

Biogas and RNG Market Trends

Scott Martin, P.E.
September 27, 2024



AGENDA

- Biogas Use Basics
- Renewable Thermal Certificates
- Biogas Use Considerations in Missouri
- RNG Market Drivers
- Project Development Considerations
- Q&A/Discussion

Biogas Market Overview

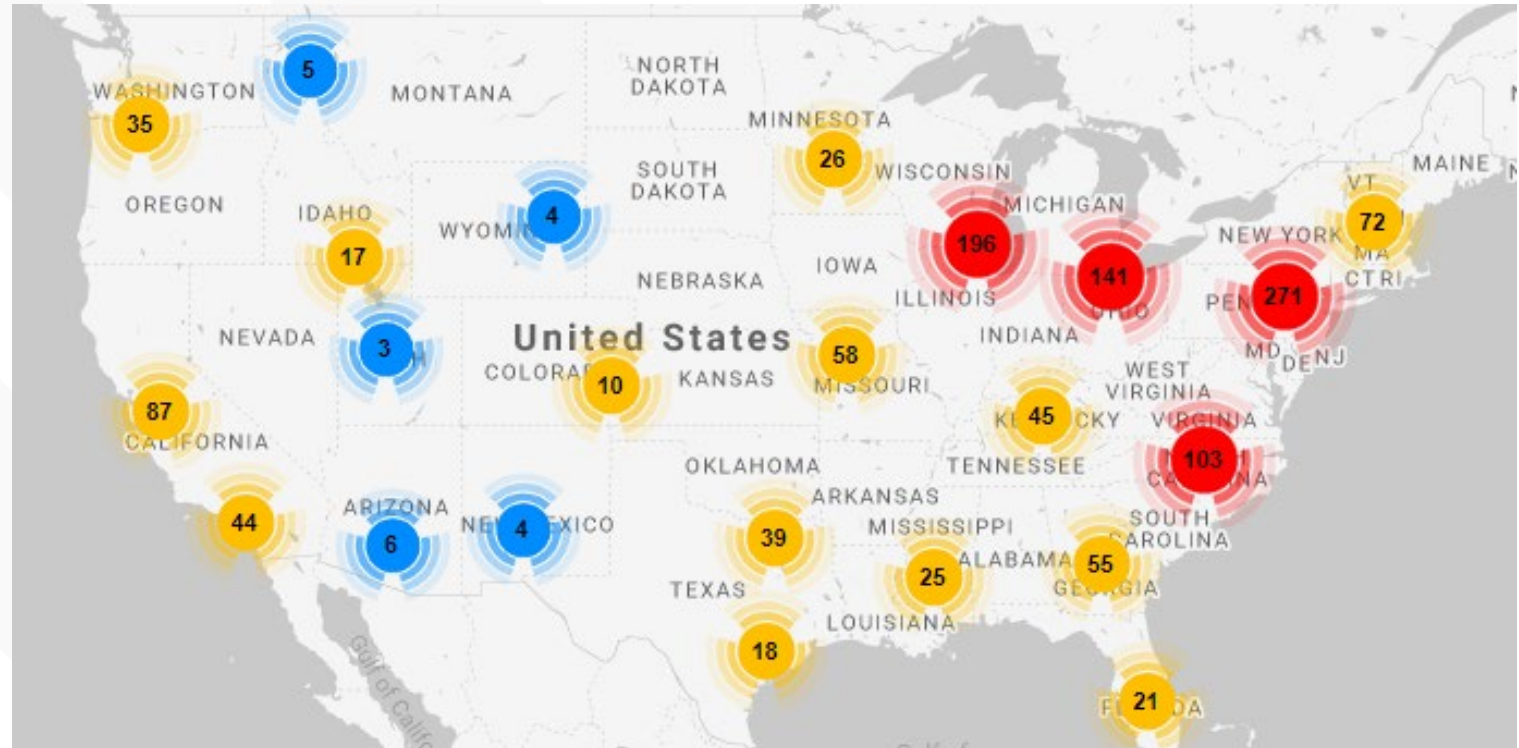
▶ 2,300 Current Sites Producing Biogas with Capture Systems

▶ 350 Manure / Ag

▶ 1,250 WWTP

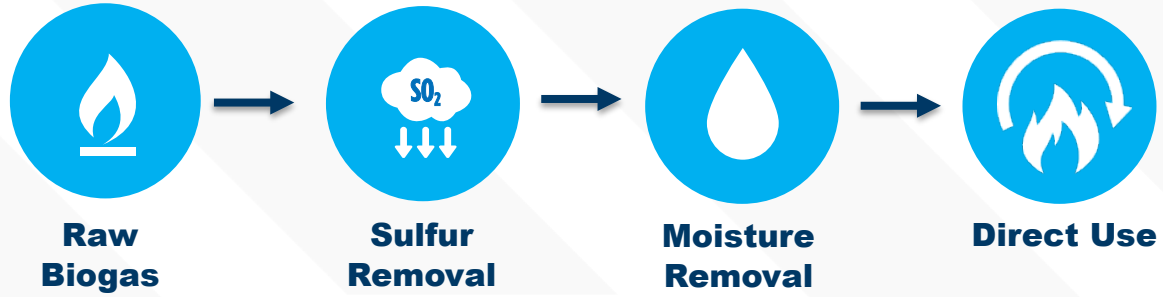
▶ 650 Landfill

▶ 50 Food Waste



<https://americanbiogasCouncil.org/biogas-market-snapshot/>

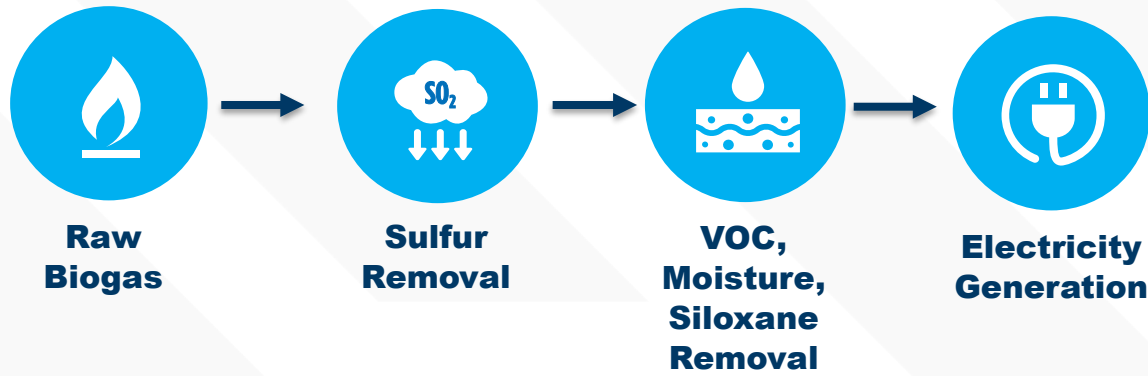
End Uses – Direct Use



- Offset fuel costs
- Demand varies seasonally
- Limited incentives

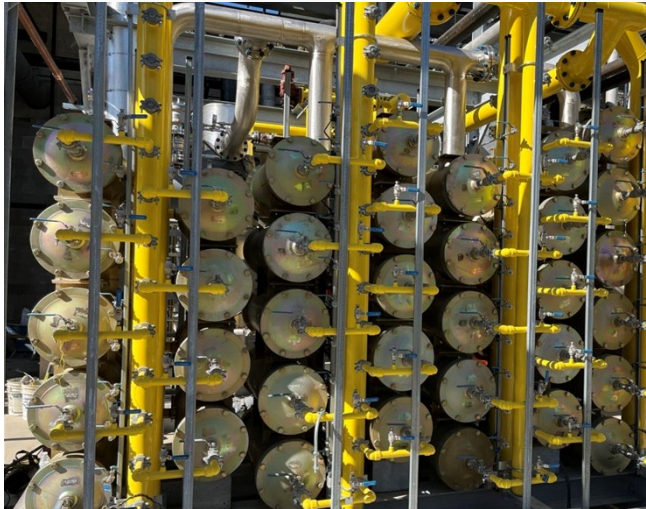
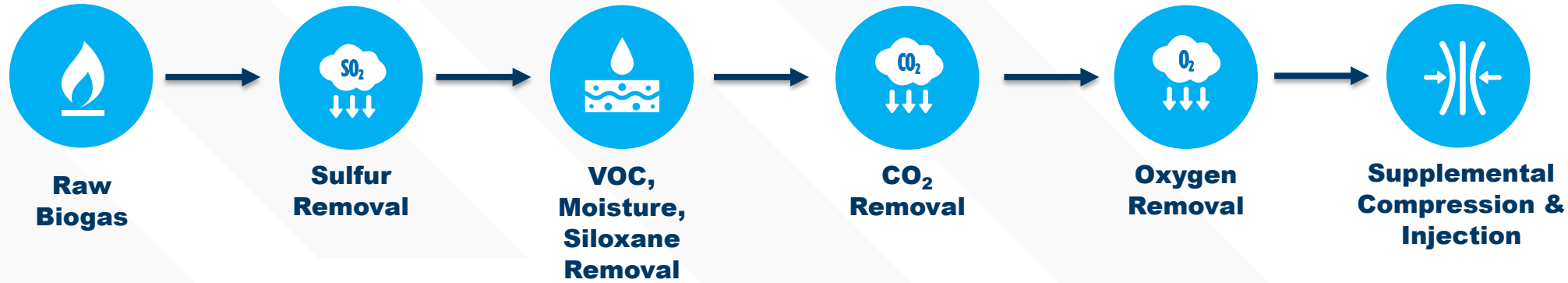


End Uses - Electricity / CHP



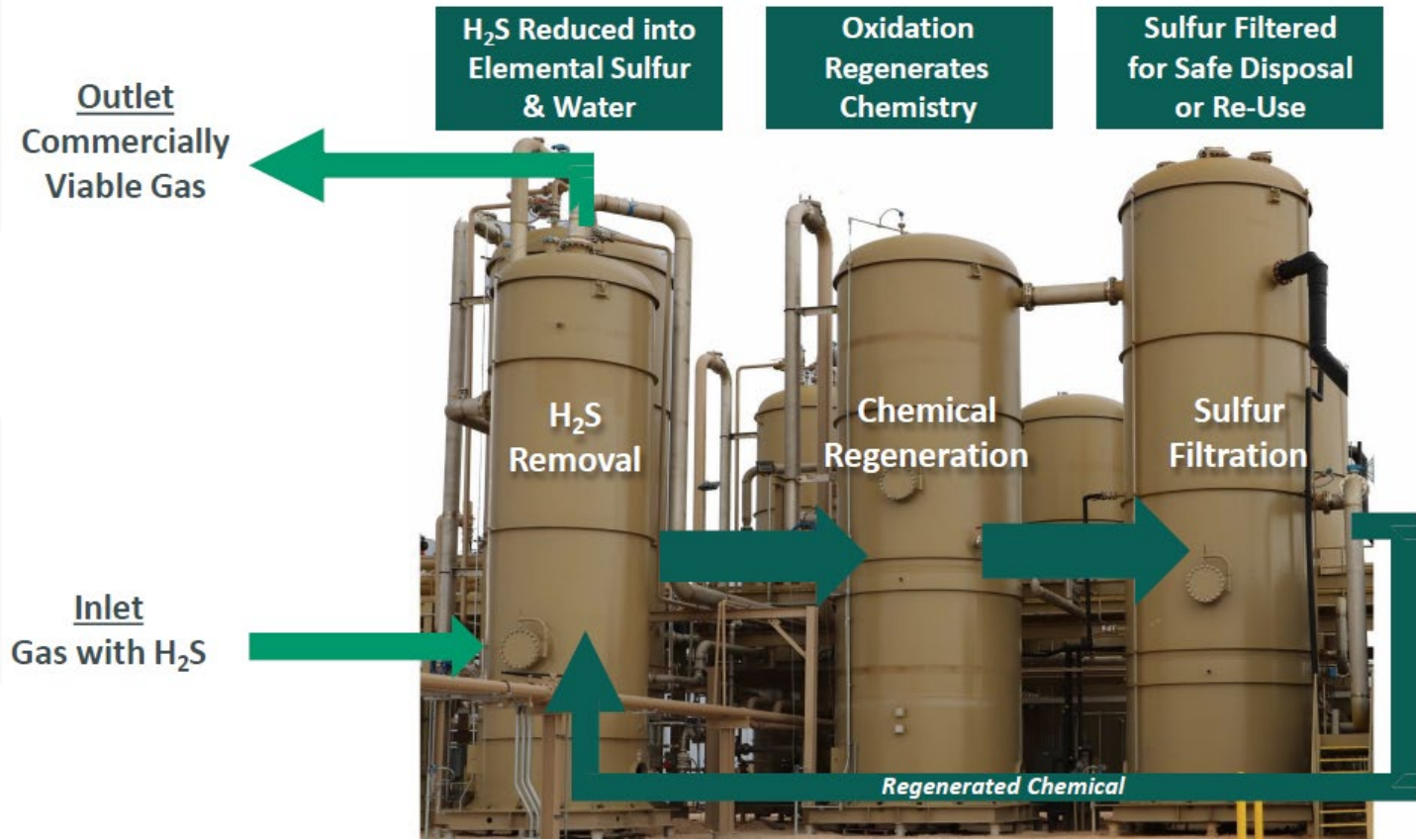
- Offset electricity
- Offset heat & air conditioning
- Limited incentives

End Uses – Renewable Natural Gas



- Exports biogas to natural gas grid
- Existing state and federal incentives

End Uses - Sulfur Removal



- Regenerative - High Flow or High H₂S
- Fixed Media - Low Flow or Low H₂S

End Uses - Sulfur Removal

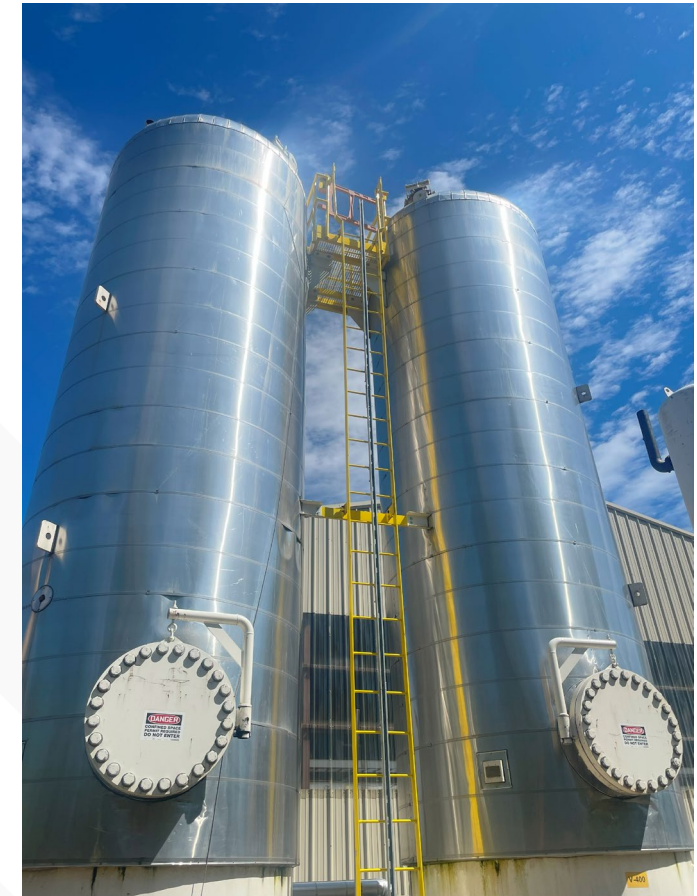
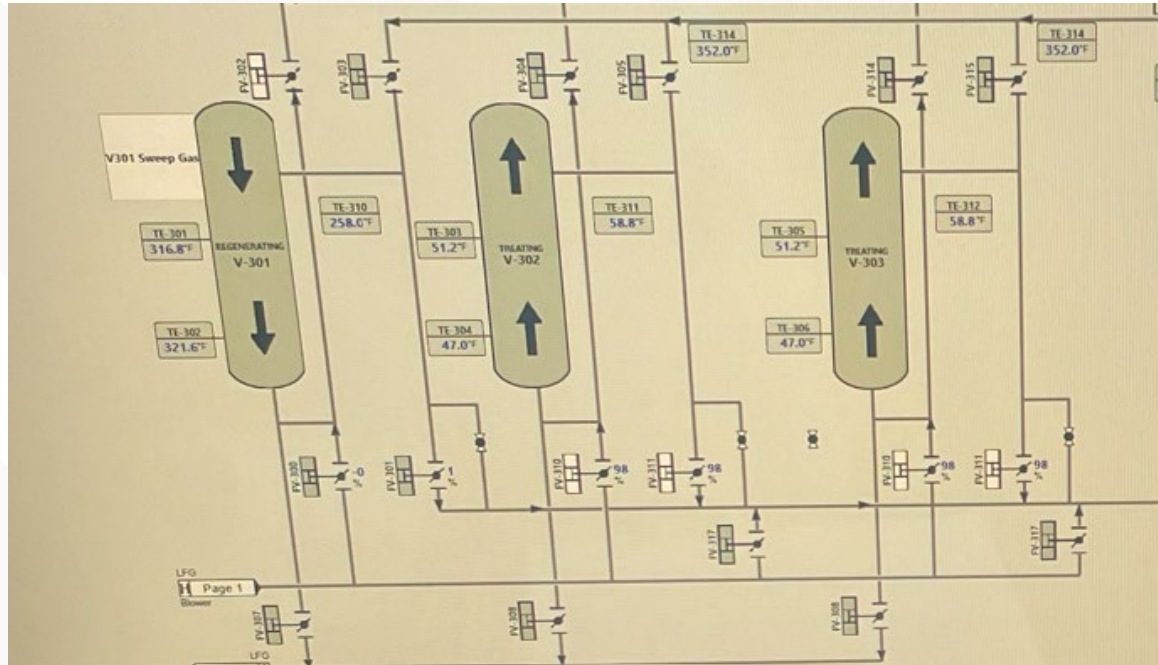
		ppmV H2S									
		100	250	500	750	1,000	1,500	2,000	3,000	4,000	7,500
SCFM	25	0.3	0.8	1.6	2.4	3.2	4.8	6.4	9.6	12.8	23.9
	50	0.6	1.6	3.2	4.8	6.4	9.6	12.8	19.1	25.5	47.8
	100	1.3	3.2	6.4	9.6	12.8	19.1	25.5	38.3	51.0	95.6
	200	2.6	6.4	12.8	19.1	25.5	38.3	51.0	76.5	102.0	191.3
	300	3.8	9.6	19.1	28.7	38.3	57.4	76.5	114.8	153.0	286.9
	400	5.1	12.8	25.5	38.3	51.0	76.5	102.0	153.0	204.0	382.5
	500	6.4	15.9	31.9	47.8	63.8	95.6	127.5	191.3	255.0	478.2
	750	9.6	23.9	47.8	71.7	95.6	143.4	191.3	286.9	382.5	717.2
	1,000	12.8	31.9	63.8	95.6	127.5	191.3	255.0	382.5	510.0	956.3
	1,500	19.1	47.8	95.6	143.4	191.3	286.9	382.5	573.8	765.1	1,434.5
	2,000	25.5	63.8	127.5	191.3	255.0	382.5	510.0	765.1	1,020.1	1,912.6
	3,000	38.3	95.6	191.3	286.9	382.5	573.8	765.1	1,147.6	1,530.1	2,869.0
	4,000	51.0	127.5	255.0	382.5	510.0	765.1	1,020.1	1,530.1	2,040.2	3,825.3
	5,000	63.8	159.4	318.8	478.2	637.5	956.3	1,275.1	1,912.6	2,550.2	4,781.6
	7,500	95.6	239.1	478.2	717.2	956.3	1,434.5	1,912.6	2,869.0	3,825.3	7,172.4

Non-regenerable dry media

Chemical treatment

Biological Scrubber

End Uses - VOC / Siloxane Removal



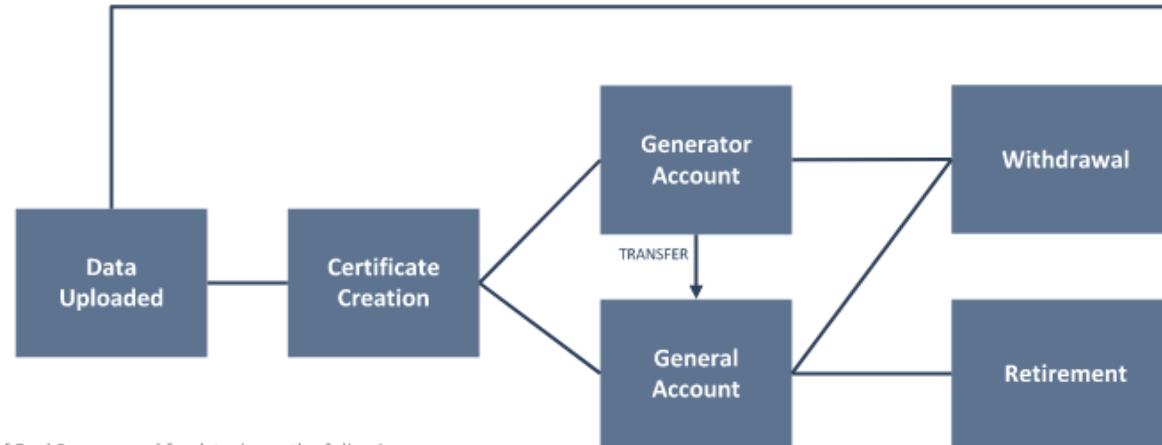
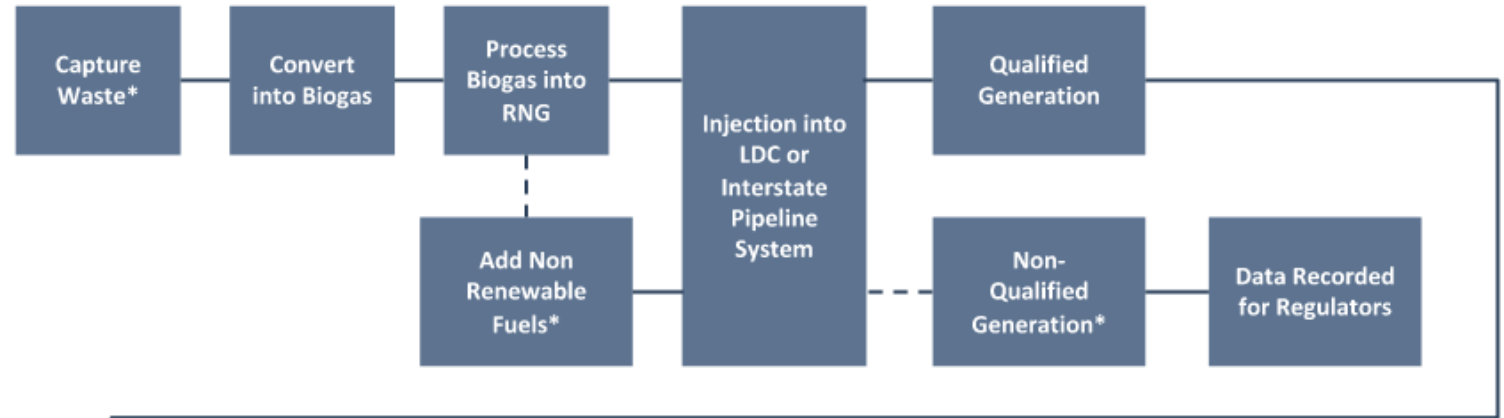
- Regenerative - High Flow or High VOCs
- Fixed Media - Low Flow or Low VOCs

RTC - Marketplace (RNG)

Renewable Thermal Credits (RTC)

- Tracking System for Retirement of Thermal Credits
- M-RETS
- Confirmed CI Pathways

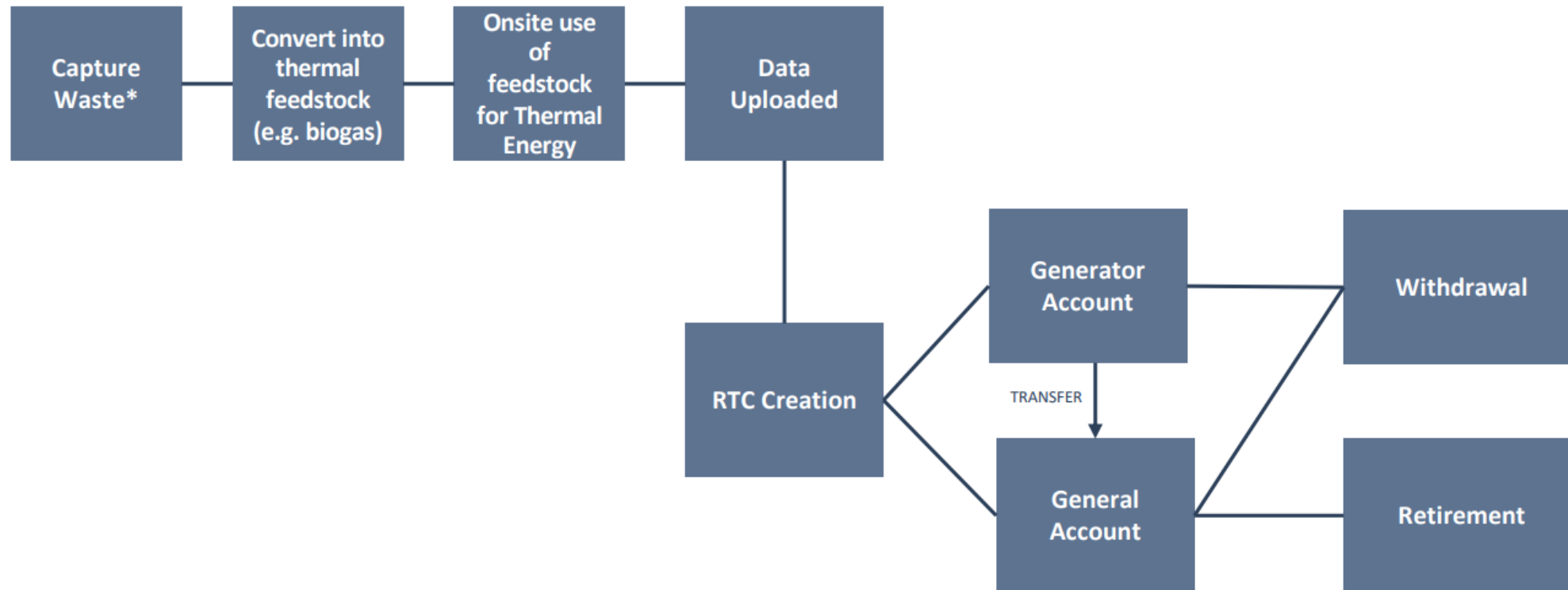
RTC Process



* List of Fuel Sources and feedstocks on the following page.

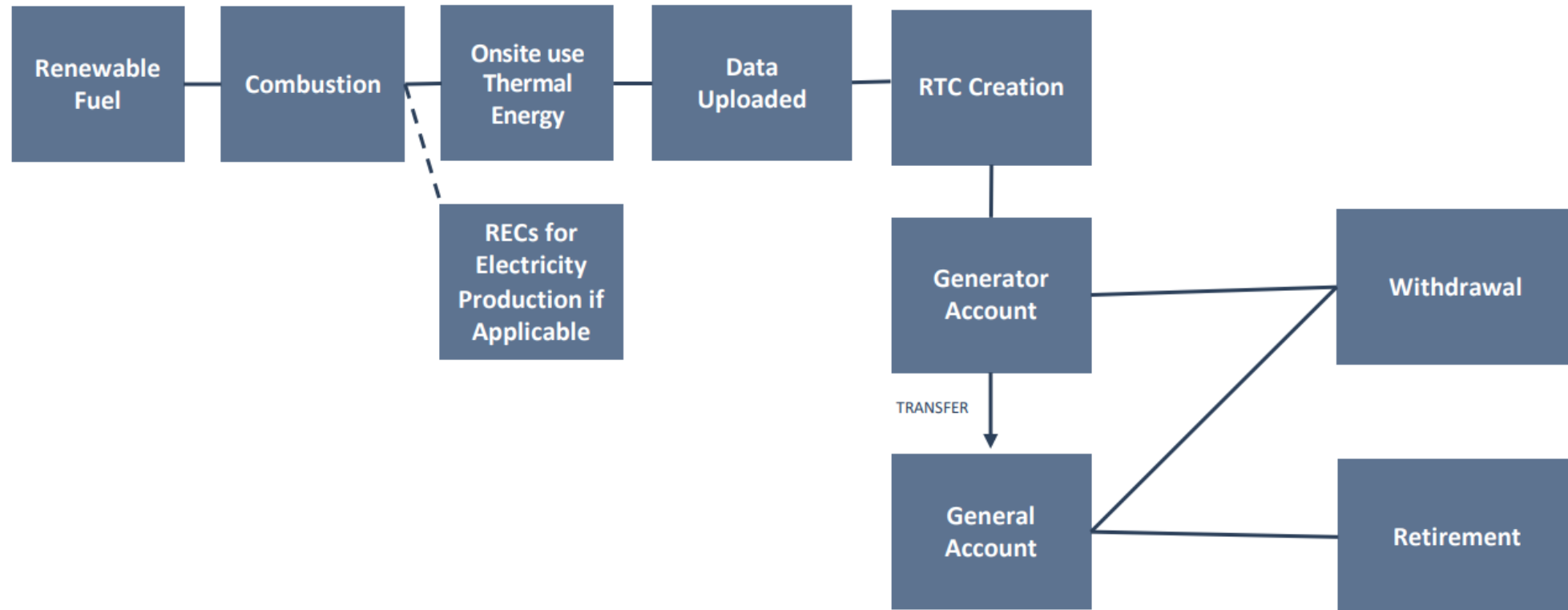
RTC - Marketplace - OnSite

Onsite Thermal Process



RTC - Marketplace - CHP

Combined Heat and Power Thermal Process

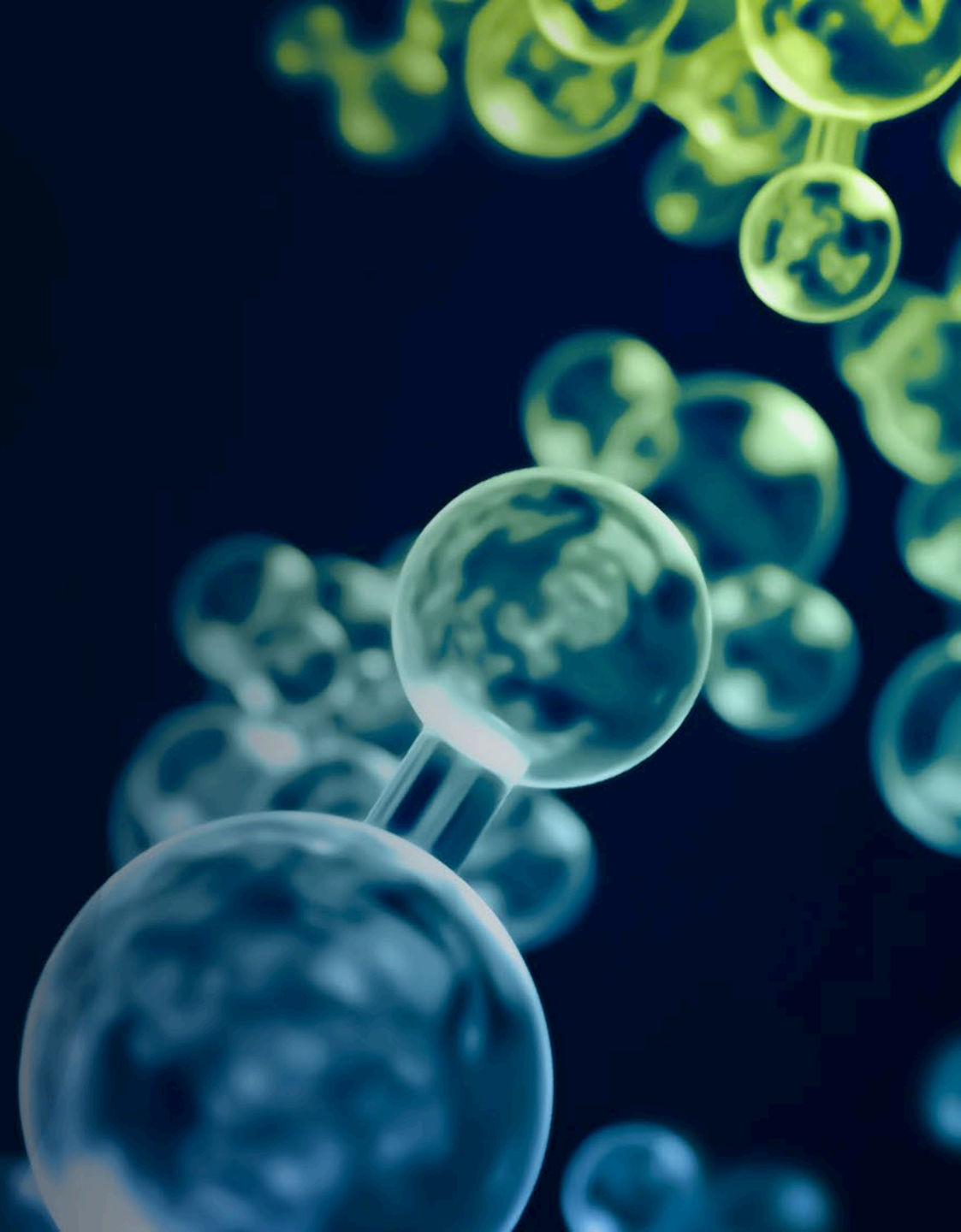


RTC - Mechanics

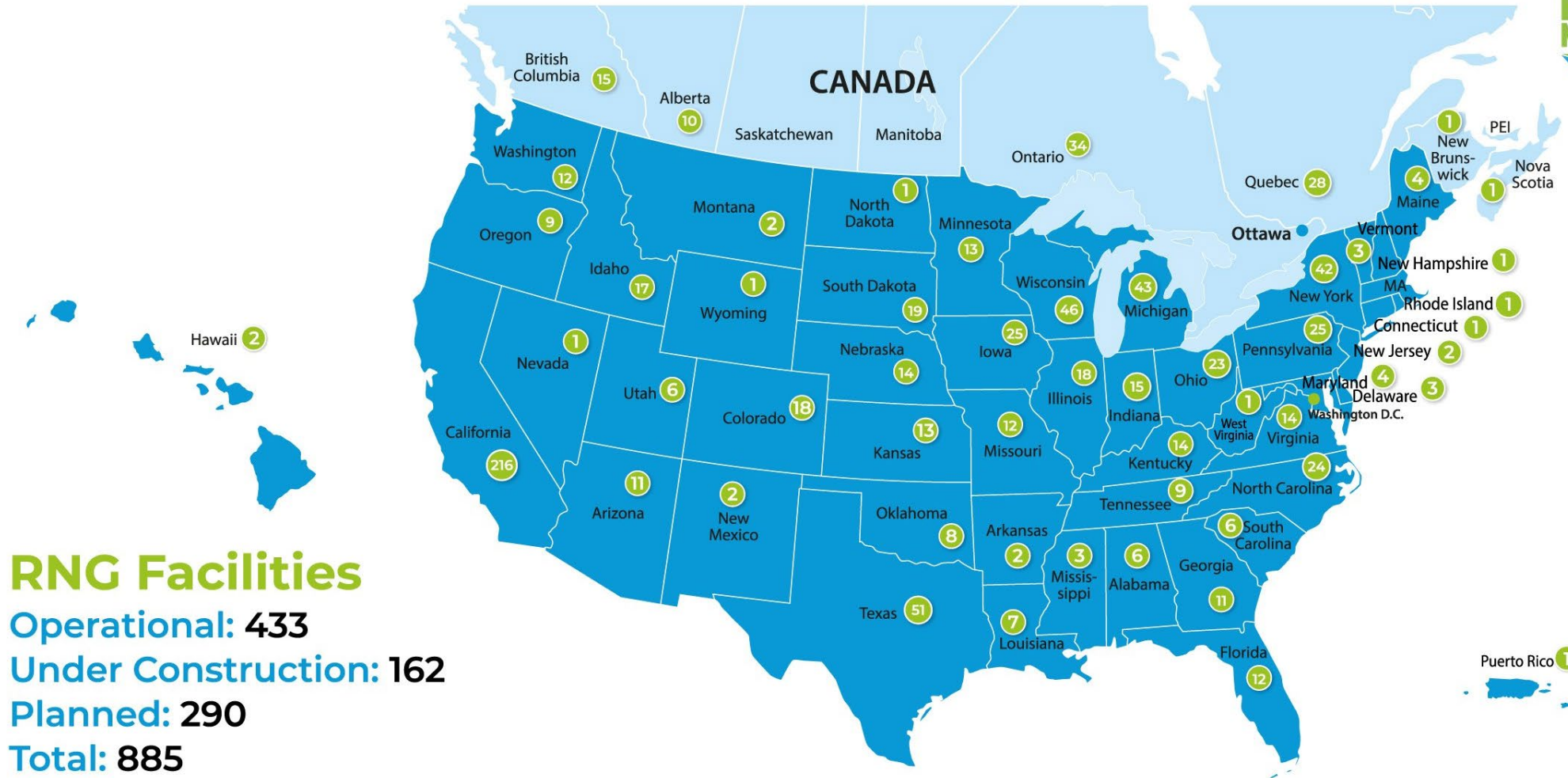
<i>Verification objective</i>	<i>Method</i>	<i>Frequency</i>
1. The carbon intensity (CI) of the RNG source is equal to or less than what is claimed initially. If more than one, each CI must be done. Generators that utilize an IRE but do not track a CI are exempt from this requirement.	<ol style="list-style-type: none"> 1. Review all inputs and outputs that could affect CI 2. Recalculate CI based on annual data 3. Confirm annual CI is within an acceptable range 4. Prepare report and upload to the M-RETS System via the Generator Documents 	Annual
2. Reported gas volumes injected into the common carrier pipeline are accurate	<ol style="list-style-type: none"> 1. Review EDI/meter data 2. Submit gas volumes injected into the M-RETS System 3. Review meter calibration 4. Compare with proof of biogas production 5. Verify biogas production from inputs/outputs 6. Confirm upgrading unit efficiency 7. Prepare a report of the above and upload it to M-RETS via the generation submission process. 	Monthly (via attestation, and becomes attached to certificate and visible to future owners in the chain of custody)
3. The RNG production site is physically connected to a common carrier pipeline	Visual inspection	Annual
4. The Environmental Attributes are intact, and the same gas claimed in M-RETS is not sold elsewhere.	Affidavit from biogas producer and RNG producer and upload Affidavits into M-RETS via the Generator Documents Portal.	Quarterly (provided one time at the Annual Review on or after January 1)

- M-RETS facilitates a unique, traceable digital certificate (i.e., one RTC) for every dekatherm (“dth”) of verified renewable thermal energy recorded on the platform.
- 3rd Party verification is required.
- M-RETS provides for—but does not require—the ability to track carbon pathways and carbon intensity (CI) values with comprehensive documentation as part of each certificate.
- Once issued, M-RETS users can choose to transfer (buy/sell), retire (to fulfill commitments), import, or export RTCs.
- M-RETS registers projects in across North America, including all Canadian provinces.

RNG MARKET OVERVIEW



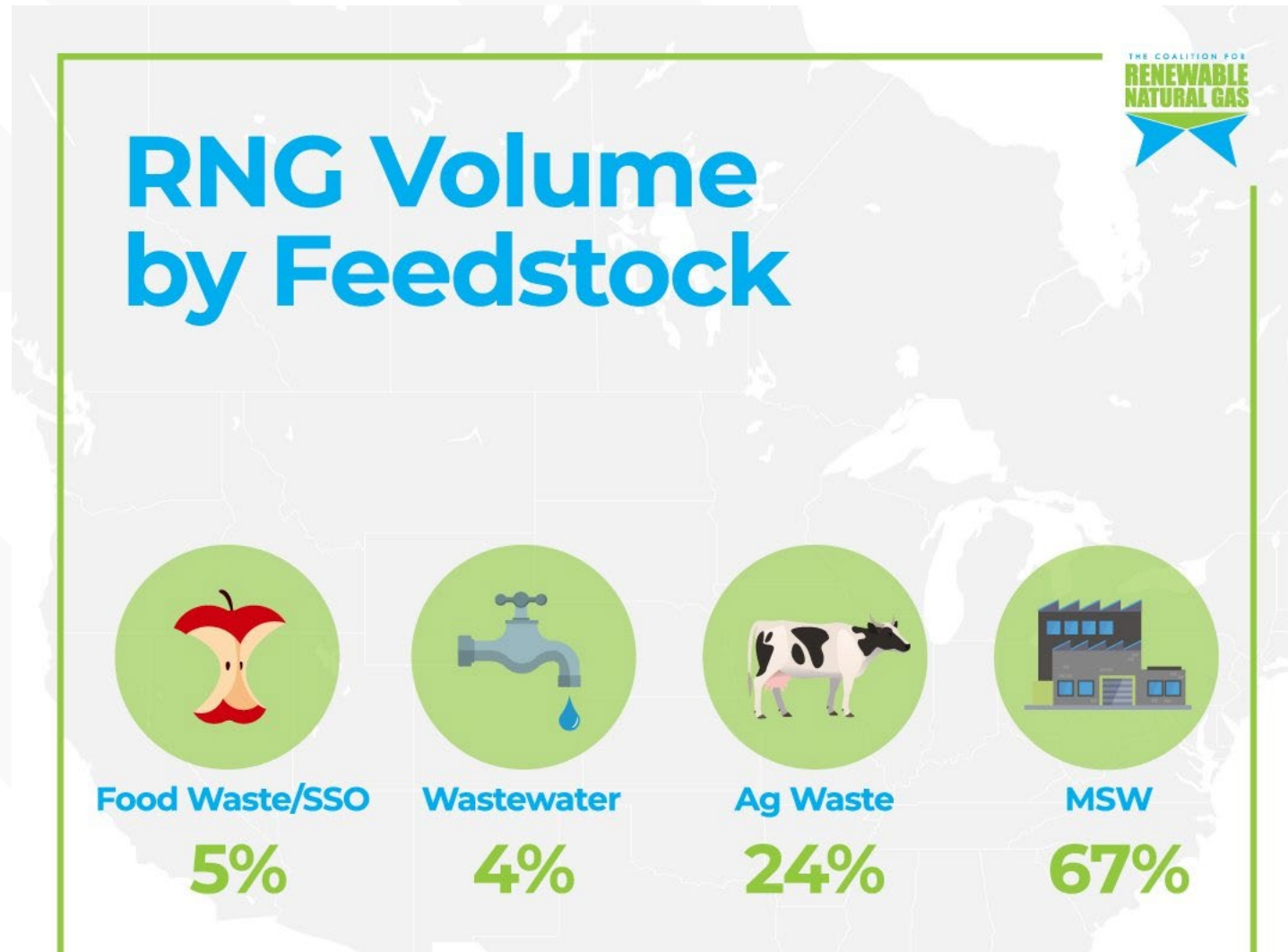
Active RNG Projects



Active RNG Projects

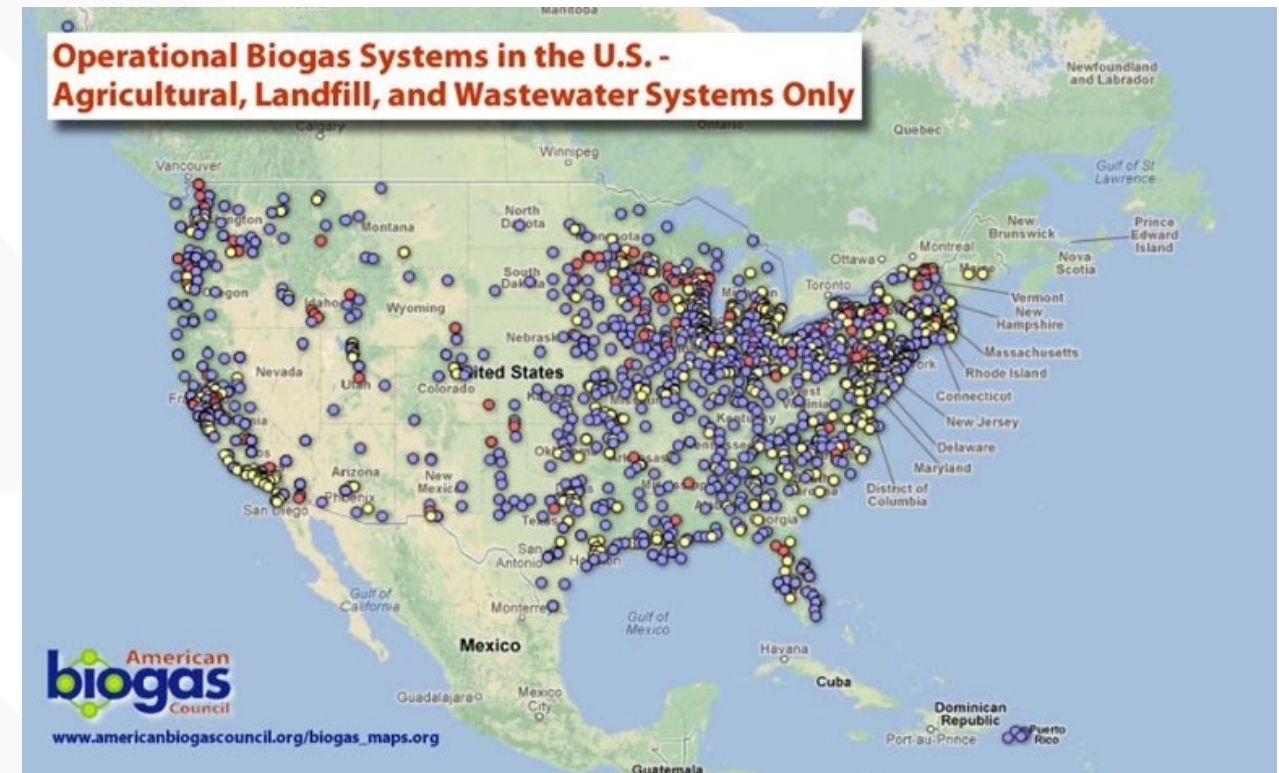


RNG Volume by Feedstock



RNG Prospects

- **800+ operating prospects for RNG**
 - 355 operational agriculture biogas facilities that can be fitted with RNG projects
 - 474 candidate landfills for landfill gas/RNG projects
- **10,000+ Potential for new projects:**
 - 8,000+ Livestock Biogas Facilities
 - 2,500+ Water/Wastewater Biogas Facilities

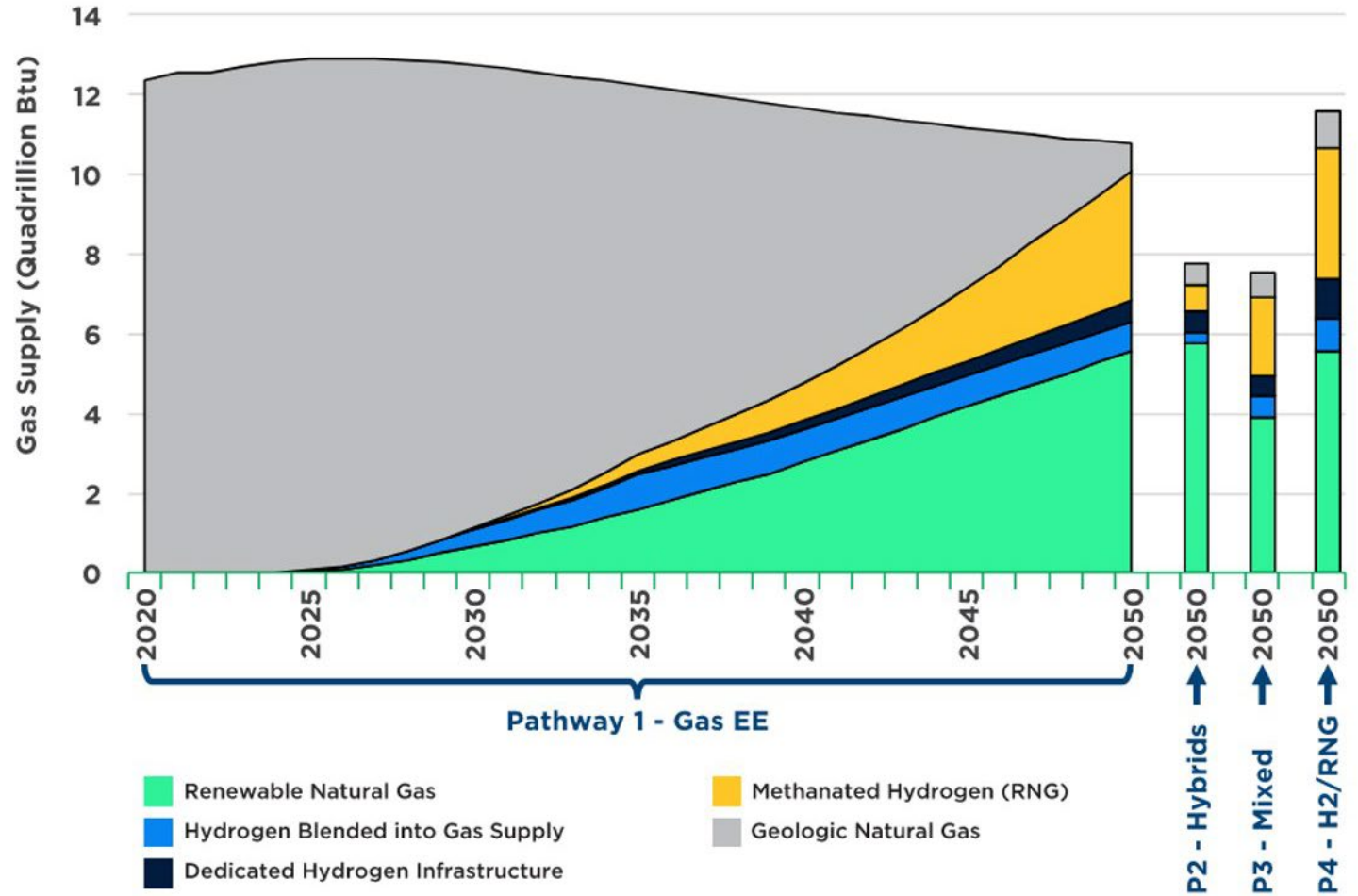


WHY RNG?

Biogas can be cleaned, conditioned, and injected into natural gas pipelines to be used as a feedstock for the decarbonization of:

- Transportation
- Fuel Refining
- Pipeline Infrastructure
- Power Generation
- Manufacturing

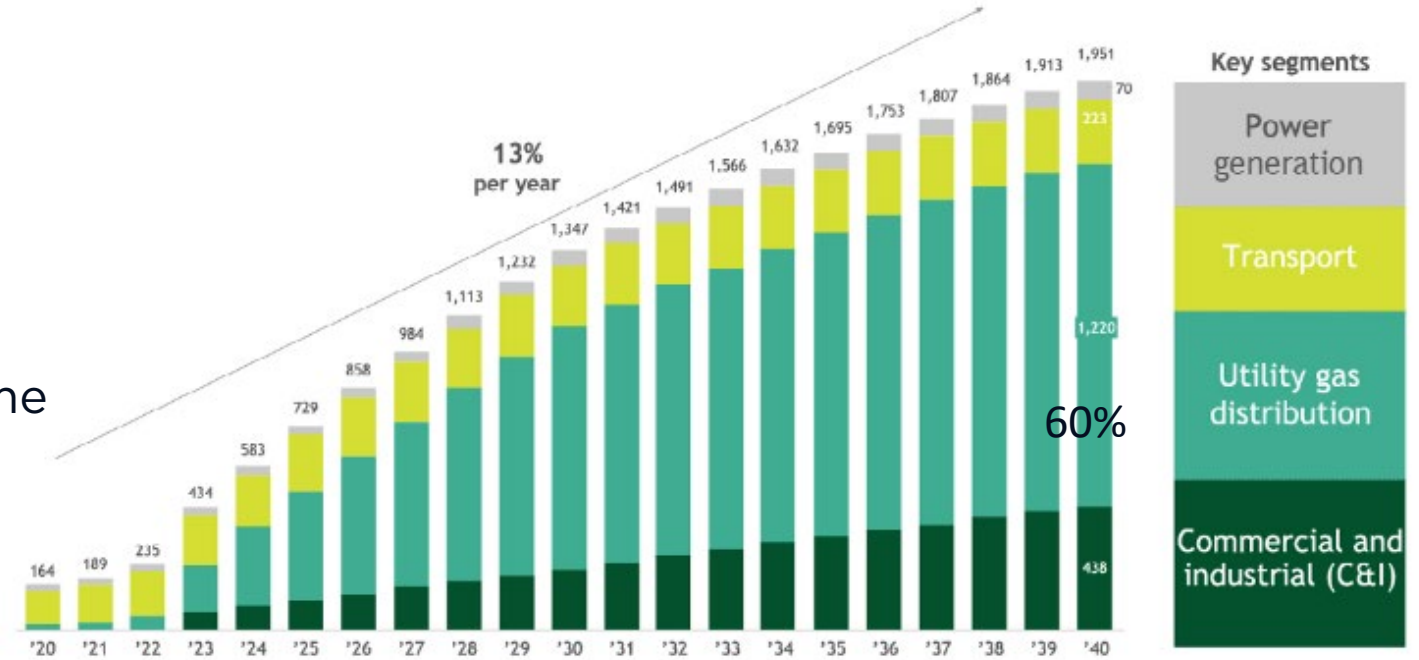
To meet Net-Zero Goals, RNG may need to account for 51% of natural gas supply by 2050.



Market Drivers- RNG Demand

- Voluntary Demand
 - Renewable Thermal Certificates
- Regulatory Incentives
 - Renewable Fuels Standard (New Volume Obligations)
 - State/Canada Low-Carbon Fuel Standards
 - Utility cost recovery
- Funding Incentives
 - State grants/funding programs for RNG development and interconnection
 - Inflation Reduction Act

Voluntary Demand to Exceed Production 5X by 2030



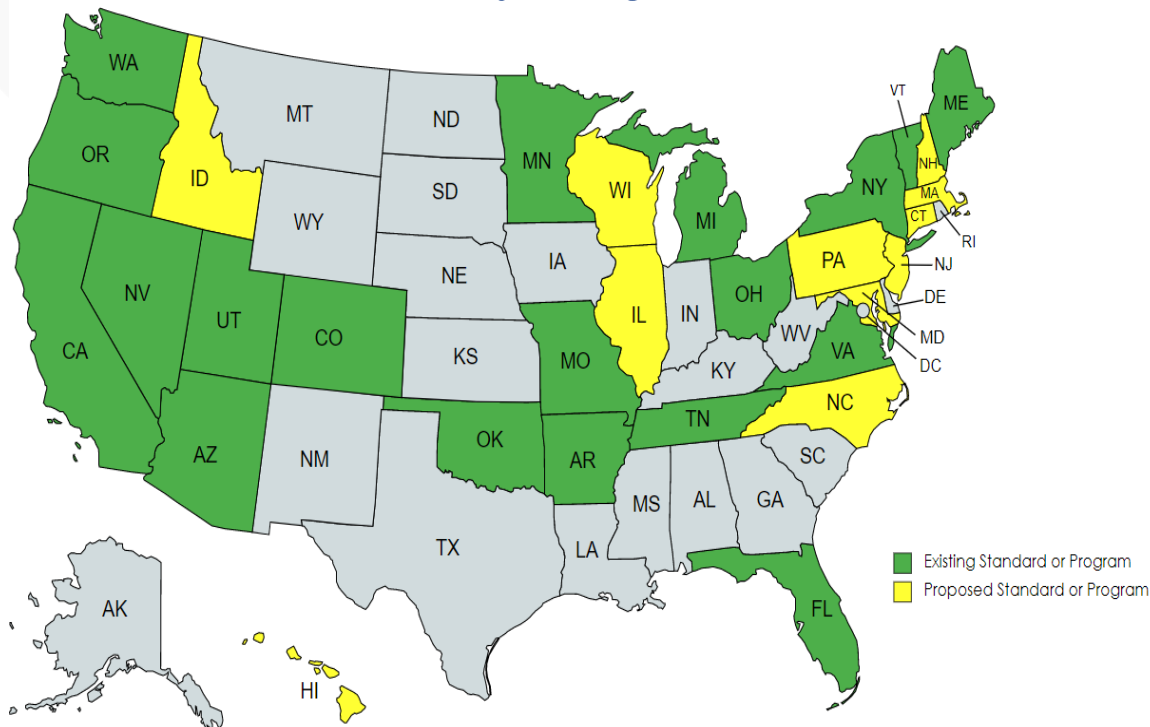
Source: HIS; EIA; RNG coalition; EIA Residential Energy Survey; EIA Natural Gas Annual Respondent Query System; Oxford Economics; market participant interviews; utility RNG adoption announcements;

RNG coalition; IOP science; American Gas Association; Argonne Labs; EPA, CER; BCG analysis

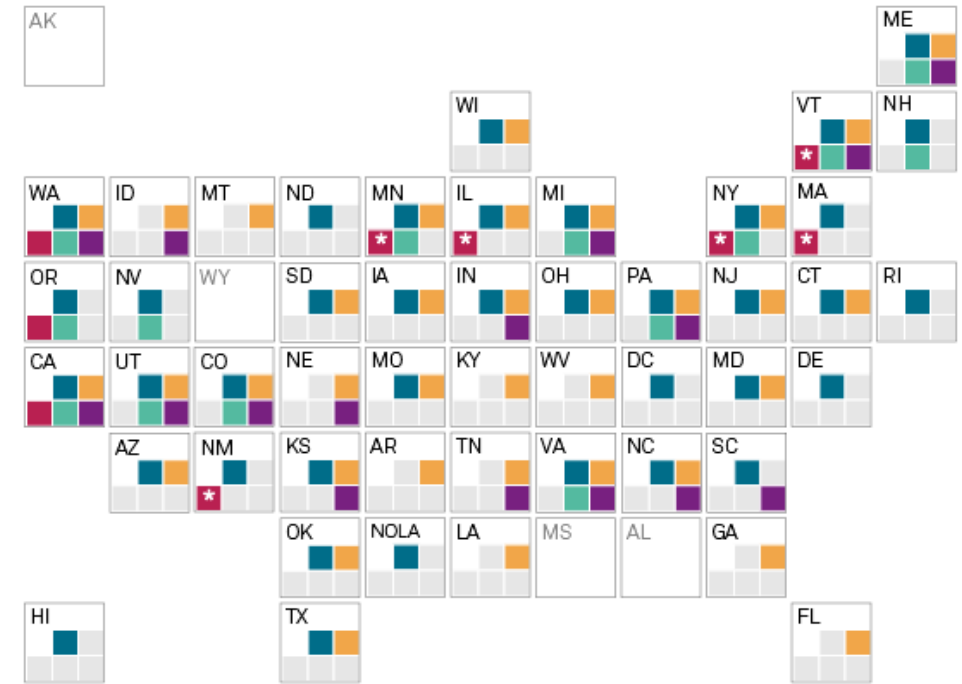
- Boston Consulting Group - "Is Renewable Natural Gas Poised for Future Growth or Doomed to Decline?"

Voluntary RNG Markets - Utilities

- ▶ Natural Gas Utilities
 - Cost Recovery States
 - Voluntary Programs
 - Mandatory Programs



Renewable natural gas policies and programs



Data compiled Sept. 21, 2023.
 RPS = renewable portfolio standard;
 RNG = renewable natural gas.
 * Legislation pending.
 Sources: Regulatory Research Associates,
 a group within S&P Global Commodity
 Insights; US Environmental Protection
 Agency; RNG Coalition.
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- Mandatory RPS program
- RNG interconnection standard/tariff
- RNG procurement standard/policy
- Voluntary residential RNG program
- Clean fuel policy

RNG Market Drivers - Utilities

- Voluntary Market Attributes -
 - RFP of RNG Attributes - NW Natural, Hawaii Gas, Puget Sound, Avista, etc.
- Voluntary Purchase Program – Customers purchasing “blocks”
 - RNG Only
 - Mixture of RNG and Other Carbon Offset Programs
- Rate Increases to Build RNG Production Facilities
 - Increase rates and monetize RNG projects through capital investment and retire the environmental attributes (EA) of the behalf of the utilities' customers (the rate payers)
- Rate Decrease to Build RNG Production Facilities
 - Sell the EA on credit markets (LCFS, RFS, etc.) and realize the revenue to decrease rates for customers.
 - EAs are retired by others. Not the utility.
- Non-Regulated Utility Developers
 - Black Hills, NW Natural, Peak Renewables, etc.

Market Drivers

Utility Voluntary Purchase Program - Customers purchasing “blocks”

- RNG Only
- Mixture of RNG and Other Carbon Offset Programs (Example: Nicor Gas “Total Green”)

TotalGreen™ Basic: \$0.0734 per therm

TotalGreen™ Basic offsets 0.6% of the carbon dioxide emissions through (RNG) environmental attributes and the remaining 99.4% of emissions through carbon offsets.

TotalGreen™ Premium: \$0.2646 per therm

TotalGreen™ Premium offsets 10.3% of the carbon dioxide emissions through RNG environmental attributes and the remaining 89.7% of emissions through carbon offsets.

State	Utility	Established Voluntary Program	Blended or RNG Only	Value of the Therms	\$/MMBTU
California	Southern California Gas Co (SoCalGas) & San Diego Electric Co.	Y	RNG	\$1.51/therm for RNG	\$ 15.10
Colorado	Black Hills Corporation	Y	Blended	\$5/20.5 therms	\$ 2.44
Idaho	Avista	Y	RNG	\$5/1.5 therms	\$ 33.33
Kansas	Black Hills Energy	Y	Blended	See Above	
Maine	Summit Natural Gas	Y	Blended	\$7.44/10% RNG percent of use 18.60/25% \$37.2/50% \$74.40/100%	\$ 2.34
Michigan	DTE Energy	Y	Blended	\$4/ 1.375 MT CO2 achieved through both carbon offsets and RNG	
Minnesota	CenterPoint Energy	Y	RNG	\$3.89/ therm of RNG	\$ 38.90
Nebraska	Black Hills Energy	Y	Blended	See Above	
New Hampshire	Liberty Utilities	Y	RNG		\$ 25.00
North Carolina	Piedmont Natural Gas (Duke Energy)	Y	Blended	\$3/mo per block of 12.5 therms	\$ 2.40
North Carolina	Public Service Company of North Carolina (Dominion)	Y	Blended	\$3/mo per block of 12.5 therms	\$ 2.40
Oregon	Northwest Natural	Y	RNG	Non Voluntary, Rates increased to offset the cost.	
Utah	Dominion Energy Questar Gas	Y	RNG	\$5/5 therms	\$10 for Attributes + \$ for Natural Gas Supply
Vermont	Vermont Gas Systems Inc	Y	RNG	Blended - \$1/100CF/Therm Local - \$1.33/100CF/Therm	\$10 to \$13 for attributes + \$ for Natural Gas Supply
Virginia	Colombia Gas of Virginia	Y	Blended	\$3/Dekatherm	\$ 3.00
Washington	Puget Sound Energy	Y	RNG	\$3.75/2.7 therms	\$13.89 for Attributes + \$ for Natural Gas Supply

RFS Set – Proposed (December ‘22) vs Final (July ‘23)

	2023	2024	Increase '23-'24	2025	Increase '24-'25
Final CNG/LNG Derived from Biogas	831	1,039	25%	1,299	25%
Proposed CNG/LNG from Biogas	719.3	813.9	13.2%	920.9	13.1%
<i>Difference Final vs. Proposal</i>	111.7	225.1		378.1	
<i>Difference Final vs. Proposal, Percent</i>	15.5%	27.7%		41.1%	

- EPA used a 25% increase in the Final Rule, versus a roughly 13% increase in the Proposal.
- First time EPA has provided RVO projections for more than just 1 year

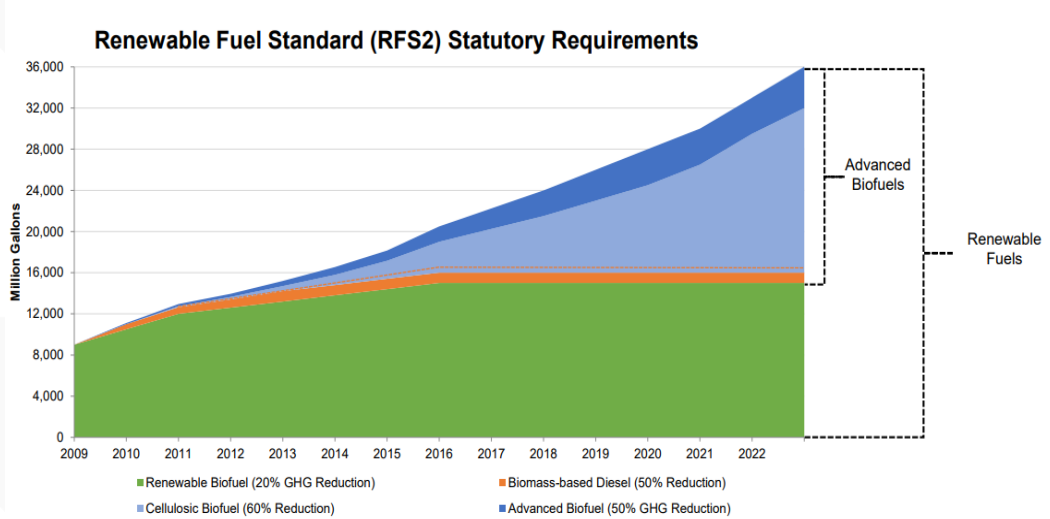
Source: <https://www.rngcoalition.com/infographic>

RNG Incentives – Transportation Fuel

- ▶ RFS – “Set Rule” Proposed December ‘22
 - Finalized July ‘23
- ▶ ~~Proposes eRIN’s for the first time.~~
- ▶ *Biointermediate* to include:
 - biogas used to make a renewable fuel other than RNG or electricity”
- ▶ D3 RIN price forecasts are bullish:
 - Continued growth in RNG production
- ▶ Biofuel industry is optimistic that EPA RVO targets would be adjusted higher
 - The intent of both RFS2 and “Set Rule” to grow the cellulosic category

Renewable Volume Obligations (billion RINS)	2023	2024	2025
Cellulosic biofuel (D3)	0.84	1.09	1.38
Advanced biofuel (D5)	5.94	6.54	7.33

Source: EPA



Source: <https://www.naseo.org/Data/Sites/1/rfs-and-rin-basics.pdf>

MARKET DRIVERS – ACQUISITIONS

Biogas infrastructure transactions

Deal announced	Buyer	Buyer's core business	Company acquired	Transaction value (\$M)
10/31/22	Chesapeake Utilities Corp.	● Gas and electric utility	Planet Found Energy Development LLC ●	9.4
10/31/22	Macquarie Asset Management Inc.	● Investment fund	BayWa r.e. bioenergy GmbH ●	Undisclosed
10/17/22	BP PLC	● Integrated oil and gas company	Archaea Energy Inc. ●	4,100.0
09/20/22	HIG Capital LLC	● Investment firm	Northern Biogas LLC ●	Undisclosed
07/20/22	BlackRock Real Assets	● Investment fund	Vanguard Renewables ●	700.0
12/02/21	ArcLight Clean Transition Corp. II	● Special purpose acquisition company	OPAL Fuels ●	1,750.0
07/16/21	Kinder Morgan	● Oil and gas pipeline operator	Kinetrex Energy ●	310.0
05/11/21	Montauk Renewables Inc.	● Biogas provider	NR3 LLC ●	16.3
04/26/21	St1 Nordic	● Petroleum refiner and retail distributor	E.ON Biofor ●	Undisclosed
04/15/21	Engie SA	● Gas and electric utility	Deal Farm Biogas ●	Undisclosed
04/07/21	Rice Acquisition	● Special purpose acquisition company	Aria Energy ●	680.0
04/07/21	Rice Acquisition	● Special purpose acquisition company	Archaea Energy ●	347.0
01/11/21	Total SA	● Integrated oil and gas company	Fonroche Biogas ●	Undisclosed

● Private ● Public ● Subsidiary of public company

As of Nov. 28, 2022.

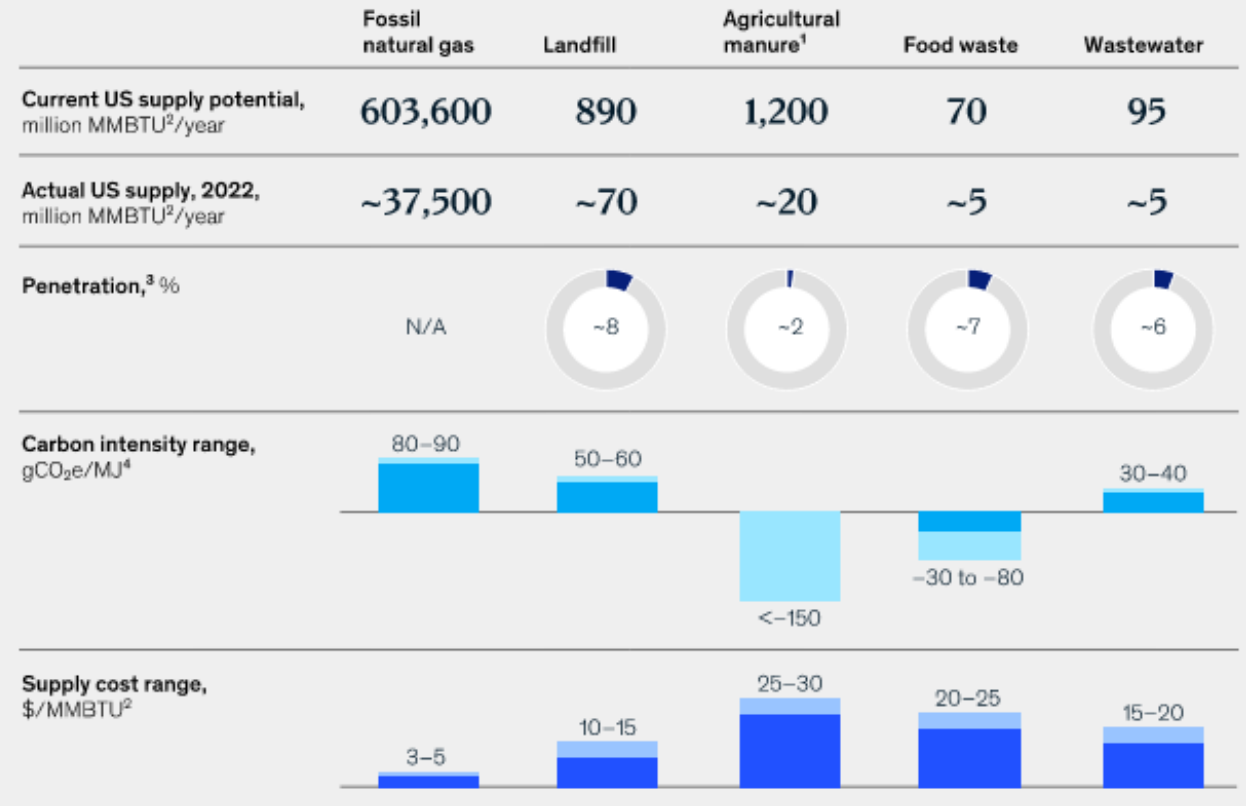
Sources: Raymond James & Associates; S&P Global Market Intelligence.

Enbridge to purchase U.S. renewable gas facilities for US \$1.2 billion (11/3/23)

Market Drivers- RNG Supply

- 1% of Natural Gas
- By 2030 RNG Supply 7x 2020 Levels (EIA)
- By 2050 RNG Supply 27x 2020 Levels (EIA)
- Supply Levels only at 2/3 of expected demand.

Renewable natural gas (RNG) production pathways



¹Includes chicken and swine.

²Million British thermal units.

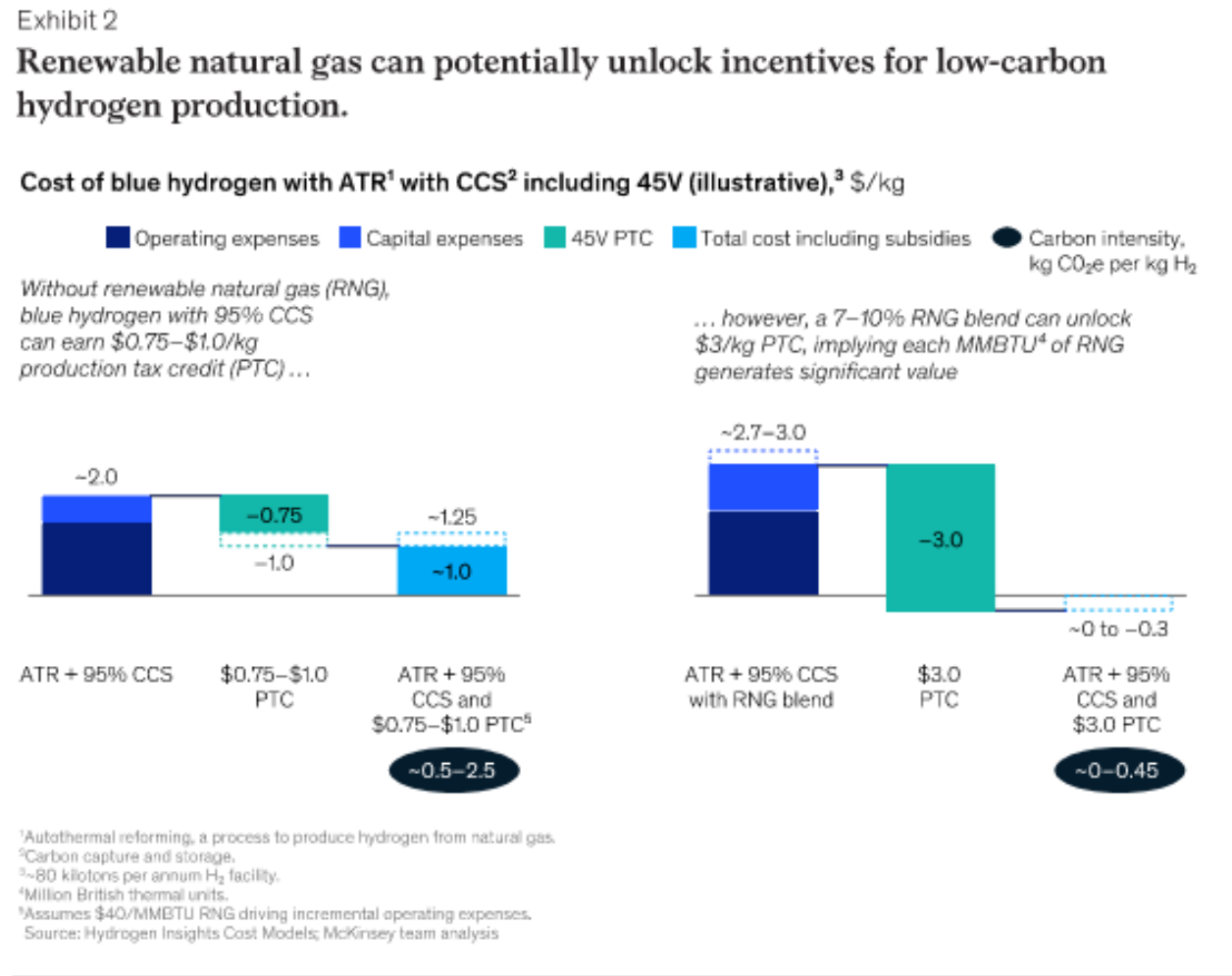
³Calculated as supply divided by potential.

⁴Grams of carbon dioxide equivalent per megajoule of energy.

Source: CARB; EIA; McKinsey analysis

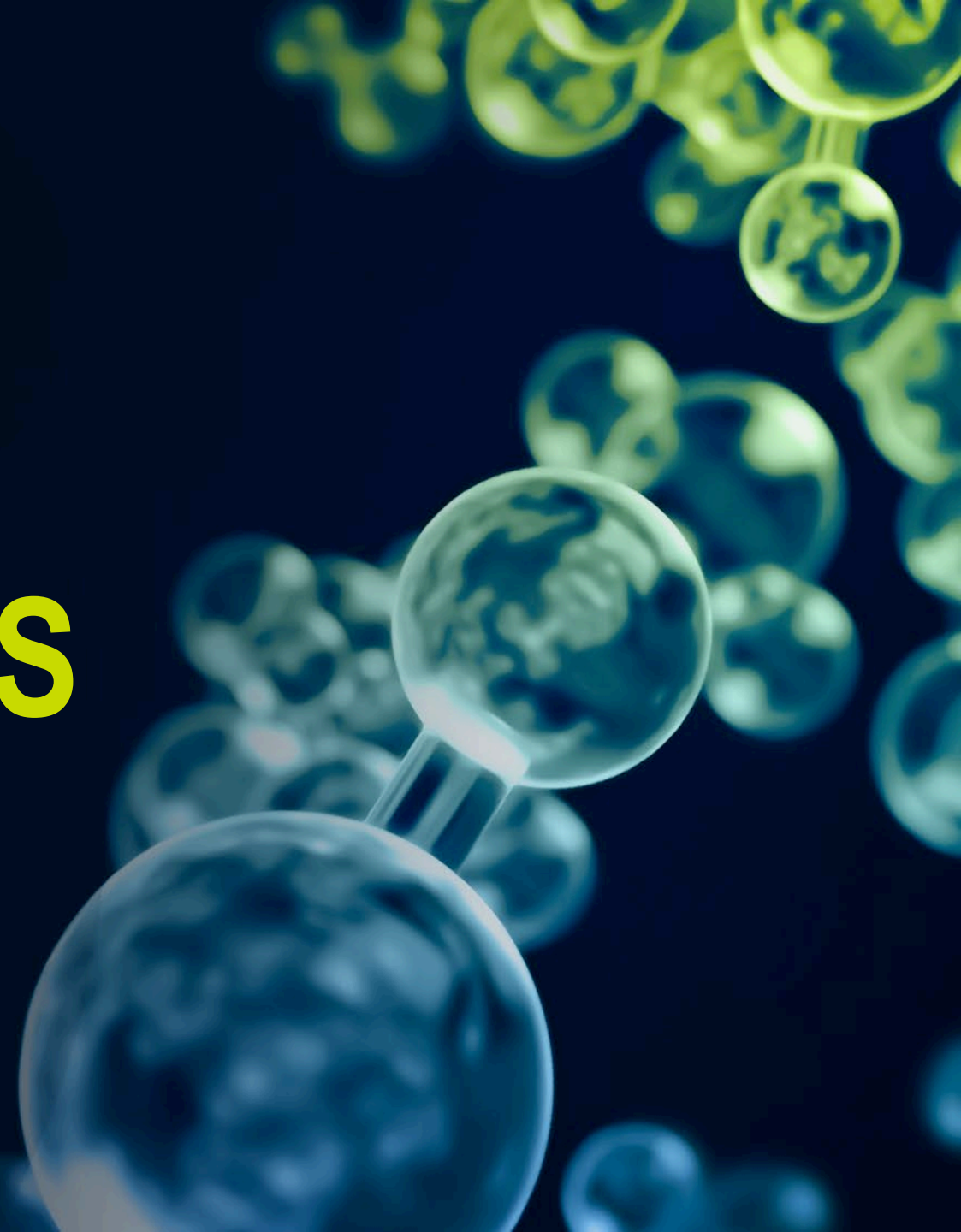
Other Market Drivers for RNG

- H2 Production
- Biogenic CO2 as a Byproduct
- RNG to Other Countries
- SAF
- Sustainable Fertilizers/Nutrient Management



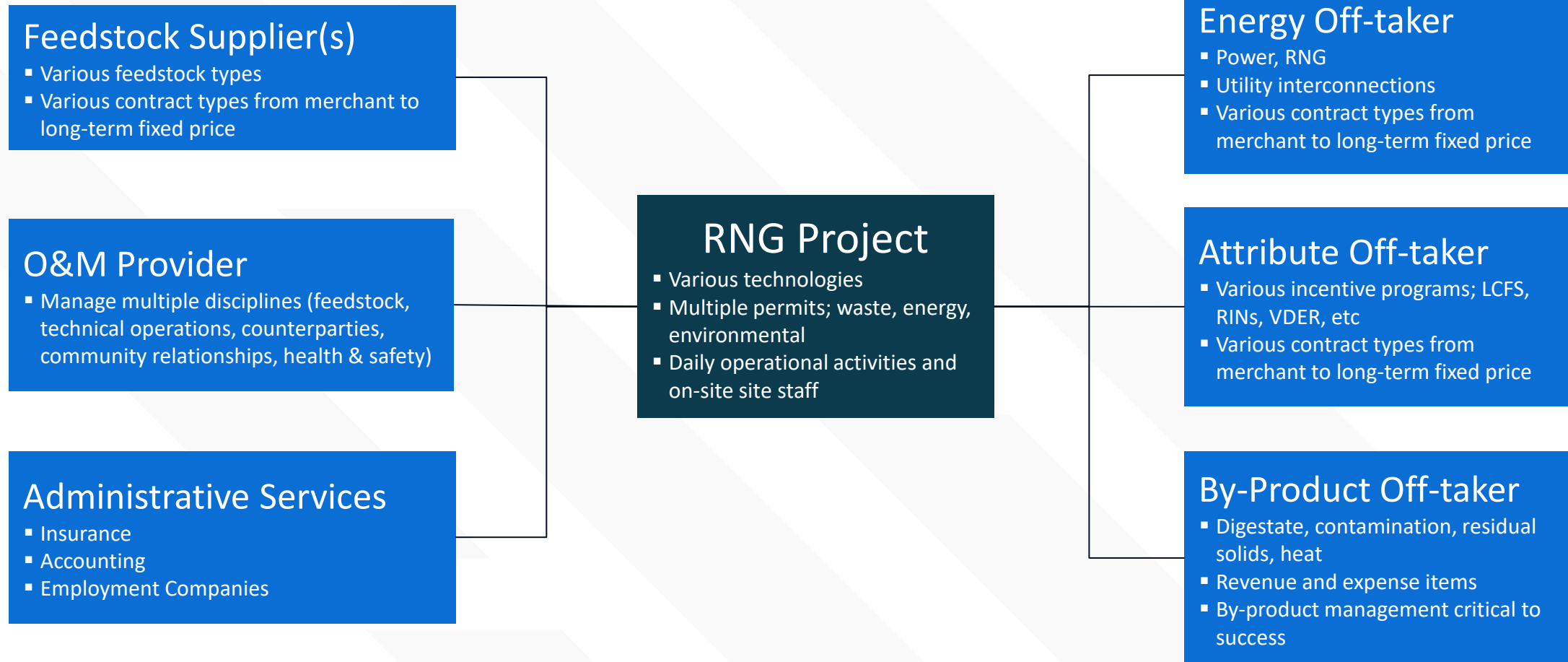
¹⁰ Pathways to commercial liftoff: Clean hydrogen, U.S. Department of Energy, March 2023.

PROJECT DEVELOPMENT CONSIDERATIONS



Generic RNG Business Model

AD projects include procurement of a feedstock, processing of the feedstock, produce commercial products for sale, and disposal of waste by-products

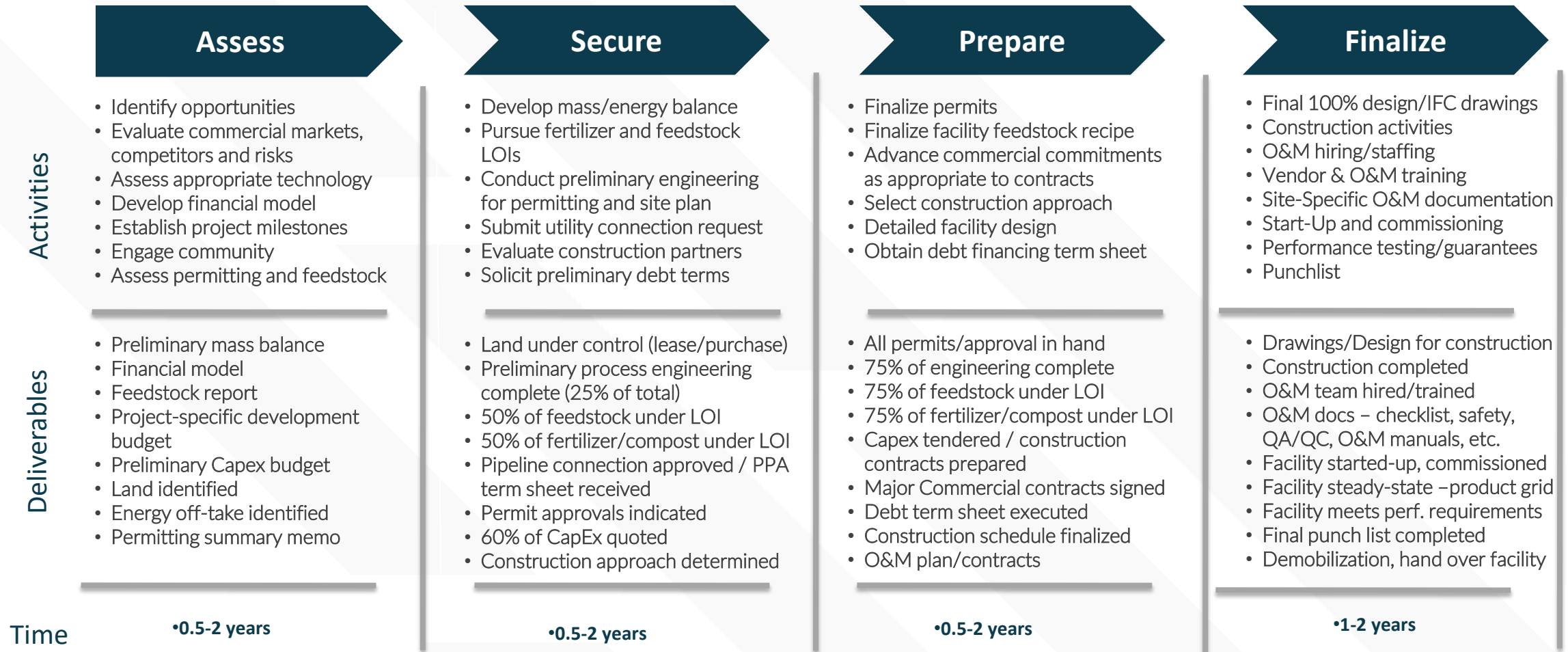


Partnering with 3rd Party Project Developers

How?

- Evaluation of Preliminary Concept of RNG Project
- Proposed facility location and land ownership (layout plan)
- Expected biogas quality / production rates
 - Understand required treatment steps
 - Peak anticipated hourly/daily flow rates
 - Expected daily/seasonal variations - Ability to accept supply
- Anticipated gas quality and pressure at the interconnect point
 - Gas Specification can impact RNG Project Economics
 - Information about proposed technology (including commercial track record)
- Preliminary Cost Evaluation / Financial Analysis

Project Stage Gates



WWTP and RNG EPC

Spire / KCMO P3



Progressive Open Book EPC - DBFOM

- Current THP Project
- Long History Working at WWTP
- 1,300 Scfm
- Supported Regulated Utility as Design-Build Partner
- RNG Process Evaluation / Design
- Permitting
- Construction / Commissioning

Biosolids and Organics RNG Design-Build

Unified Government of Wyandotte County and Kansas City, Kansas



Progressive Design Build

- High Strength Organic Waste (HSOW) Market Survey
- HSOW Receiving and Processing Facilities
- 50 DTPD Capacity
- RNG Process Evaluation / Design
- Permitting
- Construction / Commissioning
- IRA Benefit

Questions?



Scott Martin, P.E.

samartin@burnsmcd.com

816-588-3278

