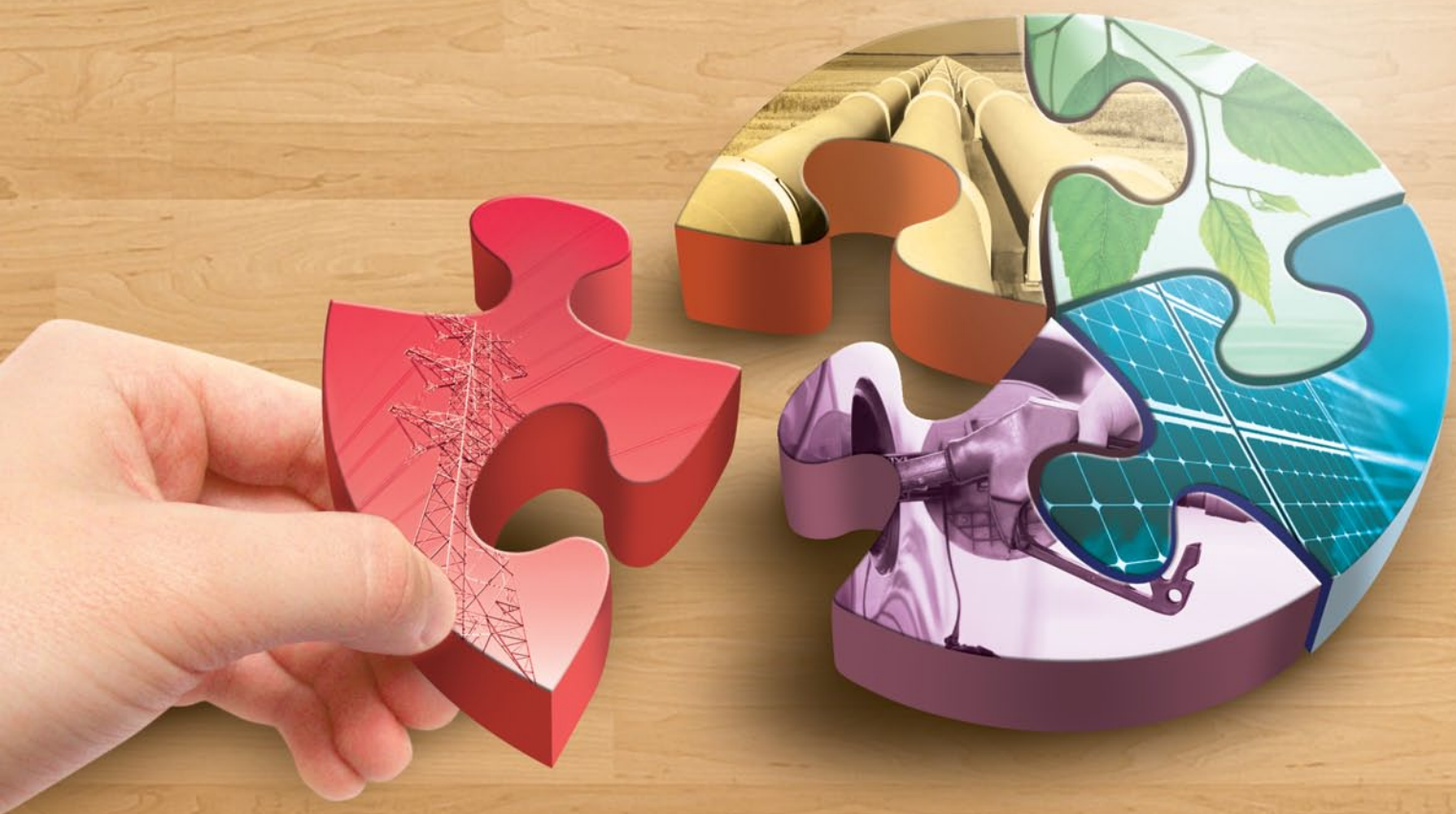
Energy Policy
and Planning Office
MINISTRY OF ENERGY

EPPO JOURNAL

Special Issue 2016

THAILAND INTEGRATED ENERGY BLUEPRINT



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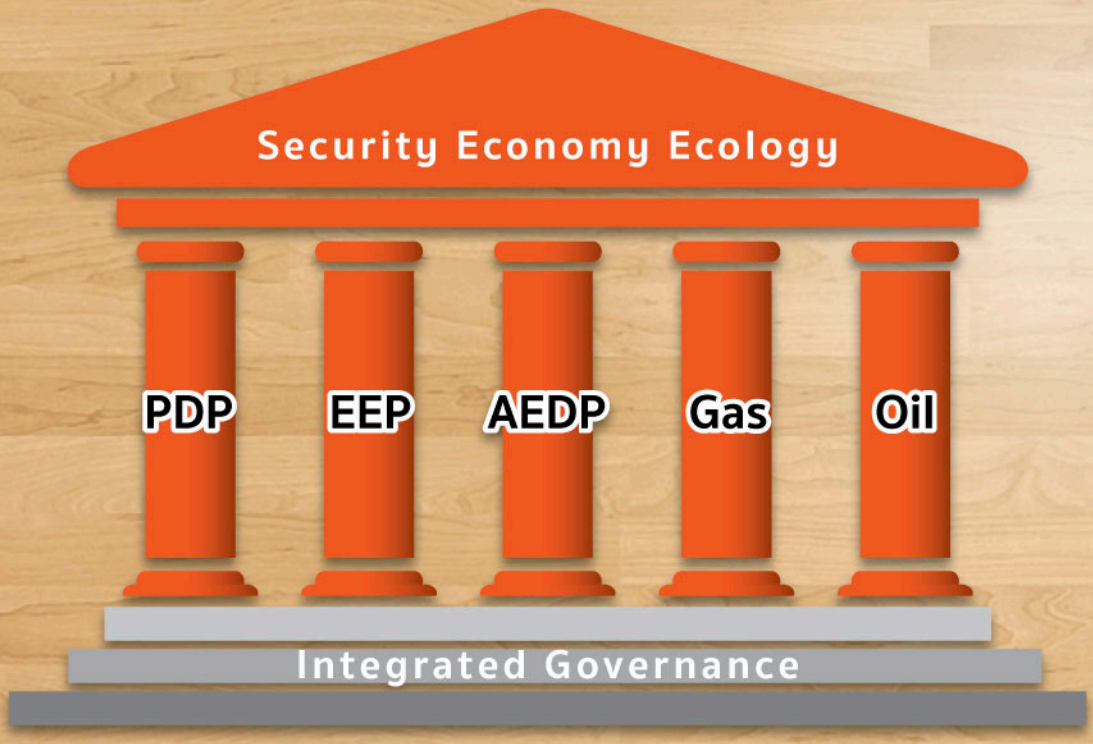

Energy Policy
and Planning Office
MINISTRY OF ENERGY

Greeting

This special edition of Energy Policy Journal is presented by the Energy Policy and Planning Office or EPPO, focusing on Thailand's new five integrated energy plans. These five national energy plans are the framework that the Ministry of Energy has established in pursuance of successfully achieving national energy security according to the government policy and readiness for the ASEAN Economic Community (AEC). Five integrated energy plans are Power Development Plan of Thailand (PDP 2015), Energy Efficiency Plan (EEP 2015), Alternative Energy Development Plan (AEDP 2015), Natural Gas Supply Plan (Gas Plan 2015), and Oil Supply Management Plan (Oil Plan 2015). Details and integration among five plans can be explored in this special edition of the Journal.

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Contents

Ministry of Energy outlines the national energy integrated plans aiming at three crucial aspects: **security, economy and ecology.**

Firstly, security focuses on securing supply of energy, which responds to growing energy demand according to the growths of economy and population as well as urbanization. Appropriate diversification of fuel mix is also highlighted.

Secondly, economy focuses on achieving fair energy prices that supports the development of economics and society in a long term, reforming the fuels price structure to reflect their real cost and achieve an appropriate taxing system, increasing energy efficiency and increasing of the public awareness of the efficient fuel usage.

Thirdly, ecology aims at increasing the portion of energy production from renewable energy sources and the use of high-efficiency technologies to produce energy for pollution reduction purpose.

Ministry of Energy establishes **the integrated national energy plan** under 5 categories including:

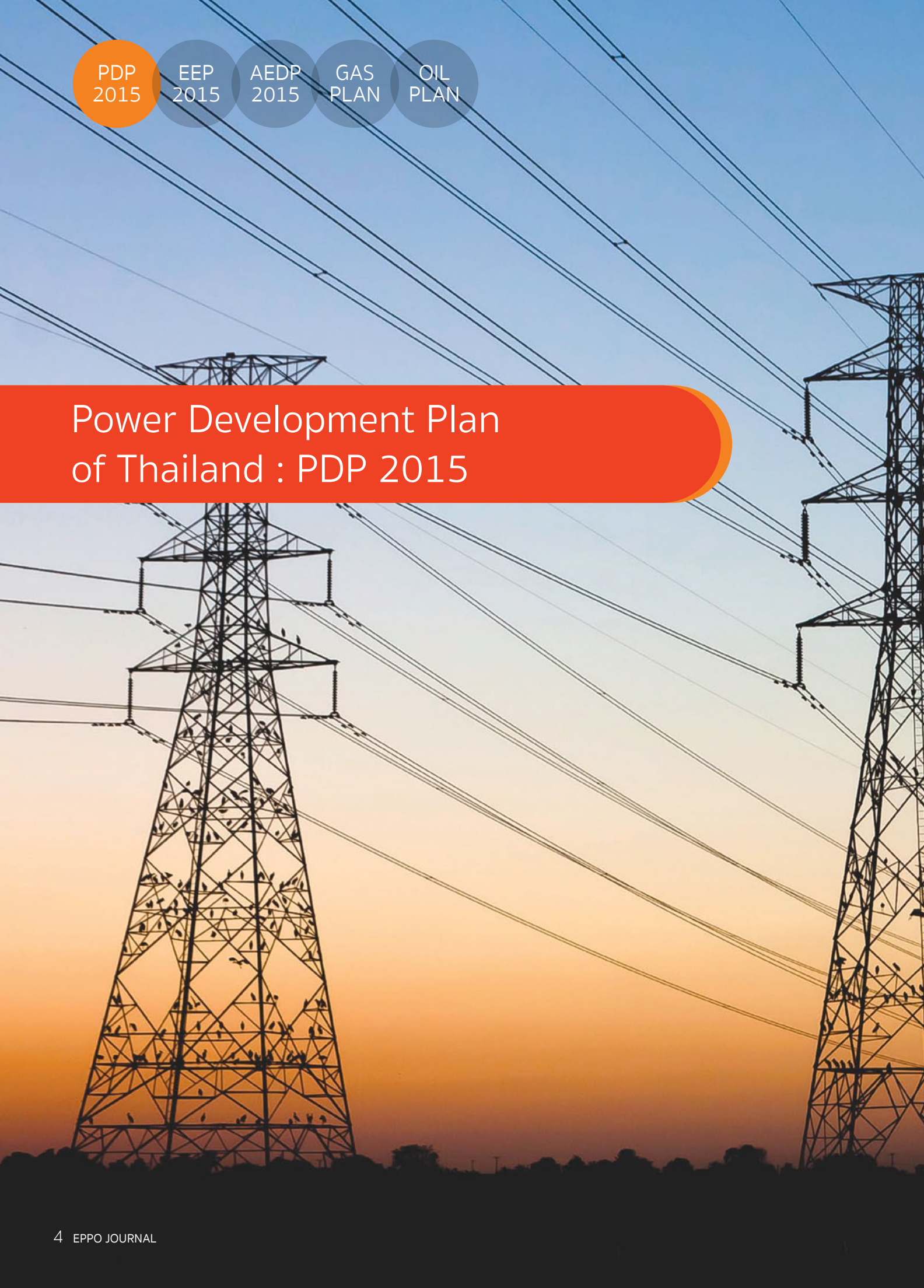
(1) Power Development Plan of Thailand : (PDP)

(2) Energy Efficiency Plan : (EEP)

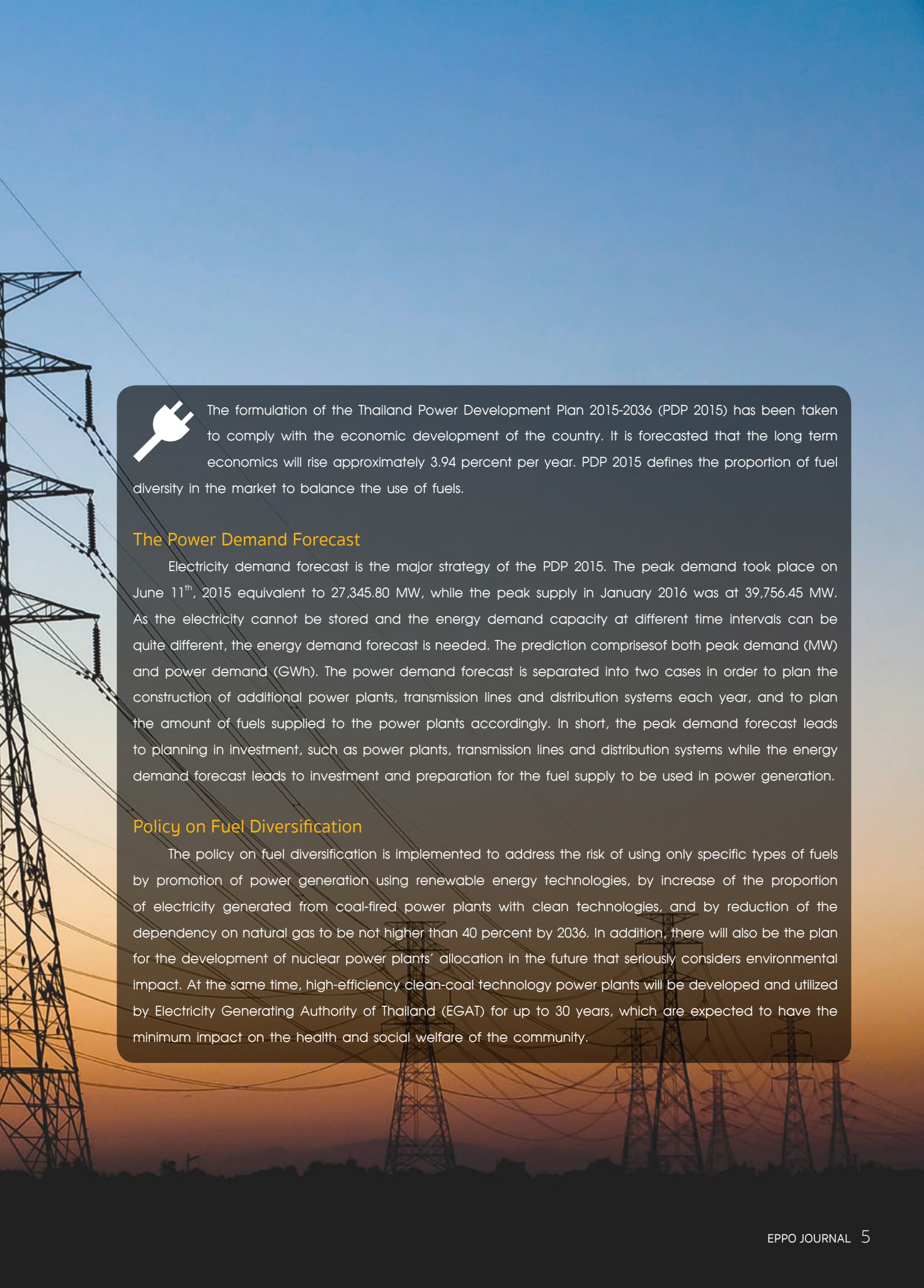
(3) Alternative Energy Development Plan : (AEDP)

(4) Natural Gas Supplying Plan : (Gas Plan)

(5) Oil Management Plan : (Oil Plan)



Power Development Plan of Thailand : PDP 2015



The formulation of the Thailand Power Development Plan 2015-2036 (PDP 2015) has been taken to comply with the economic development of the country. It is forecasted that the long term economics will rise approximately 3.94 percent per year. PDP 2015 defines the proportion of fuel diversity in the market to balance the use of fuels.

The Power Demand Forecast

Electricity demand forecast is the major strategy of the PDP 2015. The peak demand took place on June 11th, 2015 equivalent to 27,345.80 MW, while the peak supply in January 2016 was at 39,756.45 MW. As the electricity cannot be stored and the energy demand capacity at different time intervals can be quite different, the energy demand forecast is needed. The prediction comprisesof both peak demand (MW) and power demand (GWh). The power demand forecast is separated into two cases in order to plan the construction of additional power plants, transmission lines and distribution systems each year, and to plan the amount of fuels supplied to the power plants accordingly. In short, the peak demand forecast leads to planning in investment, such as power plants, transmission lines and distribution systems while the energy demand forecast leads to investment and preparation for the fuel supply to be used in power generation.

Policy on Fuel Diversification

The policy on fuel diversification is implemented to address the risk of using only specific types of fuels by promotion of power generation using renewable energy technologies, by increase of the proportion of electricity generated from coal-fired power plants with clean technologies, and by reduction of the dependency on natural gas to be not higher than 40 percent by 2036. In addition, there will also be the plan for the development of nuclear power plants' allocation in the future that seriously considers environmental impact. At the same time, high-efficiency clean-coal technology power plants will be developed and utilized by Electricity Generating Authority of Thailand (EGAT) for up to 30 years, which are expected to have the minimum impact on the health and social welfare of the community.

Power Development Plan of Thailand : PDP 2015

The power development plan of Thailand, 2015-2036 (PDP 2015) in collaboration with the Ministry of Energy and Electricity Generating Authority of Thailand, is the main power plan for the country. The goal is to enhancing stability of the system, reduce dependence on natural gas, increase the proportion of electricity from clean coal technology, increase the amount of power purchase from neighboring countries and increase the proportion of electricity from renewable energy. Including the development of power transmission and distribution system to support the development of renewable energy and get ready for ASEAN Economic Community (AEC)

The power demand forecasting

In preparing the forecast of electricity demand of the country, Office of the National Economic and Social Development Board (NESDB) has projected the likely long-term economic growth (GDP) in 2015-2036 with an average 3.94 percent per year, account the growth of population to be 0.03 percent per year and have a plan to apply Energy Conservation Plan (EEDP) in to use. The goal is to reduce the use of electricity in 2036 equal to 89,672 million units. As well as considering the development of renewable and alternative energy development plan (AEDP) for the electricity generating sector in 2036 that will generate energy to the system equal to 19,634.4 MW.

The load forecast used to formulate the PDP 2015 as a result of energy conservation plans and plans for the development of renewable and alternative fuels in the years 2015 to 2036 total net electricity demand of the country have average growth rate 2.67 percent per year. In 2036 the total electricity demand forecasting net (energy) and net peak (peak) are approximately 326,119 units and 49,655 MW respectively.

Electricity demand situation of the country

Last year, the peak demand (Peak), net of EGAT occurred on Wednesday, April 23, 2015 at 02:26 P.M. is 26,942.1 MW at 37.5 degrees Celsius, an increase from peak demand. (peak), net of EGAT in 2014 equal to344.0 MW or 1.29 percent, which needs maximum power (peak) net of EGAT in 2014 equal to 26,598.1 MW. Demand for electricity of EGAT in 2557 is equal to 177,580 million units, higher than the demand for electricity, net of EGAT in 2014 is equal to 173,535 million units, an increase of 4,045 units or 2.33 percent increased.

For the forecast demand peak net of the country in 2557 (at the same time with EGAT) is equal to 27,633.5 MW, increase 2.03 percent and the demand for electric power net of 2015, the value of 5338.8 million, an increase of 2014 units or 3.01 per cent.

PDP 2015 plan will focus on stability of the system by cover the whole power generate, transmission and distribution by area. The area that considered high risk to power outage was expanded in to 2 areas.

1. Considering the stability of the power system in the south.

Average electricity demand in the south increases approximately 3 percent per year, so it is necessary to develop more power plants in the last three years, from 2031 to 2036 as follows.

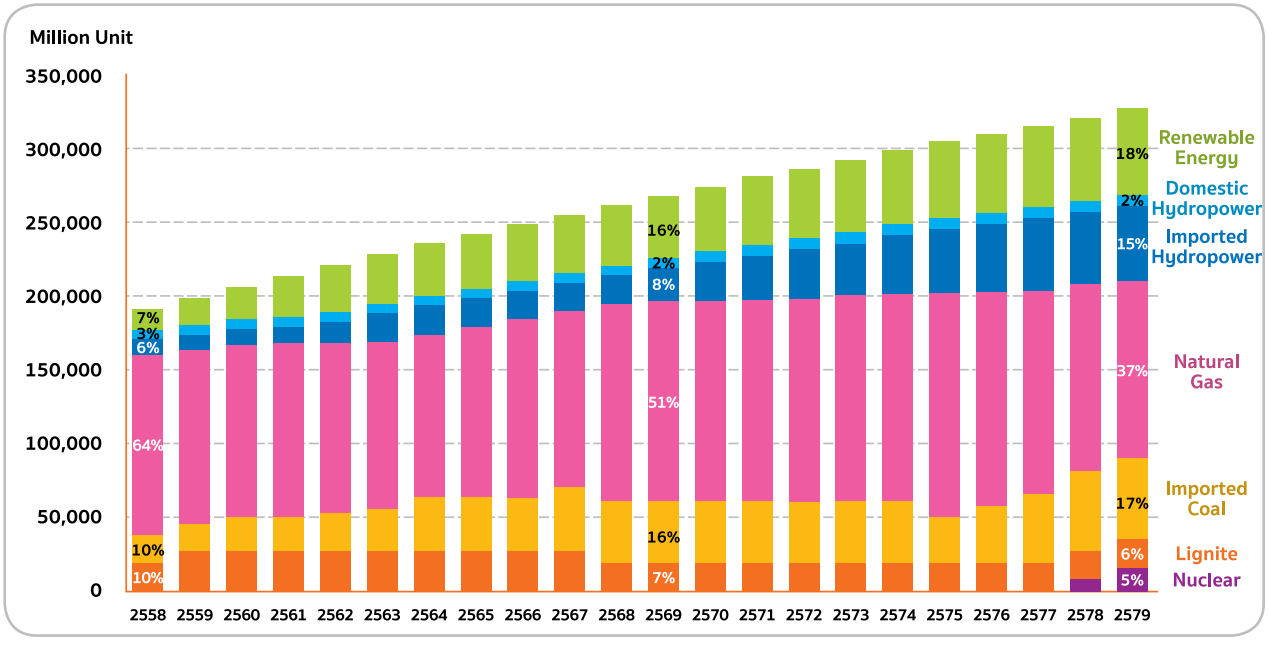
- 2031 Krabi coal-fired power plant capacity net 800 MW
- • 2033 Thepa coal-fired power plant 1st generator capacity net 1,000 MW
- • 2036 coal power plant 2nd generator capacity net 1,000 MW

2. Considering the stability of the power system and central Bangkok and central area.

Due to the use of electricity in Bangkok, high amount of power demand accounted around 30 percent, the power in the area need to rely on more power from the other area. This will cause lower power stability combine with expire power plant in the area and the importance of being the main business area, these are the reason that the area need more power plant to match the demand of the system and increase the power stability to reach the standard in 2031-2037.

- 2031 replacement Units for Southern Bangkok power plant generator 1-5 capacity net 1,300 MW and Replacement units for Bangpakong power plant generator 1-2 capacity net 1,300 MW
- 2033 replacement Units for Southern Bangkok power plant generator 1-5 capacity net 1,300 MW
- 2034 replacement Units for Wangnoi power plant generator 1-2 capacity net 1,300 MW
- 2036 replacement Units for Wangnoi power plant generator 3 capacity net 1,300 MW

The proportion of fuels used for power generation in PDP 2015



The consumption of coal at present is 10-15 percent while in the new PDP will be increased to 17 percent. Renewable energy is currently used at 8 percent and will be increased to 15-20 percent. Due to high cost and lack of stability of renewable energy, increasing the proportion of renewable energy excessively will cause problems to arise. A decent power development plan should therefore based primarily on primary energy production before adding renewable energy into the system. Purchasing electricity from neighboring countries will be increased from 7 percent to 15-20 percent via negotiations with Myanmar and Cambodia while the proportion of natural gas will gradually decline to 37 percent in the future.

Thailand's power development plan (PDP 2015)

The guidelines for the formulation of PDP 2015 described above can be concluded that the importance of the power development plan of years 2015-2036 (PDP 2015) can be briefly summarized as follows: at the end of year 2036, the net power generation capacity will be 70,335 MW, consisting of current power generation at the end of 2015, 37,612 MW, and power generation capacity of new power plants of 57,459 MW. The expired power plant generation has been suspended in years 2015 to 2036 by 24,736 MW.

Electric power generation in the years 2015-2036

- Power capacity in December 2014	37,612	MW
- New power capacity in 2015-2036	57,459	MW
- Removed power capacity in 2015-2036	-24,736	MW
- Total power capacity in 2036	70,335	MW

New power generation capacity 2015-2036

New power generation capacity in 2015-2036 is equal to 57,459 MW. The power plants are categorized as follows:

Renewable energy power plant	**21,648**	**MW**
- Domestic	12,105	MW
- Imported	9,543	MW
Pumped storage hydro power plant	**2,101**	**MW**
Co-generation 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
- Imported	1,473	MW
Total	**57,459**	**MW**

New power generation capacity in 2015-2026

Power plant projects as planned in this period (first 10 years) are mostly the committed projects that are supported to promote stability of the power system, especially in high-risk and crucial areas. The new total power generation capacity is 36,804 MW, and the details are shown below:

Renewable energy power plant	**10,644**	**MW**
- Domestic	8,101	MW
- Imported	2,543	MW
Pumped storage hydro power plant	**1,300**	**MW**
Co-generation power plant	**4,119**	**MW**
Combine cycle power plant	**14,878**	**MW**
Thermal power plant	**5,863**	**MW**
- Coal/Lignite power plant	4,390	MW
- Imported	1,473	MW
Total	**36,804**	**MW**

New power generation capacity in 2027-2036

Power plant projects as planned in this period (last 10 years) are the power plant projects in the country along with the power purchase from neighboring countries to meet the energy demand and to replace the expired power plants. The new power generation capacity will be raised to 20,655 MW and the details are shown below:

Renewable energy power plant	**11,004**	**MW**
- Domestic	4,004	MW
- Imported	7,000	MW
Pumped Hydro storage power plant	**801**	**MW**
Combine cycle power plant (2x1,300)	**2,600**	**MW**
Thermal power plant	**6,250**	**MW**
- Coal 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**

Power generation capacity from renewable energy in Thailand

Since the government policy aims at incorporating renewable and alternative energy in 2015-2036 (AEDP) to substitute the use of fossil fuels by 30 percent by year 2036, in the power generation sector, Power Development Plan of Thailand combines renewable energy power plants for 19,634.4 MW totally. This is only the installed capacity. When referring the power generation contracts, the contracted power generation capacity will be 17,678.9 MW, comprising contractual agreements in the current power system at the end of 2557 of 5,872.1 MW, deducted expiring contract of 298.1 MW, new power generation capacity of 12,104.9 MW. The new power generation capacity from renewable energy in years 2015-2026 is 8,101.2 MW, and years 2027-2036 is 4,003.7 MW. The details are as follows:

Power generation capacity from renewable energy in 2015-2036

New renewable energy projects inyears 2015-2026		
- Solar energy	3,292.5	MW
- Wind energy	1,643.7	MW
- Hydro energy	191.0	MW
- Biomass	2,122.6	MW
- Bio-gas	199.1	MW
- Municipal Solid Waste	373.2	MW
- Energy crop	279.1	MW
Total	**8,101.2**	**MW**

New renewable energy projects in years 2027-2036		
- Solar energy	1,077.6	MW
- Wind energy	910.2	MW
- Hydro energy	86.9	MW
- Biomass	1,363.9	MW
- Bio-gas	108.2	MW
- Municipal Solid Waste	56.0	MW
- Energy crops	400.9	MW
Total	**4,003.7**	**MW**

The role of private sector in power generation

PDP 2015 contains new power plants that purchase from major independent power producer (IPP) and small power producer including committed power purchase from neighboring countries with commitment using signed contract with EGAT in 2015-2023. The details are described as follows:

Independent Power Producer (IPP): In 2015-2022, there are 7 projects already signed Power Purchase Agreement (PPA) with EGAT. These projects are accounted for 8,070 MW as listed below:

Independent Power Producer (IPP) 2015-2022

Project	Capacity in contract (MW)	Operating date (Year)
Gulf JPUT Ltd. Co. Set 1 and Set 2	1,600	2015
Kanorm replacement power plant Set 1	930	2016
National power supply Ltd. Co. Generator 1-4	540	2016-2017
Gulf SRC Ltd. Co. Set 1	1,250	2021
Gulf SRC Ltd. Co. Set 2	1,250	2022
Gulf PD Ltd. Co. Set 1	1,250	2023
Gulf PD Ltd. Co. Set 2	1,250	2024
Total	**8,070**	

Small Power Producer (SPP): In 2015-2023, there will be power purchase from SPP for 97 projects in total. Total capacity is 5,922 MW which are divided into: (1) 41 Cogeneration projects with total capacity of 3,660 MW, (2) 25 contract renew Cogeneration projects with total capacity of 424 MW, and (3) 31 renewable energy projects with total capacity of 1,838 MW.

Very Small Power Producer (VSPP): In 2015-2036, there will be power purchase from VSPP (following AEDP) with total capacity of 9,735.6 MW which are divided into: (1) 31 renewable energy projects, with total capacity of 9,701 MW, and (2) Cogeneration, with total capacity of 34.6 MW.

Power purchase from neighboring countries: In 2015-2019, there will be contract in electricity purchase (PPA) with EGAT. 4 Project in total, Capacity total 3,316 MW included these following project.

Power purchase from neighboring countries in 2015-2019

Project	Capacity in contract (MW)	Operating date (year)
Hong-sa Lignite power plant generator 1-3	3x491	2015-2016
Saiyaburi Hydro power plant	1,220	2019
Sepien-Senamnoi Hydro power plant	354	2019
Namngeab Hydro power plant 1	269	2019
Total	**3,316**	

Transmission System Development Plan

Power reliability and quality

Consideration of the stability and quality of electrical power are the important issues that EGAT, PEA, and MEA concern the most. In order to reach the global standard, this strategy focuses on technical aspect including reliability and quality of electricity. To develop smart grid network system, power systems will be able to produces energy sufficiently and continuously without voltage and electric-current quality problems, which can lead to damage the equipment in the electrical system.

Energy sustainability and efficiency

Consideration of energy sustainability and efficiency is the point where many countries give a lot of concern to. Due to the need in finding new alternative energy sources to produce energy instead of using limited fossil fuels, and the need for efficient management in power utilization to reduce demand on fuels and greenhouse gas emission to environment, smart grid network system is developed. The smart grid system will help reduce cost, scarce of fuel resources, and environmental impact. However, the smart grid network will have to be able to accept high power generation capacity from renewable energy into the network.

Utility operation and service

Consideration of the utility operation and service needs to be evaluated in parallel with the development of new technologies or innovation of smart grid network system because smart grid development can convey significantly meanings that the operation of the power system and power commercialization must be significantly developed. To measure these qualifications, the index to guarantee this qualification is necessary. Smart grid network development will help the operation of service providers in both techniques and services with higher efficiency and more. This will result in better services to customers.

Integration and interoperability

The Integration and Interoperability of new innovative devices to be applied with smart grid network system must be carefully considered. These devices need to transfer data to each other all the time. Integration of all devices in the system to support the same controlling standards, the systematic design of the smart grid is essential. Moreover, there are other factors to concern, such as, facilitating the integration of renewable energy sources into the system within short period of time. The development of smart grid system interoperability need ICT technologies to support and this will also foster new form of services to consumer.

Economic and industrial competitiveness

Consideration ofthe potential in economic and industrial competitiveness is needed as the development of smart grid network system will cause direct impact to the economic and industrial sectors in term of increasing investment, higher employment rate, and investment in industrial sector for new innovations, such as smart appliances and electric vehicle (EV). Nevertheless, the development of the smart grid network system with the dependence on imported foreign technology alone will not be sustainable and adversely affect the economy of the country. Therefore, to develop the smart grid network system which is a new technology for Thailand will strengthen the domestic capacity building workforce to keep up with other countries in terms of technology development. As a result, investment in capacity building and domestic industrial promotion via smart grid development will have a part in activating the growth of economic and industrial sectors of Thailand, synchronously.

Project lists/transmission system plans in 2015-2036
PDP 2015

Project	Finish Year
Projects/Plans that EGAT are approved and under construction	
1. Transmission System Expansion Project in Bangkok and Central (Suburb) area Phase 3.	2016-2018
2. Transmission System Expansion Project Phase 12.	2016-2020
3. Transmission System Improvement Project in Eastern Region. To enhance system stability.	2017 / 2019
4. Improvement of power transmission system Project in Western and South. To enhance system stability.	2019 / 2022
5. Improvement and expansion of the aging power grid applications Project Phase 1: The high-voltage station.	2017
6. Improvement and expansion of the aging power grid applications Project Phase 1: The high-voltage transmission line.	2019
7. Improvement and expansion of the aging power grid applications Project Phase 2.	2020
8. Power grid to purchase electricity Project from Hongsa lignite thermal power plants.	2015
9. Power grid to purchase electricity Project from major private company producers, (IPP 2007).	2013-2020
10. Expansion of the power transmission system for power plants, independent power producers, small Cogeneration System, following the regulations of year 2010.	2017
11. Power grid for purchase electricity from hydropower plants Nam Ngum 3 and Nam Theun 1.	2017
12. Transmission System Development Project in Ubon Ratchathani, Yasothon and Amnat Charoen to purchase electricity from the Project in the Lao.	2018
13. Transmission System Development Project in Loei, Nong Bua Lamphu, Khon Kaen and to purchase electricity from the Project in the Lao.	2018

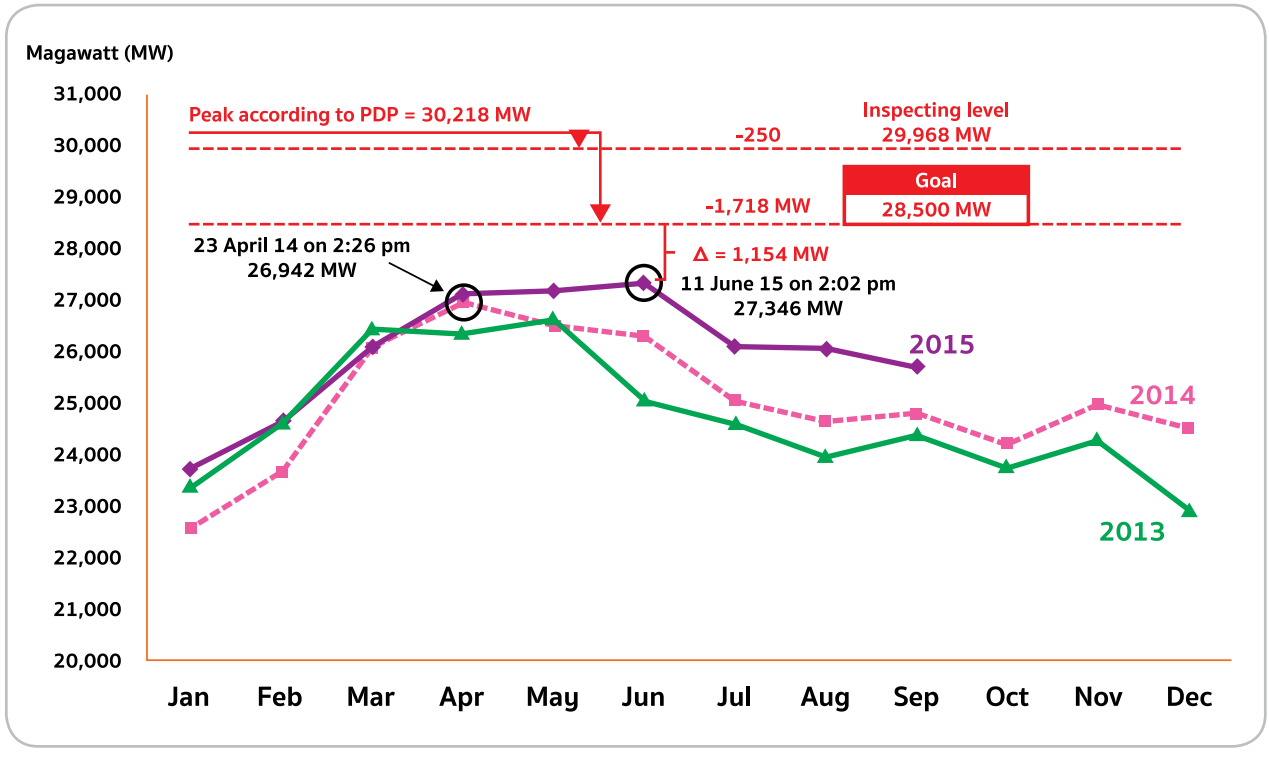
Project	Finish Year
Projects that EGAThas currently studied and awaited for approval	
1. Improvement of power transmission system in the Northeast. Lower Northern, central region, and Bangkok, to enhance system stability.	2019 / 2021 / 2023
2. Improvement of power transmission system in the Upper North, to enhance system stability.	2019 / 2021
3. Extension of transmission system in Bangkok and Metropolitan Areas Phase 4.	2019-2025
4. Extension of transmission system in Bangkok and Metropolitan Areas Phase 5	2026-2032
5. Extension of transmission system in Bangkok and Metropolitan Areas Phase 6.	2033-2039
6. Extension of transmission system phase 13.	2019-2018
7. Extension of transmission system phase 14.	2026-2032
8. Extension of transmission system phase 15.	2033-2039
9. Development of transmission system to accommodate the special economic zone.	2020-2036
10. Improvement of power transmission system in the South, to enhance system stability.	2020 / 2023
11. Project development of submarine cable systems to the area of Koh Samui, Thailand for more stability.	2021
12. Improvement of power transmission system in the Upper North, to enhance security, power systems, Phase 2.	2024-2029
13. Improvement and expansion of the aging power grid deployment phase 3.	2017-2021
14. Improvement and expansion of the aging power grid deployment phase 4.	2022-2026
15. Transmission system to purchase electricity from power producers IPP Phase 3 (IPP 2012).	2021-2026
16. Transmission system to connect new power plants in the country.	2018-2036
17. Transmission system to purchase electricity from power plants in neighboring countries.	2025-2036
18. Links between transmission systems to systems in the country.	2019-2036
19. Development of the electrical smart grid network system.	2015-2036

Important projects in 2016

1. Demand reduction

1.1 Demand response and campaign in reducing the use of energy in summer

Reduce peak load in 2016 to be 28,500 MW.



1.2 Reducing power consumption measure in government sector

To stimulate 8,297 units of governmental sector to decrease power consumption by 10 percent compared to Energy Utilization Index (EUI).

Information on 13th Nov 15 (closing on 30th Nov 15)

Region	Province	Organization	Report Completed (Organization)	Electricity (15) (kWh)	Over than EUI (Organization)	Oil (15) (Liter)	Over than EUI (Organization)
BKK		475	275	763,463,053	62	20,697,985	19
1 North	9	882	625	52,843,307	59	7,654,581	41
2 Central	21	1,761	1,411	136,867,890	152	9,811,736	113
3 Northeast	20	2,561	1,796	149,682,515	156	39,984,251	117
4 East	7	584	414	36,370,645	66	3,267,761	33
5 West	5	500	432	41,528,909	35	3,599,002	26
6 South	14	1,534	1,251	106,498,336	154	10,092,116	119
Total	76	8,297	6,204	1,287,254,654	684	95,107,432	468

1.3 Reducing power consumption measure in public sector

To create the campaign in increasing energy awareness and adopting measures that has a clear result, such as, Changing to use higher energy saving device campaign, Number 5 energy saving label, LED promotion, etc. as well as other measures in every sector of society. The estimation in 20 year time is to save energy by 89,000 units in total.

"หารสอง เปลี่ยนใหม่ประหยัดชัวร์" campaign in 2016

2. Supply management

2.1 Tracking power plants according to PDP 2015

The goal to provide electricity into the system can be identified as:

New power plant projects of EGAT to supply a total power of 870.3 MW in system which consists of North Bangkok power plant unit 2 for 848.3 MW, Bang Lang Dam power plant for 12 MW, photovoltaic Sirindhorn Dam power plant for 0.3 MW and photovoltaic EGAT power plant for 10 MW.

Power purchase from neighboring countries, Hongsa power plant 3, plant 3, for 491 MW.

Project from private power producers which will feed power of 2,440 MW into the system, consisting of:

- Power Purchase from major private power producers (IPP) such as the 1st batch of renewable power plants for 930 MW, NPS power plant in Khanom power plant, plants 1-2, for 270 MW.

- Power Purchase from small private power producers (SPP) of 1,240 MW such as Firm (Cogen) for 810 MW and Non-firm (RE + Cogen) for 430 MW.

Tracking on feeding electricity in the system such as solar in pipe and projects under the Adder in 2015 (as of 30-Sep-2015) of 4,476 MW. These projects consist of solar in pipe of 968 MW, solar rooftop of 63 MW, adder (excluding solar) of 389 MW, and adder solar of

106 MW. In year 2016, The goals of Adder and FiT solar are 619.4 MW and 600 MW, respectively.

Tracking on power purchasing plans from renewable energy in the form FiT, such as FiT from 3 high-risk provinces (COD 2017) of 46 MW, FiT Solar governor (COD 2016) of 600 MW, FiT Bidding (biomass, biogas, etc.) (COD 2017) of 500 MW FiT waste (COD 2017) of 104 MW, and FiT industrial waste (COD 2019) of 50 MW.

2.2 Tracking on transmission system development project

Tracking on the development of the transmission system to accommodate the increasing demand for electricity, to enhance the stability of the power system, and to support connection of power plants from neighboring countries planned in PDP 2015.

2.3 Communication plan for PDP 2015 formulation

To promote events for information, knowledge and understanding of the PDP 2015 and various power plant technologies, especially clean coal power plant.

2.4 Research on policy study

2.4.1 The preparation of the rate to purchase power from SPP GiT-RE

Feed-in-tariff determination for SPP to propose NEPC for consideration and approval as there is no FiT for SPP-RE currently.

2.4.2 Study plans for electricity in the special economic zone

Planning of the power system in the special economic zone to propose to Committee on Energy Policy Administration in January 2016, and studying of tariff in the special economic zone and AEC to be completed for presentation to KBG in August 2016.

The special economic zone consists of 1) Mae-Sot District, Tak 2) Muang District, Mukdahan 3) Muang District, Nong-Khai 4) Aranyaprathet District, Sa-kaew 5) Klong-yai District, Trat. 6) Sadao District, Songkhla.

2.4.3 Research on smart grid

KBG has approved the master plan to drive the development of integrated smart grid network system of Thailand in the short term.(2017-2021) within July 2016.

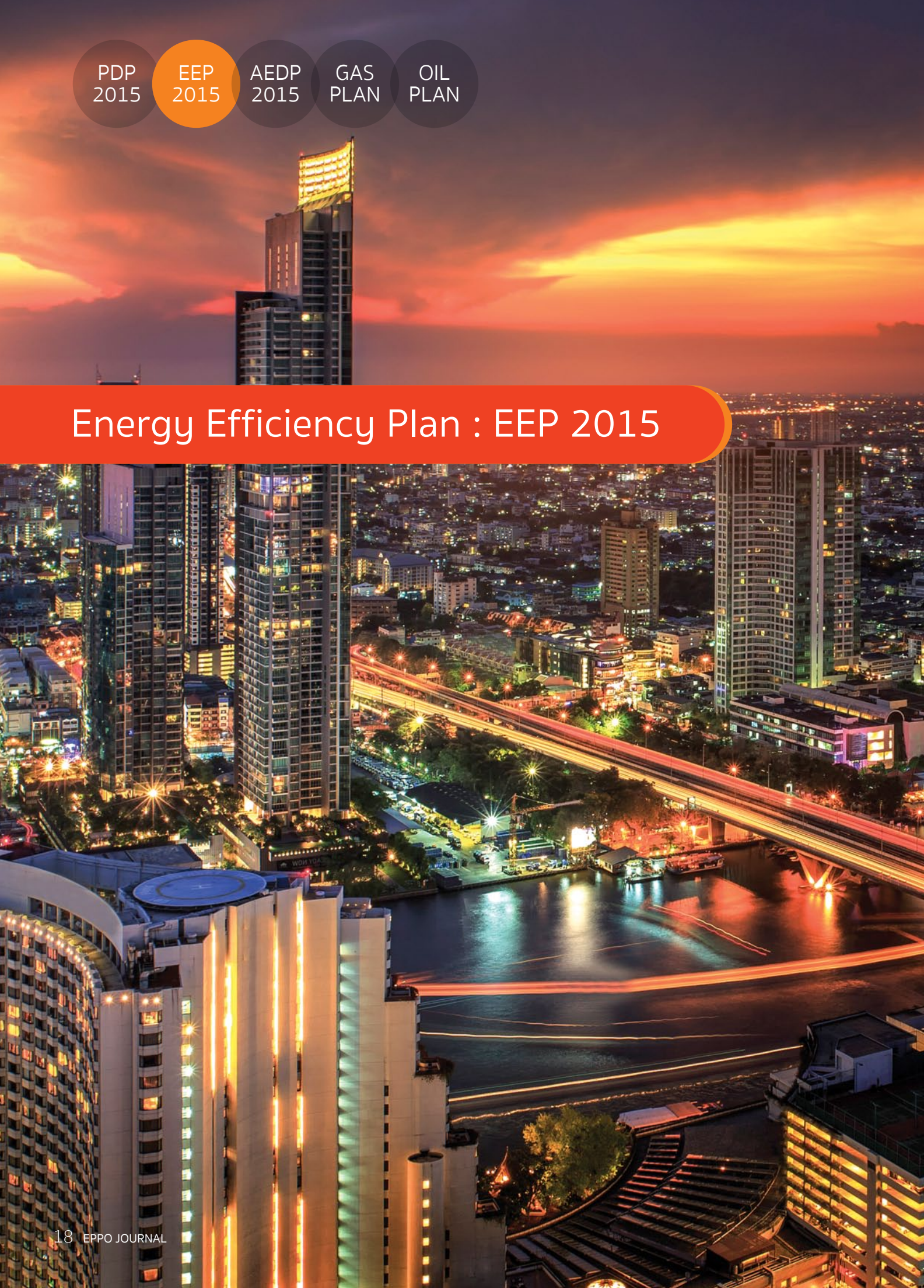
2.4.4 Promoting the use of electric vehicles (EVs)

Guidelines for study the use of EVs in Thailand

- To determine the number of goals
- To establish a policy to promote, such as tax and privileges for users
- Pilot projects for EV utilizations
- To structure charging standard
- To structure the electricity tariff and service charges
- Model on allowing service station
- To promote relevant research etc.

PDP 2015 | EEP 2015 | AEDP 2015 | GAS PLAN | OIL PLAN

Energy Efficiency Plan : EEP 2015



Energy Efficiency Plan in the past has used strategies and regulations for promotions in various aspects to help in technical support and education to raise awareness of the public about energy conservation. Overall, this plan focuses on incorporating the use of enforcement of regulations and measures, as well as promotion and support to selected governmental organization, public and private sectors who have availability in resources and expertise, such as Electricity Generating Authority and industry associations. In addition, applying measures that would have wider effects to raise awareness and to change the behavior of energy consumers, behavior of entrepreneurs and the direction of the market (Market Transformation), by creating an innovative campaign on publicity, such as, linking energy conservation with environmental protection and global warming reduction, is included. Collaborating with private company a key partnership (Public-Private Partnership) in promoting energy conservation and using professional energy management company (ESCO) are the key mechanisms to provide sound advices and to implement energy conservation measures that require more advanced techniques. Moreover, increasing self-reliance on technology will reduce cost on technological investment, achieve higher accessibility to higher energy efficient technologies, and strengthen businesses with high energy efficiency products.

Highlights of the Energy Efficiency Plan

Energy conservation in this plan has two focuses, namely (1) reduction of wasteful use of energy and (2) increasing of energy efficiency, which provides the same output with less energy consumption. The goal is to reduce energy intensity by 30 percent in 2036 compared to 2010. In all economic aspects, the sectors that need to reduce energy consumption mostly are transportation sector (30,213 ktoe in 2036) and industry sector (14,516 ktoe in 2036). Another highlight of the plan is theaverage energy saving of 25,392 ktoe per year, which is equivalent to 330,100 million baht per year and the CO_2 emission reduction of 177 million tons in 2036. The plan also includes additional measures, such as the measure to change market direction (Market Transformation) and behavior of energy consumers by regulating the manufacturers to declare label showing their energy efficiency performance on their building, appliances and vehicles. This enforcement aims at providing consumers choices of energy efficient commodities. Additionally, there is also the measure to promote the use of high energy-efficient vehicles.

Energy Efficiency Plan : EEP 2015

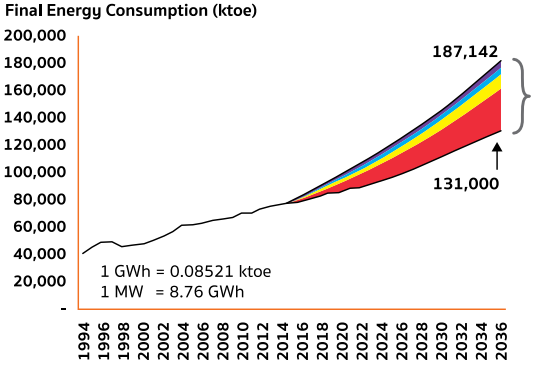
For short and medium terms, the world oil prices are predicted to decrease below 50 USD per barrel. The Ministry of Energy realizes that this is a good opportunity to raise the intensification for driving the energy efficiency plan by updating the previous plan (2011-2030). The assumptions used in the preparation of EEP are integrated with the other four major energy plans of Ministry of Energy, namely power development plan of Thailand, alternative energy development plan, Thailand's natural gas supply plan and oil management plan. The assumptions used to forecast energy demand in the future include.

- Growth rate of gross domestic product (GDP)
- Population growth rate
- The model developed using statistic data dating back in 1994-2013

Target and perspective of energy consumption decrease

Reduce Energy Intensity to 30%
2015-2036 (based year 2010)

Decrease Energy Consumption at 2036 by 56,142 ktoe



Seven Main Measures (EE1-EE7)

		ktoe
EE1	Enforcement of Energy Conservation Standard in Designated Factory/Building	5,156
EE2	Building Energy Code (BEC) for the New Buildings	1,166
EE3	Standard and Labelling of Device, Machine and Material for Energy Conservation	4,149
EE4	Energy Efficiency Resource Standard (EERS) for Large Energy Producers and Distributors	500
EE5	Financial Support for Energy Performance chievement	9,524
EE6	Promoting Greater Use of LED	991
EE7	Energy Conservation in Transportation Sector	30,213
	Total EE1-EE7	51,700

During 2015-2036, the aim to reduce energy intensity is 30 percent. This will result in reducing energy consumption in 2036 for 56,142 ktoe or more. The main measures applied in the plan are; for example, standards for energy conservation in factories and buildings, building standards for new construction for energy conservation, standards and labeling of machinery and materials equipment used for energy conservation, mandatory standards of energy conservation for manufacturers and distributors, assistance and subsidies for operations relating to energy conservation, using energy-saving lighting system, and energy conservation in transportation.

Strategy to push energy efficiency plan forward

The Ministry of Energy has reviewed the energy efficiency plan of years 2011-2030 by organizing four seminars across the country, and then incorporating the information and comments obtained from the seminars to improve the plan for years 2015-2036. The revision continues to use the combination of enforcement (Push) through regulatory measures under Energy Conservation Act, 1992 and 2007 and motivation (Pull) through financial measures using energy conservation (ENCON) fund to help promote energy conservation. Apart from the governmental policy to abandon/review subsidizing energy prices to raise public awareness among energy consumers that the price is based on market mechanisms, the Ministry of Energy has also focused on four business groups, namely industrial sector, business and governmental building sector, residential sector and transportation sector. EEP 2015 has categorized into 3 strategies and 10 measures in order to drive strategic plans into action.

Three strategies in energy efficiency plan

1. Compulsory Program

1.1 Measure to enforce 2007 Energy Conservation Act for buildings/factories that install larger than 1,000 kW or 1,175 kVA transformer, use electricity from steam generator or other sources at higher than 20 million mega joules, which applies to a total of 7,870 buildings and 11,335 factories. A measure to charge additional fees energy (surcharge) for electricity may be applied. Overall target to reduce energy consumption is 28 percent from 1,674 ktoe of electricity and 3,482 ktoe of heat.

1.2 Measure to standardize the use of energy in new buildings (Building Code) for 4,130 buildings, via collaboration with the Ministry of Industry and the Ministry of Interior to reduce energy demand by 36 percent of energy demand in new buildings (equivalent to 1,166 ktoe electricity). In addition, promotion of high standard measure to help the new buildings to reach the international standard, such as LEED standard or TREES standard of Green Building Institute of Thailand is applied.

1.3 Measure to mandate energy efficiency labeling on 22 electrical appliances and 8 heating equipment to reduce energy demand by 6-35 percent from 2,025 ktoe of electricity and 2,125 ktoe of heat.

1.4 Measure to require the manufacturer or provider of electricity to help consumer toward Energy Efficiency Resource Standard (EERS). This can reduce energy demand by 0.3 percent without reducing productivity, which is accounted for 500 ktoe of electricity.

2. Voluntary Program

2.1 Measure on financial assistance or subsidiaries to accelerate a decision to change the device and to manage energy usage efficiently. This will reduce energy for 10-30 percent from 1,285 ktoe of electricity and 8,234 ktoe of heat. The mechanisms to provide support are:

- Through organizations, both public and private businesses, who develop a comprehensive energy conservation program (Turnkey) to help bear the risk (Risk Retention) on investment and act on behalf of the owner, also known as Energy Service Company (ESCO).
- Through reduced interest rate, such as low-interest rate loan (Soft Loan), Revolving funds, Joint Venture and grant, etc.

2.2 Measure on promotion of the use of saving-energy by replacing incandescent lighting (2 million units in governmental buildings and 3 million units in public paths) with Light Emitting Diode (LED). This can reduce energy demand by 50 percent, or 928 ktoe of electricity, and also promote the LED market by making it cheaper and widely available to the public.

2.3 Energy conservation measures in the transportation sector

- Regulate the price of fuel in the transportation sector to reflect the actual costs in order to address consumer awareness on energy prices and the changing energy consumption behavior. This can reduce power consumption by 456 ktoe in total.
- Support the policy of the Ministry of Finance to restructure vehicle excise tax to depend upon the amount of carbon dioxide emissions. This will reduce energy demand by 27 percent, or 13,731 ktoe.
- Optimize the logistic of oil by developing oil transportation via pipeline. This will reduce fuel consumption by about 40 million liters per year, or about 34 ktoe.
- Support policies and programs from the Ministry of Transport in the development of infrastructure, traffic and transportation. In particular, the transformation from wheel to rail transportation will reduce energy consumption by 78 percent, or 9,745 ktoe.

- Study, plan and initiate the plan to support the use of electric vehicles to reduce energy demand by 1,123 ktoe.
- Ministry of energy will assist commercialized transportation operators as follows:
  - In engineering aspect, to reduce transportation costs, via equipment replacement, car improvement, tire selection, backhauling management, etc. This will reduce energy demand by 10-12 percent, or 3,633 ktoe.
  - In personnel development aspect, via the development of energy-saving driving (ECO Driving), which will reduce energy demand by 25 percent, or1,491 ktoe.

2.4 Measure to promote education, research, development of energy conservation technology, environmental protection and problem-solving affected by conservation of energy, and appropriate energy policy and planning.

3. Complementary Program

3.1 Measure to support development in personnel and to increase manpower.

3.2 Measure to support the campaign to raise awareness in energy value and to change behavior in energy consumption.

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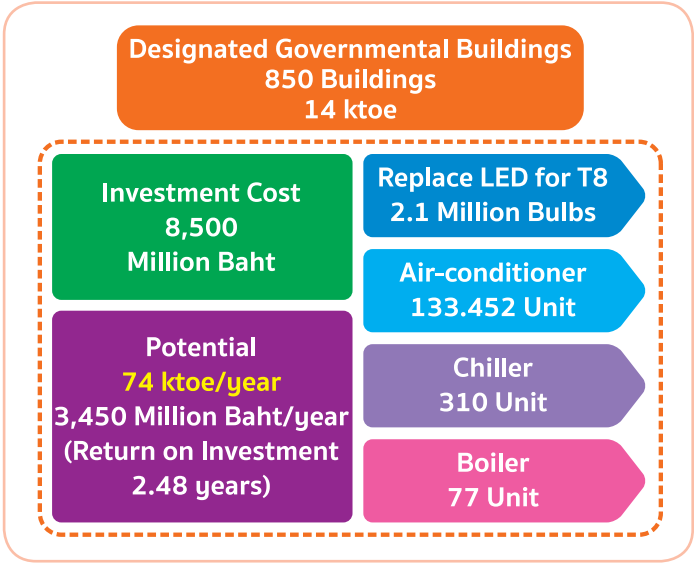
10 measures of energy efficiency plan

1. Measure for designated factories and buildings management

At present, there are 5,285 designated factories and 3,008 designated buildings that consume energy for 21,430 ktoe and 1,144 ktoe, respectively. From 2036 forecast, the number of designated factories and buildings will increase to 11,300 and 6,100 units, which will increase energy consumption to 41,600 ktoe and 3,500 ktoe, respectively. Regulatory approaches for energy management, according to the standards, are intensively set and tracked in a systematic way. This will encourage the buildings and factories to raise production in a energy efficiency manner.



Action plan

- ✓ Regulate designated factories and building in energy management system to be complied with standards.
- ✓ Develop system to operate with energy auditors.
- ✓ Register and train responsible energy personnel.
- ✓ Develop the mechanism for monitoring and modify regulations and laws.
- ✓ Develop a tracking system and database as well as energy efficiency indicators.
- ✓ Prepare system to allow special fee to be levied from the controlled factory and building that cannot reduced energy target set by themselves.
- ✓ Expect potential investment from controlled factories and buildings

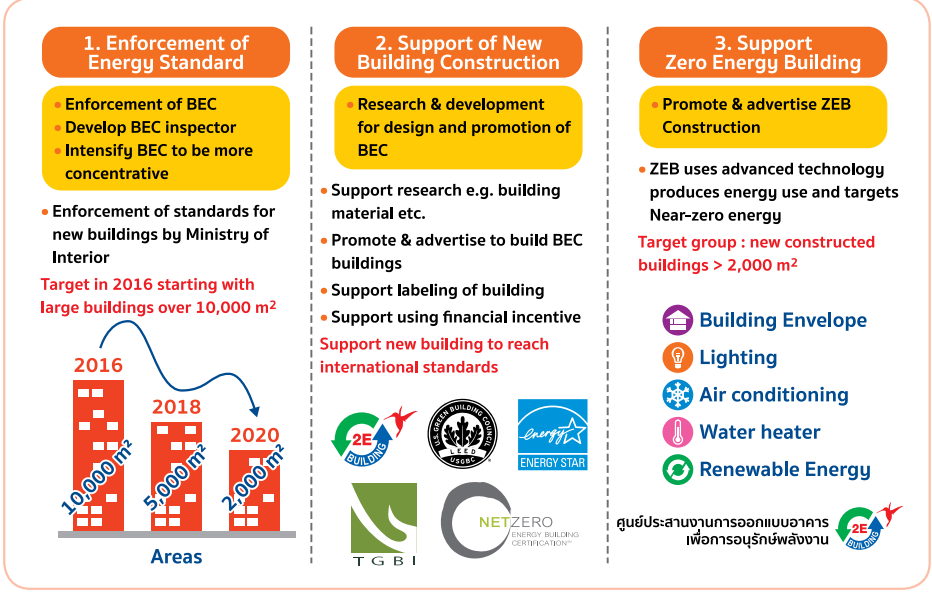
2. Measures for buildings standard

Currently, large-scale buildings (more than 2,000 square meters) are in the process to be regulated by energy conservation law according to the BEC standard with a procedure to apply for a construction permit under the Building Control Act of the Department of Public Works on Town and Country Planning (DPT)

Collaboration with the DPT includes both legal binding of building standard (BEC) for the new building and encouraging advanced green building standard in the international levels such as LEED standard or TREES standard by Green Building Institute of Thailand.

Action plan

- ✓ Regulate new building to follow Ministry of Energy (new buildings or additions over 2,000 sq.m.) through the Energy Conservation Building Center.
- ✓ Promote the construction of new buildings to follow regulation by the Ministry of Energy.
- ✓ Initiate measures to encourage new buildings to reach green building international standards such as LEED or TREES.
- ✓ Encourage the construction of NET ZERO ENERGY BUILDING
- ✓ Expect additional investment in the construction of new building according to imposing green building standards

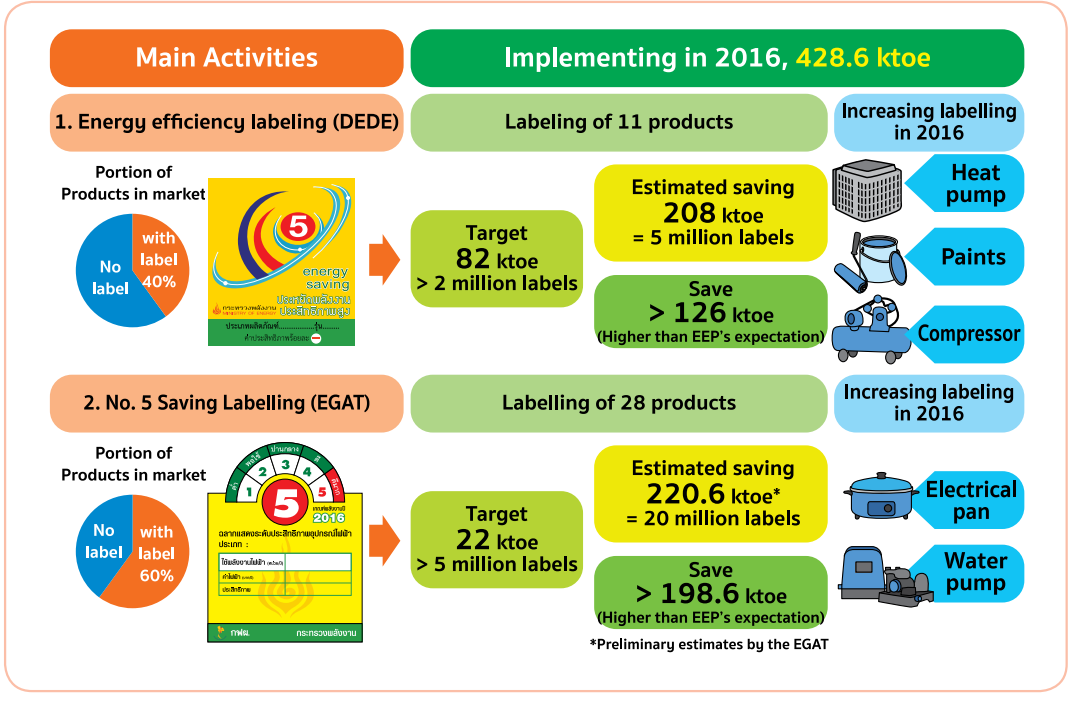


3. Measure on energy efficiency standard and labeling

Currently, there exist energy efficiency standards for 57 products, 27 of which have been used as the basis of energy efficiency labeling as follows:

- EGAT applies No. 5 label (energy efficient label) for 19 electrical products
- Department of Alternative Energy Development and Efficiency (DEDE) applies No. 5 label for 8 heating products

This measure aims to enhance the energy efficiency assessment through No. 5 labeling with encouragement on the producers and distributors to improve their main energy-consuming products (identified as 70 percent of home appliances) including air conditions, refrigerators, stoves, lamps, small-sized engines. In addition, energy labeling has been extended to other energy-affecting parts such as tires.



Action plan

✓ Promote machines, equipment and materials for energy conservation by continuous labeling
- o Electrical appliances by EGAT
- o Heating equipment by DEDE

✓ Expand the list of machines, equipment and materials used for energy conservation by labeling, as well as revising and raising the efficiency standards of the equipment

✓ Expected additional investment in equipment upgrades

4. Measure on compulsory energy efficiency resource standards (EERS) for the energy production

This measure aims to encourage manufacturers or providers of electricity to help service users or energy consumers increase efficient usage of energy via Energy Efficiency. Since this is the new measure for Thailand, study on appropriate mechanisms in applying this measure in Thailand. The system for inspection and tracking for continuous operation are needed.

Action plan

- ✓ Develop standard criteria in energy conservation for power producers and distributors to follow with their clients or upon mutual agreement
- ✓ Develop legislation to support standards for energy conservation
- ✓ Regulate power producers and distributors to perform energy conservation for their clients
- ✓ Expect possible investment in equipment upgrades

5. Measure on financial support

Promote the implementation of energy conservation by improving the investment subsidies for energy-efficient equipment. The development of subsidy will be changed from cost base to performance base.

Expand the target group to include residence and transportation sectors by adding support for specific target groups (reusing waste heat) to increase the energy consumption per unit of production and change the program to be span continuously over three years period instead of the former program (year by year).

Soft Loan 4,500 Million Baht

Implementing in 2016 for 1,845 Million Baht

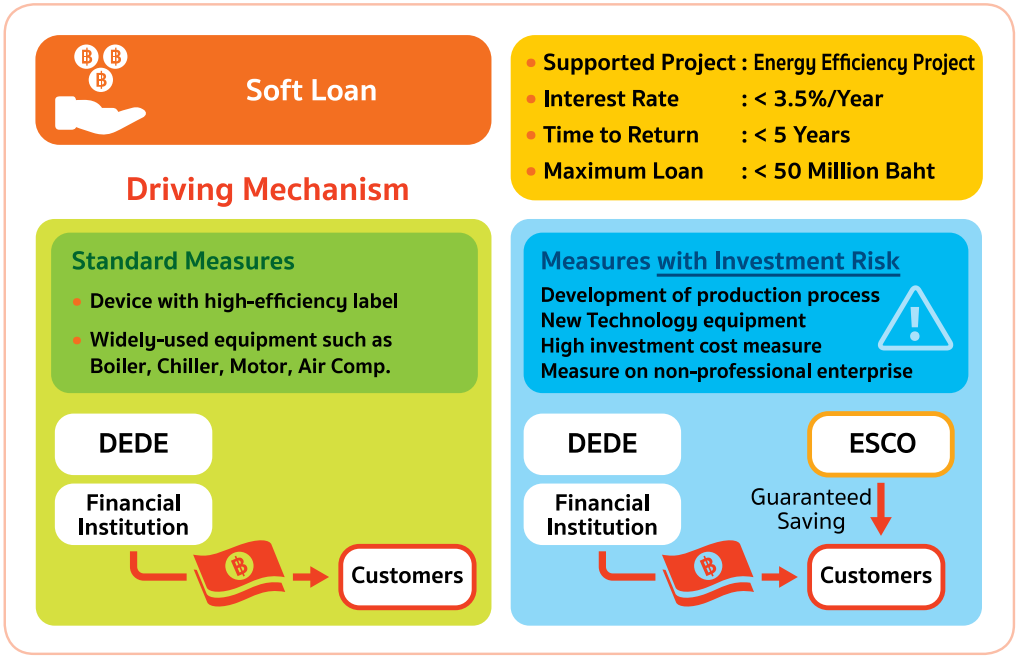
Total Saving 87 ktoe

Target Group		Measure		Loan/Saving
Industrial Cluster according to MoE's Strategic Area	Icehouse Energy Consumption 512.74 ktoe Potential 76.91 ktoe	High Efficiency Compresssor Freezer Evaporative	Condenser Heat Recovery	Loan of 135 Million Baht (7.32%) Save 7 ktoe
Entrepreneurs Having > 10-Year Machines	Other Sectors	Chiller Boiler Air Compressor Motor		Loan of 1,585 Million Baht (85.91%) Save 74 ktoe
Building Code	New Buildings Exceeding BEC	Improve OTTV RTTV and Other Systems		Loan of 125 Million Baht (6.78%) Save 6 ktoe
SME	All Sectors	Promote Equipment Changing		Loan of 2,655 Million Baht Save 126 ktoe

OTTV : Overall Thermal Transfer Value
RTTV : Roof Thermal Transfer Value

Action plan

- ✓ Subsidize for energy savings in machines and equipment according to Standard Offer Program (SOP)
- ✓ Subsidize for energy savings by tenders (DSM Bidding)
- ✓ Provide low interest rate loan (Soft loan) for energy conservation purpose
- ✓ Provide working capital for Energy Conservation by Energy Services Companies (ESCO Revolving Fund)
- ✓ Provide tax Incentive for energy conservation purpose
- ✓ Expect possible investment in equipment upgrades



6. Measure on the use of LED

Presently, most of light bulbs used in Thailand are fluorescent. However, new technology allows Light Emitting Diode (LED) bulbs to conserve energy up to 30-70 percent with a longer lifespan. LED can replace the traditional fluorescent bulb to help reduce energy consumption but with the high price. Hence, the promotion of LED is necessary.

This measure aims to decrease LED price in order to make it more affordable to the public and entrepreneurs, as well as changing the fluorescent light bulbs in governmental sector to set example for private sector and to reduce energy consumption.

Action plan

- ✓ Conduct pilot project to replace with LED bulbs in governmental buildings
- ✓ Support the use of LED bulbs via the price mechanism
- ✓ Use LED bulbs for street lights
- ✓ Use LED bulbs for public lights
- ✓ Expect possible investment in light bulbs upgrades

7. Measure on energy conservation in the transportation sector

Action plan can be divided into four groups.

Group 1

Regulation of fuel cost to reflect actual cost of fuels used in transportation sector

1) Restructure fuel prices to reflect the actual cost in each fuel type
2) Restructure the excise tax rate to be fair to all types of fuel consumers

Group 2

Improvement of fuel efficiency in vehicles

1) Encourage the public to buy efficient and energy-saving vehicles by adjusting tax depending on CO_2 emission to reflect directly on energy consumption, and also by mandating fuel economy labeling.
2) Encourage the public to choose energy-saving tires by energy efficiency labeling

Group 3

Promotion of the management of operations for trucks and buses

1) Improve energy efficiency in transportation operators by supporting the experts and measures to fleet management, transportation technology and workshops in order to increase driving skills
2) Improve energy efficiency in trucks and buses via financial support

Group 4

1) Develop transportation infrastructure to support transportation switching pattern according to the master plan of the Ministry of Transportation such as developing 12 new lines of sky trains and 3,150 km. of double-track railways
2) Increase efficiency for oil logistic via pipeline
3) Study, plan, and operate necessary support for the use of electric vehicles

Action plan

- ✓ Remove/review subsidies for energy prices (diesel)
- ✓ Encourage the use of energy-efficient vehicles, tax and energy efficiency labels
- ✓ Introduce energy efficiency labeling of tires.
- ✓ Management of transportation system for energy-saving purpose
- ✓ Introduce energy efficiency driving (ECO Driving)
- ✓ Provide working capital to promote the conservation of energy for the transportation sector
- ✓ Promote financial support for energy saving output resulted from transportation sector
- ✓ Develop transportation infrastructure, public railway transportation and connecting systems
- ✓ Develop transportation infrastructure via double-track railway
- ✓ Expand the pipeline for oil logistics
- ✓ Introduce electric vehicles (EV).
- ✓ Expect possible investment in vehicles upgrades

8. Measure for promotion of education, research, technology development on energy conservation

This measure aims to conduct systematic research toward country self-reliance. The method will begin with the research to commercialization and widespread applications including study and research on development in energy conservation technology, environmental protection and environmental problem-solving due to energy conservation. Energy policy and planning is focused to support the implementation of seven main measures with emphasis on research with high potential for commercial purposes and high impact on energy efficiency.

Action plan

- ✓ Develop strategy and research plans with periodic review over time
- ✓ Establish working group to drive energy conservation research
- ✓ Develop database system and information technology on research and development in energy conser vation fields
- ✓ Support energy conservation research in Lab Scale level
- ✓ Support energy conservation research in Scaled-Up level
- ✓ Support energy conservation research in Pilot level
- ✓ Develop systematic mechanism with motivating activities for research toward commercialization

9. Measure on personnel development in energy conservation fields

- Support human resource development continuously to enhance their knowledges on related sectors in all levels
- Develop framework in energy conservation to support the implementation of seven main measures
  1. Train and develop personnel to support the implementation of the law
  2. Increase knowledges and skills in selection and operation of high efficiency equipment for the public
  3. Increase knowledges and skills in selection and operation of vehicles efficiently
  4. Develop appropriate educational system for students, teachers and researcher at all levels
  5. Develop governmental personnel who has responsibility in regulating and auditing energy conservation

Action plan

- ✓ Develop strategy and development plan with periodic review over time
- ✓ Develop the system and monitoring the result
- ✓ Provide scholarship for undergraduate to doctoral degrees both domestic and abroad toward energy conservation
- ✓ Support the research funding for undergraduate to doctoral students
- ✓ Develop related educational programs for both governmental and educational personnel
- ✓ Develop teaching materials, skills for selection and operation of high efficiency equipment for the youth and adults
- ✓ Continuously develop the potential of educational personnel
- ✓ Support human resource development activities to support the implementation of seven measures

10. Measure to create public awareness on energy conservation

- Support the campaign to raise awareness about energy value and to change energy consumption behavior across all sectors and levels
- Provide the public with information and activities related to energy conservation to support the implement of seven measures as follows:
    1. Press campaign to raise awareness of energy conservation for people in workplace in all levels, from managers to operators
    2. Press campaign to raise popularity in energy conservation buildings
    3. Press campaign to provide information and raise popularity in high efficiency equipment, such as air-conditions, automotive tires and LEDs
    4. Press campaign with factual information about various fuel costs in transportation sector
- Continuously use the campaign to raise integrated awareness, such as advertisement, contests and participated activities

Action plan

✓ Develop strategy and plan for a public relation campaign with periodic review

✓ Develop the standard and assessment on the conservation behavior, improve database and information technology

✓ Campaign to raise integrated awareness in energy conservation behavior via advertisement, contests and participated activities

✓ Provide activities to raise awearenes in energy conservation to support the 7 measures

✓ Conduct conservation behavior assessment

The continuous improvement of strategy to drive energy conservation under three strategies, ten measures in four economic sectors will help reduce energy consumption in residential and factory buildings resulting in lower production cost in the short term and strengthen the country's economy in the long term. Moreover, the strategy motivates both awareness and discipline to people in every sector and level to use energy conservatively and efficiently.

Provincial energy support

Additionally, provincial energy centers are designated to support energy conservation in industrial sector through consultations on local energy legislation, promotion of factual energy information, and help other agencies in the area for exploration on efficient use of energy in the governmental sector.

PDP 2015 | EEP 2015 | AEDP 2015 | GAS PLAN | OIL PLAN

Alternative Energy Development Plan : AEDP 2015

With forecasted final energy demand in EEP 2015, Alternative Energy Development Plan (AEDP 2015) has been prepared. In case of successfully achieving energy intensity reduction by 30 percent in 2036 compared to 2010 (EEP 2015), the predicted final (end-used) energy demand in 2036 will be approximately 131,000 ktoe. Total electricity demand in the PDP 2015 in 2036 is 326,119 million units or equivalent to 27,789 ktoe. Thermal energy demand projected in 2036 is 68,413 ktoe. Fuel demand in transportation sector projected in the Oil Plan 2015 is equal to 34,798 ktoe. All energy demand outlook predicted in other plans are contributed to the AEDP 2015 in defining goals to ramping up the ratio of renewable energy usage and renewable energy resource potential consideration in terms of electrical, thermal, and bio-energy accounting for 30 percent of the final energy consumption in 2036.

Direction for the development of renewable energy according to the AEDP 2015

Developing renewable energy as an alternative source of national energy instead of imported oil in the future has contributed to strengthen the energy security of Thailand, support production industry of domestic renewable energy technology, and carry out research development to promote Thai national renewable technology with competitiveness in international market. Within AEDP 2015, Ministry of Energy (MoE) has identified strategies to advocate renewable energy development in six approaches, as follows:

1. Promotion of corporative community in production and utilization of renewable energy in a large scale
2. Adjustment of inspiring measures suitable for private sectors' investment
3. Amendments of laws and legislations that do not support the development of renewable energy
4. Improvement of necessary infrastructures e.g. transmission line system, distribution line and Smart Grid system development
5. Enhancement of public relation, and education for correct understanding of the public
6. Encouragement on utilizing research work as a tool to drive the development in renewable energy industry

Alternative Energy Development Plan : AEDP 2015

The development of AEDP 2015 realizes the importance of potential alternative energy production from various raw materials in the country, the development of appropriate technology to generate alternative energy, and the combined benefits in social and environmental aspects from alternative energy production.

The development of alternative energy in Thailand has been continuously expanded, which is resulted from the policy to promote production and use of alternative energy in the forms of electrical energy, thermal energy, and bio-fuels. In year 2014, the total amount of alternative energy used is totally 9,025 ktoe, increasing from the previous year (2013) by 9.6 percent and equivalent to 11.9 percent out of 2014 end-used energy, as shown in the table below.

Operational results of alternative energy dimension in 2012-1014

Alternative Energy	Unit	Results		
		2012	2013	2014
Electricity*	**Megawatt (MW)**	**2,786**	**3,788**	**4,494**
	ktoe	**1,138**	**1,341**	**1,467**
1. Solar	MW	376.72	823.46	1,298.51
2. Wind	MW	111.73	222.71	224.47
3. Small hydro	MW	101.75	108.80	142.01
4. Biomass	MW	1,959.95	2,320.78	2,451.82
5. Biogas	MW	193.40	265.23	311.50
6. Municipal waste	MW	42.72	47.48	65.72
Thermal	**ktoe**	**4,886**	**5,279**	**5,775**
1. Solar	ktoe	3.50	4.50	45.10
2. Biomass	ktoe	4,346.00	4,694.00	5,144.00
3. Biogas	ktoe	458.00	495.00	528.00
4. Energy from waste	ktoe	78.20	85.00	98.10
Biofuel	**10^6 litres/day**	**4.20**	**5.50**	**6.10**
	ktoe	**1,270**	**5.50**	**1,783**
1. Ethanol	10^6 litres/day	1.40	2.60	3.21
2. Bio-diesel	10^6 litres/day	2.80	2.90	2.89
Alternative energy usage (ktoe)		**7,294**	**8,232**	**8,232**
End-used energy (ktoe)		**73,316**	**75,214**	**75,214**
Ratio of AE to End-used energy (%)		**9.95**	**10.94**	**11.91**

**Including off grid power generation except large-hydro power*

Goals of renewable energy development

The development of renewable energy is a part of overall policy framework, which is necessary to be integrated with other plans for driving the AEDP 2015 accordingly. Predicted amount of final energy demand is considered in preparation of the AEDP 2015 in accordance with the EEP 2015. In case of successfully achieving energy intensity reduction by 30 percent in 2036 compared to 2010 EEP 2015), the predicted final (end-used) energy demand in 2036 will be approximately 131,000 ktoe. Total electricity demand in the PDP 2015 in 2036 is 326,119 million units or equivalent to 27,789 ktoe. Thermal energy demand projected in 2036 is 68,413 ktoe. Fuel demand in transportation sector projected in the Oil Plan 2015 is equal to 34,798 ktoe. All energy demand outlook predicted in other plans are contributed to the AEDP 2015 in defining goals to ramping up the ratio of renewable energy usage under renewable energy resource potential consideration in terms of electrical, thermal, and bio-energy accounting for 30 percent of the final energy consumption in 2036.

Goals of renewable energy development under the AEDP in 2036

Types of Energy	Sep 2015 (MW)	Target (MW)
1. Municipal waste	134.72	500.00
2. Industrial waste	-	50.00
3. Biomass	2,676.50	5,570.00
4. Biogas (waste water/ sewage)	365.10	600.00
5. Small hydro power	172.06	376.00
6. Biogas (Energy crop)	-	680.00
7. Wind power	225.37	3,002.00
8. Solar power	1,313.65	6,000.00
9. Large hydro power	2,906.40	2,906.40
Total	7,793.80	19,684.40

Types of Energy	Sep 2015 (ktoe)	Target (ktoe)
1. Energy from waste	63.60	495.00
2. Biomass	4,369.00	22,100.00
3. Biogas	390.90	1,283.00
4. Solar power	5.60	1,200.00
5. Other alternative energy*	-	10.00
Total	4,829.10	25,088.40

*Other thermal alternative energy such as Geothermal, Oil from used tires

Types of Energy	Sep 2015	Target	
Biofuels	10^6 liter/day	10^6 liter/day	ktoe
1. Ethanol	3.52	11.30	2,103.50
2. Biodiesel	3.17	14.00	4,404.82
3. Pyrolysis oil	-	0.53	170.87
4. Compressed biomethane (ton/day)	-	4,800.00	2,023.24
5. Other alternative energy*	-		10.00
Total	6.69		8,712.43

*Other alternative fuels such as Bio-oil, Hydrogen etc.

Alternative Energy Target
= 30% to final energy consumption

Electricity
5,588.24 ktoe
(4.27%)
→ AE Ratio in Electricity Sector 20%

Thermal
25,088.00 ktoe
(19.15%)
→ AE Ratio in Heat Sector 36%

Bio-energy
8,712.43 ktoe
(6.65%)
→ AE Ratio in Fuel Sector 25%

Power generation from renewable energy

Ministry of Energy has set the policy in promoting power generation from renewable energy since 1989 and permitted the Electricity Generating Authority of Thailand (EGAT) to purchase electricity from Small Power Produce (SPP), who generates electricity with steam (Cogeneration) using agricultural waste or biomass. The unused thermal energy from the process is used to harvest electricity to sell back to transmission line system. The additional use of the excess thermal energy enables power generation to be effective and lessens the duty on investment in electricity production and trading of governmental sector. After SPP success, electricity generated from other renewable energy e.g. solar power, biogas, waste, hydro energy, wind energy from Very Small Power Produce (VSPP) of less than 10 MW has been accepted in order to distribute more opportunity to distant areas. This help reduce the loss from electrical system and cost on the investment of large-scale power plant construction through a financial support (Adder). Adder rates and the support durations are different depending on the types of renewable energy. There is also special adder rate for buying electricity from power plant projects in southern border regions, e.g. Yala, Pattani, Narathiwat, and four districts in Songkhla provinces. Resulted from this motivating measure, electricity production from renewable energy has increased every year. In 2007, the proportion of national electricity produced from renewable energy (including off grid power generation but excluding large-scale hydro power) was 4.3 percent and increased to 9.87 percent in 2014.

Targets of electricity production from renewable energy

The Ministry of Energy considers various aspects to determine the targets in the development of electricity production from renewable energy. There are several aspects in making the targets certain and aligned with the potential of fuels and the accessibility of electrical system, as follows:

- **Potential of remaining renewable energy resources for each technology**

Assessment from overall renewable energy fuels is deducted by used renewable energy fuels for each type of renewable energy fuels.

- **Electricity demand**

Assessment on the electricity demand predicted by MEA and PEA with demand adjustment in accordance with the EEP 2015 has yield the final national electricity demand in 2036 of 326,119 million units.

- **Receptiveness of transmission line to electricity produced from renewable energy**

In the PDP 2015, EGAT evaluated the potential of transmission line available for electricity from renewable energy for each station annually from 2015-2024. The availability is rather limited. After 2024 onwards, the limitation of the transmission line will be lessened, which will enable the development of transmission line to be fully reflect the targets on electricity production from renewable energy.

- **Merit order from Levelized Cost of Electricity (LCOE) and government policy in terms ofsocial benefit and environmental cost from renewable energy power plants**

Considering related costs (construction, operation and maintenance costs of renewable energy plant), as well as fuel cost in case of energy produced from biomass, waste, and biogas from energy crop, net capital cost of electricity production will be calculated for overall lifetime of the renewable energy plant. The merit order of renewable energy technology is prioritized following the supporting policy by the government. The government contemplates each renewable energy technology on the intensity of financial effect (amount of money gained), greenhouse gas reduction including the evolution of employment opportunity.

- **Allocation of electricity production by Renewable Energy Zoning (RE Zoning)**

RE zoning is the mean to define the targets of electricity production from various types of renewable energy using Renewable Energy Supply-Demand Matching principle. The orders of applicable quantity of renewable energy resources are organized following the policy on Merit Order to comply with electricity demand in each area and transmission line limitation. The process steps to complete the goals are:

(1) Merit Order is determined according to the capital cost of electricity production from renewable energy, as well as social and environmental benefits. Merit Order is set to comply with the governmental policy, which promotes energy from waste and bio-energy to enhance advantages for both farmers and society. Moreover, the accessibility to electrical energy in distant areas is also taken into account. The Merit Order is then ranked subsequently as shown in the table below.

1	2	3	4	5	6	7	8
Waste	**Biomass**	**Biogas from wastes**	**Small hydro power**	**Biogas from energy crop**	**Wind energy**	**Solar energy**	**Geothermal thermal power**

(2) Allocation of electricity production targets from each renewable energy fuels for each zone (RE Zoning) uses the installed capacity of electrical energy and the committed projects (to the governmental sector) as the basis for consideration. This will allow the possibility to calculate the desired amount of electricity need to be operated (new projects) for that area in terms of additional need of the electricity and transmission line limitation.

As shown in the table below, the goal of electricity production from renewable energy for each type of fuels according to the AEDP 2015 is accounted for 20 percent of the net energy demand in the country, which in accordance with the PDP 2015 target for the electricity produced from renewable energy at 15-20 percent in 2036.

Status and targets of electricity production from renewable energy for each type of fuels

Fuel types	Status at the end of 2014* (Megawatt)	Target year 2036 (Megawatt)
1. Municipal waste	65.72	500.00
2. Industrial waste	-	50.00
3. Biomass	2,451.82	5,570.00
4. Biogas from wastes	311.50	600.00
5. Small hydro power	142.01	376.00
6. Biogas (Energy crop)	-	680.00
7. Wind energy	224.47	3,002.00
8. Solar power	1,298.51	6,000.00
9. Large hydro power	-	2,906.40**
Total installed capacity (MW)	**4,494.03**	**19,684.40**
Total Electrical Energy (10^6 unit)	17,217	65,588.07
National Electricity Demand (10^6 unit)	174,467	326,119.00
Renewable energy ratio (%)	**9.87**	**20.11**

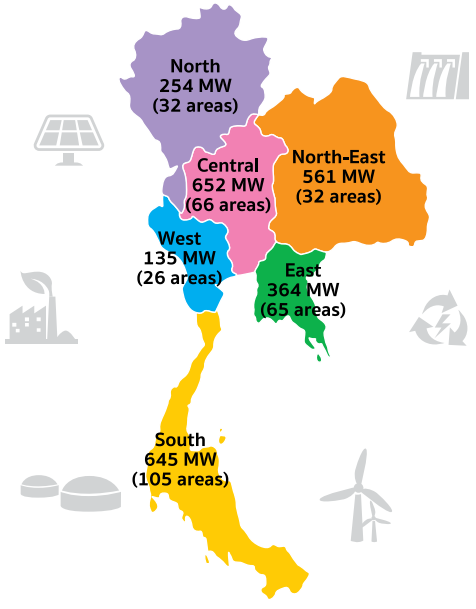
** Including off grid power generation and excluding large-hydro power*

*** Current installed capacity, large hydro power is included in the AEDP 2015*

Support for electricity from renewable energy in 2016

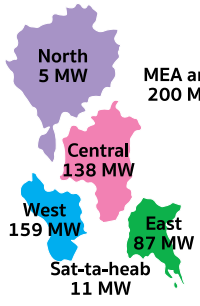
Integrated Operation with Provincial Energy Office :
Tracking projects with problems or not in progress

Acceleration and problem solving of COD into the system



Project on electricity production from solar energy for governmental sector and agricultural co-operative

Define FiT for < 5 MW/area at 5.66 Baht/unit and support for 25 years



Period 1 : Total 600 MW
- Gov. Organization 300 MW
- Agri. Co-op. 300 MW

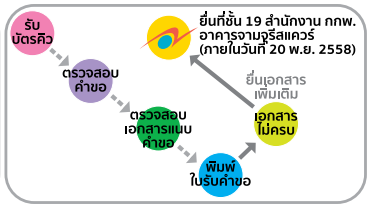
Gov. Organization
1 Project / 1 Unit of Work / 1 Area

Agri. Co-op.
1 Project / 1 Agri. Co-op.

Step of Proposition

Number of Project Proposals
618 Projects, 2,905.50 MW

11 Dec 15 Proposal List of Project Qualified
15 Dec 15 Project Draw
24 Dec 15 Announce Results



Heat production from renewable energy

Main industries that use heat from renewable energy are related to agriculture, such as sugar, palm oil, cassava flour, wood-processing, paper, rice-mill, and animal-farm industries. These industries all contain process wastes that can be used as raw materials for energy production in the forms of biomass (such as bagasse, rice husk, woodchip, palm fiber, palm shell, and sawdust) and biogas to reduce the cost for purchasing the fuels.

The government policy to promote electricity production from renewable energy using cogeneration, such as biogas production from animal dung and industrial waste water, as well as solar thermal for hot water and drying shown in the table below, aims to motivate the investment for efficiency improvement in energy production system. The increment of renewable energy ratio to replace the use of fossil fuels would enable competitiveness for industry by reducing capital and fuel cost from waste recycling, as well as creating healthy environment to the surrounding society.

Thermal energy used from renewable energy in 2010-2014

Heat from RE	Thermal Energy (ktoe)				
	Year 2010	Year 2011	Year 2012	Year 2013	Year 2014
Biomass	3,449	4,123	4,346	4,694	5,184
Biogas	311	402	458	495	488
Waste	1.1	1.7	78.2	85.0	98
Solar	1.8	2.0	4.0	4.5	5.1
Total	**3,763**	**4,529**	**4,886**	**5,279**	**5,775**

Biomass is one of the renewable energy resources, which contributes to most of thermal energy production. In 2014, thermal energy production from biomass was 89 percent, followed by biogas at 9 percent, and the remaining percent from waste and solar thermal. However, there is an increasing promotion on thermal energy production from waste and solar in the service and residential sectors.

Targets of heat generation from renewable energy

The energy demand in the country is mainly for heat generation. Thermal energy intensity has been continuously increased from growing economy, such as economy and industry expansion, society and community expansion, and tourism industry as well as agricultural sector. The determination of targets in heat generation is listed as follows:

(1) Energy demand for heat generation In 2036, energy demand forecast for heat generation is 68,413 ktoe, which is in accordance with final energy demand from the EEP 2015 and the PDP 2015, with the fuel demand in transportation sector following the Oil Plan.

(2) Potential evaluation for heat generation Renewable energy resources are divided into four groups:

(2.1) Heat generation from remaining renewable energy raw materials, such as waste, biomass and biogas. This is the remaining potential from other energy productions, as shown in the table below.

The potential of unused fuels from other energy productions

Fuel types	Unit	Remaining potential	Potential to produce energy		
			Electricity	Pyrolysis oil	Heat
1. Waste					
• Land-filled waste	10^6 ton	30.80	-	-	24.64
• Used tires	ton/year	547,500	-	-	383,250
• Municipal waste*	ton/day	68,088	35,000	4,690	4,500
2. Biomass					
• Remaining biomass	10^6 ton/year	31.42	37.43	-	42.51
• Additional biomass obtained from the MoA plan	10^6 ton/year	48.52			
3. Biogas					
• Amount of waste water/waste	10^6 m^3/year	3,411	1,142	-	1,245

** Not all municipal waste can be used to produce energy due to limitation in collection and storage*

(2.2) Heat generation from fast-growing trees is considered from the potential of waned areas of fast-growing tree plantation, where the waned areas are selected from the critical and severed levels in the reforming land for agriculture (outside the irrigation areas) not suitable for economic crop plantation. Thailand has the areas with potential to grow fast-growing tress approximately for 4 million Rai. If only one-third or 1.45 million Rai of this area is considered, biomass can be produced for approximately 18 million ton/year.

(2.3) Heat production from solar energy is evaluated from the potential targets of three solar thermal technologies used for hot water, drying system, and cooling system. The goal to promote heat generation from solar energy is 1,200 ktoe.

- Solar hot water system has the target groups on hotel, resort, andhospital. Hot water is used to service customers or patients in washing processes within the organization, as well as those in industrial and residential sectors. The goal of solar hot water system installation is about 9.17 million m^2 or equivalent to thermal energy production of 1,160 ktoe.
- Solar drying system has the target groups on drying business in both household, and small and medium industrial levels. The drying method from solar radition is introduced instead of natural sun dry to avoid damage from insects, dust and moisture in the air, which automatically raise the standard of the dried products. The goal of solar drying system installation is 75,000 m^2 or equivalent to thermal energy production of 5 ktoe.
- Solar cooling system utilizes solar hot water as heat resource for absorption chiller system. This can be used in large-scale building e.g. office building, hotel, shopping mall, and hospitals. The goal of solar cooling system installation is 300,000 m^2 or equivalent to thermal energy production of 35 ktoe

(2.4) Heat generation from other renewable energy relies on raw material resources under investigation or research and development that could have the potential in the future, where appropriate technology is developed and capital cost can be competitive to other types of fuels such as geothermal energy etc.

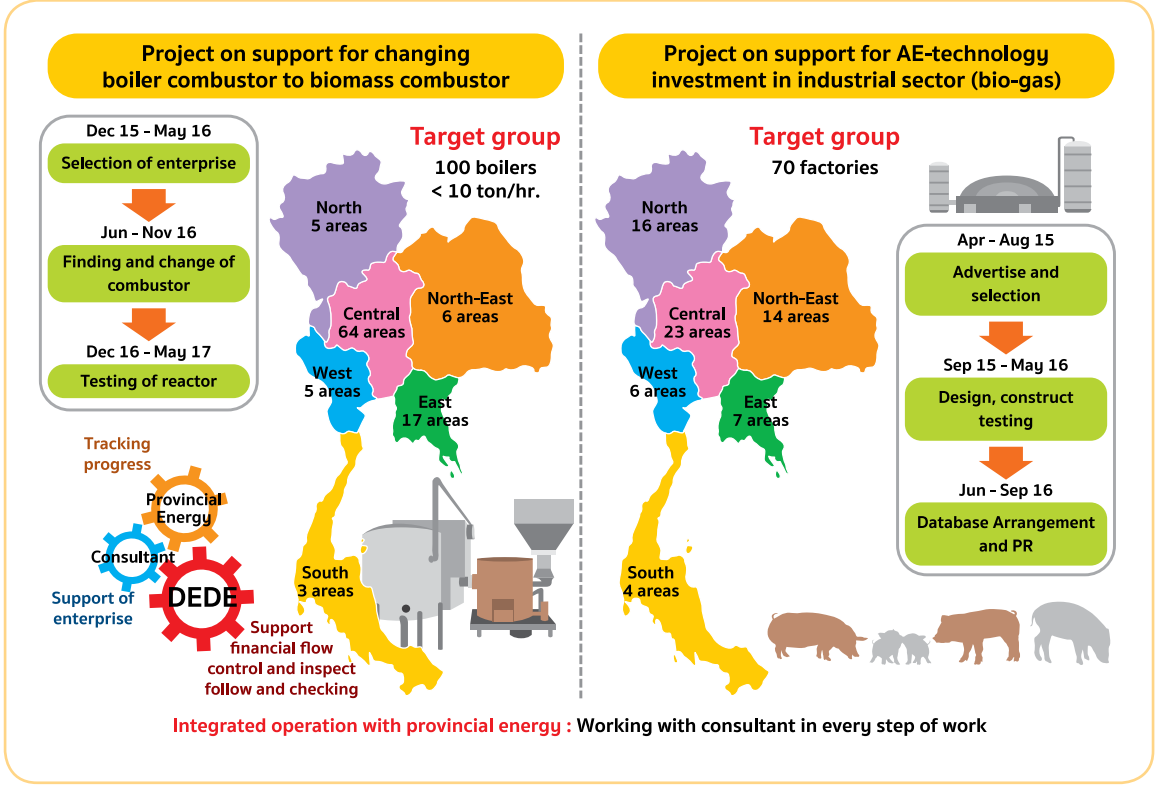
The following table summarizes status and target of heat generation from various renewable energy resources.

Status and targets of heat generation from renewable energy for each type of fuels

Fuel types	Status at the end of 2014 (ktoe)	Target year 2036 (ktoe)
1. Waste	98.10	495.00
2. Biomass	5,144.00	22,100.00
3. Biogas	528.00	1,283.00
4. Solar energy	5.10	1,200.00
5. Other thermal renewable energy*	-	10.00
Total	**5,775.20**	**25,088.00**
National heat demand	33,419.54	68,413.40
RE ratio in heat generation (%)	**17.28**	**36.67**

** Such as geothermal, fuel-oil from used tires etc.*

The promotion of renewable energy in thermal generation sector in 2016



Biofuel production from renewable energy fuels

Biofuel development in Thailand has been following his Majesty the King initiative since a decade ago and setting it as main policy for energy security and renewable energy foundation of Thailand with special focus on gasoline and diesel replacement by biofuels produced within the country.

The MoE has officially promoted biofuels since 2004 by installing the biofuel production plants, increasing biofuel stations, enhancing the reliability on biofuels. However, the use of biofuels has not been significant until 2008, where a global energy crisis affecting the oil prices to increase higher than $150 per barrel leading to the higher demand for biofuel in the country. Biofuels were utilized to reduce the amount of imported oil by increasing the use of ethanol from 0.71 to 1.29 million liters/day, and biodiesel from 0.80 to 1.40 million liters/day.

Bio-diesel utilization increased substantially again in 2011 when the MoE has mandated the blending ratio of biodiesel in diesel at 3-5 percent, which was later increased to 7 perfect in 2014. Nonetheless, there was still the seasonal fluctuations of crude palm oil quantity, which is the raw material to produce biodiesel. Hence, the MoE had to lessen the amount of biodiesel to balance the raw materials within the country. From 2014, Thailand has 10 biodiesel plants with total production capacity of 4.96 million liter/day and has produced biodiesel to replace diesel fuel for 1,054.92 million liter or equivalently 2.89 million liter/day.

Ethanol has been increasingly used in 2013 because the MoE has removed gasoline with octane number 91, which had the market share of 40 percent of the total gasoline provided. Thai people have used gasohol increasingly due to rising world crude oil prices in the period of 2013-2014. This resulted in the growth of ethanol utilization. In 2014, the number of ethanol production plants increased to 22 plants, with total production capacity of 5.31 million liter/day, and the total quantity of ethanol used was 1,185.50 million liter/day or equivalent to 3.25 million liter/day. The usage of both ethanol and biodiesel is shown in the table below.

Biofuel application (ethanol and bio-diesel) in 2010-2014

Biofuel	The quantity of fuel oil (million liter/day)				
	Year 2010	Year 2011	Year 2012	Year 2013	Year 2014
Ethanol	1.2	1.2	1.4	2.6	3.2
Bio-diesel	1.7	2.1	2.7	2.9	2.9
Total	**2.9**	**3.3**	**4.1**	**5.5**	**6.1**

Targets of fuel production in transportation sector from renewable energy

The determination of the targets in promotion of biofuel production has taken into account the energy demand in transportation sector and the biofuel production capability as follows:

1. Energy demand forecast in transportation sector. From Oil Plan in 2036, the fuel demand in transportation sector is forecasted at 34,798 ktoe.

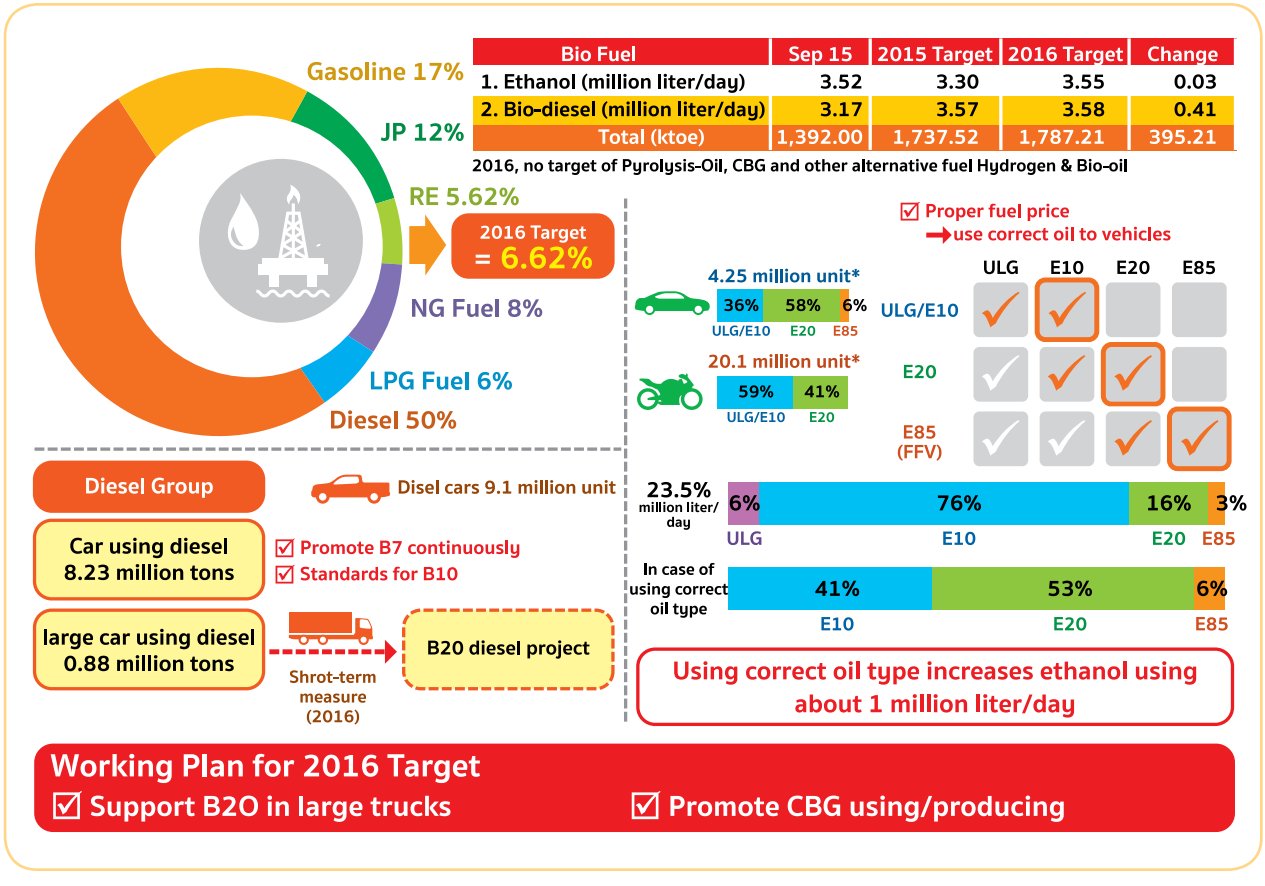
2. Evaluation of the production potential of biofuel. Biofuels, at present, are produced from food crops (1st generation biofuel). Main raw materials include bagasse, cassava, and oil palm, which are the important economy crops of the country. The draft strategy of the MoA has been used in the consideration of target determination for the MoE. The MoE supports the use of remaining agricultural products (from domestic consumption and export) as raw materials for energy production in order to balance food and fuel crop with maximum utilization in the country. The renewable energy resources are categorized into five groups as shown in the table below;

Status and targets of fuel production from renewable energy in transportation sector

Fuel types	Status at the end of 2014		Target year 2036	
	10^6 liter/day	ktoe	10^6 liter/day	ktoe
1. Biofuel	2.89	909.28	14.00	4,404.82
2. Ethanol	3.21	872.88	11.30	2,103.50
3. Pyrolysis oil			0.53	170.87
4. Compressed bio-methane (ton/day)			4,800.00	2,023.24
5. Other alternative fuels*				10.00
Total (ktoe)		**1,782.16**		**8,712.43**
Fuel demand in transportation sector		26,801.00		34,798.00
Ratio of biofuel production in transportation sector (%)		**6.65**		**25.04**

** Such as Bio-oil, hydrogen etc.*

Renewable energy to produce biofuels



Promotion of renewable energy in transportation sector in 2036

Project on supporting B20 in large trucks

Target group
Large trucks
500-1,000 unit

Benefits
- Promote B20
- Increase possibility in using palm-oil

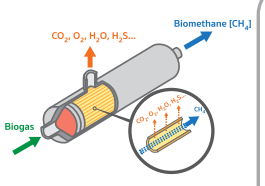
Feb 16
Selection of attender
Mar - Sep 16
Using B20 in large trucks
Financial support for B20 (11.6%)
Dec 16
Advertise and assurance

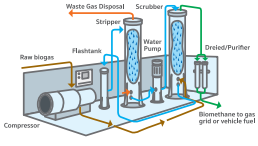
Provincial Energy
DEDE

Project on supporting CBG in enterprise using bio-gas system in vehicles

Benefits
- Assurance and promote CBG

Target group
Vehicles
Factories
13.7 ton/day





Dec 15 - May 16
Selection of attender
Jun 16 - Aug 17
Support production and testing CBG
Nov 17
Advertise and assurance

Integrated operation with provincial energy : Testing and advertisement of projects

Targeted values in the AEDP in 2036

The MoE defines the targeted values of renewable energy ratios in the forms of electrical energy, thermal energy, and biofuel under the AEDP 2015 for 30 percent of the end-used energy in 2036.

Targeted values in the AEDP in 2036

Energy types		Targeted year 2036	
Electricity		**ktoe**	**5,588.24**
		Megawatt (MW)	**19,684.40**
1. Municipal waste		MW	500.00
2. Industrial waste		MW	50.00
3. Biomass		MW	5,570.00
4. Biogas (waste water/sewage)		MW	600.00
5. Small hydro power		MW	376.00
6. Biogas (Energy crop)		MW	680.00
7. Wind power		MW	3,002.00
8. Solar power		MW	6,000.00
9. Large hydro power		MW	2,906.40
Heat		**ktoe**	**25,088.00**
1. Energy from waste		ktoe	495.00
2. Biomass		ktoe	22,100.00
3. Biogas		ktoe	1,283.00
4. Solar thermal		ktoe	1,200.00
5. Other alternative energy		ktoe	10.00
Biofuel		**ktoe**	**8,712.43**
1. Bio-diesel		10^6 liters/day	14.00
2. Ethanol		10^6 liters/day	11.30
3. Pyrolysis oil		10^6 liters/day	0.53
4. Compressed bio-methane		ton/day	4,800.00
5. Other alternative fuels		ktoe	10.00
Alternative energy consumption (ktoe)			**39,388.67**
Final energy consumption (ktoe)			**131,000.00**
Ratio of alternative energy to final energy consumption (%)			**30**

Strategy to promote alternative energy development

The MoE has proposed the strategies to promote the alternative energy development as shown in the table below:

Strategic Plan 1 The preparation of raw material and alternative energy technology **Goal The development of production capability, raw material management using suitable technology**			
Strategy	**Electricity production**	**Heat production**	**Biofuel production**
Strategy 1.1 Development of other alternative raw materials and potential area for growing energy crop	• Zoning for growing energy crop to be used as alternative energy's raw material • Develop and promote other alternative raw materials never been used as fuels such as agricultural waste, waste from industrial process by coordinating with other related organizations		
			Research and development of alternative non-food crop for raw materials such as sweet corn, cellulose, and algae etc.
Strategy 1.2 Improvement of alternative energy raw material management and utilization, effectively	• Promote alternative energy raw material management systematically such as logistic, contract farming • Standard setting and development of alternative fuels for commercial purposes; for examples, standards of compressed solid fuel (Pellet), pyrolysis oil etc.		
	• Promote alternative energy utilization to replace or co-firing fuels such as Biomass pellet or Bio-coke for energy production		
Strategy 1.3 Promotion of appropriate technology development for alternative energy production and utilization	• Promote usage of local content and technology • Develop parts, devices or novel alternative energy technologies suitable for different areas with potential for commercialization • Standardize material, equipment, installation system, and performance testing of the alternative energy		
	• Research and development of appropriate energy storage system	• Develop high-efficiency or advanced energy production technology	• Develop automobile technology that can use biofuels at higher portion • Develop high-quality biodiesel such as H-FAME, BHD etc. • Develop Compressed

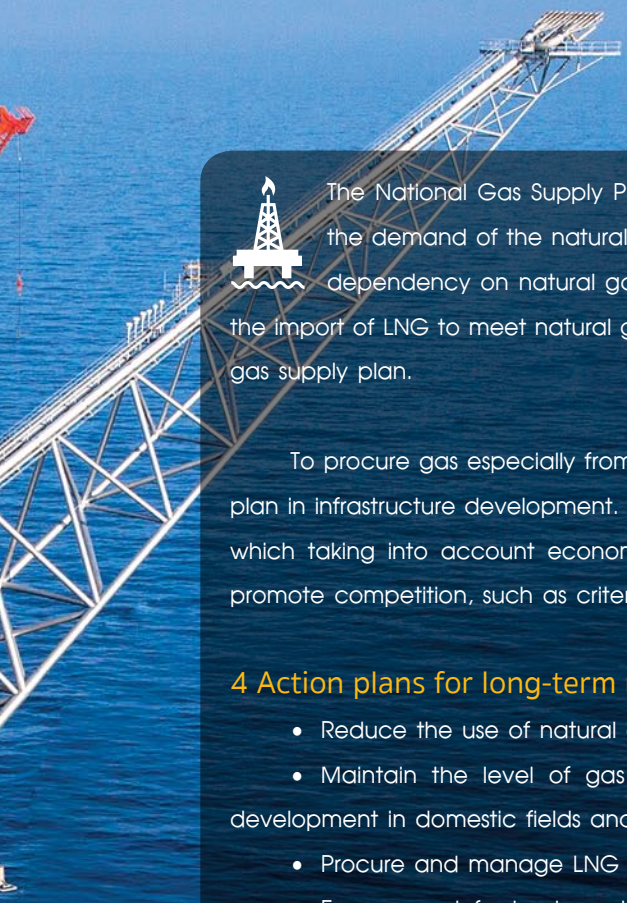
Strategic Plan 1 The preparation of raw material and alternative energy technology Goal The development of production capability, raw material management using suitable technology			
Strategy	**Electricity production**	**Heat production**	**Biofuel production**
Strategy 1.4 Improvement of infrastructure to suitably support alternative energy production and utilization	Establish testing center for device and technology with capability to certify renewable energy technology		
	• Improve transmission line system (Smart grid) for electricity production from alternative energy • Study infrastructure development for new alternative energy implementation such as fuel cells etc.	• Establish common municipal waste center Promote the development of business /residential buildings to comply with alternative energy technologies such as solar hot water installation etc.	• Increase the numbers of biofuel stations nationwide
Strategic Plan 2 Potential expansion of alternative energy production, applications, and market **Goal** Encouragement in the capability of alternative energy production and demand			
Strategy	**Electricity production**	**Heat production**	**Biofuel production**
Strategy 2.1 Support household and community to take part in alternative energy production and utilization	• Support power plant own by community or other governmental sector in distant areas • Support the Distributed Green Generation : DGG) to produce electricity from raw materials in their areas • Promote electricity self-consumption for governmental sector, business building or residential buildings • Develop appropriately integrated electricity production for geo graphic conditions such as the combination of wind and solar energy etc.	• Promote materials, devices for high-efficiency heat production in household such as high-efficiency charcoal stove etc. • Promote alternative energy system production with simple technology such application of biogas obtained from organic waste to replace LPG • Promote applications of alternative energy in industrial factory and commercial buildings such as using CBG or RDF to replace fuel oil and LPG	• Promote biofuel production in the community level
Strategy 2.2 Promotion of the investment for appropriate alternative energy for producers and consumers in the country	Promote investment on alternative energy using tax incentives and financial supporting measures		
	• Promote electricity purchase into transmission system via competitive bidding • Support electricity purchase into transmission system via net metering to promote self-consumption • Review and adjust electricity purchasing rates for various situations	• Study the guidelines for Renewable Heat Incentive	• Define suitable price structure to motivate RE applications and to reflect the actual cost of RE production • Promote the utilization of biofuels in the governmental organizations aggressively • Promote the production and distribution of automobile technologies or engines ca pable with biofuels at higher portion in the mixed fuels

Strategic Plan 2 Potential expansion of alternative energy production, applications, and market Goal Encouragement in the capability of alternative energy production and demand			
Strategy	**Electricity production**	**Heat production**	**Biofuel production**
Strategy 2.3 Promotion of capital cost reduction, and efficiency improvement of alternative energy business	• Promote the modification and replacement of machines, devices to improve production and utilization efficiency • Promote value-added waste from production process and related industry		
Strategy 2.4 Development of alternative energy laws, as well as modification of existing laws to support alternative energy development	• Enact laws on alternative energy • Improve regulations for support of alternative energy development with safety in production, transportation, and consumption		
Strategic Plan 3 Awareness creation and, knowledge attainment, and facts in alternative energy dimension **Goal Awareness creation, knowledge and understanding to alternative energy production and consumption in efficient and sustainable ways**			
Strategy	**Electricity production**	**Heat production**	**Biofuel production**
Strategy 3.1 Development of Information Technology (IT) to manage information in renewable energy	• Develop infrastructure system for correct, up-to-date, information of renewable energy to be prepared for connections with other related organizations		
Strategy 3.2 Distribution, public relation of information, news, knowledge, and statistic data of alternative energy	• Promote activities or programs relating to alternative energy such as energy contest • Distribute, public relation of information, news, and knowledge through various Medias such as website, newspapers, radio, TV etc. • Develop and improve latest informative news, state-of-the-art academic journals and statistic data		
Strategy 3.3 Development of personnel to gain knowledge and understand alternative energy for theoretical and practical utilization	• Develop alternative energy curriculum for academic institutions and organizations • Training, knowledge transfer in alternative energy topics to other organizations, institutions for advanced applications		
Strategy 3.4 Development of related alternative energy networks and support of participations in national and international energy networks	• Establish learning center on alternative energy in community or regional levels • Build cooperation and support alternative energy network in community level to enhance acceptability and to minimize resistance • Develop international energy network for collaboration and energy information exchange		

The increasing proportion of alternative energy utilization in the form of electrical energy, heat, and biogas under the AEDP 2015 to 30 percent of the final energy consumption in 2036 is equivalent to fossil fuel consumption reduction around 39,388 ktoe or fossil fuel cost reduction of 590,820 million baht. This amount of fossil fuel reduction can be converted to greenhouse gas reduction from combustion for 140 million ton CO_2. This enables the AEDP 2015 is one of the most crucial national integrated plans for the MoE in order to achieve the energy policy framework on **Energy Security, Economy, and Ecology.**

PDP 2015 | EEP 2015 | AEDP 2015 | GAS PLAN | OIL PLAN

Natural Gas Supply Plan : Gas Plan 2015



The National Gas Supply Plan focuses on the implementation plans which seek to accommodate the demand of the natural gas. The plan emphasizes on the reduction of natural gas usage or the dependency on natural gas as well as extending the natural gas supply from domestic resources, the import of LNG to meet natural gas demand and the development of infrastructure for long-term natural gas supply plan.

To procure gas especially from LNG imports until 2022 to meet future gas demand requires investment plan in infrastructure development. This includes proper plans for gas pipelines and LNG Receiving Terminals which taking into account economic, environmental and security aspects to comply with the policy to promote competition, such as criteria for the concrete TPA.

4 Action plans for long-term natural gas supply plan

- Reduce the use of natural gas whose cost is rising rapidly due to imported LNG
- Maintain the level of gas production from domestic resources by promoting exploration and development in domestic fields and the use of technology
- Procure and manage LNG efficiently
- Encourage infrastructure development and prepare guidelines for competition in both physical (a network of gas pipelines and LNG Receiving Terminal) and the rules that conform to the gas supply plan (Third Party Access : TPA)

Natural Gas Supply Plan : Gas Plan 2015

Plan to manage the country's natural gas to meet the demand and to be sufficient in the future (Gas Plan 2015) has been integrated with the Power Development Plan (PDP 2015), the Energy Efficiency Plan (EEP 2015) and the Alternative Energy Development Plant (AEDP 2015) by targeting actions in four key aspects as follows:

1. Reduce the use of natural gas whose cost is rising rapidly due to imported LNG.

2. Maintain the level of production from domestic resources by promoting exploration and development in domestic fields and the use of technology.

3. Procure and mange LNG efficiently.

4. Encourage Infrastructures development and prepare guidelines for competition in both physical (a network of gas pipelines and receiving LNG dock) and the rules that conform to the procurement plan (Third Party Access : TPA).

By following these four aspects, Thailand will be able to supply natural gas to meet with the demand. The import of LNG as of 2036 will be reducedby more than 25 million tons per year, lower than the former plan which predicted Thailand would rely 100 percent on imported LNG or more than 47 million tons per year (approximately 6,500 million cubic feet per day) in 2036. Moreover, it also includes frameworks on procurement and management of LNG in the future to promote competition. To comply with the PDP 2015, the MoE then prepared a long term natural gas supply plan under **the natural gas management plan 2015-2036** and proposed to the NEPC to consider the plan which comprised three cases as follows:

1. The base case

Under this case, the country can develop power plants by diversifying fuel mix in power generation, reducing their dependence on natural gas, increasing power imports from neighboring countries, promoting renewable energy in power generation, introducing nuclear power plant at the end of the plan, and promoting energy efficiency. This case assumes that the country can proceed as planned in the Power Development Plan (PDP 2015), Energy Efficiency Plan (EEP 2015), and the Alternative Energy and Development Plan (AEDP 2015).

The demand for natural gas will increase from 4,810 million cubic feet per day in 2015 to 5,099 million cubic feet per day in 2019, representing an average growth rate of 1.6 percent per year. However in the long-term, it is expected to decline to 4,344 million cubic feet per day in 2036. Domestic natural gas supply will be around 3,300-3,400 million cubic feet per day until 2022, and will constantly decline to 1,270 million cubic feet per day in 2036. In addition, natural gas imported from Myanmar will decline steadily after 2015 and terminate in 2029.

Imported LNG will increase approximately 10.7 percent annually during 2015-2036, up from an average of 484 million cubic feet per day or 3.5 million tons per year in 2015 to 3,073 million cubic feet per day, or 22 million tons per year in 2036.

2. The case which taking in to account the risks from the delay of coal-fired power plant projects

Under this case, the demand for natural gas in each year is higher than that of the base case. Demand for natural gas increases from 4,810 million cubic feet per day in 2015 to 5,528 million cubic feet per day in 2019 or accounted for 3.5 percent of growth rate annually. In the long- term, natural gas demand is expected to slightly increase to 5,658 million cubic feet per day in 2036. Domestic natural gas supply will increase to 3,300-3,400 million cubic feet per day until 2022 and will constantly decline to 1,270 million cubic feet per day in 2036. Natural gas imported from Myanmar will decline steadily after 2015 and end in 2029.

Imported LNG is also higher than the base case as it will increase at an average of 12.4 percent annually during 2015-2036, up from 484 million cubic feet per day or 3.5 million tons per year in 2015 to 4,382 million cubic feet per dayor 31.3 million tons per year in 2036.

3. The case which taking into account the concessions that due to expire in 2022-2023 and its risks of disruption in production

Under this case, the volume of natural gas supply from the domestic resources will decrease during the years 2018-2025 because it is expected that the concessionaires will stop their investments and development in the fields. For the long -term forecast, demand for natural gas will be similar to the base case, as natural gas demand will be at 4,344 million cubic feet daily in 2036.

The impact of the reduction of the supply of natural gas from the expired concessions causes the demand for domestic natural gas to be higher than the supply of natural gas from domestic sources and from Myanmar combined. If to the country has toimport LNG to replace such lost of supply, the amount of LNG imported is expected to be as high as 1,785 million cubic feet per day (13 million tons per annum) in 2018 and will increase to 2,580 million cubic feet per day (18 million tons per annum) in 2022.

Concession management that will end in 2022-2023

Goal — Natural gas to continuously be produced

Responsible Group — Petroleum Committee/ sub-committee Petroleum Concession Management Bureau

Related Authorities — Dept. of Mineral Fuels

Pragrammes/Projects	Plans/Results					Expected Completion Date
	2015	2016				
	Q4	Q1	Q2	Q3	Q4	
1. Determining petroleum resource						Nov 15
2. Determining the value of assets to be installed						Feb 16
3. Considered by Petroleum Committee						Dec 15/Feb 16 Apr 16
4. Propose to Energy Minister/NEPC						May 16
5. Drafting legislation						Dec 16

The country's natural gas demand and supply forecasts in each case above indicate that the country tends to import more LNG worth several hundred billion baht per year in the future. Thus, LNG business will become more important both in terms of energy security and the overall economy of the country. The government then has to consider ways of promoting competition in the LNG business and regulating the procurement of LNG and its management.

The demand for natural gas

Demand for natural gas in Thailand had grown steadily during the past five years (2010-2014) with average growth rate of 5.6 percent per year. Most of the demand was in the electricity generating sector. For the next 10 years, demand for natural gas will increase in all sectors including electricity generating, industrial, and transportation sectors. It is predicted to increase from 4,810 million cubic feet per day (at 1,000 Btu per 1 cubic feet of natural gas) in 2015 to 5,099 million cubic feet per day in 2019 or 1.6 percent average annual growth. However, in the long-term, it is expected to decrease to 4,344 million cubic feet per day in 2036 due to the decline of natural gas in electricity generating sector resulted from the policy to diversify fuel mix in electricity generating sector. The demand forecast of each sector can be described as follows:

Electricity generating sector

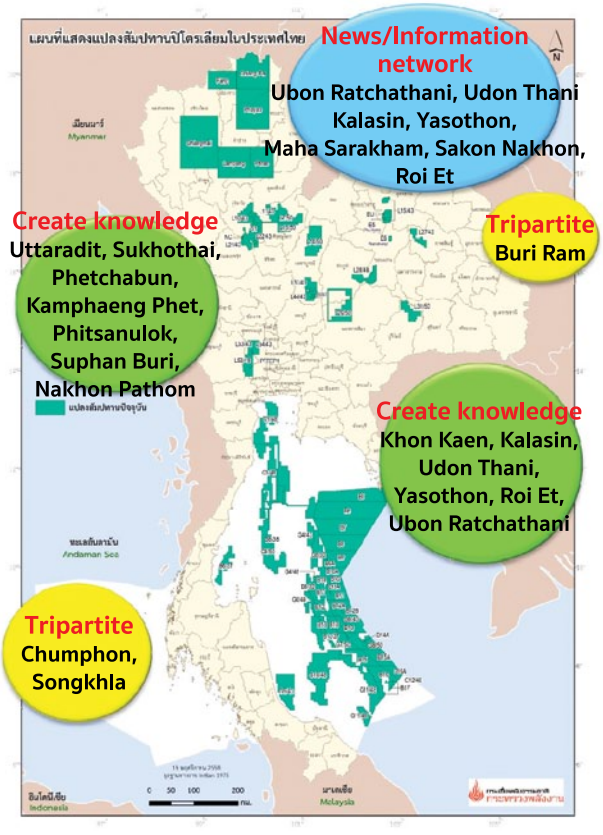
The PDP 2015 focuses on the diversification of fuel mixfor electricity generation in order to reduce the risk of dependence on some types of fuels and takes into account the cost of generating electricity by increasing the proportion of electricity generating from clean coal technology, increasing supply of electricity from abroad, promoting the use of renewable energy to generate electricity and introducing nuclear power plants at the end of the plan. The PDP 2015 is integrated with the EEP 2015 which target to reduce energy consumption by 89,672 million units in 2036 and the AEDP 2015 which set to generate electricity to the grid by 19,634 MW in 2036. Results of the operations described above will reduce the proportion of natural gas use in electricity generating sector in PDP 2015 from 64 percent in 2014 to 37 percent in 2036.

It is expected that the demand for natural gas in the electricity generating sector will change slightly from 2,787 million cubic feet per day in 2015 to be at 3,037 million cubic feet per day in 2036, averaging about 0.5 percent annual growth. After that, the demand will decline to 2,609 million cubic feet in 2036.

Petrochemical sector

The use of natural gas in the petrochemical sector depends up on the volume of natural gas from the Gulf of Thailand that passes through the gas separation plants. Currently, there are six gas separation plants with total capacity of 2,740 million cubic feet per day. It is expected that the demand for natural gas in the petrochemical sector will average about 1,000 million cubic feet per day from now until 2025. After that, demand for gas in the petrochemical sector will continue to decline along with the rate of natural gas production from the Gulf of Thailand. Demand for natural gas in the petrochemical sector is expected to drop to about 450 million cubic feet a day in 2036.

Creating awareness and network of petroleum sector



Target

Increase awareness and positive attitude towards the mission of petroleum management to the public in various sectors and to be a network to carry out petroleum exploration and production activities.

Target Group

Provincial government agencies / district office, community leaders, provincial energy agencies, press, public and students in target areas.

Directions

Meeting: provincial level and small group
Meet with community leaders
Press release/radio
Activities to reinforce knowledge
Establish news/information center
Set up Tripartite

Period: During 2016

Industrial sector

Forecast of demand for natural gas in industrial sector is in line with the expansion plan of the natural gas pipeline network. At present, PTT is constructing onshore gas pipelines from Rayong to Kaeng Khoi (the 4th pipeline) and regional natural gas pipelines including natural gas pipeline to Nakhon Sawan and natural gas pipeline to Nakhon Ratchasima. The forecast of natural gas demand in industrial sector came from data collection in industrial

market along the current and future pipelines (which include the first, second, third and fourth onshore pipelines , the regional gas pipeline to Nakhon Sawan and Nakhon Ratchasima, and all gas distribution pipeline networks). As a result, the demand for natural gas in the industrial sector during 2014-2019will increase at an average growth rate of 5.5 percent whereas in the long-term (2019-2036), such compound annual growth rate will drop to 0.2 percent.Those result in the increase of gas demand in industrial sector from the current of 700 million cubic feet per day in 2015 to 900 million cubic feet per day in 2036.

Transportation sector

Demand for natural gas in the transportation sector is in accordance with the government policy that promotes the use of natural gas in the transportation sector, especially trucks and buses, and policy on restructuring fuels' prices and NGV price under the Oil Plan. It is expected that the use of natural gas in the transportation sector will grow at the rate of 3.4 percent during 2015-2019. While, in the long-term, such growth is expected to fall to -0.4 percent (during 2019-2036) with the utilization rate at around 340 million cubic feet per day in 2036.

Action plan to support the Gas Plan 2015

The Ministry of Energy has set the frameworks to support the gas plan 2015 as follows:

1. Reduce the use of natural gas whose costs are rising rapidly due to LNG imports

- Introducing price signal and adjusting pool pricing for new natural gas consumers to consider the economic cost of each project, whichwill be based on LNG prices but not the average gas prices from the Gulf and imported gas (pool price). For the guideline of adjusting the pool price, Energy Policy and Planning Office (EPPO) and Energy Regulatory Commission (ERC) are currently conducting a study which is due to finish by the first quarter of 2016.

- Reduce the dependence on natural gas by diversifying fuel use under the PDP 2015. Reduce the dependence on natural gas for electricity generation by developing power plants as planned in the PDP 2015, emphasizing on the increase of the proportion of electricity generated from clean coal technology, and increasing the proportion of electricity generated from renewable energy in accordance with the AEDP 2015 from 8 percent to 20 percent of the total electricity demand of the country or from 7,490 MW of installed capacity in 2014 to 19,634 MW in 2036.

- Accelerate energy efficiency measures to optimize the use of natural gas in industrial sector to comply with the EEP 2015 under six key action plans which are: 1) the management of designated factories and buildings, 2) the implementation of building standard, 3) the implementation of Energy Efficiency Standards and Labeling measures (HEPs. & MEPs), 4) financial support, 5) promote the use of LED and 6) enforcement of energy efficiency standards for energy producers and distributors. If the above plans are successfully implemented, it would help reduce the electricity consumption by 89,672 units during 2014-2036.

- Promote the use of natural gas for vehicles (NGV) in public transports and trucks.

2. Maintain the level of production from domestic resources by promoting exploration and development in domestic fields and the use of technology.

- Open new round of bidding for petroleum exploration and production concessions in order to continue petroleum exploration. At present, there are three gas fields in the Thai Gulf whose gas has already been discovered and will be opened for bidding. It is expected that gas reserves will be about 0.3 trillion cubic feet. The preliminary assessment shows the potential resources to be opened for bidding may have around 1-5 trillion cubic feet of natural gas and 20-50 million barrels of crude oil with a minimum investment of 5,000 million baht.

- The management of expiring concessions is to maintain natural gas production of major gas fields in the Thai Gulf and to develop existing petroleum resources after the concession expired. The MoE is currently in the process of drafting guidelines for the management of such concessions in one-year time frame as approved by the National Energy Policy Council (NEPC) on May 14th, 2015.

- Managing natural gas resources in the Thai Gulf: In the short-term, MoE will incorporating with PTT to reduce Bypass Gas (gas not passed through GSP). At present, the natural gas from the Thai Gulf and the Thailand-Malaysia joint developed areas in the Gulf of Thailand can produce natural gas at an average rate of 3,700 million cubic feet per day. However, the six GSPs can receive natural gas at a maximum of 2,740 million cubic feet per day. These result in bypass gas of more than 900 million cubic feet per day. To reduce the volume of natural gas delivered from the Gulf will help extend the production life of gas fields and maximize gas utilization. Imported LNG should be considered when its price is close to the prices of gas in the Thai Gulf in order to replace gas from the Thai Gulf when the production starts decline. In long-term, there will be supports for the development of small fields (Marginal Field) and for the increase ofrecovery rate.

- The development of natural gas with neighboring countries.

3. Procure and manage LNG efficiently

- Increase the number of suppliers and distributors to build domestic competition as the country tends to import more LNG in the future, from 2 million tons per year at the present to 24 million tons per year in the next 20 years, or about 70 percent of the natural gas supply of the country at that time. Statistically, the countries with LNG imports of more than 3.5 million tons per annum have more than oneLNG importers. Therefore, the MoE has a policy to increase the number of LNG suppliers to promote the competition in the LNG business. This will need a proper legal framework and

management to support the upcoming competitions. Major issues to be considered include 1) the revision of natural gas pricing mechanism for new market, from Pool Price to LNG Market Price (currently studying by EPPO and ERC). And 2) the stipulation of TPA for LNG Terminal.

- Strengthen cooperation in the supply of natural gas in the AEC level via ASCOPE including the establishment of AEC LNG Buyer Club.

- Establish LNG bureau to support and investigate risks of procurement and to set up database and analytical tool (Global LNG Database and Analytical Tools). In the next 20 years, LNG import tends to increase by 12-15 times from today, which is accounted for more than 400,000 million baht per year. The policies to foster competition in the supply of LNG will result in increasing suppliers and distributors in the future. Thus, suitable regulation for LNG procurement and management are needed (the study on the restructuring of the natural gas business is currently conducting by EPPO and ERC).

4. Encourage infrastructure development and prepare guidelines for competition in both physical (a network of gas pipelines and receiving LNG dock) and the rules that conform to the gas supply plan (Third Party Access : TPA)

The longterm natural gas supply plan indicates that the existing infrastructure and those under construction (for LNG for up to 10 million tons per year) can support imported LNG until 2022. To be able to meet natural gas demand in the future, it is necessary to have the investment and development plan forgas infrastructures including the natural gas pipeline and the LNG receiving terminal by taking into account economic, environmental and energy security aspects and the rules that are in line with the policy to promote competition such as TPA.

There are three cases for the longterm natural gas supply plan. The base case is selected by the Ministry of Energy to use as a reference for future action plans. To make gas demand and supply in line with the base case, the MoE is required to undertake major projects such asthe construction of coal-fired power plants to diversify fuel use in electricity generation, the AEDP and EEDP, the new bidding round for petroleum concession, the management of expiring concessions and etc. There will also be plans for infrastructure development to support the supply of natural gas and LNG imports in the future. At present, the first phase of LNG receiving terminal has a capacity of up to 5 million tons per annum, while the second phase is currently under construction and expected to be completed by 2017. By combining both phases, it will have a capacity of 10 million tons per annum in total. By considering the natural gas supply plan under the base case, such LNG infrastructures will be able to receive the LNG imports until 2022. Therefore, it is necessary to prepare for the management and the development of infrastructures to support the increasing demand of LNG and to prevent natural gas shortage of in the future.

PDP 2015 | EEP 2015 | AEDP 2015 | GAS PLAN | OIL PLAN

Oil Supply Management Plan : Oil Plan 2015

Long-term Oil Plan 2015-2036 is aimed to determine the management of fuels to be aligned with the aims of the other plans, especially with the EEP 2015 and the AEDP 2015. The Oil Plan 2015 also aims at providing the policy framework and the preparation of the future Oil Plan, by taking into account surrounding factors and possible risks that could evolve and affect the development national energy both directly and indirectly.

Fuels demand forecast resulted in the preparation of the Oil Plan to support the measures on fuel saving in transportation sector under the Energy Efficiency Plan 2015-2036 (the EEP 2015), the management of fuel types, the revision of oil price structure, and the ethanol and biodiesel usage promotion under the AEDP 2015. It can be seen that the Oil Plan has been established to incorporate with the other plans and make the energy integrated plan more successful in long term.

Five principles in preparation of the Oil Plan 2015

1. The support energy efficiency measures in transportation sector according to the Energy Efficiency Plan (EEP 2015)
2. The management of fuel types
3. The revision of fuel prices
4. The promotion to boost ethanol and biodiesel usage to comply the Alternative Energy Development Plan 2015-2036 (AEDP 2015)
5. The investment supports in fuel related infrastructure

Oil Supply Management Plan : Oil Plan 2015

National energy policies and plans, which have continuously been proceeded by the Ministry of Energy, are the integration of all energy plans particularly the Oil Plan that links with other energy plans in an attempt to balance energy usage more effectively and to determine the directions of energy policy development.

The preparation of the Oil Plan 2015

The Oil Plan 2015 is an integration plan between the EEP 2015 and the AEDP 2015, while the oil demand forecast is based on the EEP 2015.

According to the Oil Plan, "Fuels" means oil, gas, liquid petroleum used as a fuel and natural gas for vehicles (NGV). This plan focuses on the fuels use in transportation sector whose consumption is the highest compared to other sectors. Under the EEP 2015, demand for fuels under Business-as-Usual (BAU) case will increase to 65,459 ktoe in 2036, as shown in the table below. The energy efficiency measure in transportation sector under the EEP 2015 can be divided into four groups as follows:

Group 1 Regulate fuel prices in transport sector to reflect actual costs.

Group 2 Improve the fuel efficiency in automobiles.

Group 3 Promote the management of trucks and buses.

Group 4 Develop infrastructure for transports.

Fuel Oils demand forecast database

Unit : ktoe

Economic sectors	Oil types	BAU		EEP 100%	
		Year 2026	Year 2036	Year 2026	Year 2036
Transport	Gasoline	9,303	12,934	4,683	4,523
	Diesel	17,086	24,309	9,898	10,067
	LPG	4,601	8,001	2,785	4,264
	Natural gas	5,731	9,269	4,020	5,447
	JP-8	7,206	10,036	7,206	10,036
	Fuel oil	1,010	909	1,010	909
	Sub total (transport)	**44,937**	**65,459**	**29,602**	**35,246**
All sectors	Gasoline	9,381	13,012	4,760	4,600
	Diesel	23,972	32,389	16,784	18,147
	LPG	8,986	13,022	7,170	9,285
	Natural gas	5,731	9,269	4,020	5,447
	JP-8	7,217	10,047	7,217	10,047
	Fuel oil	1,699	1,598	1,699	1,598
	Total	**56,985**	**79,338**	**41,650**	**49,125**

Source : EPPO
Remark : BAU = Business as Usual
EEP = Energy Efficiency Plan
ktoe = kilo ton of oil equivalent

Preparation of 5-principle oil plan

According to the fuel demand forecast, the department of Energy Business (DOEB), the ministry of Energy, defines 5 principles in the Oil Plan which are:

- ✓ The support on energy efficiency measures in transportation sector according to the Energy Efficiency Plan (EEP 2015).
- ✓ The management of fuel types.
- ✓ The revision of fuel prices to reflect actual costs.
- ✓ The promotion to boost ethanol and biodiesel usage to comply the Alternative Energy Development Plan 2015-2036 (AEDP 2015).
- ✓ Investment supports in fuel related infrastructures.

Measures and the management of fuel use

1. To Support energy efficiency measures in the transportation sector according to the Energy Efficiency Plan (EEP 2015)

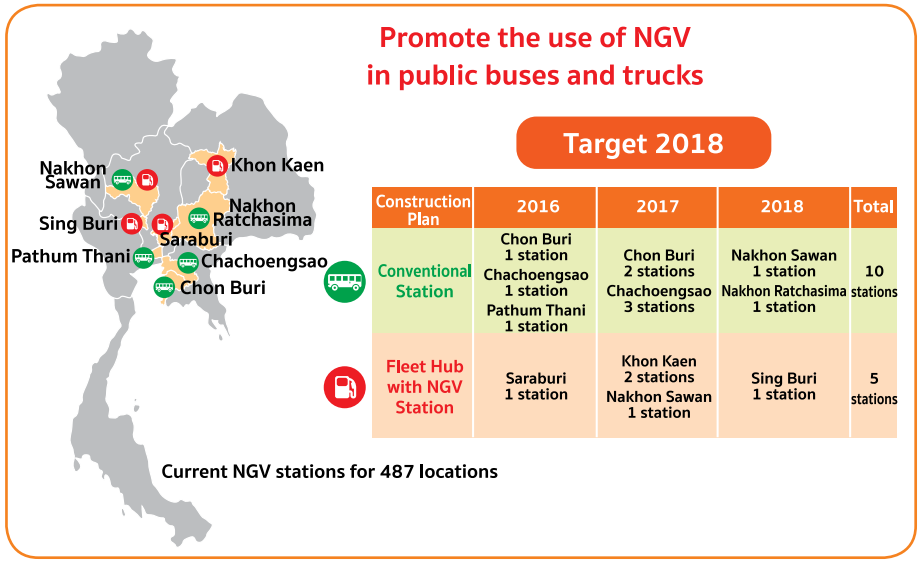
The EEP 2015 aims at reducing energy intensity by 30 percent in 2036 compared to 2010. Under the plan, there are four energy efficiency measures in four economic sectors including transportation, industrial, large/small-scale business buildings, and residential sectors. In the transportation sector, energy-saving target is set at 30,213 ktoe.

The measures also include guideline to encourage the useof eco-car, labeling of energy efficiency in vehicles' tires, the management of transportation for energy saving, Energy Service Company Revolving Fund, supports on energy saving in transportation sector (SOP+DSM), the development of transport infrastructure e.g. electrical railway mass transit and double-track railway, and the improvement of oil logistics by developing oil pipeline system.

2. To manage fuel types properly

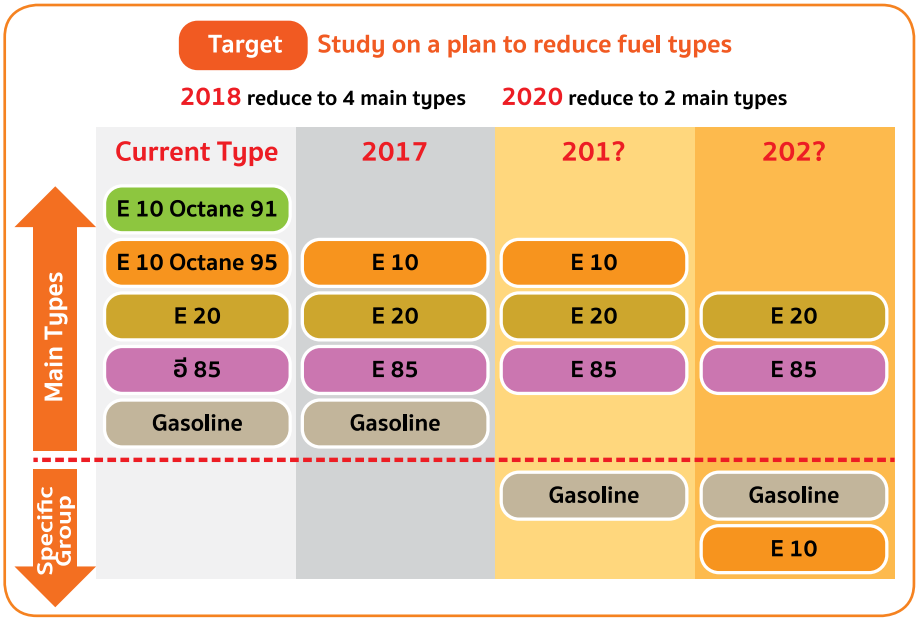
There are several measures for the management of oil and fuel types to suit consumers' needs. For liquefied petroleum gas, measures include the restructuring of LPG price to reflect costof each supply source and the collection of excise tax on heating value by comparing with gasoline and gasohol to reduce distortionin the market mechanism, For CNG or NGV, the measures are the adjustment of NGV retail price to reflect actual cost, the NGV retail price subsidies for public transport vehicles and trucks, and the collection of excise tax at the same rate as other fuels used in transportation sector. Moreover, there are relevant measures for service stations; for examples, supports for the construction of NGV stations only along the gas pipelines, the establishment of truck loading terminal with NGV station (NGV Terminal Hub), and the specific supports for public transport vehicles and trucks to use NGV.

The measure to expand the NGV service station



Construction Plan	2016	2017	2018	Total
Conventional Station	Chon Buri 1 station Chachoengsao 1 station Pathum Thani 1 station	Chon Buri 2 stations Chachoengsao 3 stations	Nakhon Sawan 1 station Nakhon Ratchasima 1 station	10 stations
Fleet Hub with NGV Station	Saraburi 1 station	Khon Kaen 2 stations Nakhon Sawan 1 station	Sing Buri 1 station	5 stations

Reduce fuel types (gasoline and gasohol)



For the management of fuel type to comply with ASEAN standards, types of fuels will be reduced and their qualities will be pushed to the similar standard. The use of ethanol will depend on the potential of car engine. Types of fuels in gasoline-gasohol group will be adjusted to complywith the vehicle technology by taking into account the balance of oil refineries. For the oil pricemeasure, the price difference of each type of gasohol will be determined.In addition, a working group to specify fuel quality standards for transportation sector in ASEAN region will be established.

3. To revisefuel prices to reflect actual costs

This measure is to conform fuel price structure to actual costs and to have proper tax rates among different types of fuels and consumers in order to increase energy efficiency of the country. On 15th December 2014, the National Energy Policy Council (NEPC) approved the framework and action plans for the restructuring of fuel prices in transportation sector which can be summarized as follows:

1) Energy prices must reflect its actual cost

2) The price of fuel used in transportation sector should have the similar tax rate.

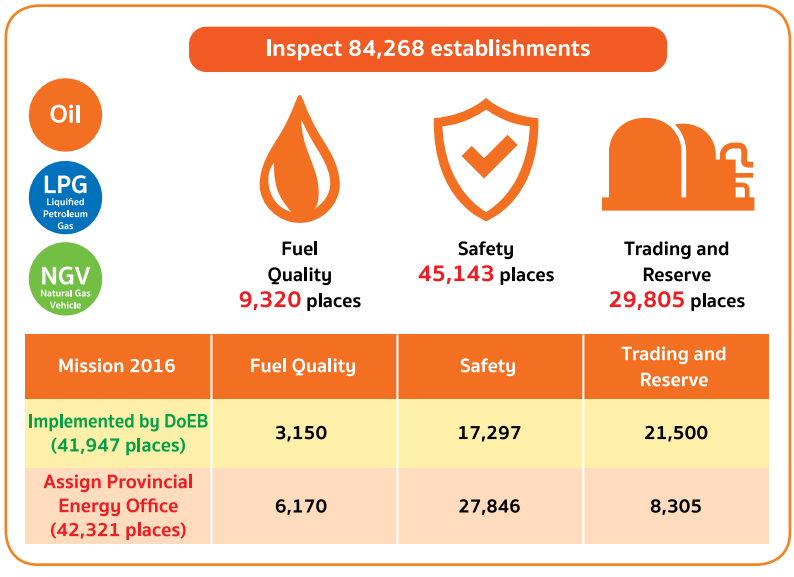
3) Oil Fund has to be used for stabilizing fuel prices and promoting the use of renewable energy

4) Reduce cross-subsidy among different fuel types

5) Marketing margin should be set at the appropriate level.

6) Oil Fund collection rate should be similar and rely on heating values.

Implementation



Mission 2016	Fuel Quality	Safety	Trading and Reserve
Implemented by DoEB (41,947 places)	3,150	17,297	21,500
Assign Provincial Energy Office (42,321 places)	6,170	27,846	8,305

3.1 The restructuring of oil prices

- To adjust excise tax rate in gasoline group and diesel to be in the range of 2.85 to 5.55 baht/liter by taking into account the emission costs and the maintenance costs of damaged road.
- To define the retail price difference among each fuel.
- To set appropriate and fair rate for marketing margin.

3.2 The restructuring of LPG prices

- LPG price should reflect actual costs of each supply source.
- Adjust excise tax rate on heating value by comparing with gasoline-gasohol group to reduce market distortion.

3.3 The restructuring of NGV price

- NGV price should reflect its actual cost.
- To consider the collection of excise tax.

4. To encourage the use of ethanol and biodiesel to comply with the Alternative Energy Development Plan 2015-2036 (AEDP 2015)

Encouragethe use of biofuel by taking into account the production potential of agricultural raw materials, without any impacts on food, and the technology of automobile.

4.1 Encourage the use of ethanol in transportation sector

- Encourage the use of gasohol that suit the potential of the car through public relations to build confidence and understanding about gasohol E20 and gasohol E85
- Introduce programs to promote the use of gasohol E85 in government's and state enterprises'cars and motorcycles.
- Set price difference to attract car users to use gasohol.
- Promote tax incentives for automobiles that fueled with a higher percentage of ethanol.

4.2 Encourage the use of biodiesel in transportation sector

- Encourage the use of B20 in truck fleets.
- Use tax incentives measures to promote the use of higher blend biodiesel to accommodate with the new automobile tax structure for cars with H-FAME technology.

5. Support the investment in oil infrastructure

There will be efficient logistic support system by developing transportation of oil via pipelines, which will be opened to private sector to carry out the oil pipeline construction to the Northern and Northeast regions with an aim to initiate free competition. The construction has to complywith the conditions set by the MoE and to seek cooperation from other governmental agencies to provide supports by allowing the laying of oil pipeline in their lands such as the Department of Highways, Department of Rural Roads, State Railway of Thailand, Royal Irrigation Department, and Electricity Generating Authority of Thailand to attract the investment from private sector. The MoE will collaborate with the private sectors, who are interested to investing in oil pipeline, to consider the route of oil pipelines, the location of oil depot and the volume of oil to be delivered through the pipelines. At present, the Energy Regulatory Commission (ERC), is regulating the gas pipeline. Thus ERC should be assigned to regulate the oil pipeline.

For the strategic oil reserve plan to support the investment in oil infrastructure, MoE will conduct a study in order to carry out the strategic oil reserve guidelines whose details are as follows:

- Strategic oil reserve is the responsibility of the government.
- Commercial oil reserveis the responsibility of the private sector.
- Number of days of strategic reserve depends upon global crisis such as wars or disaster to oil producers
- Number ofdays of commercial oil reserve depends upon normal situation with chances of unexpected events such as accidents or problems in transport.

The tasks that need to be cooperated by provincial energy agencies include:

Oil tank trucks: The licenses for new oil tank trucks have to apply directly through the DoEB. In case that the application has already been submitted to the provincial energy agencies, such application also has to be forwarded to the DoEB.

Fuel sampling: collect fuel samples and send them within the prescribed period of time.

Checking fuel inventories: announcing the rate of fuel reserves and the method of measuring the amount of oil remaining in the tank.

Notification and verification of information: update the notification of change of business and the cancellation of business of fuel traders (if any).

Manuals for citizen: gather problems and obstacles caused by public services and conduct public satisfaction survey in order to develop guidelines for the public.

Expansion of oil pipelines: taking part in the public hearings on environmental impact assessment (EIA) and coordinating with local authorities.

Replace NGV steel cylinders with composite cylinders: composite cylinders are safer to government officers and people in three southern provinces of Thailand than steel cylinders. Therefore, it is necessary to increase concentration in public relation, monitoring, and coordination.

The determination of fuel management under the Oil Plan to comply with the other energy plans focuses on the efficient management of fuels in all sectors by taking into account the current energy situations. This will as well strengthen energy development of Thailand in the future.

Conclusion

The Ministry of Energy has established the policy which combines all five energy plans together (Energy Development Plans Integration) including (1) Power Development Plan (PDP), (2) Energy Efficiency Plan (EEP), (3) Alternative Energy Development Plan (AEDP), (4) Gas Plan, and (5) Oil Plan. The major goal of the policy is to bring all the management in energy aspects to be in the same direction systematically. To achieve that goal, the MoE, has taken a stand on the principle combining; **Energy Security,** targeting at electricity supplying sufficiently to electricity demand and diversification of fuel mixed used to reduce the risk on using an only one type of fuel; **Economy,** targeting at suitable cost of electricity production and efficient electricity usage in various economics sectors; and **Ecology,** targeting at reducing environmental and community impacts, especially the ratio of CO_2 reduction to electricity production unit for economy development purpose of the country.

Key Milestone under the Long-term Thailand Energy Integrated Blueprint

	Details	Outputs
Power Development Plan (PDP) 	• **Increase balance in energy consumption** via clean-coal technology for electricity production • Coal Center	• Increase portion in using coal from 20% to 25% • **Use clean-coal by 20%** from previous over all coal used
Energy Efficiency Plan (EEP) 	• **Cancel compensation of oil price** to reflect actual cost in the global market • **Activate energy conservation** through various measures to promote energy conservation	• **Aim at reducing Energy Intensity by 30%**
Alternative Energy Development Plan (AEDP) : Alternative Energy 	• **Action plan for each type of alternative energy according to Cost Effectiveness principle :** o Provoke : waste, biomass and natural gas o Continuous operate : solar power o Follow : wind power	• Increase portion in using alternative energy **in electricity production to 20%** (currently around 9%)
Alternative Energy Development Plan (AEDP) : Bio-fuels 	• **Increase product quantity in agricultural sector** to reduce imported oil, increase Bio-fuels, and generate income for farmers	• **Aim to using Bio-fuels at 20-25% in transportation sector** (currently 7%) • Raise GDP at 50,000 million baht/year
Oil and Natural Gas 	• **Extend lifespan of resources in the country** using the policy to motivate exploration and production in the country, and to manage expiring concession	• Limit the decreasing rate of natural gas production in domestic resources from 2-5% per year (from 11% per year)
Economics Sector 	• **The measure to assist the poor** to response to the demand of specific group of people	• Raise financial amount in the economic system for 380,800 million baht for the highest benefits

THAILAND INTEGRATED ENERGY BLUEPRINT

Power Development Plan

Energy Efficiency Plan

Alternative Energy Development Plan

Oil Plan

Gas Plan

Energy Policy and Planning Office
MINISTRY OF ENERGY