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Prepared By: Sakchai Preechajarn, Ponnarong Prasertsri, Maysa Chanikornpradit, Agricultural Specialist

Approved By: ERIC MULLIS

Report Highlights:

The new 20-year AEDP (2018 – 2037), which was approved by the Cabinet on April 30, 2019, is likely to lower the biofuel consumption target. The biofuel price subsidy will be phased out during 2020 – 2022 under the new State Oil Fund Act, which was enacted on September 24, 2019. Ethanol production and consumption for 2019 is expected to continue to increase, albeit at a slower pace than 2017 due to the delay in the cessation of Octane 91 E10 sales. Biodiesel production and consumption is expected to grow by 12 and 11 percent respectively in 2019.

I. Executive Summary

The new 20-year AEDP 2018 (2018 – 2037) was approved by the Cabinet on April 30, 2019. The government is in the process of reviewing the ethanol and biodiesel consumption targets, which are expected to be lower than the initial targets set in the old ADEP in 2015 due to uncertainty in having adequate supplies of feedstocks for ethanol and biodiesel production since the government still restricts biofuel imports. The government has also restructured the administration of the State Oil Fund through the new State Oil Fund Act B.E. 2562 (2019), which was enacted on September 24, 2019. The new State Oil Fund Act aims to control the financial liability of the State Oil Fund and limit government price subsidies to only fossil fuel, since the government already provides a subsidy for feedstocks of biofuels via government domestic support programs. Under the new State Oil Fund Act, the government will gradually reduce the current price subsidy on gasohol and biodiesel during 2020 - 2022.

Feedstocks for ethanol production in Thailand are sugarcane, molasses (by-product from cane sugar processing), and cassava roots. In 2019, ethanol production is expected to increase by 9 percent due to expanded production capacity of molasses-based ethanol plants. Ethanol consumption is expected to increase approximately 6 percent from 2018. Ethanol consumption and production year-over-year growth, however, has slowed from the record 12 percent growth in 2017 due to the delay in the cessation of Octane 91 E10 sales. The average ethanol-gasoline blend level rose above E12 beginning 2017 and has risen slowly to reach and estimated 13.5 percent in 2019 due mainly to the further progress in E20 sales.

Biodiesel is produced from palm oil derived feedstock such as crude palm oil (CPO), refined bleached deodorized palm oil (RBDPO), palm stearin, and free fatty acids of palm oil (FFA). Biodiesel production is forecast to increase by 12 percent in 2019. 2019 biodiesel consumption is forecast to grow by 11 percent due to growing diesel consumption, a higher mandatory biodiesel blending rate in late 2018, and a surge in B20 consumption. The average national on-road blend rate which has steadily risen since 2017 is estimated at 7.2 percent in 2019.

After introducing B10 supplies to the market in early 2019, the government announced in October 2019 that B10 supplies will be available for all gasoline stations across the country on March 1, 2020. It is anticipated that the government will subsidize the price to attract the use of B10. Meanwhile, the government intends to lower price subsidy incentives for B20 but maintain mandatory 6.6-7.0 percent blending rates as an option for some vehicles that might be better fit for B7 use.

II. Policy and Program

At the 2015 Paris Climate Conference, Thailand committed to reduce its greenhouse gas (GHG) emissions by 110-140 million tons of carbon dioxide (CO2) or 20-25 percent of 2015 emissions by 2030. The 2016 Nationally Determined Contribution (NDC) roadmap plans to reduce CO2 emissions by 113 million tons by 2030 in total energy use including transport. To do this, the roadmap includes increasing renewable energy use in households, industry, and power generation as a percent of total use in these sectors; promoting biofuels; and, increasing efficiency in power generation, transport, buildings, and industry.

The NDC was incorporated into Thailand's National Energy Plan (2015 – 2036) (also known as Thailand Integrated Energy Blueprint (TIEB 2015)), which was endorsed in October 2015 and aligned with Thailand's 11th National Economic and Social Development Plan. The current national energy plan includes five master plans: the Alternative Energy Development Plan (AEDP), the Power Development Plan (PDP), the Energy Efficiency Development Plan (EEDP), the Oil Development Plan (ODP), and the Gas Development Plan (GDP).

As a result of the TIEB 2015, the AEDP 2012 (2012-2021) was replaced by a new AEDP 2015 (2015-2036). While both AEDP 2012 and AEDP 2015 target national energy security and domestic economic development rather than environmental protection, the bottom line of the revised AEDP 2015 is to extend the planned coverage from 10 years to 20 years and to integrate all sectoral energy plans, i.e. AEDP, PDP, EEDP, ODP, GDP, with the national economic and social development plan. The AEDP 2015 has an overall goal that 30 percent of total energy consumption will come from renewable energy by 2036. Under the AEDP 2015, the share of renewable and alternative energy from biofuel is targeted to increase from 7 percent of total fuel energy use in 2015 to 25 percent in 2036. In order to accomplish this energy goal, the Thai government has set the ethanol consumption target of 4.1 billion liters by 2036 from 1.18 billion liters in 2015 and the biodiesel consumption target at 5.1 billion liters by 2036 from 1.24 billion liters in 2015.

With respect to ethanol policy, the government has promoted the use of gasohol through price incentives at the gas pump and an excise tax reduction for cars compatible with E20 and E85 gasohol without mandating compulsory use of gasoline/ethanol mixes since the first AEDP (2004 – 2011) and the second 15-year AEDP (2008 – 2022). The government has, however, imposed a mandatory blending requirement for biodiesel in diesel that is supplied across all market sectors, including road use, agriculture, and industry to increase biodiesel consumption. Inland shipping and trains do not play a big role in Thailand's transportation system for now. Based on statistics reported by Department of Alternative Energy Development and Efficiency, combined diesel use under these two categories account for approximately 3 percent of total diesel use.

To meet domestic demand, the government has raised the palm oil acreage target to 10.20 million rai (1.63 million hectares) by 2036 from 4.4 million rai (0.70 million hectares) in 2015, under the condition that only domestic palm oil will be used as a feedstock and that other feedstocks, like animal fats and used cooking oil (UCO), will play an insignificant role in production.

The TIEB 2015 also set the production target for second and third generation biofuels at 10 kilotons of oil equivalent (ktoe) by 2036. The government supports this objective by supporting research at Thai universities. The development of second-generation biofuels from biomass and third generation biofuels from algae are still in the research and development phase and not close to commercialization.

The Ministry of Energy developed the revised 20-year AEDP 2018 due to sluggish global price expectations for petroleum, limited domestic feedstock supplies for ethanol and biodiesel, and a lack of imports. The production of these agricultural crops is far below the target under the biofuel development plan implemented over the past decade. The average yield of sugarcane is still at 11-12 metric tons per rai (69-75 MT/hectare) compared to the target of more than 15 metric tons per rai (94 MT/hectare). While molasses-based ethanol producers are technically able to switch their feedstocks to sugarcane juice that is normally used for sugar production, it is not economically viable as they are

required by the Cane and Sugar Act to share the revenue from this sugarcane juice-based ethanol with sugarcane farmers. The average yield of cassava remains around 3.5 metric tons per rai (22 MT/hectare), compared to the target of 5 metric tons per rai (31 MT/hectare). Production of crude palm oil (CPO), the main feedstock for biodiesel production, can fluctuate significantly because of weather conditions.

The new 20-year AEDP (2018 – 2037) was approved by the Cabinet on April 30, 2019. The government is in the process of reviewing the ethanol and biodiesel consumption targets, which are expected to be lower than the initial targets set in the old ADEP in 2015 due to uncertainty in having adequate supplies of feedstocks for ethanol and biodiesel production while the government still restricts the imports of both ethanol and biodiesel. The government has also restructured the administration of the State Oil Fund through the new State Oil Fund Act B.E. 2562 (2019), which was enacted on September 24, 2019. The new State Oil Fund Act aims to control the financial liability of the State Oil Fund and limit government price subsidies to only fossil fuel, since the government already provides a subsidy for feedstocks of biofuels via government domestic support programs. Under the new State Oil Fund Act, the government will gradually reduce the current price subsidy on gasohol and biodiesel during 2020 - 2022.

By solely relying on domestic resources and excluding imports from any role in meeting future biofuel consumption targets, Thailand will 1) be forced to temporarily lower biofuel use targets or price surges when weather-related feedstock shortages occur; 2) not meet higher long-term biofuel use goals, and set permanently lower goals below blend levels the vehicle fleet can absorb and some other countries have already reached, and thus increase the risk of falling short of its COP21 commitments; and 3) likely see higher GHG emissions from biofuels tied to direct land use change, which could even make some biofuels (especially palm oil biodiesel) a worse alternative to fossil fuels. Permitting some role for imports unlocks the full positive potential contribution biofuels can make to 1) lowering health costs tied to toxic air pollution from fossil fuels, and 2) lowering some of the cost future generations will bear from climate change tied to escalating carbon emissions.

Thailand does not currently have any environmental sustainability requirements established for transport biofuels. Thailand does, however, restrict land use change to avoid negative impacts on food crops; biodiversity; and air, water, and soil quality. For example, Thailand has increased the planted area for sugarcane and cassava (a source of feedstock for ethanol production), and for oil palm (a source of feedstock for biodiesel production) by transitioning existing farmland from other crops, such as rubber, rice, corn, and other field crops, into farmland for biofuel crops.

2.1 Ethanol

Under the new AEDP 2018, the government is expected to lower the ethanol consumption target to 2.4 billion liters in 2037, down by 41 percent from the initial target of 4.1 billion in the old ADEP in 2015 due to uncertainty in having adequate supplies of molasses and cassava, the primary feedstocks for ethanol production. This uncertainty has caused the government to delay eliminating the sale of octane 91 E10, which was scheduled to occur on January 1, 2018. In 2019, sales of octane 91 E10 still account for 30 percent of total gasohol sales, compared to one third of total gasohol sales in 2018. The MOE expects that the cessation of octane 91 E10 sales will increase ethanol demand by doubling sales of E20. However, the government is uncertain if domestic supplies of molasses and cassava will be sufficient to

meet this demand if octane 91 E10 sales are eliminated and is unwilling to allow imports. The MOE is conducting a feasibility study to gauge the impact of having E20 as the primary gasoline and phase out octane 91 E10. The timeframe of such initiative implementation has not been revealed. Additionally, demand for gasoline and gasohol is expected to slow down in the longer run due to the commercialization of electrical vehicles and high-speed train project which is under construction.

While the new government intends to announce the new ethanol consumption target in AEDP 2018 by the end of 2019, the State Oil Fund Act has been restructured by the previous government and enacted on September 24, 2019. Under the new State Oil Fund Act (2019), the price subsidies on gasohol will be reduced gradually over the next three years, starting in 2020. By 2022, all price subsidies on gasohol will be terminated, particularly for E20 and E85, which are currently subsidized by the Fund at 1.78 baht/liter and 7.38 baht/liter, respectively (Table 4.1.2). The price subsidies on E85 will be reduced by half in 2020, and down further by 25 percent each in 2021 and 2022. Meanwhile, the price subsidy on E20 will decline by 25% in 2020, and down further 25% in 2021 until no subsidy in 2022. By 2022, the government expects that E20 will be a primary gasohol as the retail prices of E20 will be respectively cheaper than E10 and E85 by 7-8 percent and 4-5 percent.

The current price subsidies for gasohol, which are paid by the State Oil Fund, make gasohol 20 – 40 percent cheaper than premium gasoline. These government price subsidies have led to gasohol consumption accounting for 97 percent of total gasoline consumption in 2019. The government also supports the manufacturing of vehicles that are compatible with E20 and E85 gasohol. Improvements in the fuel efficiency of vehicles is promoted by setting the excise tax rate for Eco-cars (less than 1,300 cc engines with fuel consumption rate of no more than 5 liters per 100 kilometers) at 17 percent compared to 30 percent for E10 vehicles. Moreover, the government provides an additional 3 percent reduction in the excise tax rate for the manufacturing of Eco-cars that are able to use E85 gasohol. This helped increase annual sales of E20 and E85 passenger cars, which account for approximately 60 percent of total passenger cars.

2.2 Biodiesel

Under the AEDP 2015, the Thai government set the biodiesel consumption target at 5.1 billion liters by 2036. On the demand side, the government continues to impose the mandatory blending of biodiesel in diesel for all end use markets. The plan aims to increase the mandatory blend rate from the current requirement of B7 to B10 and B20. The government has subsidized the use of B20 in large trucks on a voluntary basis since 2016. Although the government intended to implement a mandatory B10 requirement in 2018 for all diesel sales, it has not yet done so. On the supply side, the government increased palm oil target acreage to 10.20 million rai (1.63 million hectares) by 2036. Production of palm fresh fruit bunch (FFB) is expected to reach 29.46 million metric tons (MMT) in 2036. Out of FFB production, 4.24 MMT of FFB would be processed as biodiesel in 2036.

However, policy makers in both the MOE and the Ministry of Agriculture and Cooperatives (MOAC) agreed that the mandatory biodiesel consumption plan for 2036 may be unattainable (given that the current strategy does not permit imports) and is therefore being reexamined in AEDP 2018. Despite increases in harvested area, extreme weather conditions in Thailand have affected crude palm oil (CPO) production, complicating the ability of policy makers to meet production targets. For example, CPO

production stagnated at 1.8-2.0 million from 2014-2016 due to dry weather conditions, causing the Ministry of Energy to lower the mandatory biodiesel use target.

III. Gasoline and Diesel

Under the Energy Efficiency Development Plan (EEDP), seven core measures are laid out to increase the country's energy efficiency, aiming at reducing final energy consumption (FEC) in 2036 to 30 percent of the 2010 baseline. The core measures include energy efficiency improvements in industrial facilities, energy-saving housing promotions, efficiency promotions for electric appliances and eco-stickers, mandatory application of the Energy Efficiency Resource Standard, soft loan provisions for energy efficiency improvements, promoting LED use, and energy efficiency promotions in the transportation sector. In 2018, the EEDP saved final energy consumption by approximately 8 percent from the 2010 baseline, mainly due to an improvement in energy efficiency in residential and transportation sectors. This is a slight increase in final energy consumption saving as the government slowly implemented the energy efficiency development programs during the transition to the new 20-year AEDP 2018.

Table 3.1: Thailand Fuel Use (2010-2019)

Fuel Use (Million Liters)										
Calendar Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019f**
Gasoline Total	7,418	7,331	7,705	8,233	8,567	9,714	10,680	11,030	11,373	11,770
Diesel Total	18,480	19,192	20,565	20,892	21,071	21,921	22,708	23,265	23,602	24,050
On-road	11,100	11,510	12,340	12,500	12,640	13,153	13,625	13,959	14,161	14,430
Agriculture	3,670	3,840	4,113	4,160	4,214	4,384	4,540	4,653	4,720	4,810
Construction & Mining	154	160	165	167	169	174	229	233	236	240
Shipping & Rail	415	420	451	513	466	484	454	465	472	490
Industry	3,141	3,262	3,496	3,552	3,582	3,726	3,860	3,955	4,013	4,080
Heating	0	0	0	0	0	0	0	0	0	0
Jet Fuel Total	4,712	5,077	5,091	5,562	5,513	6,033	6,468	6,743	7,095	7,125
Total Fuel Markets	30,610	31,600	33,361	34,687	35,151	37,668	39,856	41,038	42,070	42,945

f = forecast
Source: Department of Energy Business, Ministry of Energy

Diesel blending mandates have been effective in increasing biodiesel consumption with the national average blend rate effectively doubling over the past decade. The mandates are strictly controlled and monitored and must be used in all diesel fuels used in transport and industry. In general, the main markets for diesel use in Thailand are on-road transportation, accounting for about 60 percent of total diesel consumption, followed by agriculture at 20 percent, industry at 17 percent, and other uses including trains and inland shipping at 3 percent.

To increase energy efficiency in transportation, the government plans to: 1) phase out the subsidy for gasoline and diesel so that prices reflect actual production costs; 2) promote the acquisition of eco-vehicle fleets through tax incentives; 3) increase eco-tire use; 4) support transportation infrastructure; 5) construct double-tracked railways and high-speed train systems; 6) fund electric vehicle (EV) research and development; and 7) support fuel pipeline expansion. The total government budget to increase energy efficiency is 1,484 billion baht (U.S. $43 billion) from 2015-2036, with the goal to reduce final

energy consumption in an amount of 30,213 ktoe by 2036. Some projects such as double-tracked railways, the high-speed trains, and the development of EV cars have already been started. The MOE anticipates that EV cars should be widely introduced by 2024 and that by 2036 Thailand will have 1.2 million EV cars. In addition, the first double-tracked railways and high-speed trains are scheduled to be operational by 2023.

The Thai government also initiated a campaign to promote Eco passenger cars in 2007 through excise tax incentives and Board of Investment (BOI)'s privileges on corporate income tax-free and import duty-free on machinery. Sales of Eco passenger cars, commencing in 2010, grew significantly to 179,000 cars in 2013. Due to unfavorable economic conditions, sales were stagnant during 2014-2017. However, according to industry sources, sales of Eco passenger cars from 2010 to Jan 2019 was 1,121,837 cars. In 2018, Eco passenger car sales was 209,522 cars, which is a 34 percent increase from 2017. In early 2019, the Thai government tried to push forward the production of EcoEV vehicles, which includes Hybrid Electric Vehicle (HEV), Plug in Hybrid Vehicle (PHEV), Battery Electric Vehicle (BEV) and Fuel Cell Electric Vehicle (FCEV) by curbing half of the levied excise tax. However, industry did not agree with the government's approach to promote investment on EcoEVs. Industry argued that there already is an existing import duty exemption provided for the importation of key parts of HEV and that HEVs with CO2 emission ratios not over 100 grams/kilometer already receive a reduced excise tax of 10 percent compared to 14 percent for Eco passenger cars. The small demand for PHEV and BEV and lack of electric charging stations are also unfavorable factors that make this government incentive program ineffective thus far.

Based on the implementation of the EEDP measures, government sources anticipate that gasoline consumption should grow at a rate of 3 percent per annum during 2023-2027, while diesel consumption should increase at a slower pace of 1.5-2.0 percent per annum in those years.

IV. Ethanol

4.1 Consumption

Fuel ethanol consumption during January – August 2019 totaled 1.1 billion liters. This is a 7 percent increase from the same period in 2018 driven mostly by rising gasohol consumption, which increased to 7.6 billion liters, up 5 percent from the same period last year (Table 4.1.1). Meanwhile, premium and regular gasoline (fuels that do not include ethanol) consumption declined to 260 million liters during January – August 2019, down 14 percent from the same period last year. Consumption of gasohol accounted for 97 percent of total gasoline consumption driven by government's price subsidies on gasohol via the State Oil Fund, particularly for E20 gasohol. The government maintains E20 and E85 retail prices at approximately 30 and 40 percent cheaper than premium gasoline (Table 4.1.2). Similarly, E10 retail prices were 20 percent cheaper than premium gasoline. In addition, the number of gasohol stations continues to increase nationwide up to 4,440 stations for E20 and 1,449 stations for E85 in August 2019, a 10 and 17 percent increase from the same period last year. Meanwhile, the consumption of octane 91 E10 declined by 5 percent during January – August 2019 as consumers continue to shift from octane 91 E10 to octane 95 E10 and E20. This shift is mainly due to government tax changes implemented since 2017, which have lowered the price difference between octane 91 E10 and octane 95 E10. This has effectively set the price difference between octane 91 E10 and octane 95 E10 at 0.27 baht per liter (U.S. $0.03/gallon).

Table 4.1.1: Thailand's Gasoline and Gasohol Consumption (Unit: Million Liters)

Type of Gasoline	2013	2014	2015	2016	2017	2018	January - August		
							2018	2019	% Change
Gasoline	**763**	**559**	**583**	**561**	**508**	**437**	**303**	**260**	**-14.2**
Regular (octane 91)	147	61	81	71	57	39	31	22	-29.6
Premium (octane 95)	616	498	502	490	451	398	272	238	-12.5
Gasohol	**7,470**	**8,008**	**9,130**	**10,119**	**10,521**	**10,936**	**7,241**	**7,568**	**4.5**
- Gasohol E10 Octane 91	3,337	3,595	4,019	4,073	3,885	3,638	2,455	2,333	-5.0
- Gasohol E10 Octane 95	3,030	2,735	3,283	3,968	4,350	4,739	3,122	3,350	7.3
- Gasohol E20	963	1,344	1,511	1,753	1,903	2,122	1,383	1,570	13.5
- Gasohol E85	141	334	318	325	383	437	281	315	11.8
Total	**8,233**	**8,567**	**9,714**	**10,680**	**11,029**	**11,373**	**7,544**	**7,828**	**3.8**

Source: Department of Energy Business, Ministry of Energy

Table 4.1.2: Price Structure of Gasoline and Gasohol in Bangkok (October 9, 2019)

	Premium gasoline (octane 95)	Gasohol			
		E10 Octane 95	E10 Octane 91	E20	E85
Ex-Refinery Factory Price	15.4582	16.0506	15.6629	16.7087	20.3946
Excise Tax	6.5000	5.8500	5.8500	5.2000	0.9750
Municipal Tax	0.6500	0.5850	0.5850	0.5200	0.0975
State Oil Fund	7.0800	1.1200	1.1200	-1.7800	-7.3800
Conservation Fund	0.1000	0.1000	0.1000	0.1000	0.1000
Wholesale Price (WS)	29.7882	23.7056	23.3179	20.7487	14.1871
Value Added Tax (VAT)	2.0852	1.6594	1.6323	1.4524	0.9931
WS+VAT	31.8734	25.3650	24.9502	22.2012	15.1801
Marketing Margin	2.6043	1.7617	1.8971	1.9055	4.3550
VAT	0.1823	0.1233	0.1328	0.1334	0.3049
Retail Price	34.66	27.25	26.98	24.24	19.84

Note: Exchange rate = 30.6505 baht/$
Source: Petroleum Division, Energy Policy and Planning Office, Ministry of Energy

In 2019, fuel ethanol consumption is expected to increase to 1.6 billion liters, up approximately 6 percent from 2018 (Table 4.1.3). This is a slower growth rate than the 12 percent year-over-year increase achieved in 2017 and the result of the delay in the cessation of Octane 91 E10 sales. According to the Ministry of Energy's research, the elimination of octane 91 E10 sales will cause 50 percent of octane 91 E10 consumption to shift to E20 consumption, followed by octane 95 E10 (45%) and E85 consumption (5%). Additionally, the government has no plans to further reduce the price difference between octane 91 E10 and octane 95 E10 and E20 as these products are already similarly priced. The government expects that if sales of octane 91 E10 are not eliminated, the national blend rate will remain at the current level of 13 percent, which is consistent with the government's short-run target. However, in the longer run, if the government maintains the sales of octane 91 E10, they will be unable to meet the industrial ethanol consumption target of 4.1 billion liters.

Table 4.1.3: Thailand's Production, Supply and Demand for Ethanol Used as Fuel and Other Industrial Chemicals

Ethanol Used as Fuel and Other Industrial Chemicals (Million Liters)										
Calendar Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019f
Beginning Stocks	44	48	63	22	42	40	37	30	54	31
Fuel Begin Stocks	24	22	58	20	21	26	21	17	40	27
Production	521	613	790	1,048	1,070	1,190	1,290	1,480	1,500	1,660
Fuel Production	451	486	471	950	1,058	1,174	1,276	1,461	1,485	1,600
Imports	7	6	6	5	11	11	13	12	12	13
Fuel Imports	0	0	0	0	0	0	0	0	0	0
Exports	48	139	304	64	5	0	0	0	0	40
Fuel Exports	0	0	0	0	0	0	0	0	0	0
Consumption	476	465	533	969	1,078	1,204	1,310	1,468	1,535	1,610
Fuel Consumption	453	450	509	949	1,053	1,179	1,280	1,438	1,498	1,590
Ending Stocks	48	63	22	42	40	37	30	54	31	44
Fuel Ending Stocks	22	58	20	21	26	21	17	40	27	37
Total BalanceCheck	0	0	0	0	0	0	0	0	0	0
Fuel BalanceCheck	0	0	0	0	0	0	0	0	0	0
Refineries Producing Fuel Ethanol (Million Liters)										
Number of Refineries	19	19	19	21	21	21	21	26	26	26
Nameplate Capacity	977	977	977	1,307	1,472	1,472	1,472	1,875	1,910	1,950
Capacity Use (%)	46.2%	49.7%	48.2%	72.7%	71.9%	79.8%	86.7%	77.9%	77.7%	82.1%
Co-product Production (1,000 MT)										
Bagasse	132	134	180	209	243	252	216	261	262	271
Feedstock Use for Fuel Ethanol (1,000 MT)										
Sugarcane	480	486	654	760	882	915	787	949	953	986
Molasses	1,100	1,415	1,418	2,615	2,895	3,165	3,067	3,617	4,075	4,795
Cassava	925	650	468	1,670	1,864	2,166	3,014	3,272	2,729	2,604
Market Penetration (Million Liters)										
Fuel Ethanol Use	453	450	509	949	1,053	1,179	1,280	1,438	1,498	1,590
Gasoline Use	7,418	7,331	7,705	8,233	8,567	9,714	10,680	11,029	11,373	11,770
Blend Rate (%)	6.1%	6.1%	6.6%	11.5%	12.3%	12.1%	12.0%	13.0%	13.2%	13.5%

Note: Beverage ethanol is not included in this table.
Cassava-based ethanol production mainly uses fresh cassava root as feedstock.
The conversion rate is 1 MT:160 liters.
The conversion rate of molasses-based ethanol is 1 MT:240 liters.
The conversion rate of sugarcane-based ethanol is 1 MT:75 liters.
Co-product of sugarcane-based ethanol production is bagasse (275 kg/1 MT of sugarcane).
2019 figures are FAS estimates.

Source: Department of Alternative Energy Development and Efficiency, Ministry of Energy (Fuel Ethanol Production Data)
Department of Energy of Business, Ministry of Energy (Fuel Ethanol Consumption Data).
Liquor Distillery Organization, Excise Department, Ministry of Finance (Industrial Ethanol Production and Consumption Data)
The Customs Department, Ministry of Finance (Ethanol Export and Import Data)

4.2 Production

Feedstocks for ethanol production in Thailand are sugarcane, molasses, and cassava roots. Ethanol production during January – June 2019 totaled 819 million liters. This is a 9 percent increase from the same period in 2018 due to expanded production capacity of molasses-based ethanol plants. Presently, there are 26 fuel ethanol plants operating with total production capacity of around 1.95 billion liters per year. Molasses-based ethanol accounts for 70 percent of total ethanol production, up from 65 percent in 2018 due to being relatively cheaper feedstock than cassava. Meanwhile, cassava-based ethanol accounts for 25 percent of total ethanol production, down from 30 percent in 2018 as average farm-prices of new-crop cassava remained at high levels in the first half of 2019. Sugarcane-based ethanol production operates at full capacity and accounts for around 5 percent of total ethanol production.

Fuel ethanol production is expected to increase to approximately 1.6 billion liters in 2019, up 10 percent from 2018, to meet domestic and export demand. Molasses is expected to be the primary feedstock for the increased ethanol production. Molasses-based ethanol production is forecast to increase to 1.2 billion liters, using around 4.8 million metric tons of molasses, up 18 percent from 2018. This is expected to be fulfilled by MY2018/19 molasses production, which is still high at 5.9 million metric tons, up further 7 percent from the record levels in MY2017/18 as MY2018/19 sugarcane production remains high at around record levels of over 130 million metric tons. The sole sugarcane-based ethanol plant is expected to operate at full capacity in 2019 using around 1 million metric tons of sugarcane. Cassava-based ethanol production is expected to decline to 416 million liters from 436 million liters in 2018, using around 2.6 million metric tons of cassava root, which is a 5 percent reduction from 2018 due to higher prices and high sugarcane supplies for molasses-based ethanol production.

4.3 Trade

According to the Thai Department of Customs, fuel ethanol is a controlled import/export product (HS22072011 and HS22072019). Traders must apply for import/export permits, which are controlled by the Ministry of Energy (MOE). To date, the MOE has never approved any imports of fuel ethanol due to sufficient supplies of locally produced ethanol. Ethanol producers normally only export ethanol for industrial uses and a lack of storage facilities is a constraint to the export of fuel ethanol. In 2011 and 2012, Thailand exported a significant amount of ethanol, mainly to the Philippines. However, ethanol exports have been zero to marginal since 2014 due to strong domestic demand.

In 2019, the government approved around 40 million liters of non-fuel industrial ethanol exports from two ethanol manufacturers. These exports will likely take place in the last quarter of 2019, mostly destined for China. Meanwhile, during January – August 2019, non-fuel industrial ethanol imports totaled 8.8 million liters, down slightly from the same period last year. Non-fuel industrial ethanol imports in 2019 are expected to increase to 12.5 million liters, up 2 percent from 2018, mainly for use in the pharmaceutical and cosmetic industries. This accounts for around 1 percent of total ethanol consumption. The Thai government imposed a 2.5 baht/liter duty on ethanol imports (U.S. $0.31/gallon), based on 30.34 baht/U.S. $1.00, as of November 1, 2019.

V. Biodiesel

5.1 Consumption

Diesel consumption is forecast to grow at 1.9 percent in 2019, as compared to 1.4 percent in 2018. The average blending rate of biodiesel in diesel production is forecast at 7.2 percent in 2019, up from 6.5 percent in 2018, reflecting the fact that the mandatory blending rate increased to 6.6-7.0 in November 2018. In addition, there was a surge in B20 consumption driven by a price subsidy. Biodiesel consumption is forecast to grow by 11 percent from 1.57 billion liters in 2018 to 1.74 billion liters in 2019.

The Thai government continues to focus on increasing blending rates of biodiesel. In 2018, the Thai government started subsidizing retail prices for B20, making B20 prices to be 3 baht/liter (9 U.S. cent) lower than B7 prices. In addition, the retail price gap between B20 and B7 increased to 5 baht for 3 months from December 1, 2018 to February 28, 2019, to absorb surplus supplies of palm oil. After

many years of unsuccessful incentive programs, car manufactures in Thailand began cooperating with the Thai government to promote the use of B10. After introducing B10 supplies to the market in early 2019, the government announced in October 2019 that B10 supplies will be available for all gasoline stations across the country on March 1, 2020. It is anticipated that the government will subsidize the price to attract the use of B10. Meanwhile, the government intends to lower price subsidy incentives for B20, but maintain mandatory 6.6-7.0 percent blending rates as an option for some vehicles that might be better fit for B7 use.

Below is the historical implementation of mandatory use for specific biodiesel since 2007:

June 2007	Mandatory use of B2 and voluntary use of B5
June 2010	Mandatory use of B3 and voluntary use of B5
March 2011	Mandatory use of B2 and voluntary use of B5
May 2011	Mandatory use of B3-B5
July 2011	Mandatory use of B4
January 2012	Mandatory use of B5
July 19, 2012	Mandatory use of B3.5
November 1, 2012	Mandatory use of B5
January 1, 2014	Mandatory use of B7
February 17, 2014	Adjust mandatory use from B7 to B3.5
May 14, 2014	Return implementing mandatory use of B7
January 22, 2015	Adjust mandatory use from B7 to B3.5
April 17, 2015	Return implementing mandatory use of B7
July 25, 2016	Adjust mandatory use from B7 to B5
August 25, 2016	Adjust mandatory use from B5 to B3
November 16, 2016	Adjust mandatory use from B3 to B5
May 8, 2017	Implementing mandatory use of B6.5-7.0
November 8, 2018	Adjust mandatory use from B6.5-7.0 to B6.6-7.0

Below is the composition of biodiesel retail prices.

Table 5.1.1: Breakdown of Biodiesel Retail Prices, Baht/liter

	Biodiesel B7 (Baht/liter) as of October 30, 2018	Biodiesel B7 (Baht/liter) as of October 30, 2019	Biodiesel B20 (Baht/liter) as of October 30, 2019
Ex-Refinery Prices	20.2470	15.5522	16.2993
Excise Tax	5.9800	5.9900	5.1530
Municipal Tax	0.5980	0.5990	0.5153
Oil Fund Fee	-0.6000	0.0500	-2.5500
Conservation Fund Fee	0.1000	0.1000	0.1000
Wholesale Prices	26.3250	22.2912	19.5176
Value Added Tax	1.8428	1.5604	1.3662
Wholesale Prices + VAT	28.1678	23.8515	20.8839
Marketing Margin	1.6096	1.9051	1.8749
Value Added Tax	0.1127	0.1334	0.1312
Retail Prices	**29.8901**	**25.8900**	**22.8900**

Source: Energy Planning and Policy Office (EPPO), Ministry of Energy

The Energy Policy and Planning Office (EPPO) under the Ministry of Energy calculates reference prices for biodiesel based on actual biodiesel production cost and announces them on a weekly basis. The reference prices are used as a guideline for biodiesel transactions. However, most biodiesel producers usually receive 3-5 baht/liter (9-15 U.S. cents/liter) lower than these reference prices due to limited competition among diesel manufacturers. In 2019, actual biodiesel prices paid by petroleum (diesel) refineries reportedly ranged between 20-25 baht/liters (70-87 U.S. cents/liter).

5.2 Production

Biodiesel is currently produced from palm oil-derived feedstock such as crude palm oil (CPO), refined bleached deodorized palm oil (RBDPO), palm stearin, and free fatty acids of palm oil (FFA). Thailand's campaign to use used cooking oil (UCO) is limited to one or two biodiesel companies as a corporate social responsibility campaign and use is limited to 5-6 million liters of cooking oil in 2019 (4,800 metric tons equivalent). Biodiesel production is driven by government mandates and are mainly aimed to help palm farmers. All palm oil feedstocks used for biodiesel are domestic since the government strictly controls the import of palm oil. Meanwhile, the blending of biodiesel among petroleum refineries is strictly controlled and monitored to comply with the mandatory biodiesel blending requirements. All domestic diesel is required to meet these blending requirements including diesel for on-road inland shipping, trains, agriculture, and industrial.

Table 5.2.1: Biodiesel Production and Use in Thailand

Biodiesel (Million Liters)										
Calendar Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019f**
Beginning Stocks	8	22	12	33	20	18	24	20	50	50
Production	660	630	910	1,080	1,170	1,250	1,240	1,427	1,567	1,755
Imports	0	0	5	6	12	2	5	2	2	2
Exports	0	0	4	49	4	3	16	4	1	15
Consumption	646	640	890	1,050	1,180	1,243	1,233	1,395	1,568	1,742
Ending Stocks	22	12	33	20	18	24	20	50	50	50
BalanceCheck	0	0	0	0	0	0	0	0	0	0
Production Capacity (Million Liters)										
Number of Biorefineries	13	13	10	10	10	12	12	12	13	12
Nameplate Capacity	2,170	2,170	1,600	1,600	1,600	2,060	2,060	2,060	2,310	2,445
Capacity Use (%)	30.4%	29.0%	56.9%	67.5%	73.1%	60.7%	60.2%	69.3%	67.8%	71.8%
Feedstock Use for Fuel (1,000 MT)										
RBDPO/CPO	445	390	630	775	825	857	838	965	1,060	1,190
Stearin	180	190	200	210	235	250	260	286	328	365
FFA of Palm Oil	0	0	20	25	55	83	82	109	102	114
Used Cooking Oil	1	1	1	1	2	2	2	3	4	5
Market Penetration (Million Liters)										
Biodiesel, on-road use	389	380	540	650	707	749	763	836	920	1,038
Diesel, on-road use	11,100	11,510	12,340	12,500	12,640	13,153	13,625	13,959	14,161	14,430
Blend Rate (%)	3.5%	3.3%	4.4%	5.2%	5.6%	5.7%	5.6%	6.0%	6.5%	7.2%
Diesel, total use	18,480	19,192	20,565	20,892	21,071	21,921	22,708	23,265	23,602	24,050

f = forecast

Source: Ministry of Energy, Ministry of Commerce

Note: In this report, the biodiesel yields for all type of feedstock (RBDPO, CPO, stearin, FFA of palm oil, and used cooking oil) are the same at 1,050 liters per metric tons of feedstock weight.

Palm oil production in 2019 is forecast to increase by 14 percent to 3.2 MMT from 2.8 MMT in 2018 due mainly to increased harvested area and increased number of more matured palm plantation. Biodiesel production in 2018 reached a record 1.57 billion liters, up from 1.43 billion liters in 2017 due to increased CPO feedstocks. Biodiesel production is forecast to grow by 12 percent in 2019 to 1.76 billion liters in line with the increased 2019 biodiesel demand and no trade. It is estimated that about 70 percent of biodiesel is derived from RBDPO or CPO, 22 percent from palm stearin, and 8 percent from FFA.

Bangchak Petroleum and Bio Energy Plus reportedly terminated their biodiesel operation in 2019. As a result, 12 producers are currently operating with an estimated total production capacity of 2.45 billion liters per annum.

Table 5.2.2: List of Operating B100 Producers in Thailand

	Company	Capacity (Million liters per annum)	Feedstock Type
1	Pure Energy	265	Palm Stearin, CPO
2	Patum Vegetable Oil	460	CPO, RBDPO, Stearin
3	GI Green Power ⅟	70	CPO, RBDPO, Stearin
4	A.I. Energy	165	Palm Stearin
5	Veera Suwan	65	Palm Stearin, RBDPO
6	Global Green Chemical	520	CPO, RBDPO
7	New Biodiesel	330	CPO, RBDPO, Stearin, FFA
8	Absolute Power P	100	CPO, RBDPO, Stearin
9	Bangchak Biofuel	280	CPO, Stearin
10	PPP Green Complex	150	RBDPO, Stearin
11	Bio Synergy	10	CPO, used cooking oil
12	Trang Palm Oil	30	CPO, RBDPO, Stearin
	Total	2,445	

Note: ⅟ originally called B. Grimm Green Power
Source: Department of Energy Business and FAS Estimates

5.3 Trade

The Thai Government prohibits biodiesel imports to protect domestic palm growers. Thailand's biodiesel imports and exports are minimal and are found by looking at biodiesel (adjusted to B100 equivalent) traded under HTS codes 3826.00 and 2710.20. Exports of biodiesel (B100 equivalent) were one million liters in 2018, as compared to 4 million liters in 2017. Imports of biodiesel (B100 equivalent) totaled 2 million liters in 2018.

The import tariff for petroleum oil containing up to and including 30 percent biodiesel by volume (HTS 2710.20) is 0.01 baht/liter (28 cents per 1,000 liters). There is no import tariff for biodiesel greater than B30 and up to and including B100 (pure biodiesel) (HTS 3826.00).

VI. Advanced Biofuels

The AEDP 2015 includes a production objective for pyrolysis oil (also known as bio-oil or biocrude) of 194 million liters per annum by 2036. The first commercial pyrolysis oil company, called Ayutthaya Clean Energy, is currently under its test run operation, once operational it will have a capacity of 7.92 million liters. The main feedstock for the facility will be waste plastic, and all pyrolysis oil production from the plant will be used as fuel for Ayutthaya Clean Energy's electricity generation plant which has a capacity of 3 megawatts (MW). The development of biojet fuel production in Thailand is that technical and feasibility studies stage.

There has been no progress in the commercialization of other types of advanced biofuels in Thailand, and the potential for progress is further dimmed due to weaker global prices for petroleum products and

the likely lowered the biofuel use targets for 2036. For example, plans to construct an ethanol plant using cane bagasse for cellulosic ethanol has stalled due to commercial infeasibility. The production of Hydrogenated Vegetable Oil (HVO), a type of renewable drop-in diesel, is no longer being commercialized in Thailand due to unsubsidized high production cost. Thailand is unlikely to allow the imports of HVO as a supplement to its biodiesel market.

VII. Statistical Information

Ethanol is harmonized under HS2207.10 and HS2207.20, and Post's estimate of ethanol imports and exports in the Ethanol PS&D (Table 4.1) is based on HS2207.20.11 and HS2207.20.19 reported by the Thai Customs Department. These codes represent ethanol for fuel and industrial uses. Other import and export figures of ethanol under HS2207.10 and HS2207.20 include beverage ethanol which is not include in the ethanol supply/demand balance table.

Post's estimates of biodiesel imports and exports is based on HS2710.20, described as petroleum oils containing up to and including 30 percent biodiesel by volume, and HS3826.00, described as biodiesel above B30 and including B100, both reported by Thai Customs Department. All trade is reported in B100 equivalent. All products traded under 3826.00 are B100. Meanwhile, all trade under 2710.20 contains 5% biodiesel.

Post's estimate for ethanol stocks is based on the weekly ethanol stocks reported by the Thai Ethanol Manufacturing Association. As there is no similar data source for biodiesel, Post's estimate for biodiesel stocks is based on conversations with biodiesel producers and equals a stocks-to-use ratio of 2-4% in past years.

Attachments:

No Attachments