	1.3	2.5	3.7	4.8	5.9	6.9	7.9	8.9	9.8	9.7
	Total	GWh	15,770	17,981	18,010	18,498	25,376	25,761	25,761	25,761	25,761	25,761	25,761	29,051	32,550	36,518	39,808	42,903	46,403	49,903	53,403	56,903	55,602	57,496
		%	8.3	9.1	8.8	8.7	11.5	11.3	11.0	10.7	10.4	10.1	9.9	10.9	11.9	13.0	13.9	14.7	15.6	16.4	17.3	18.1	17.4	17.6
Natural gas / LNG	- EGAT	GWh	48,165	48,064	47,196	50,355	42,984	40,445	40,909	50,097	51,912	52,896	51,069	52,335	51,548	56,358	45,282	46,277	47,259	56,421	58,642	52,372	46,495	42,963
		%	25.3	24.3	22.9	23.7	19.5	17.7	17.4	20.8	21.0	20.8	19.6	19.6	18.9	20.1	15.9	15.9	15.8	18.6	19.0	16.7	14.5	13.2
		MMCFD	1,005	987	995	1,062	813	767	779	947	979	994	938	962	947	1,016	820	839	856	1,019	1,062	948	842	776
	- IPP	GWh	51,969	41,871	41,673	35,512	32,996	29,289	25,918	22,713	26,995	25,603	42,828	44,044	45,300	41,078	53,018	53,679	54,542	56,142	46,481	45,218	40,755	38,793
		%	27.3	21.2	20.3	16.7	15.0	12.8	11.0	9.4	10.9	10.1	16.4	16.5	16.6	14.7	18.6	18.4	18.3	18.5	15.0	14.4	12.7	11.9
		MMCFD	1,054	847	865	715	668	550	487	427	505	477	790	811	835	754	970	982	997	1,023	840	817	736	700
	- SPP Firm	GWh	20,838	24,660	32,066	36,807	40,598	41,740	41,317	41,172	40,397	38,924	38,195	37,817	37,817	37,817	37,817	37,817	37,817	37,817	37,817	37,817	37,764	37,186
		%	11.0	12.5	15.6	17.3	18.4	18.3	17.6	17.1	16.3	15.3	14.6	14.1	13.8	13.5	13.3	13.0	12.7	12.4	12.2	12.0	11.8	11.4
	- SPP Non-firm	GWh	1,113	1,113	1,113	1,113	1,113	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034
		%	0.6	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3
	- VSPP/ DEDE/ PE	GWh	96	114	127	127	127	139	139	139	139	139	151	151	151	151	151	164	164	164	164	164	176	176
		%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Total	GWh	122,180	115,820	122,174	123,914	117,818	112,646	109,316	115,155	120,476	118,595	133,277	135,381	135,849	136,437	137,302	138,970	140,815	151,577	144,138	136,604	126,224	120,152
		%	64.2	58.5	59.4	58.3	53.4	49.4	46.6	47.7	48.6	46.6	51.1	50.6	49.7	48.7	48.1	47.7	47.2	49.9	46.6	43.4	39.4	36.8
		MMCFD	2,059	1,834	1,861	1,777	1,481	1,317	1,266	1,375	1,484	1,471	1,728	1,773	1,781	1,770	1,790	1,820	1,854	2,042	1,901	1,765	1,578	1,475
Fuel oil	- EGAT	GWh	589	677	125	260	307	-	-	-	-	-	0	0	0	0	0	0	0	1	1	-	-	-
		%	0.3	0.3	0.1	0.1	0.1	-	-	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	-
		Million liters	169	199	37	76	90	-	-	-	-	-	0	0	0	0	0	0	0	0	0	-	-	-
	- IPP	GWh	295	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		%	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Million liters	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	- SPP Firm	GWh	32	31	32	32	17	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
		%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	GWh	915	708	157	292	324	6	6	6	6	6	6	6	6	7	7	7	7	7	7	6	6	6
		%	0.5	0.4	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Million liters	247	199	37	76	90	-	-	-	-	-	0	0	0	0	0	0	0	0	0	-	-	-
Diesel	- EGAT/Private se	GWh	413	57	43	59	57	17	22	19	19	25	19	19	19	19	19	19	19	19	24	30	35	35
		%	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Million liters	84	13	10	13	16	4	6	5	5	6	4	4	4	4	4	4	4	4	6	7	8	8
	- New capacity	GWh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	1	1
		%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0.0
		Million liters	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0
	Total	GWh	413	57	43	59	57	17	22	19	19	25	19	19	19	19	19	19	19	19	24	30	36	36
		%	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Million liters	84	13	10	13	16	4	6	5	5	6	4	4	4	4	4	4	4	4	6	7	8	8
Lignite	- EGAT	GWh	16,001	16,745	17,080	17,677	16,532	17,275	17,320	16,543	16,505	16,574	8,025	8,023	8,025	8,049	8,025	8,025	8,025	8,049	8,025	8,025	8,025	8,049
		%	8.4	8.5	8.3	8.3	7.5	7.6	7.4	6.9	6.7	6.5	3.1	3.0	2.9	2.9	2.8	2.8	2.7	2.6	2.6	2.6	2.5	2.5
		Million tons	16	16	16	17	15	15	15	13	13	13	6	6	6	6	6	5	5	5	5	5	5	5
	- Loas	GWh	4,182	11,087	10,947	10,393	10,954	11,261	11,243	11,258	11,237	11,282	11,256	11,257	11,258	11,292	11,258	11,258	11,258	11,292	11,258	11,258	11,258	11,292
		%	2.2	5.6	5.3	4.9	5.0	4.9	4.8	4.7	4.5	4.4	4.3	4.2	4.1	4.0	3.9	3.9	3.8	3.7	3.6	3.6	3.5	3.5
		Million tons	5	13	13	13	13	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
	Total	GWh	20,183	27,832	28,027	28,070	27,486	28,537	28,563	27,801	27,741	27,855	19,281	19,280	19,283	19,341	19,284	19,284	19,284	19,341	19,284	19,284	19,284	19,341
		%	10.6	14.1	13.6	13.2	12.5	12.5	12.2	11.5	11.2	11.0	7.4	7.2	7.1	6.9	6.8	6.6	6.5	6.4	6.2	6.1	6.0	5.9
		Million tons	21	29	30	29	28	23	23	21	21	21	13	13	13	13	13	13	13	13	13	13	13	13
Coal import	- EGAT	GWh	-	-	-	-	1,168	6,008	13,715	13,735	13,698	21,443	21,384	21,395	21,394	21,464	21,401	21,401	21,401	21,464	21,401	21,401	21,401	21,464
		%	-	-	-	-	0.5	2.6	5.8	5.7	5.5	8.4	8.2	8.0	7.8	7.7	7.5	7.3	7.2	7.1	6.9	6.8	6.7	6.6
		Million tons	-	-	-	-	0	2	5	5	5	8	8	8	8	8	8	8	8	8	8	8	8	8
	- IPP	GWh	15,816	16,418	15,049	13,548	15,658	18,598	19,140	19,284	19,211	19,371	19,372	19,417	19,423	19,511	19,456	19,458	19,464	9,245	9,172	9,172	9,172	9,199
		%	8.3	8.3	7.3	6.4	7.1	8.1	8.2	8.0	7.8	7.6	7.4	7.3	7.1	7.0	6.8	6.7	6.5	3.0	3.0	2.9	2.9	2.8
		Million tons	6	6	6	5	6	7	7	8	8	8	8	8	8	8	8	8	8	4	4	4	4	4
	- SPP Firm	GWh	2,260	2,675	2,173	2,143	2,143	2,544	2,537	2,537	2,537	1,696	645	519	519	519	519	519	519	519	519	519	519	519
		%	1.2	1.4	1.1	1.0	1.0	1.1	1.1	1.1	1.0	0.7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	- SPP Non-firm	GWh	212	212	212	212	212	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186
		%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	- New capacity	GWh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7,643	15,286	22,929	22,998
		%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.5	4.9	7.2	7.1
		Million tons	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	6	9	9
	Total	GWh	18,287	19,305	17,433	15,903	19,181	27,335	35,579	35,742	35,631	42,696	41,587	41,516	41,522	41,679	41,561	41,563	41,569	31,413	38,920	46,563	54,206	54,365
		%	9.6	9.8	8.5	7.5	8.7	12.0	15.2	14.8	14.4	16.8	15.9	15.5	15.2	14.9	14.6	14.3	13.9	10.3	12.6	14.8	16.9	16.7
		Million tons	6	6	6	5	6	10	13	13	13	16	16	16	16	16	16	16	16	12	15	17	20	20
Renewable	- EGAT	GWh	172	221	228	309	346	767	905	923	978	1,075	1,128	1,168	1,227	1,238	1,333	1,414	1,505	1,542	1,604	1,615	1,659	1,673
		%	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	- SPP Firm	GWh	2,516	2,532	2,512	2,512	2,525	2,315	2,296	2,296	2,296	2,068	1,784	1,543	1,478	1,209	752	752	576	445	409	378	263	263
		%	1.3	1.3	1.2	1.2	1.1	1.0	1.0	1.0	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.3	0.2	0.1	0.1	0.1	0.1	0.1
	- SPP Non-firm	GWh	2,104	2,606	3,108	4,209	4,209	5,945	5,945	5,945	5,945	5,945	5,945	5,945	5,945	5,945	5,945	5,945	5,945	5,945	5,945	5,945	5,945	5,945
		%	1.1	1.3	1.5	2.0	1.9	2.6	2.5	2.5	2.4	2.3	2.3	2.2	2.2	2.1	2.1	2.0	2.0	2.0	1.9	1.9	1.9	1.8
	- VSPP/DEDE/ PE	GWh	7,614	10,697	13,825	18,618	23,041	24,778	26,130	27,494	28,686	30,177	31,846	33,590	35,430	37,415	39,243	40,532	41,979	43,533	45,157	47,005	48,734	50,618
		%	4.0	5.4	6.7	8.8	10.4	10.9	11.1	11.4	11.6	11.9	12.2	12.6	13.0	13.4	13.8	13.9	14.1	14.3	14.6	14.9	15.2	15.5
	Total	GWh	12,405	16,056	19,674	25,648	30,121	33,805	35,276	36,658	37,905	39,266	40,703	42,246	44,080	45,807	47,273	48,643	50,006	51,465	53,115	54,944	56,601	58,499
		%	6.5	8.1	9.6	12.1	13.7	14.8	15.0	15.2	15.3	15.4	15.6	15.8	16.1	16.4	16.6	16.7	16.8	16.9	17.2	17.5	17.7	17.9
Interconnection	- Thailand-Malays	GWh	131	132	131	131	140	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131
		%	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nuclear	- EGAT	GWh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8,024	16,094
		%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.5	4.9
		Tons	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	32
Grand total		GWh	190,285	197,891	205,649	212,515	220,503	228,238	234,654	241,273	247,671	254,334	260,764	267,629	273,440	279,939	285,384	291,519	298,234	303,856	309,021	314,465	320,114	326,119

Appendix 7

Carbon dioxide emission

from power generation

CARBON DIOXIDE EMISSION FROM POWER GENERATION

Year	PDP2010 Revision 3		PDP2015	
	Annually ($kgCO_2/kWh$)	Annually (Thousand tons)	Annually ($kgCO_2/kWh$)	Annually (Thousand tons)
2015	0.448	90,016	0.457	86,998
2016	0.430	90,514	0.428	84,787
2017	0.429	94,183	0.422	86,874
2018	0.413	94,023	0.407	86,555
2019	0.416	98,290	0.377	83,111
2020	0.412	101,424	0.383	87,337
2021	0.407	103,982	0.399	93,689
2022	0.410	108,750	0.393	94,714
2023	0.413	113,321	0.390	96,495
2024	0.406	115,575	0.401	101,907
2025	0.407	119,959	0.377	98,281
2026	0.403	122,885	0.370	98,950
2027	0.391	123,203	0.363	99,128
2028	0.395	128,430	0.354	99,062
2029	0.391	131,185	0.348	99,352
2030	0.385	133,539	0.342	99,822
2031	-	-	0.337	100,521
2032	-	-	0.312	94,657
2033	-	-	0.320	98,811
2034	-	-	0.327	102,975
2035	-	-	0.332	106,315
2036	-	-	0.319	104,075

Remark: The estimation was conducted according to “IPCC Guidelines for National Greenhouse Gas Inventories”