The Promise of Renewable Gaseous Fuels

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Southern California Gas Company

» The nation’s largest natural gas distribution utility
  - 20.9 million consumers
  - 5.8 million meters
  - 500 communities

» Subsidiary of Sempra Energy (SRE)

» Affiliated with SDG&E

» Leader in customer satisfaction, pipeline safety and environmental solutions
NOx is a Unique Challenge for SoCal

Over **80%** of Southern California is in “Extreme” non-attainment areas for meeting federal ozone standards:


1 Air Quality Management District (AQMD)
Need 80%+ Reductions in Both NOx and GHG

Projected Statewide GHG reduction
SCAQMD co-benefit NOx reduction from statewide GHG program (1)
SCAQMD needed reduction to meet federal ozone standards (1)

2050 California Air Resources Board Statewide GHG Target

80 ppb ozone standard (2)
75 ppb ozone standard (2)

1 South Coast Air Quality Management District (SCAQMD)
2 parts per billion (ppb)
Methane as a transportation fuel can address 2050 goals through total vehicle system improvements and RNG fuel blends.
Methane pathways are complementary to hydrogen pathways and may serve different vocations
Renewable Natural Gas is a necessary part of the path to 2050

**Graph: GHG emissions (from 1990 levels)**

- **Petroleum Fuels**
- **Compressed Natural Gas & Liquefied Natural Gas**
- **Natural Gas Vehicles (NGV)**
- **NGV Efficiency Improvements -- Aerodynamics, Advanced Engines, and Hybridization**
- **2050 Goal**
- **Renewable Natural Gas/ Hydrogen Blends**
Fuel economy improvement will be critical for all vehicle platforms -- Natural Gas platforms have similar fuel economy potential to diesel platforms.

### Breakdown of Energy Loss for Long Haul

Source: Department of Energy “Super Truck” program

### Sources of Fuel Economy Improvement

<table>
<thead>
<tr>
<th>Fuel Economy Contributor</th>
<th>Highway</th>
<th>Urban Vocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine</td>
<td>15% - 20%</td>
<td>15% - 20%</td>
</tr>
<tr>
<td>Hybridization</td>
<td>10%</td>
<td>30% - 35%</td>
</tr>
<tr>
<td>Aerodynamics</td>
<td>12%</td>
<td>0% - 6%</td>
</tr>
<tr>
<td>Transmission</td>
<td>7%</td>
<td>4%</td>
</tr>
<tr>
<td>Rolling Resistance</td>
<td>11%</td>
<td>2% - 3%</td>
</tr>
<tr>
<td>Weight</td>
<td>1%</td>
<td>1% - 4%</td>
</tr>
</tbody>
</table>

Source: National Petroleum Council
Vehicle economics and fuel price have the potential to meet emissions goals without the need for long-term subsidies
Renewable and zero-carbon pathways are key

Natural Gas w/ CCUS  Organics Conversion  Power-to-Gas  Artificial Photosynthesis

Anaerobic Digestion  Thermo-chemical  Electrolysis

Renewable Natural Gas  Hydrogen

CO2  Methanation  Reformation
Renewable Fuel Pathways and the Gas Grid
We Can Deliver Natural Gas Virtually Anywhere in SoCal

Southern California Gas Company Facilities

LEGEND

- Reciprocating Compressor Station
- Centrifugal Compressor Station
- Pressure Limiting Station
- Storage Field
- Transmission Backbone

400

NOT TO SCALE
Vast Storage Infrastructure – Months of Capacity

Southern California Storage Resources

Goleta

Aliso Canyon

Playa Del Rey

Honor Rancho
Bio-derived RNG is the low-cost pathway – energy crops offer further potential

Right side of the stack becomes wider and less expensive over time

In-state resources only, 50% resource conversion, no energy crops
Major Nox co-benefit potential

Note:
1. Analysis includes T7 Drayage, T7 Single, T7 Solid Waste Collection Vehicle, T7 Tractor, T7 Tractor Construction, T7 Agriculture, T7 Single Construction, T7 Public, T7 IS, T6 Instate Heavy, T6 Instate Small, T6 Utility, T6 Public, T6 TS, T6 Agriculture, T6 Instate Construction Heavy, T6 Instate Construction Small, LHDDT, and LHDGT.
2. Maximum incentives range from $15,500 - $35,000/Truck depending on the vehicle type and engine size.
3. Assumed penetration rates after the incentive period ends remain at the 2023 level due to some mechanism.
4. Incentive Program ends in 2023; post-2023, mechanism maintains new sales penetration of NZE NG trucks at 2023 levels.
RNG could be a drop-in fuel by 2025
Opportunity Areas

» Use of dedicated energy crops to produce methane

» Co-production of methane and hydrogen with other products

» Joint deployment analysis and planning for all three primary renewable biofuels
  - Liquids
  - Methane
  - Hydrogen