Got Gas? Use it for Vehicle Fuel under the Updated Renewable Fuel Standard

John Willis, P.E. BCEE
David Babson
Cynthia Finley
Steven Marshall, P.E.
Presentation Outline

• Renewable Fuel Standard (RFS) and Cellulosic Determination
• RIN Pricing and EPA’s Past Efforts
• St. Petersburg Class-A Digestion and Energy Upgrades
  • Project Scope Overview
  • Summary of Budget Economics
  • Impact of Cellulosic Determination and Current RIN Pricing
• Why the RFS is Likely to Continue
• Conclusions
Renewable Fuel Standard (RFS) and Cellulosic Determination
RFS Program Structure

• Created under the Energy Policy Act of 2005 (EPAct)

• Energy Independence and Security Act of 2007 (EISA) further amended the CAA by expanding RFS program

• EPA implemented RFS program in consultation with the US Department of Agriculture and the Department of Energy
Pathways II Improved on Pathways I

- Pathways I originally classified Biogas (from Landfills, sewage and waste treatment plants, manure digesters) as for D5 (Advanced) RINs
- RFS Pathways II was published on July 18, 2014
- Pathway Q provided designation as D3 (cellulosic) RINs for any:
  - “Renewable Compressed Natural Gas, Renewable Liquefied Natural Gas, Renewable Electricity”
  - produced from “Biogas from landfills, municipal wastewater treatment facility digesters, agricultural digesters, and separated MSW digesters; and biogas from the cellulosic components of biomass processed in other waste digesters.”
Many wonder what happens to RINs after 2022?

- In order to understand why, we look at RFS-2 Table I.A.1-1...
- What’s the “magic” with 2022?
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- In order to understand why, we look at RFS-2 Table I.A.1-1...
- What’s the “magic” with 2022?

2022 is where the table ends...
A virtual “cliff”
Many wonder what happens to RINs after 2022?

- In order to understand why, we look at RFS-2 Table I.A.1-1...
- What’s the “magic” with 2022?
- There’s a footnote! One that suggests that it’s “up to EPA”...

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<tr>
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<th>Advanced biofuel requirement</th>
<th>Total renewable fuel requirement</th>
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<tbody>
<tr>
<td>2009</td>
<td>n/a</td>
<td>0.5</td>
<td>0.6</td>
<td>11.1</td>
</tr>
<tr>
<td>2010</td>
<td>0.1</td>
<td>0.65</td>
<td>0.95</td>
<td>12.95</td>
</tr>
<tr>
<td>2011</td>
<td>0.25</td>
<td>0.90</td>
<td>1.35</td>
<td>13.95</td>
</tr>
<tr>
<td>2012</td>
<td>0.5</td>
<td>1.0</td>
<td>2.0</td>
<td>15.2</td>
</tr>
<tr>
<td>2013</td>
<td>1.0</td>
<td>a</td>
<td>2.75</td>
<td>16.55</td>
</tr>
<tr>
<td>2014</td>
<td>1.75</td>
<td>a</td>
<td>3.75</td>
<td>18.15</td>
</tr>
<tr>
<td>2015</td>
<td>3.0</td>
<td>a</td>
<td>5.5</td>
<td>20.5</td>
</tr>
<tr>
<td>2016</td>
<td>4.25</td>
<td>a</td>
<td>7.25</td>
<td>22.25</td>
</tr>
</tbody>
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2023+ | b | b | B | b

*a To be determined by EPA through a future rulemaking, but no less than 1.0 billion gallons.

*b To be determined by EPA through a future rulemaking.
Many wonder what happens to RINs after 2022?

- In order to understand why, we look at RFS-2 Table I.A.1-1...
- What’s the “magic” with 2022?
- There’s a footnote! One that suggests that it’s “up to EPA”...
- It’s wrong to assume “that’s never any good 😕”

| Year | Cellulosic biofuel requirement | Biomass-based diesel requirement | Advanced biofuel requirement | Total renewable fuel requirement |
|------|-------------------------------|---------------------------------|-------------------------------|---------------------------------
| 2009 | n/a                           | 0.5                             | 0.6                           | 11.1                            |
| 2010 | 0.1                           | 0.65                            | 0.95                          | 12.95                           |
| 2011 | 0.25                          | 0.80                            | 1.35                          | 13.95                           |
| 2012 | 0.5                           | 1.0                             | 2.0                           | 15.2                            |
| 2013 | 1.0                           | a                               | 2.75                          | 16.55                           |
| 2014 | 1.75                          | a                               | 3.75                          | 18.15                           |
| 2015 | 3.0                           | a                               | 5.5                           | 20.5                            |
| 2016 | 4.25                          | a                               | 7.25                          | 22.25                           |
| 2023+ | b                              | b                               | B                             |                                   |

- **2023+**
  - b
  - b
  - B

- **b** To be determined by EPA through a future rulemaking, but no less than 1.0 billion gallons.

- **To be determined by EPA through a future rulemaking.**
Reconfiguring the Table as a Graph of Required Volumes and Percentages

Annual Volume Required, Billion Gallons of Ethanol Equivalent per Year

Year

Data presented are taken from Table I.A.1-1 of the RFS2 Rule, 2009

Requirements for Biodiesel beyond 2013 and other renewable fuels beyond 2022 will be determined by EPA rulemaking but must be greater or equal to the last numeric quantity.
What happens after 2022? Read the Rule...

“The statutorily-prescribed phase-in period ends in 2012 for biomass-based diesel and in 2022 for cellulosic biofuel, advanced biofuel, and total renewable fuel. Beyond these years, EISA requires EPA to determine the applicable volumes based on a review of the implementation of the program up to that time, and an analysis of a wide variety of factors such as the impact of the production of renewable fuels on the environment, energy security, infrastructure, costs, and other factors. For these future standards, EPA must promulgate rules establishing the applicable volumes no later than 14 months before the first year for which such applicable volumes would apply. For biomass-based diesel, this would mean that final rules would need to be issued by October 31, 2011 for application starting on January 1, 2013. In today’s rulemaking, we are not suggesting any specific volume requirements for biomass-based diesel for 2013 and beyond that would be appropriate under the statutory criteria that we must consider. Likewise, we are not suggesting any specific volume requirements for the other three renewable fuel categories for 2023 and beyond. However, the statute requires that the biomass-based diesel volume in 2013 and beyond must be no less than 1.0 billion gallons, and that advanced biofuels in 2023 and beyond must represent at a minimum the same percentage of total renewable fuel as it does in 2022.
Is there an example as to “What EPA might do” after 2022?

Past History: Biodiesel...

<table>
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<th>Fuel Type</th>
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<th>EPA-Revised 2013 Volumes(^a), million gal</th>
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<tr>
<td>Cellulosic Biofuel</td>
<td>1,000</td>
<td>6.0</td>
<td>0.010%</td>
<td>1,750</td>
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<td>Biomass-Based Diesel</td>
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\(^a\)Data from EPA-420-F-13-042, August 2013

\(^b\)Data from EPA-420-F-13-048, November 2013

RFS2 requires that the Administrator sets the standards based on these volumes each November for the following year based in part on information provided from the Energy Information Agency (EIA).
RIN Pricing and EPA’s Past Efforts
What happens if there’s not enough Renewable Fuel?

Past History: Cellulosic...

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Past History: Advanced...

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Advanced RIN Pricing (OPIS & EPA)
**EPA-Determined Volumes set Market: Multiple times and has been done retroactively**

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Data from TABLES I.A-1; I.A-3; and I.B.5-1 in 40 CFR part 80, RIN 2060-AS22 (June 2015)
What are the Current Requirements?

In 2022:
- Advanced = 21 Billion Gallons / Year
- Cellulosic = 16 Billion Gallons / Year

Data from TABLES I.A-1; I.A-3; and I.B.5-1 in 40 CFR part 80, RIN 2060-AS22 (June 2015)
What are Future RIN Prices Going to be???
What are Future RIN Prices Going to be???

Can’t see that well but should be a lot more than $0.00
St. Petersburg Class-A Digestion and Energy Upgrades
System Overview

- 316,627 served
- 35 mgd wastewater flow
- 4 WRFs
- 9.35¢/kWh for power
- 10,000 dry tpy WAS
- 6,200 dry tpy biosolids

Business Case Evaluation (BCE) evaluated over 35 options
Starting with the Conclusion

• Project Under Development
  • Consolidates solids handling at the SWWRF
  • Produces Class-AA biosolids using EPA-Batch TPAD
  • Completely powers the plant using new, natural-gas-fueled engines that supply 100% of thermophilic digester heat
  • Produces ~1,700 diesel-gallon-equivalents (DGE)/day of renewable CNG for use in the City’s sanitation trucks
Current Program Under Design:

Legend:
- Sludge
- Process Heat
- Gas Pipes
- Natural Gas
- Class-A Fertilizer
- Compressing
- Vehicle Fuel
- Electrical Power
- Biogas Treatment
- Boilers
- Engin
- Batch Tanks
- Meso Digester
- Thermo Digester
- Primary and Secondary Sludge Co-Thickening
- Dewatering
Multiple Players:

- Primary and Secondary Sludges
- GBT Co-Thickening
- Thermo Digester
- Batch Tanks
- Meso Digester
- Biogas Treatment
- Compressor
- Vehicle Fuel
- Class-A Fertilizer
- Natural Gas
- Boilers
- Electrical Power
- AECOM
- Carollo
- BV

Legend:
- Sludge
- Pipes
- Process Heat
- Gas Pipes
Multiple Players:

- Haskell CMAR/Contractor
- Carollo
- Brown and Caldwell
- AECOM

Diagram:

- Thermo Digester
- Biogas Treatment
- Engin
- Boilers
- Natural Gas
- Electrical Power
- Compressors
- Vehicle Fuel
- Multiple Players:
  - Primary and Secondary Sludge
  - GBT Co-Thickening
  - Batch Tanks
  - Meso Digester
  - Dewatering
  - Class-A Fertilizer
- Legend:
  - Sludge Pipes
  - Process Heat
  - Natural Gas Pipes

Legend:
- Sludge Pipes
- Process Heat
- Natural Gas Pipes
Overall Project Economics

<table>
<thead>
<tr>
<th>Project under Development</th>
<th>20-Year PW</th>
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</thead>
<tbody>
<tr>
<td>• Project Under Development</td>
<td></td>
</tr>
<tr>
<td>• $90M in construction that offsets prior $53M in solids CIP</td>
<td>-$37M</td>
</tr>
<tr>
<td>• Consolidates solids handling at the SWWRF; breaks even by saving labor, adding polymer, adding iron dosing</td>
<td>$0</td>
</tr>
<tr>
<td>• Produces Class-AA biosolids according to Florida Biosolids Rule (Chapter 62-640); saves ~$1.3M/yr</td>
<td>+$23M</td>
</tr>
<tr>
<td>• Completely powers the plant using new, natural-gas-fueled engines that also supply 100% of thermophilic digester heating needs; saves ~$300k/yr</td>
<td>+$5M</td>
</tr>
<tr>
<td>• Provides additional liquid-stream efficiency, peak flow capacity, and resiliency</td>
<td>$0</td>
</tr>
<tr>
<td>• Produces 1,700GDE/day of rCNG for use by the City’s sanitation truck fleet</td>
<td>?????</td>
</tr>
</tbody>
</table>

• Predicted $\sim 1,700$gpd diesel-gallon-equivalent production matches Sanitation Truck consumption

• $\sim $2.75/gallon “sale”

• Plus $0.62$/gallon for Advanced RINs
## So what is Renewable Fuel worth to St. Pete?

<table>
<thead>
<tr>
<th>Scenario</th>
<th>GDE/D</th>
<th>Est. Date</th>
<th>Fuel Price, $/DGE</th>
<th>Annual Fuel Revenue</th>
<th>RIN Class</th>
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<th>Annual RIN Revenue</th>
<th>Total Annual Revenue</th>
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<tr>
<td>Initial Plan, Full-Value</td>
<td>1,600</td>
<td>Apr-13</td>
<td>$2.75</td>
<td>$1,606,000</td>
<td>D5</td>
<td>$0.62</td>
<td>$1.06</td>
<td>100%</td>
<td>$362,080</td>
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Or ~$34M PW so overall project SAVES $25M
So what is Renewable Fuel worth to St. Pete?

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<td>Jan-17</td>
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<td>$1,109,600</td>
<td>D3</td>
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Or ~$36M PW so overall project SAVES $27M
So what is Renewable Fuel worth to St. Pete?

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Or ~$47M PW so overall project SAVES $38M
Why the RFS is Likely to Continue
Why expect the RFS to Continue?

1. The Federal Rules are set to self-perpetuate
Why expect the RFS to Continue?

1. The Federal Rules are set to self-perpetuate
2. It IS a lot of money to various interests
Why expect the RFS to Continue?

1. The Federal Rules are set to self-perpetuate
2. It IS a lot of money to various RIN Producers

<table>
<thead>
<tr>
<th>RIN Category</th>
<th>Legislated 2016 EGE Obligation, Mgal/yr(^a)</th>
<th>EPA-Revised 2016 EGE Obligation, Mgal/yr(^b)</th>
<th>Assumed Displaced Fuel Type</th>
<th>Fuel Price, $/gal(^c)</th>
<th>Fuel Price, $/EGE</th>
<th>Annual Fuel Revenue, M$/yr</th>
<th>RIN Bid Price, $/EGE(^d)</th>
<th>Annual RIN Revenue, M$/yr</th>
<th>Total Annual Revenue, M$/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>D3 - Cellulosic</td>
<td>4,250</td>
<td>206</td>
<td>CNG as GDE</td>
<td>$2.00</td>
<td>$1.18</td>
<td>$242</td>
<td>$1.86</td>
<td>$383</td>
<td>$625</td>
</tr>
<tr>
<td>D4 - Biodiesel</td>
<td>1,000</td>
<td>1,800</td>
<td>Diesel</td>
<td>$2.40</td>
<td>$1.41</td>
<td>$2,539</td>
<td>$0.95</td>
<td>$1,710</td>
<td>$4,249</td>
</tr>
<tr>
<td>D5 - Advanced</td>
<td>7,250</td>
<td>3,400</td>
<td>Ethanol</td>
<td>$1.38</td>
<td>$1.38</td>
<td>$4,692</td>
<td>$0.92</td>
<td>$3,128</td>
<td>$7,820</td>
</tr>
<tr>
<td>Total Renewable</td>
<td>22,250</td>
<td>17,400</td>
<td>Ethanol</td>
<td>$1.38</td>
<td>$1.38</td>
<td>$16,552</td>
<td>$0.87</td>
<td>$10,435</td>
<td>$26,987</td>
</tr>
<tr>
<td>D6 - Corn Ethanol</td>
<td>9,750</td>
<td>11,994</td>
<td>Ethanol</td>
<td>$1.38</td>
<td>$1.38</td>
<td>$16,552</td>
<td>$0.87</td>
<td>$10,435</td>
<td>$26,987</td>
</tr>
<tr>
<td>Total Value</td>
<td>22,250</td>
<td>17,400</td>
<td>Ethanol</td>
<td>$1.38</td>
<td>$1.38</td>
<td>$24,024</td>
<td>$0.90</td>
<td>$15,656</td>
<td>$39,680</td>
</tr>
</tbody>
</table>

Notes:
- c. US Energy Information Administration (http://www.eia.gov/petroleum/gasdiesel/) on 8-5-2016, US-wide averages are cite
Why expect the RFS to Continue?

1. The Federal Rules are set to self-perpetuate
2. It **IS** a lot of money to *various interests*

~2 B$/yr to environmental interests and ~21 B$/yr to farmers
Why expect the RFS to Continue?

1. The Federal Rules are set to self-perpetuate
2. It IS a lot of money to various interests
3. It’s NOT a lot of money to the Petroleum Industry
Why expect the RFS to Continue?

1. The Federal Rules are set to self-perpetuate
2. It IS a lot of money to various interests
3. It’s NOT a lot of money to the Petroleum Industry

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Product &quot;Moved&quot;, Bgal/yr</th>
<th>Assumed Fuel Type</th>
<th>Price, $/gal</th>
<th>Annual Revenue (negative values are costs), B$/yr</th>
<th>% of Petroleum Industry Total Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline Sold in the USA</td>
<td>140</td>
<td>Gas</td>
<td>$1.38</td>
<td>$194</td>
<td>65%</td>
</tr>
<tr>
<td>Diesel Sold in the USA</td>
<td>49</td>
<td>Diesel</td>
<td>$2.40</td>
<td>$117</td>
<td>39%</td>
</tr>
<tr>
<td>Ethanol Sold in the USA</td>
<td>12.0</td>
<td>Various</td>
<td>$1.38</td>
<td>$17</td>
<td>6%</td>
</tr>
<tr>
<td>RIN Obligations</td>
<td>22.3</td>
<td>Various</td>
<td>-$1.38</td>
<td>-$31</td>
<td>-10%</td>
</tr>
<tr>
<td>Fuel-Sold Totals (w/o RINs)</td>
<td>189</td>
<td></td>
<td>$1.64</td>
<td>$310</td>
<td>110%</td>
</tr>
<tr>
<td>Totals adjusted for RINs</td>
<td>189</td>
<td></td>
<td>$1.57</td>
<td>$296</td>
<td>100%</td>
</tr>
</tbody>
</table>

Notes:
a. 2015 annual gasoline consumption from https://www.eia.gov/tools/faqs/faq.cfm?id=23&t=10 accessed on 8-6-2015
b. From "note a" then ratioed by 22%-to-56% based on EIA graph of Fuel used for U.S. Transportation, 2013
c. From EPA-Revised 2016 EGE Obligation from Previous "RFS Producer's Stake" Table
d. US Energy Information Administration (http://www.eia.gov/petroleum/gasdiesel/ on 8-5-2016; US-wide averages for gas and diesel)
The Current Laws, are the Current Laws
The Current Laws, are the Current Laws
But are Always Subject to Change...

• Point of Obligation: Refineries vs. Terminals
Conclusions
What are Future RIN Prices Going to be???
What are Future RIN Prices Going to be???

Can’t see that well but should be a lot more than $0.00
Conclusions

- Cellulosic Classification makes digester-gas vehicle fuel even more attractive
- The Rule is designed to self perpetuate
- Finding a consistent, large-volume fuel use by fewer big vehicles makes these projects easier to justify
- Being a “Water Resource Recovery Facility” can
  Restock your $$Green$$
Thank You

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