



# THAILAND ALTERNATIVE ENERGY



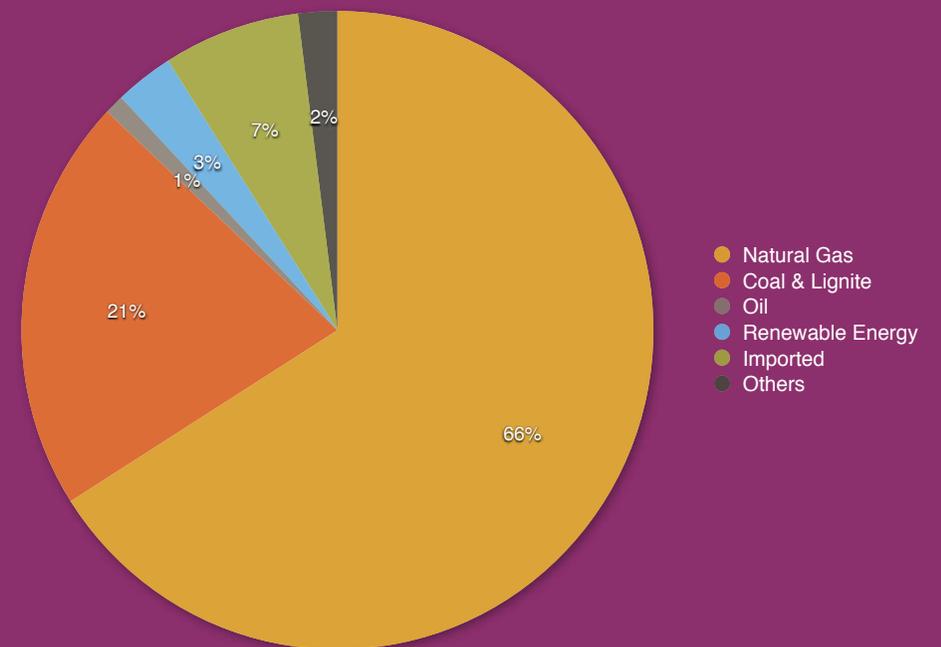
## ALTERNATIVE ENERGY IN THAILAND

In order to strengthen Thailand's long-term energy security and global economic competitiveness the country has committed itself to develop its alternative energy capabilities. This policy emerged at the national level as the Alternative Energy and Development Plan (AEDP), a 10 year initiative (2012-2021) to better diversify and build a more sustainable energy sector. With this plan, Thailand has set the target of increasing alternative energy consumption from 9,025 ktoe (kilo tonnes of oil equivalent) in 2014 to 24,638 ktoe in 2021. The Department of Alternative Energy and Development and Efficiency has been assigned to oversee alternative and renewable energy improvement.

According to the Energy Policy and Planning Office, Ministry of Energy, Thailand used the equivalent of 2 million barrels of oil per day in 2014. Furthermore, the sector is heavily reliant on foreign inputs considering over half (57%) of that energy is imported. Total energy expenditure in 2014 was US\$66 billion, 1.87% higher than in 2013. The largest energy consumers in 2014 are the industrial (using 37.1% of total energy) and transportation (using 35.4% of total energy) sectors.

In general, the major source of power generation in Thailand comes from natural gas, contributing to 66% of the total share in 2014. The other significant sources are coal and lignite which make up 21% of the share. Renewable energy currently only represents 3% of the power produced in Thailand. However, according to the AEDP initiative, this will be increased considerably in the coming years. This will be further explained in the following section.

Thailand's Power Generation by Energy Sources, 2014



Source: Energy Policy and Planning Office, Ministry of Energy



# ENERGY SAVINGS AND TARGETS

## The Renewable and Alternative Energy Development Plan (AEDP), 2012-2021

It is expected that the energy demand in Thailand will continue to rise. As previously mentioned, Thailand's commercial energy consumption in 2014 averaged 2 million barrels of oil per day; this is a 2.5% increase from the previous year. Furthermore, the government projection as stated in the AEDP plan, estimates the energy demand in 2021 will reach 99,838 ktoe, a 47% increase from the 2014 level which was 68,101 ktoe.

More importantly, the government plans to reduce Thailand's reliance on foreign energy import that accounted for more than 57% of the primary commercial energy demand in 2014. Thailand's oil sector was even more reliant on imports, reaching 85% of total domestic oil consumption. In an effort to cut down on these dependencies and increase energy security the AEDP initiative was formed.



The end goal of the AEDP is to achieve 25% reliance on total national energy generation from alternative or renewable sources by the year 2021 and to set the country's societal development on a path towards a low-carbon usage base, away from fossil fuels. The breakdown of the sources is: solar, wind, hydro-power, bio-energy (biomass, bio-gas, MSW), biofuels (ethanol, bio-diesel, new alternative diesel fuel), and new energy sources (tidal, geothermal).

The main focus of the plan is on solar and bio-energy because of the suitability and ease of production for these energy sources in Thailand. The country's tropical location makes it an ideal place for the development of solar energy as the country receives a large amount of solar radiation throughout the year. As for bio-energy, Thailand's economy is heavily based on agriculture, leading to the production of large amounts of agriculture and municipal waste that could be converted into usable energy.

The Ministry of Energy established a roadmap as a strategy to promote the Alternative Energy Development Plan through the following six strategic initiatives:

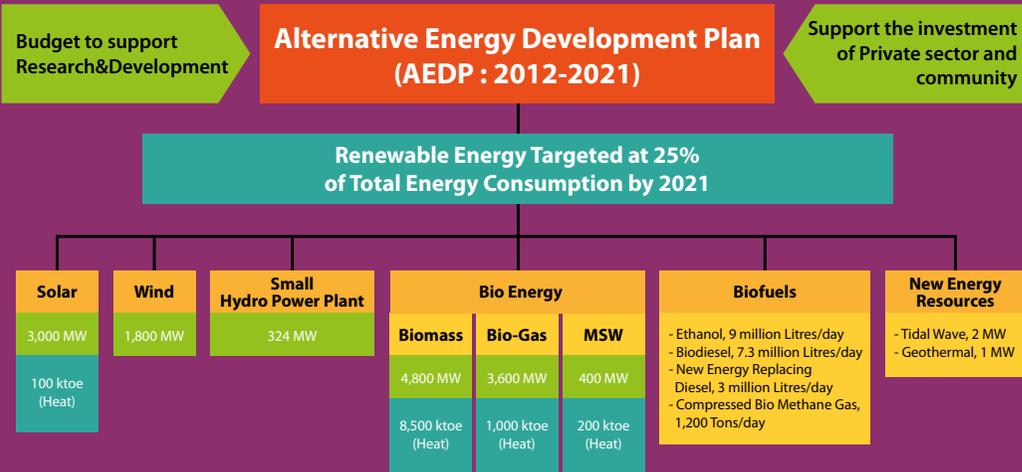
1. Promoting community collaboration in the broadening of production and consumption of renewable energy.
2. Adjusting the incentive measures to promote stronger investment from the private sector.
3. Amending the laws and regulations that do not benefit renewable energy development.
4. Improving the infrastructure system of transmission lines, power distribution lines, and including the development of a Smart Grid System.
5. Improving public relations and building up public awareness and understanding.
6. Promoting research as a mechanism for the development of a holistic alternative energy industry.





**Alternative Energy Development Plan (AEDP)  
2012 – 2021**

**Development of low-carbon society**



Source: Department of Alternative Energy Development and Efficiency, Ministry of Energy as of 2015

**The AEDP Renewable Energy Consumption Target (2021) and 2014**

Type of Energy	Unit	Target 2021	As of 2014
<b>Total Electricity</b>	<b>MW</b>	<b>13,927</b>	<b>4,494</b>
Solar	MW	3,000	1,299
Wind	MW	1,800	224
Small Hydro Power	MW	324	142
Biomass	MW	4,800	2,452
Biogas	MW	3,600	312
MSW	MW	400	66
New Energy	MW	3	-
<b>Total Heat</b>	<b>ktoe</b>	<b>9,801</b>	<b>5,775</b>
Solar	ktoe	100	5
Biomass	ktoe	8,500	5,184
Biogas	ktoe	1,000	488
MSW	ktoe	200	98
<b>Total Biofuels</b>	<b>million litres/day</b>	<b>19.2</b>	<b>6</b>
Ethanol	million litres/day	9	3
Biodiesel	million litres/day	7.2	3
New Energy Replacing Diesel	million litres/day	3	-
Compressed Bio-Methane Gas	ton/day	1,200	-
<b>Alternative Energy</b>		<b>25%</b>	<b>11.91%</b>

Source: Department of Alternative Energy Development and Efficiency, Ministry of Energy as of 2015

# Biomass

Energy sourced from biomass is set to be one of the main players in the AEDP initiative to ramp up renewable energy production. This strategy is advantageous because, Thailand, being an agriculture based economy, produces around 80 million tons of agriculture waste per year. This is a substantial pool of untapped energy available to be capitalized on. Biomass energy production utilizes the combustion or partial-combustion of organic material that could be converted to electricity or fuel. The materials readily available in the country are solid waste from rice, sugarcane, cassava, corn, rubber and palm production. In 2014, Thailand consumed 2,452 megawatts of energy from biomass. According to the AEDP, Thailand aims to increase the use of biomass for energy to 4,800 megawatts by 2021. The government has also included biomass energy in the country's Feed-in Tariff scheme.

# Biogas

Biogas could be produced from pig farms, cattle farms, animal slaughter houses, palm oil production, sugar factories, paper factories, ethanol factories and municipal solid waste. The main process behind it involves the decomposition of organic matter by bacteria which produces gases that are usable as fuel. The gas that is produced is mainly composed of methane mixed with carbon dioxide and other elements at trace levels. Thailand consumed 312 megawatts of electricity produced from biogas energy in 2014. AEDP aims for 3,600 megawatts of biogas utilization by 2021. The government has also included biogas energy in the country's Feed-in Tariff scheme.



## Agricultural Residues

Type of Agriculture Crop	Annual Crop Production (Million ton/year)	Generated Waste	Annual Waste Production (Million ton/year)	Potential Area in Thailand
Sugar cane	100	Top and leaf, Bagasse	15	Northeast, North
Oil palm	15	Palm shell, Fiber, Empty fruit bunch, Trunk	21	South
Rice	39	Husk, Straw	11	North, Northeast
Maize	5	Cob, Stalk	9	North, Northeast
Cassava	30	Rhizome	6	Northeast, North
Rubber tree	0.22	Root, Sawdust, Slab	0.88	South, East
Coconut	1	Shell, Husk, Flower	0.26	South, West
Cashew nut	0.09	Shell	0.07	East, Northeast
Legume	0.06	Stalk, Shell, Leaf	0.06	North, Northeast

Source: Department of Alternative Energy Development and Efficiency, Ministry of Energy as of 2013



**“We see a bright future for biogas power plants: Thailand not only possesses an abundance of renewable energy material and waste but also a strong framework that supports the generation of biogas from these sources. With over 10 years’ experience in the biogas sector, we actively support to utilize this renewable energy potential.”**

-Dr. Nils Rottmann, Managing Director, North-Tec Biogas Thailand Co., Ltd.;  
BioEnergy Germany Co. Ltd.-

# Municipal Solid Waste (MSW)

Utilizing municipal solid waste is also another strategy used by the government to promote alternative energy. It also has the added benefit of increasing landfill capacity, by reducing storage materials. In 2014, Thailand generated approximately 26 million tons of MSW much of which could be converted to energy. MSW is converted to electrical energy mainly through incineration in heat boilers and powering turbines. Currently there are 21 waste power plants in Thailand. In 2014, Thailand consumed 66 megawatts of power through MSW. These numbers are set to grow as the AEDP initiative has set a target of 400 megawatts by 2021. The government has also included MSW energy in the country's Feed-in Tariff scheme.

# Biofuels

A more sustainable source of fuel for combustion engines has been a primary focus for the Royal Thai government's energy security plans. Biofuels have been characterized as being cleaner, more economic, widely available and less harmful to human and environmental health than fossil fuels.

Biofuels that are currently commercially produced and utilized in Thailand can be categorized into two general types, biodiesel and ethanol. **Biodiesel** is a diesel fuel substitute derived from lipid-based biomass, through transesterification. Commercially available products in the market are "B100" and "B5" biodiesel. Overall production of biodiesel is increasing. In 2014, two more biodiesel manufacturers obtained the quality standards accreditation set by the Department of Energy Business, with a total production capacity of 560,000 liters per day. The goal of AEDP is to increase the consumption of biodiesel to 7.2 million liters per day by 2021.

The other form of biofuel in the country is ethanol. **Ethanol** is a petrol fuel substitute that is derived from sugar-based biomass and lignocellulose biomass, by fermenting plant materials such as sugar cane molasses, tapioca, paddy straw, cassava and corn. Raw material used for ethanol production is widely available in Thailand. In 2014, Thailand was the world's largest exporter of cassava starch and the second largest exporter of refined sugar.

The consumption of ethanol was 3 million liters per day in 2014 and is estimated to reach the target of 9 million liters per day by 2021. Currently, there are 21 factories producing ethanol in Thailand with a total capacity of 5.04 million liters per day. The government has also included biofuel energy in the country's Feed-in Tariff scheme.



# Solar Energy

Thailand has a high potential for utilizing solar radiation as an alternative source of energy. The average solar radiation received throughout the country is 18.2 MJ/m<sup>2</sup> per day. Moreover, according to the Department of Alternative Energy Development and Efficiency, only 0.5% of the total land area in Thailand receives less than 16 MJ/m<sup>2</sup> per day of sunlight, making most areas suitable for solar energy harvesting. The areas receiving the highest amount of radiation are in the north-eastern and some parts of the central region. The country is exposed to the highest amount of sunlight during April and May.

Solar electrical power generation can be divided into two forms, photovoltaics (PV) and solar thermal heat systems. The photovoltaic process in solar cells converts solar energy directly into electricity. In a solar thermal heat system, solar energy is concentrated via reflections and used to heat fluids to generate steam, which in turn drives a steam turbine that produces electricity. This is considered one of the cleanest methods of electricity production as no emission is involved in the energy production process.

Thailand aims to substantially increase its solar energy production and economic support for this renewable technology. In 2014, Thailand solar power plant installation was 1,299 megawatts. Thailand's AEDP targets solar energy installation capacity of 3,000 megawatts by 2021. The government has also included solar energy in the country's Feed-in Tariff scheme.



## Wind Power

Wind power generation in Thailand has high potential in the offshore and gulf regions and is also feasible inland. The largest wind farm in Thailand is in Nakhon Ratchasima province and has a production capacity of 207 megawatts. While local wind energy potential is composed of many different factors including varying topography, the main meteorological factor influencing overall wind potential in Thailand is the seasonal monsoons. During the hot season winds speed can reach up to 20 km per hour and in the cool season this is reduced to around 10 km per hour. Overall wind speed can vary from one to more than seven meters per second. The highest wind speeds are found in the southern region of Thailand, in between the Andaman Sea and the Gulf of Thailand. Some areas in the north-eastern and western regions are also known to have strong winds. The government has also included wind energy in the country's Feed-in Tariff scheme.

In 2014, Thailand consumed 224 megawatts of commercial wind power and is aiming to reach 1,800 megawatts by 2021.

## Hydropower

Small hydropower plants have emerged as another viable option to increase Thailand's renewable energy usage. According to the Department of Alternative Energy Development and Efficiency there are 43 small hydropower plants currently in operation, with the highest concentration in the northern mountainous region. Small hydropower plant projects are also a crucial tool in controlling irrigation for agriculture usage and supporting rural communities' development programs.

In 2014, Thailand's small hydropower energy production totaled 142 megawatts. Thailand's AEDP has a target to increase power generation from small hydropower plants to 324 megawatts by 2021. The government has also included small hydropower in the country's Feed-in Tariff scheme.

## CLEAN DEVELOPMENT MECHANISM (CDM)

Thailand is also part of the global effort to reduce carbon emission to mitigate climate change. A mechanism to expedite that effort is the Clean Development Mechanism (CDM). This is a tool formed under the Kyoto Protocol to reduce carbon dioxide level in the atmosphere through carbon credit trading. It allows foreign investors from designated countries to buy carbon credits to offset their emission levels and helps the host country develop its sustainability goals through investments in green projects by trading Certified Emission reduction (CER) credits. In 2013, Thailand Greenhouse Gas Management Organization (TGO) issued a Letter of Approval (LoA) for 221 CDM projects, with expected average annual CER credits worth 12.71 megaton of carbon dioxide equivalent/year.





## SUPPORT FOR INVESTORS

To promote investment in renewable energy development, the Thai government has also initiated a Feed-in Tariff scheme to help new investors mitigate investment risks from the inconsistent nature of renewable energy sources such as local solar radiation exposure, water & wind availability and biological feedstock for energy production. Feed-in Tariff rate (FiTF) is a fixed buying rate for electricity calculated from initial investment of power plant construction and the full lifetime used of its operation and maintenance cost. Further, price inflation for raw material used in biological energy production (for waste, biomass and biogas) is expected. As such, the scheme will also compensate for this by adding an additional rate (FiTv,2017) on top of the fixed buying rate (resulting in FiT(1)). Additionally, rate add-ons (FiT Premium) are offered for targeted biofuel groups and projects located in the Southern border provinces. The details are as follows:

### FiT Rate For Very Small Renewable Power Producer Projects (VSPP)

Production Capacity (MW)	FiT (Baht/Unit)				FiT Premium (Baht/Unit)	
	FiTF	FiTv,2017	FiT <sup>(1)</sup>	Support Duration (Years)	Biofuel Project Group Participants (For the first 8 years)	Southern Border Provinces Group Participants <sup>(2)</sup> (For the duration of the project)
1) Waste (Integrated Waste Disposal)						
Installed Capacity ≤ 1 MW	3.13	3.21	6.34	20	0.70	0.50
Installed Capacity > 1-3 MW	2.61	3.21	5.82	20	0.70	0.50
Installed Capacity > 3 MW	2.39	2.69	5.08	20	0.70	0.50

Production Capacity (MW)	FiT (Baht/Unit)				FiT Premium (Baht/Unit)	
	FiTF	FiTv,2017	FiT <sup>(1)</sup>	Support Duration (Years)	Biofuel Project Group Participants (For the first 8 years)	Southern Border Provinces Group Participants <sup>(2)</sup> (For the duration of the project)
2) Waste (Landfill)	5.60	-	5.60	10	-	0.50
3) Biomass						
Installed Capacity ≤ 1 MW	3.13	2.21	5.34	20	0.50	0.50
Installed Capacity > 1-3 MW	2.61	2.21	4.82	20	0.40	0.50
Installed Capacity > 3 MW	2.39	1.85	4.24	20	0.30	0.50
4) Biogas (Liquid/solid waste)	3.76	-	3.76	20	0.50	0.50
5) Biogas (Energy Crops)	2.79	2.55	5.34	20	0.50	0.50
6) Water Energy						
Installed Capacity ≤ 200 kW	4.90	-	4.90	20	-	0.50
7) Wind Energy	6.06	-	6.06	20	-	0.50

Source: Energy Policy & Planning Office, Ministry of Energy as of 2015

Notes:

FiTF: Feed-in Tariff fixed rate, calculated from initial investment of the power plant construction and the full lifetime of its operation and maintenance cost.

FiTv,2017: Feed-in Tariff variable, calculated from investment cost of raw materials used for power generation that changes according to time.

(1)  $FiT = FiTF + FiTv$ . This FiT rate will only apply to projects that feed electricity into the system within the year 2017. After 2017, FiTv rate will continuously increase according to the core inflation rate. This only applies to waste (integrated waste disposal), biomass and biogas (energy crops) categories.

(2) Projects in Yala, Pattani, Narathiwat and Chana, Thepha, Saba-Yoi and Na-Thawi districts in Songkhla provinces.

### Solar Feed-in Tariff (FiT) Program

Renewable source	Power plant capacity	Support Duration (Years)	Feed-in Tariff rate (Baht/kWh)	Cap
Rooftop solar	0-10 kW	25	6.85	200MW
	10-250 kW	25	6.4	200MW
	250kW-1MW	25	6.01	200MW
Community ground-mounted solar	-	25	5.66	800MW

Source: Energy Policy & Planning Office, Ministry of Energy as of 2015



## SUPPORTING AGENCIES ENCOURAGING ALTERNATIVE ENERGY USE

- Ministry of Energy (MOE):
  - The Energy Policy and Planning Office (EPPO) is the main authority in the formulation and administration of energy policies and planning for national sustainability.
  - The Department of Alternative Energy Development and Efficiency (DEDE) has a mission to support and promote clean energy production and consumption that is consistent with the situation of each area, and is cost-effective and sustainable.
- Ministry of Natural Resources and Environment of Thailand (MNRE) is in charge of the protection of Thailand's mineral, marine, water and coastal resources, administering environmental protection through laws governing these jurisdictions.
- Ministry of Science and Technology (MOST): Formerly the "Ministry of Science, Technology and Energy". It is the principle agency in developing science, technology and innovation for the purposes of solving the country's socio-economics problems and enhancing its long-term competitive capacity.

**"The Kingdom of Thailand's strategic location, along with its abundant resources for renewable energy, progressive government policies and incentives, make it not only the Hub of ASEAN power grid but also the hub for seeking out future opportunities in regional co-development and investment."**

-Supamas Trivisvavet, Managing Director, CK Power PLC-

## ATTRACTIVE INVESTMENT INCENTIVES

Thailand Board of Investment (BOI) offers a wide range of tax and non-tax incentives for projects that meet national development objectives.

Tax-based incentives include exemption or reduction of import duties on machinery and raw materials, and corporate income tax exemption of up to eight years. Non-tax incentives include permission to bring in expatriates, own land and take or remit foreign currency abroad.

Recognizing the importance of the role alternative energy can play in the socio-economic development of Thailand, the Board of Investments offers attractive incentives to projects in alternative energy.

The production of electricity or steam from waste or refuse-derived fuel has been classified as an activity of special importance and benefit to the country. As such, projects in this activity will be granted 8-year corporate income tax exemptions without being subject to a corporate income tax exemption cap, as well as exemptions of import duty on machinery and non-tax incentives.



In addition, projects approved for the manufacture of solar cells and/or raw materials for solar cells as well as projects approved for the production of electricity and steam from renewable energy sources, e.g. solar energy, wind energy, biomass or biogas, are granted an 8-year corporate income tax holiday, exemptions of import duty on machinery as well as non-tax incentives.

Projects that manufacture fuel from agricultural products or agricultural scrap or garbage or waste, e.g. biomass to liquid (BTL) or biogas from wastewater, are also granted an 8-year corporate income tax holiday, exemptions of import duty on machinery and import duty on raw or essential materials used in manufacturing export products, as well as non-tax incentives.

Projects that manufacture biomass briquettes and pellets are granted a 5-year corporate income tax holiday, exemptions of import duty on machinery as well as non-tax incentives.

### BOI Promoted Renewable Power Plants

Fuel	Approved		Operated	
	No.	Capacity (MW)	No	Capacity (MW)
Waste (MSW & Non Hazardous Industrial Waste )	18	228	-	-
Biomass	196	2,793	37	470
Biogas	196	585	37	109
Solar Farm	239	1,422	52	176
Solar Rooftop	153	83	-	-
Wind	36	1,916	-	-
Waste Heat	7	172	3	86
<b>Total</b>	<b>845</b>	<b>7,199</b>	<b>129</b>	<b>841</b>

Source: The Board of Investment of Thailand (BOI) as of June 2015

### BOI Promoted Biomass Power Plant

Type of Fuel	No.	Capacity (MW)
Bagasse & Sugarcane Leaves	47	1,403.8
Wood Chip	49	657.3
Rice Husk	58	492.7
Palm Shell/Fiber and EFB	22	159.2
Cassava Finger Root Trunk and Rhizome	8	50.3
Corn Cob and Trunk	1	0.2
Napier Grass	3	8.4
Others	8	20.6
<b>Total</b>	<b>196</b>	<b>2,793</b>

Source: The Board of Investment of Thailand (BOI) as of June 2015



## FOR FURTHER INFORMATION

**Thailand Board of Investment (BOI):** <http://www.boi.go.th>

**The Department of Alternative Energy Development and Efficiency (DEDE):** <http://www.dede.go.th>

**The Energy Policy and Planning Office (EPPO):** <http://www.eppo.go.th/>

**Ministry of Energy of Thailand (MOE):** <http://www.energy.go.th/>

**Ministry of Natural Resources and Environment of Thailand (MNRE):** <http://www.mnre.go.th/>

**Ministry of Science and Technology of Thailand (MOST):** <http://www.most.go.th>

**Thailand Greenhouse Gas Management Organization (TGO):** <http://www.tgo.or.th/>

**Electricity Generating Authority of Thailand (EGAT):** <http://www.egat.or.th>

**Provincial Electricity Authority (PEA):** <http://www.pea.or.th>

**Metropolitan Electricity Authority (MEA):** <http://www.mea.or.th>

**Office of the Energy Regulatory Commission of Thailand (OERC):** <http://www.oerc.go.th>

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