Anaerobic Digester
Technology Implementation
Our Performance – By the Numbers

- Audits of Over 160 Biofuel Plants in 20 Countries
- Over 2.6 Billion Gallons of Biofuel Capacity Under Management
- Over 74 Producers have enrolled in the RIN Compliance Program
- Assisted Registration & Preparation for more than 90 LCFS Pathway Projects
- Transacted over 3.1 Billion RINs in 2017
- 8.6 Million RINs Processed each day on our automated platform

Why EcoEngineers?

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EcoEngineers has pioneered the following services to support the build out of a biogas industry:

- Biomass Asset Mapping
- Waste Shed Surveys
- Financial Analysis and ROI
- Final Substrate List
- Feedstock Agreements
- Pipeline Injection Agreements
- Technology Selection
- Aggregate Off-Take Options
- RIN Academy
- RFS and LCFS Compliance
What To Do With Food Waste

- According to EPA, 21.6% of landfilled material was food waste
- Only 5.1% of food waste generated was composted
- Opportunity to achieve waste diversion goals by targeting food waste for "beneficial reuse" – ANAEROBIC DIGESTION.

Source: Advancing Sustainable Materials Management: 2014 Fact Sheet, November 2016, USEPA.
What is Anaerobic Digestion?

- Biological processes in which microorganisms break down biodegradable material in the absence of oxygen.

- Different sources: manure, municipal wastewater treatment, industrial wastewater treatment, municipal solid waste.

- Different type of digester technology depending on waste.

- American Biogas Council.org
Digestion 101

Anaerobic Digester

- Slurry & Manure
- Food & Amenity Waste
- Crops & Residues

Digesterate

Biogas

- Power
- Gas Grid
- Transport Fuel

RNG

Heat
Benefits of AD System Services

**Divert Waste from Landfill:**
- Decrease Rate of Landfill Growth
- Extend Airspace Limitations

**Improve Air Quality:**
- Reduce Odor
- Reduce Methane Emissions
- “Good Neighbor” Relationship

**Biodegrades Easily:**
- Small amount of residue remains

**Increase and Diversify Revenue:**
- Tipping Fees, RNG Sales, Nutrient Sales

**Produce Natural Gas Fuel:**
- Electricity or Pipeline Quality Natural Gas
Biogas Beneficial Uses

Boilers
Power Generation
CNG Vehicle Fueling
Pipeline Injection

Raw to Moderately Upgraded
Pipeline quality

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One MMBTU of Pipeline Quality Biogas Produced in the Midwest and Used for Transportation in California – Assumes Cellulosic Feedstock and D3 RINs

<table>
<thead>
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<th></th>
<th>Value</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Value of Gas</td>
<td>$3.00</td>
<td>8%</td>
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<tr>
<td>Value of Federal Credits (RINs)</td>
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<tr>
<td>Value of California Credits (LCFS)</td>
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<tr>
<td>Total</td>
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Carbon Credits Add Significant Value to RNG

![RFS Graph](image)
Lifecycle of an AD/RNG Project

1. Waste Shed Analysis
2. Cash Flow Projections – RFS / LCFS Spotlight
3. Feedstock procurement & D3 vs. D5 co-digestion
4. Injection into a commercial distribution pipeline
5. Contracts
6. EPA/CARB approval
7. Ongoing Compliance Requirements
1. Waste Shed Analysis – What materials are available in a given study area?

- Small Area to Large Region
- Identify potential feedstock sources for AD.
- Besides Industrial Food Waste: 
  - Universities
  - Hospitals
  - Prisons
- Use ArcGIS software to determine hotspots for potential development.
Wasteshed Analysis

Key Insight:
How can existing AD systems be leveraged to consolidate leadership positions in key sectors?
Cash Flow Projections - Type of Feedstock Matter!

Renewable Fuel Standard (RFS)

- Cellulosic based feedstocks can generate D3 RINs (municipal WWTP biosolids, landfill gas, manure, agricultural residues, and other feedstocks) with an adjusted cellulose content of 75% or greater.
- All others – which includes food waste, FOG, and most industrial high strength wastes – can generate D5 RINs.
- Why does this matter? Current values: D5 RIN = $0.50 vs D3 RIN = $2.40

California LCFS

- No D-code “buckets”. All facilities have individual carbon intensity (CI) score. Dairy manure typically scores the best, followed by other manures, municipal WWTP, food waste digesters, and landfills.
Physical Separation is a Solution

From this:

WWTP Biosolids → Food Waste → Anaerobic Digester → Dedicated NG Distribution → Commercial NG Pipeline Distribution → CNG/LNG Vehicles

To this:

WWTP Biosolids → Food Waste → Anaerobic Digester → Dedicated NG Distribution → Commercial NG Pipeline Distribution → CNG/LNG Vehicles → Local CNG/LNG Vehicles
Establish Pipeline Interconnection

- Begin discussions during feasibility study phase
- Engage pipeline utilities to ask connection fee and O&M schedule
- LDCs typically lower pressure and lower connection cost but may not take gas
- Interstate pipeline companies required to receive the gas onto the system
- Carefully review proposed interconnection agreement
Feedstock and Gas Sales Contract Terms

**Feedstock contracts**
- Long term contracts possible

**Offtake contracts**
- Longer term possible – but is that in the best interests of the project? Investors want certainty in an uncertain market

**RIN sales contracts**
- Longer term possible but with exit clauses
- Investors want certainty in an uncertain market
EPA & CARB Approval Process

- EPA registration after substantial completion
- LCFS application after 3 months of operational data
- Approach each agency in advance with non-traditional questions
  - Unique pipeline interconnection
  - Unique process/equipment
  - Project with no EPA precedent
Quality Assurance Program (RFS)

- Producers who elect to participate in a QAP program can generate a verified “Q-RIN”
- Optional program but considered required for sale of D3 and D5 RINs
- EcoEngineers can provide this service, including:
  - Quarterly EMTS Reporting Assistance
  - Corrective Action Assistance
  - General Consulting
  - RIN Management

Third Party Engineering Reviews (RFS)

- Required to be submitted to EPA every three years
- Must be conducted by a licensed, professional, third-party engineer

QAP for LCFS Participation – will be required in 2020
Potential Project Pitfalls

Pipeline connection:
- Too great a distance or too great a cost
- LDCs – not required to take the gas and may refuse to accept it
- Unusual quality requirements

EPA acceptance:
- D3/D5 co-processing
- Bio-intermediates

Feedstock Mix:
- Feedstock mix will depend on the digester technology available/used
- Digesters like consistency
- Digesters are not garbage cans

Overall complexity:
- AD/Biogas projects have a lot of moving parts covering a wide range of areas of expertise
  - Anaerobic digestion, civil/site planning, biogas upgrading, pipeline construction, interconnect with natural gas pipeline, regulatory work – local DNR, EPA, CARB
Portland, Oregon:
- Teaming up with Waste Management to collect separated food waste. A third-party company will process the collected food waste into a slurry and deliver it into the City of Portland’s digesters.
- Utilizing existing infrastructure keeps costs down – new ADs can be very expensive

Des Moines WRA:
- The WRA is unique in that it accepts almost any hauled waste into its digesters. They are working to upgrade the biogas they produce to RNG and inject into MidAmerican’s pipeline.
- D3/D4 co-processing has been a hurdle to overcome given that they accept a lot of different, non-cellulosic wastes. They will be physically segregating into D3 and D5 digesters.

Alton, Illinois:
- Regional AD project located just outside of St. Louis
- Considerable research has gone into establishing consistent sources of feedstock and determining how big the digester should be
- In the preliminary design phase
Creating sustainable solutions for a better tomorrow
Thank You! Questions?

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