Latest Biofuels Developments in the USA

Joint ISCC Technical Committee Meeting – North & South America
Presented by: Steffen Mueller, PhD & Jacki Cassady

June 24, 2015
Overview

• Certification & Quality Assurance Programs: Businesses and Buyers Want Verification
• The New RFS2 Renewable Volume Obligation
  – Industry Reactions
• Outlook
  – Cellulosic Ethanol
  – Renewable CNG and LNG
  – Argentinian Exports to the US
• LCFS Updates
• New Clean Fuels Programs on the Horizon
• Genscape Sustainability and QAP Solutions
Certification & Quality Assurance Programs: Businesses and Buyers Want Verification

Certification Trend:

- Environment & Energy Daily Article: “DEFORESTATION: U.S. food giants, investors say palm oil standards are too weak” 6/2/15
- Roundtable on Sustainable Palm Oil (RSPO) provides sustainability certification for the industry.
- Investors and Business signed letter stating “RSPO inconsistently enforces its guidelines” and stating further “RSPO is lagging behind many corporations' sustainable sourcing policies”

Green Century Capital, First Affirmative Financial Network,
Certification & Quality Assurance Programs: Businesses and Buyers Want Verification

QAP Trend

- An increasing number of companies across fuel types are adopting QAP.
  - The number of Genscape QAP clients has more than doubled since the passage of the final rule on QAP.
  - Approximately half of Genscape’s QAP client base produces ethanol.
  - Requests for proposals have rapidly emerged from the ethanol industry for corn-based, sugar-based and cellulosic ethanol.
  - Genscape QAP represents about 17% of total D6 Ethanol RIN Market.
## Renewable Fuels Standard 2 Overview

<table>
<thead>
<tr>
<th>Fuel</th>
<th>RIN Code</th>
<th>% reduction from displaced gasoline/diesel (2005 baseline)</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable fuel</td>
<td>D6</td>
<td>20%</td>
<td>Fuel produced from renewable biomass and that is used to replace or reduce the quantity of fossil fuel present in a transportation fuel.**</td>
</tr>
<tr>
<td>Advanced biofuel</td>
<td>D5</td>
<td>50%*</td>
<td>Renewable fuel other than ethanol derived from corn starch.</td>
</tr>
<tr>
<td>Biomass-based diesel</td>
<td>D4</td>
<td>50%</td>
<td>Includes both biodiesel (mono-alkyl esters) and non-ester renewable diesel (including cellulosic diesel). It includes any diesel fuel made from biomass feedstocks.</td>
</tr>
<tr>
<td>Cellulosic biofuel</td>
<td>D3</td>
<td>60%</td>
<td>Renewable fuel derived from any cellulose, hemicelluloses, or lignin each of which must originate from renewable biomass.</td>
</tr>
</tbody>
</table>
## Current Market Activity: RIN and LCFS credits

### 2012-2015 RIN Pricing in cents/RIN & LCFS in dollars/MT

<table>
<thead>
<tr>
<th>Year</th>
<th>Type</th>
<th>Bid</th>
<th>Ask</th>
<th>Year</th>
<th>Type</th>
<th>Bid</th>
<th>Ask</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>D6</td>
<td>44.00</td>
<td>44.50</td>
<td>2013</td>
<td>D3*</td>
<td>-</td>
<td>42.00</td>
</tr>
<tr>
<td>2014</td>
<td>D6</td>
<td>44.00</td>
<td>44.50</td>
<td>2014</td>
<td>D3*</td>
<td>-</td>
<td>49.00</td>
</tr>
<tr>
<td>2015</td>
<td>D6</td>
<td>44.00</td>
<td>44.50</td>
<td>2015</td>
<td>D3*</td>
<td>-</td>
<td>64.00</td>
</tr>
</tbody>
</table>

Source: Current as of June 19, 2015

### Total RINs and Net RINs Generated

<table>
<thead>
<tr>
<th>Fuel (D Code)</th>
<th>Total RINs Generated</th>
<th>RIN Generation Error Corrections</th>
<th>Net RINs Generated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulosic Biofuel (D3)</td>
<td>37,015,812</td>
<td>115,756</td>
<td>36,900,056</td>
</tr>
<tr>
<td>Biomass-Based Diesel (D4)</td>
<td>955,367,091</td>
<td>595,633</td>
<td>954,771,458</td>
</tr>
<tr>
<td>Advanced Biofuel (D5)</td>
<td>34,735,138</td>
<td>9,279</td>
<td>34,725,859</td>
</tr>
<tr>
<td>Renewable Fuel (D6)</td>
<td>5,990,196,409</td>
<td>635,553</td>
<td>5,989,560,856</td>
</tr>
<tr>
<td>Cellulosic Diesel (D7)</td>
<td>173,731</td>
<td>17,373</td>
<td>156,358</td>
</tr>
</tbody>
</table>

Source: Current as of June 10, 2015
[http://www.epa.gov/otaq/fuels/rfsdata/2015emts.htm](http://www.epa.gov/otaq/fuels/rfsdata/2015emts.htm)
New Renewable Volume Obligations Released 5/29/15 & Industry Reactions

- Conventional Biofuels Organizations Characterize RVO as “Blendwall Oriented.” Not stimulating innovation.
- EPA Hearing in Kansas City, KS on 6/25/15

### Original RVO (Billion Gallon)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Renewable Fuel</th>
<th>Cellulosic (D3)</th>
<th>Biomass Based Diesel (D4)</th>
<th>Total Advanced</th>
<th>Conventional (D6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>18.15</td>
<td>1.75</td>
<td>1</td>
<td>3.75</td>
<td>14.4</td>
</tr>
<tr>
<td>2015</td>
<td>20.5</td>
<td>3</td>
<td>1</td>
<td>5.5</td>
<td>15</td>
</tr>
<tr>
<td>2016</td>
<td>22.25</td>
<td>4.25</td>
<td>1</td>
<td>7.25</td>
<td>15</td>
</tr>
</tbody>
</table>

### New RVO

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Renewable Fuel</th>
<th>Cellulosic</th>
<th>Biomass Based Diesel</th>
<th>Total Advanced</th>
<th>Conventional</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>15.93</td>
<td>0.033</td>
<td>1.631</td>
<td>2.68</td>
<td>13.25</td>
</tr>
<tr>
<td>2015</td>
<td>16.3</td>
<td>0.106</td>
<td>1.7</td>
<td>2.9</td>
<td>13.4</td>
</tr>
<tr>
<td>2016</td>
<td>17.4</td>
<td>0.206</td>
<td>1.8</td>
<td>3.4</td>
<td>14</td>
</tr>
</tbody>
</table>
• Argonne GREET life cycle emissions analyses estimate that corn ethanol GHG emissions are 19-48% (mean=34%) lower than conventional gasoline.

• EPA’s RVO adjustment from the original RVO to the waived RVO will likely leave conventional biofuels short by 1.6 billion gallons in 2015
  – Original RVO of 15 billion gallons for 2015 to the waived RVO of 13.4 billion gallons in 2015.

• The 1.6 billion gallons difference will increase GHG emissions by 4,520,000 tonnes CO2e for 2015.
What is Genscape’s outlook for cellulosic biofuels?

<table>
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<tr>
<th>RFS2 Pathways II Effective August 18, 2014</th>
<th>Current 2015 Cellulosic Activity</th>
<th>Key Factors</th>
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<tr>
<td>RFS2 qualification of renewable CNG/LNG as cellulosic fuels</td>
<td>Q1 2015: more than 19 million D3 RINs generated</td>
<td>Commercialization of cellulosic ethanol technology for production of fuels from cellulosic based renewable “crude”</td>
</tr>
<tr>
<td>In 2014, EPA reported 33 million D3 RINs generated</td>
<td>Landfill gas (LFG) primary source of renewable CNG/LNG production</td>
<td>Increase in number of registered renewable CNG and LNG producers</td>
</tr>
<tr>
<td>2014 Cellulosic Ethanol: 700,000 RINs generated</td>
<td>Q1 2015 Cellulosic Ethanol: 286,000 RINs generated</td>
<td></td>
</tr>
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2014 Cellulosic Ethanol: 700,000 RINs generated

Landfill gas (LFG) primary source of renewable CNG/LNG production

Q1 2015: more than 19 million D3 RINs generated

Q1 2015 Cellulosic Ethanol: 286,000 RINs generated

Commercialization of cellulosic ethanol technology for production of fuels from cellulosic based renewable “crude”

Increase in number of registered renewable CNG and LNG producers
Major Technology Investments in Cellulosic Ethanol

• POET-DSM partnership
  – Cellulosic commercialization starting with the 25 Mmgy
  – Open Sept 2014: Project LIBERTY facility in Emmetsburg, IA
  – Indications of expansive feedstock storage
  – Projected to reach “final acceptance stage” in Q3 2015.

• Abengoa Bioenergy opened its 25 Mmgy cellulosic facility in Hugoton, KS in October 2014.

• In 2014, Syngenta entered into an agreement to license QCCP’s Cellerate™ technology
  – Increase ethanol plants ability to convert corn kernel fiber to ethanol.
  – 11 QCCP projects that it will reach its capacity of 2 Mmgy

• DuPont constructing a 30 Mmgy plant in Nevada, IA.
  – The Ames Tribune reported in January that the company was experiencing delays due to labor shortages.
Marketplace Supply & Demand: Landfill Methane Outreach Program (LMOP) & RFS2

Landfill Methane Outreach Program database lists more than 40 high BTU, LNG or alternative fuel project types currently in operation with three more under construction

- 15 states
- Total production capacity of 148 MMcfd of LFG
  - 1 RIN/77000Btu (LHV)
  - Raw potential of about 750 million RINs/year
- Only about one-third of producers RFS2 registered
- The LMOP Database lists more than 1700 landfills that have potential or are candidates for energy development.

Renewable Natural Gas Coalition data

- About 40 landfill gas to renewable natural gas projects listed
- Estimated that RNG industry will produce 167 million ethanol equivalent gallons dedicated to transportation fuel

RFS2

- At least 28 EPA approved, registered biogas facilities in the EMTS as of 9/18/2014
- April 2015 Two additional registered projects
- Genscape estimates annual production capacity of 160 MM ethanol equivalent gallons
Renewable CNG and LNG Production Limitations

• Conventional natural gas prices and the uncertainty in the RFS2 volumes are the biggest hurdles for the expansion of renewable natural gas for CNG and LNG fuels.
  – Based on Renewable Natural Gas Coalition estimates, it costs at least $5.50 per MMBtu to produce pipeline quality gas from landfill gas when compared to conventional gas sources.
  – RIN credits, LCFS credits and sometimes RECs stack up to bridge or exceed the gap.
  – The EIA reported that the average natural gas spot price at Henry Hub for March 2015 was about $2.83 compared to $4.90 a year prior, indicating that the landscape has become more difficult for RNG this year.
Several companies in Argentina, working through their trade association, “CARBIO” replaced the stringent feedstock recordkeeping requirements of the RFS regulations.

- Argentinian biodiesel companies allowed to use “survey plan”
- Product must meet definition of renewable biomass
- Bypass “map and track” feedstock requirement
- Soybean oil from Argentinian soybean fields can be sourced from land producing agricultural crops on or before December 19, 2007

US Industry fears that “if not addressed, this may allow hundreds of millions of gallons of biodiesel to be imported into the United States that do not meet the sustainability requirements for renewable biomass under the Renewable Fuel Standard (RFS).”
California Air Resources Board (CARB) Low Carbon Fuel Standard (LCFS)

- Foundation is AB 32, Global Warming Solutions Act of 2006 with goals for reduction to GHGs to 1990 levels by 2020

- LCFS requires 10% drop in Carbon Intensity ("CI") of transportation fuels from 2010 to 2020
  (a) Establishes CI Baseline for Program Use
  (b) Imposes Declining CI requirements
  (c) Sets CI levels for various fuels

- Regulated party must meet CI standards similar to Obligated Party Renewable Volume Obligations (RVOs) under RFS2

- Parties can benefit from both RINs and LCFS credits
## Low Carbon Fuel Standard (LCFS) Re-Adoption 2015

### Tier 1 Fuels
- 23 Conventional Fuels including:
  - Starch- and sugar-based ethanol
  - Biodiesel
  - Renewable Diesel
  - Renewable CNG/LNG

### Tier 2 Fuels
- “Next Generation” fuels including:
  - Cellulosic alcohols
  - Drop-in fuels
  - Electricity
  - First-Gen fuels using innovative production processes

### LCFS Re-adoption
- Effective January 1, 2016
  - Cost containment mechanism
  - Revised CI values for various fuels (updates to GREET)
  - New iLUC values
  - Low Carbon Fuel Availability Analysis
  - New Compliance Curve Enforcement—Third Party Audit Opportunities (QAP)
Marketplace Supply & Demand: LCFS Marketplace
Clean Fuels Programs Horizon

Oregon: Reporting year 2015, Compliance Year 2016
CARB LCFS-based program with similar CI values and transaction reporting system for credit transactions (LRT)

Washington: Pending state legislation with earliest adoption in 2017

British Columbia: similar model to both CARB LCFS and Oregon but no clear timeline
Genscape Solutions
Genscape Land Use Analysis Software

- Dual Viewer: Synchronized side-by-side land use comparison across time-stamped historic imagery
- Land use change risk classification by county
- Preloaded USDA historical (2007) and most current NAIP imagery (2014)
- Import field boundaries in KML/KMZ file format
- Measure distance to nearest State and National Parks and Protected Areas (NOGO areas) and Elevators
- Assessments can be annotated and saved as individual projects
- US tools populated with imagery for all major agricultural counties
Genscape QAP Process with Real-time Monitoring

1 – Feedstock receipt monitoring
- Truck/rail/barge imaging
- Pump/motor monitoring
- Storage level monitoring

2 – Processing & energy monitoring
- Pump sensors
- IR heat signatures

3 – Fuel output
- Pump/motor monitoring
- IR tank levels
- Tank level meter data

4 – Transportation & Destination
- Secure rail data
- Unit train tracking
- Imaging
Questions?

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