



A New Approach to Generate RINs with Biogas

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Summary

- **logen has a new large-scale opportunity for biogas in transportation fuels**
 - “RHC fuels” – renewable hydrogen content in fuels
 - 5-6 billion RIN/year potential using existing refining assets
 - Only capital cost required is pipeline quality biogas production
 - Meets criteria for RIN and LCFS credit generation
- **Attractive option for meeting RFS goals**
 - Creates capacity to use large volumes of biogas from conventional sources (landfills, wastewater treatment, anaerobic digesters) in existing refining assets
 - Makes “drop-in” fuel meeting current gasoline and diesel specifications
 - All key technology elements are proven: biogas production, hydrogen production, and hydrogenation of refinery streams
 - Works in combination with cellulosic ethanol production, driving further expansion
 - Does not obsolete refining assets
- **Expected premiums to natural gas of \$12-17/MMBtu**
 - This is attractive enough to drive industry expansion toward large volumes of cellulosic biofuel

Who is Iogen?

Making Cellulosic Ethanol Since 2004



- Over 30 years development, with \$500 million invested
- 9 years of scale-up experience in our integrated demo plant
- About 300 patents issued or pending
- Strong focus on technology validation and solid commercial implementation
- History with blue chip partners



We're implementing CE at commercial scale in Brazil



Brazil's largest cane processor, Iogen partner

- 24 sugar/ethanol mills,
- ~ 65 m tonnes/yr. crushing
- ~ US\$ 30 billion sales
- ~ 40,000 employees

Brazilian Sugar Mills



Raízen Costa Pinto Mill, Piracicaba, Brazil



The Costa Pinto 2G Ethanol Project – Start-up Q4 2014



- US ~\$100 million
- 40 m litres/yr. 2G ethanol
- Bagasse as feedstock
- Residue to boiler
- Once operational, Raizen plans for 7 more plants

Cellulosic biofuels can also be generated with landfill gas, “LFG”

EPA Proposed Rule: LFG = cellulosic

- EPA currently recognizes landfill and other biogas use in transportation for generation of advanced biofuel (D5) RINs
- EPA has proposed that landfill biogas converted into certain transportation fuels earn cellulosic biofuel (D3) RINs
- Expecting final rule in 2014

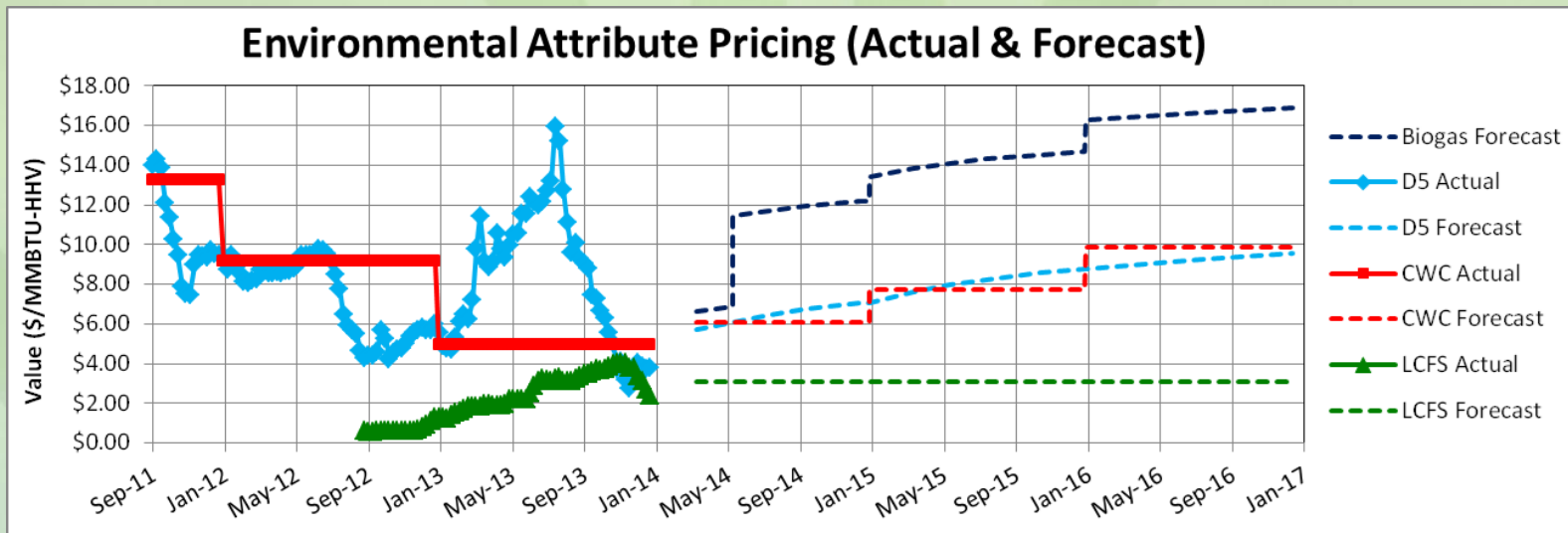
Significant Positive Price Impact

- Cellulosic biofuel status will likely add \$5-9/MMBtu above existing premiums
- This should accelerate development of LFG as a biofuel

LFG premium values \$12 – 17/MMBtu over NG

Biogas Premiums Expected to Rise

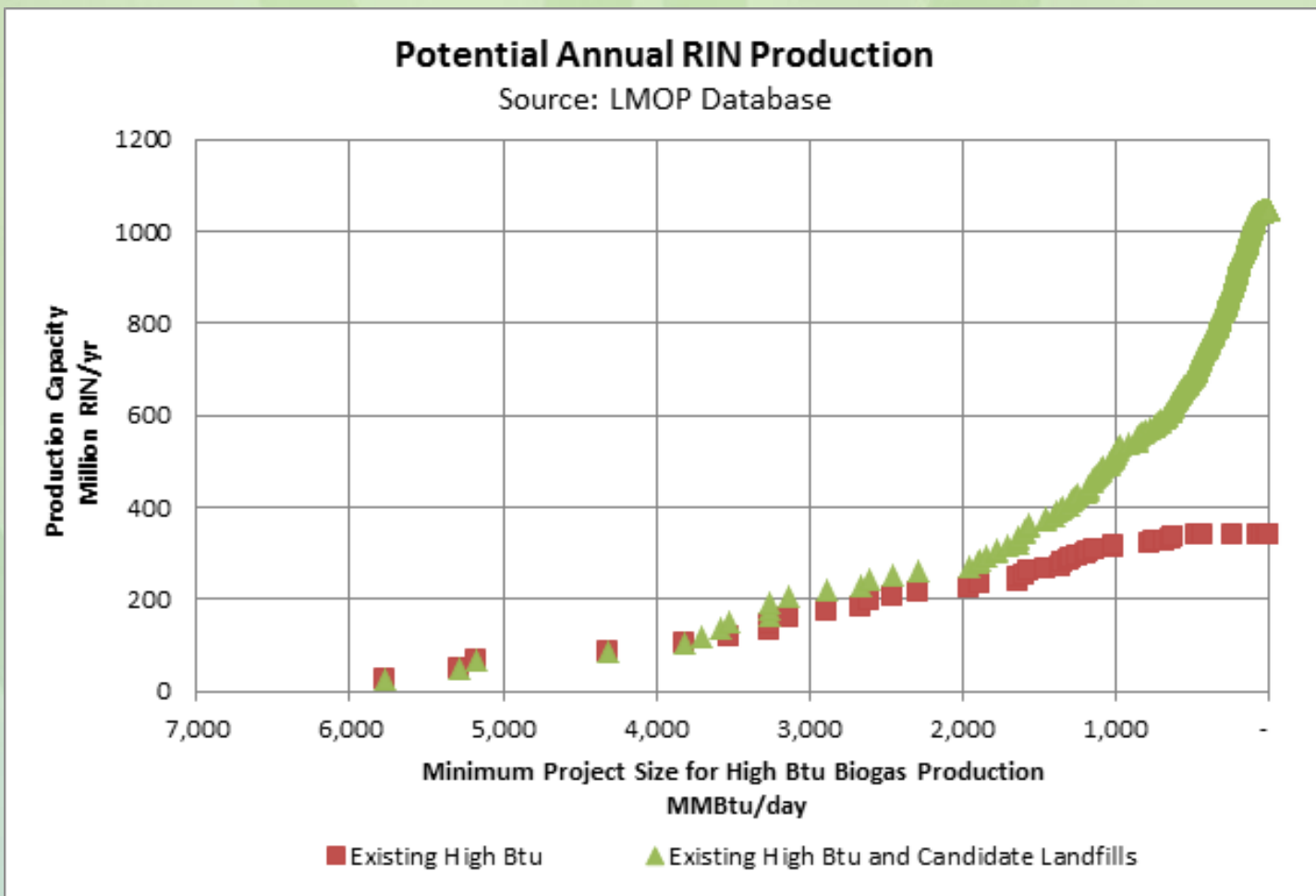
Primarily driven by cellulosic designation and lower oil price



Basis:

- Landfill gas achieves cellulosic status in Q2 2014
- Cellulosic waiver credit (CWC) price forecast based upon oil price futures and legislated formula
- D5 RINs estimated by Iogen using forward markets for commodities and lowest cost economics for advanced biofuels
- LCFS credit price forecasted as flat at \$65/MT
- No reinstatement of biodiesel tax credit
- Biogas forecast market price estimated as D5 + CWC + LCFS, minus 25% of premium value as distribution cost.

LFG could Produce more than 600 MG of Cellulosic Biofuel





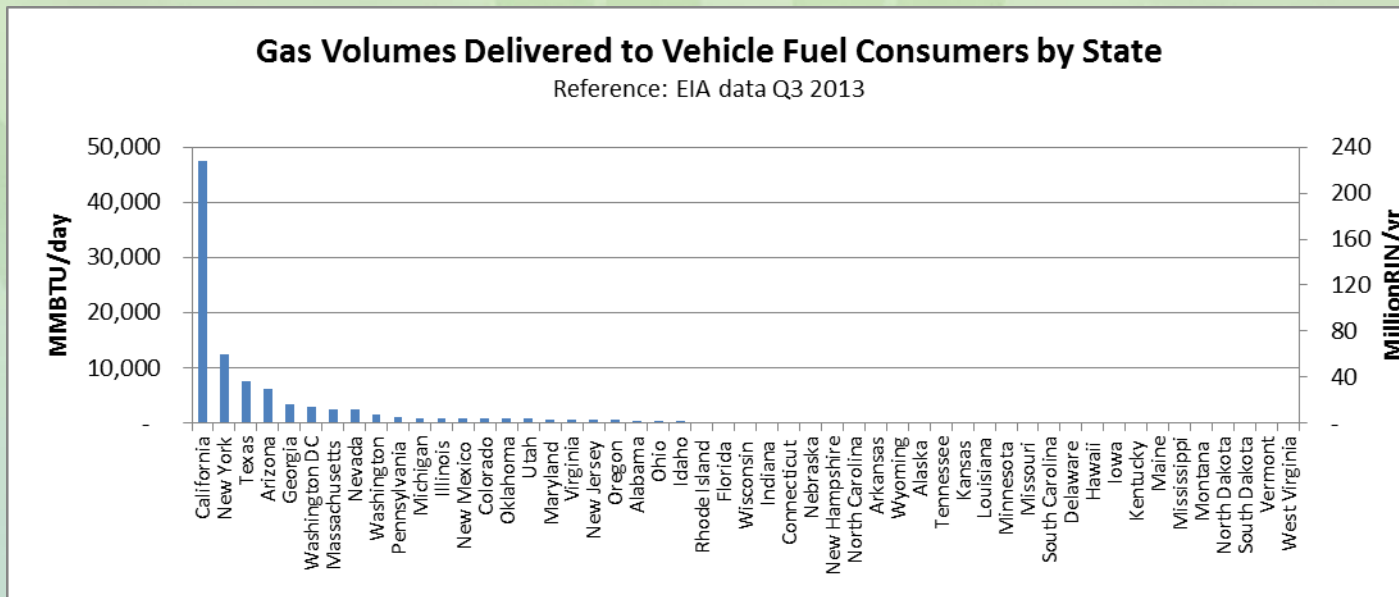
CNG/LNG is the Dominant Transportation Opportunity

EPA proposed cellulosic biofuels from LFG:

Fuel Type	Production Process Requirements	Current Capacity (MM RIN/yr)
Renewable CNG or LNG	Any	425 MM RIN/yr, serving natural gas vehicles
Renewable Electricity	Any	Small. Use in electric vehicles, potentially growing
Cellulosic Naphtha	Fischer-Tropsch process, facilities must produce at least 20% of their electricity use at the facility	Zero. No production capacity, fuel would be sold in gasoline

CNG/LNG channels are available, within limits

- Existing CNG/LNG channels are limited to certain regions, with only a limited number of states with readily accessible volumes
- Distribution has EPA compliance burdens: discontinuous use, many dispensing units, variable locations, administrative complexity
- Volumes used can be subject to market conditions (NG / diesel spread)



New Biogas Sources will Stress CNG/LNG Capacity

- **Biogas from cellulosic ethanol plants could be 2,000 to 10,000 MMBtu per day per plant.**
- **Extensive interest in anaerobic digestion of a range of waste materials**
 - Municipal wastewater treatment
 - Food and yard waste
 - Farm waste



New Biogas Opportunity:

Renewable Hydrogen Content in Fuels

Simple Description:

Renewable Biogas



Renewable Hydrogen



Renewable Hydrogen Content in Gasoline or Diesel

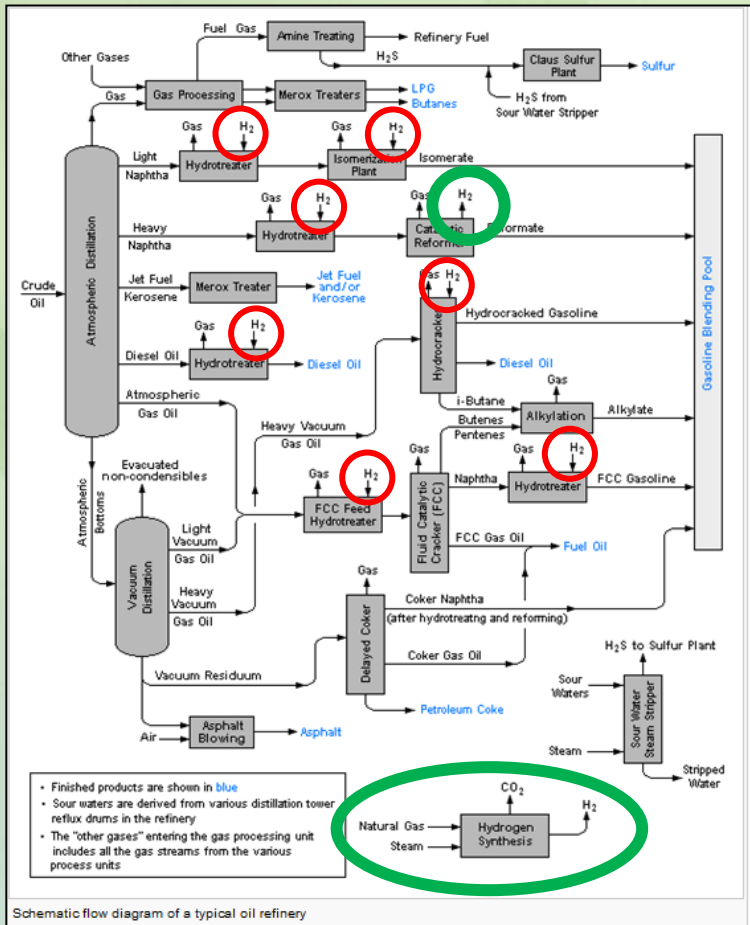


RINs and LCFS credits

Implementation in Conventional Oil Refineries

Key Features

- “Renewable Hydrogen” is made by using biogas to displace natural gas that is already used to make hydrogen in steam methane reformers.
- “Renewable Hydrogen Content” (RHC) is made by deploying the renewable hydrogen in refinery units where hydrogen is already incorporated into the fossil fuel backbone and the final product is transportation fuel.
- The process uses existing refinery equipment and involves no process or capital changes
- Potential for RHC fuels is on the order of 5-6 billion RINs/yr., about 10X the current capacity for CNG/LNG

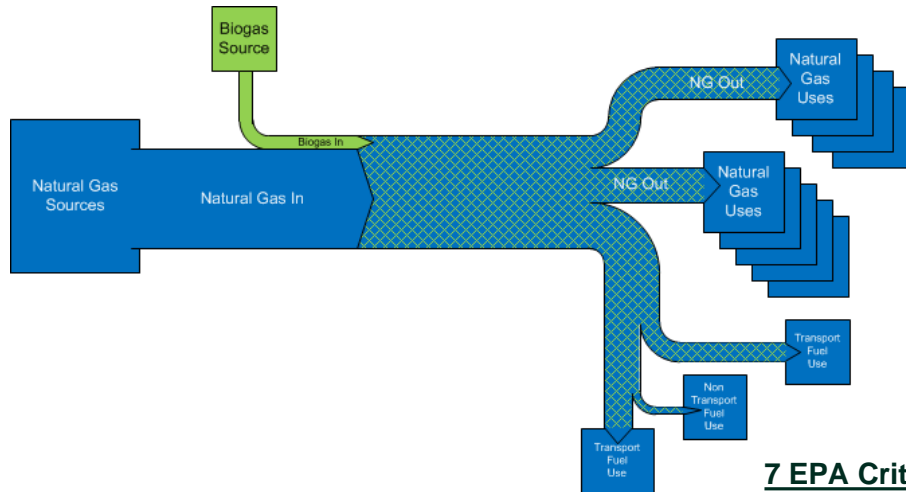


How do Transfers in Mixed Systems Work?

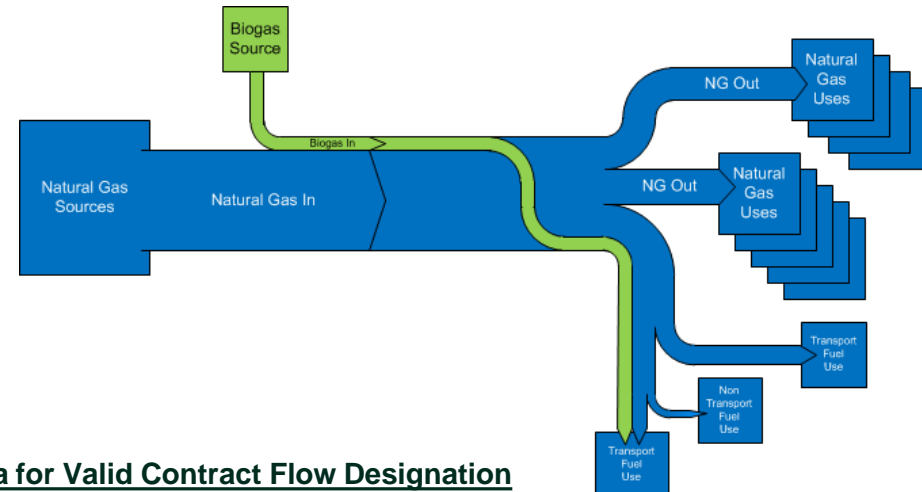
EPA Practice:

Contract Flow Defines Environmental Attribute Flow (not Molecule Flow)

Molecule Flow



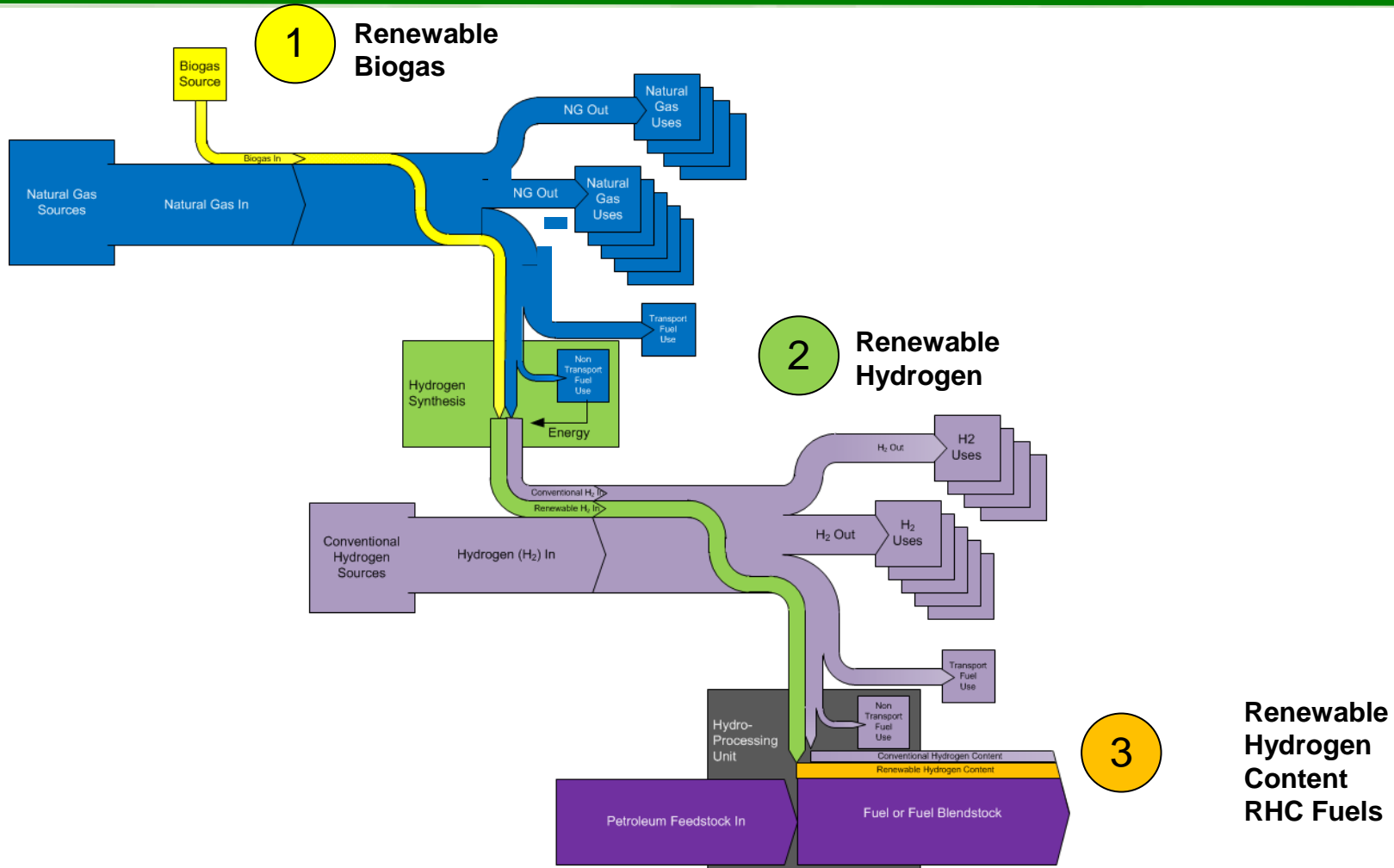
Contract Flow



7 EPA Criteria for Valid Contract Flow Designation

1. Contract in place linking source to transportation use
2. Physical connection
3. Continuous metering in/out
4. Balance of flows in/out
5. Environmental attributes used nowhere else
6. Timing match
7. Confirmed actual transportation use

Contract Transfers for Renewable Hydrogen Content - RHC Fuels





Advantages for Biogas Producers to Supply RHC Fuel Production

- **Expands the market potential of biogas in transportation**
 - 10X the capacity of CNG/LNG
- **Eliminates the need for capital investment beyond making pipeline quality biogas**
 - No special vehicles
 - No additional fuel processing capacity required
 - No new fuel stations – end fuel used in today’s cars and trucks
- **Targets many large customers (refiners) who have gas volume certainty and RFS volume obligations**
 - Single refiners can take entire capacity of biogas facilities
 - Much fewer logistical issues in managing distribution and RFS compliance
 - Likely greater ability to contract for longer periods
 - Attractive compliance strategy for refiners, utilizing their assets

Advantages of RHC Fuels in Meeting RFS Targets

- **New “drop-in” cellulosic biofuel with no distribution issues**
 - Meets identical specifications as current fossil fuels but with cellulosic content and lower GHG emissions
 - Lowers capital cost of implementation by leveraging existing assets
- **Much lower technology risk and hurdles in execution**
 - Biogas production, hydrogen production, and hydrogenation in refining operations are already well-proven technologies
- **Potential for 5-6 billion gallons of cellulosic biofuel**
 - Large potential supply from landfills and anaerobic digestion facilities
 - Expected to increase total fuel output from cellulosic ethanol facilities
- **Refiners’ assets are not made obsolete by RHC cellulosic biofuel production**



Commercial and Regulatory Status

- **Patents**

- Iogen has patented the use of renewable hydrogen in refineries to make renewable content and fuel credits
- Iogen has filed a total of 4 US patent applications relating to this technology

- **Regulatory Approval**

- Iogen is engaged with both EPA and CARB about regulatory approval

- **Commercial Development**

- Iogen is already working with selected LFG producers and California refineries
- We are interested in establishing relationships with more LFG producers

logen's Plans



- **In the short term, logen will commercialize RHC fuels, working with:**
 - Regulators
 - Biogas producers
 - California Refiners
- **logen is also developing cellulosic ethanol projects which will also make biogas for RHC fuels**
 - Straw and stover as feedstock
 - Increased yield of cellulosic biofuel
 - Large scale operation

Thank You

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