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Biofuels Annual

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Report Highlights:

The government is reviewing the current Thailand Integrated Energy Blueprint, including the Alternative Energy Development Plan (AEDP 2015). The endorsement of the new AEDP has been postponed probably until mid-2019. In 2018, ethanol production and consumption growth is expected to slow down due to the delay in the government plan to eliminate the sale of octane 91 E10. Meanwhile, biodiesel production and consumption is expected to grow by 8-10 percent in 2018.

Post:
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I. Executive Summary

Under Thailand's ethanol policy, the government promotes the use of gasohol (ethanol-gasoline blends) through price incentives (tax relief at the retail level) and an excise tax reduction for cars compatible with E20 and E85 gasohol. To increase biodiesel consumption, the government requires the mandatory blending of biodiesel in diesel supplied across all market sectors, including road use, trains, inland shipping, agriculture, and industry.

The Ministry of Energy is reportedly reviewing the current Thailand Integrated Energy Blueprint (TIEB 2015), including the Alternative Energy Development Plan (AEDP) 2015, taking into consideration that volatile global prices for petroleum will continue in the long-term and that domestic feedstock supplies for ethanol and biodiesel production may not be sufficient to meet the current biofuel consumption goals for 2036. However, the endorsement of the new AEDP has been delayed from the original timeframe of late 2017 to mid-2019.

Feedstocks for ethanol production in Thailand are sugarcane, molasses (by-product from cane sugar processing), and cassava roots. In 2018, ethanol production and consumption growth is expected to slow down as the government has delayed the plan to eliminate the sale of octane 91 E10 due to concerns about feedstock supplies. However, ethanol consumption continues to grow due to the government's continued promotion of ethanol use through price incentives, and thus production grows as well given the insular nature of the market.

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 8 percent in 2018. 2018 biodiesel consumption is forecast to grow by 10 percent due to growing diesel consumption and higher biodiesel blending rates as a result of increased supplies of crude palm.

The Thai government has not been successful in convincing car manufacturers in Thailand to implement mandatory B10 use. In response, the government enacted new initiatives in 2018 to promote the use of B20 by subsidizing retail prices for B20. This has led B20 prices to be 3 baht/liter (9 U.S. cent) lower than B7 prices. In addition, the government will increase the retail price gap between B20 and B7 to 5 baht for 3 months from December 1, 2018 to February 28, 2019 to absorb surplus supplies of palm oil.

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 the energy and transport sectors. To do this, the roadmap includes

increasing renewable energy in households, industry, and power generation; promoting biofuels; and increasing efficiency in power generation, transport, buildings, and industry.

The NDC was translated 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 the 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 promotes the use of gasohol through price incentives at the gas pump and an excise tax reduction for cars compatible with E20 and E85 gasohol. To increase biodiesel consumption, the government imposes a mandatory blending requirement for biodiesel in diesel that is supplied across all market sectors, including road use, agriculture, and industry. Inland shipping and trains do not play a big role in Thailand's transportation system as for now. Based on the statistics reported by Department of Alternative Energy Development and Efficiency, diesel use under these two categories each account for approximately 2 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 is reportedly reviewing the current TIEB 2015, including the AEDP 2015, due to sluggish global price expectations for petroleum and limited feedstock supplies for ethanol and biodiesel. 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). Also, 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.

Endorsement of the new AEDP plan has been delayed from the original timeframe of 2017 to mid-2019. Under the new AEDP plan, consumption targets for both gasohol and biodiesel in 2036 will reportedly each be reduced to 2.6 billion liters. If realized, this represents a very large adjustment lowering the current volume targets for 2036 by one-third and one-half for fuel ethanol and biodiesel, respectively. Despite the lower biofuel consumption target, the AEDP 2015 overall goal that 30 percent of total energy consumption will come from renewable energy in 2036 will reportedly remain unchanged. To achieve this target the government is considering increasing the role renewable energy will play for electricity and heat consumption.

There are no environmental sustainability requirements established for transport biofuels such as minimal greenhouse gas emissions reductions vis-a-vis fossil fuels, restrictions on land use change to avoid negative impacts on food crops, biodiversity, or air, water and soil quality.

2.1 Ethanol

The government is expected to lower the ethanol consumption target under AEDP 2015 to 2.6 billion liters in 2036, down by 37 percent from the initial target of 4.1 billion liters, due to uncertainty over the ability to further increase molasses and cassava supplies, 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. Presently, sales of octane 91 E10 account for approximately one third of total gasohol sales. The MOE expects that 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. Additionally, demand for gasoline and gasohol is expected to slow down in the longer run due to the commercialization of electrical vehicles and the operation of double-track railways and high-speed trains in the next five years.

The government continues to promote the use of gasohol through price incentives into 2018. The price subsidies, which are paid by the State Oil Fund, make gasohol 20 – 40 percent cheaper than premium gasoline. The government also supports the manufacturing of vehicles which are compatible with E20 and E85 gasohol. Improvements in the fuel efficiency of the vehicle fleet 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 which are able to use E85 gasohol.

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) recently agreed that the mandatory biodiesel consumption plan for 2036 may be unattainable (given that the strategy does not permit reliance on imports) and is therefore being reexamined. Despite increases in harvested area, extreme weather conditions in Thailand have in the past 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. Additionally, increasing oil palm acreage may prove more challenging than previously anticipated due to limited arable land and the potential attractiveness of other crops such as rubber and rice.

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.

Table 3.1: Thailand Fuel Use (2009-2018)

Fuel Use History (Million Liters)										
Calendar Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018f
Gasoline Total	7,524	7,418	7,331	7,705	8,233	8,567	9,714	10,680	11,030	11,300
Diesel Total	18,465	18,480	19,192	20,565	20,892	21,071	21,921	22,708	23,265	23,750
On-road	11,080	11,100	11,510	12,340	12,500	12,640	13,153	13,625	13,959	14,280
Agriculture	3,691	3,670	3,840	4,113	4,160	4,214	4,384	4,540	4,653	4,760
Construction & Mining	157	154	160	165	167	169	174	229	233	239
Shipping & Rail	413	415	420	451	513	466	484	454	465	476
Industry	3,124	3,141	3,262	3,496	3,552	3,582	3,726	3,860	3,955	3,995
Heating	0	0	0	0	0	0	0	0	0	0
Jet Fuel Total	4,432	4,712	5,077	5,091	5,562	5,513	6,033	6,468	6,743	7,050
Total Fuel Markets	30,421	30,610	31,600	33,361	34,687	35,151	37,668	39,856	41,038	42,100

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

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 development; 6) fund electric vehicle (EV) research and development; and 7) support fuel pipeline transportation. 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 car 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 car, commencing in 2010, grew significantly to 179,000 cars in 2013. Due to unfavorable economic conditions, sales were stagnant during 2014-2017. Industry sources anticipated that sales of Eco passenger cars will reach to 200,000 cars in 2018, exceeding an amount of total sales of non-Eco passenger car as the first time.

Based on the implementation of the EEDP measures, The government sources anticipate that gasoline consumption should grow at a rate of 5 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

Ethanol consumption during January – September 2018 totaled 1.1 billion liters. This is a 6 percent increase from the same period in 2017 driven by gasohol consumption which increased to 8.1 billion liters, up 3 percent from the same period last year (Table 4.1). Meanwhile, premium and regular gasoline consumption declined to 336 million liters during January – September 2018, down 13 percent from the same period last year. Consumption of gasohol accounted for 96 percent of total gasoline consumption driven by government's price subsidies via the State Oil Fund. Presently, the government maintains E20 and E85 retail prices at approximately 30 and 40 percent cheaper than premium gasoline (Table 4.2). Similarly, E10 retail prices were 20 percent cheaper than premium gasoline. Additionally, the number of gasohol stations continues to increase nationwide up to 4,085 stations for E20 and 1,258 stations for E85 in September 2018, a 17 percent increase from the same period last year. However, the consumption of octane 91 E10 declined by 7 percent during January – September 2018 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 in 2017, which has 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: Thailand's Gasoline and Gasohol Consumption (Unit: Million Liters)

Type of Gasoline	2013	2014	2015	2016	2017	January - September		
						2017	2018	% Change
Gasoline	763	559	583	561	508	384	336	-12.5
Regular (octane 91)	147	61	81	71	57	42	33	-22.7
Premium (octane 95)	616	498	502	490	451	342	303	-11.3
Gasohol	7,470	8,008	9,130	10,119	10,521	7,856	8,111	3.2
- Gasohol E10 Octane 91	3,337	3,595	4,019	4,073	3,885	2,931	2,737	-6.6
- Gasohol E10 Octane 95	3,030	2,735	3,283	3,968	4,350	3,232	3,501	8.3
- Gasohol E20	963	1,344	1,511	1,753	1,903	1,410	1,555	10.3
- Gasohol E85	141	334	318	325	383	283	318	12.3
Total	8,233	8,567	9,714	10,680	11,029	8,240	8,447	2.5

Source: Department of Energy Business, Ministry of Energy

Table 4.2: Price Structure of Gasoline and Gasohol in Bangkok (November 7, 2018)

	Premium gasoline (octane 95)	Gasohol			
		E10 Octane 95	E10 Octane 91	E20	E85
Ex-Refinery Factory Price	16.4266	17.0461	16.6267	17.7344	21.5892
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	7.6800	1.7200	1.7200	-1.1800	-6.7800
Conservation Fund	0.1000	0.1000	0.1000	0.1000	0.1000
Wholesale Price (WS)	31.3566	25.3011	24.8817	22.3744	15.9817
Value Added Tax (VAT)	2.1950	1.7711	1.7417	1.5662	1.1187
WS+VAT	33.5516	27.0722	26.6234	23.9407	17.1004
Marketing Margin	3.0733	2.2223	2.3893	2.3358	3.5884
VAT	0.2151	0.1556	0.1673	0.1635	0.2512
Retail Price	36.84	29.45	29.18	26.44	20.94

Note: Exchange rate = 33.13 baht/\$

Source: Petroleum Division, Energy Policy and Planning Office, Ministry of Energy

In 2018, ethanol consumption is expected to increase to 1.5 billion liters, up approximately 4 percent

from 2017 (Table 4.3). This is slower growth 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 4.3: 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	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018f
Beginning Stocks	63	44	48	63	22	42	40	37	30	54
Fuel Begin Stocks	62	24	22	58	20	21	26	21	17	40
Production	467	521	613	790	1,048	1,070	1,190	1,290	1,480	1,500
Fuel Production	419	451	486	471	950	1,058	1,174	1,276	1,461	1,480
Imports	6	7	6	6	5	11	11	13	12	13
Fuel Imports	0	0	0	0	0	0	0	0	0	0
Exports	16	48	139	304	64	5	0	0	0	0
Fuel Exports	0	0	0	0	0	0	0	0	0	0
Consumption	476	476	465	533	969	1,078	1,204	1,310	1,468	1,520
Fuel Consumption	457	453	450	509	949	1,053	1,179	1,280	1,438	1,500
Ending Stocks	44	48	63	22	42	40	37	30	54	47
Fuel Ending Stocks	24	22	58	20	21	26	21	17	40	20
Total Balance Check	0	0	0	0	0	0	0	0	0	0
Fuel Balance Check	0	0	0	0	0	0	0	0	0	0
Production Capacity (Million Liters)										
Number of Refineries	11	19	19	19	21	21	21	21	26	26
Nameplate Capacity	581	977	977	977	1,307	1,472	1,472	1,472	1,875	1,875
Capacity Use (%)	80	53	63	81	80	73	81	88	79	80
Co-product Production (1,000 MT)										
Bagasse	44	132	134	180	209	243	252	216	261	290
Feedstock Use for Fuel (1,000 MT)										
Sugarcane	160	480	486	654	760	882	915	787	949	1,056
Molasses	1,287	1,100	1,415	1,418	2,615	2,895	3,165	3,067	3,617	3,991
Cassava	557	925	650	468	1,670	1,864	2,166	3,014	3,272	2,778
Feedstock D										
Market Penetration (Million Liters)										
Fuel Ethanol	457	453	450	509	949	1,053	1,179	1,280	1,438	1,500
Gasoline	7,524	7,418	7,331	7,705	8,233	8,567	9,714	10,680	11,030	11,300
Blend Rate (%)	6	6	6	7	12	12	12	12	13	13
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).										
- 2018 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 – September 2018 totaled 1.1 billion liters, up approximately 2 percent from the same period in 2017. This is a lower production growth than the 15 percent production growth in 2017 when two new cassava-based ethanol facilities began to operate. Presently, there are 26 fuel ethanol plants operating with production capacity of around 1.9 billion liters per year. Molasses-based ethanol accounts for 65 percent of total ethanol production, up from 60 percent in 2017 due to being relatively cheaper feedstock than cassava. Meanwhile, cassava-based ethanol accounts for 30 percent of total ethanol production, down from 35 percent in 2017, as farm-prices of cassava during January – September 2018 increased by 50 percent from the same period last year. Sugarcane-based ethanol production operates at full capacity and accounts for around 5 percent of total ethanol production.

With no trade, fuel ethanol production is expected to increase to approximately 1.5 billion liters in 2018, up 1 percent from 2017, to meet demand. Molasses is expected to be the primary feedstock for the increased ethanol production. Molasses-based ethanol production is forecast to increase to 957 million liters, using around 4 million metric tons of molasses, up 10 percent from 2017 due to the recovery in sugarcane production. MY2017/18 sugarcane production increased to 135 million metric tons with molasses production increasing to 5.5 million metric tons, up 41 percent from MY2016/17 due to increased acreage and favorable weather conditions. Additionally, the sole sugarcane-based ethanol plant is expected to operate at full capacity in 2018 using around 1 million metric tons of sugarcane. Cassava-based ethanol production declined to 445 million liters from 523 million liters in 2017, using around 2.8 million metric tons of cassava root which is a 15 percent reduction from 2017 due to higher prices and increased sugarcane supplies for molasses-based ethanol production.

Sources expect that two additional new fuel ethanol plants will begin to operate in 2019. By 2019, total production capacity will likely increase to 2.1 billion liters per year, up 10 percent from 2018. Production capacity will consist of approximately 1.1 billion liters of molasses-based ethanol, 0.1 billion liters of sugarcane-based ethanol, and 0.9 billion liters of cassava-based ethanol.

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 considered by the Ministry of Energy (MOE). To date, the MOE has never approved any imports of fuel ethanol into Thailand 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 long-term constraint to the export of fuel ethanol. In 2011 and 2012, Thailand exported significant amount of ethanol, mainly to the Philippines. However, ethanol exports are marginal since 2014 due to strong domestic demand.

Non-fuel industrial ethanol exports in 2018 are expected to remain zero due to growing domestic demand for non-fuel ethanol. However, the government has recently approved around 30 million liters of non-fuel industrial ethanol exports from a recently established cassava-based ethanol plant. These exports will likely take place in 2019, mostly destined for China. Meanwhile, during January – September 2018, non-fuel industrial ethanol imports totaled 9.4 million liters, up 4 percent from the same period last year. Non-fuel industrial ethanol imports in 2018 are expected to increase to 12.5 million liters, up 4 percent from 2017, 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. \$0.29/gallon), based on 32.7 baht/U.S. \$1.00, as of November 8, 2018.

V. Biodiesel

5.1 Consumption

Diesel blending mandates have been effective in increasing biodiesel consumption. The mandates are strictly controlled and monitored and must be used in all diesel fuels. 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.

Although the government is implementing several measures under the EEDP, diesel consumption is forecast to grow at 2 percent in 2018, as compared to 2.5 percent in 2017.

The average blending rate of biodiesel in diesel production is forecast at 6.5 percent in 2018, up from 6.0 percent in 2017, reflecting the fact that the mandatory biodiesel blending rate has been between 6.5-7.0 percent for most of 2018. Effective on November 8, 2018, the mandatory blending rate increased to 6.6-7.0. Due to the growth in diesel consumption and an upward biodiesel blending rate, biodiesel consumption is forecast to grow by 10 percent from 1.40 billion liters in 2017 to 1.54 billion liters in 2018.

Despite its efforts over the past couple years, the Thai government has not been successful in convincing car manufacturers in Thailand to enforce mandatory B10 use. In response, the government has enacted new initiatives in 2018 to promote the use of B20 by subsidizing retail prices for B20. This has led B20 prices to be 3 baht/liter (9 U.S. cent) lower than B7 prices. In addition, the government will increase the retail price gap between B20 and B7 to 5 baht for 3 months from December 1, 2018 to February 28, 2019 to absorb surplus supplies of palm oil.

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: Breakdown of Biodiesel Retail Prices, Baht/liter

	Biodiesel B7 (Baht/liter) as of November 8, 2017	Biodiesel B7 (Baht/liter) as of November 8, 2018	Biodiesel B20 (Baht/liter) as of November 8, 2018
Ex-Refinery Prices	16.7205	18.8654	19.3071
Excise Tax	5.8500	5.9800	5.1520
Municipal Tax	0.5850	0.5980	0.5152
Oil Fund Fee	0.0100	0.2000	-2.5000
Conservation Fund Fee	0.2500	0.1000	0.1000
Wholesale Prices	23.4155	25.7344	22.5743
Value Added Tax	1.6391	1.8014	1.5802
Wholesale Prices + VAT	25.0546	27.5358	24.1545
Marketing Margin	1.2481	1.9199	2.2761
Value Added Tax	0.0874	0.1344	0.1593
Retail Prices	26.3901	29.5901	26.5899

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 2018, actual biodiesel prices paid by petroleum (diesel) refineries reportedly ranged between 23-28 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 utilize used cooking oil for biodiesel production exists among one or two biodiesel companies as a corporate social responsibility campaign; however, the use is limited to 5-6 million liters of cooking oil per annum. 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: Biodiesel Production and Use in Thailand

Biodiesel (Million Liters)										
Calendar Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018f
Beginning Stocks	7	8	22	12	33	20	18	24	20	50
Production	610	660	630	910	1,080	1,170	1,250	1,240	1,427	1,540
Imports	0	0	0	5	6	12	2	5	2	2
Exports	0	0	0	4	49	4	3	16	4	1
Consumption	609	646	640	890	1,050	1,180	1,243	1,233	1,395	1,540
Ending Stocks	8	22	12	33	20	18	24	20	50	51
Balance Check	0	0	0	0	0	0	0	0	0	0
Production Capacity (Million Liters)										
Number of Biorefineries	13	13	13	10	10	10	12	12	12	14
Nameplate Capacity	2,170	2,170	2,170	1,600	1,600	1,600	2,060	2,060	2,060	2,310
Capacity Use (%)	28.1%	30.4%	29.0%	56.9%	67.5%	73.1%	60.7%	60.2%	69.3%	66.7%
Feedstock Use for Fuel (1,000 MT)										
RBDPO/CPO	400	445	390	630	775	825	857	838	965	1,040
Stearin	170	180	190	200	210	235	250	260	286	320
FFA of Palm Oil	0	0	0	20	25	55	83	82	109	110
Market Penetration (Million Liters)										
Biodiesel, on-road use	366	389	380	540	650	707	749	763	836	935
Diesel, on-road use	11,080	11,100	11,150	12,340	12,500	12,640	13,153	13,625	13,959	14,280
On-road Blend Rate (%)	3.3%	3.5%	3.4%	4.4%	5.2%	5.6%	5.7%	5.6%	6.0%	6.5%
Diesel, total use	18,465	18,480	19,192	20,565	20,892	21,071	21,921	22,708	23,265	23,750
f = forecast										
Source: Ministry of Energy, Ministry of Commerce										
Note: In this report, the biodiesel yields for all types of feedstock (RBDPO, CPO, stearin, and FFA of palm oil) are the same at 1,050 liters per metric tons of feedstock weight.										

Crude palm oil (CPO) production in 2017 increased to 2.5 MMT from 1.9 MMT in 2016 due to bumper palm crop production. Harvested area in 2017 increased by 3 percent from 2016 as declining rubber prices over the past 4-5 years have caused many farmers to replace rubber plantations with palm oil plantations. Additionally, favorable weather conditions in the second half of 2016 and in 2017 caused average yields of fresh fruit bunch (FFB) and oil extraction rates to be extremely high. CPO production in 2018 is forecast to increase further to 2.7 MMT reflecting increased harvested area.

Biodiesel production in 2017 reached a record 1.43 billion liters, up from 1.24 billion liters in 2016 due to increased CPO feedstocks. Biodiesel production is forecast to grow by 8 percent in 2018 to 1.54 billion liters in line with the increased 2018 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.

Post believes that the AEDP 2019, if endorsed, will not only limit mandatory blending rates, but will also seriously affect the current promotion of lower-cost H-FAME biodiesel in preparation for B10 and above mandates. H-FAME is a process, developed by a Japanese research team, to upgrade the quality of conventional biodiesel or fatty acid methyl ester (FAME) through partial hydrogenation. As a result of the anticipated lower mandatory blending rates, Global Green Chemical (GGC), a large biodiesel producer in Thailand, suspended its plan to construct an H-FAME processing plant.

Currently, 14 producers are operating with an estimated total production capacity of 2.06 billion liters per annum. GGC acquired B. Grimm Green Power and changed its name to GI Green Power in 2016.

The GGC began running its second plant in 2018, adding another 210 million liters per annum to its current 450 million liters production capacity combined from its first plant and GI Green Power. PP Green Complex with a production capacity of 150 million liters per annum also become operational in 2018.

Table 5.3: List of Operating B100 Producers in Thailand

	Company	Capacity (Million liters per annum)	Feedstock Type
1	Bangchak Petroleum	16	CPO, RBDPO
2	Pure Energy	264	Palm Stearin, CPO
3	Patum Vegetable Oil	462	CPO, RBDPO, Stearin
4	GI Green Power ^γ	66	CPO, RBDPO, Stearin
5	A.I. Energy	165	Palm Stearin
6	Veera Suwan	65	Palm Stearin, RBDPO
7	Global Green Chemical	330	CPO, RBDPO
8	New Biodiesel	330	CPO, RBDPO, Stearin, FFA
9	Absolute Power P	98	CPO, RBDPO, Stearin
10	Bangchak Biofuel	264	CPO, Stearin
11	Bio Energy Phs	60	RBDPO, Stearin
12	PPP Green Complex	150	RBDPO, Stearin
13	Bio Synergy	10	CPO, used cooking oil
14	Trang Palm Oil	30	CPO, RBDPO, Stearin
	Total	2,310	
^γ	Originalled called B. Grimm Green Power		

Source: Department of Energy Business and FAS Estimates

5.3 Trade

The Thai Government restricts the import of biodiesel 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 3.6 million liters in 2017, as compared to 15.9 million liters in 2016. Imports of biodiesel (B100 equivalent) totaled 2.0 million liters in 2017, as compared to 5.0 million liters in 2016.

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 the 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, has postponed its pyrolysis oil operation from the original timeframe of 2017 to early 2019, 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).

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, the planning to construct a molasses-based 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.

VII. Statistical Information

While ethanol is harmonized under HS2207.10 and HS2207.20, 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. Meanwhile, 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, and assumes that all products traded under 3826.00 are B100 and that 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.

End of report.