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Thailand

Biofuels Annual

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Approved By:
Paul Welcher, Agricultural Attaché

Prepared By:
Sakchai Preechajan and Ponnarong Prasertsri, Agricultural Specialist

Report Highlights:
Thailand is currently implementing their Alternative Energy Development Plan 2015 (AEDP 2015). However, the Ministry of Energy is reportedly revising the plan's targets downward due to lower petroleum price expectations and limited feedstock supplies of ethanol and biodiesel. While the new AEDP plan may not be officially endorsed until late 2017, early revisions reduce the final target for both gasohol and biodiesel consumption in 2036 to 2.6 billion liters each.

Post:
Bangkok

Executive Summary:
Thailand is currently implementing their Alternative Energy Development Plan 2015 (AEDP 2015) which covers the development of renewable and alternative energy in Thailand until 2036. 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 has a targeted increase from 7 percent of total fuel energy use in 2015 to 25 percent in 2036. To meet this goal, the Thai government is targeting an increase in ethanol consumption from 1.18 billion liters in 2015 to 4.1 billion liters by 2036, and an increase in biodiesel consumption from 1.24 billion liters in 2015 to 5.1 billion liters by 2036.

Under Thailand's ethanol policy, the government promotes the use of gasohol 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 continues to impose the mandatory blending of biodiesel in fossil 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 AEDP 2015, taking into consideration that the low global price for petroleum may continue in the long-term and domestic feedstock supplies for ethanol and biodiesel production may not be able to meet the current biofuel consumption goals for 2036. The domestic production of these agricultural crops is far below the target under the biofuel development plan implemented over the past decade. Average yield of sugarcane is still at 11-12 metric tons per rai (69-75 MT/hectare), compared to the 2036 target of more than 15 metric tons per rai (94 MT/hectare). Similarly, the average yield of cassava remains at around 3.5 metric tons per rai (22 MT/hectare), compared to the 2036 target of 5 metric tons per rai (31 MT/hectare). Furthermore, production of crude palm oil (CPO), the main feedstock for biodiesel production, has been stagnate in the past couple years and the outlook for future production is still uncertain.

While the new AEDP plan will not likely be officially endorsed until late 2017, there is a strong expectation that targets in the AEDP 2015 (2015-2036) for gasohol and biodiesel consumption in 2036 will be lowered to 2.6 billion liters for each. The strategy, as in the past, is that the goals for biofuels use must be met using domestic resources only with no reliance on imports of biofuels or biofuel feedstock.

Feedstocks for ethanol production in Thailand are sugarcane, molasses (by-products from cane sugar processing), and cassava roots. Biodiesel is produced from palm oil derived feedstock such as CPO, refined bleached deodorized palm oil (RBDPO), palm stearin, and free fatty acids of palm oil (FFA).

In 2018, ethanol production is forecast to increase by 7 percent to 1.5 billion liters from 1.4 billion liters in 2017 while biodiesel production is forecast to rise by 4 percent to 1.48 billion liters from 1.42 billion liters in 2017. The increased biofuel production in 2018 reflects higher domestic biofuel demand driven by continued price subsidies on gasohol prices through State Oil Fund (SOF) and an anticipated biodiesel blending rates of 5-7 percent in the diesel pool.

Ethanol is a controlled import/export product. Traders must have import/export permits which are considered by the Ministry of Energy (MOE). The same is true for biodiesel which also has import/export restrictions. To date, the MOE has never approved any imports of fuel ethanol into Thailand, and restricts biodiesel imports to very minimal levels.

II. Policy and Program

Thailand's National Energy Plan (2015 – 2036) or Thailand Integrated Energy Blueprint (TIEB 2015) was endorsed in October 2015 and aligned with Thailand's the 11th National Economic and Social Development Plan. The current national energy plan includes 5 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). The TIEB also formed the basis for Thailand's commitments at the 2015 United Nations Climate Change Conference (COP 21).

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 plan year coverage from 10 years to 20 years and integrating all national 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 ethanol consumption targets of 4.1 billion liters by 2036 from 1.18 billion liters in 2015, and biodiesel consumption targets 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 and an excise tax reduction for cars compatible with E20 and E85 gasohol. To increase biodiesel consumption, the government continues to impose the mandatory blending of biodiesel in diesel production that is supplied across all market sectors, mainly 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 1 percent of total diesel use.

To meet domestic demand, the government has raised palm oil acreage targets 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 other feedstocks, like animal fats and used cooking oil (UCO), will play an insignificant role in its production.

The TIEB 2015 also set the production target for the second and third generation biofuels at 10 kilotons of oil equivalent (ktoe) by 2036. The government is supporting this objective by supporting research at Thai universities. Both the production of second generation biofuel from biomass and third generation biofuel 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. 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, average yield of cassava remains at 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, has also been stagnate in the past couple years and the outlook for future production is still uncertain.

While the new AEDP plan is not expected to be officially endorsed until late 2017, reportedly the consumption target for both gasohol and biodiesel in 2036 will each be reduced to 2.6 billion liters. If realized, this represents are very large adjustment lowering the current volume targets for 2036 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 the current AEDP 2015 to 2.6 billion liters in 2036, down by 37 percent from the initial target of 4.1 billion liter ethanol AEDP 2015 due to uncertainties about future domestic production increases for molasses and cassava, the primary feedstocks for ethanol production. Limited supplies of feedstocks will also likely cause the government to delay the plan to eliminate the sale of octane 91 E10, which is planned to occur on January 1, 2018. The sales of octane 91 E10 account for approximately 40 percent of total gasohol sales. The MOE expects that the cessation of octane 91 E10 sales will increase ethanol demand doubling sales of E20 in 2018. However, the government is uncertain if domestic supplies of molasses and cassava will be sufficient to meet demand if octane 91 E10 sales are eliminated, and unwilling to open the door to imports.

The government is likely to continue 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 km.) at 17 percent compared to 30 percent for E10 vehicles. Moreover, the government gives an additional 3 percent reduction in the excise tax rate for the manufacturing of Eco-cars which 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 began subsidizing the use of B20 in large trucks on a voluntary basis beginning 2016, and intends to implement the B10 requirement in 2018 for all diesel sales. 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 the strategy does not permit reliance on imports) and is therefore being reexamined. Despite an increase in harvested area, crude palm oil (CPO) production, the only feedstock used for biodiesel in Thailand, stagnated at 1.8-2.0 million from 2014-2016 due to unfavorable weather conditions. Increasing oil palm acreage may prove more challenging than previously anticipated due to limited arable land and the profitability of crop alternatives 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) at 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 (Historical and Projected)

Fuel Use History (Million Liters)										
Calendar Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Gasoline Total	7,121	7,524	7,418	7,331	7,705	8,233	8,567	9,714	10,680	11,200
Diesel Total	17,634	18,465	18,480	19,192	20,565	20,892	21,071	21,921	22,708	23,400
On-road	10,580	11,080	11,100	11,510	12,340	12,500	12,640	13,153	13,625	14,040
Agriculture	3,527	3,691	3,670	3,840	4,113	4,160	4,214	4,384	4,540	4,680
Construction & Mining	155	157	154	160	165	167	169	174	229	234
Shipping & Rail	375	413	415	420	451	513	466	484	454	468
Industry	2,997	3,124	3,141	3,262	3,496	3,552	3,582	3,726	3,860	3,978
Heating	0	0	0	0	0	0	0	0	0	0
Jet Fuel Total	4,538	4,317	4,609	4,976	4,992	5,211	5,321	5,579	5,738	5,885
Total Fuel Markets	29,293	30,306	30,507	31,499	33,262	34,336	34,959	37,214	39,126	40,485

Fuel Use Projections (Million Liters)										
Calendar Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Gasoline Total	11,800	12,400	13,000	13,650	14,330	15,050	15,800	16,600	17,430	18,300
Diesel Total	24,100	24,700	25,320	26,000	26,700	27,300	27,850	28,340	28,840	29,340
On-road	14,460	14,820	15,190	15,600	16,020	16,380	16,710	17,004	17,304	17,600
Agriculture	4,820	4,940	5,064	5,200	5,340	5,460	5,570	5,668	5,768	5,868
Construction & Mining	243	246	256	260	267	273	278	283	288	298
Shipping & Rail	480	494	506	520	534	546	557	567	577	586
Industry	4,097	4,200	4,304	4,420	4,539	4,641	4,735	4,818	4,903	4,988
Heating	0	0	0	0	0	0	0	0	0	0
Jet Fuel Total	6,040	6,160	6,310	6,475	6,670	6,855	7,060	7,260	7,440	7,620
Total Fuel Markets	41,940	43,260	44,630	46,125	47,700	49,205	50,710	52,200	53,710	55,260

Source: Department of Alternative Energy Development and Efficientcy

To increase energy efficiency in transportation, the government plans to: 1) phase out a 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-track railway and hi-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 (~$43 billion) from 2015-2036, reducing final energy consumption by 30,213ktoe by 2036. Some projects such as the double-track railway, the hi-speed train, and the EV cars have already been started. The MOE anticipates that the 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-track railway and hi-speed train are scheduled to be operational by 2023.

Based on the EEDP measure implementation, Post anticipates 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 Production

Feedstocks for ethanol production in Thailand are sugarcane, molasses (by-products from cane sugar processing), and cassava roots. Fuel ethanol production is expected to increase to around 1.4 billion liters in 2017 as two new cassava-based ethanol facilities have begun to operate in early 2017. This is a 7 percent increase from 2016 when the government was uncertain if domestic supplies of ethanol would meet the growing gasohol demand due to tight domestic supplies of molasses-based ethanol caused by a drought-triggered reduction in sugarcane production. The two new ethanol plants will increase ethanol production capacity 25 percent. Production capacity consists of approximately 1 billion liters of

molasses-based ethanol, 0.1 billion liters of sugarcane-based ethanol, and 0.7 billion liters of cassava-based ethanol.

Table 4.1: 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	2018
Beginning Stocks	63	44	48	63	22	42	40	37	30	30
Fuel Begin Stocks	62	24	22	58	20	21	26	21	17	17
Production	467	521	613	790	1,048	1,070	1,190	1,290	1,385	1,500
Fuel Production	419	451	486	471	950	1,058	1,174	1,276	1,370	1,480
Imports	6	7	6	6	5	11	11	13	15	10
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	1,390	1,490
Fuel Consumption	457	453	450	509	949	1,053	1,179	1,280	1,360	1,460
Ending Stocks	44	48	63	22	42	40	37	30	40	50
Fuel Ending Stocks	24	22	58	20	21	26	21	17	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
Production Capacity (Million Liters)										
Number of Refineries	11	19	19	19	21	21	21	21	23	23
Nameplate Capacity	581	977	977	977	1,307	1,472	1,472	1,472	1,815	1,815
Capacity Use (%)	80	53	63	81	80	73	81	88	76	83
Co-product Production (1,000 MT)										
Bagasse	44	132	134	180	209	243	252	216	201	257
Feedstock Use for Fuel (1,000 MT)										
Sugarcane	160	480	486	654	760	882	915	787	730	933
Molasses	1,287	1,100	1,415	1,418	2,615	2,895	3,166	3,067	2,914	3,753
Cassava	557	925	650	468	1,670	1,864	2,166	3,014	3,859	3,193
Market Penetration (Million Liters)										
Fuel Ethanol	457	453	450	509	949	1,053	1,179	1,280	1,360	1,460
Gasoline	7,524	7,418	7,331	7,705	8,233	8,567	9,714	10,680	11,200	11,800
Blend Rate (%)	6	6	6	7	12	12	12	12	12	12

Note: - Beverage ethanol is not included in this table.
- Cassava-based ethanol production mainly uses fresh cassav root as feedstock. The convesion 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).
- 2017 and 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)

In the first quarter of 2017, ethanol production totaled 367 million liters. This is a 17 percent increase from the same period in 2016. Molasses-based ethanol dominated overall ethanol production, accounting for approximately 60 percent of total ethanol production, followed by cassava (35%) and sugarcane (5%). However, in the last nine months of 2017, the share of molasses-based ethanol

production is expected to decline to approximately 50 percent of total ethanol production due to the reduction in molasses supplies for two consecutive years caused by a drought-triggered reduction in sugarcane production (See: GAIN Report: TH7045, Sugar Annual 2017, April 2017). MY2016/17 sugarcane production, which is mainly used for sugar production, further declined 1 percent to around 93 million metric tons. Molasses production was 3.9 million metric tons, which is a decline of 9 percent from MY2015/16. The sole sugarcane-based ethanol plant is expected to operate at 55 million liters, using around 0.7 million metric tons of sugarcane in 2017, down 7 percent from 2016 levels due to drought. Meanwhile, cassava-based ethanol production is expected to increase to 617 million liters in 2017, offsetting the reduction in molasses-based ethanol. As a result, cassava-based ethanol is expected to account for 45 percent of total ethanol production in 2017, up from 38 percent in 2016. The demand for cassava is expected to increase to 3.9 million metric tons, up 28 percent from 2016 in anticipation of limited supplies of molasses.

In 2018, fuel ethanol production is forecast to increase to 1.5 billion liters. This is an 8 percent increase from 2017. Molasses is expected to be the primary feedstock for the increased ethanol production. Molasses-based ethanol production is forecast to increase to 0.9 billion liters using 3.8 million metric tons of molasses, up 29 percent from 2017 in anticipation of the recovery of molasses production. MY2017/18 sugarcane production is expected to increase to 105 million metric tons with molasses production increasing to 4.5 million metric tons, up 18 percent from MY2016/17 in anticipation of more favorable weather conditions. Additionally, the sole sugarcane-base ethanol plant is likely to operate at full capacity of around 70 million liter per year using approximately 1 million metric tons of sugarcane. Cassava-based ethanol production is expected to decline to 0.5 billion liters from 0.6 billion liters in 2017, using around 3.2 million metric tons of cassava which is a 17 percent reduction from 2016 in anticipation of a recovery in molasses-based ethanol production.

The production of non-fuel ethanol is controlled by the government. The Liquor Distillery Organization, which is under the authority of the Excise Department of the Ministry of Finance, has a monopoly on the production of industrial-grade ethanol in Thailand with a production capacity of 20 million liters per day. Meanwhile, domestic demand for industrial-grade ethanol, particularly for medical, pharmacy, paints and cosmetic uses, is around 18 million liters per year. The primary feedstock for industrial-grade ethanol production is molasses and cassava.

4.2 Consumption

In the first quarter of 2017, ethanol consumption totaled 0.3 billion liters. This is an 8 percent increase from the same period in 2016 due to gasohol consumption growing to 2.5 billion liters, up 3.6 percent from the same period last year (Table 4.2). Meanwhile, premium and regular gasoline consumption declined to 0.1 billion liters, down 6 percent from the same period last year. Consumption of gasohol accounted for 95 percent of total gasoline consumption driven by government's price subsidies via the State Oil Fund, particularly for E20 and E85. Presently, E20 and E85 retail prices are approximately 30 and 40 percent cheaper than premium gasoline, respectively (Table 4.3). Also, E10 retail prices are 20 percent cheaper than premium gasoline. Additionally, consumption of octane 95 E10 increased significantly as the government lowered the price difference between octane 95 and 91 E10 in order to encourage consumers to shift to octane 95 E10 consumption. Additionally, the number of gasohol stations continued to increase nationwide to 3,396 stations for E20 and 1,000 stations for E85 in April 2017, up approximately 10 percent and 20 percent from the same period last year.

Table 4.2: Thailand's Gasoline and Gasohol Consumption (Unit: Million Liters)

Type of Gasoline	2011	2012	2013	2014	2015	2016	Jan. - Mar.		% Change
							2016	2017	
Gasoline	**3,119**	**3,250**	**763**	**559**	**583**	**561**	**143**	**131**	**-8.5**
Regular (octane 91)	3,077	3,208	147	61	81	71	23	18	-22.7
Premium (octane 95)	42	42	616	498	502	490	120	113	-5.7
Gasohol	**4,213**	**4,455**	**7,470**	**8,008**	**9,130**	**10,119**	**2,448**	**2,535**	**3.6**
- Gasohol E10 Octane 91	1,860	2,121	3,337	3,595	4,019	4,073	1,017	972	-4.4
- Gasohol E10 Octane 95	2,122	1,932	3,030	2,735	3,283	3,968	939	1,026	9.3
- Gasohol E20	222	367	963	1,344	1,511	1,753	418	447	6.9
- Gasohol E85	9.10	36	141	334	318	325	74	90	21.6
Total	**7,332**	**7,705**	**8,233**	**8,567**	**9,714**	**10,680**	**2,591**	**2,666**	**2.9**

Source: Department of Energy Business, Ministry of Energy

Table 4.3 Price Structure of Gasoline and Gasohol in Bangkok (June 9, 2017)

	Premium gasoline (octane 95)	Gasohol			
		E10 Octane 95	E10 Octane 91	E20	E85
Ex-Refinery Factory Price	14.2561	15.4224	15.1853	16.6013	22.3440
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	6.3100	0.3500	0.3500	-3.0000	-9.3500
Conservation Fund	0.2500	0.2500	0.2500	0.2500	0.2500
Wholesale Price (WS)	27.9661	22.4574	22.2203	19.5713	14.3165
Value Added Tax (VAT)	1.9576	1.5720	1.5554	1.3700	1.0022
WS+VAT	29.9237	24.0295	23.7758	20.9413	15.3187
Marketing Margin	3.2115	2.0753	2.0600	2.6156	3.8517
VAT	0.2248	0.1453	0.1442	0.1831	0.2696
Retail Price	33.36	26.25	25.98	23.74	19.44

Note: Exchange rate = 33.5 baht/$

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

Table 4.4: Price Structure of Gasoline and Gasohol in Bangkok (June 9, 2016)

	Premium gasoline (octane 95)	Gasohol			
		E10 Octane 95	E10 Octane 91	E20	E85
Ex-Refinery Factory Price	14.2822	15.2496	15.0073	16.2034	20.6556
Excise Tax	6.0000	5.4000	5.4000	4.8000	0.9000
Municipal Tax	0.6000	0.5400	0.5400	0.4800	0.0900
State Oil Fund	6.3100	0.2540	0.2090	-2.7520	-9.2960
Conservation Fund	0.2500	0.2500	0.2500	0.2500	0.2500
Wholesale Price (WS)	27.4422	21.6936	21.4063	18.9814	12.5996
Value Added Tax (VAT)	1.9210	1.5186	1.4984	1.3287	0.8820
WS+VAT	29.3632	23.2122	22.9048	20.3101	13.4815
Marketing Margin	2.9877	2.2316	2.1264	2.5513	5.0547
VAT	0.2091	0.1562	0.1488	0.1786	0.3538
Retail Price	32.56	25.60	25.18	23.04	18.89
Note: Exchange rate = 35.5 baht/$					
Source: Petroleum Division, Energy Policy and Planning Office, Ministry of Energy					

In 2017, ethanol consumption is expected to increase to 1.4 billion liters, which is consistent with the 20-year National Energy Plan (2015 - 2036). This is a 6 percent increase from 2016 in anticipation of growing gasohol consumption, particularly for E20 and E85 driven by the government's current price subsidies that make E20 and E85 retail prices cheaper than E10 and premium gasoline.

In 2018, ethanol consumption is forecast to increase to 1.5 billion liters in line with the 20-year National Energy Plan. This is a 7 percent increase from 2017 in anticipation of continued growing gasohol consumption. The government is expected to maintain the price subsidies through the State Oil Fund on gasohol, particularly on E20 and E85 in order to stimulate E20 and E85 consumption. Additionally, the government is not expected to proceed with the elimination of octane 91 E10 sales in 2018 due concerns about limited domestic feedstock supplies. According to the Ministry of Energy's study 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 consumption (45%) and E85 consumption (5%). Similarly, if octane 91 E10 sales are eliminated, E20 consumption is expected to double the current levels of 1.7 billion liters per year that will need an additional 330 million liters of ethanol per year for E20 production. This could put upward pressure on domestic prices of related agricultural products and gasohol prices.

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 MOE. To date, the MOE has never approved any imports of fuel ethanol into Thailand. Ethanol producers normally only export ethanol for industrial uses and lack of storage facilities is a long-term constraint to the export of fuel ethanol.

Non-fuel industrial ethanol exports are likely to be marginal to zero in 2017 and 2018 mainly due to growing domestic demand for non-fuel ethanol. In 2016, exports of industrial-grade ethanol were marginal at around 0.1 million liters. Meanwhile, non-fuel industrial ethanol imports increased to 13 million liters in 2016, up 20 percent from 2015, mainly for use in the pharmaceutical and cosmetic industries. This accounted for approximately 1 percent of total ethanol production. The Thai government imposes a 2.5 baht/liter duty on ethanol imports (28 US cents/gallon, based on 33.8 baht/USD, as of June 19, 2017).

4.4. Stocks

Ethanol stocks are expected to increase to 40-50 million liters in 2017 and 2018, up significantly from a record low in 2016 when domestic supplies of primary feed stocks were tight. The increase of ending stocks of ethanol reflects the establishment of new cassava-based ethanol facilities in 2017 and a recovery of molasses-based ethanol production. Additionally, the government is expected to delay the elimination of octane 91 E10 sales in 2018.

V. Biodiesel

5.1 Production

B100, or biodiesel, in Thailand 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 unused cooking oil per annum. Biodiesel production is driven by government mandates, mainly aimed to help palm farmers. All palm oil feedstocks used for biodiesel are domestic since the government strictly controls the imports 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 5.1: Biodiesel Production and Use in Thailand

Biodiesel (Million Liters)										
Calendar Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Beginning Stocks	7	8	22	12	33	20	18	24	20	25
Production	610	660	630	910	1,080	1,170	1,250	1,240	1,420	1,480
Imports	0	0	0	5	6	12	2	5	5	5
Exports	0	0	0	4	49	4	3	16	20	25
Consumption	609	646	640	890	1,050	1,180	1,243	1,233	1,400	1,470
Ending Stocks	8	22	12	33	20	18	24	20	25	15
BalanceCheck	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	2,290
Capacity Use (%)	28.1%	30.4%	29.0%	56.9%	67.5%	73.1%	60.7%	60.2%	68.9%	64.6%
Feedstock Use for Fuel (1,000 MT)										
RBDPO/CPO	400	445	390	630	775	825	857	838	960	1,000
Stearin	170	180	190	200	210	235	250	260	297	310
FFA of Palm Oil	0	0	0	20	25	55	83	82	95	100
Market Penetration (Million Liters)										
Biodiesel, on-road use	366	389	380	540	650	707	749	763	842	882
Diesel, on-road use	11,080	11,100	11,150	12,340	12,500	12,640	13,153	13,625	14,040	14,460
Blend Rate (%)	3.3%	3.5%	3.4%	4.4%	5.2%	5.6%	5.7%	5.6%	6.0%	6.1%
Diesel, total use										
Note:										
Feedstock (1MT): Biodiesel (1.05 liters)										

Biodiesel production in 2016 dropped for the first time in recent history to 1.24 billion liters from 1.25 billion liters in 2015. Due to a drought affecting CPO production, the government reduced the mandatory biodiesel blending rates from B7 to B5 in July 2017 and to B3 in August 2017. Biodiesel production is forecast to grow slightly in both 2017 and 2018, to 1.42 billion liters and 1.48 billion liters respectively, based on the likelihood that the mandatory blending requirement will range between B5 and B7. Post anticipates that the new AEDP (AEDP 2017) will discourage any mandatory goal beyond B7 from 2018-2020. This implies that a growth of biodiesel production for these particular years depends on increasing diesel consumption.

It is estimated that about 70 percent of B100 is derived from RBDPO or CPO, 22 percent from palm stearin, and 8 percent from FFA.

Available CPO supply for domestic food, feed, and industrial use, plus exports is forecast to increase to 2.2 million metric tons (MMT) in 2018 from 2.0 MMT in 2017. Despite ongoing increases in planted

and harvested palm area, palm oil productivity over the past couple years has been hindered by dry conditions from 2014 to the middle of 2016. As a result, total CPO production in 2016 dropped by 10 percent to 1.8 MMT from 2.07 MMT in 2015.

Table 5.2: Thailand's Production, Supply and Demand for CPO

Oil, Palm	2015/2016		2016/2017		2017/2018		
Market Begin Year	Jan 2016		Jan 2017		Jan 2018		
Thailand	USDA Official	New Post	USDA Official	New Post	USDA Official	New Post	
							(Units)
Area Planted	0	0	0	0	0	0	(1000 HA)
Area Harvested	735	700	750	720	0	750	(1000 HA)
Trees	0	0	0	0	0	0	(1000 TREES)
Beginning Stocks	205	205	240	148	0	193	(1000 MT)
Production	2100	1804	2300	2000	0	2200	(1000 MT)
MY Imports	28	28	25	30	0	30	(1000 MT)
MY Imp. from U.S.	0	0	0	0	0	0	(1000 MT)
MY Imp. from EU	0	0	0	0	0	0	(1000 MT)
Total Supply	2333	2037	2565	2178	0	2423	(1000 MT)
MY Exports	39	39	60	40	0	80	(1000 MT)
MY Exp. to EU	0	0	0	0	0	0	(1000 MT)
Industrial Dom. Cons.	1430	1250	1520	1330	0	1450	(1000 MT)
Food Use Dom. Cons.	530	530	570	540	0	570	(1000 MT)
Feed Waste Dom. Cons.	94	70	95	75	0	90	(1000 MT)
Total Dom. Cons.	2054	1850	2185	1945	0	2110	(1000 MT)
Ending Stocks	240	148	320	193	0	233	(1000 MT)
Total Distribution	2333	2037	2565	2178	0	2423	(1000 MT)
CY Imports	20	28	20	30	0	30	(1000 MT)
CY Imp. from U.S.	0	0	0	0	0	0	(1000 MT)
CY Exports	50	39	50	40	0	80	(1000 MT)
CY Exp. to U.S.	0	0	0	0	0	0	(1000 MT)
Yield	2.8571	2.5771	3.0667	2.7778	0	2.9333	(MT/HA)

Post believes that the AEDP 2017, if endorsed, will not only limit the mandatory blending rates, but also seriously affect the current promotion of the use 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, 12 producers, according to the Department of Energy Business, 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 is constructing a new biodiesel plant which will add another 210 million liters per annum to its current 450 million liters from two

plants (CCG and GI Green Power) in 2018. Another biodiesel plant with a production capacity of 110 million liters per annum is also under construction and scheduled to operate 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 ½	66	CPO, RBDPO, Stearin
5	A.I. Energy	165	Palm Stearin
6	Veera Suwan	66	Palm Stearin, RBDPO
7	Global Green Chemical	330	CPO, RBDPO
8	New Biodiesel	330	CPO, RBDPO, Stearin, FFA
9	Absolute Power P	99	CPO, RBDPO, Stearin
10	Bangchak Biofuel	264	CPO, Stearin
	Total	2,062	

½ Originalled called B. Grimm Green Power

Source: Department of Energy Business and FAS Estimates

5.2 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's policy in 2016 was to have a B7 mandatory blending rate, due to inadequate palm oil feedstocks and import control, the government adjusted the mandatory biodiesel blending rates three times in 2016. As a result, the average blending rate of biodiesel in diesel production dropped to 5.6 percent in 2016 from 5.7 percent in 2015. The average blending rate is expected to increase to 6.0 percent in 2017 based on the anticipation of recovery in CPO production.

Although the government is implementing several measures under the EEDP, diesel consumption, which is a derived demand for biodiesel use, is forecasted to sustain annual growth of 2.5-2.7 percent from 2018-2022, and is then forecasted to slow to 1.5-2.0 percent after 2022 and the scheduled completion of Thailand high-speed train. Total official diesel sales, reported by Department of Energy

Business, increased by 3.5 percent in 2016 to 22.7 billion liters. Prevailing low prices are expected to drive biodiesel consumption up 3.0 percent per annum equally in 2017 and 2018.

Biodiesel consumption is expected to grow to 1.42 billion liters 2017 and 1.48 billion liters in 2018, respectively.

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	Return implementing mandatory use of B7

Below is the composition of B7 biodiesel retail prices.

Table 5.4: Breakdown of B7 Biodiesel Retail Prices, Baht/liter

	As of June 9, 2016	As of June 9, 2017
Ex-Refinery Factory Price	15.5970	14.3202
Excise Tax	5.3500	5.8500
Municipal Tax	0.5350	0.5850
State Oil Fund	0.1400	0.0100
Conservation Fund	0.2500	0.2500
Wholesale Price (WS)	21.8729	21.0152
Value Added Tax (VAT)	1.5311	1.4711
WS+VAT	23.4040	22.4862
Marketing Margin	1.5757	1.9661
VAT	0.1103	0.1376
Retail Price	25.0900	24.59
Note: Exchange rate = 33.5 baht/$		
Source: Petroleum Division, Enery Policy and Planning Office, Ministry of Energy		

The Energy Policy and Planning Office (EPPO) under 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 transaction, however, most biodiesel producers usually receive 3-5 baht/liter (9-14 cents/liter) lower than these reference prices due to limited competition among diesel manufacturers. In 2016, actual biodiesel prices paid by petroleum (diesel) refineries reportedly ranged between 32.50-33.60 baht/liters (94-97 cents/liter).

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 adding together biodiesel (adjusted to B100 equivalent) moving under HTS codes 3826.00 and 2710.20. Exports of biodiesel (B100 equivalent) were 15.9 million liters in 2016, as compared to 2.81 million liters in 2015. Imports of biodiesel (B100 equivalent) totaled 5.0 million liters in 2016, as compared to 1.85 million liters in 2015.

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), while there is no import tariff for biodiesel greater than B30 and up to and including B100 (pure biodiesel) (HTS 3826.00).

5.4 Ending Stocks

Biodiesel production is driven solely by contracts between palm growers and refineries. As a result, the country's biodiesel stocks, held by either biodiesel producers or petroleum oil refineries, are quite low somewhere around 20-25 million liters or about 10 days of utilization.

VI. Advanced Biofuels

The AEDP 2015 includes an objective for pyrorysis oil of 194 million liters per annum by 2036. The first commercial pyrorysis oil company, called Ayutthaya Clean Energy, is scheduled to be operational by the end of 2017, with a capacity of 7.92 million liters. The main feedstock for the facility will be waste plastic, and all pyrosysis 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 move to lower the biofuel use goals for 2036. For example, a molasses-based ethanol plant using cane bagasse for cellulosic ethanol has stalled due to lack of commercial feasibility. The production of Hydrogenated Vegetable Oil (HVO), a type of renewable drop-in diesel, is no longer being commercialized in Thailand due to its high production cost and lack of government subsidy.

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 harmonized codes represent ethanol for fuel and industrial uses. Meanwhile, other import and export figures of ethanol under HS2207.10 and HS2207.20 will be beverage ethanol which is not include in the PS&D.

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 all product moving under 3826.00 is B100 and 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.