Renewable Fuel Standard

prepared for:

AICHE Meeting

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Turner, Mason & Company

- International consulting practice since 1971
- Downstream focus; refinery/chemical engineers
- Industry and financial clients
- Publish various outlook and forecast products
  - Crude and Refined Products Outlook
  - Refinery Construction Outlook
  - World Crude Oil Outlook
  - Special Studies

Presenter

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Renewable Fuel Standard Experience

- Consultation
- Renewable Fuel Producer Registration
- RIN Generation
- Reporting
- Due Diligence
- Technical expert for attestations

Agenda

- Regulation
- How it works
  - RINs
  - Obligated Parties
- Production History
- RIN Price History
- Feedstocks
- Registered Producers
- Fraudulent Production
- Next Steps

Renewable Fuel Standard

- Regulation:
  - Under the Clean Air Act Section 211(o) as amended by the Energy Independence and Security Act of 2007 (EISA)

  Title 40: Protection of Environment

  Part 80: Regulation of Fuels and Fuel Additives

  Subpart K: Renewable Fuel Standard (RFS1applied September 1, 2007 through June 30, 2010)

  Subpart M: Renewable Fuel Standard (RFS2 applied after July 1, 2010)
- Purpose:

  RFS2 mandates the use of 36 billion gallons of renewable fuel by 2022
- Applicability:

  The provisions of Subpart M shall apply for all renewable fuel produced on or after July 1, 2010

How it Works

(Renewable Fuel Standard)

- Renewable fuel producers generate RINs (renewable identification numbers)
- RINs generated and traded through EMTS (EPA Moderated Transaction System) [computer] and documented on product transfer documents
- Obligated parties annually retire RINs per their obligation
- Renewable fuel exporters retire RINs

RIN Generation

- Renewable fuel meets definition of renewable biomass and used in transportation fuel, heating oil or jet fuel.
- Generally 1 RIN per 1 gallon of renewable fuel produced (biodiesel 1.5 RIN/gal)
- One of five D Codes generated:

D-Code	Description	Common Product
D3	Cellulosic Biofuel	Cellulosic ethanol
D4	Biomass-based Diesel	Biodiesel
D5	Advanced Biofuel	Sugarcane ethanol
D6	Renewable Fuel	Ethanol (corn)
D7	Cellulosic Diesel	Cellulosic diesel

Renewable Fuel Types

Biodiesel and Ethanol Currently Make up 99% of Renewable Fuel

Biodiesel
Biogas
Butanol
Cellulosic Diesel
Cellulosic Ethanol
Cellulosic Heating Oil
Cellulosic Jet Fuel
Cellulosic Naphtha
Cellulosic Renewable Gasoline
Cellulosic Renewable Gasoline Blendstock
Fatty Acid Ethyl Ester
LPG
Naphtha
Non-cellulosic Ethanol
Non-ester Renewable Diesel
Renewable Compressed Natural Gas
Renewable Electricity
Renewable Heating Oil
Renewable Jet Fuel
Renewable Liquefied Natural Gas

Renewable Biomass Definition

Renewable biomass means each of the following (including any incidental, de minimis contaminants that are impractical to remove and are related to customary feedstock production and transport):

1) Planted crops and crop residue harvested from existing agricultural land cleared or cultivated prior to December 19, 2007 and that was nonforested and either actively managed or fallow on December 19, 2007.
2) Planted trees and tree residue from a tree plantation located on non-federal land (including land belonging to an Indian tribe or an Indian individual that is held in trust by the U.S. or subject to a restriction against alienation imposed by the U.S.) that was cleared at any time prior to December 19, 2007 and actively managed on December 19, 2007.
3) Animal waste material and animal byproducts.
4) Slash and pre-commercial thinnings from non-federal forestland (including forestland belonging to an Indian tribe or an Indian individual, that are held in trust by the United States or subject to a restriction against alienation imposed by the United States) that is not ecologically sensitive forestland.
5) Biomass (organic matter that is available on a renewable or recurring basis) obtained from the immediate vicinity of buildings and other areas regularly occupied by people, or of public infrastructure, in an area at risk of wildfire.
6) Algae.
7) Separated yard waste or food waste, including recycled cooking and trap grease, and materials described in §80.1426(f)(5)(i).

Aggregated land use approvals: U.S. and Canada

Table I.A.1-1 Renewable Fuel Volume Requirements for RFS2 (billion gallons)

	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
2017	5.5	a	9.0	24.0
2018	7.0	a	11.0	26.0
2019	8.5	a	13.0	28.0
2020	10.5	a	15.0	30.0
2021	13.5	a	18.0	33.0
2022	16.0	a	21.0	36.0
2023+	b	b	B	b

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

- EISA established the renewable fuel volumes shown in Table I.A.1–1
- It also requires that the Administrator set the standards based on these volumes each November for the following year based in part on information provided from the EIA
- i.e. cellulosic biofuel standard be set on the volume projected to be available during the following year

2014 Renewable Fuel Standard Still Not Finalized

RFS Volume Comparison, 2013 vs. 2014 (Billion Gallons)				
	2013 RFS Volume[a]	Proposed 2014 Renewable Fuel Volumes[a]		
Category	2013 RFS	Original	Proposed	Range
Cellulosic Biofuel	0.006	1.75	0.017	0.008-0.030
Biomass Based Diesel	1.28	b	1.28	1.28
Advanced Biofuel	2.75	3.75	2.2	2.0-2.51
Renewable Fuel	16.55	18.15	15.21	15.00-15.52

[a] All volumes are ethanol-equivalent, except for biomass-based diesel which is actual

[b] To be determined by EPA through a future rulemaking, but no less than 1.0 billion

- 2014 gasoline demand TM&C projection: 134 billion gallons
- If you assume none of advanced biofuel is ethanol,
  - 14.4 billion gallons of ethanol blended into gasoline
  - 10.75% ethanol in gasoline pool
  - Extra 0.75%
    - 1.2 billion gallons (78,300 BPD) of E85
    - 6.7 billion gallons (435,000 BPD) of E15
    - 2013 E85 sales of 200 million gallons (13,000 BPD)
    - 2014 E15 sales, EPA projected to be 0.

Obligated Parties

- RINs retired annually for produced (or imported) gasoline or diesel (heating oil and jet not included)

  RVO (Renewable Volume Obligation)

  => total gallons gasoline and diesel produced in year

RVO Name	G&D Production, gallons	2013 RFS	RVO (gallons)
Cellulosic Biofuel	1,000,000	0.0005%	5
Biomass-Based Diesel	1,000,000	1.13%	11,300
Advanced Biofuel	1,000,000	1.62%	16,200
Renewable Fuel	1,000,000	9.74%	97,400

Lifecycle GHG Reduction Requirements

Lifecycle GHG Reduction Must be Less than the Lifecycle GHG Emissions of the 2005 Baseline Average Gasoline or Diesel Fuel That it Replaces

Table I.A.3-1-Lifecycle GHG Thresholds Specified in EISA
[Percent Reduction from Baseline]

Renewable Fuel	20	does not meet threshold
Advanced Biofuel	50	meets threshold
Biomass-based Diesel	50	meets threshold
Cellulosic Biofuel	60	meets threshold

- Grandfathering

  Certain facilities are “grandfathered” and are not required to meet the 20% GHG threshold
  - All facilities (domestic and foreign) that commenced construction before December 19, 2007
  - Ethanol facilities that commenced construction prior to December 31, 2009 and use natural gas and/or biomass for process heat
- Advanced technologies listed in Table 2 to § 80.1426
- Efficient-producer status
  - Expedited process announced March 2014
  - Late September 2014 9 ethanol plants granted

Table 1&2 to §80.1426

Table 1			
Fuel Type	Feedstock	Production process requirements	D-Code
Ethanol	Corn Starch	All of the following: Dry mill process, using natural gas, biomass, or biogas for process energy and at least two advanced technologies from Table 2 to this section	6
Ethanol	Corn Starch	All of the following: Dry mill process, using natural gas, biomass, or biogas for process energy and at least one of the advanced technologies from Table 2 to this section plus drying no more than 65% of the distillers grains with solubles it markets annually	6

Table 2- Advanced Technologies
Corn oil fractionation that is applied to at least 90% of the corn used to produce ethanol on a calendar year basis.
Corn oil extraction that is applied to the whole stillage and/or derivatives of whole stillage and results in recovery of corn oil at an annual average rate equal to or greater than 1.33 pounds oil per bushel of corn processed into ethanol.
Membrane separation in which at least 90% of ethanol dehydration is carried out using a hydrophilic membrane on a calendar year basis.
Raw starch hydrolysis that is used for at least 90% of starch hydrolysis used to produce ethanol instead of hydrolysis using a traditional high heat cooking process, calculated on a calendar year basis.
Combined heat and power such that, on a calendar year basis, at least 90% of the thermal energy associated with ethanol production (including thermal energy produced at the facility and that which is derived from an off-site waste heat supplier), exclusive of any thermal energy used for the drying of distillers grains and solubles, is used to produce electricity prior to being used to meet the process heat requirements of the facility.

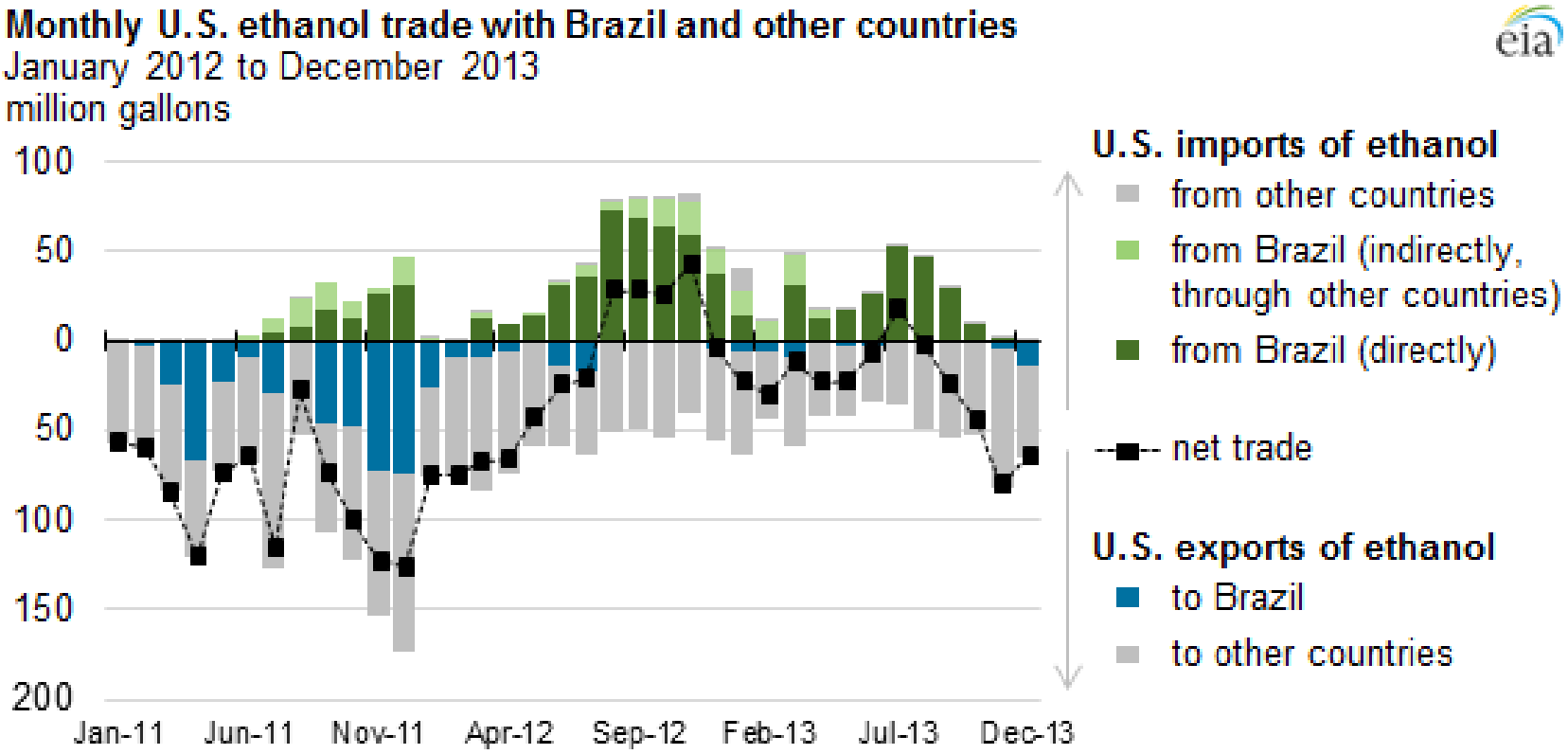
Fuel Demand

Gasoline, Diesel, Ethanol & Biodiesel

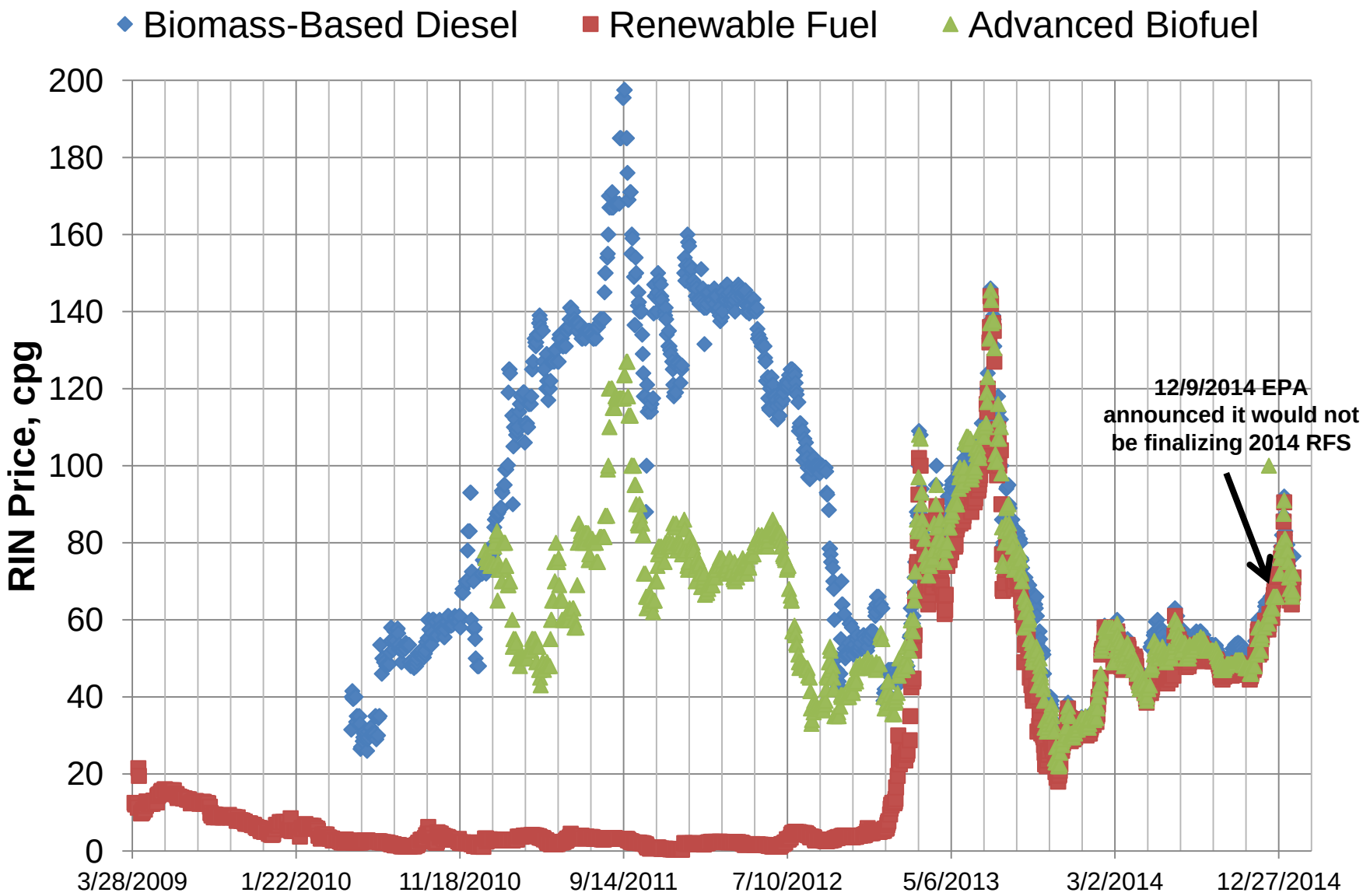
Thousands of Barrels per Day	2010	2011	2012	2013	2014(3)
Motor Gasolines	8,993	8,753	8,682	8,774	8,769
Other Gasolines[2]	271	269	250	282	277
Total Gasolines	9,264	9,022	8,932	9,056	9,046
Ethanol	877	900	886	858	915
Distillate Fuels	3,800	3,899	3,741	3,835	3,906
Jet Fuel/Kerosene	1,452	1,437	1,403	1,425	1,446
Other Middle Distillates	211	183	135	106	108
Total Middle Distillates	5,463	5,519	5,279	5,366	5,460
Biodiesel	29	71	69	102	96

(1) Historical data from US DOE/EIA.
(2) Naphtha feedstock and aviation gasoline.
(3) 2014 Gasoline and Diesel is forecasted
(4) Ethanol and Biodiesel volumes per EPA EMTS data (RINs generated on) 1st 10 mo 2014
(5) Besides biodiesel and ethanol RINs also generated from biogas, heating oil, naphtha, non-ester renewable diesel, cellulosic diesel, cellulosic renewable gasoline blendstock, butanol, renewable compressed natural gas, and renewable liquified natural gas but only 5% of total RINs

Ethanol Imports & Exports



Current Year RIN Price



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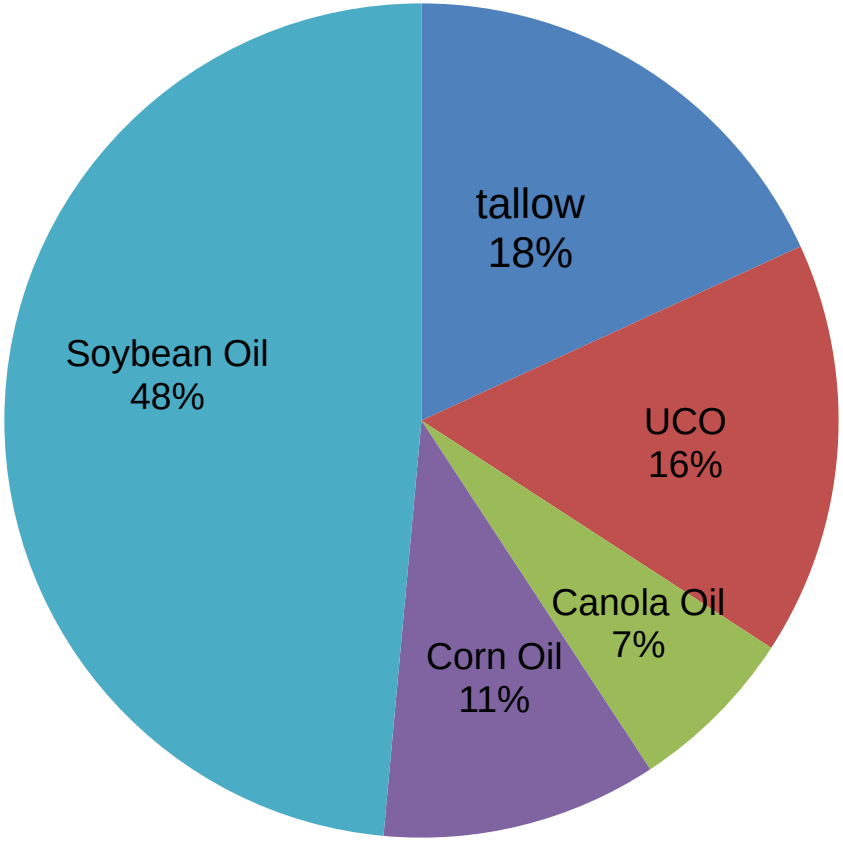
US Biodiesel Feedstocks

Jan-May 2014



Source: EIA

Cellulosic Feedstocks

Specific Cellulosic Ethanol Feedstocks	EMTS Cellulosic Ethanol Feedstock Categories
Corn Stover	Agricultural Residues
Cotton Gin Trash	Agricultural Residues
Sweet Sorghum Pulp	Agricultural Residues
Sugarcane Bagasse	Agricultural Residues
Wheat Straw	Agricultural Residues
Rice Straw	Agricultural Residues
Barley Straw	Agricultural Residues
Oat Straw	Agricultural Residues
Citrus Residue	Agricultural Residues
Sugarcane Straw	Agricultural Residues
Corn Stalks	Agricultural Residues
Oat Hulls	Agricultural Residues
Energy Sorghum	Agricultural Residues
Grass Species	Switchgrass
Switchgrass	Switchgrass
Miscanthus	Miscanthus
Municipal Solid Waste (MSW)	Municipal Solid Waste (MSW)
Poplar	Forest Residues
Willow	Forest Residues
Mixed Paper	Forest Residues
Wood Chips	Forest Residues
Sawdust	Forest Residues
Forest Thinnings	Forest Thinnings
Arundo Donax	Arundo Donax
Energy Cane	Energy Cane
Pennisetum purpureum	Pennisetum purpureum

<u>Cellulosic Ethanol Facts</u>

- 2013 13 MGPD plant in Italy (largest plant in world)
- 2015 50 MGPD plant in China (will be largest plant in world)
- US Production
  - 2014 52 MGPD (0.1% of RINs) with 36 registered producers
  - 2013 1 MGPD
  - Original rulemaking had 2014 @ 4,795 MGPD (@ 1% of that)

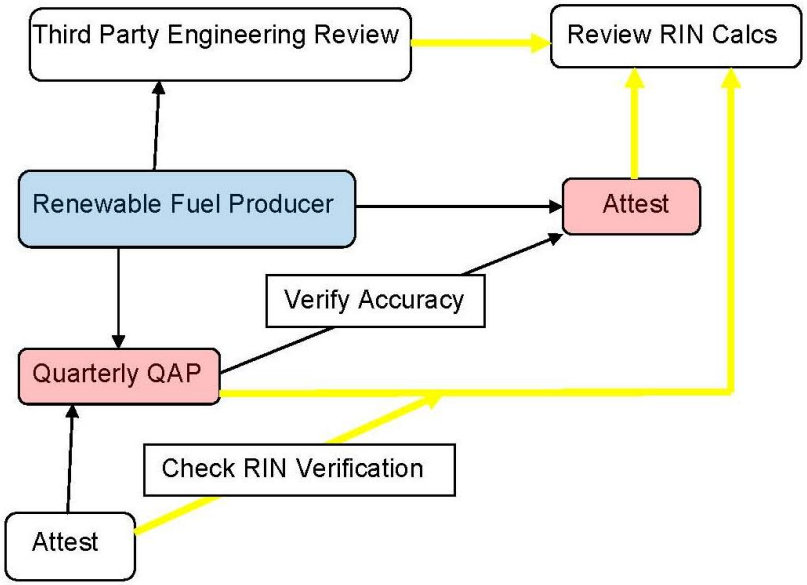
Number of EPA Registered Renewable Fuel Producers

D Code	Description	US	Canada	Other Foreign	Total
D3	Cellulosic	36	0	0	**36**
D4	Biomass-Based Diesel	181	10	61	**252**
D5	Advanced Biofuel	46	0	213	**259**
D6	Renewable Fuel	196	6	6	**208**
D7	Cellulosic Diesel	3	0	0	**3**
Total		**462**	**16**	**280**	**758**

Fraudulent Renewable Fuel

- Regulations forcing non-economical production of renewable fuel sets basis
- First fraudulent biodiesel producers never produced biodiesel
- With ~ 800 producers, due diligence difficult
- Obligated parties did varying levels of due diligence
  - Hired consultants
  - Bought from known producers
- EPA implementing QAP

RFS2 Assurances of RIN Validity



QAP Auditor cannot generate RINs for Renewable Fuel Producer but can submit compliance reports as an agent

Cannot be same company

Third Party Engineer must be professional engineer

Attestor must be certified public accountant

QAP auditor must have both qualifications of a professional engineer and a certified public accountant

Renewable Fuel and LCFS

- All biodiesel generates the same amount of credits (RINs) in the EPA program (1 gal = 1.5 RIN)
- Biodiesel generates different credits (carbon intensities- CI) in the California program
- If the biodiesel is used in California, then both RINs and CI's can be generated

Renewable Fuel and LCFS

FUEL PATHWAY CODE	CARBON INTENSITY (CI) VALUE (gCO2e/MJ)	FUEL PATHWAY DESCRIPTION	PHYSICAL PATHWAY CODE	PHYSICAL PATHWAY DESCRIPTION
ULSD001	**98.03**	**ULSD - based on the average crude oil supplied to California refineries and average California refinery efficiencies**		
BIOD001	83.25	Biodiesel-Conversion of Midwest **soybeans** to biodiesel (fatty acid methyl esters - FAME)	PHY01	Fuel produced in CA
BIOD006	62.99	Biodiesel - Pathways for conversion of North American **Canola** to biodiesel (fatty acid methyl esters -FAME)	PHY01	Fuel produced in CA
BIOD008	40.18	Biodiesel - Conversion of **mixed-animal-fat-**to-Biodiesel produced in the United States; high energy rendering.	PHY01	Fuel produced in CA
BIOD021	29.27	Biodiesel produced from **corn oil** extracted at Dry Mill ethanol plants in corn-oil-producing states; Wet or Dry DGS; Biodiesel produced in either the corn-oil-producing states or in the Western U.S.; NG	PHY01	Fuel produced in CA
BIOD004	18.72	Biodiesel - Conversion of waste oils (**Used Cooking Oil**) to biodiesel (fatty acid methyl esters - FAME) where "cooking" is required. Fuel produced in the Midwest	PHY08	By truck from U.S. to CA
BIOD002	15.84	Biodiesel - Conversion of waste oils (**Used Cooking Oil**) to biodiesel (fatty acid methyl esters -FAME) where “cooking” is required	PHY01	Fuel produced in CA
BIOD011	15.01	Biodiesel - South Korean **UCO** biodiesel; Cooking not required	PHY09	By ocean tanker to California
BIOD005	13.83	Biodiesel - Conversion of waste oils (**Used Cooking Oil**) to biodiesel (fatty acid methyl esters-FAME) where "cooking" is not required. Fuel produced in the Midwest	PHY08	By truck from U.S. to CA
BIOD003	11.76	Biodiesel - Conversion of waste oils (**Used Cooking Oil**) to biodiesel (fatty acid methyl esters -FAME) where “cooking” is not required	PHY01	Fuel produced in CA
BIOD007_1	4.00	Biodiesel - Conversion of **corn oil**, extracted from distillers grains prior to the drying process, to biodiesel	PHY01	Fuel produced in CA

Next Steps

- Standards for 2014 and 2015 need to be set
- Get around blendwall
  - Increased E15/E85
  - Increased biodiesel
- Increase cellulosic ethanol production (won't effect blendwall because of nesting)

Questions

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