Preliminary AEO2013: Biofuels and Petroleum

AEO2013 Liquid Fuels Markets Working Group Meeting
Office of Petroleum, Natural Gas & Biofuels Analysis
October 4, 2012 | Washington, DC

WORKING GROUP PRESENTATION FOR DISCUSSION PURPOSES
DO NOT QUOTE OR CITE AS RESULTS ARE SUBJECT TO CHANGE
Overview

• World oil price path assumptions
• Liquid fuels demands
• Biofuels production and consumption
• Technology assessment update
• Petroleum product imports and exports
Oil price cases for AEO2013P compared to AEO2012

annual average price of light, low sulfur crude oil
real 2011 dollars per barrel

Source: Preliminary AEO2013 runs, dated as of 10/01/12
AEO2013 projects lower U.S. transportation liquid fuels demand, compared to AEO2012 projections.

Source: Preliminary AEO2013 runs, dated as of 10/1/12
U.S. reliance on imported liquid fuels is lower due to increased domestic production and greater fuel efficiency.

![Graph showing historical and projected consumption and production of oil](chart)

- **Consumption**: 60% peak, 40% in projections.
- **Production**: 50% in projections.

**Source**: Preliminary AEO2013 runs, dated as of 10/1/12

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U.S. Liquid Fuels Consumption by Source

Million barrels per day

Source: Preliminary AEO2013 runs, dated as of 10/1/12
Fuel consumption changes, 2008-2015 and 2015-2040 (thousand barrels per day)

Source: Preliminary AEO2013 runs, dated as of 10/1/12
U. S. Biofuels Production

U.S. biofuels production million barrels per day

Source: Preliminary AEO2013 runs, dated as of 10/1/12
Ethanol Consumption in E85 and E10/E15 Motor Gasoline Blends

Billion gallons


History Projections

Ethanol blended into gasoline

Ethanol in E85

AEO2013P

AEO2012

Source: Preliminary AEO2013 runs, dated as of 10/1/12

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Biofuel RIN generation falls short of goal throughout projection

billion ethanol-equivalent gallons

Legislated RFS in 2022

<table>
<thead>
<tr>
<th></th>
<th>AEO2012</th>
<th>AEO2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>2022</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>2040</td>
<td>30</td>
<td>30</td>
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</tbody>
</table>

Source: Preliminary AEO2013 runs, dated as of 10/1/12
California Low Carbon Fuel Standard (LCFS)

- The California LCFS “will reduce greenhouse gas emissions by reducing the full fuel-cycle, carbon intensity of the transportation fuel pool used in California”, according to http://www.arb.ca.gov/fuels/lcfs/CleanFinalRegOrder_02012011.pdf

- The average carbon intensity (CI), measured in gCO2e/MJ, for mogas-related fuels and diesel-related fuels must decrease by 10% from 2010 to 2020 according to schedules published in the Regulation.

- Key drivers for LCFS projections in AEO2013:
  - Availability of flex fuel vehicles, E85 penetration, electric vehicles, etc.
  - Development of drop-in fuels
  - Cost for non-compliance
The *average* Carbon Intensity of biodiesel in B20 required to meet LCFS targets is much lower than conventional soy biodiesel.
The average Carbon Intensity of ethanol in E10/E85 required to meet LCFS targets is much lower than conventional corn ethanol.
## AEO2013 Technology Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units of measure</th>
<th>Gas to liquids</th>
<th>Coal to liquids</th>
<th>Corn ethanol</th>
<th>Fame Biodiesel</th>
<th>Renewable Diesel</th>
<th>Cellulosic ethanol</th>
<th>Biomass pyrolysis unit</th>
<th>Biomass to liquids</th>
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<tbody>
<tr>
<td>Design location</td>
<td></td>
<td>Gulf</td>
<td>Mountain</td>
<td>Midwest</td>
<td>Gulf</td>
<td>Midwest</td>
<td>Gulf</td>
<td>Midwest</td>
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<td>Nameplate capacity</td>
<td>b/d</td>
<td>34,000</td>
<td>50,000</td>
<td>6,523</td>
<td>1,305</td>
<td>2,000</td>
<td>3,700</td>
<td>1,374</td>
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<td>Overnight capital cost</td>
<td>$/bd</td>
<td>$90,723</td>
<td>$160,301</td>
<td>$34,777</td>
<td>$31,933</td>
<td>$36,132</td>
<td>$148,189</td>
<td>$126,806</td>
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<td>Thermal efficiency</td>
<td>Percent</td>
<td>55</td>
<td>46</td>
<td>53</td>
<td>95</td>
<td>99</td>
<td>49</td>
<td>40</td>
<td>51</td>
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<td>Process yield</td>
<td>bbl/unit</td>
<td>0.10</td>
<td>1.57</td>
<td>0.07</td>
<td>0.99</td>
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<td>2.22</td>
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<td>Capacity factor</td>
<td>Percent</td>
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<td>Economic lifetime</td>
<td>Years</td>
<td>15</td>
<td>15</td>
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<tr>
<td>Construction lead time</td>
<td>Years</td>
<td>4</td>
<td>4</td>
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</tbody>
</table>
## GTL Technology Parameters

|                           |                 |        |                | ²
|                            |                 |        |                |    |
| Nameplate capacity         | b/d             | 34,000 | 44,900         | 32,293 |
| Overnight capital cost ¹   | $/bd            | 76,610 | 60,738         | 88,013 |
| Thermal efficiency         | %               | 54     | 55             | 84 |
| Capacity factor            | %               | 85     | ND             | ND |
| Economic lifetime          | Years           | 15     | -              | - |
| Construction lead time     | Years           | 4      | -              | - |
| Feedstock                  |                 |        |                |    |
| Natural gas               | MM scf/day      | 300    | 412            | 200 |
| Raw water                 | gal/minute      | 13     | ND             | ND |
| N-Butane                  | lb/h            | 3      | ND             | ND |
| Products                  |                 |        |                |    |
| Gasoline                  | b/d             | 9,690  | 17,000         | 3,958 |
| Diesel                    | b/d             | 24,310 | 26,200         | 28,240 |
| Propane                   | lb/h            | -      | 1,700          | 0 |
| CO2                       | tons/day        | -      | 4,084          | - |
| Net Power                 | kWh/bbl         | -      | 0.14           | 0 |

1. All costs escalated to 2011$ using CEPCI and U.S. labor costs.
2. Korea study overnight capital cost adjusted to reflect US construction labor conditions.
3. ND = no data
GTL Production

Million barrels per day

Reference Case  
Low Oil Price Case

High Oil Price Case  
2012 High Oil Price Case

Source: Preliminary AEO2013 runs, dated as of 10/1/12
U.S. Petroleum Refinery Distillate Yields

Percent of total feedstock throughput

Source: Preliminary AEO2013 runs, dated as of 10/1/12
U.S. Liquid Fuels Product Exports and Imports

- The U.S. is expected to remain a net exporter of product liquid fuels for the entire projection period.
- Due to delays in completing new refining capacity in Latin America, U.S. product exports are expected to grow in the near future.
- Net motor gasoline imports will reflect a gradual decline, as higher efficiency vehicles begin to lead to lower gasoline consumption.
EIA Projected Liquid Fuels Product Trade Balance (excluding biofuels)

Thousand barrels per day

Imports
Exports
Net

2005  2010  2015  2020  2025  2030  2035  2040

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U.S. Liquid Fuel Products Imports (excluding biofuels)

Imported Petroleum Products
Thousands barrels per day

- Petrochemical Feedstock
- Distillate
- Resid
- LPG_Other
- Motor Gasoline
- Unfinished Oils
- Jet Fuel

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