Biodiesel policy in Thailand

Dec. 13, 2017

Dr. Apiradee Thammanomai
Email – apiradee_t@dede.go.th
**Agenda**

<table>
<thead>
<tr>
<th>1. <strong>About the Plan</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Alternative Energy Development Plan (AEDP)</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. <strong>About the Bioethanol</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Bioethanol – Creation of demand and market</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. <strong>About the Biodiesel</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Biodiesel – Creation of demand and market</em></td>
</tr>
</tbody>
</table>
Out of energy produced, natural gas takes the largest share. BUT...natural gas resource is depleting and decreasing.

Source – EPPO (2017)
Thailand imported energy increasingly over the year. This is especially true for crude oil and NG.

Source – EPPO (2017)
Total energy demand also increases especially in fuel demand. Oil demand is rising due to low oil price.

Source – EPPO (2017)
Thailand Energy Masterplan

- **Power Development Plan (PDP)**
  - (Cabinet approve in Jun. 30, 2015)

- **Energy efficient Plan (EEP)**
  - (Cabinet approve in Oct. 6, 2015)

- **Alternative Energy Development plan (AEDP)**
  - (Cabinet approve in Oct. 27, 2015)

- **Gas plan (GAS)**
  - (Cabinet approve in Oct. 27, 2015)

- **Oil plan (OIL)**
  - (Cabinet approve in Oct. 27, 2015)
AEDP – History and Objectives

Renewable/Alternative Energy Development Plan

- REDP (2008-2022)
- AEDP (2012-2021)
- AEDP (2015-2036)

**Economy**
- To develop alternative energy production with suitable technology

**Energy Security**
- To fully utilize county’s alternative energy potentials

**Ecology**
- To increase social and community benefits from alternative energy production and usage
AEDP 2015 - Targets

Overall Targets

30% Renewable Energy in total energy consumption by 2036

Electricity
19,684.4 MW

Heat
25,088 ktoe

Fuel
11.3 MLPD Ethanol
14 MLPD B100

+0.53 MLPD Pyrolysis Oil
+4,800 TPD of CBG

Energy Sources:
- Wind
- Hydro
- Waste
- Solar
- Biomass
- Biogas
- Ethanol
- Biodiesel
- Compressed Biogas

Bioethanol
Bureau of biofuel development (DEDE)
AEDP 2015 Targets - Biofuel

2016 biofuel usage
1,742 ktoe

Fuel

2036 RE Biofuel targets
8,712 ktoe*
(25.04% of fuel demand)

Unit: MLPD
Ethanol
11.3
Biodiesel
14
Pyrolysis oil
0.53

Ethanol
3.67
Biodiesel
3.37
Pyrolysis oil

Unit: TPD
CBG
4,800 TPD

Remark: * ktoe equivalent of biofuel

Bioethanol
Bureau of biofuel development (DEDE)
### Agenda

**1. About the Plan**

Alternative Energy Development Plan (AEDP)

**2. About the Bioethanol**

*Bioethanol – Creation of demand and market*

**3. About the Biodiesel**

*Biodiesel – Creation of demand and market*
Bioethanol

Feedstock
- Sugar-based (Sugarcane and its derivatives)
- Starch-based (Cassava, Corn)
- Cellulosic-based (Rice straw, Bagasse)

Ethanol supply

26 ethanol plants
Total capacity of 5.79 MLPD

- Hybrid 0.9 MLPD
- Cassava 2.08 MLPD
- Molasses 2.81 MLPD

3.15 MT of Molasses were used to produce ethanol in 2016
2.50 MT of Cassava were used to produce ethanol in 2016

1,214 Million liter
Of ethanol was produced in 2016
Feedstock - Sugarcane plantation

Source: Office of Agriculture economics (2016)
Office of the cane and sugar board (2016)

Area: 1 Hectare = 6.25 Rai

- **Demand of Sugarcane products (2015)**

  - Sugarcane: 106.3 MT
  - Sugar: 11.34 MT
  - Molasses: 4.61 MT
  - Domestic uses: 2.50 MT
  - Export: 8.84 MT
  - Ethanol: 3.17 MT
  - Others: 1.45 MT

**Yield (T/Rai)**
- 2012: 98.4
- 2013: 100.1
- 2014: 103.7
- 2015: 106.3
- 2016: 94.14
- 2017: 91

**Cane output (MT)**
- 2012: 8.01
- 2013: 8.26
- 2014: 8.46
- 2015: 8.76
- 2016: 8.91
- 2017: 9.07
Feedstock - Cassava plantation

Yield (T/Rai)

<table>
<thead>
<tr>
<th>Year</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield</td>
<td>3.51</td>
<td>3.49</td>
<td>3.56</td>
<td>3.61</td>
<td>3.43</td>
<td>3.61</td>
</tr>
</tbody>
</table>

Cassava output (MT)

<table>
<thead>
<tr>
<th>Year</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassava output</td>
<td>29.85</td>
<td>30.23</td>
<td>30.02</td>
<td>32.36</td>
<td>30.56</td>
<td>31.19</td>
</tr>
</tbody>
</table>

Production by province

- Dark purple: > 1,000,000 Ton
- Light purple: 500,000 - 1,000,000 Ton
- Light orange: 100,000 - 500,000 Ton
- Light yellow: < 100,000 Ton

Area: 1 Hectare = 6.25 Rai

Demand of Cassava products (2015p)

- Domestic uses 32.36 MT
- Local uses 9.48 MT
- Ethanol 2.3 MT
- Cassava pellets 0.4 MT
- Cassava chips 7.3 MT
- Cassava starch 3.9 MT
- Stock/Import 9.52 MT

Source: Office of Agriculture economics (2016)
Bioethanol - Ethanol production

Thailand has 25 ethanol plants

<table>
<thead>
<tr>
<th>Feedstock</th>
<th>Capacity (ML/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molasses/Sugar cane</td>
<td>2.49</td>
</tr>
<tr>
<td>Cassava</td>
<td>2.08</td>
</tr>
<tr>
<td>Molasses and Cassava</td>
<td>0.90</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5.47</td>
</tr>
</tbody>
</table>

Ethanol production (Unit : ML)

<table>
<thead>
<tr>
<th>Year</th>
<th>Molasses</th>
<th>Sugarcane juice</th>
<th>Cassava</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>520</td>
<td>656</td>
<td>265</td>
</tr>
<tr>
<td>2012</td>
<td>381</td>
<td>532</td>
<td>692</td>
</tr>
<tr>
<td>2013</td>
<td>103</td>
<td>45</td>
<td>694</td>
</tr>
<tr>
<td>2014</td>
<td>37</td>
<td>57</td>
<td>759</td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td>69</td>
<td>754</td>
</tr>
<tr>
<td>2016</td>
<td></td>
<td>59</td>
<td>1214</td>
</tr>
</tbody>
</table>

Total ethanol produced (Unit : ML)

<table>
<thead>
<tr>
<th>Year</th>
<th>Molasses</th>
<th>Sugarcane juice</th>
<th>Cassava</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>103</td>
<td>45</td>
<td>265</td>
</tr>
<tr>
<td>2012</td>
<td>381</td>
<td>532</td>
<td>692</td>
</tr>
<tr>
<td>2013</td>
<td>103</td>
<td>45</td>
<td>694</td>
</tr>
<tr>
<td>2014</td>
<td>37</td>
<td>57</td>
<td>759</td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td>69</td>
<td>754</td>
</tr>
<tr>
<td>2016</td>
<td></td>
<td>59</td>
<td>1214</td>
</tr>
</tbody>
</table>

Feedstock uses (Unit : MT)

<table>
<thead>
<tr>
<th>Type</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molasses</td>
<td>1.59</td>
<td>2.22</td>
<td>2.62</td>
<td>2.90</td>
<td>3.17</td>
<td>3.15</td>
</tr>
<tr>
<td>Sugarcane juice</td>
<td>0.49</td>
<td>0.65</td>
<td>0.76</td>
<td>0.88</td>
<td>0.91</td>
<td>0.79</td>
</tr>
<tr>
<td>Cassava</td>
<td>0.65</td>
<td>0.47</td>
<td>1.67</td>
<td>1.86</td>
<td>2.17</td>
<td>2.50</td>
</tr>
</tbody>
</table>

Source - Department of Alternative Energy and Efficiency
Ethanol policy in Thailand is “All about Marketing”

- Is our product good?
- Is our price competitive?
- Is our place accessible?
- Is our promotion enough?
Product - Ethanol and Gasohol

- Ethanol has ~70% heating value of gasoline
- Thailand’s fuel ethanol spec. is up to international standard
- Quality of fuel grade ethanol is tightly controlled by the Department of Energy Business.

- Ethanol blended gasoline is called “GASOHOL”
  - 90% gasoline & 9-10% ethanol: E10 (91)
  - 80% gasoline & 19-20% ethanol: E20
  - 75% and above ethanol: E85

Bioethanol

Bureau of biofuel development (DEDE)
### Price – Gasohol price structure

<table>
<thead>
<tr>
<th>UNIT: BAHT/LITRE</th>
<th>EX-REF. TAX</th>
<th>M. TAX</th>
<th>OIL FUND</th>
<th>CONSV. FUND</th>
<th>WHOLESALE PRICE(WS)</th>
<th>VAT</th>
<th>WS&amp;VAT</th>
<th>MARKETING MARGIN</th>
<th>VAT</th>
<th>RETAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULG</td>
<td>15.5956</td>
<td>6.5000</td>
<td>0.6500</td>
<td>6.3100</td>
<td>0.2500</td>
<td>29.3056</td>
<td>2.0514</td>
<td>31.3570</td>
<td>2.6196</td>
<td>0.1834</td>
</tr>
<tr>
<td>GASOHOL95 E10</td>
<td>16.6344</td>
<td>5.8500</td>
<td>0.5850</td>
<td>0.3500</td>
<td>0.2500</td>
<td>23.6694</td>
<td>1.6569</td>
<td>25.3262</td>
<td>1.6110</td>
<td>0.1128</td>
</tr>
<tr>
<td>GASOHOL91</td>
<td>16.4029</td>
<td>5.8500</td>
<td>0.5850</td>
<td>0.3500</td>
<td>0.2500</td>
<td>23.4379</td>
<td>1.6407</td>
<td>25.0786</td>
<td>1.5901</td>
<td>0.1113</td>
</tr>
<tr>
<td>GASOHOL95 E20</td>
<td>17.6746</td>
<td>5.2000</td>
<td>0.5200</td>
<td>-3.0000</td>
<td>0.2500</td>
<td>20.6446</td>
<td>1.4451</td>
<td>22.0898</td>
<td>2.2899</td>
<td>0.1603</td>
</tr>
<tr>
<td>GASOHOL95 E85</td>
<td>22.6639</td>
<td>0.9750</td>
<td>0.0975</td>
<td>-9.3500</td>
<td>0.2500</td>
<td>14.6364</td>
<td>1.0245</td>
<td>15.6609</td>
<td>4.0926</td>
<td>0.2865</td>
</tr>
<tr>
<td>H-DIESEL</td>
<td>15.8781</td>
<td>5.8500</td>
<td>0.5850</td>
<td>0.0100</td>
<td>0.2500</td>
<td>22.5731</td>
<td>1.5801</td>
<td>24.1532</td>
<td>1.5298</td>
<td>0.1071</td>
</tr>
<tr>
<td>FO 600 (1) 2%S</td>
<td>11.8230</td>
<td>0.6400</td>
<td>0.0640</td>
<td>0.0600</td>
<td>0.0700</td>
<td>12.6570</td>
<td>0.8860</td>
<td>13.5430</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FO 1500 (2) 2%S</td>
<td>11.5244</td>
<td>0.6400</td>
<td>0.0640</td>
<td>0.0600</td>
<td>0.0700</td>
<td>12.3584</td>
<td>0.8651</td>
<td>13.2235</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPG</td>
<td>20.7216</td>
<td>2.1700</td>
<td>0.2170</td>
<td>-6.5965</td>
<td>0.0000</td>
<td>16.5121</td>
<td>1.1558</td>
<td>17.6679</td>
<td>3.2566</td>
<td>0.2280</td>
</tr>
</tbody>
</table>

**Exchange Rate**

= 33.2976 BAHT/$

**Biofuel reference price**

- Ethanol Reference Price = 25.02 BAHT/LITRE
- Biodiesel(B100) Reference Price = 25.58 BAHT/LITRE

---

**Example of fuel price structure (Source – EPPO Oct.24, 2017)**

Bureau of biofuel development (DEDE)
Price – Oil fund makes gasohol competitive

Oil fund collections of ULG and E10s and subsidies to E20 and E85 create price incentives for E20 and E85.

<table>
<thead>
<tr>
<th>UNIT: BAHT/LITRE</th>
<th>EX-REFIN. (AVG)</th>
<th>OIL FUND</th>
<th>RETAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULG (Unleaded gasoline)</td>
<td>15.5956</td>
<td>6.3100</td>
<td>34.16</td>
</tr>
<tr>
<td>GASOHOL95 E10</td>
<td>16.6344</td>
<td>0.3500</td>
<td>27.05</td>
</tr>
<tr>
<td>GASOHOL91</td>
<td>16.4029</td>
<td>0.3500</td>
<td>26.78</td>
</tr>
<tr>
<td>GASOHOL95 E20</td>
<td>17.6746</td>
<td>-3.0000</td>
<td>24.54</td>
</tr>
<tr>
<td>GASOHOL95 E85</td>
<td>22.6639</td>
<td>-9.3500</td>
<td>20.04</td>
</tr>
</tbody>
</table>

Ethanol has *less heating value* than gasoline yet ethanol *is more expensive*

To incentivize gasohol, oil fund is used to make gasohol competitive to gasoline.
Place – Where can we find gasohol?

There are total over 25,000 gas stations with about 18,500 small-non-brand stations

**E10 stations** are well-spread in Thailand

Sources – Department of Energy Business (2017)
Place – Vehicles that can use gasohol

**ULG** (Unleaded gasoline)

- Pure gasoline
- 90% gasoline
- 9 - 10% ethanol
- E10 (91) & E10 (95)

**E10**

- 90% gasoline
- 9 - 10% ethanol
- E10 (91) & E10 (95)

**E20**

- 80% gasoline
- 19- 20% ethanol

**E85**

- 15% gasoline
- 75% and above ethanol

**All cars**

- 32% ULG/E10
- 57% E20
- 11% E85

**Most cars manufactured since 1995**

- 44% ULG/E10
- 56% E20

**Most cars manufactured since 2008**

**Flex-fuel Vehicles (FFV)**

- FFV cars in Thailand are produced by Toyota, Honda, Nissan, Mitsubishi, Chevrolet, Volvo, Mazda and Ford. Yamaha offered FFV motorcycles.

- Out of new cars and motorcycles registered in 2016
  - 47% are FFV cars
  - 83% are E20 motorcycles

Sources – Department of Land Transportation (2016)
Thai Automotive Industry Association (2016)
**Policy results – fuel usage**

**Fuel uses (Unit: MLPD)**

- **2012**
  - ULG: 0.10
  - E10 (95): 5.81
  - E10 (91): 5.29
  - E20: 0.10
  - E85: 8.90

- **2013**
  - ULG: 0.39
  - E10 (95): 2.64
  - E10 (91): 9.14
  - E20: 0.39
  - E85: 8.30

- **2014**
  - ULG: 0.91
  - E10 (95): 3.68
  - E10 (91): 9.85
  - E20: 0.91
  - E85: 7.49

- **2015**
  - ULG: 0.87
  - E10 (95): 4.14
  - E10 (91): 11.01
  - E20: 0.87
  - E85: 11.13

- **2016**
  - ULG: 0.89
  - E10 (95): 4.79
  - E10 (91): 10.84
  - E20: 0.89
  - E85: 10.84

**Ethanol uses (Unit: MLPD)**

- **2012**: 1.39
- **2013**: 2.60
- **2014**: 3.15
- **2015**: 3.35
- **2016**: 3.67

**Bioethanol**

**Bureau of biofuel development (DEDE)**
**Obstacles met in Thailand ethanol development**

**Molasses and cassava chips**
- Competing demand from other industries
- Freely export/Import without system to track local stocks

**Plantation**
- Sugarcane and cassava
  - High cost of production due to low yield in some areas
  - Limit plantation areas for sugarcane

**Feedstock**

**Ethanol**
- Need more ethanol plants for future demand (As planned)
- Lack of open trading system for ethanol

**“Gasohol”**
- Ethanol is more expensive than gasoline
- No measures to systemically increase E20/E85 stations coverage

**Vehicles**
- E20 car and motorcycles owners still prefer E10
- More EV cars in the future
- More FFV motorcycles are needed
Future policies

Promoting Ethanol Consumption

Ethanol Consumption Promoting Policies
1. Increase gasohol demand through marketing mechanisms
   (Price incentive/Gasohol service coverage/PR)
2. Increase share of gasohol vehicles
   (Increase E20/E85 compatible car)

Promoting Sustainable Ethanol Production

Ethanol Production Promoting Policies
1. Promote more sustainable and more efficient ethanol feedstock plantation/production
2. Increase ethanol production efficiency
   (Reduce production cost + logistic cost)
Future for ethanol will depend on:

- **Price** Lower
- **Feed stock** diversify
- **Cars** More E85 vehicles

2017 - 2036
Agenda

1. About the Plan
   Alternative Energy Development Plan (AEDP)

2. About the Bioethanol
   Bioethanol – Creation of demand and market

3. About the Biodiesel
   Biodiesel – Creation of demand and market
Biodiesel can be produced by 2 methods. The simple one is through “transesterification process” using oil from oil plants such as palm, rapeseed, sunflower etc. The more complicated one is using “Gasification process” using any agricultural or forestry residues. The biodiesel or B100 will then be blended with regular fossil diesel. At the moment, car industry in Thailand accepts maximum ratio of 7% or B7.
There are only some certain areas suitable for oil palm plantation in Thailand (eg. Southern and Eastern).

**Oil palm plantation area:** 0.73 million Hectare

Remark – yielding plantation

- **Crude palm oil:** 1.81 MT
- **Domestic consumption:** 0.97 MT
- **Biodiesel Production:** 0.82 MT
- **Export:** 0.06 MT

Average (2016) B100 consumption: 3.37 ML/day

There are 12 biodiesel plant with capacity of 6.52 MLPD

Source: Department of Agricultural economics
Ministry of Energy has announced the biodiesel B7 blend mandate since January 2014.
Mandate and biodiesel usage

- Jan. 1, 2014 - Thailand diesel mandate biodiesel blending between 6 – 7%
- Due to domestic palm oil shortage, the blending range was extend lower to 3.5 – 7%
  - Feb. 17 – May. 13, 2014 and Jan. 20 – Apr. 15, 2015
- Aug. 3, 2016 - Thailand diesel mandate biodiesel blending between 6.5 – 7%
- Aug. 25, 2016 - Thailand diesel mandate biodiesel blending between 3 – 7%
- Nov.25, 2016 - Thailand diesel mandate biodiesel blending between 5 – 7%
- May 8, 2017 - Thailand diesel mandate biodiesel blending between 6.5 – 7%

Biodiesel

Bureau of biofuel development (DEDE)
Future of biodiesel will depend on:

- Lower price
- Higher biodiesel blend
- Blend wall
- Rail public transportation
- B7 B10
Thank you for your attention

Thank you