Innovation

RENEWABLE GAS
Driving Emissions Reductions for California’s Clean Energy Future
SoCalGas: Largest Gas Distribution Utility in United States

SoCalGas® provides natural gas to 21 Million Customers

1 Trillion cubic feet (Tcf) of natural gas delivered annually

5% of US gas deliveries

135 Billion cubic feet (Bcf) of natural gas storage capacity

3% of US storage capacity

Serving customers for over 140 Years

Nearly 100,000 Miles of distributions mains and service lines

Over 3,500 Miles of natural gas transmission lines

5.8 million meters

Sacramento
San Francisco
SoCalGas
Los Angeles
San Diego
CALIFORNIA
Is leading the way on environmental policy

- **AB 32** – GHG emissions to 1990 levels by 2020
- **SB 350** – 50% renewable electricity by 2030
- **SB 32** – GHG emissions to 40% below 1990 levels by 2030
- **SB 1383** – 40% reduction in SLCP emissions
- **EO B-16-12** – 80% GHG reduction in transportation sector by 2050
GHG reduction to 1990 levels (AB 32)

40% reduction in methane (SB 1383)

50% RPS and doubling of EE (SB 350)

40% GHG reduction below 1990 levels (SB 32)

80% GHG reduction below 1990 levels (EO B-30-15)
CALIFORNIA

Tops the list…

• Largest economy in the US, and 6th in the world
• Most private sector job growth since the recession
• Most manufacturing activity, output, and exports in the US
• More clean tech venture capital than any other state, and second most globally
• Largest advanced energy industry in the US

• WORST AIR QUALITY??
We have a DUAL CHALLENGE

**FEDERAL CLEAN AIR ACT**

Reduce SMOG by at least **55%**
by 2031 in the San Joaquin Valley and South Coast Air Basin

**CA CLIMATE GOALS (AB32, SB32, SB1383, GOVERNOR’S EO)**

Reduce greenhouse gas emissions to **40%**
below 1990 levels by 2030

&

Reduce methane emissions by **40%**
below 2013 levels by 2030
WHERE DO CA’S GHGs COME FROM?

- Transportation: 37%
- Industrial: 24%
- Electricity Generation (In State): 12%
- Agriculture: 8%
- Residential: 6%
- Commercial: 5%
- Not Specified: <1%

2014 Total CA Emissions: 441.5 MMTCO2e

Source: California’s Air Resources Board, Greenhouse Gas Inventory
LCFS’s DECLINING CARBON INTENSITY

- Historical CI Targets
- Future CI Targets

Fuels below standard generate credits
Fuels above standard generate deficits

Percent Reduction in Carbon Intensity

Yearly Periods: 2011 to 2022
WHAT IS A “WELL-TO-WHEELS” CI?

Fuel Lifecycle for California Reformulated Gasoline Blendstock for Oxygenate Blending (CARBOB)¹

CARBOB
100 gCO₂e/MJ*
* Totals may not sum due to rounding

74 g/MJ
Vehicle

1 g/MJ
Transportation

14 g/MJ
Refinery

12 g/MJ
Oil Well

¹ CARBOB makes up the petroleum fraction of California reformulated gasoline (CaRFG) before any fuel oxygenate is added.

Fuel Lifecycle for Landfill Gas to CNG

Biogas to CNG in California
25 gCO₂e/MJ*
* Totals may not sum due to rounding

Biogas Upgrading
19 g/MJ

Avoided Flare Credit
-66 g/MJ

Landfill Gas Recovery

Pipeline Transmission
5 g/MJ

Compression & Refueling
2 g/MJ

61 g/MJ
CNG Trucks + efficiency penalty

3 g/MJ

1 g/MJ

WHAT ABOUT SLCPs?

20 Year Global Warming Potential (GWP) Inventories:

- Methane – 118 MMT
- HFC Gases – 40 MMT
- Black Carbon – 38 MMT
SB 1383
Renewable Gas Related Directives

▪ Establish/reiterate statutory goals to reduce landfilling of organic waste from 2014 levels: 50% by 2020 and 75% by 2025

▪ Establish energy infrastructure development and procurement policies to encourage biomethane [ARB, with PUC and CEC, by Jan 1, 2018]

▪ Develop pilot financial mechanism to reduce uncertainty associated with environmental credits (e.g. LCFS) in support of dairy RG for vehicles [ARB]

▪ Ensure pre-regulation dairy biofuels projects receive at least 10 years of LCFS revenue [ARB, by Jan 1, 2018]

▪ Develop recommendations to encourage the development and use of RG. State agencies are authorized to implement policies based on these recommendations. [CEC, 2017 IEPR]

▪ Direct gas corporations to implement not less than 5 dairy RG injection pilot projects. Reasonable pipeline infrastructure costs are recoverable in rates. [PUC with ARB and CDFA, by Jan 1, 2018]
What is Renewable Natural Gas?

- Biogas is produced during the natural anaerobic digestion of organic waste.
- Anaerobic digestion breaks down waste at landfills, wastewater treatment plants, and manure lagoons.
- Certain types of organic waste, such as forest biomass and agricultural residue, can break down through anaerobic digestion, but are better suited for thermo-chemical conversion (e.g. gasification) to produce RG.
- Raw biogas and syngas can be processed to produce RG, which can be pipeline-injected and transported to customers anywhere on the pipeline network, or can be stored for use at a later time.
- In addition to organic waste, Power-to-Gas technology can be used to create RG from renewable electricity.
RENEWABLE GAS
Provides MAJOR Benefits

**RG can reduce GHGs by up to 400%**

Source: ARB’s LCFS Pathways.
https://www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm
The good news is, we have a CLEAR FOCUS

The Transportation Sector is responsible for
80% SCAG & SJV’s smog, and nearly 40% of CA’s GHG emissions

HEAVY-DUTY Trucks contribute the most smog-forming emissions in our region

NEARLY 90,000 Heavy-duty Trucks travel on the I-5, I-710, and CA-99 freeways on high traffic days

Sources: 2012 South Coast Air Quality Management Plan & California Air Resources Board (CARB), California GHG Emissions Inventory 200-2012, released in May 2014
These transportation emissions have a **disproportionate impact** on disadvantaged communities.
MAKING FREIGHT SUSTAINABLE IN CA

HEAVY-DUTY NGVs using RG are California’s best choice for reducing GHG emissions and smog.

Near-zero natural gas engines can reduce vehicle $NO_x$ emissions by 90% or more.

By switching to renewable natural gas, we can reduce vehicle GHG emissions by 80% or more.

According to the Low Carbon Fuel Standard program, CA’s NGVs are fueled with >60% RG today.
Clean, green renewable gas

Putting methane from organic waste to beneficial use

Collect waste from dairies, farms, and communities

Produce biogas, using anaerobic digestion

Purify the methane

Put in the Pipeline for future use

To fuel trucks and other natural gas needs
RENEWABLE GAS
Practical benefits for California

Waste to Biogas
- Significantly Reduce Odors
- Better Control of Waste Water
- Enhanced Nutrient Recovery and Plant-availability

Collect in Pipelines
- Efficiently Transport Biogas
- No Truck Traffic, Noise, or Emissions
- Open Access System for Future Growth

Process & Upgrade
- Ensure Gas is Safe for Existing Pipelines
- Ensure Proper Combustion and Consumer Safety

Pipeline Injection
- Efficient Transportation to Existing Customers
- Flexible, Reliable, and Resilient Energy Network
- No New Combustion Source

End Use
- Near-zero Emissions
- Displaces Traditional Fuel
- Clean, Reliable, Resilient Energy
RENEWABLE GAS
Provides MAJOR Benefits

California-sourced RG can replace **20% or more** of CA’s residential natural gas use

Developing RG in CA Can:
Provide Local Fuel,
Create Jobs,
Improve Air and Water Quality, and
Better Manage our Waste Streams

In the future, **Hydrogen and Power-to-Gas** can complement these pathways

*RG can reduce GHGs by up to 400%*

Source: ARB’s LCFS Pathways.
[https://www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm](https://www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm)
HOW DO WE GET TO 2030?

**INVEST** in facilities to produce RG from California’s waste, and **near-zero emissions heavy-duty natural gas trucks** to use RG

**DELIVER RG** to customers. Today, RG provides the most value fueling heavy-duty trucks **to reduce GHG emissions and clean our air**, and it can easily be deployed via pipelines to meet other needs in the future.
HOW DO WE GET TO 2050?

Establish a Renewable Gas Standard

Invest in facilities to produce RG from California’s waste

Accelerate the market adoption of NZE trucks

Deliver RG to customers

Improve the Certainty of RG’s value
Federal Renewable Fuel Standard
Produce 36 billion gallons of renewable fuel by 2023

California's Low-Carbon Fuel Standard
Reduce Carbon Intensity of Transportation Fuels by 10% by 2020

Potential Renewable Gas Production Opportunities:
Wastewater Treatment Plants
Landfills
Landfill-diverted green waste
Dairies
Agricultural Residue
Forest Waste

Estimated Potential Value of RG as a Transportation Fuel

- RG production and injection cost is typically $8-15+/MMBtu, depending on several factors
- Incentives and new policies can help lower this cost
- SoCalGas’ BCS Tariff
Largest natural gas distribution utility in the US, with 100,000 miles of existing pipelines to transport RG

Actively engaged in promoting NGVs and RG

Research new technologies to provide low-carbon energy solutions for our customers

SoCalGas’ customers make up more than half of all California residents

SoCalGas® is an experienced operator of natural gas infrastructure – making important investments while maintaining the lowest fuel cost for customers.
Conclusion

Developing RG and deploying clean trucks will allow us to:

- Meet clean-air goals sooner
- Diversify our green energy sources
- Improve energy reliability
- Help win the climate change fight
APPENDIX
HOW DO RG FUELED TRUCKS STACK UP?

What a $500 million investment in clean trucking can achieve:

- **Number of Trucks Incentivized**
  - 8,264
  - 2,232
  - 952

- **Smog-Forming Emissions Reductions**
  - 3,810
  - 1,249
  - 533

- **Greenhouse Gas (GHG) Reductions**
  - 4,990
  - 3,058
  - 2,285
  - 1,126

*Compared to Baseline Diesel (weighted tons)
+Compared to Baseline Diesel (thousand MT CO2e)

- **Natural Gas Vehicle (NGV)**
  - Commercially available in 2016
- **Electric HD Truck CA Grid**
  - California Air Resources Board projects commercial availability in 2030†
- **Fuel Cell HD Truck - 33% RH2**
  - †ARB Technology Assessments 2015

Source: NGV Gamechanger Whitepaper
Nationally, we can produce **8 to 13 Tcf/y** of RG by 2030

This is roughly **5 to 8 times** California’s total projected natural gas use in 2030

Comparison of CA RNG feedstock studies

RNG Production Potential in California (Bcf/year)

- Energy Crops
- Forestry and Forest Product Residue
- Agricultural Residue
- Fats, Oils, and Greases
- Organic Municipal Solid Waste
- WWTP
- Landfill Gas
- Dairy and Poultry Manure

~64 Bcf/y (10% of 2030 Projected Statewide Utility Total)
~32 Bcf/y (5% of 2030 Projected Statewide Core)

(1&2) Includes Data from: The Bioenergy Association of California Whitepaper (BAC), The American Gas Foundation potential study (AGF), The National Petroleum Council feedstock overview (NPC), and the U.S. DOE Billion Ton update (DOE).


(4) The Feasibility of Renewable Natural Gas as a Large-Scale, Low Carbon Substitute,” Updated June 2016. Amy Myers Jaffe, Principal Investigator; STEPS Program, Institute of Transportation Studies, UC Davis
2030 PROJECTED CORE NATURAL GAS USAGE
RESIDENTIAL, COMMERCIAL, NGV

2030 STATEWIDE
637 BCF/Y

5% RNG REQUIRED
2030
32 BCF/Y

RNG PRODUCTION POTENTIAL IN STATE

FROM DAIRY, WASTEWATER, LANDFILL & ORGANIC MSW RESOURCES IN CA

2030
90.6 BCF/Y
32 BCF/Y

2030 PROJECTED NGV USAGE STATEWIDE

2030
28 BCF/Y

2016
16 BCF/Y

CURRENT SocalGas CORE CUSTOMER THROUGHOUT

2016
310 BCF/Y
6 BCF/Y

ESTIMATED RNG USE TODAY
RNG PRODUCTION POTENTIAL IN STATE

90.6 BCF/Y FROM DAIRY, WASTEWATER, LANDFILL & ORGANIC MSW RESOURCES IN CA
Biogas Conditioning Tariff

» **Summary:** The BCS Tariff is a new utility tariff that allows SoCalGas to design, install, own, operate & maintain biogas conditioning/upgrading equipment on or adjacent to the customers premise
  - SoCalGas will not own the biogas entering or the upgraded biogas leaving the biogas conditioning/upgrading facility
  - For pipeline injection, customer must pay for all costs associated with the interconnection facilities

» **What is included in SoCalGas’ turnkey solution?**
  - 100% of the upfront capital
  - Biogas conditioning/upgrading facilities design
  - Equipment and construction RFP
  - Vendor selection and management
  - Project/construction management
  - Facility operation and ongoing maintenance
  - Contract management
De-Carbonizing the Pipeline:
Electrolysis of Excess Renewable Electricity (Power-to-Gas)
Power-to-Gas Projects: Provides green hydrogen pathway and grid storage

- 30 Projects Now Launched In Europe
- 20 Projects Launched in Germany in last 8 years, with at least 5 more in development
Grid Injected Projects

• UC Irvine demonstration (hydrogen), Irvine, CA

• NREL demonstration (methanated hydrogen), Golden, CO

• IESO large scale commercial project (methanated hydrogen), Ontario, Canada