SUBSTANTIAL WASTE POTENTIAL: ENERGY AND CLIMATE
150 million tons of waste to landfills annually and nearly half is organic
Food waste is a big contributor to the material entering landfills and it doesn’t need to be
Transportation Sector Biogas Trends
Untapped Biomethane Potential

Potential

- Municipal Solid Waste (MSW): 10,541,327 tonnes/year
- Municipal Wastewater: 4,108,802 tonnes/year
- Untapped Potential: 1,865,674 tonnes/year
Untapped Biomethane Potential

10,541,327 tonnes/year

Potential

4,108,802 tonnes/year

Recoverable

Municipal Solid Waste (MSW)  Municipal Wastewater
Untapped Biomethane Potential

10,541,327 tonnes/year

Recoverable

4,108,802 tonnes/year

Recovered

1,865,674 tonnes/year

Potential

Municipal Solid Waste (MSW)

Municipal Wastewater
Solid wastes and wastewater are geographically distributed resources
Co-digestion of waste and wastewater can mitigate the landfill emissions and optimize biofuel generation while leveraging existing infrastructure.
The wide variety of biogas uses
The prospect of using biogas electricity for transportation leads to zero emissions driving and lots of environmental credits.
Food waste must be diverted from landfills: for fuels - yes, but more for the climate

- **Potential Climate Mitigation**
  - Organics Diversion (methane mitigation)
  - Petroleum Displacement (energy potential)

Food waste must be diverted from landfills: for fuels - yes, but more for the climate

- Clean Air Act Authority
  - Direct regulation
  - Renewable Fuel Standard
  - Producer limitations
  - Incentives for state mitigation under the Clean Power Plan
Food waste must be diverted from landfills: for fuels - yes, but more for the climate

- Clean Air Act Authority
  - Direct regulation
  - Renewable Fuel Standard
    - producer limitations
  - Incentives for state mitigation under the Clean Power Plan
BIOGAS PATHWAYS UNDER THE RENEWABLE FUEL STANDARD
EISA – The maker of the RIN
<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Fuel</th>
<th>GHG Reduction Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulosic Biofuels</td>
<td>Cellulosic ethanol cellulosic naphtha, etc.</td>
<td>60%</td>
</tr>
<tr>
<td>Biomass-based Diesel</td>
<td>Biodiesel, renewable diesel, etc.</td>
<td>50%</td>
</tr>
<tr>
<td>Advanced Biofuels</td>
<td>Sugarcane ethanol, biogas, renewable heating oil</td>
<td>50%</td>
</tr>
<tr>
<td>Renewable Fuel</td>
<td>Corn ethanol</td>
<td>20%</td>
</tr>
<tr>
<td>Cellulosic Diesel</td>
<td>Fischer-Tropsch diesel from cellulosic material</td>
<td>60%</td>
</tr>
</tbody>
</table>
Biofuel Pathways Under the RFS

Feedstock
- Corn, soybean oil, biomass waste, etc.

Process
- fermentation, transesterification, pyrolysis, etc.

Fuel
- Ethanol, biodiesel, naptha, etc.
The biogas pathway

Feedstock

Biogas from...

Process

Any

Fuel

CNG, LNG and Electricity

CNG

LNG

Electricity
Cellulosics: The non-food fuels

Cumulative Cellulosic Biofuel Produced

Millions of Ethanol Equivalent Gallons

- May-10
- Aug-10
- Nov-10
- Feb-11
- May-11
- Aug-11
- Nov-11
- Feb-12
- May-12
- Aug-12
- Nov-12
- Feb-13
- May-13
- Aug-13
- Nov-13
- Feb-14
- May-14
- Aug-14
- Nov-14
- Feb-15
Cellulosics: The non-food fuels

Cumulative Cellulosic Biofuel Produced

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Cellulosics: The non-food fuels

Cumulative Cellulosic Biofuel Produced

Millions of Ethanol Equivalent Gallons

OPPORTUNITIES FOR ENVIRONMENTAL CREDITS FOR BIOGAS DERIVED TRANSPORTATION FUELS
The wide variety of fuels and uses
### RIN Value and Fuel Cost

<table>
<thead>
<tr>
<th>Wellhead NG Price ($/1000 ft³)</th>
<th>RNG RIN Value ($/1000 ft³)</th>
<th>Total RNG Value ($/1000 ft³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$3.20</td>
<td>$13.34</td>
<td>$16.34</td>
</tr>
</tbody>
</table>

**RNG Value > 5 X**
The biogas to electricity pathway
Implementing the e-RIN pathway

• Configuration – how to account for the amount of electricity used in the transportation sector

• Equivalence Value – how much credit to give electricity as a renewable transportation fuel
Configuration matters

• Charging stations could capture between 15% and 20% of total fleet charging

• Vehicle telematics data could capture between 85% and 95% of total fleet charging
EPA May 1, 2007 RFS Rule: renewable fuel is assigned an Equivalence Value that precisely accounts for the amount of petroleum in motor vehicle fuel that is reduced or replaced by that renewable fuel in comparison to ethanol.
### e-RINs: Potential and Value

#### Long-term potential

<table>
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<tr>
<th>EVs Powered</th>
<th>IC Car Gasoline Displacement</th>
<th>RIN Generation Potential</th>
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<td>14 million</td>
<td>42 million cars</td>
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#### Immediate potential

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The e-RIN pathway is more of a clean vehicle policy than a clean fuel policy.
# e-RINs: Potential and Value

## Long-term potential

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<td></td>
<td>10 million</td>
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</table>
Policy Forward and Organics Bans

• Now – get the e-RIN pathway right

• Going forward – use all of the available authority in the Clean Air Act to direct better waste management

• On going – Regularly update policy implementation to continually adapt waste regulations and carbon incentives to meet more ambitious climate goals
THANK YOU!

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