**INTRODUCTION AND FOCUS AREAS**

The Center for Renewable Natural Gas (CRNG) focuses on improving technology and reducing barriers to achieve widespread commercial production and utilization of RNG in California and beyond. The goal of the Center is to collaborate with public and private industry stakeholders to develop, validate, and improve RNG technologies, and to implement pilot-scale demonstration and testbeds to vet the viability of new technologies.

**FACILITATING RNG ADOPTION FROM LAB TO MARKET**

**CORE BENEFITS OF RNG**

- GHG Reduction
- Energy Storage Solution
- Improved Public Health
- Vehicle Emission Reduction
- Economic/Job Development
- Sustainable Waste Management

**SUPPORTING AGENCIES**

- Southern California Gas Company
- National Center for Sustainable Transportation

**CONTACT**

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Overview:

Harvesting Process: Anaerobic Digestion

Focus Areas:

1. High Yield Thermochemical RNG Production
   - Develop cost-effective technologies to commercially produce fuel-grade RNG from forest biomass, agricultural residue, etc. Address wide-scale adoption barriers such as feedstock logistics/pretreatment challenges, tar formation, gas cleanup, and high capital costs.

2. Power-to-Gas Production
   - Develop cost-efficiency systems to convert excess renewable electricity into hydrogen or methane as a means to increase the renewable energy content of the pipeline infrastructure while addressing grid capacity and storage issues.

3. Methanation Pathways
   - Optimize hydrogen conversion to methane, especially in the power-to-gas context where direct hydrogen injection into pipeline or long-term hydrogen storage is not viable.

4. Life Cycle and Techno-Economic Analysis
   - Conduct systems-level analyses of RNG production pathways to evaluate greenhouse gas and criteria pollutant emissions, material and energy balances (efficiencies), and commercial viability (economics).

5. Anaerobic Digestion
   - Optimize digestion pathways and technology options and address logistic and cost issues associated with feedstock collection and conversion.

CRNG Focus Areas

1. High Field Thermochemical RNG Production
2. Power-to-Gas Production
3. Methanation Pathways
4. Life Cycle and Techno-Economic Analysis
5. Anaerobic Digestion

Goals

- Develop cost-effective technologies to commercially produce fuel-grade RNG from forest biomass, agricultural residue, etc. Address wide-scale adoption barriers such as feedstock logistics/pretreatment challenges, tar formation, gas cleanup, and high capital costs.
- Develop cost-efficiency systems to convert excess renewable electricity into hydrogen or methane as a means to increase the renewable energy content of the pipeline infrastructure while addressing grid capacity and storage issues.
- Optimize hydrogen conversion to methane, especially in the power-to-gas context where direct hydrogen injection into pipeline or long-term hydrogen storage is not viable.
- Conduct systems-level analyses of RNG production pathways to evaluate greenhouse gas and criteria pollutant emissions, material and energy balances (efficiencies), and commercial viability (economics).
- Optimize digestion pathways and technology options and address logistic and cost issues associated with feedstock collection and conversion.

Estimated RNG Energy Potential

- 3,000 MW of renewable electricity – enough to power more than 5 million homes.

Energy Source: WIND / SOLAR

Focus Areas:

- Enables unlimited amounts of renewably-generated power to be stored indefinitely, transported to regions of energy demand using existing natural gas infrastructure, and dispatched when and as we need it.

Energy Source: FOREST BIOMASS

Focus Areas:

- Wildfires, largely fueled by dead trees, are responsible for 52% of California’s black carbon emissions, more than all diesel vehicles and power plants combined.
- In addition to reducing the risk of wildfires, converting forest biomass to power can lead to much-needed job creation.

Energy Source: LIVESTOCK & DAIRY MANURE

Focus Areas:

- California’s 1.7 million dairy cows produce more than 50% of the state’s methane emissions, a highly potent GHG.
- Converting dairy waste to energy reduces GHG emissions, provides income to dairy farmers and helps protect local air, water, and soil quality.

Energy Source: FOOD & GREEN WASTE

Focus Areas:

- The majority of the organic waste being disposed in landfills is food waste and yard clippings.
- This organic material can be used in dedicated ISAD facilities to produce high-quality RNG, which is one of the few RNG sources with a negative carbon footprint (identified by the Air Resources Board).

Energy Source: LANDFILLS

Focus Areas:

- Nearly 50% (1.6 million tons) of waste decomposing in California’s landfills could be used to produce energy.
- Using this waste to generate electricity would reduce annual CO₂ emissions from fossil fuels by approximately 7 million metric tons.
- Waste-derived fuels are among the lowest carbon fuels identified by the Air Resources Board.

Energy Source: WASTEWATER

Focus Areas:

- Converting biomethane from California’s 500+ wastewater treatment plants to electricity and fuels would reduce the state’s annual GHG emissions by more than 1 million metric tons.
- Using the digested material in place of inorganic synthetic fertilizer (which requires roughly 0.22 gallon of fossil fuels per pound of inorganic nitrogen to produce) would significantly reduce GHG emissions.

Energy Source: TRANSPORTATION FUEL

Transportation Fuel

<table>
<thead>
<tr>
<th>Carbon Intensity* (g CO₂e/MJ)</th>
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<tbody>
<tr>
<td>Diesel</td>
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<tr>
<td>102.01</td>
</tr>
<tr>
<td>Gasoline</td>
</tr>
<tr>
<td>59.49</td>
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<tr>
<td>Hydrogen from Natural Gas</td>
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<tr>
<td>105.48</td>
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<tr>
<td>Electricity – CA Grid</td>
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<tr>
<td>106.18</td>
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<tr>
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<tr>
<td>Alcohol</td>
</tr>
<tr>
<td>88.16</td>
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<tr>
<td>Biomass</td>
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<td>117.93 to 31.98</td>
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<tr>
<td>RNG – Landfill Gas</td>
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<tr>
<td>24.92</td>
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<td>RNG – Waste-to-Energy Biomass</td>
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<td>RNG – Food/Drainage Waste</td>
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<tr>
<td>22.93</td>
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<tr>
<td>RNG – Diary Biogas (Prospective)</td>
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<td>22.93</td>
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</tbody>
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*Carbon Intensity measured in grams CO₂e per megajoule energy