Renewable Natural Gas:

Using RNG to Reduce Methane from Organic Wastes and Help Achieve California's Climate Goals

Sam Wade
Coalition for Renewable Natural Gas
Director of Public Policy
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About the RNG Coalition

- The leading advocacy and education voice for RNG in North America
- We advocate for the 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
- RNG developers, marketers, financiers, technology providers, consultants, utilities and labor coming together
- 98%+ of the RNG supply in North America

RNG Coalition LEADERSHIP Members

Not all pictured, for a full list see: https://www.rngcoalition.com/coalitionmembers

RNG Coalition GENERAL Members

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RNG Coalition ACADEMIC Members

Columbia University in the City of New York

Cornell University Founded A.D. 1865

Renewable Energy & Sustainability Center at Farmingdale State College

Iowa State University of Science and Technology

Michigan State University

TomKatCenter for Sustainable Energy Stanford University

Advanced Energy Research and Technology Center at Stony Brook University

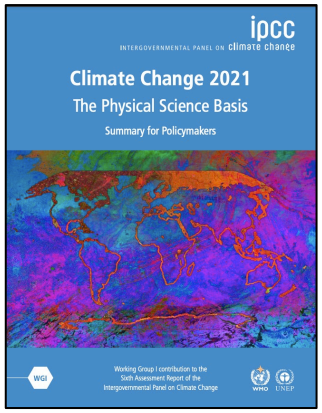
University of Idaho

University of California

UC Riverside University of California | CE-CERT

UC San Diego

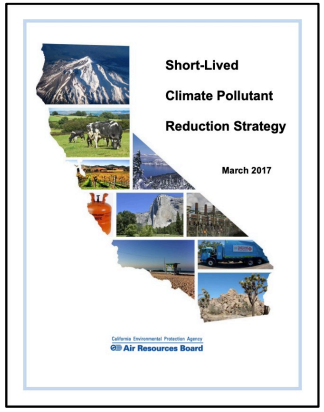
Abating Methane from Organic Wastes Remains a Critical Climate Strategy, both in Globally and in California



"Sustained methane mitigation, wherever it occurs, stands out as an option that combines near- and long-term gains on surface temperature and leads to air quality benefits by reducing surface ozone levels globally."

"Over time scales of 10 to 20 years, the global temperature response to a year's worth of current emissions of SLCFs is at least as large as that due to a year's worth of CO_2 emissions (high confidence). Sectors producing the largest SLCF-induced warming are those dominated by CH_4 emissions: fossil fuel production and distribution, agriculture and waste management."

"For example, some short-term 'win-win' policies that simultaneously improve air quality and limit climate change include the implementation of energy efficiency measures, ***methane capture and recovery from solid waste management*** and oil and gas industry…"



"California's organic waste streams are responsible for half of the State's methane emissions and represent a valuable energy and soil-enhancing resource. Effectively implementing the measures described in this SLCP Strategy will not only reduce methane emissions but provide many other benefits as well, including cutting emissions of CO_2 and boosting economic growth in agricultural and rural communities."

IPCC, 2021. Climate Change 2021: The Physical Science Basis. Chapter 6. Short-Lived Climate Forcers. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter_06.pdf
CARB, 2017. Short Lived Climate Pollution Reduction Strategy. https://ww2.arb.ca.gov/sites/default/files/2020-07/final_SLCP_strategy.pdf

SB 1383 (Lara, 2016) Goals and Progress

- CalRecycle:

"Organics recycling and recovery infrastructure is growing, but still needs significant expansion to provide the recycling capacity necessary to meet the SB1383 disposal and methane reduction goals."

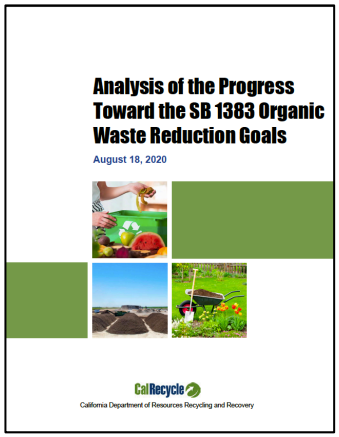
"Due to high capital expenses, AD facilities often rely on revenue from renewable energy incentives to make projects economically feasible."

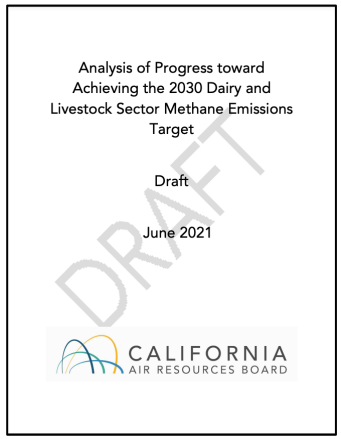
- CARB:

"This Analysis shows that the dairy and livestock sector is projected to achieve just over half of the annual methane emissions reductions necessary to achieve the target by 2030 through modifications to manure management systems—primarily using anaerobic digesters—and additional reductions through decreases in animal populations."

"New or expanded local, State, or federal incentives or funding mechanisms could potentially accelerate the capture and beneficial use of California biomethane, provide additional revenue necessary to ensure that California's dairy manure methane emissions are captured, and direct the biogas to difficult-to-decarbonize sectors"

- RNG industry stands ready to help achieve the goals, agrees that economics of RNG production will be a key driver





https://www2.calrecycle.ca.gov/Publications/Details/1693
https://ww2.arb.ca.gov/sites/default/files/2021-06/draft-2030-dairy-livestock-ch4-analysis.pdf

RNG Production Facilities In North America

How Much RNG Can Be Made from CA Organic Waste Materials?

Natural Gas Demand							
		Transport	Commercial	Residential	Power Gen	Industrial	Total
2019 California Natural Gas Demand (BCF)		27	256	465	578	768	2,094
% of Total Demand		1%	12%	22%	28%	37%	100%
RNG Supply[1]							
RNG Potential Study	Potential (BCF)	Percent of Demand					
UC Davis (ITS)[2]	82	304%	32%	18%	14%	11%	**4%**
ICF (2019) Low	148	550%	58%	32%	26%	19%	**7%**
LLNL[3]	196	726%	77%	42%	34%	26%	**9%**
ICF (2017)	208	771%	81%	45%	36%	27%	**10%**
ICF (2019) High	280	1037%	109%	60%	48%	36%	**13%**
UC Davis (Biomass Collaborative)	351	1300%	137%	75%	61%	46%	**17%**
E3 and UCI (2020)	387	1433%	151%	83%	67%	50%	**18%**
ICF (2019) Technical	596	2206%	233%	128%	103%	78%	**28%**

[1] All estimates are for California feedstocks only; [2] Economically feasible estimate at assumed LCFS and RIN Prices; [3] 2025 estimate (reduces to 170 in 2045 due to landfill diversion)

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_energypolicy/

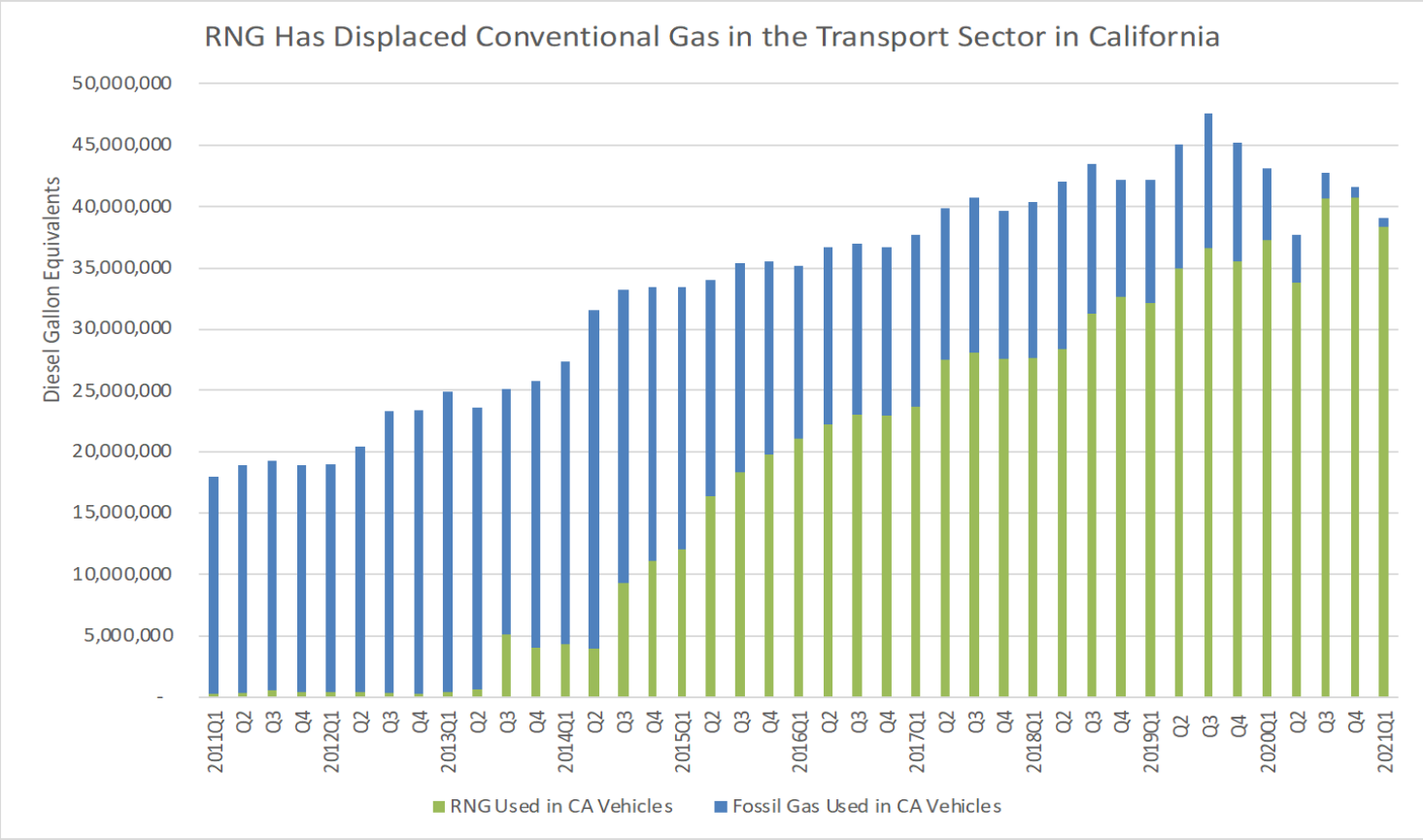
ICF 2019 Renewable Sources of Natural Gas: Supply and Emissions Reduction Assessment https://www.gasfoundation.org/wp-content/uploads/2019/12/AGF-2019-RNG-Study-Full-Report-FINAL-12-18-19.pdf

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

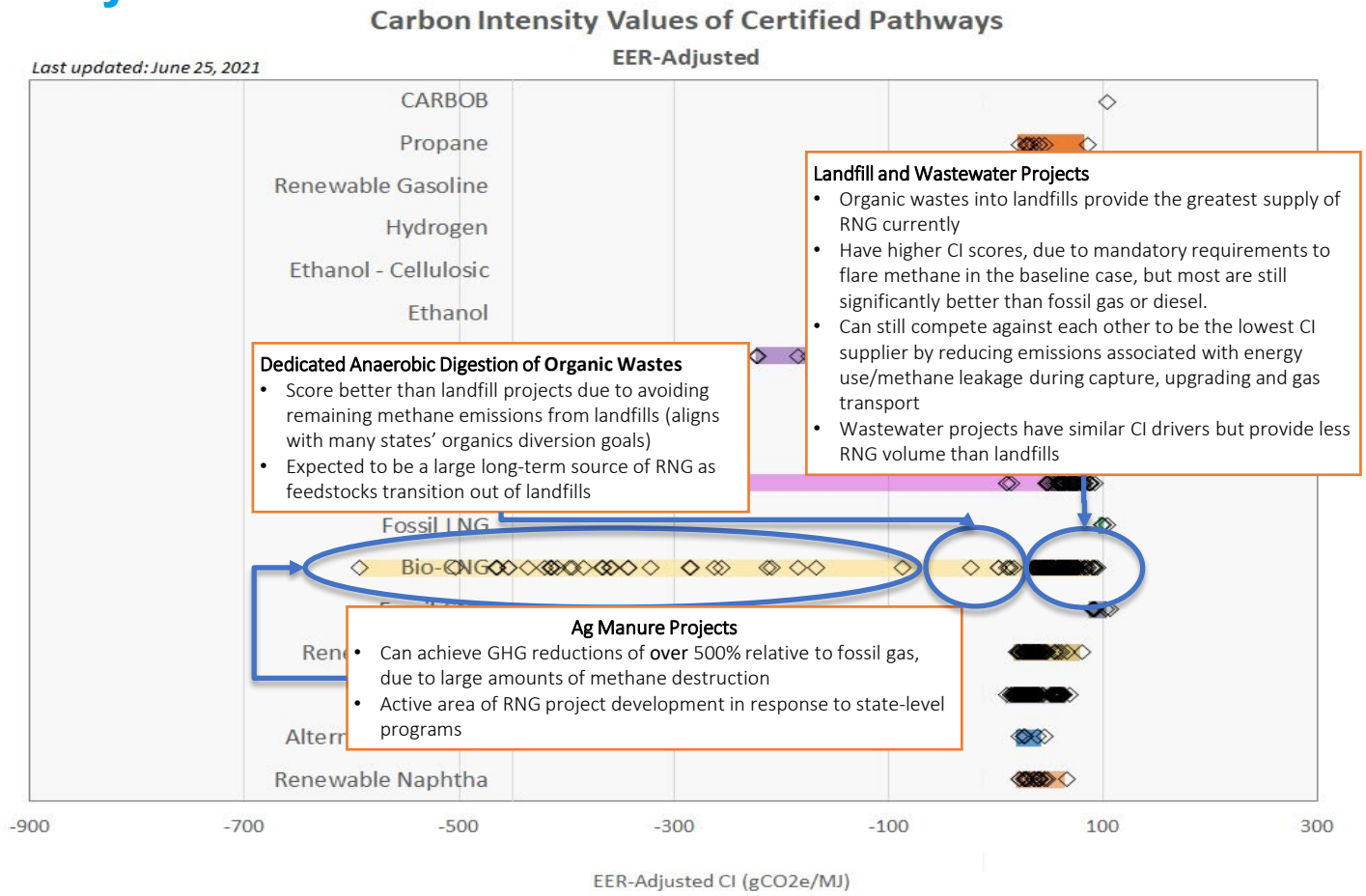
E3 and UCI 2020 The Challenge of Retail Gas in California's Low Carbon Future, Appendix A https://ww2.energy.ca.gov/2019publications/CEC-500-2019-055/CEC-500-2019-055-AP-G.pdf

Source for demand data: EIA Natural Gas Consumption by End Use https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_sca_m.htm

CA Low Carbon Fuel Standard (LCFS) is Working, Achieved 98% RNG Blend Rate in Transportation NGVs in Q1 2021



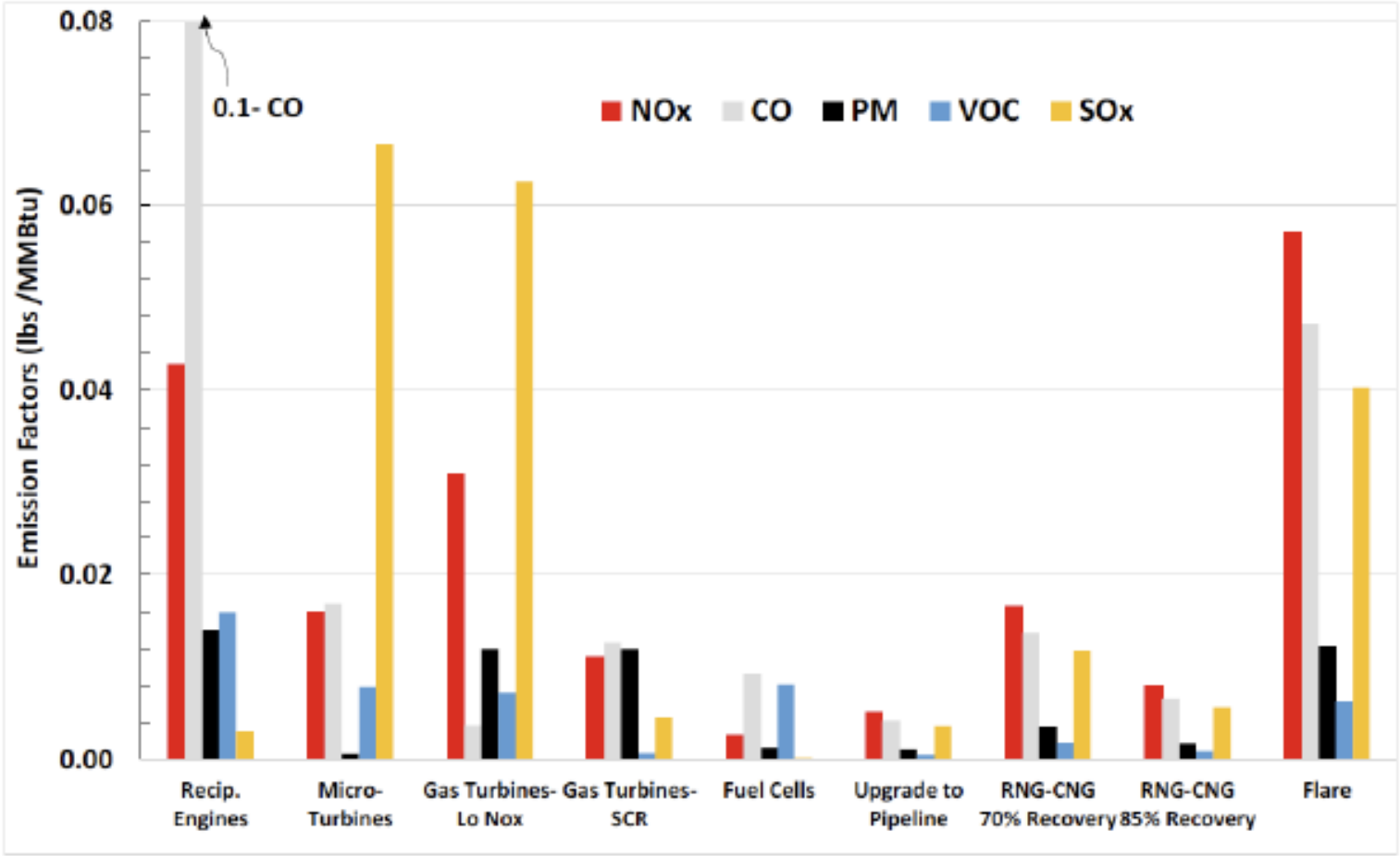
Each LCFS RNG Pathway Has a Unique Lifecycle Carbon Intensity Score. All Are Better than Conventional Gas.



Many Concepts from LCFS can be Imported into Other Policies to Promote RNG (e.g., Utility Procurement Programs)

- Key metric should always be "mass of CO_2e/MJ of gas delivered," matching the LCFS.
- Lifecycle analysis using this metric can addresses common critiques/concerns about RNG:
  - High carbon/energy intensive methods won't be used to make RNG (would have poor scores)
  - Methane leakage rates are captured in the scoring (less leaks → better score)
  - Minimize transportation distances/new gas infrastructure (minimize transport distance/lower embedded emissions → better score)
- LCA tools need to keep improving over time:
  - Avoided methane benefits from displacing landfill disposal of organics may currently be undercounted

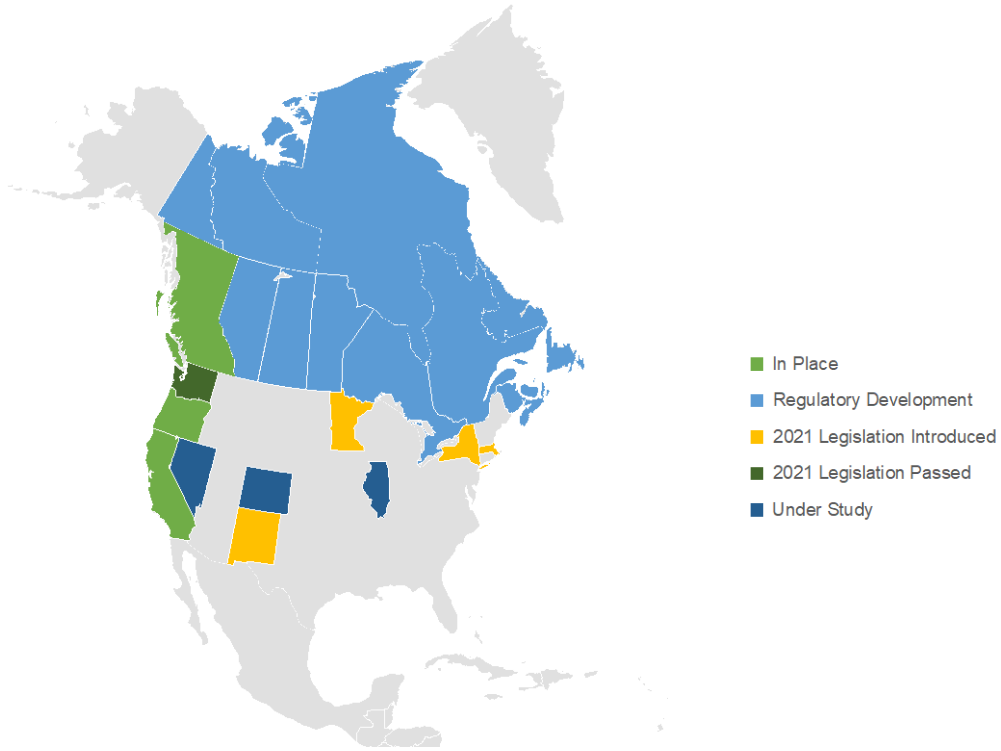
Criteria Air Pollutant Performance of Pipeline-Injection Projects Likely to be Preferable Compared to On-site Combustion (Non-Fuel-Cell Power Gen or Flaring)



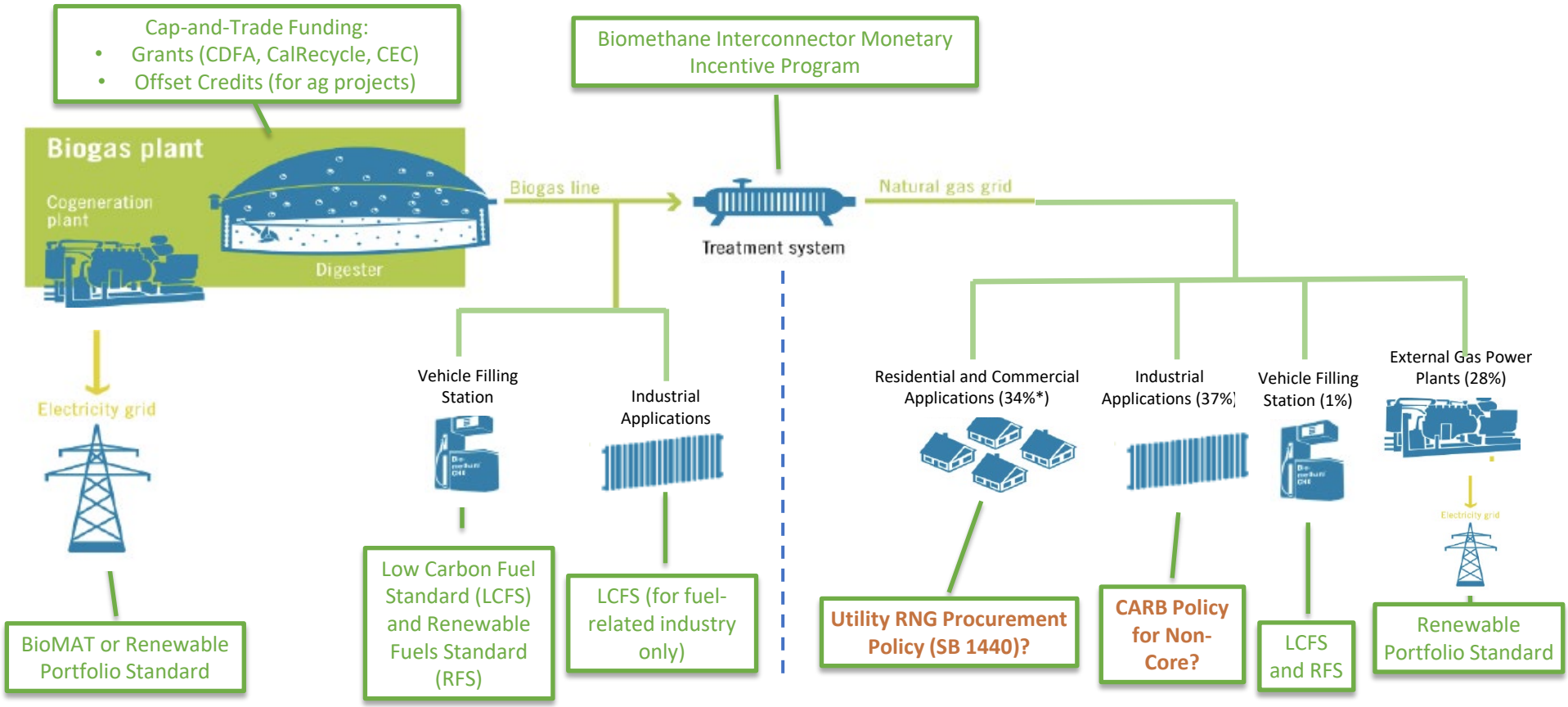
Citation:

- US EPA, *Evaluating the Air Quality, Climate & Economic Impacts of Biogas Management Technologies*, September 2016, https://nepis.epa.gov/Exe/ZyPDF.cgi/P100QCXZ.PDF?Dockey=P100QCXZ.PDF
- California Air Resources Board, *Dairy Digester Emissions Matrix*, https://ww2.arb.ca.gov/sites/default/files/2020-07/dairy-emissions-matrix-113018.pdf

California Leadership is Leading to Expansion of Clean Fuel Standards Across North America



Current CA Policy Promotes RNG Creation, Use in Transportation and Power. But not Use in the Largest Gas Demand Sectors (Residential, Commercial, Industrial).



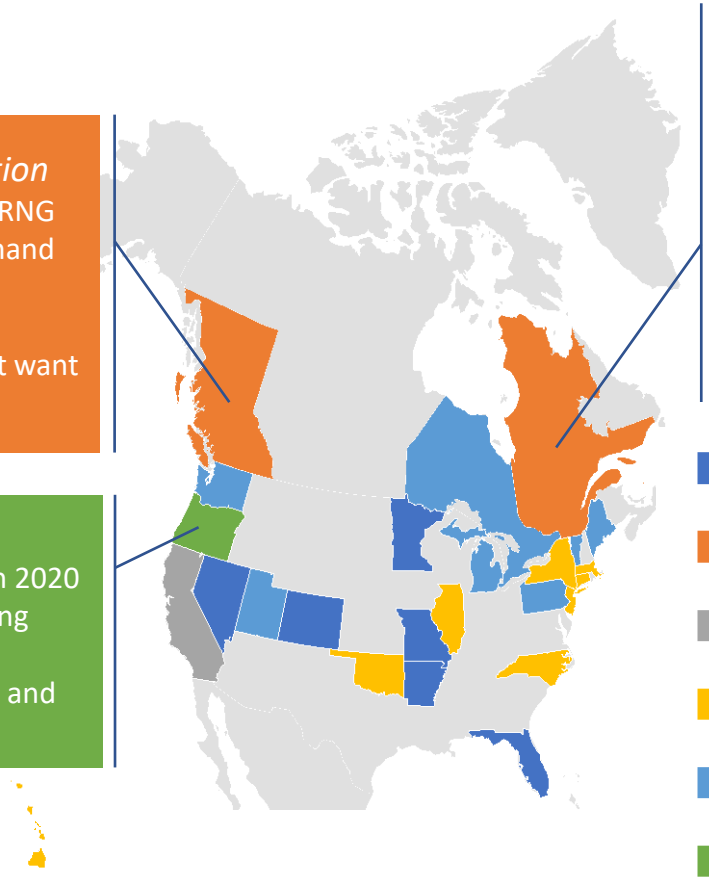
* Percentages of 2019 total natural gas volume delivered to customers in California, US EIA

Graphic Source: Modified from Biowaste to Bioenergy, FvB, 2016

RNG Procurement by Gas Utilities is also a Growing Trend Across North America

BC *GHG Reduction Regulation*
- Allows utilities to procure RNG for up to 15% of 2015 demand for all customers
- Fortis BC offers an opt-in product for customers that want more RNG

OR *SB 98 (2019)*
- Implemented by OR PUC in 2020
- Northwest Natural procuring RNG today
- Soft target of 15% by 2030 and 30% by 2045



Quebec *Regulation Respecting the Quantity of RNG to be Delivered by a Distributor*
- Requires utilities to procure RNG for at least 10% of 2030 demand for all customers
- Gazifere offers an opt-in product for customers that want more RNG

Leg Passed, Regulatory Development (All Customers)

In Place (All Customers and Opt-in)

Leg Passed, Regulatory Development Underway (All Customers and Opt-in)

Proposed Legislation or Utility Filing

In Place (Opt-in Customers)

In Place (All Customers)

https://www.nwnatural.com/about-us/environment/renewable-natural-gas
https://www.fortisbc.com/services/sustainable-energy-options/renewable-natural-gas
https://gazifere.com/en/renewable-natural-gas/

Studies on Deep Decarbonization All See a Role for RNG, Disagree About What Sector Should Use It

Table 2-1 | The Role of RNG in Deep Decarbonization Studies

REGION	STUDY	FINDINGS AND ASSUMPTIONS RELATED TO ROLE OF RNG IN DEEP DECARBONIZATION BY MIDCENTURY OR EARLIER
California	Deep Decarbonization in a High Renewables Future (Mahone et al. 2018)	**Transport**: Light-duty vehicles move toward 100% electrification. Medium- and heavy-duty vehicles use biomethane alongside mix of CNG, hydrogen, and other biofuel options. **Stationary end uses:** Alongside large-scale building electrification, RNG displaces additional building gas demand.
California	Getting to Neutral: Options for Negative Emissions in California (Baker et al. 2020)	**Cross-cutting**: Reaching net-zero emissions will require scaling of net-negative decarbonization strategies. RNG and hydrogen from organic wastes can play a role if coupled with emerging CCS technologies to achieve added carbon removal.
Oregon/ Washington	Pacific Northwest Pathways to 2050 (Aas et al. 2018)	**Stationary end uses**: Alongside electrification efforts, RNG and hydrogen may be used in existing gas distribution networks to help decarbonize hard-to-abate end uses and meet peak heating demand.
Northeast	Northeastern Regional Assessment of Strategic Electrification (Hopkins et al. 2017)	**Cross-cutting**: Alongside rapid electrification, RNG and other low-carbon fuel supply can be deployed to further lower emissions.
Northeast	Northeast 80x50 Pathway (National Grid 2018)	**Stationary end uses**: Region can reduce emissions through rapid transition away from liquid fuels in building heating and conversion to electric heat pumps, natural gas, and renewable natural gas from local feedstocks.
Northeast	The Role of Renewable Biofuels in a Low Carbon Economy (Lowell and Saha 2020)	**Cross-cutting**: Complementary deployment of biofuels may be viable for decarbonization. **Transport**: Alongside significant electrification of heavy-duty vehicles (with the exception of combination trucks), RNG fuels 80–100% of NG vehicles in 2030. **Stationary end uses**: Alongside electrification, RNG may be used to meet 5–10% of residential and commercial heating demand in 2030.

Notes: CNG = Compressed natural gas; CCS = Carbon capture and storage; NG = Natural gas.
Source: WRI authors, based on studies cited above.

WRI 2020, Renewable Natural Gas as a Climate Strategy: Guidance for State Policymakers
https://static1.squarespace.com/static/53a09c47e4b050b5ad5bf4f5/t/60ad57a35aaa6563fbc3e508/1621972901032/2020_Dec+World+Resources+Institute_Renewable-natural-gas-climate-strategy.pdf

CARB Should Articulate a Multi-Phase Strategy for Use of RNG Resource in this Scoping Plan Cycle

Near-Term: Reduce Methane Emissions

- Build the RNG projects immediately to reduce methane from organic waste streams as fast as possible
- Expand LCFS-like incentives to other sectors
- Reach 2030 SCLP reduction goals
- Begin to decarbonize the gas system

Mid-Term: Begin to Prioritize RNG Use in Hard to Decarbonize Sectors

- RNG projects that are pipeline injected offer a flexible resource that can be sent to the sectors that most need it over time (i.e., those that prove to be hard to decarbonize in other ways)
- This choice becomes more important when remaining gas demand is closer to RNG supply

Long-Term: Manage Transition to H_2 with CCS

- When hydrogen transport infrastructure develops, consider transitioning bio feedstocks to H_2 molecule as the energy carrier (especially for non-AD feedstocks)
- Couple H_2 production with Carbon Capture and Sequestration to get carbon negative outcomes

Conclusions

- Many additional opportunities exist to deploy RNG across all California sectors that currently use conventional gas
  - Critical to build out RNG to reach methane reduction goals and to begin the decarbonization of the gas sector
- California's LCFS is a proven model to support RNG project development
  - RNG is delivering the promised GHG benefits and remains the lowest carbon fuel in the LCFS program
  - Similar support needed to promote RNG across additional end uses
- RNG production capacity expansion will allow cities, counties, and California's waste and agricultural sector to comply with SB 1383 requirements
- Timely California leadership will be highly valuable in providing a consistent vision for how the RNG resource is developed and used across North America

Speaker Info

Sam Wade
RNG Coalition, Director of Public Policy
sam@rngcoalition.com
(916) 588-3033
RNGCoalition.com