



# **TOWARD WIDESPREAD USE OF RENEWABLE NATURAL GAS: OPPORTUNITIES AND CHALLENGES**

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## ABOUT THE RNG COALITION

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**The leading advocacy and education voice for RNG in North America**

**The RNG Coalition advocates for sustainable development, deployment and utilization of renewable natural gas so that present and future generations will have access to domestic, renewable, clean fuel and energy.**

**Utilities, developers, marketers, financiers, technology providers, consultants, and labor coming together.**

**98%+ of the RNG supply in north America.**

THE COALITION FOR  
**RENEWABLE  
NATURAL GAS**



## WHAT IS RNG?

**Renewable Natural Gas (RNG)** is an **interchangeable** substitute or replacement for **Geologic Natural Gas**. The most common type of RNG today is Biomethane.

**Biomethane** is a product gas derived from the decomposition of **organic materials** in **renewable waste streams** (landfill, diverted organics, food waste, wastewater treatment, livestock & agricultural operations).

### POTENTIAL SOURCES OF ORGANICS USED TO PRODUCE RNG INCLUDE:



**FOOD WASTE**  
**66.5 MILLION**  
**TONS / YEAR**



**WASTEWATER**  
**17,000**  
**FACILITIES**



**AGRICULTURE**  
**WASTE**  
**8,000**  
**LARGE FARMS**  
**AND DAIRIES**

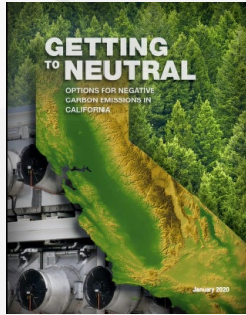


**LANDFILL GAS**  
**1,750**  
**LANDFILLS**

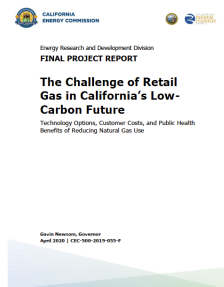
# WHY PROMOTE THE USE OF RNG?

Productive use of organic wastes is critical to reaching carbon neutral goal

# RECENT STUDIES OF HOW TO REACH CA'S GHG REDUCTION GOALS ALL SHOW SIGNIFICANT GROWTH IN RENEWABLE NATURAL GAS USE



“Converting [waste] biomass into fuels with simultaneous capture of the process CO<sub>2</sub> emissions holds the greatest potential for negative emissions in the State. A broad array of processing options is available, and includes collecting biogas from landfills, dairies, and wastewater treatment plants for **upgrading to pipeline renewable natural gas**; conversion of woody biomass to liquid fuels and biochar through pyrolysis; and conversion of woody biomass to gaseous fuels through gasification.” – LLNL, page 4-5



“Efforts to reduce built environment emissions, particularly strategies to reduce GHG emissions from natural gas use in buildings via efficiency or electrification, could also lead to reductions in natural gas demand over time. However, no Energy and Environmental Economics, Inc. (E3) study has yet identified a strategy that eliminates the use of pipeline gas altogether, since zero carbon gas alternatives can replace natural gas in the pipeline. Every scenario leaves residual gas demands in industry, while others allow gas usage in the buildings or transportation sector. The implication is that **any scenario that meets California's climate policy goals uses some amount of renewable natural gas (RNG).**” – E3 and UC Irvine, page 1

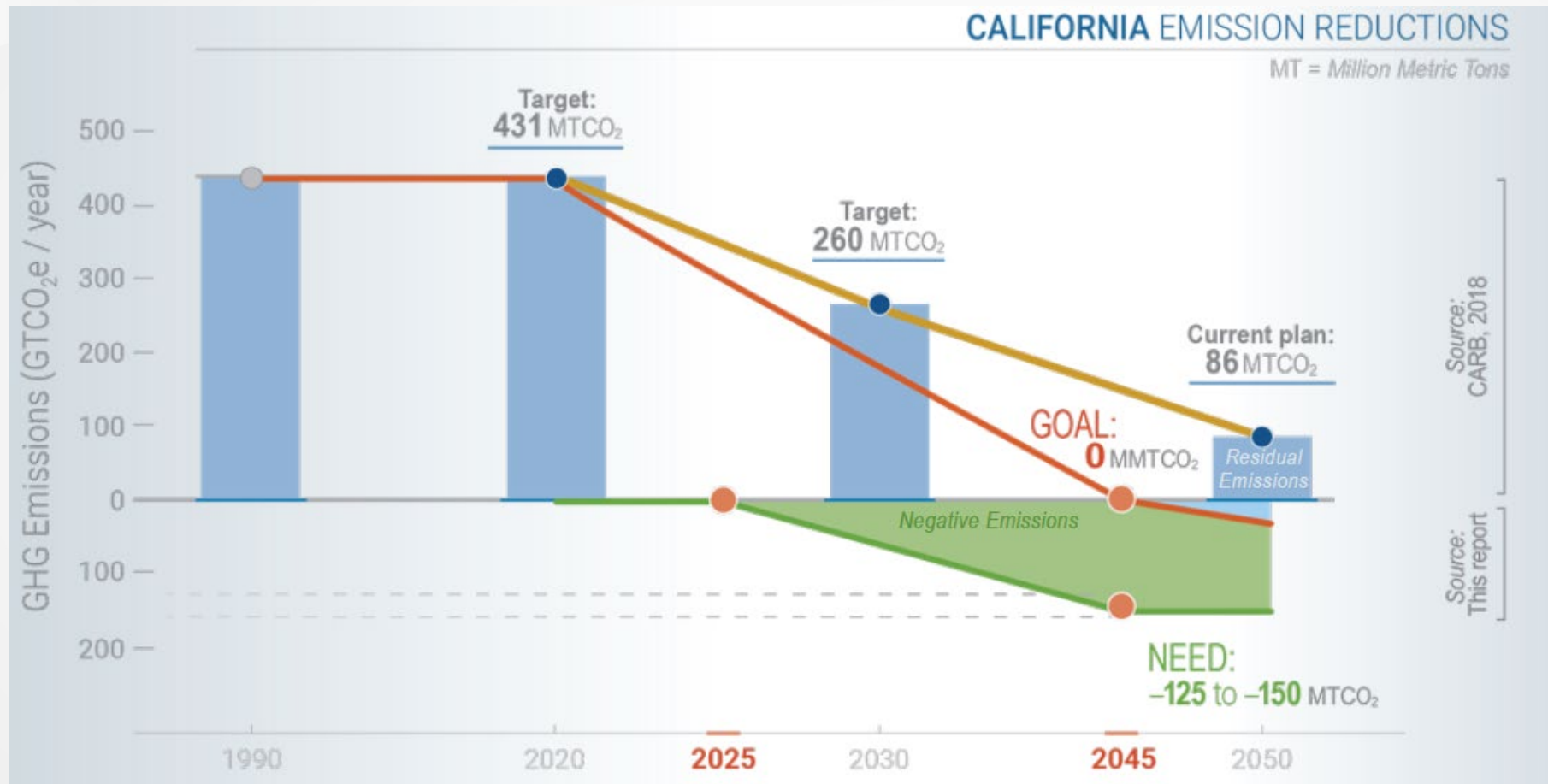


“**The development of RNG in California has multiple tangible benefits:** RNG is a carbon neutral fuel; RNG diverts methane from being released into the atmosphere, enabling major emissions reductions from the difficult-to-decarbonize Industry and Agriculture sectors; and it leverages existing carbon infrastructure, potentially avoiding the costly stranding of these established systems and their associated workforces, as well as their time-consuming and costly replacement.” – EFI, page xix

## Citations:

- LLNL, *Getting to Neutral: Options for Negative Carbon Emissions in California*, Baker et al., January, 2020, Lawrence Livermore National Laboratory (LLNL) [https://www-gs.llnl.gov/content/assets/docs/energy/Getting\\_to\\_Neutral.pdf](https://www-gs.llnl.gov/content/assets/docs/energy/Getting_to_Neutral.pdf)
- E3 and UC Irvine, *The Challenge of Retail Gas in California's Low-Carbon Future: Technology Options, Customer Costs and Public Health Benefits of Reducing Natural Gas Use*. Aas et al., April 2020, California Energy Commission. Publication Number: CEC-500-2019-055-F <https://ww2.energy.ca.gov/2019publications/CEC-500-2019-055/CEC-500-2019-055-F.pdf>
- Energy Futures Initiative (EFI), *Optionality, Flexibility, and Innovation, Pathways for Deep Decarbonization in California*, May 2019 [https://static1.squarespace.com/static/58ec123cb3db2bd94e057628/t/5ced6fc515fcc0b190b60cd2/1559064542876/EFI\\_CA\\_Decarbonization\\_Full.pdf](https://static1.squarespace.com/static/58ec123cb3db2bd94e057628/t/5ced6fc515fcc0b190b60cd2/1559064542876/EFI_CA_Decarbonization_Full.pdf).

# LAURENCE LIVERMORE NATIONAL LAB STUDY HIGHLIGHTS THE IMPORTANCE OF NEGATIVE EMISSIONS IF CARBON NEUTRALITY IS TO BE ACHIEVED





## LLNL HIGHLIGHTS KEY STRATEGIES THAT ACHIEVE NEGATIVE EMISSIONS

How can California achieve 125 MT/year of negative emissions by mid-century?

■ Natural and Working Lands



25 MT/year

■ Waste Biomass Conversion to Fuels with CO<sub>2</sub> Storage



83 MT/year

■ Direct Air Capture with CO<sub>2</sub> Storage



17 MT/year

Technological readiness: mid-to-high – no new breakthroughs required

RNG is part of the strategy

It is the only commercially available fuel with some "carbon negative" (i.e., better than carbon neutral) performance today.

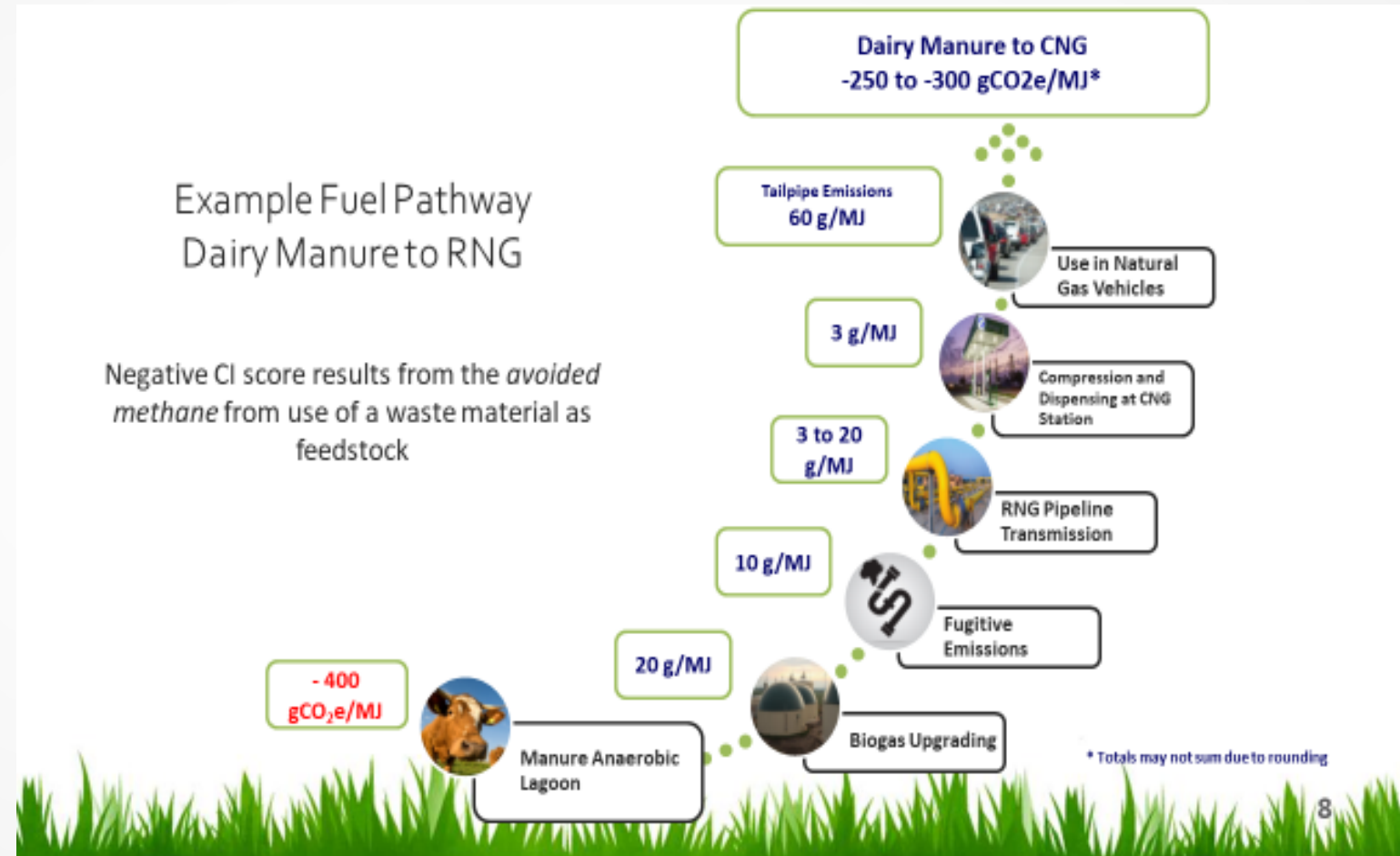
# WHAT IS THE GREENHOUSE GAS PERFORMANCE OF RNG PROJECTS?

- All commercially available supply of RNG has excellent greenhouse gas (GHG) performance relative to fossil fuels like diesel and conventional natural gas
- Promoting RNG using policies based on lifecycle accounting ensures GHG benefits are achieved

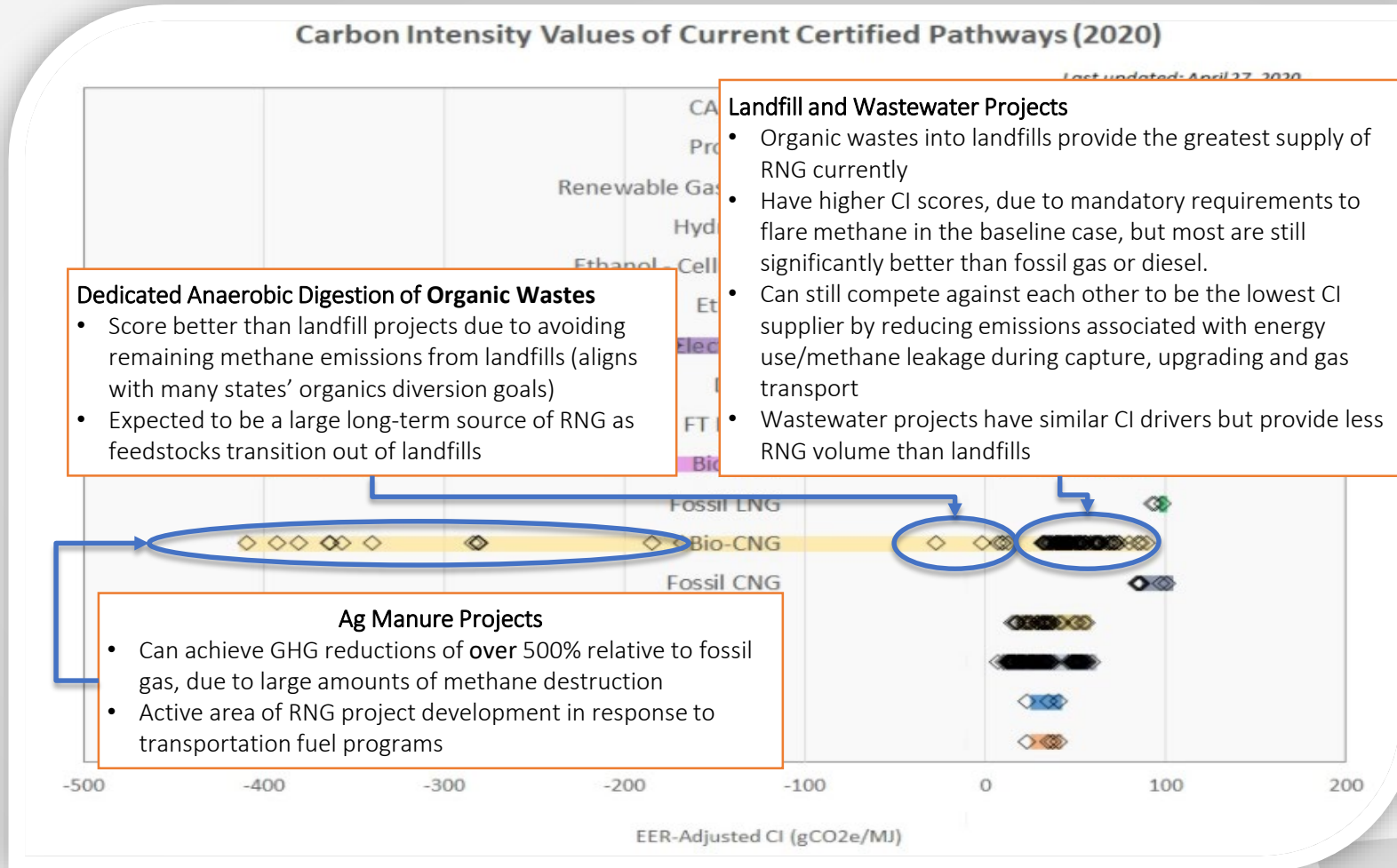


# COMMERCIALLY AVAILABLE RNG TODAY GENERALLY HAS EXCELLENT GREENHOUSE GAS PERFORMANCE RELATIVE TO CONVENTIONAL FUELS

- CARB's Low Carbon Fuel Standard (LCFS) contains a robust accounting framework for evaluating the lifecycle greenhouse gas performance of RNG Projects
- This scoring can easily be adapted to non-vehicle end uses (by removing the compression step and vehicle efficiency penalty)



# LCFS CARBON INTENSITY (CI) SCORING SYSTEM CREATES THE CORRECT INCENTIVES TO PROCURE THE LOWEST-GHG RNG



# THE OPPORTUNITY

RNG feedstocks are largely untapped, both in California and nationwide

## MANY STUDIES HAVE SHOWN RNG'S POTENTIAL TO SERVE A SIGNIFICANT SHARE OF CALIFORNIA'S GAS DEMAND

Current Natural Gas Demand							
	Transport	Commercial	Residential	Power Gen	Industrial	Total	
2018 California Natural Gas Demand (BCF)	24	248	424	615	766	2,077	
% of Total Demand	1%	12%	20%	30%	37%	100%	
RNG Supply <sup>1</sup>							
RNG Potential Study	Potential (BCF)	RNG Potential as a Percent of Current Demand (by Category)					
UC Davis (ITS) <sup>2</sup>	82	342%	33%	19%	13%	11%	4%
ICF (2019) Low	148	618%	60%	35%	24%	19%	7%
LLNL <sup>3</sup>	196	817%	79%	46%	32%	26%	9%
ICF (2017)	208	868%	84%	49%	34%	27%	10%
ICF (2019) High	280	1167%	113%	66%	46%	37%	13%
UC Davis (Biomass Collaborative)	351	1463%	142%	83%	57%	46%	17%
E3 and UCI	387	1613%	156%	91%	63%	51%	19%
ICF (2019) Technical	596	2482%	240%	140%	97%	78%	29%

<sup>1</sup> From California feedstocks only

<sup>2</sup> UCD ITS studied what was economically feasible at assumed LCFS and RIN prices

<sup>3</sup> 2025 estimate (reduces to 170 in 2045 due to waste reduction)

Source for supply estimates:

- 2017 Integrated Energy Policy Report (Summarizes UC Davis (ICF), ICF 2017 and UC Davis Biomass Collaborative) [https://www.energy.ca.gov/2017\\_energy/policy/](https://www.energy.ca.gov/2017_energy/policy/)
- ICF 2019 *Renewable Sources of Natural Gas: Supply and Emissions Reduction Assessment* <https://www.gasfoundation.org/wp-content/uploads/2019/12/AGF-2019-RNG-Study-Full-Report-FINAL-12-18-19.pdf>
- LLNL 2020 Getting to Neutral: Options for Negative Carbon Emissions in California [https://www-gs.llnl.gov/content/assets/docs/energy/Getting\\_to\\_Neutral.pdf](https://www-gs.llnl.gov/content/assets/docs/energy/Getting_to_Neutral.pdf)
- E3 and UCI 2020 The Challenge of Retail Gas in California's Low Carbon Future, Appendix A <https://www2.energy.ca.gov/2019publications/CEC-500-2019-055/CEC-500-2019-055-AP-G.pdf>

Source for demand data: *EIA Natural Gas Consumption by End Use* [https://www.eia.gov/dnav/ng/ng\\_cons\\_sum\\_dcu\\_sca\\_m.htm](https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_sca_m.htm)

## THERE ARE MANY WAYS TO MAKE RNG

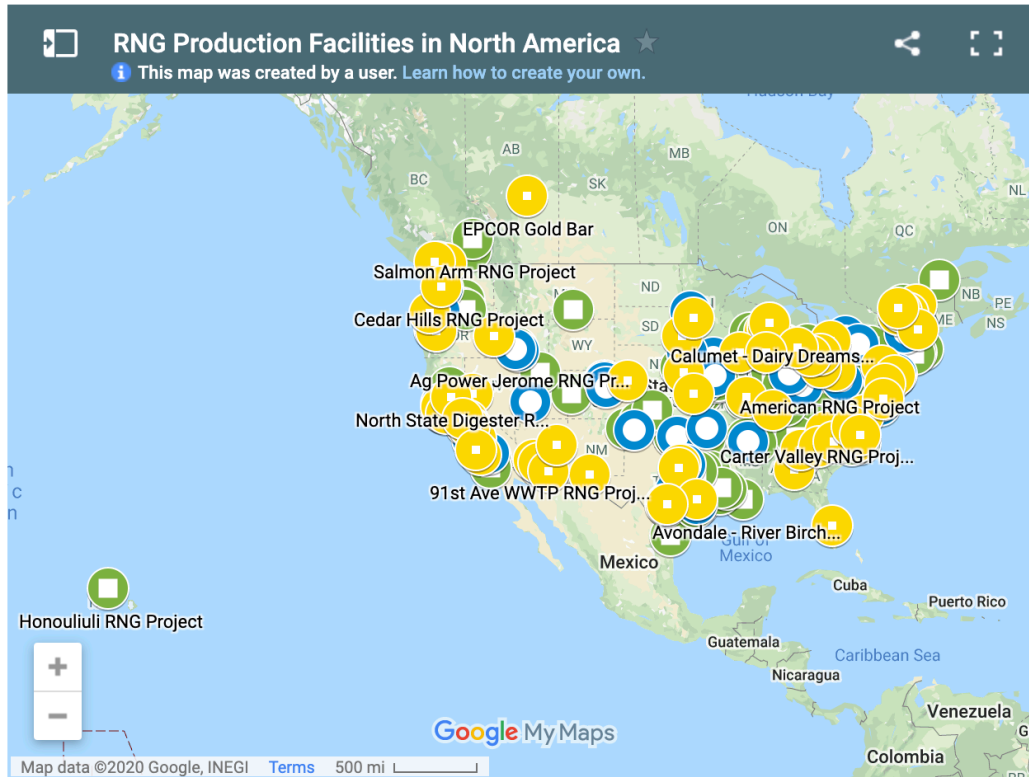
RNG Potential by Feedstock Category (tBtu/y)										
Production Method	Biomethane via Anaerobic Digestion				Biomethane via Thermal Gasification				Power to Gas	Total
Feedstock	Landfill	Animal Manure	Wastewater	Food Waste	Ag Residue	Forest Residue	Energy Crops	MSW	Water and Waste CO <sub>2</sub>	All
US Feedstocks	866	462	34	64	641	236	838	695	679	4,513
California Feedstocks	125	32	4	8	24	5	0	85	N/A	283

Source:

- High scenario from ICF 2019 *Renewable Sources of Natural Gas: Supply and Emissions Reduction Assessment* <https://www.gasfoundation.org/wp-content/uploads/2019/12/AGF-2019-RNG-Study-Full-Report-FINAL-12-18-19.pdf>

# PIPELINE-CONNECTED RNG PROJECTS ARE A RAPIDLY GROWING SUBSET OF ALL PROJECTS

## RENEWABLE NATURAL GAS PRODUCTION FACILITIES IN NORTH AMERICA




### RNG PRODUCTION FACILITY COUNTER

129 OPERATIONAL/ONLINE (U.S. - 118, CANADA - 11)


35 UNDER CONSTRUCTION (U.S. - 34, CANADA - 1)

75 IN SUBSTANTIAL DEVELOPMENT (U.S. - 64, CANADA - 11)

### MAP KEY

 Operational / Online

 Under Construction

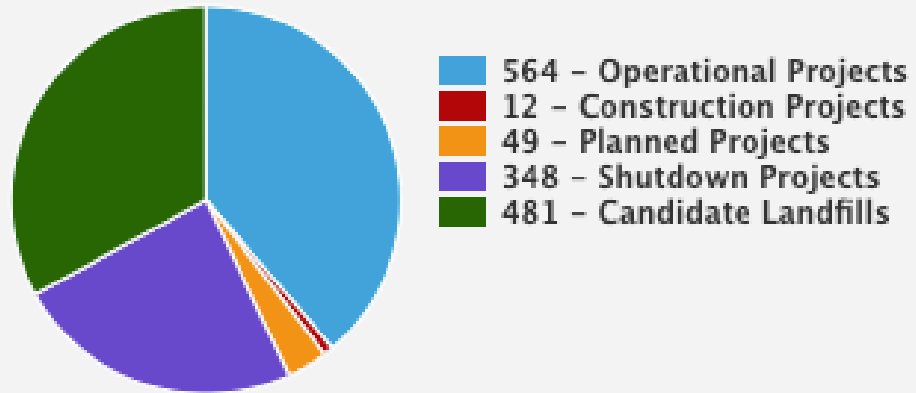
 Substantial Development

Use of pipeline-injected RNG can be shifted to whichever sector needs it over time

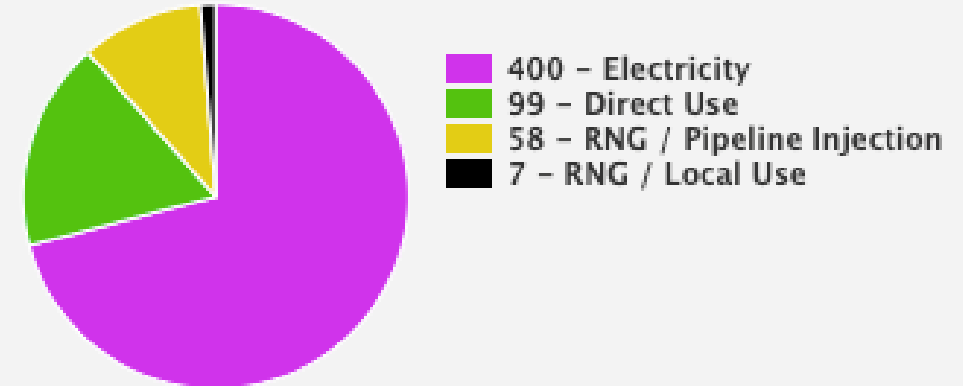


## LANDFILL GAS IS THE MOST ESTABLISHED FORM OF RNG

LFG Energy Project and Candidate Landfill Summary (March 2020)



Operational LFG Energy Projects by Type (March 2020)



## ANIMAL MANURE RNG PROJECTS ARE AN AREA OF UNTAPPED POTENTIAL CURRENTLY UNDERGOING STRONG GROWTH IN CALIFORNIA



### Market Opportunities for Biogas Recovery Systems at U.S. Livestock Facilities



 United States Environmental Protection Agency  
[www.epa.gov/agstar](http://www.epa.gov/agstar)

June 2018  
EPA-430-R-18-006

### Projects - 255 operational projects in the United States

- 205 Dairy
- 44 Hog
- 7 Poultry
- 8 Beef

*Note: Data as of March 2020. Total exceeds 255 because some projects accept manure from more than one animal type.*

US EPA's AgSTAR estimates that biogas recovery systems are technically feasible at over 8,000 large dairy and hog operations

## RNG SUPPLY CURVES

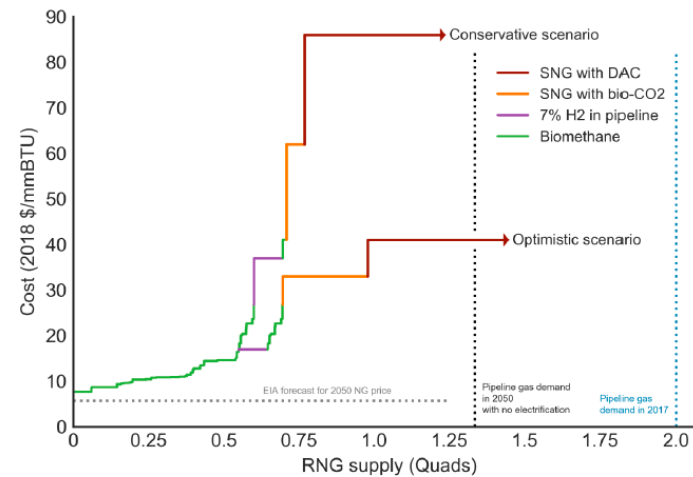
### E3 AND THE UNIVERSITY OF CALIFORNIA, IRVINE

### ICF

#### Key observations:

- Biomethane is lower cost relative to other renewable gases
- Similar range of biomethane prices (less than \$20/MMBtu) across studies
- High uncertainty in costs of synthetic natural gas/H<sub>2</sub>
- E3/UCI includes population-weighted share of nation-wide feedstock supply
- ICF curve is for the US as a whole

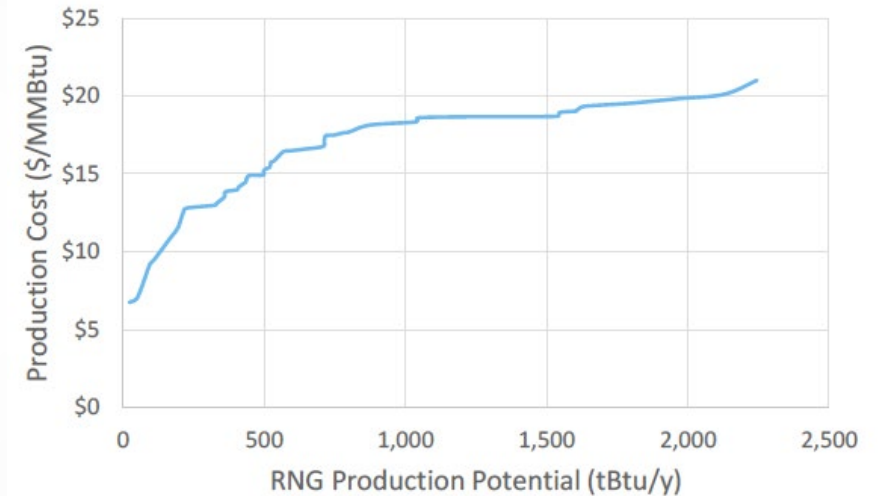
**Figure 8: California RNG Technical Potential Supply Curve in 2050, Assuming All Biomass Is Directed to RNG**



The biomethane supply curve segments (green) are based on allocating California's population-weighted share of U.S. waste and residue biomass entirely to biomethane. In the PATHWAYS scenarios, much of the biomass is used for liquid fuels to displace petroleum consumption in transportation and industry.

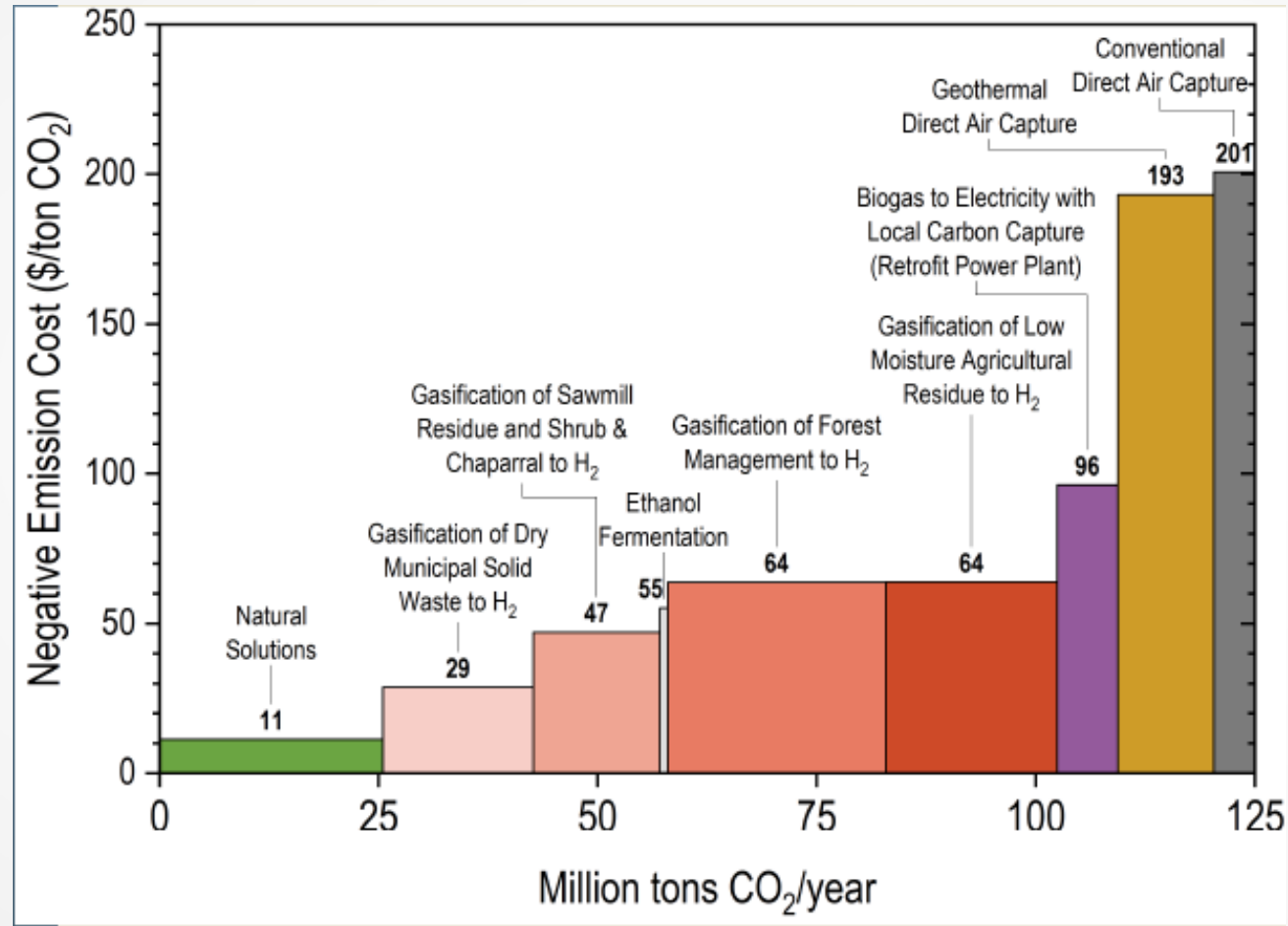
Source: E3

**Figure 34. Combined RNG Supply-Cost Curve, less than \$20/MMBtu in 2040**



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# LLNL Shows RNG-related Negative GHG Abatement at Prices Lower than Current LCFS Prices



# CHALLENGES

RNG policies must provide long-run policy support for the industry to scale (including for use outside of the transportation sector)

## UNDERSTANDING BARRIERS TO RNG DEPLOYMENT

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### **Operational Risk**

- Feedstock availability
- Feedstock consistency
- Equipment failure

### **Project Economics**

- Large upfront costs
- Operational and maintenance costs

### **Market Risk**

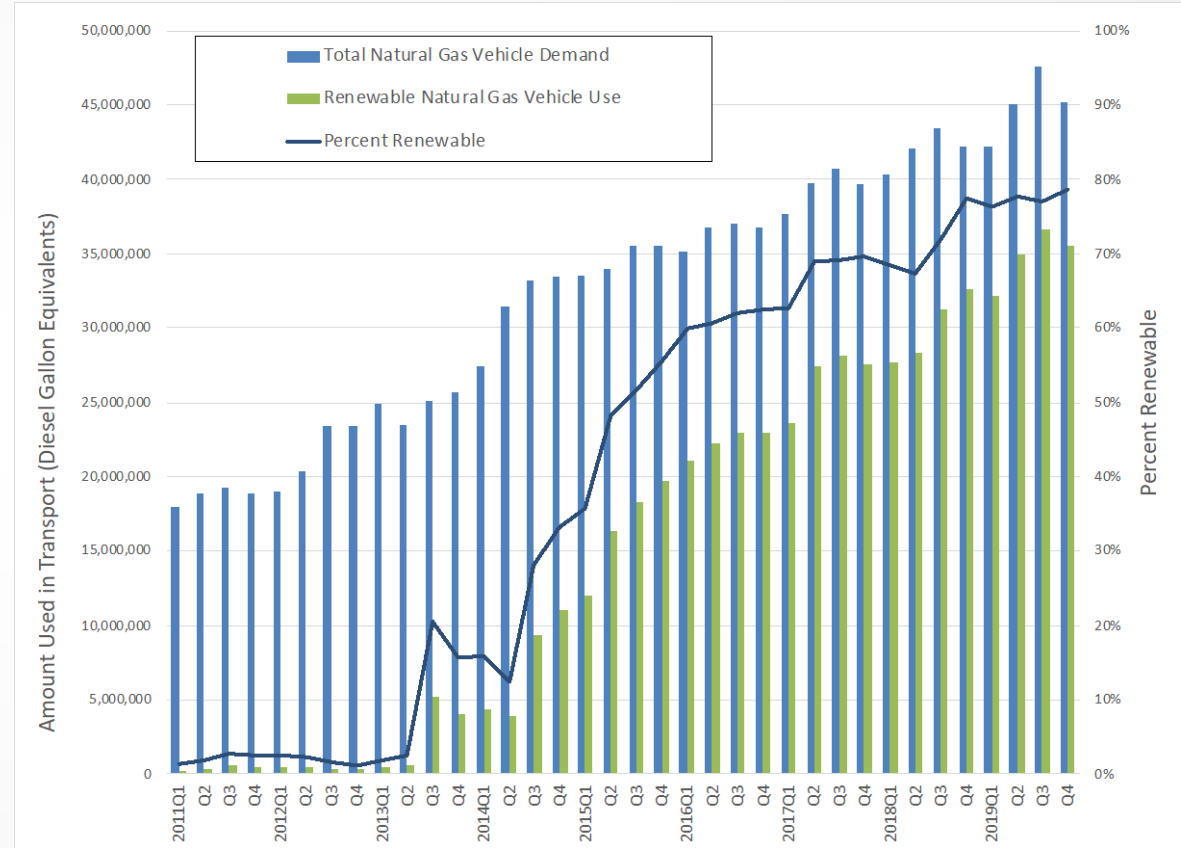
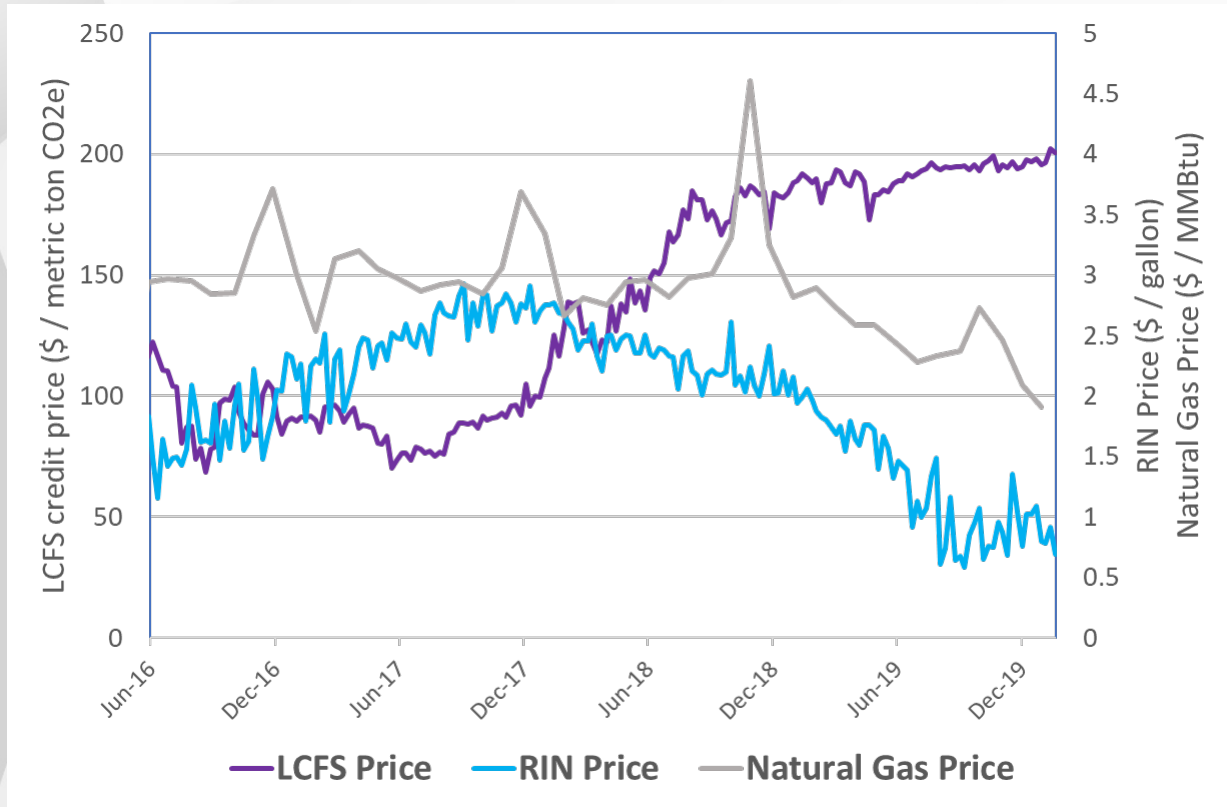
- Uncertainty in gas prices, credit prices

### **Regulatory Risk**

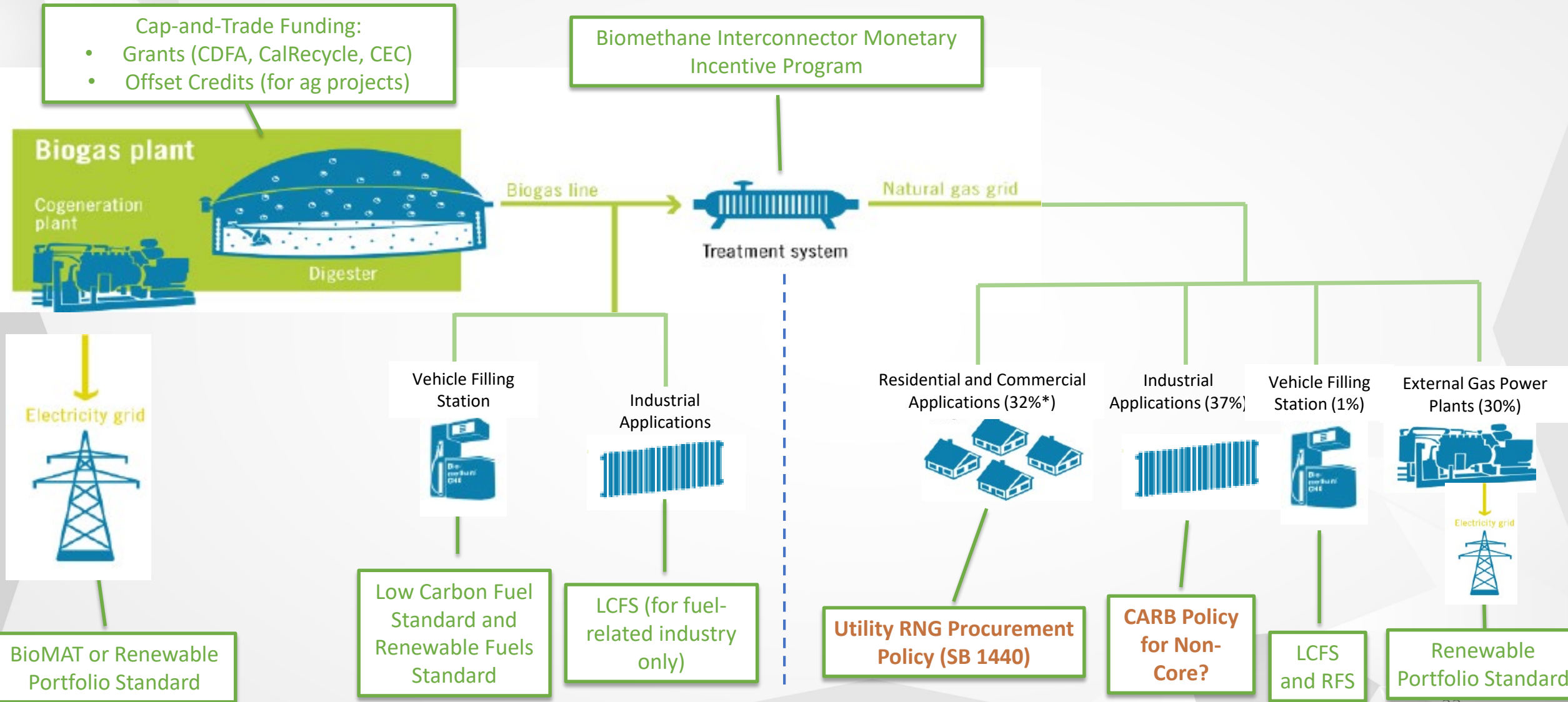
- Shifting political forces
- Reliance on stable rulemaking
- No strong policy in large end-use sectors



# DUE TO STRONG POLICY SUPPORT FROM CALIFORNIA'S LCFS, RNG IS SATURATING EXISTING VEHICLE DEMAND



# DESPITE THE SUCCESS IN TRANSPORTATION, CURRENT CA POLICY DOES NOT PROMOTE SIGNIFICANT RNG USE IN THE OTHER MAJOR GAS DEMAND SECTORS (RESIDENTIAL, COMMERCIAL, INDUSTRIAL AND POWER)



## CONCLUSIONS

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- Widespread use of RNG is likely necessary to reach California's Carbon Neutrality goal
- Some RNG can already provide carbon-negative performance today
- RNG is complementary to methods to reduce GHGs through gas demand reduction (efficiency and electrification)
- Aligning GHG accounting in RNG programs with the Low Carbon Fuel Standard will create the proper incentives to reduce lifecycle emissions
- Implementation of a Renewable Gas Standard—in line with legislative direction from SB 1440—is critical to decarbonize any remaining California demand for the energy services currently provided by fossil natural gas
- Similar policy support should also be developed by CARB to incent RNG use by non-core customers



## **SPEAKER INFO**

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