POWER GENERATION

July 2020

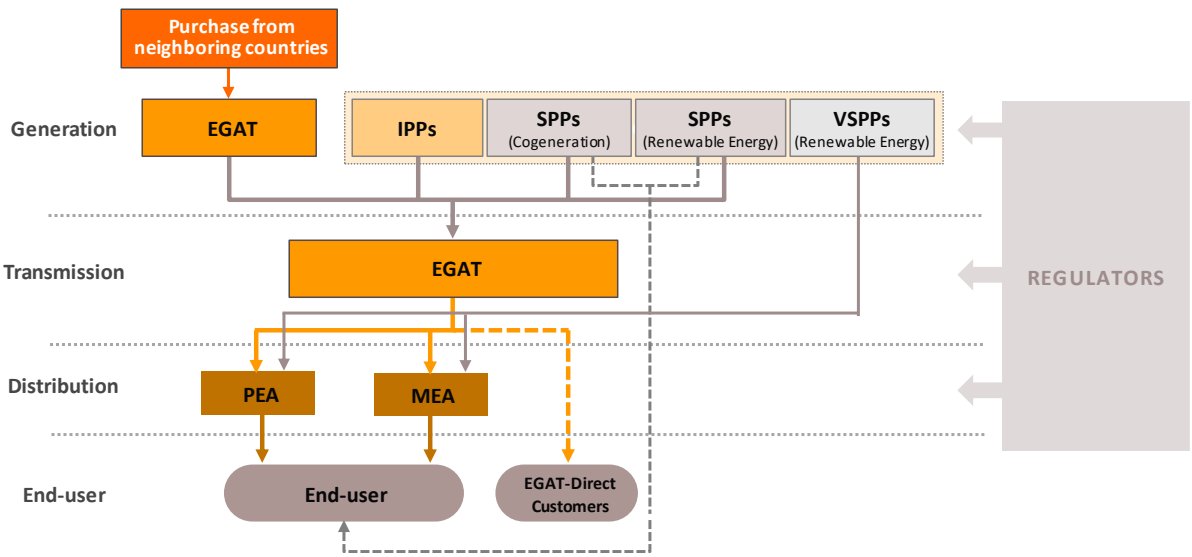
Narin Tunpaiboon
narin.tunpaiboon@krungsri.com
+662 296 2943

In the first half of 2020, the government had rushed to contain the Covid-19 pandemic by imposing a nationwide lockdown that effectively halted most economic activities (manufacturing and services) in the country. For full year 2020, this will reduce electricity demand by 2.0-3.0%, compared to 2.7% growth in 2019. However, in 2021 and 2022, demand is expected to rebound and private-sector power plant operators should see better business conditions as the economy returns to *near-normal.* Meanwhile, generation capacity will continue to be driven by the government's investment support measures under the Power Development Plan and Alternative Energy Development Plan. After 2021, we anticipate greater investment from players in the rooftop solar, biomass, biogas, and waste-to-energy segments. These players will benefit from government support that will take the form of a steady increase in electricity purchases, and they would also be more competitive with better cost-control and access to raw materials. In the wind power segment, the government will start to buy wind-generated power in 2022-2024, when high-voltage lines to connect wind farms to the grid should be completed.

Overview

Thailand's power generation industry is structured in line with the enhanced single-buyer model with state bodies being the sole buyers and distributors of power through the national grid. The Electricity Generating Authority of Thailand (EGAT) is both a producer and, by purchasing power from private-sector 'independent power producers' (IPPs) and 'small power producers' (SPPs), a buyer of electricity. It also has a monopoly in the distribution of electricity in the country. In addition, the Metropolitan Electricity Authority (MEA) and the Provincial Electricity Authority (PEA) are responsible for distributing power as well as buying electricity from 'very small power producers' (VSPPs) (Figure 1).

Figure 1: Thailand's Electricity Supply Chain



Source: EPPO, compiled by Krungsri Research

The most important features of the Thai electricity generation industry are as follows: (i) Unlike other goods, electricity cannot be stored and must be distributed to users immediately through a transmission and distribution system. (ii) Expanding capacity to meet future demand requires long-term planning because power stations take 5-7 years to construct depending on the type of power plant. This long-term plan is the national power development plan, which main objective is to ensure that electricity supply is sufficient to meet future demand. (iii) Hence, state bodies have a major role in managing generation and distribution, as well as setting tariffs and investment targets to increase supply to the national grid.

Electricity demand growth will depend on the following:

- **Rising domestic demand**. This would be determined by the health of the economy. Generally, demand for electricity grows at 0.9-1.1 times the rate of GDP growth (Figure 2). In 2019, the major sources of demand were industrial, business, and household sectors which accounted for 44.6%, 25.5% and 25.5% of national electricity consumption, respectively, and others 4.4% (Figure 3). Within the industrial sector, the food industry was the biggest consumer, followed by steel & basic metals, electronics, auto assembly, and plastics production. In the services sector, there was strongest demand from serviced apartments and guest houses, followed by department stores, hotels, retailers, and wholesale operations.
- **Government policy:** (i) The Power Development Plan (PDP) and the Alternative Energy Development Plan (AEDP) lays out the desired total generating capacity for each type of power plant[1/]. (ii) They also set the pricing for renewable energy (because producing power from renewables costs more than electricity produced from fossil fuels, i.e. natural gas, coal, and oil), and this is now used to determine the feed-in tariff[2/] (FiT). Previously, the adder system was used to calculate payments[3/] (Box 1). (iii) The government also has plans to expand the power distribution network to support the increasing generation capacity, especially from renewable sources.

Private power producers have an increasing role in the sector (Figure 4). In 2019, the private sector controlled 57.7% of power generating capacity (or 49,304 megawatts), split between IPPs (30.3% of total power supply) and SPPs and VSPPs (27.4%). The remaining 42.3% is produced by EGAT, which is also responsible for buying-in power from neighboring countries.

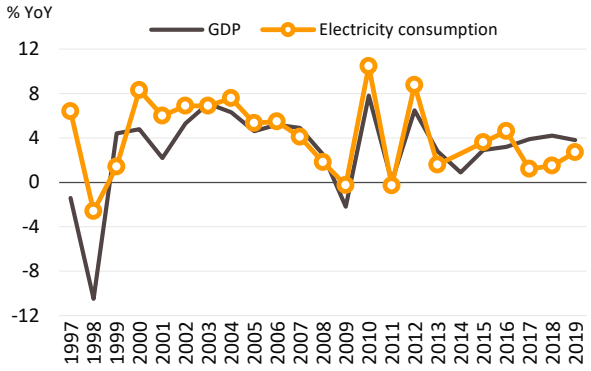
Power plant operators can be split into two groups, by fuel source.

(1) Fossil fuel and hydropower. This includes plants that are fueled by natural gas, coal/lignite and oil, as well as large-scale hydropower plants. In 2019, 57.5% of the electricity produced in Thailand were fueled by natural gas (down from 72.0% in 2010), followed by coal, hydroelectric and oil (Figure 5).

(2) Renewables and alternative sources. This includes plants fueled by biomass (generally agricultural waste), biogas (including manure, waste water from agro-processing industries, and bioenergy crops), waste (consumer and industrial), solar, wind and micro-hydro plants. Electricity from these sources contributed 10.1% of national electricity consumption in 2019 compared to only 2.1% in 2010.

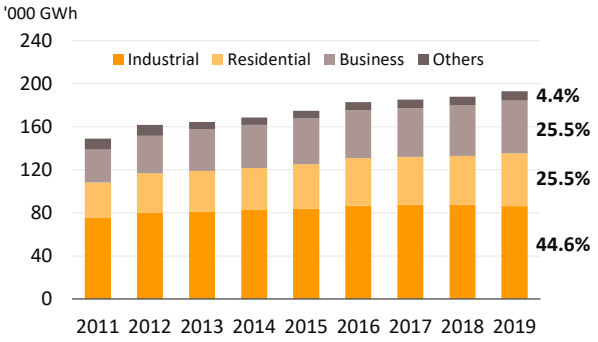
Currently, proven reserves (P1) of natural gas in the Gulf of Thailand is 6.4 trn cubic feet[4/], while annual national consumption is 1.3 trn cubic feet (source: Department of Mineral Fuels, December 2018). This means Thailand has sufficient supply for only another 5-6 years, after which we would have to import gas, most probably from Myanmar. Because of this, **the PDP emphasizes the increasing use of renewables in power generation.**

Figure 2: Correlation between Electricity Demand and Economic Growth



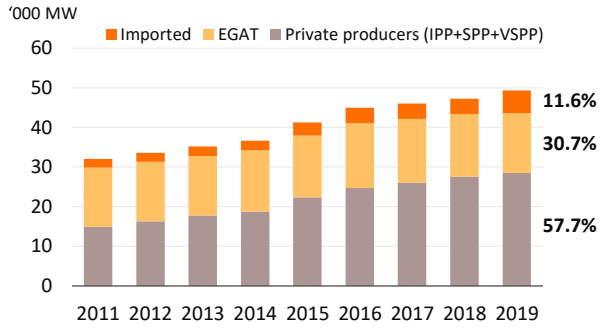
Sources: Energy Policy and Planning Office (EPPO) / NESDC

Figure 3: Electricity Consumption by Segment



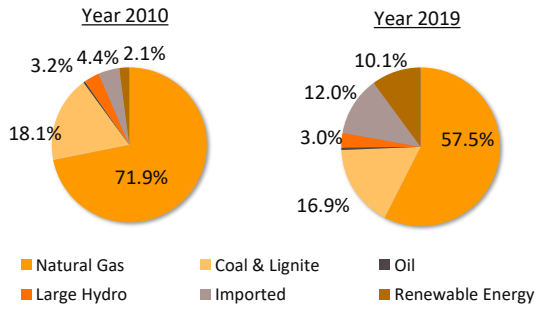
Source: EPPO

Figure 4: Installed Capacity (by producer)



Source: EPPO

Figure 5: Power Generation (GWh) by fuel



1/ In the past, this was a 15-year framework, which was then extended to 20 years. At that time, the Energy Policy and Planning Office (EPPO) undertook planning in cooperation with the Department of Alternative Energy Development and Efficiency (DEDE) but planning for 2018-2037 is within the remit of the PDP and the AEDP.

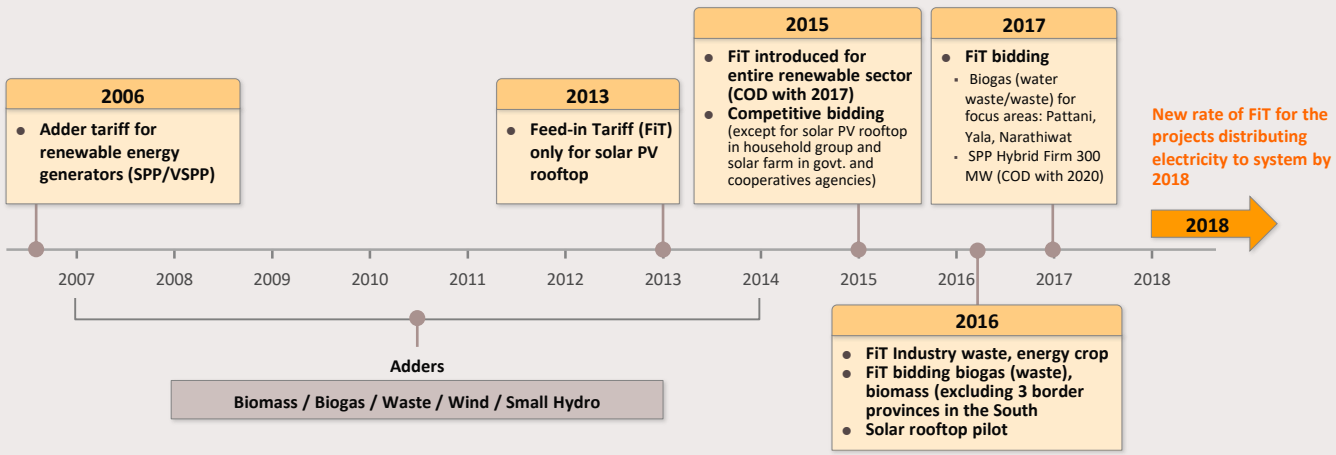
2/ The net price for purchases of electricity is set at a rate that reflects the real costs of production of different types of power over the course of the 20-25 years for which contracts to supply run. These are allotted through a process of competitive bidding organized by the Office of Energy Regulatory Commission (ERC).

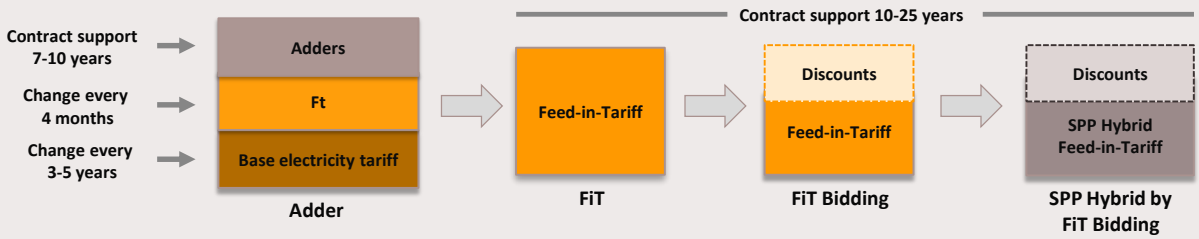
3/ Under this system, an additional payment is added to the cost of electricity sold to the grid for a period of supply running for 7 years. Admission to the system is on a first-come, first-served basis.

4/ Reserves are in deposits that have already been explored. Plans, which have been approved in accordance with national laws, have been put in place for the exploitation of these reserves and extracting this gas should be commercially viable.

Box 1

Pricing System Development in Thailand (from Adder to Feed-in Tariff)





Source: Compiled by Krungsri Research

Feed-in Tariff for VSPP of Renewable (2020)

Type of renewable energy	FiT (THB/kWh)			Period of support
	FiT(F) 1/	FiT(V2020) 2/	Total caculated FiT	
1. Biomass				
Capacity ≤ 1 MW	3.13	**2.25**	**5.38**	20
Capacity >1-3 MW	2.61	**2.25**	**4.86**	20
Capacity >3 MW	2.39	**1.88**	**4.27**	20
2. Biogas (waste water/other waste)				
All size	3.76	-	**3.76**	20
3. Biogas (energy crop)				
All size	2.79	**2.60**	**5.39**	20
4. MSW (waste management)				
Capacity ≤ 1 MW	3.13	**3.27**	**6.40**	20
Capacity >1-3 MW	2.61	**3.27**	**5.88**	20
Capacity >3 MW	2.39	**2.74**	**5.13**	20
5. MSW (landfill)	5.60	-	**5.60**	10
6. Industry waste (VSPP new plant)	3.39	**2.74**	**6.13**	10
7. Wind				
All size	6.06	-	**6.06**	20
8. Hydropower				
Capacity ≤200 kW	4.9	-	**4.90**	20
9. Solar				
Solar farm	5.66	-		25
Rooftop (residential)				
capacity 0-10 kWp	6.85	-		25
Rooftop (building/factory)				
capacity>10-250 kWp	6.40	-		25
capacity>250-1,000 kWp	6.01	-		25
10. SPP hybrid firm	1.81	**1.88**	**3.69**	20

Source: EPPO, ERC
Note:
1/ FiT (F) is fixed component e.g.cost of electricity plant construction, operating/maintenance expense, land rent.
2/ FiT(V2020) is variable component for some type of renewable energy, which is adjusted depending on feedstock cost and inflation

There are three major groups of private-sector players in the power-generating sector.

- **Independent Power Producers (IPPs)**

  Total installed generating capacity: Over 90 megawatts. These producers mainly use natural gas and coal to fuel their power stations. The most important players are (i) Ratchaburi Electricity Generating Holdings, (ii) Gulf JP NS, (iii) Gulf JP UT, (iv) Gulf Power Generation, (v) Ratchaburi Power, (vi) BLCP Power, (vii) Electricity Generating, (viii) Glow IPP, (ix) Global Power Synergy, (x) Ratchaburi Electricity Generating, (xi) Gheco-One, and (xii) Eastern Power & Electric.

  Revenue: The revenues of players in this group are exposed to low risk because the IPPs sign long-term (25-year) power supply contracts with EGAT. Revenue is generated from two sources: (i) a guaranteed 'minimum intake' specified in the contract with EGAT, and (ii) power supply directly to the grid to meet demand. Hence, their revenues are dependent on national electricity consumption, although some players also get receipts from their investments in power-generating facilities overseas, including Myanmar, Laos PDR, Indonesia, the Philippines and Australia.

- **Small Power Producers (SPP)**

  Installed capacity required to qualify as an SPP: 10-90 megawatts. SPPs typically generate power from natural gas, coal, oil and renewables, and sell mostly to EGAT. A small proportion of their output is sold to industrial consumers that are located near the SPP's power stations. SPPs can be split into (i) 'firm'-type SPPs, which have a 20-25-year contract to supply power to EGAT and are normally fueled by natural gas or coal, and (ii) 'non-firm' SPPs, which have 5-year contracts (extendable in 5-year increments) and are normally fueled by renewables such as such as solar power, wind power, waste and biomass.

  Revenue: SPPs have two primary sources of revenues. (i) Derived from long-term contracts with EGAT that, like IPP contracts, come with a minimum revenue guarantee. This means SPPs only have mild exposure to risk of weak earning. (ii) Derived from supplying electricity to industrial consumers located close to the power stations. However, this revenue can fluctuate according to the overall economic conditions and the individual industry cycles. Beyond this, some players also receive returns on investments in power assets overseas, including solar-based electricity generation assets in Japan, China and Taiwan, and wind-power assets in Vietnam.

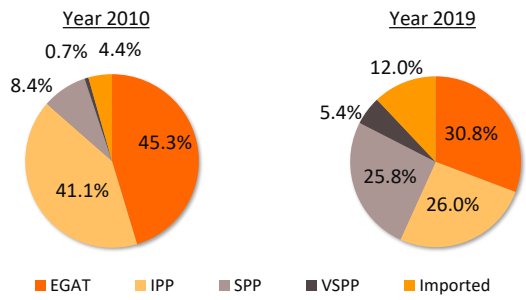
- **Very Small Power Producers (VSPPs)**

  Installed capacity to qualify as a VSPP: Under 10 megawatts. VSPPs typically generate electricity from renewables (including solar, wind, hydropower, biomass, biogas and waste) for their own use, and sell any surplus production to MEA or PEA at rates determined by the feed-in tariff (FiT) for that particular generating technology and other circumstances for as long as the project runs (Box 1). The majority of VSPPs that sell electricity fueled by renewables are involved with engineering, designing, procurement and construction, or manufacturers of solar cells and related equipment, as these operators have the necessary expertise to install and maintain the renewable electricity systems.

  Revenue: VSPPs supply electricity to the MEA or the PEA according to conditions specified in their contracts. They will receive payment when the electricity enters the grid (i.e. it is a COD system). Players that generate power from natural sources (i.e. solar, wind or hydropower) are likely to run at a loss in the first 1-2 years due to high cost of building and outfitting production sites, but following this initial period, the situation will improve supported by revenue from the sale of electricity. However, earnings could be volatile for players which produce electricity from biomass, biogas and waste, because of limited access to and fluctuating prices of raw materials.

Between 2013 and 2019, the share of electricity produced by SPPs and VSPPs had surged with government support under the AEDP and increasing purchases of electricity from this group of suppliers. By 2019, their contribution to the national energy mix had jumped to 5.4% of all electricity sold through the grid from only 0.7% in 2010 (Figure 6). **The major players in the energy sector that are listed on the stock exchange and that produce power from renewables** include Energy Absolute (EA) (solar and wind), SPCG (solar), Gunkul (solar, wind and biomass), TPC Power Holdings (TPCH) (biomass), Thai Solar Energy (TSE) (solar and biomass), and Power Solution Technologies (solar, biomass and biogas) (Figure 7). Some of these companies also invest in renewables-based power generation assets abroad.

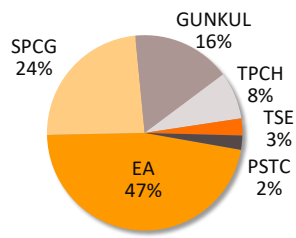
Figure 6: Power Generation (GWh) by producer



Source: EPPO

Figure 7: Market Share of Listed Companies in Renewable Energy Sector

(average 2017-2019)



Source: Stock Exchange of Thailand

Major Players in Thailand

Table 1: IPPs

Companies	Contracted Capacity (MW)	Fuel Type
Ratchaburi Electricity Generating Holding	3,481	Gas
Gulf JP NS	1,600	Gas
Gulf JP UT	1,600	Gas
Gulf Power Generation	1,468	Gas
Ratchaburi Power	1,400	Gas
BLCP Power	1,347	Coal
Electricity Generating	930	Gas
Glow IPP	713	Gas
Global Power Synergy	700	Gas
Ratchaburi Electricity Generating (TECO)	700	Gas
Gheco-One	660	Coal
Eastern Power & Electric	350	Gas

Source: EGAT

Table 2: SPPs

Companies	Contracted Capacity (MW)	Fuel Type
Firm		
Cogeneration		
Amata B. Grimm Power (10 projects)	870.0	Gas
Gulf JP (7 projects)	630.0	Gas
Glow SPP (8 projects)	590.0	Gas, Coal
Gulf TS (4 projects)	360.0	Gas
Rojana Power (3 projects)	270.0	Gas
Glow Energy (3 projects)	194.0	Gas
National Power Supply (2 projects)	180.0	Coal
Rathcaburi world Congeneration (2 projects)	180.0	Gas
SSUT (2 projects)	180.0	Gas
TOP SPP (2 projects)	180.0	Gas
Bangpa-in Cogeneration (2 projects)	180.0	Gas
B. Grimm BIP Power (2 projects)	180.0	Gas
Banpong Utilities (2 projects)	180.0	Gas
IRPC Clean Power (2 projects)	180.0	Gas
PPTC	90.0	Gas
Renewable		
National Power Plants (3 projects)	99.0	Husk, Biomass
A.T. Power	20.0	Husk
Moong Charoen Biomass	15.5	Husk
Mitrphol Bio-Power (4 projects)	76.8	Bagasse
Khonburi Power Piant	22.0	Bagasse
Khon Kaen Sugar Power Plant	20.0	Bagasse
Gulf Yala Green	20.2	Para-wood residue

Companies	Contracted Capacity (MW)	Fuel Type
Non-Firm		
Cogeneration		
Global Power Synergy (2 projects)	100.0	Gas
PTT Global Chemical	60.0	Gas
DCAP	65.0	Gas
IRPC	45.0	Gas, Coal, Fuel
Renewable		
EA Solar (3 projects)	180.0	Solar
Natural Energy Development	55.0	Solar
SPPIC	41.0	Solar
Sermsang Palang Ngan	40.0	Solar
BCPG	30.0	Solar
EA Wind (3 projects)	126.0	Wind
First Korat Wind	90.0	Wind
KR2	90.0	Wind
KRS Tree	90.0	Wind
KR One	90.0	Wind
Chaiyaphum Wind Farm	80.0	Wind
Khaokor Wind Power	60.0	Wind
Watabak Wind	60.0	Wind
TPI Polene Power (3 projects)	163.0	Waste
Mitrphol Bio-Power (5 projects)	103.0	Bagasse, Husk
Kaset Thai Bio Power	60.0	Bagasse
ES Power (2 projects)	40.0	Bagasse
Thai Ekaluck Power	38.0	Bagasse
Ruamphol Biopower	38.0	Bagasse

Source: EGAT, compiled by Krungsri Research

Table 3: VSPPs

Companies	Contracted Capacity (MW)
Solar	
Solar Power (34 projects)	199.9
Bangchak Solar Energy (13 projects)	95.0
Equator Solar (18 projects) *	91.0
Siam Solar Energy (11 projects) ***	88.0
Rang Ngern Solution (11 projects) **	87.0
17 Anyavee Holding (13 projects) *	75.0
B.Grim Yanhee Solar Power (8 projects)	59.7
Solarco (6 projects)	57.0
Power Technology International (9 projects) *	55.6
Energy Serve (9 projects) *	53.6
Health Planet Management (5 projects) *	48.0
Wind	
Wind Energy Development (2 projects) **	10.0
Lom Ligor project	9.0
Theppana Wind Farm	6.9
Lam Takhong Wind	2.5

Companies	Contracted Capacity (MW)
Biomass	
Erawan Power (4 projects)	32.0
Advance Clean Power (3 projects)	24.0
Oscar Save The World (2 projects) ***	17.6
Mitr Phol Bio Power (3 projects)	16.2
Thip Kamphangphet Bio Energy (2 projects)	16.0
Thai Roong Ruang Electricity Generating (2 projects)	16.0
Advance Agro Power Plant (2 projects)	16.0
Biogas	
Energy Plus (6 projects)	13.6
KS Bio-Plus (3 projects)	10.1
TSM Bio Energy (2 projects)	8.0
EH & Renewable	8.0
VG Energy (2 projects)	7.0
Waste	
PJT Technology (3 projects)	14.5
C&G Environmental Protection (Thailand)	9.8
Green Power Energy	9.0
Zenithy Green Energy	8.0
Ratchaburi-EEP Renewable Energy	8.0

Note: * affiliated with Super Block PCL. (SUPER)
** affiliated with Gunkul Engineering PCL. (GUNKUL)
*** affiliated with Thai Solar Energy PCL. (TSE)

Source: DEDE, compiled by Krungsri Research

Situation

National electricity consumption rose by 2.7% to 192,960 gigawatt-hours in 2019, accelerating from +1.5% in 2018. This was driven by greater demand from the business sector and households, which each accounted for 25.5% of electricity consumption. Demand from households rose by 8.8% (Figure 8) due to exceptionally hot weather, which pushed up peak demand in May to a new high of 30,853 megawatts. Demand from the business sector increased by 5.9% due to greater energy consumption at apartments & guesthouses (+13.6%), hospitals & clinics (+6.3%), and restaurants (+5.5%). But power consumption by the industrial sector (44.8% of total) slipped 2.0% due to weaker demand in the following sectors: steel & basic metals (-9.9%), auto assembly (-6.3%), electronics (-6.0%), and food (-0.9%).

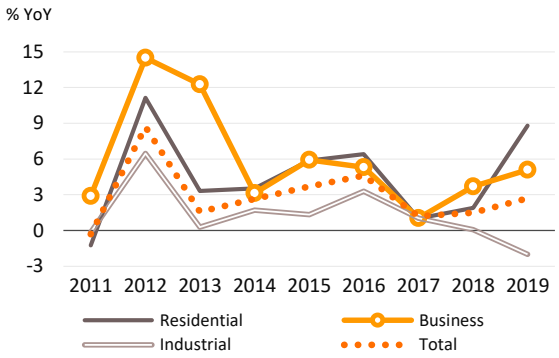
2019 national power generation rose by 3.7% (from +1.6% in 2018) to a total of 212,050 gigawatt-hours. Following a 0.8% increase in 2018, the volume of electricity supplied to the grid by EGAT (account for 30.8% of electricity produced in the country) rose by 1.4%. IPPs (26% share) saw their production increase by 1.6%, following a decline of 14.7% in 2018. SPPs and VSPPs (31.2% combined share) expanded power generation by 12.2% and 9.9%, respectively (Figure 9). This uptick for SPPs and VSPPs was driven by the push in the past few years to buy electricity generated from renewables, and the subsequent signing of supply agreements with EGAT. In 2019, the volume of electricity from renewables supplied to the grid (10.1% of total) rose by 19.4%. Natural gas-generated electricity (primary source of electricity with 57.5% share) rose by 4.8%, reversing from -4.0% in 2018. Electricity generated from coal (16.9% of total) was almost unchanged (+0.1%), while total electricity imported from neighboring countries (12.0% of electricity consumption) fell by 4.2%.

In 2019, there was 8,935 megawatts[5/]of renewables generating capacity was installed and ready to sell power to the grid, which represented an increase of 5.8% from 2018 (Figure 10). The largest share was taken by wind and biogas, for which installed capacity rose by 36.6% and 4.9% each. This growth in renewables generation capacity was driven by: (i) SPP suppliers of wind-power, which continued to distribute electricity through the grid as per their contracts with EGAT; (2) a biogas project in southern Thailand starting to sell to the grid; and (iii) progress in phase 2 of the program to install solar projects on sites operated by the government and agricultural cooperatives, with electricity from these installations now being available through the grid. However, when we compare the targets set in the 2015 Alternative Energy Development Plan with the current installed capacity, the national power system is only 53% of the planned 16,788 megawatts of renewables capacity envisioned for 2036. So far, power generated from biomass has made the greatest progress at 61% of target. This is followed by waste-to-energy (58% of target), micro-hydro (50%), solar (50%), wind (50%) and biogas (41%) (Figure 11).

Looking at the structure of private-sector renewables projects, in 2019, including projects that received support under the adder and FiT systems, there was a total of 973 SPP and VSPP projects selling electricity to the national grid. These had a contracted capacity of 4,965.5 megawatts. The largest capacity expansion was in waste-to-energy projects, followed by biomass, biogas, wind, and rooftop solar (Box 2).

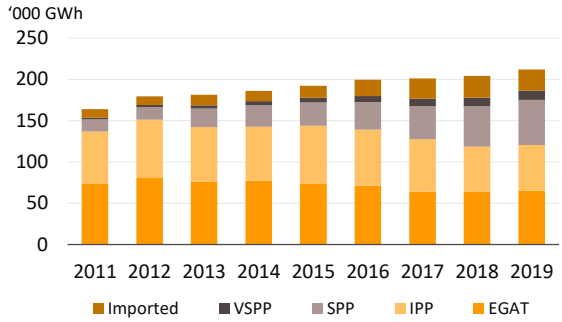
5/ Including off grid power generation, exclude large hydro power 2,906 MW

Figure 8: Electricity Consumption Growth (by sector)



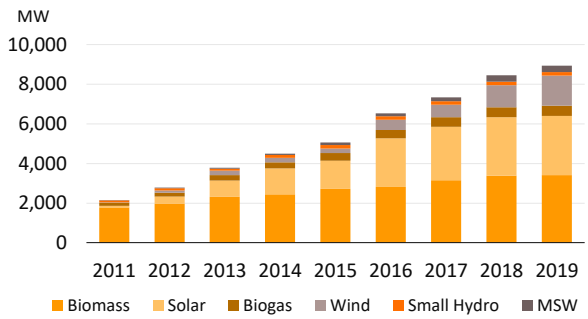
Source: EPPO

Figure 9: Power Generation (by producer)



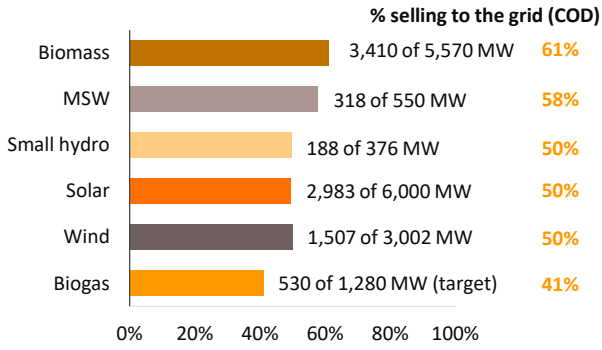
Source: EPPO

Figure 10: Installed Capacity of Renewable Energy



Source: Department of Alternative Energy Development and Efficiency (DEDE)
Note: Data was accumulated, including off grid power generation
Excluding large hydro power 2,906.40 MW

Figure 11: Renewable Energy Generation Capacity and AEDP* Target (as of 2019)



Source: DEDE
Note: Including off grid power generation
* Alternative Energy Development Plan

Box 2: Renewables operations in Thailand, by source

Solar

Since the second half of 2016, installed solar capacity has increased substantially led by solar farms operated by state bodies and agricultural cooperatives, and from rooftop installations thanks to falling costs of purchasing and installing solar panels.

Solar	SPP Power Plants		VSPP Power Plants		Total Power Plants	
As of 2019	No. of Project	Contracted Capacity (MW)	No. of Project	Contracted Capacity (MW)	No. of Project	Contracted Capacity (MW)
PPA signed (not yet selling)	-	-	-	-	-	-
Selling to the grid (COD)	7	436.0	554	2,280.4	561	2,716.4
Total	7	436.0	554	2,280.4	561	2,716.4

Wind

In 2016, the government resolved the legal issues on the use of certain types of land. And following this, SPPs that had been holding back operations were increasingly able to supply wind-powered electricity to the grid under the adder system. As a result, between 2016 and 2018, the number of wind farms had almost doubled.

Wind	SPP Power Plants		VSPP Power Plants		Total Power Plants	
As of 2019	No. of Project	Contracted Capacity (MW)	No. of Project	Contracted Capacity (MW)	No. of Project	Contracted Capacity (MW)
PPA signed (not yet selling)	-	-	2	16.0	2	16.0
Selling to the grid (COD)	3	270.0	8	36.9	11	306.9
Total	3	270.0	10	52.9	13	322.9

Biomass

In 2014 and 2015, many biomass producers encountered problems sourcing for raw material (rice husk, wood, and byproducts of oil palm processing), which pushed up prices. At the same time, many communities objected to locating power plants within or nearby, and as a result, many projects operating under the adder system had their contracts to supply power to the grid canceled. However, most of these then changed their set up to sell under the FiT system, which better reflects operators' costs, and since 2019, an increasing volume of electricity generated from biomass were sold to the national grid.

Biomass	SPP Power Plants		VSPP Power Plants		Total Power Plants	
As of 2019	No. of Project	Contracted Capacity (MW)	No. of Project	Contracted Capacity (MW)	No. of Project	Contracted Capacity (MW)
PPA signed (not yet selling)	-	-	12	59.3	12	59.3
Selling to the grid (COD)	8	216.7	170	1,077.0	178	1,293.7
Total	8	216.7	182	1,136.3	190	1,353.0

Biogas

The majority of biogas projects are running under government investment incentives, such as those pushing for larger biogas production by livestock operators or projects promoting biogas technology. Most players who participate in these operate livestock operations or biogas plants that are downstream consumers of waste products generated from agricultural processing. As supply of input becomes more secure, the number of active players in this segment have also been rising.

Biogas	SPP Power Plants		VSPP Power Plants		Total Power Plants	
As of 2019	No. of Project	Contracted Capacity (MW)	No. of Project	Contracted Capacity (MW)	No. of Project	Contracted Capacity (MW)
PPA signed (not yet selling)	-	-	3	8.0	3	8.0
Selling to the grid (COD)	-	-	180	332.0	180	332.0
Total	-	-	183	340.0	183	340.0

Waste-to-energy

From 2016 to 2019, in an attempt to find effective solutions for waste disposal, the government stepped up efforts to source electricity from waste-to-energy projects but growth has been limited by legal issues surrounding public-private partnerships and city planning laws, while local communities have again objected to having waste-to-energy plants operating near residential areas. In addition, concentrated, large-scale local sources of inputs are limited, which meant that only 550 megawatts of power is supplied by waste-to-energy projects (or 3.3% of the target in AEDP2015).

Waste	SPP Power Plants		VSPP Power Plants		Total Power Plants	
As of 2019	No. of Project	Contracted Capacity (MW)	No. of Project	Contracted Capacity (MW)	No. of Project	Contracted Capacity (MW)
PPA signed (not yet selling)	-	-	8	43.4	8	43.4
Selling to the grid (COD)	3	163.0	36	156.6	39	319.6
Total	3	163.0	44	200.0	47	363.0

Small hydro power

State purchases of electricity from private sector small-hydro projects account for a very small share of national electricity purchases. The majority of these projects involve small-scale dams or levees, which are built to hold water that is then used to produce electricity for local communities.

Small hydro power	SPP Power Plants		VSPP Power Plants		Total Power Plants	
As of 2019	No. of Project	Contracted Capacity (MW)	No. of Project	Contracted Capacity (MW)	No. of Project	Contracted Capacity (MW)
PPA signed (not yet selling)	-	-	-	-	-	-
Selling to the grid (COD)	-	-	4	0.9	4	0.9
Total	-	-	4	0.9	4	0.9

Source: ERC, compiled by Krungsri Research

Electricity demand for 5M20 shrank by 3.2% YoY due to the Covid-19 pandemic and mandatory shutdown. Demand from business and industry sectors fell by 10.4% and 5.4% YoY, respectively, because of the harsh economic effects of social distancing measures, temporary shuttering of department stores, hotels, restaurants, and entertainment sites, and closures in most sector in the economy. Against this overall decline, the shutdown meant that a large proportion of the workforce had to work from home temporarily, and this, together with steadily rising average temperatures, had boosted household electricity demand by 7.0% YoY.

Similarly, power output from generation plants fell by 1.7% YoY in 5M20. Power generated by EGAT (which contributes 34.1% of all electricity supplied to the grid) increased by 5.5% YoY. For private-sector generators, IPPs (22.3% of the total) saw production decline by 19.3% YoY, while SPPs and VSPPs (combined contribution of 31.5%) increased their production by 3.1% and 2.2% YoY, respectively. But with the government easing lockdown measures since May, demand from industry and business sectors will again pick up again the rest of the year.

The first revision for the 2018 Power Development Plan for 2020-2037 is currently awaiting cabinet approval (Box 3), and unfortunately this has delayed the implementation of some renewables projects, especially community power-generating 'quick win' schemes which will now be selling to the grid from 3Q20 instead of 1Q20.

Box 3: Progress in the original and amended Power Development Plan (PDP2018)

Power Development Plan 2018-2037 (PDP2018)	Power Development Plan for 2020-2037 (PDP2018, 1st revision)
• This specifies that installed generating capacity should reach 77,211 megawatts by 2037, a 9% increase from PDP2015 target. This would include 56,431 megawatts of new capacity to be installed over 2018-2037. Of this, natural gas contribution would increase to 53% by 2030, renewables would reach 20% and coal would drop to just 12%.	• The target for total new installed capacity remains at 56,431 megawatts by 2037, but the proportion of contribution from fossil fuels and selected renewables have been changed.
• 18,696 megawatts of renewables-fueled power will be supplied by the private sector, as follows: 1) In line with government measures to promote electricity generation from these segments between 2018 and 2037, 400 megawatts should come from waste-to-energy sources and 120 megawatts from Pracharat biogas facility in southern Thailand (jointly-operated by government, private sector and community). 2) Under the AEDP plan, installed capacity for renewables should reach 18,176 megawatts.	• The overall target for 18,696 megawatts of installed capacity is unchanged but the targets for individual segments have been revised. 1) Target for solar energy have been reduced from the earlier goal of 10,000 megawatts. 2) Target for EGAT's micro-hydro electricity production has been raised to 69 megawatts. 3) For local, community-based power generation, the goal is now for 1,933 megawatts of capacity to come on-stream during 2020-2024, produced from biomass, biogas (from waste water and energy crops) and solar hybrid systems. 4) Purchase of 120 megawatts of electricity from Southern Biomass has been postponed, with 60 megawatts p.a. coming on-stream in 2022-2023 instead of 2021-2022. 5) Purchases of 270 megawatts of wind power will be brought forward to 2022-2024 from 2034.
• Consumer electricity prices for the period 2018-2037 were forecast to reach THB 3.50-3.63/unit (with average of THB3.58/unit). This was based on the assumption that the price of imported liquefied natural gas (LNG) would weaken along with growing supply, so the PDP had been drawn up based on assumptions imported LNG would cost on average THB 244/million BTU, but they cost THB 266-329/million BTU currently.	• After 2024, consumer electricity prices are forecast to rise by THB0.06 to THB 3.64/unit due to larger share of electricity purchased from community-level producers, for which initial prices will run to THB3-5/unit. This would increase average electricity prices under the revised plan.

Source: PDP2018, compiled by Krungsri Research

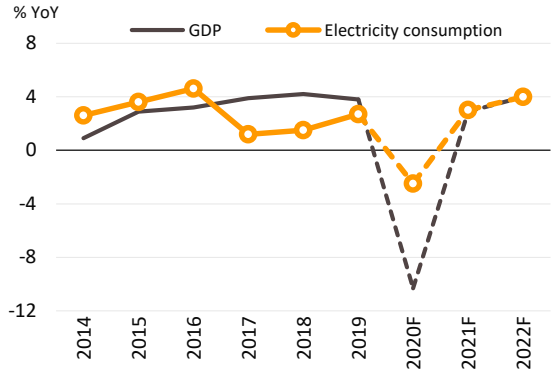
Outlook

For full-year 2020, the Covid-19 pandemic and the national lockdown will reduce annual electricity demand by 2.0-3.0% (compared with +2.7% in 2019). This would be principally driven by stalled economic activity in both services and manufacturing sectors due to the lockdown, although that has been partially offset by higher demand from the household sector as employees had been encouraged to work from home. Unfortunately, the long-term outcome of this uncertainty within the sector was to to postpone investments in private-sector renewables projects until 2021.

In 2021 and 2022, business conditions will improve somewhat for private-sector power generators, premised on assured demand and government support to invest more in the sector, as specified in the PDP.

- **Total domestic electricity consumption is forecast to grow by an average of 3.0-4.0% p.a. over the next 2 years**[6/] as the economy slowly returns to growth mode (Figure 12) and lift demand for electricity in both the business and industrial sectors. However, demand growth in the household sector will slow down as employees start returning to work in offices and working conditions normalize.
- **Power Development Plan for 2020-2037** (PDP2018, 1st revision) encourages the expansion of installed capacity and investment in new power stations in the near future with the following goals.
  - The revised PDP2018 targets 56,431 megawatts of installed capacity by 2037 (Table 4). Although natural gas contribution will be unchanged at 53%, electricity generated from renewables will play a larger role with their contribution rising to 21% of generation mix, while coal-fueled generation mix will fall to just 11% (Table 5).

Figure 12: Trend of Electricity Demand and Economic Growth



Source: EPPO / forecast by Krungsri Research

Table 4: Total Capacity under PDP2018 Revision 1

Power capacity	PDP2015 (MW)
Installed capacity as of 2014	37,612
Retired capacity (2015-2036)	-24,736
New capacity (2015-2036)	57,459
Total capacity as of 2036	**70,335**

Power capacity	PDP2018 (MW)
Installed capacity as of 2018	46,090
Retired capacity (2018-2037)	-25,310
New capacity (2018-2037)	56,431
Total capacity as of 2037	**77,211**

Source: EPPO, PDP2018 Rev.1 (Feb 2020)

Table 5: Share of Fuel used in Power Generation (%)

Fuel type	PDP2015	PDP2018	PDP2018 rev.1
Natural gas	37	53	53
Coal	23	12	11
Imported hydro	15	9	9
Renewable energy	20	20	21
Nuclear	5	0	0
Energy saving	0	6	6

Source: EPPO, PDP2018 Rev.1 (Feb 2020)

  - The overall target for the purchase of renewables-fueled electricity is unchanged at 18,696 megawatts, comprising: (i) 400 megawatts from waste-to-energy sources and 120 megawatts from government-run biogas facilities in the south of Thailand (coming online at a rate of 60 megawatts/year in 2022-2024), following government measures to promote electricity generation in these segments between 2018 and 2037; and (ii) 18,176 megawatts from renewables projects per the AEDP, though this now includes 1,933 megawatts of new capacity from local, community-based power generation capacity (from biomass, biogas, waste water and energy crops, and solar hybrid systems) in 2020-2024, and 270 megawatts of wind power which will come on-stream in 2022-2024 (Table 6).
  - From 2024, consumer electricity tariffs are expected to average THB3.64/unit, up from THB 3.58/unit specified in the earlier version of the plan. This is partly due to buying electricity from community-level producers, for which the government has set initial purchase price at THB 3-5/unit.

6/ This is on the assumption that (i) energy saving measures reduce demand by an average of 1 billion units annually, and (ii) independent power suppliers, which produce electricity for their own use or who bypass EGAT and supply electricity directly to consumers, supply some portion of this, though information is only available on suppliers generating over 1 megawatt of power.

Table 6: Renewable Energy Capacity under PDP2018 Rev.1

Power plant	Contracted capacity (MW)					
	2020	2021	2022	2023	2024	2037
(1) Government support						**520**
- Waste energy			400	400	400	400
- Biomass			60	120	120	120
(2) Under AEDP						**18,176**
- Biomass (community)	200	300	400	500	600	600
- Biogas-crops (community)	200	300	400	500	600	600
- Biogas-waste (community)	100	150	183	183	183	183
- Solar hybrid (community)	200	300	390	470	550	550
- New wind			90	180	270	1,485
- Small hydro (EGAT)	-	-	-	-	-	69
- Floating solar and hydro (EGAT)	45	45	45	69	69	2,725
- Solar	50	100	150	200	250	8,740
- Biomass	-	-	-	-	-	2,780
- Biogas	-	-	-	-	-	400
- Industrial waste	-	-	-	-	-	44
Total	**795**	**1,195**	**2,118**	**2,622**	**3,042**	**18,696**

Source: EPPO, PDP2018 Rev.1 (Feb 2020)

The above factors will encourage more investment in the three types of power generation projects, as described below.

- **For IPPs, there should be competitive bidding within the next 3-5 years.** The government will call for bids for about 700 megawatts of capacity in the west of the country in 2021-2022, to replace gas-fired power plants that will gradually reach the end of their supply contracts and lose access to the grid over 2025-2027. This will affect 8,300 megawatts of installed capacity .
- **SPPs would increase installed generation capacity and investment in new power stations**, especially natural gas-fueled cogeneration power plants which contracts will expire in 2019-2025[7/]. SPPs will also invest in renewables in the form of mixed-fuel power generation, or 'SPP hybrid firms', which Thai authorities are increasingly supporting. These power suppliers will now be paid for the next 20 years at a feed-in tariff rate of THB 3.69/unit, up from the THB3.66/unit received in 2019.
- **VSPPs are expected to step up investment from 2021,** especially in solar rooftop, biomass, biogas and waste-to-energy electricity projects because the volume of electricity supplied to the grid by these segments is still short of government targets. This presents an investment opportunity. And, in line with the PDP and AEDP, the government is supporting these segments by increasing purchases of electricity from these suppliers, while the players are also generally competitive in terms of access to raw materials and costs. For players active in wind power, the government plans to buy-in another 270 megawatts of electricity from wind farms over 2022-2024, by which time EGAT should have completed its work on the high-voltage power lines in the Northeast and South, which are required to connect commercial wind farms to the grid.

7/ SPPs are required to construct new power plants to sell electricity to EGAT, while selling prices are based on types of electricity generated from natural gas and coal.

Box 4: Summary of trends in private-sector power generation, by fuel type (2020-2022)

	Trends	Factors affecting growth	
		Positive	Negative
Natural gas (baseload power stations)	• Steady growth • Bidding will take place for new power stations to replace those which contracts will end in 2021-2022, although the bidding process may be delayed due to the Covid-19 outbreak	• The revised PDP for 2020-2037 provides for baseload power generation from natural gas to ensue energy security (the target for the proportion of energy produced from natural gas by 2037 was increased from 37% in PDP2015 to 53% in the revised PDP.)	• Natural gas reserves in the Gulf of Thailand are being depleted, so LNG imports will rise. However, imported gas is more expensive and consumer prices for electricity might rise as well.
Coal	• Growth will be limited due to concerns over the environmental impact of coal-fired power plants. New investment may have to wait until after 2027.	• At present, the strategic environmental assessment (SEA) is underway to support the proposed construction of a new coal-fired power station in the south of Thailand.	• Due to objections from local communities, the contribution of coal to the national power generation mix has been reduced. Under PDP2018, coal's share in the electricity generation mix is reduced to 11% by 2037 (from 23% in PDP2015).
Solar	• Growth will be moderate. • New investment in the production of private rooftop solar cells.	• For the period 2020-2024, the government will buy 50 megawatts of power per year (or a total of 250 megawatts) from privately-installed rooftop solar projects and from community solar hybrid producers. • Installation costs for solar cells are falling steadily.	• Although installation costs are dropping, the cost of equipment required to connect to the grid remains high, and depend on a lot of related factors such as the size and type of power production and the solar cells used.
Biomass	• Growth is moderate levels. • Most investments will be in community power production and SPP hybrid firms as these are competitive on price.	• This is a power source targeted for support by the government in the revised PDP and AEDP, which now emphasize community-based electricity production. • These suppliers are supported by the FiT system, which for 2020 pays THB4.27-5.38/unit (the rate varies with installed capacity), while average production cost is only THB2.8/unit.	• Persistent shortage of inputs would keep costs elevated.
Biogas (from waste water and energy crops)	• Moderate growth • New investment will likely come from producers who have access to inputs and are generating power for their own use, with the surplus sold to the MEA/PEA.	• This segment is targeted for government support, and the revised PDP/AEDP plans specify that the government should steadily increase purchases of power from community producers and suppliers of electricity generated from biogas made from energy crops. • Suppliers of biogas made from waste water and energy crops qualify for a per-unit feed-in tariff of either THB3.76 or THB5.39, and are exempt from requirements to engage in competitive bidding.	• There is insufficient input that is commercially-viable to use in the generation of biogas. Hence, the high marginal production costs make investment not feasible.

Source: Krungsri Research

Box 4: Summary of trends in private-sector power generation, by fuel type (2020-2022) (cont.)

	Trends	Factors affecting growth	
		Positive	Negative
Waste-to-energy	• Steady growth • Businesses that focus on collecting and separating waste will see better opportunities to grow investment.	• Electricity from landfill waste-to-energy projects qualifies for a feed-in tariff of THB5.60/unit, and players do not need to engage in competitive bidding.	• There are few concentrated sources of waste (1 MW of generation capacity consumes 100 tonnes of waste per day) and the quality of waste separation remains poor. This means plants can cause severe air pollution
Wind	• Moderate growth. • Investment opportunities will favor large-scale investors who have the necessary funds, technological understanding, and access to areas that are served by suitable transmission lines.	• SPPs will invest in areas with *Sor Por Kor* title ownership that has passed the relevant inspection criteria. (This is land which use is controlled and which cannot be sold.) Currently, transmission lines that link potential sites to the national grid are under construction. • The government plans to buy 90 megawatts of wind-generated power in 2022-2024.	• The majority of high-potential sites are in national parks that are difficult to access, and connection to transmission lines can be problematic.
Hydro power	• We foresee limited growth, and most projects will be carried out by the public sector.	• Included in the PDP2018 under floating solar power and general hydroelectric.	• The majority of sites with potential are in national parks. • Hydropower is a type of power generation particular to EGAT.

Source: Krungsri Research

Krungsri Research's view: Players will see revenue growth slow in 2020 in line with the worsening economic outlook. But in 2021 and 2022, domestic economic conditions are forecast to improve and GDP will register healthy growth again. And this will benefit larger power companies. However, costs would rise, especially for renewables projects, which could cap earnings growth at moderate levels.

- **IPPs:** For 2021-2022, the forecast is for better revenue growth driven by sales to the domestic market and higher returns from overseas investments. There will be more investment in renewables, encouraged by the revised PDP2018 plan for 2020-2037, which allows competitive bidding for only 700 megawatts of generation capacity to replace gas-fired power stations in 2021-2022 (but this might be postponed because of the Covid-19 outbreak). In addition, large-scale power stations may not be environmental-friendly and might provoke opposition from local communities. Overseas, there will be more investments in new natural gas- and coal-fired power stations and renewables (especially solar and wind) in Myanmar, Laos PDR, Indonesia, the Philippines, Australia and Japan.
- **SPPs:** Over the next three years, revenue will be sufficient for SPP's to be self-supporting. SPPs can benefit from investing in: (i) cogeneration natural gas power stations that will reach the end of their contracts over 2019-2025 but which will still be able to supply power to industrial parks and estates; (ii) new renewables projects in the form of 'SPP hybrid firms', which will enjoy fuel costs that are lower than consumer prices for electricity (costs about THB 1.81/unit whereas consumer prices are about THB 3.60/unit); and (iii) new electricity production in the Eastern Economic Corridor (EEC), where demand will rise in the near future.
- **VSPPs:** Revenue will rise steadily driven by solid demand but investment opportunities may be restricted to producers that are beneficiaries of government support measures laid out in the revised PDP and AEDP, notably private rooftop solar, biomass, biogas and waste-to-energy projects from which the government plans to increase electricity purchases. New entrants to the market that are investing in biomass, biogas and waste-to-energy projects may experience difficulty sourcing for input, while government purchases of electricity from new wind-powered projects should start in 2022-2024.

Overall, competition in the sector has grown more intense, especially for renewables, because existing operators have been expanding generation capacity and there have been several new entrants. Notably, there is increasing influence from players with huge financial and technological strengths, such as IPPs and SPPs that have a background in engineering, procurement and construction (EPC) because they have the necessary expertise to install electrical systems, or those that manufacture solar equipment. These operators have started to supply renewable power to the grid.

KRUNGSRI RESEARCH

Somprawin Manprasert, Ph.D.	**Head of Research Division and Chief Economist**
Phornphan Phoksuphat	Head of Macroeconomic and Industry Research

Macroeconomic Team

• Sujit Chaivichayachat	Head of Macroeconomic Research
• Chamadanai Marknual, Ph.D.	Senior Economist
• Churailuk Pholsri	Senior Economist (Forecasting)
• Soison Lohsuwannakul	Senior Economist (Regional Economy)
• Sathit Talaengsatya	Senior Economist (Regional Economy)

Industry Team

• Sarun Sunansathaporn	Head of Industry Research
• Taned Mahattanalai	Senior Analyst (Construction Contractors)
• Poonsuk Ninkitsaranont	Senior Analyst (Healthcare, Mobile Operators)
• Piyanuch Sathapongpakdee	Senior Analyst (Transport & Logistics)
• Narin Tunpaiboon	Senior Analyst (Power Generation, Modern Trade, Chemicals, Medical Devices)
• Puttachard Lunkam	Analyst (Hotels, Construction Materials, Industrial Estate)
• Wanna Yongpisanphob	Analyst (Automobile, Electronics & Electrical Appliances, Food & Beverages)
• Patchara Klinchuanchun	Analyst (Real Estate)
• Chaiwat Sowcharoensuk	Analyst (Agriculture)
• Aphinya Khanunthong	Analyst (Energy, Petrochemicals)

Intelligence Team

• Pimnara Hirankasi, Ph.D.	Senior Analyst
• Talublugkhana Thanadhidhasuwanna	Senior Analyst (Financial Sectors)
• Punjaphut Prasitdechsakul	Senior Analyst
• Rachot Leingchan	Analyst
• Arpakorn Nopparattayaporn	Analyst
• Chutipha Klungjaturavet	Analyst

MIS and Reporting Team

• Suratchanee Somprasong	Administrator
• Thamon Sernsuksakul	Administrator
• Chirdsak Srichaiton	MIS Officer
• Wongsagon Keawuttung	MIS Officer

For research subscription, contact ***krungsri.research@krungsri.com***

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