SoCalGas A Sempra Energy utility®

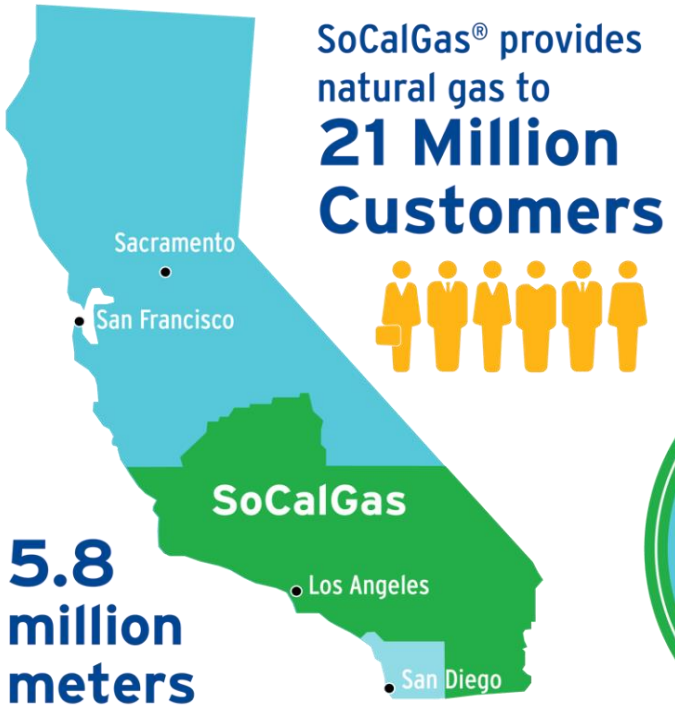
Glad to be of service.®

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**

5.8 million meters

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

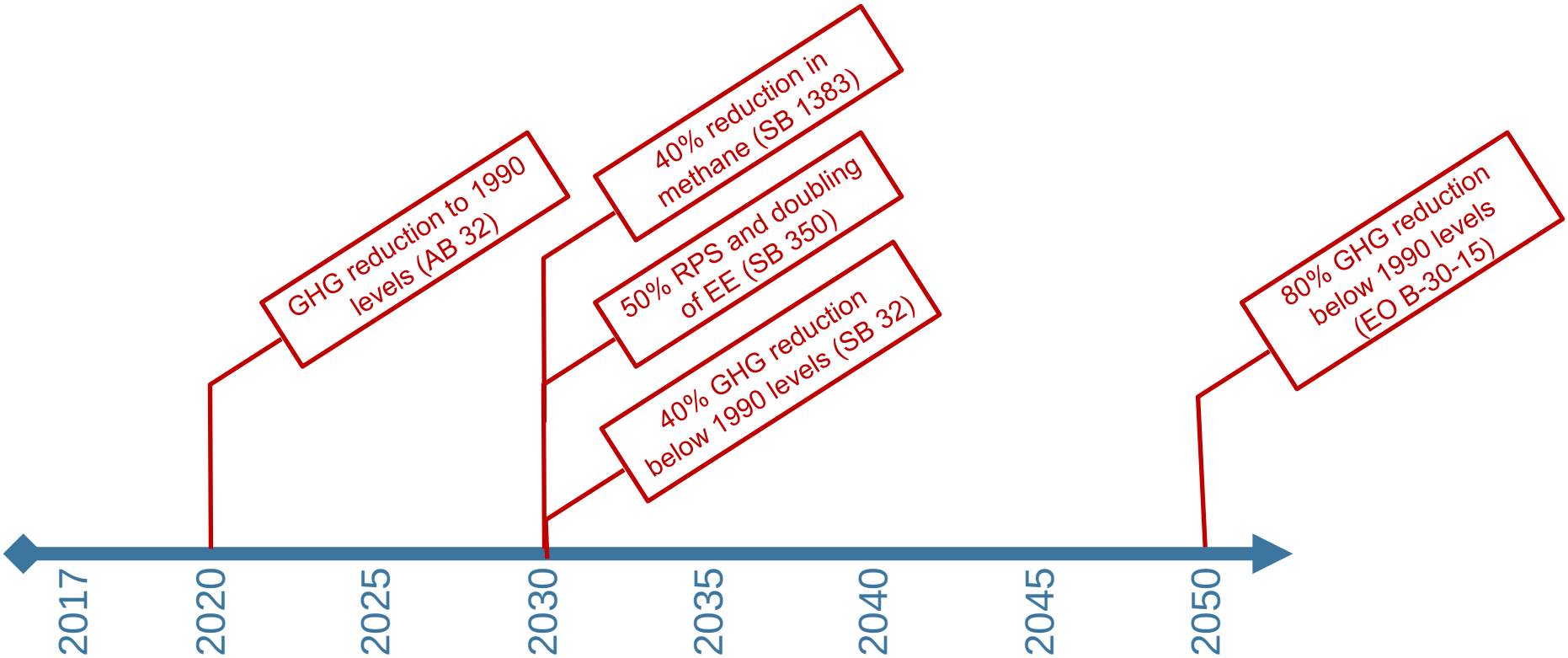
Over **3,500 Miles** of natural gas transmission lines

SoCalGas A Sempra Energy utility

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)
2017
2020
2025
2030
2035
2040
2045
2050

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

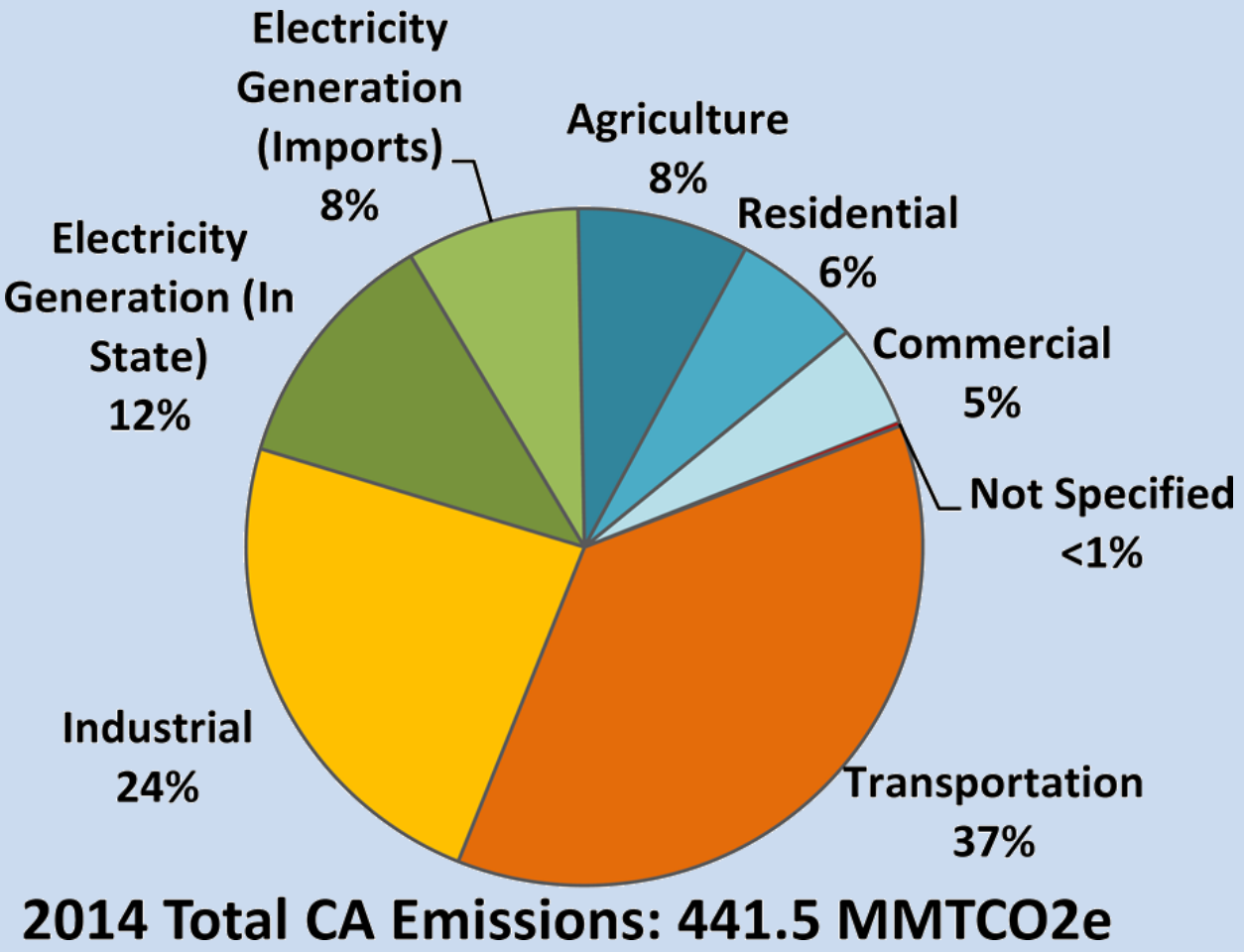
&

Reduce methane emissions by

40%

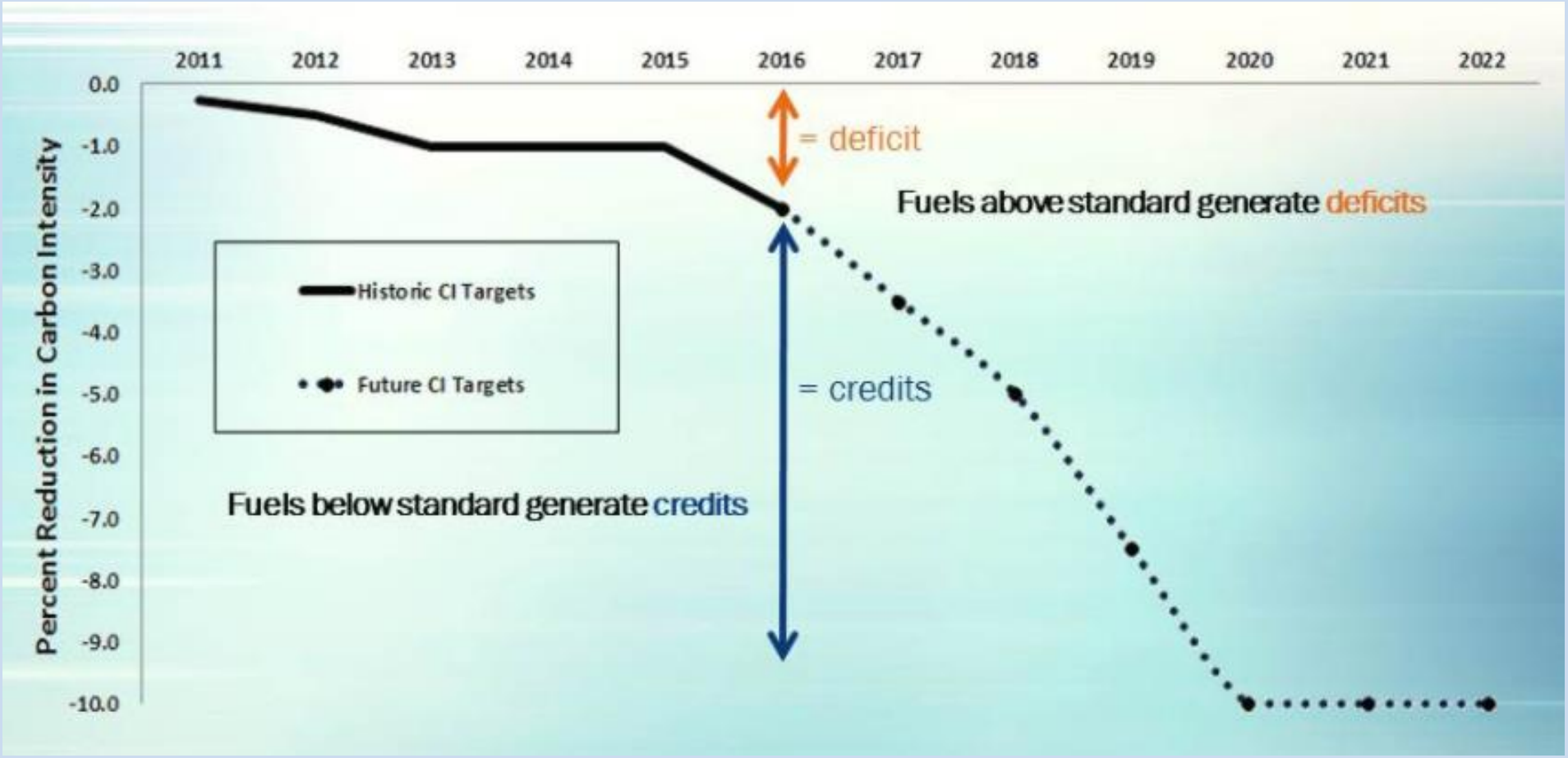
below 2013 levels by 2030

WHERE DO CA'S GHGs COME FROM?

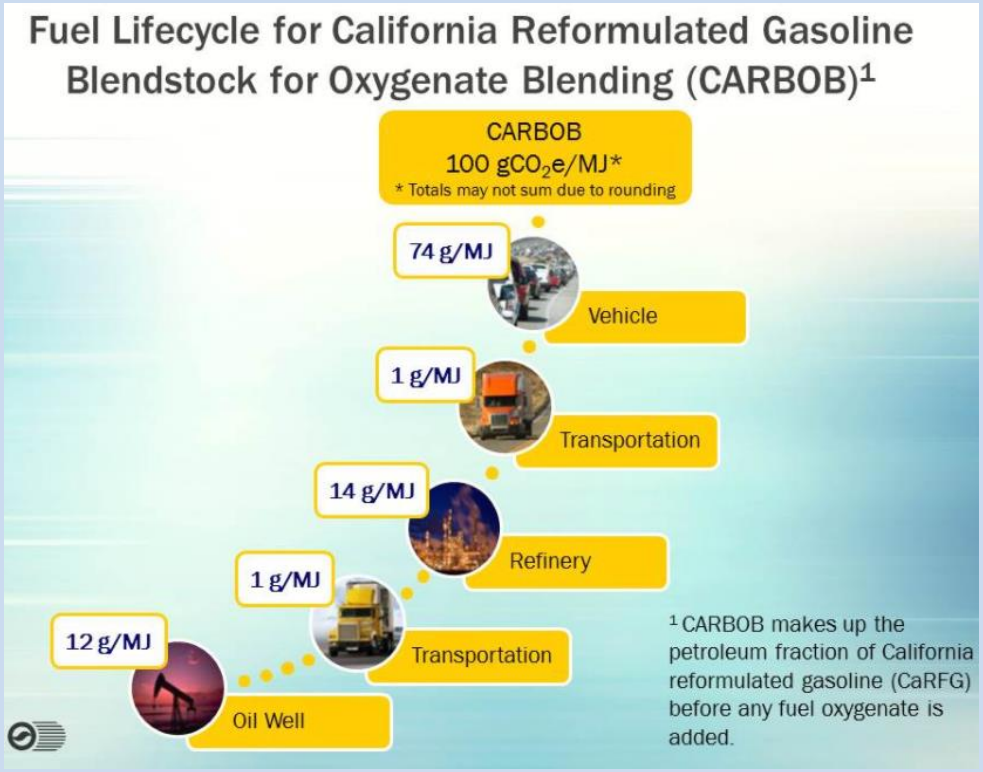


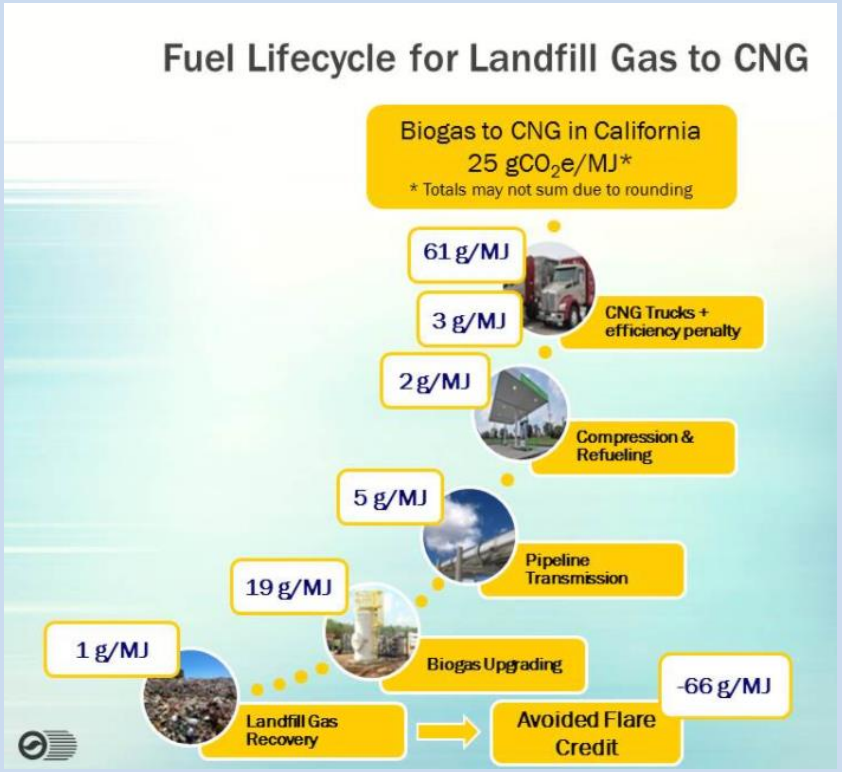
Source: California's Air Resources Board, Greenhouse Gas Inventory

LCFS's DECLINING CARBON INTENSITY



WHAT IS A "WELL-TO-WHEELS" CI?

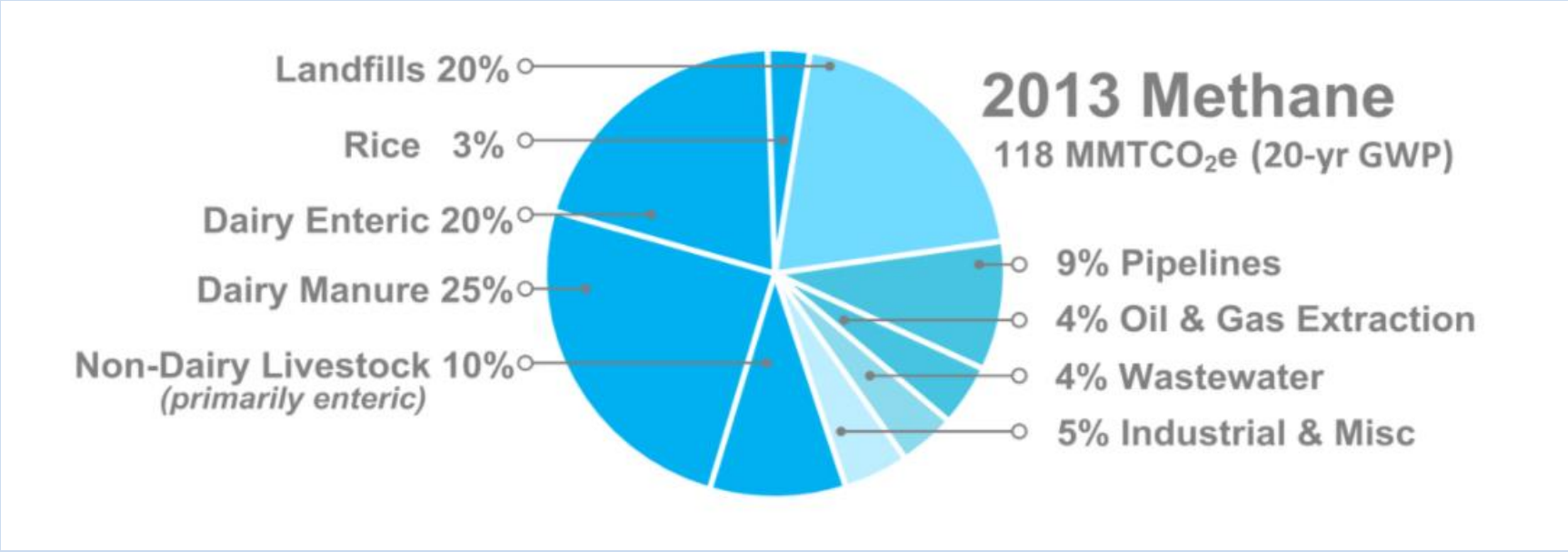




WHAT ABOUT SLCPs?

20 Year Global Warming Potential (GWP) Inventories:

- Methane – 118 MMT
- HFC Gases – 40 MMT
- Black Carbon – 38 MMT



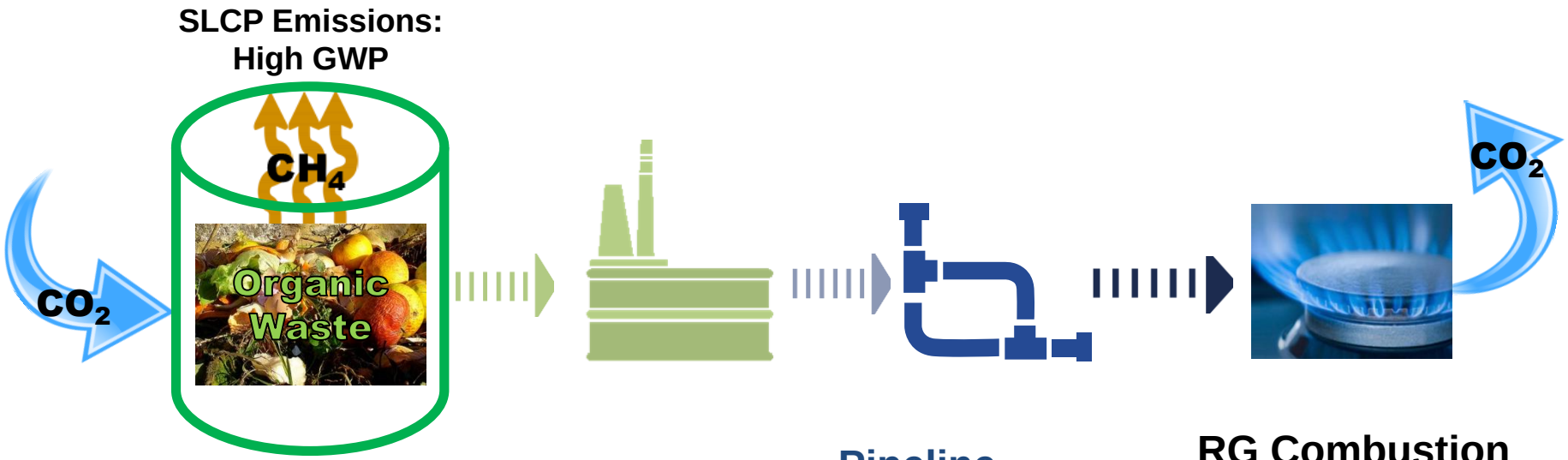
SB 1383

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]

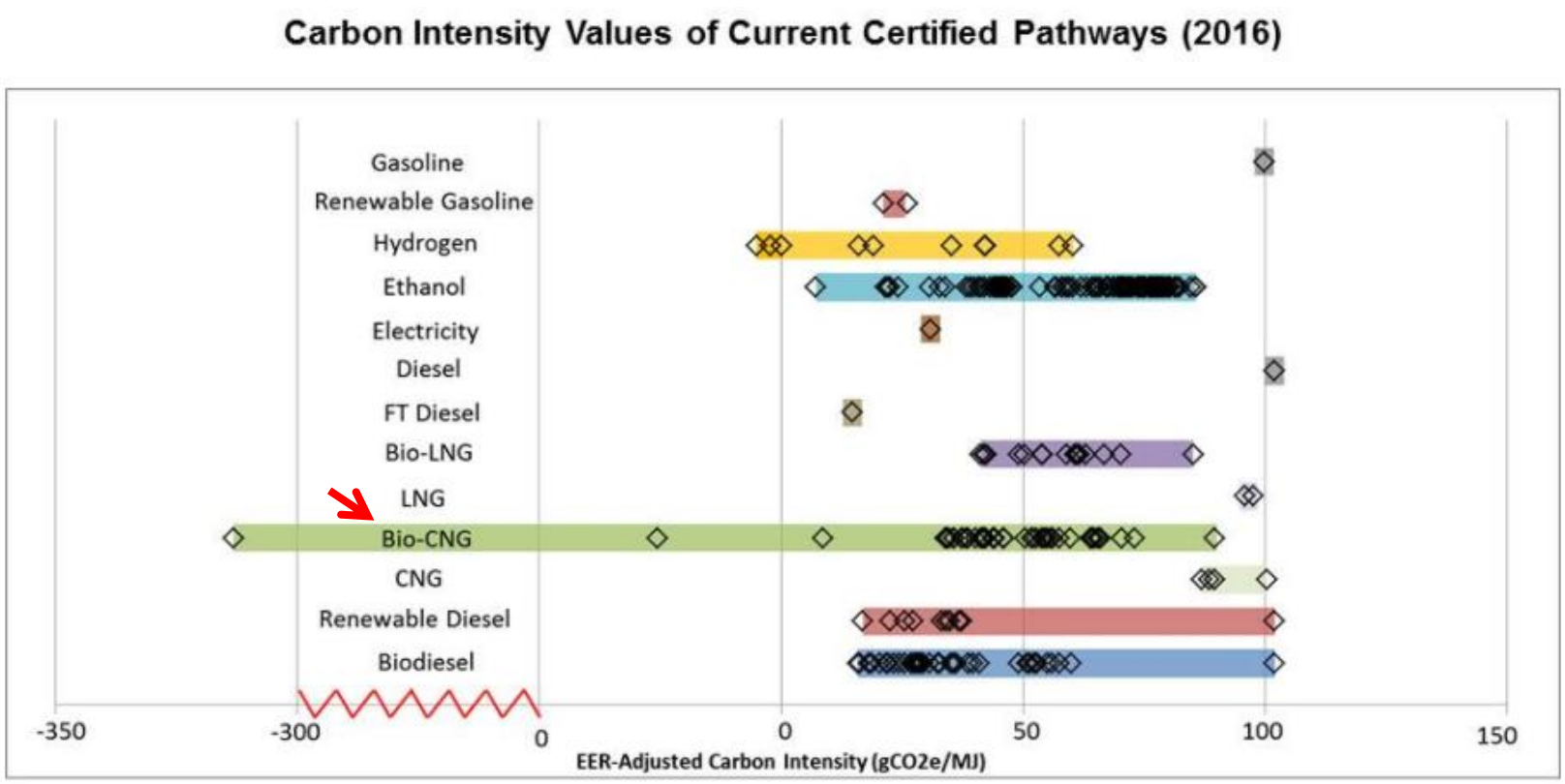
What is Renewable Natural Gas?

- 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

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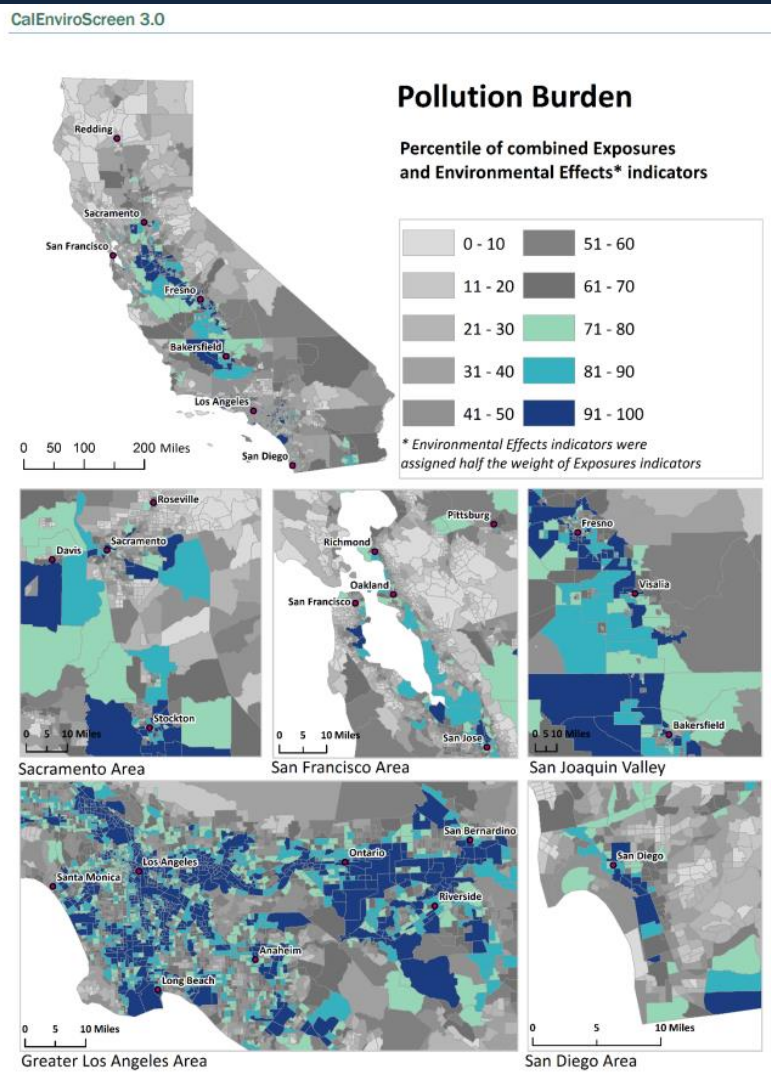
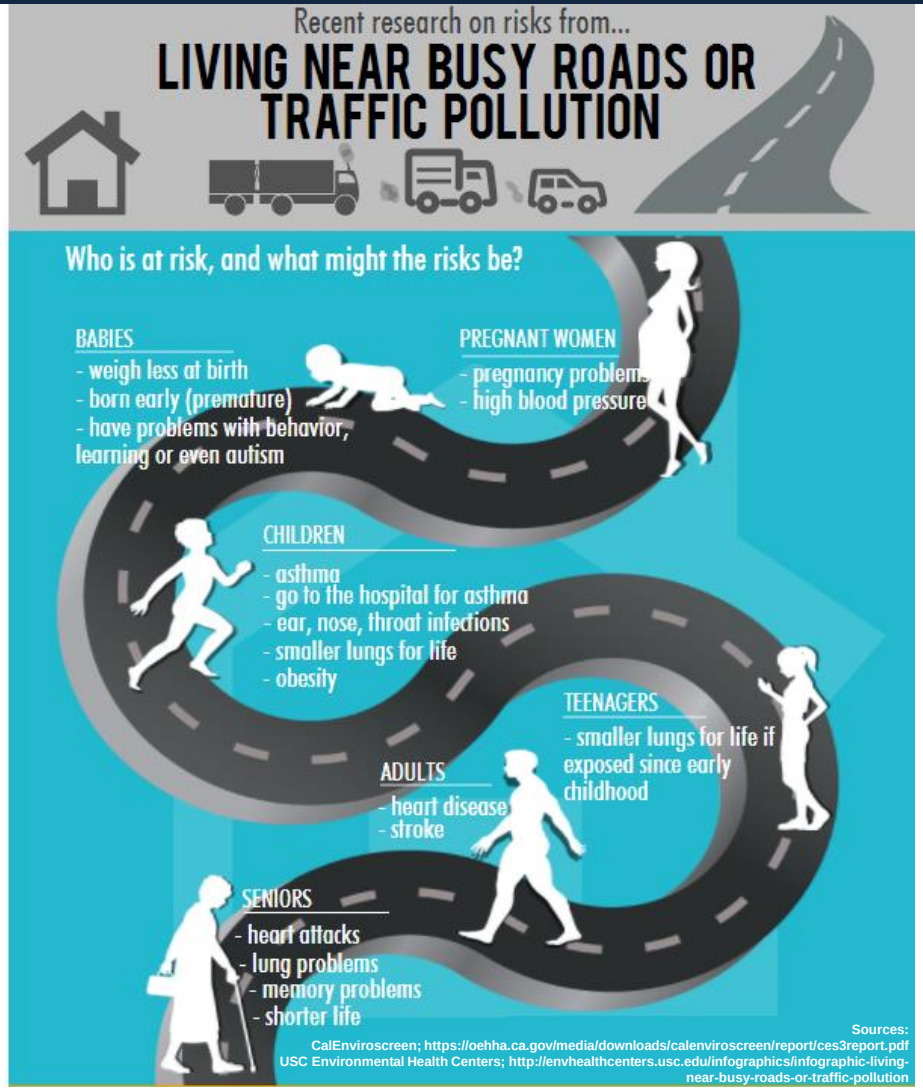
NEARLY 90,000

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

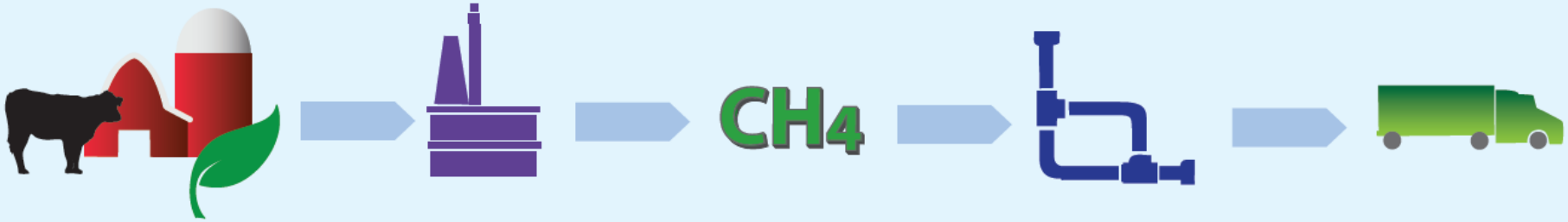
According to the Low Carbon Fuel Standard program, CA's NGVs are fueled with

>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

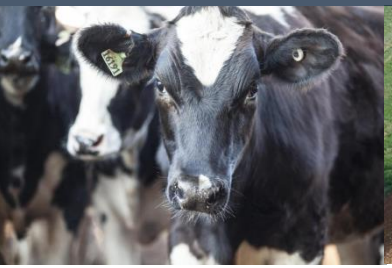
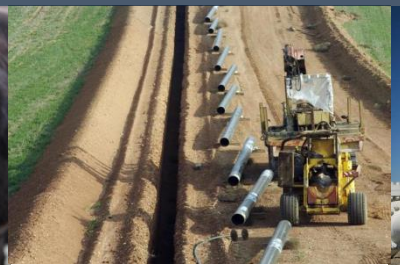
Purify the methane

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

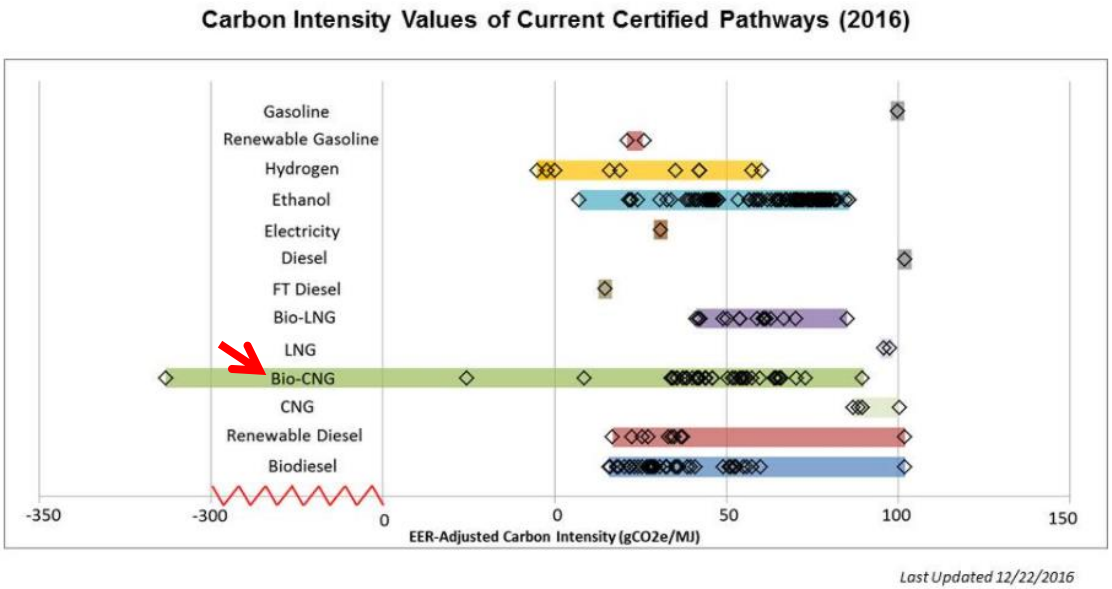
- Efficient Transportation to Existing Customers
- Flexible, Reliable, and Resilient Energy Network
- No New Combustion Source

End Use

- Near-zero Emissions
- Displaces Traditional Fuel
- Clean, Reliable, Resilient Energy

RENEWABLE GAS

Provides MAJOR Benefits



Source: ARB's LCFS Pathways.
https://www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm

RG can reduce GHGs by up to 400%

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

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

RENEWABLE GAS

Production opportunities for municipalities

Federal Renewable Fuel Standard

Produce 36 billion gallons of renewable fuel by 2023

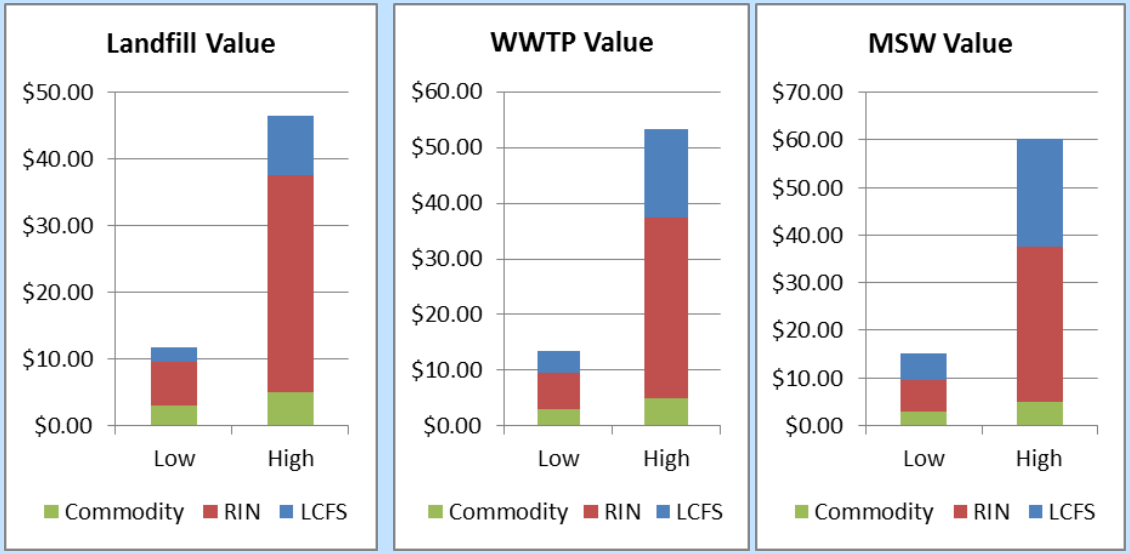
California's Low-Carbon Fuel Standard

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 <u>$8-15+/MMBtu</u>, depending on several factors**
- **Incentives and new policies can help lower this cost**
- **SoCalGas' BCS Tariff**

WHY SOCALGAS®?

We are a part of the solution.

- **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

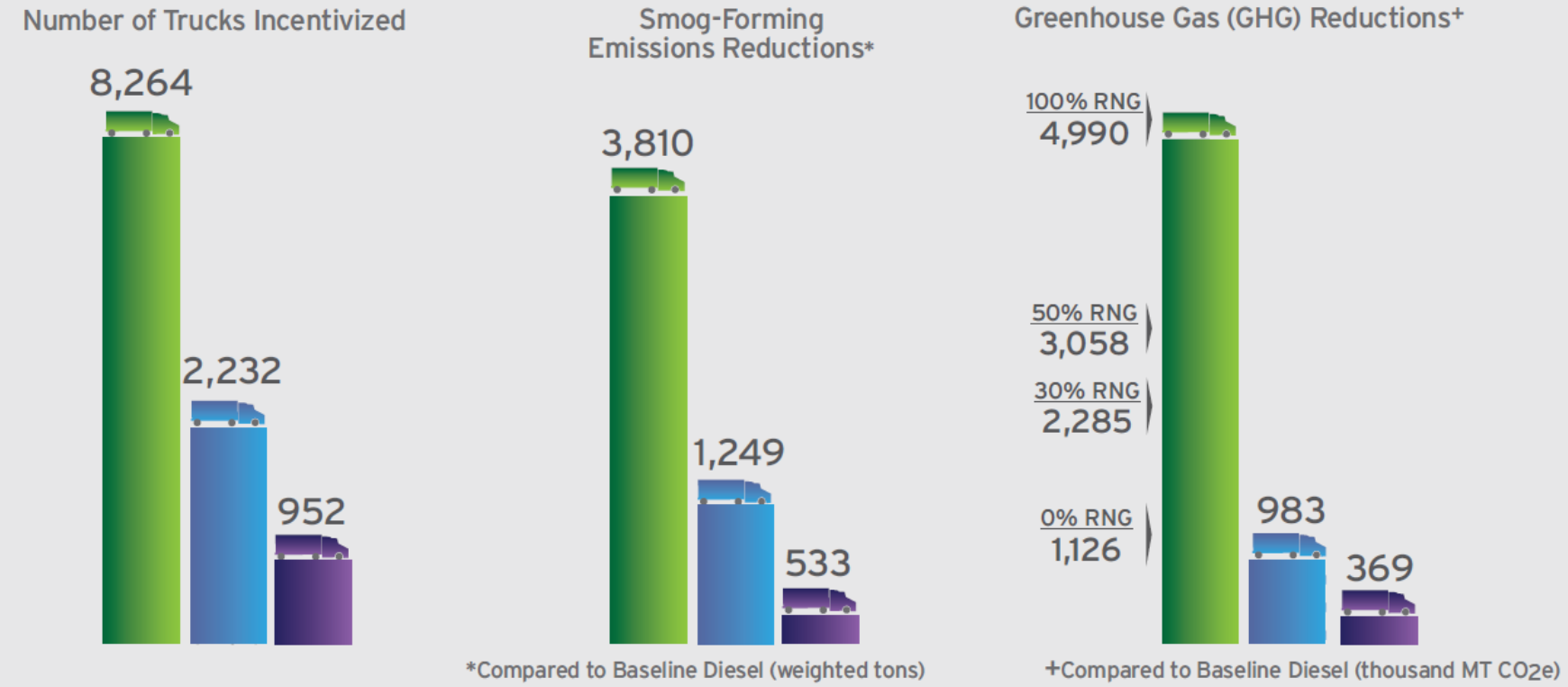
Developing RG and deploying clean trucks will allow us to:

- **Meet clean-air goals sooner**
- **Diversify our green energy sources**
- **Improve energy reliability**
- **Help win the climate change fight**

APPENDIX

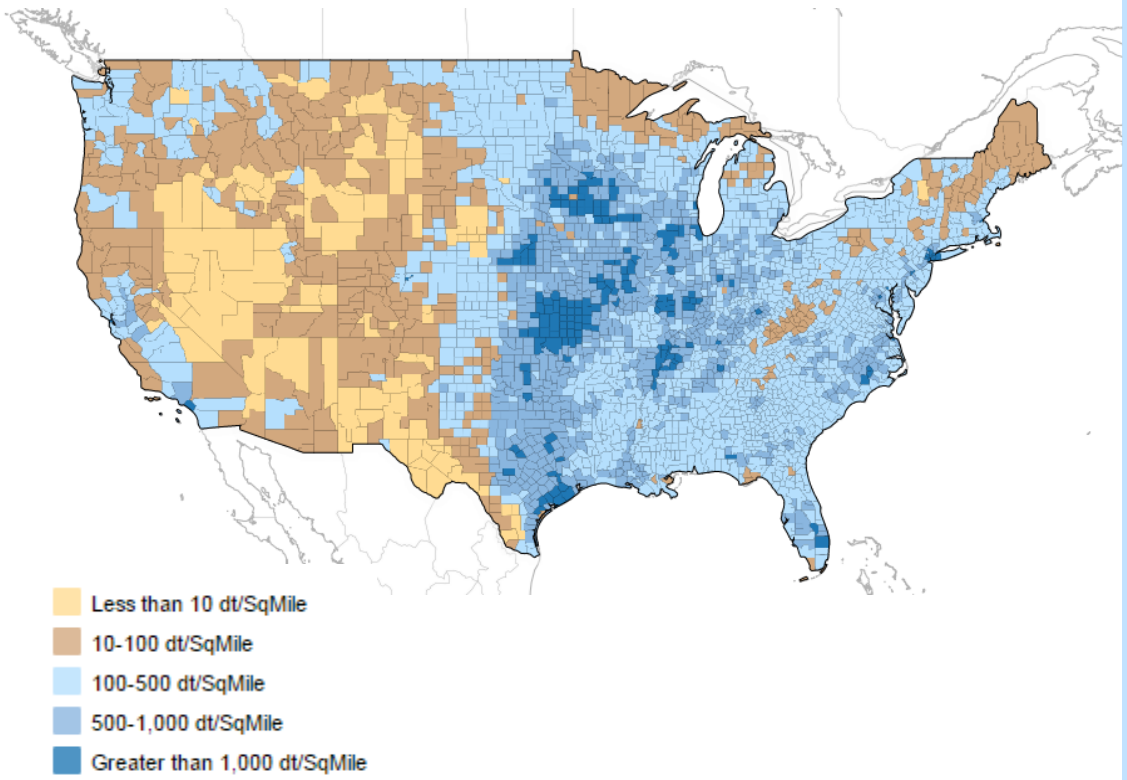
HOW DO RG FUELED TRUCKS STACK UP?

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



Source: NGV Gamechanger Whitepaper

UNITED STATES' RG PRODUCTION POTENTIAL



Source: U.S. Department of Energy. 2016. 2016 Billion-Ton Report: Advancing Domestic Resources for a Thriving Bioeconomy, Volume 1: Economic Availability of Feedstocks. M. H. Langholtz, B. J. Stokes, and L. M. Eaton (Leads), ORNL/TM-2016/160. Oak Ridge National Laboratory, Oak Ridge, TN. 448p. doi: 10.2172/1271651.; 2030 Values achievable at $60/Ton

Nationally, we can produce

8 to 13 Tcf/y

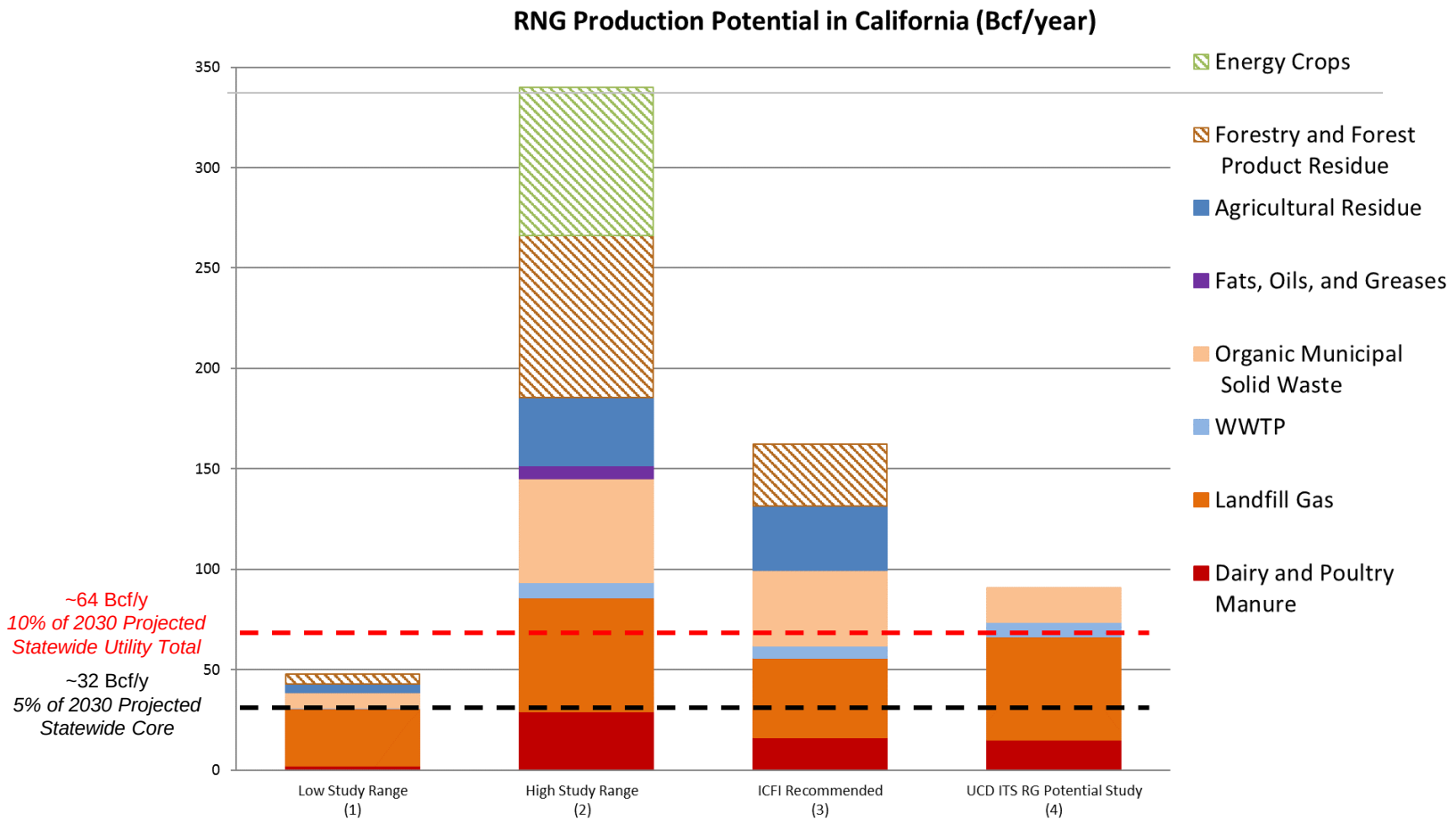
of RG by 2030

This is roughly

5 to 8 times

California's total projected natural gas use in 2030

Comparison of CA RNG feedstock studies



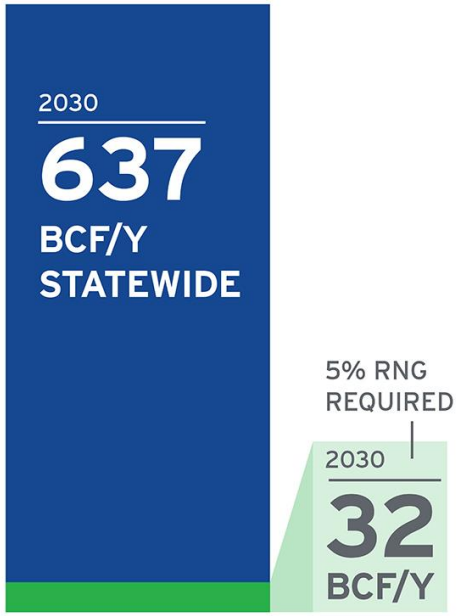
(1&2) Includes Data from: The Bioenergy Association of California Whitepaper (BAC), The American Gas Foundation potential study (AGF), The National Petroleum Council feedstock overview (NPC), and the U.S. DOE Billion Ton update (DOE).

(3) Source: : ICF International, *Renewable Natural Gas Resource and Cost Assessment* conducted for SoCalGas, June 2015

(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

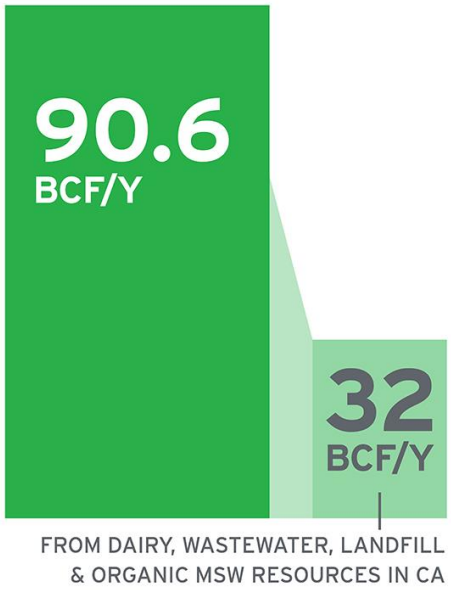
2030 PROJECTED CORE NATURAL GAS USUAGE

RESIDENTIAL, COMMERCIAL, NGV



RNG PRODUCTION POTENTIAL

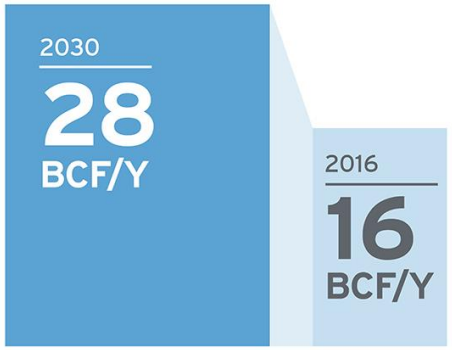
IN STATE



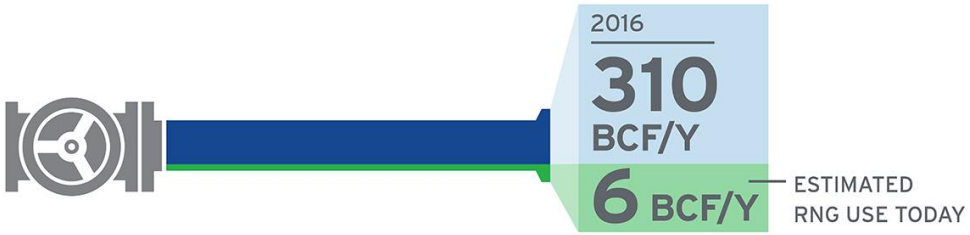
FROM DAIRY, WASTEWATER, LANDFILL & ORGANIC MSW RESOURCES IN CA

2030 PROJECTED NGV

USAGE STATEWIDE

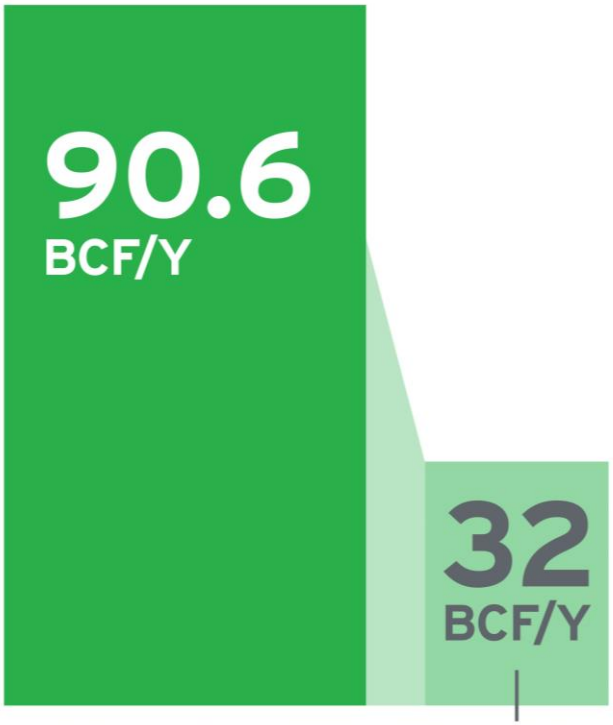


CURRENT SOCALGAS CORE CUSTOMER THROUGHOUT



RNG PRODUCTION POTENTIAL

IN STATE



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

Biogas Conditioning Tariff

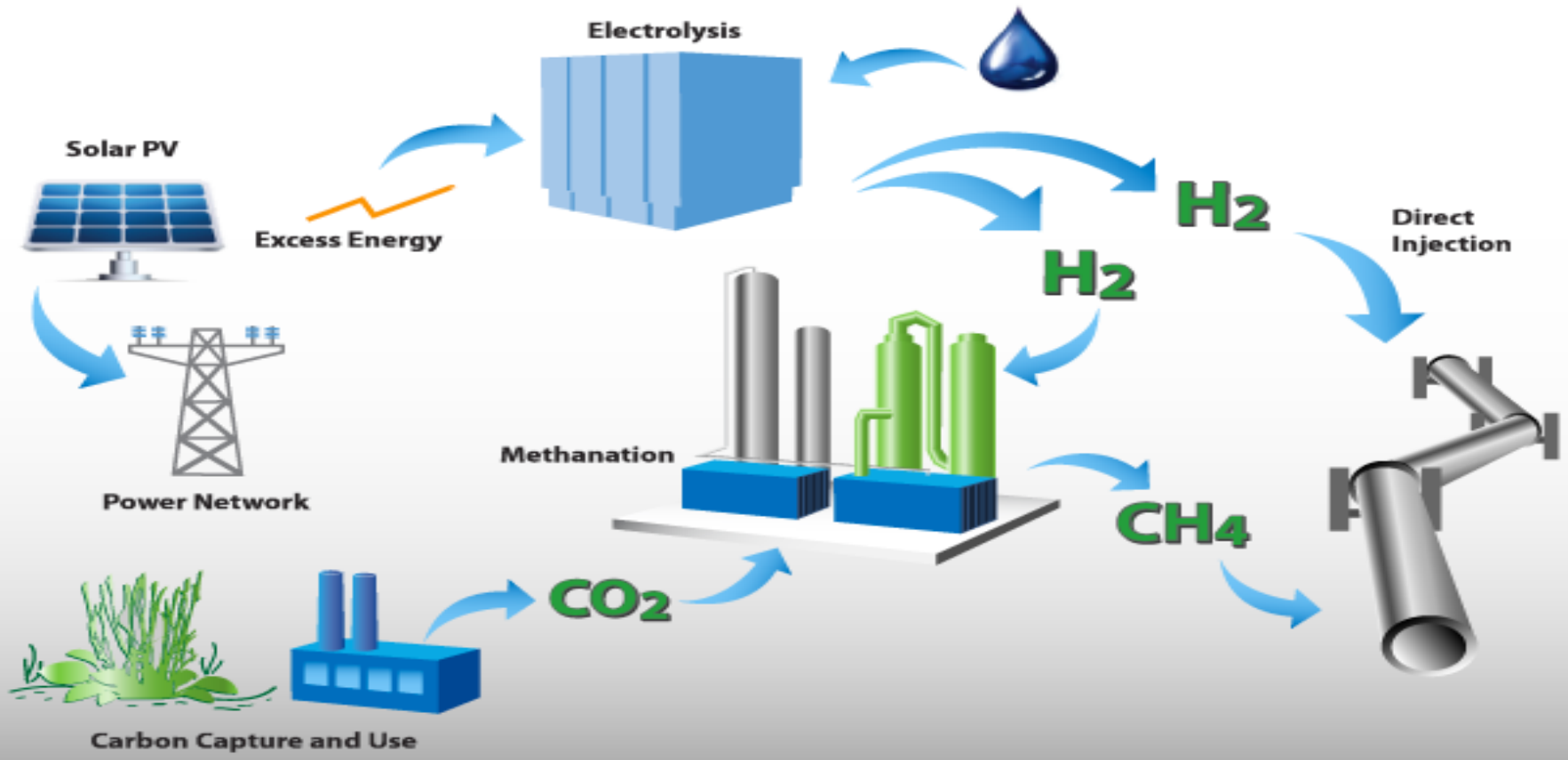
- **Summary:** The BCS Tariff is a new utility tariff that allows SoCalGas to design, install, own, operate & maintain biogas conditioning/upgrading equipment on or adjacent to the customers premise
  - SoCalGas will not own the biogas entering or the upgraded biogas leaving the biogas conditioning/upgrading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

- **<u>What is included in SoCalGas' turnkey solution?</u>**
  - 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

SoCalGas A Sempra Energy utility

De-Carbonizing the Pipeline:

Electrolysis of Excess Renewable Electricity (Power-to-Gas)



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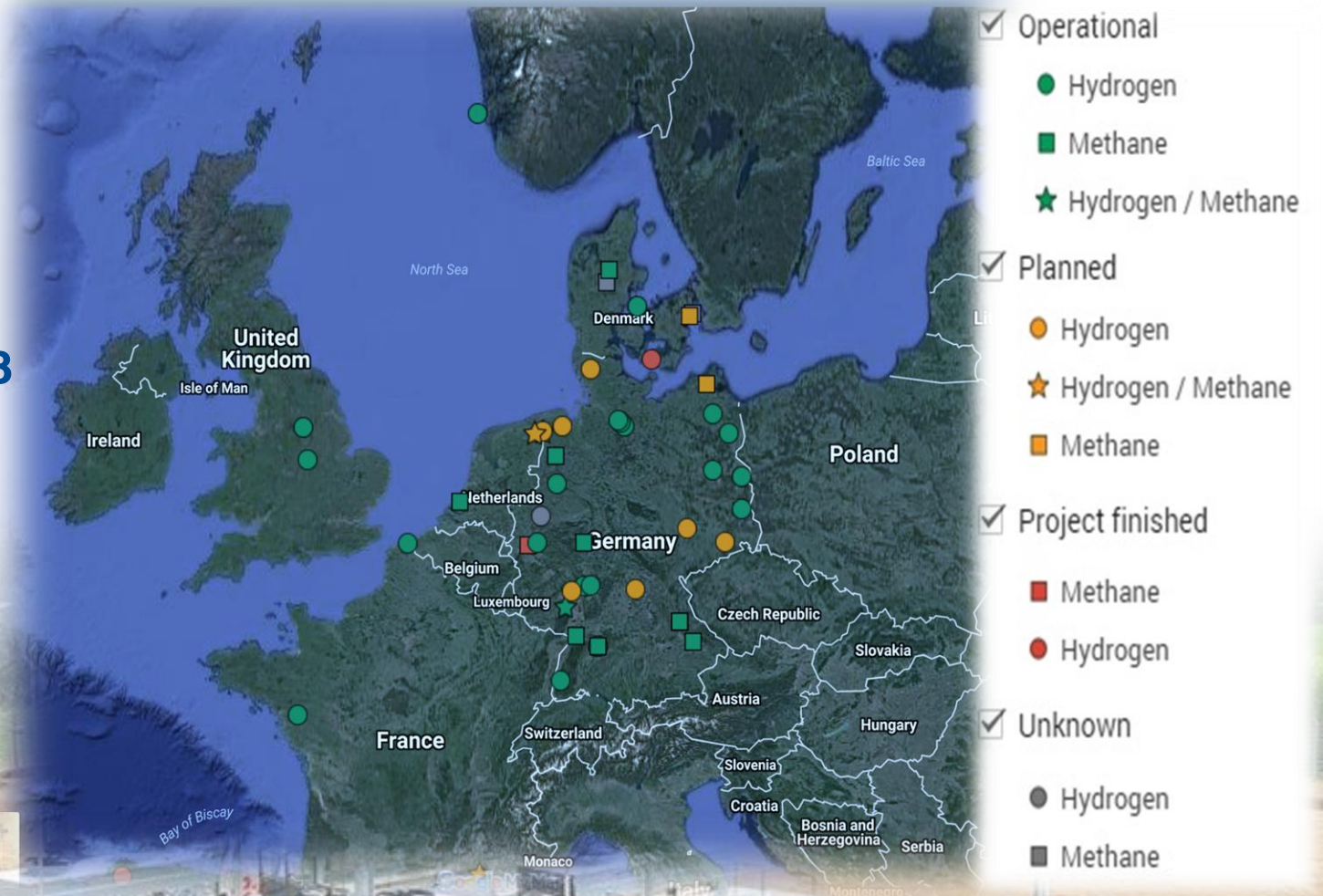
Power-to-Gas Projects:

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**



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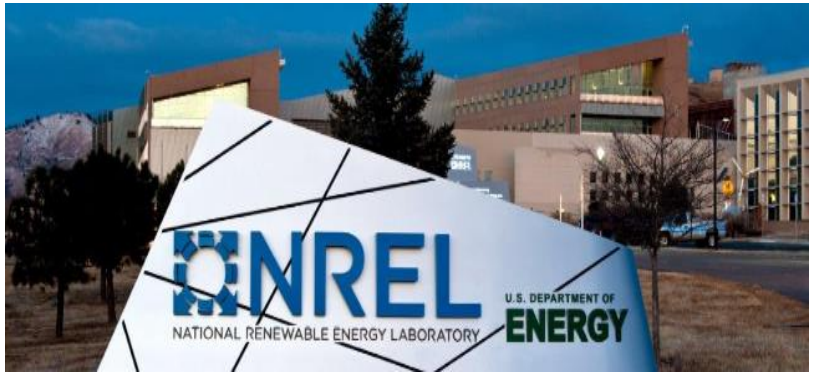
Current Projects In North America

Commercial and Demonstration Projects

Grid Injected Projects

- UC Irvine demonstration (hydrogen), Irvine, CA
- NREL demonstration (methanated hydrogen), Golden, CO
- IESO large scale commercial project (methanated hydrogen), Ontario, Canada



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