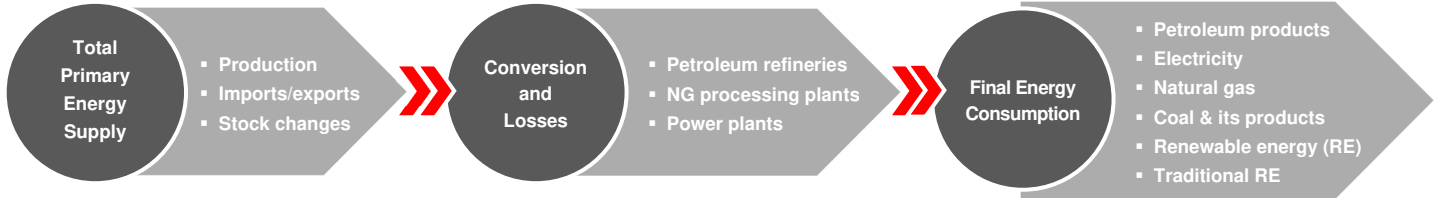


# Thailand's Energy Sector

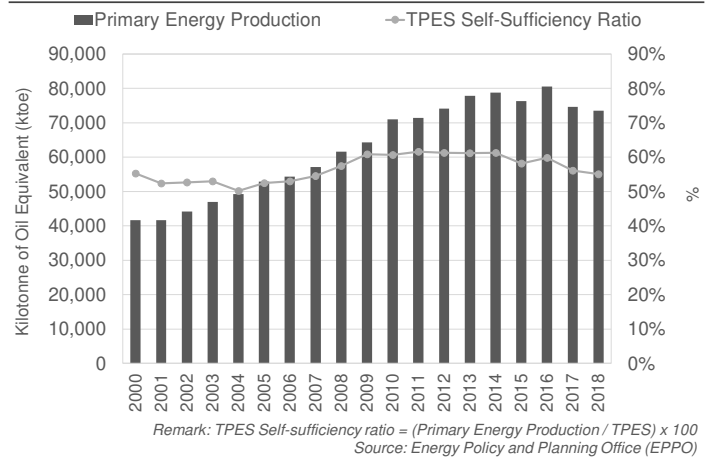
## Overview of Thailand's Energy Sector (Energy Situation in Thailand)

### The Country's Energy Flow



- Thailand's energy sector is heavily reliant on imports as over half of its primary energy supply was imported in 2018. The country is a net importer of crude oil and a net exporter of petroleum products. The TPES (Total Primary Energy Supply) self-sufficiency ratio, which measures a country's strength in energy security, announced by the Ministry of Energy, shows that Thailand has become less self-reliant in energy resources.
- Crude oil, natural gas, renewable energy, coal, and lignite are the primary sources of energy supply in Thailand, which will normally be converted to other forms before they can be used.

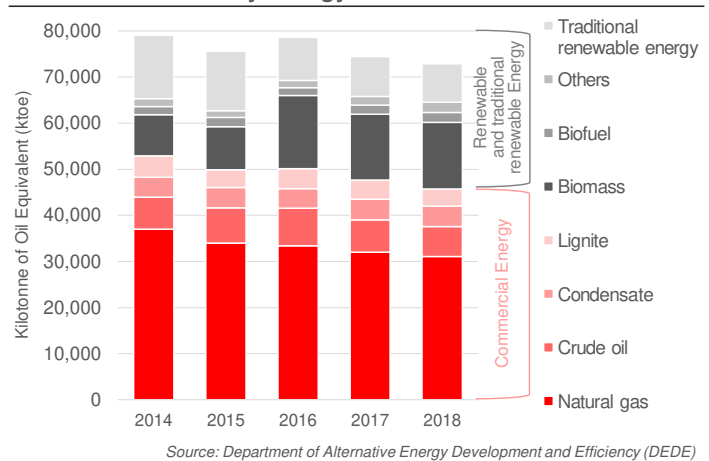
### Thailand's Energy Self-Sufficiency Ratio



### Production

- About 63% of primary energy production in Thailand is commercial energy (refers to sources that are available in the market for a definite price such as coal/lignite, electricity, petroleum and its products), followed by 26% of renewable energy (refers to energy that are available in unlimited amounts in nature which includes solar, wind, water (hydro), biomass, and biogas), and 11% of traditional renewable energy (refers to energy generated from charcoal, paddy husk, fuel wood and agricultural waste that are traditionally gathered and used especially in rural households) in 2018.

### Production of Primary Energy in Thailand

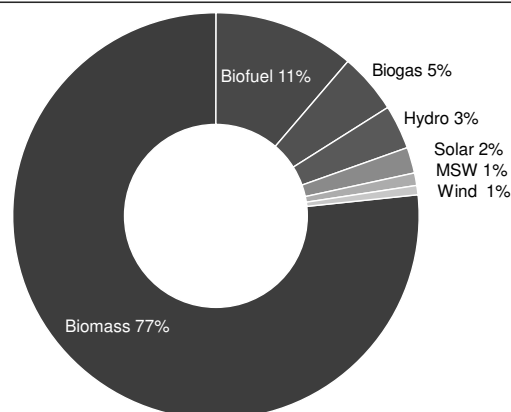


- Natural gas has been dominating energy production for decades. However, fossil fuel resources in Thailand, namely coal, oil, and natural gas have generally declined over the past few years and are projected to become exhausted in the near future due to their limited quantities as these energy sources cannot be renewed.
- With a gradual depletion of these natural resources, the government has stepped up its efforts in diversifying the power mix with greater reliance placed on renewables by providing support and incentive programs for alternative energy projects.
- The renewable energy sector has become one of the crucial source of energy for the country with an outstanding growth in production at a CAGR of 12% between 2014 and 2018. Biomass represents a significant share of renewable energy production in Thailand as the country is rich in agricultural resources, while solar and wind power have seen a sharp jump in the production sector thanks to the government's

support in relation to investments in the renewable energy sector. Production of hydropower has skyrocketed in the last two years because of high water levels in reservoirs as well as higher rainfall.

- All the energy from solar, wind, and hydropower produced in the country to date, is used to generate electricity. Thailand has two types of solar installations, rooftop and ground-mounted. The third one which is a hybrid renewable energy, hydro-floating solar, had just been introduced at the beginning of 2019 by the state-owned Energy Generating Authority of Thailand (EGAT). About 16 floating solar farms with a combined capacity of 2.7 GW of electricity will be installed on the surface of nine hydroelectric dams by 2037. Biddings of Engineering, Procurement and Construction (EPC) for the first floating solar farm project is expected to be held within 2019.

**Production of Renewable Energy in Thailand (2018)**



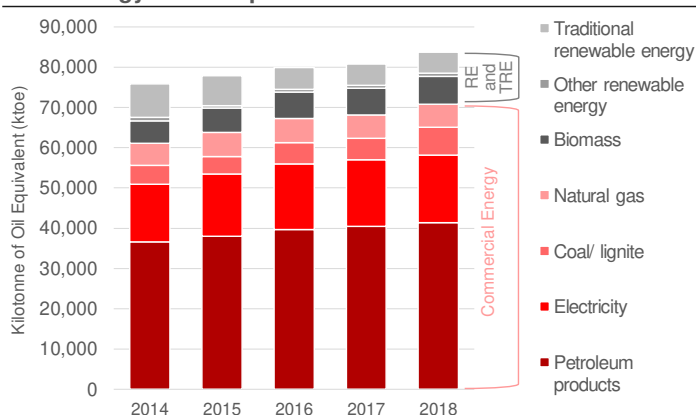
Remark: Municipal Solid Waste (MSW)  
Source: Department of Alternative Energy Development and Efficiency (DEDE)

- Although solar farms are currently make up a greater portion of the installations than rooftop ones, it is believed that the share of rooftop installations will be increasing rapidly following the government's announcement to grant the solar rooftop licenses to local households over the next 10 years. This will be the second attempt for the Thai government to buy electricity from residential solar after its first try in 2003 wasn't quite a success response because the installed residential solar could only be used for self-consumption. This time, however, they are allowed to sell surplus output back to EGAT.
- Thailand produces two general types of biofuels, ethanol and biodiesel. Ethanol is produced from sugar cane and molasses and biodiesel is produced from palm oil. A number of products, e.g. E10, E20, E85, B7, B10, B20, and B100 have been introduced into the market containing different proportion of ethanol and diesel. For example, E10 will contain 10% of ethanol blend and B7 will contain 7% of diesel as a product from palm oil. As the Thai palm oil market is facing a surplus in its supply, Ministry of Energy plans to promote the consumption of B10 nationwide in order to support the excess supply as well as encouraging the use of renewable energy.
- The production of traditional renewable energy such as fuel wood, charcaol, and paddy husk, which is used primarily in the residential sector, at around 62% of the total primary energy supply, continued to see a decline both in the producrion and cosumption sides.

## Consumption

- Thailand's total final energy consumption has been growing steadily for a consecutive number of years. Commercial energy, in particular petroluem products and electricity, was the most consumed type of energy, followed by renewable energy, and traditonal renewable energy respectively. In terms of sectors, transportation and industry used up about three-fourth of the final energy consumption in 2018.
- Most petroleum products are consumed by the transportation sector. However, given the high dependency on the importation of crude oil and petroleum products, the Thai government has been strongly driven to replace petroluem-derived fuels with alternatives such as biofuels, for the public transportation sector, providing tax incentives to biodiesel producers.

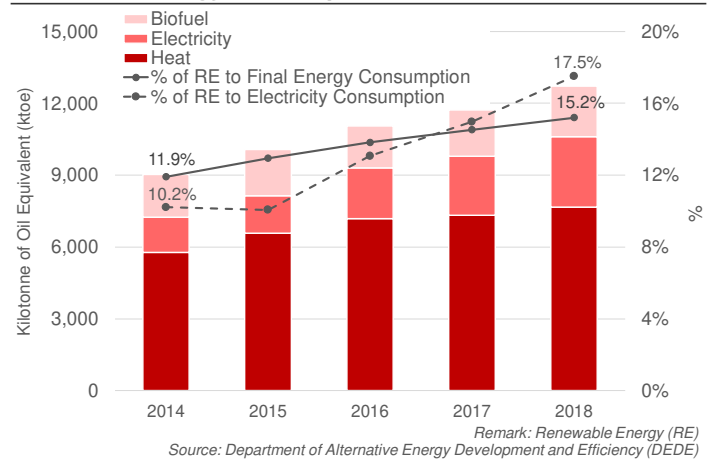
**Final Energy Consumption in Thailand**



Remark: Renewable Energy (RE), Traditional Renewable Energy (TRE)  
Source: Department of Alternative Energy Development and Efficiency (DEDE)

- Manufacturing, commercial, and residential were the largest sectors that consumed electricity in 2018. According to a report published by the Ministry of Energy, business clusters with high electricity consumption were food, iron & basic metals, electronics, and automotive, whilst consumption by major businesses in 2017 were department stores, apartments & guesthouses, hotels, and retail.
- Under the new power development plan (PDP) that recently became effective in April 2019, the demand for electricity is projected to grow moderately at an average of 3% over the next 20 years from 2018 to 2037, with the upper central region anticipated to have the highest growth rate of electricity demand at 3.8%.
- The proportion of electricity generated by the state-owned Electricity Generating Authority of Thailand (EGAT) will be reduced from 35% to 24% by the end of the plan in 2037, whilst power generation from the private sector, e.g. independent power producers (IPPs), small power producers (SPPs), and very small power producers (VSPPs), will be increased.
- Consumption of renewable energy in Thailand has continued to increase over the past couple of years. Alternative energy consumption made up 15% of the final energy consumption and 17% of the total electricity consumption in 2018.
- Alternative energy can be consumed in the form of electricity, heat, and biofuels. Heat is the most consumed type, followed by electricity, and biofuels. However, the one with remarkable growth is the consumption of electricity, derived from renewable energy namely, solar, wind, and hydro power.

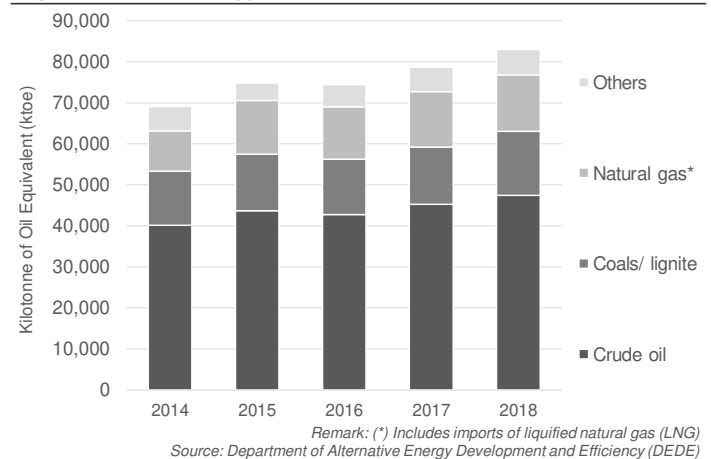
**Renewable Energy Consumption in Thailand**



**Imports & Exports**

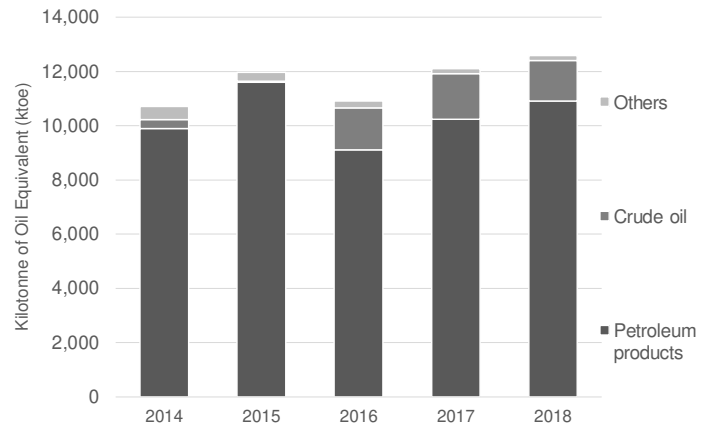
- Crude oil has long been a major import product of Thailand's energy sector. As mentioned above, Thailand is a net importer of crude oil. The country imported around 83% of Thailand's crude oil supply and this number is expected to grow even higher due to declining domestic sources. Thailand imports over two-thirds of the imported crude oil from the Middle East and Far East countries.
- Coal is the second most imported source of energy. Coal's rising demand over the past few years is a result of the depletion of domestic supplies as well as increased demand from the industrial sector, which has been slowly shifting its fuel consumption from lignite to coal. The industrial sector consumed about 63% of coal supply in 2018, while the rest was used in power plants.
- A continuing increase in the imports of natural gas came from a surge in the use of Liquefied Natural Gas (LNG) and this upward trend is likely to remain in a long-run as the government decided to liberalize Thailand's natural gas sector by purchasing LNG from other LNG importers besides PTT Plc., the nation's sole gas supplier and LNG importer to boost competition. Purchasing agreements are now being finalized and companies that offer the lowest price will be chosen and shipments are expected to begin within 2019.

**Importation of Energy to Thailand**



- Eventhough electricity only makes up a small portion of overall imports, it has witnessed the highest growth rate compared to other types of imported energy. Buying electricity from neighboring countries like Myanmar, Laos, and Cambodia was included into the nation's energy plans as it is thought to help mitigate risks regarding construction of power plants and electricity supply. It is also believed to promote good relationships between Thailand and neighboring countries.
- The amount of exports from the energy sector in Thailand is minor when compared to imports. The country is a net exporter of petroleum products, accounting for almost 90% of energy exports, followed by crude oil and traditional renewable energy. Singapore, Malaysia, and CLMV (Cambodia, Laos, Myanmar, Vietnam) are Thailand's major markets for refine fuels.

**Exportation of Energy to Thailand**

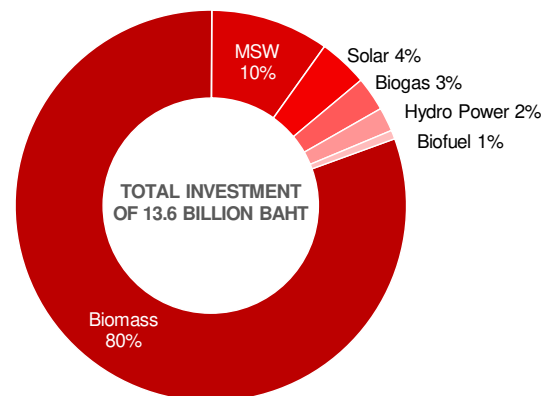


Source: Department of Alternative Energy Development and Efficiency (DEDE)

### ■ Investment Promotions Related to the Energy Sector

- Under Thailand's Foreign Business Act, the power generation business is not a restricted business activity for foreign entities. The government has made it quite clear also in both the former and recent Power Development Plans (PDP) that private investment will play quite a crucial role in the expansion of the Thai energy sector.
- Thailand has seen mixed responses towards energy investment from domestic investors. Despite quite a flourishing trade of electricity production licenses and power purchase agreements (PPAs), there are also groups of Thai investors who see greater opportunities in the overseas markets due to strong growth potential in power demand or good investment packages.
- According to the Ministry of Energy, there was approximately 13.6 billion baht worth of investment in the renewable energy sector in 2017, led by biomass, waste, and solar investments.

**Investment in Renewable Energy Businesses in Thailand (2017)**



Remark: Municipal Solid Waste (MSW)  
Source: Energy Policy and Planning Office (EPPO)

- Below are some of the major supporting schemes from the Thai government:
  - Feed-In Tariff schemes (FiT)
    - A long-term contract that is made between the government and alternative energy producers. Alternative energy-derived electricity will be offered fixed buying rates for a period of 10-25 years.
    - Structure of FiT rates consist of,
      - 1)  $FiT_F$ , fixed buying rates, calculated from the initial investment cost from construction covering lifetime-use of operation and maintenance costs.
      - 2)  $FiT_v$ , variable buying rates, calculated from price inflation of raw materials, which will vary each year according to the inflation rate.
      - 3)  $FiT_P$ , premium rates that will be paid if the projects are located in certain locations of the Southern Border Provinces, or are biofuel projects.

- Most FiT grants the largest subsidies to smaller size power producers and rooftop solar, waste, and wind energy projects are offered the highest FiT subsidies.
- New FiT applications for solar rooftop for the residential sector will open before the third quarter of 2019 with an anticipated commercial operation date in 2019. Unlike other renewable energy projects, competitive bidding will be used for the selection process. The FiT for residential rooftop solar projects will be granted on a first-come, first-served basis with a buying rate of no higher than 1.68 Thai Baht per kWh and a buying quota for each year at 100 MW for the next nine years, as outlined in the Power Development Plan (PDP) of 2018. This aims to promote solar rooftop consumption in the residential sector. With this, people can sell their excess supply back to the government, unlike the previous one in 2013, when this was not possible.

### Feed-in Tariffs rates for Renewable Energy Projects

Renewable Energy	FiT (THB/kWh)				FiT Premium (THB/ kWh)	
	FiT <sub>F</sub>	FiT <sub>v,2019</sub>	FiT	Support Duration	Biofuel Project Group Participants (For the first 8 years)	Southern Border Provinces <sup>[1]</sup> (For the whole duration of the project)
<b>1) Waste (municipal solid waste)</b>						
Installed capacity ≤ 1MW	3.13	3.25	<b>6.38</b>	20 years	0.70	0.50
Installed capacity > 1-3MW	2.61	3.25	<b>5.86</b>	20 years	0.70	0.50
Installed capacity > 3MW	2.39	2.72	<b>5.11</b>	20 years	0.70	0.50
<b>2) Waste (industrial)</b>						
General technologies	3.39	2.72	<b>6.08</b>	20 years	0.70	0.50
Plasma technologies	3.39	2.72	<b>6.08</b>	20 years	1.70	0.50
<b>3) Waste (landfill)</b>						
All sizes	5.60	-	<b>5.60</b>	10 years	-	0.50
<b>4) Biomass</b>						
Installed capacity ≤ 1MW	3.13	2.24	<b>5.37</b>	20 years	0.50	0.50
Installed capacity ≤ 3MW	2.61	2.24	<b>4.85</b>	20 years	0.40	0.50
Installed capacity > 3MW	2.39	1.87	<b>4.26</b>	20 years	0.30	0.50
<b>5) Biogas (energy crops)</b>						
All sizes	2.79	2.58	<b>5.37</b>	20 years	0.50	0.50
<b>6) Biogas (waste water/ solid waste)</b>						
All sizes	3.76	-	<b>3.76</b>	20 years	0.50	0.50
<b>7) Hydropower</b>						
Installed capacity ≤ 200 kW	4.90	-	<b>4.90</b>	20 years	-	0.50
<b>8) Wind energy</b>						
All sizes	6.06	-	<b>6.06</b>	20 years	-	0.50
<b>9) Solar</b>						
Rooftop 0-10 kWp	6.85	-	<b>6.85</b>	25 years	-	0.50
Rooftop 10-250 kWp	6.40	-	<b>6.40</b>	25 years	-	0.50
Rooftop 250-1,000 kWp	6.01	-	<b>6.01</b>	25 years	-	0.50
Solar farm	5.66	-	<b>5.66</b>	25 years	-	0.50
<b>10) Hybrid firm - use two or more alternative sources of energy</b>						
Installed capacity >10-50 MW	1.81	1.87	<b>3.68</b>	20 years	-	0.50

Source: Energy Regulatory Commission (ERC) and Thailand Board of Investment

Note: [1] Projects in Yala, Pattani, Narathiwat provinces and 4 districts in Songkhla province, namely Chana, Tapa, Saba-Yoi, and Nathawee.

[2] FiT rates will be used for projects that COD within 2017. After 2017, FiT<sub>v</sub> rates will continuously increase by core inflation.

#### ○ Thailand Board of Investment (BOI)

- Since 2014, Board of Investment has provided alternative energy projects with support mostly in the form of tax exemptions, exemptions of import duty on machinery as well as non-tax incentives. Below are the activities that are granted investment incentives from BOI
  - The following projects are granted 8-year corporate income tax holiday, exemptions of import duty on machinery as well as non-tax incentives:
    - Manufacture of fuel from agricultural products, agricultural scrap or garbage or waste (e.g. biomass to liquid and biogas from waste water).
    - Manufacture of solar cells and/or raw materials of solar cells.

- Production of electricity or electricity and steam from garbage or refuse derived fuel, and renewable energy.
- The following projects are granted 5-year corporate income tax holiday, exemptions of import duty on machinery as well as non-tax incentives:
  - Manufacture of parts and/or equipment for solar-powered products.
  - Manufacture of biomass briquettes and pellets.
- Lastly, the production of electricity from other energy sources are granted 3-year corporate income tax holiday, exemptions of import duty on machinery as well as non-tax incentives. However, there is a condition that only power plants with cogeneration systems are eligible for the incentives or that if the project uses coal, it must only use clean coal technology.

## ■ Outlook and Prospect of the Energy Sector in Thailand

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- A gradual depletion of the country's major primary energy sources, together with the rising demand for energy, driven mainly by the expanding economy as well as population growth are contributing to a sustainable energy transition towards renewables in Thailand's energy mix. Incentive policies and laws have been introduced or adjusted to liberalize the industry, providing perfect new business opportunities for both Thai and foreign companies.
  - Based on the latest vision of the Power Development Plan (PDP), biomass, solar and wind are anticipated to be the main energy resources in power generation. As the bidding for the residential solar rooftop will begin soon and continue to do so for another decade, there may be great demand for businesses like EPC (engineering, procurement, and construction) and O&M (operation and maintenance).
  - Grid development will also be an important topic for Thailand to study and invest in as higher shares of variable renewable power generation require greater levels of grid flexibility. Even though currently consumers will only be able to use solar power for self-consumption or sell the surplus to the state, consumer to consumer or C2C trading platforms will most likely take place using blockchain technology to allow households to sell and buy electricity with each other without a middleman like the EGAT.
  - Thailand has a significant renewable energy potential and some sub-sectors such as rooftop solar remain largely untapped. Now that the new PDP is enacted, four other plans related to the energy sector will soon be drawn up and implemented, as well as additional investment stimulus programs.
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