MN Renewable Energy Roundtable

Renewable Natural Gas from Biomass Feedstocks Using Anaerobic Digestion

December 1, 2022

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Welcome

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Primer on Project Scoping

Luca Zullo, Ph.D.

Sr. Director of Science and Technology, AURI

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Demystifying Anaerobic Digestion
A short primer on project scoping

Foster long-term economic benefit for Minnesota through value added agricultural products.

What is anaerobic digestion

- Anaerobic digestion is a **naturally occurring** biological process during which **consortia of bacteria** decompose organic matter in the **absence of oxygen** to obtain the energy necessary for their metabolism

- Methane and Carbon Dioxide are the **main** by-products of this metabolic activity

Anaerobic digestion has a long history

Biogas was used for heating in Assyria in the X century BCE

XVI century, the first modern observations on swamp gas.

1776: Alessandro Volta determines the existence of a direct correlation between the amount of organic matter degraded and amount of gas produced.

1808: Humphrey Davy determines that methane is produced by cattle manure

1859: First application of an *engineered anaerobic digester* to capture gas methane in India

1895: The city of Exeter, UK uses gas from sewage to fuel street lamps

1907: The German patent office issues the first patent for an anaerobic digester.

1938: First documented farm-based AD system in the UK.

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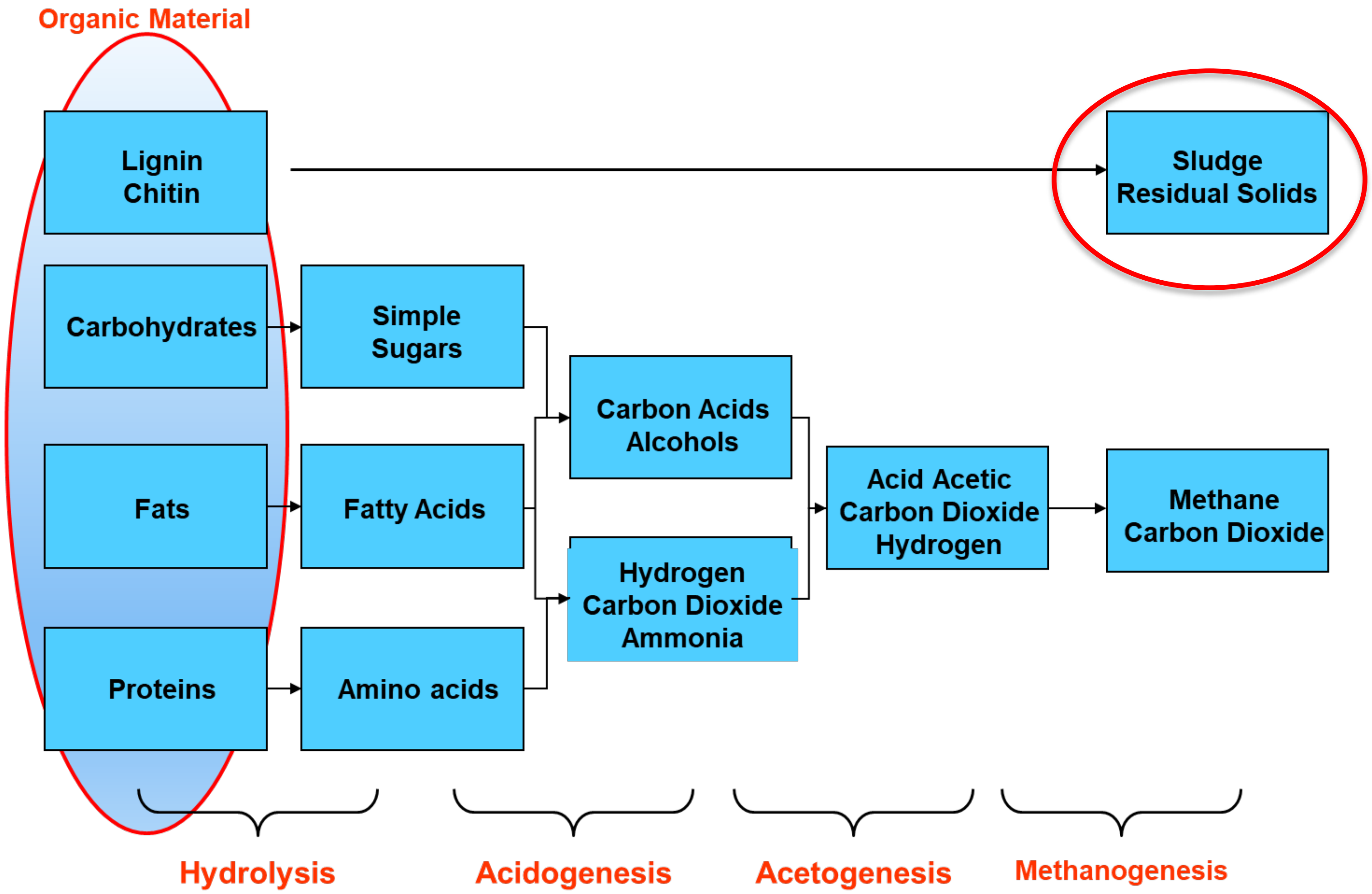
Steps of anaerobic digestions



Valuable, nutrient-rich
Fertilizer and soil amendment

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What is an anaerobic digester

- An anaerobic digester is an **engineered system** designed to carry out the digestion of organic matter and capture of biogas

- Anaerobic digesters are characterized and designed according to one or multiple features which define working conditions and performance
  - Rate of digestion (high rate, low rate)
  - Flow characteristics (stirred tank, plug flow, etc.)
  - Operating temperature (mesophilic, thermophilic)
  - Type of mixing (mechanical, hydraulic, gas, combination)
  - Optimal solid content (high, low, dry)

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The engineering of Anaerobic Digestion



- Anaerobic Digestors are **bioreactor systems** designed to:
  - Capture biogas naturally produced by biological processes
  - Provide a controlled environment for repeatable and predictable biogas production
  - Optimize gas generation yield and rate by managing:
    - Temperature
    - Mixing
    - Solid content
    - Feeding of different substrates
    - Integration processes to increase digestibility by chemical, biological, physical, or mechanical pretreatment
- Many possible geometrical configurations!

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Critical operating parameters of a digester

- Feedstock characteristics
  - Composition
  - Particle size
  - Moisture content
  - Biogas potential
- Consistent or slow varying operating conditions
  - Mixing
  - Feeding policy
  - Retention time
  - Organic load
  - Temperature
  - pH
- Control of
  - Auxiliary nutrients
  - Inhibitory substances

Understanding the feedstock and its impact on digester operations is essential!

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Feedstock characterization

- Elemental analysis
  - C, H, O, N, S, etc. content (dry basis w/w %)
- Proximate analysis
  - Volatile solids (VS), Total solids (TS), Ash
- Composition
  - Carbohydrates, lipids, lignin, etc.
  - Organic vs. inorganic nitrogen
- Biomethane potential
- Size and morphology
- Pretreatment needs
- Low solids streams or field tests
  - Chemical oxygen demand (COD)
  - Total Kjerdahl Nitrogen (TKN)

Considerable project analysis can be carried out from this data.
AURI can support producers and developers in this investigation

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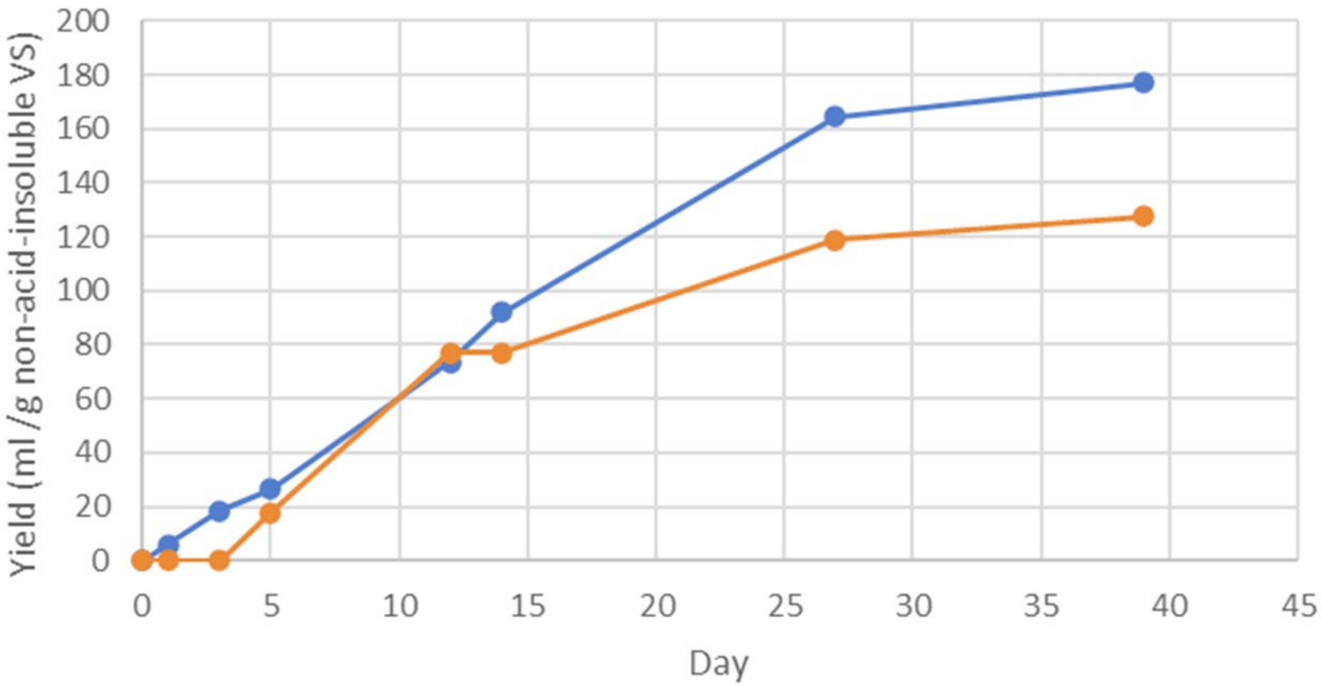
Bio-Methane Potential (BMP)



BMP is a laboratory bench scale test to determine the methane production characteristics of given feedstock.
The shape of the curve is as important as the ultimate methane generation number

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Critical operating parameters

- Organic load
  - Amount of feedstock fed daily per unit of digester volume
  - Important for noncontinuous feed and co-digestion
  - Too high and digestion is inhibited, too low and digester volume may be excessive.
- Carbon to Nitrogen ratio
  - Too low and ammonia poisoning may prevent biogas production
  - Too high and biogas and biogas production is hampered by stressed biota

Good feedstock characterization, BMP, and understanding of operating parameters allows early identification of basic project requirement, optimal digester configuration and enables preliminary but educated techno-economic analysis

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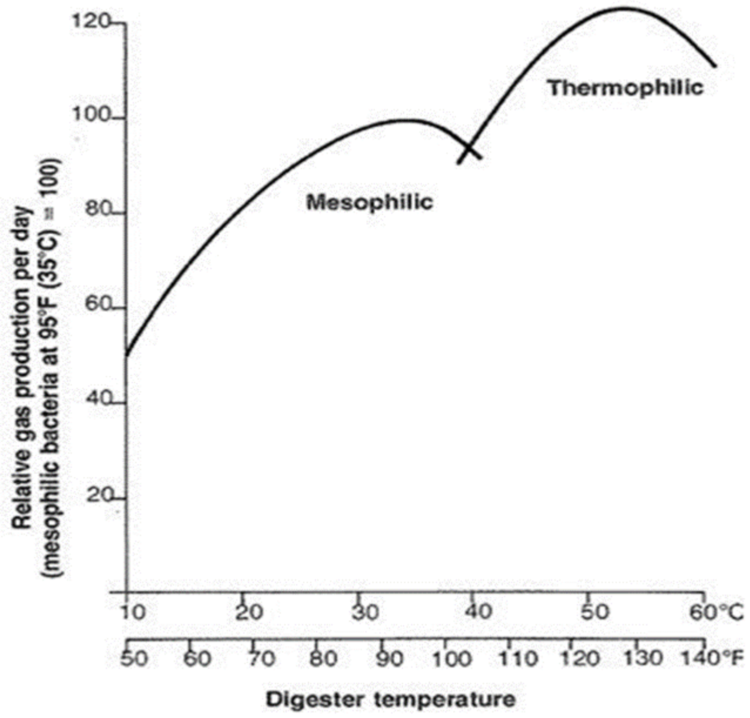
Temperature and retention time

- Digesters are designed to operate in the optimal temperature range of the bacterial consortia they host.
- The processing time (HRT or Hydraulic Retention Time) is **the average time the material spends inside the reactor**.
- Thermophilic digestion provide higher gas rate but require more precise temperature control and higher thermal parasitic load



Source: Roediger, H. Die anaerobe alkalische Schlammfaulung. Wasser-Abwasser, H.1, Verlag R. Oldenbourg, Muchen u. Wien. 1967

	Digestion type	
	Mesophilic	Thermophilic
Temperature range (Celsius)	30-40	40-55
Retention time (days)	10-40	5-20

Both are valid approaches with trade-offs and optimal applications

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Biogas Composition

Component	% (v/v) dry basis
Methane	50-70
Carbon Dioxide	50-30
Nitrogen, Oxygen, Hydrogen	Traces
Ammonia	< 1%
Hydrogen Sulfite	From traces to few thousands' ppm
Water	Saturated

Removal needed depending on use

Always manage

Biogas always requires application-dependent conditioning, but the technologies. are well-understood, proven and available from multiple vendors

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Another benefit: pathogens Destruction

Organism	Anaerobic digestion		Control	
	53 C / hours (thermophilic digestion)	35 C / days (mesophilic digestion)	18-21 C / weeks	6-15 C / weeks
Salmonella typhimurium	0.7	2.4	2.0	5.9
Salmonella dublin	0.6	2.1	-	-
Escheria coli	0.4	1.8	2.0	8.8
Staphylococcus aureus	0.5	0.9	0.9	7.1
Mycobacterium paratuberculosis	0.7	6.0	-	-
Coliform bacteria	-	3.1	2.1	9.3
Group of D-Streptococci	-	7.1	5.7	21.4
Streptococcus faecalis	1.0	2.0	-	-

Selected pathogen decimation time under different AD operating conditions vs. control

(source: Ecofys BV and Wageningen University)

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What can preclude effective AD

- Mismatch between residence time and temperature
- Poor temperature control
- pH too low or too high
- Excessive or rapidly variable organic load
- Chemical inhibition
- Inadequate mixing
- Failure of ancillary equipment not suitable for process conditions

Deep understanding of feedstock helps preventing these problems

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Supporting the development of an AD project

Feedstock characterization

Always

Bench scale digester

Often needed if:

Uncommon feedstock

Co-digestion
Variable feeding

Rheology concerns

Pilot scale digester

Not as a common need but useful for:

Optimize low C/N feed

Mixing scale-ups

Digestate studies

Training

Project scoping

Techno-economic Analysis

Design selection

AURI can support producers and developers across these stages of project scoping and definition

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Project scoping example

A farmer wants to know how many cows she needs in to recharge her new electric F-150 pickup truck!

Let’s collect some manure, characterize it, carry out a BMP and answer this question!

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How many cows do I need to recharge an electric Ford F-150?

- TS: 7.0 ± 0.5 kg/cow/day (1)
- VS: 5.6 ± 0.2 kg/cow/day (1)
- VS destruction rate: 38 ± 3 % (2)
- CH4 yield: 0.76 ± 0.1 m3 CH4/kg VS destroyed (2)
- Gas per cow
  - 5.6 x 0.38 x 0.75 = 1.60 m3 CH4/cow/day
- Energy content of methane: 35.85 MJ/m3
- Electrical efficiency 35% (3)
- Energy per cow
  - Fuel 35.85 x 1.60 = 57.36 MJ/day/cow (54,366 BTU/day/cow)
  - Electric 57.36 x 0.2278 x 0.35 = 5.57 kWh/day/cow
- Ford F-150 Lightning battery pack =131 kWh (4)

x 24 =

(1): Measured from collected samples
(2): From BMP analysis
(3): Could be higher, but German-made gensets are way too expensive
(4): She bought the long-range version

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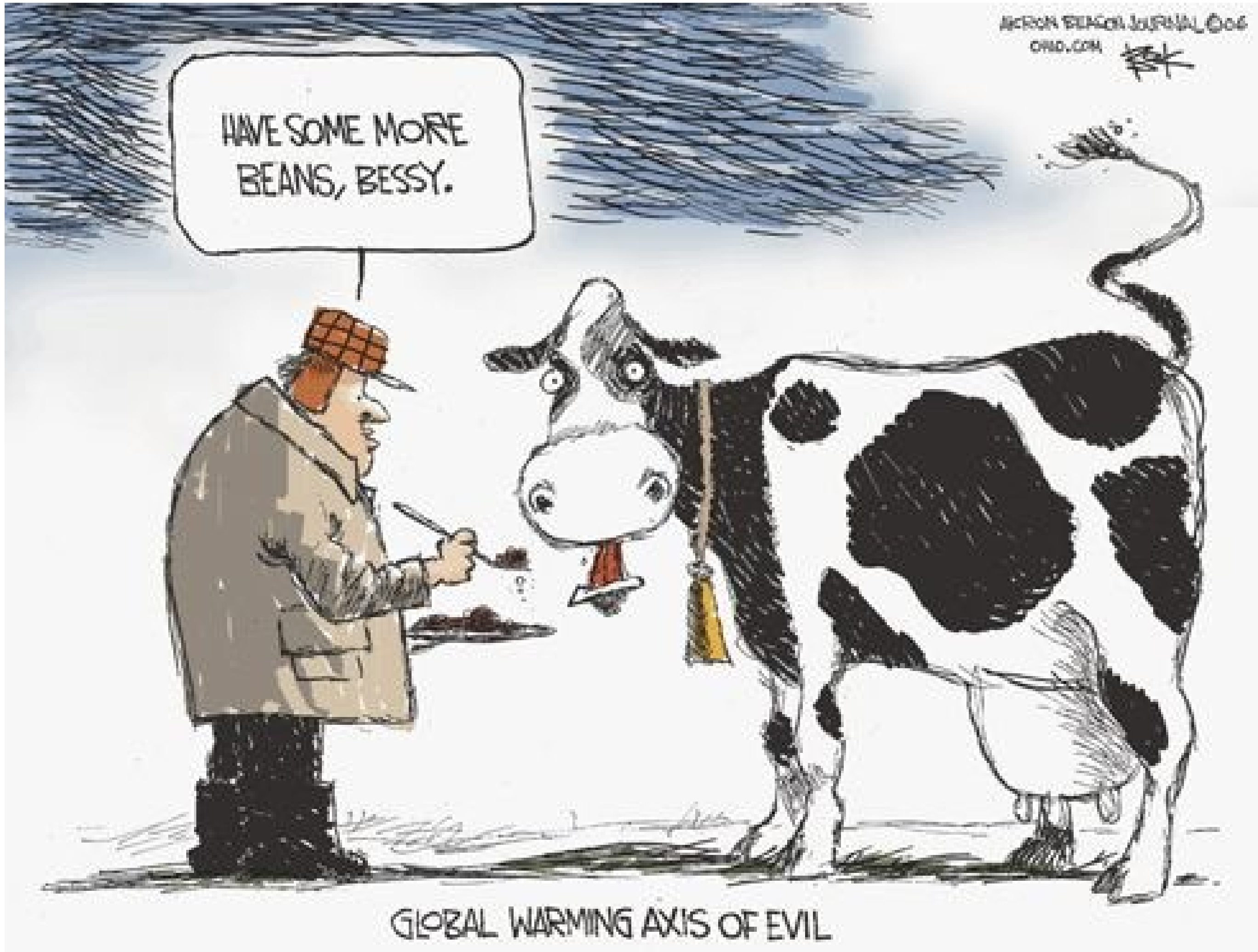
Questions?



Lessons from Abroad

Timothy Logan

General Manager,

Envitec-Biogas US LLC

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Lessons from Abroad

Stefan Dehne

Head of Technical Sales,
Envitec-Biogas USA,LLC

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EnviTec Biogas USA Inc. – Lessons from Abroad

Minnesota Renewable Energy Roundtable
RNG from Biomass Feedstocks Using Anerobic Digestion

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EnviTec Biogas

EnviTec Biogas AG / EnviTec Biogas USA Inc.

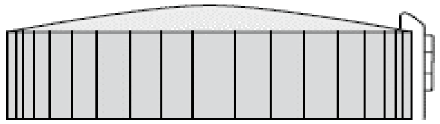
- Company History/Financials/Structure
  - Abroad
  - US
- Current Status Abroad
- Current Status in the US

EnviTec Biogas AG History/Financials

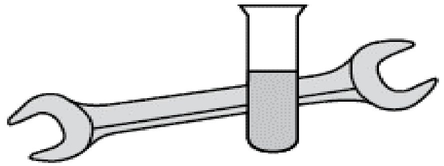
- Since 2002: built over 700 AD plants 16 countries
  - Currently operations in 17 countries
- Publicly traded on Frankfurt stock exchange since 2007 (ETG)
- 2021 Financials (Public)
  - TR $257M
    - >100M outside of Germany
  - EBT $22.7M
  - 515 employees

EnviTec Biogas AG – Operating Units
Add Value/Security via Continuous OU Feedback

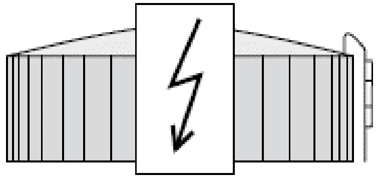
- Construction/Engineering – employs ~137



- Service – employs ~168
  - Biological service
  - Technical service
    - Scheduled
    - Unscheduled
    - 24/7 help desk (90% solved remotely)
    - 11M in stock in Germany, >1M planned for US



- Own plant operations – employs ~125
  - 89 plants owned & operated by EnviTec or JVs



- Balance is Group/AG ~125 in Lohne, Germany

EnviTec US – History & Outlook

__Current status__

- Built 4 single tank digester projects with CHP: 2012, 2013, 2017, 2018
- 2021 signed 4 contracts for sites with AD and upgrading (first EnviThans in US)
- 2022 signed 6 contracts for sites with AD and upgrading
- 2022 currently negotiating 6 additional contracts
- 2022 FEED for 3 new dairy developments

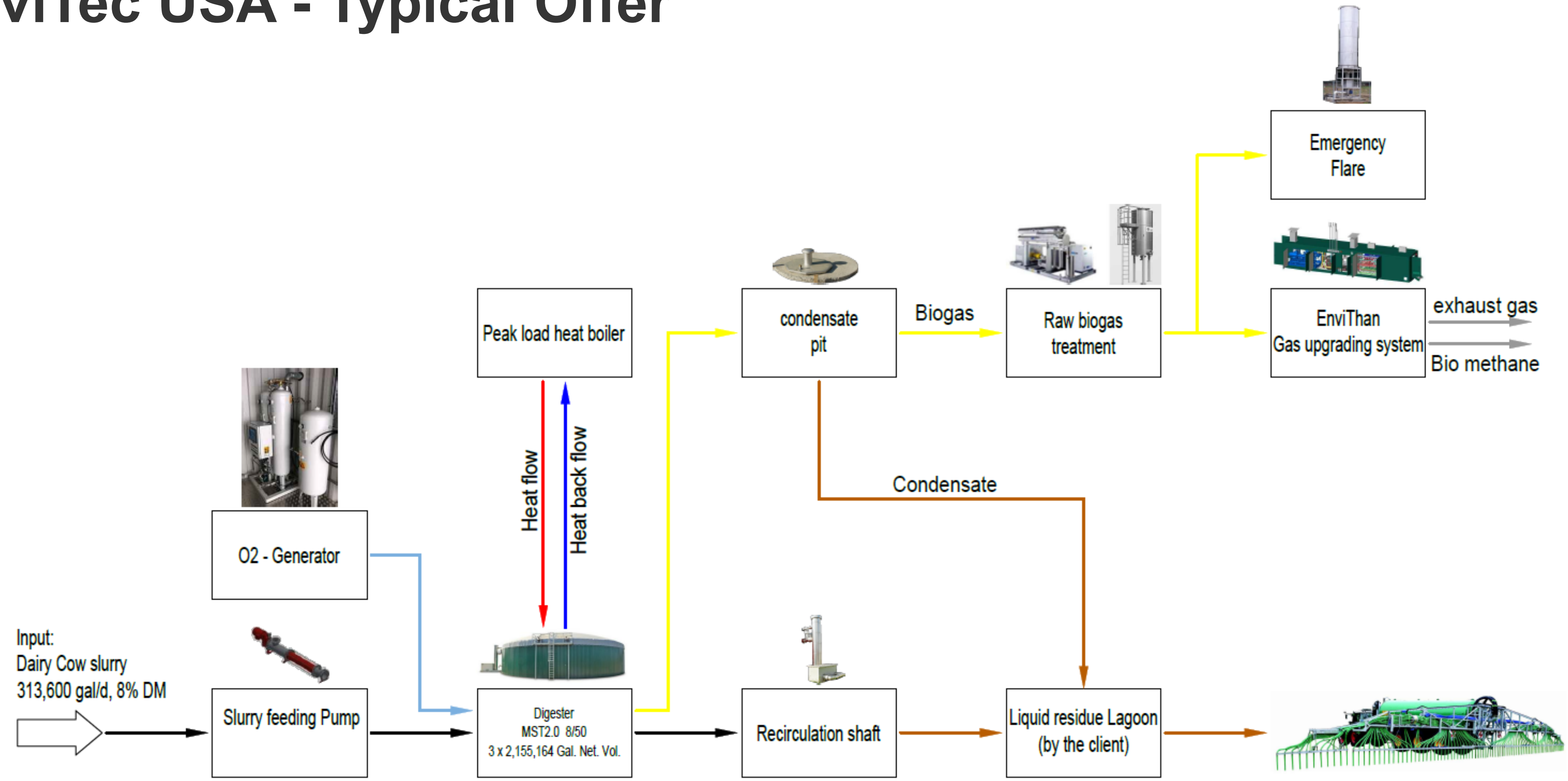
__Outlook 2023__

- Construction of at least 29 additional digester tanks *(**made in the USA**)*
- Commissioning of at least 8 additional projects and EnviThan biogas upgrading systems
- Expansion of the U.S. supply chain
- Strengthening of the U.S. presence
- Developing Spare Parts Stock and Service LLC, 24/7 help desk
- Continue to evaluate investment opportunities for Own/Operate

EnviTec USA – Lessons Learned

- Flexible in terms of contracting, can work under a full wrap EPC or contract directly with developers/investors/utilities
- Speaking the same language doesn’t guarantee understanding!
- Flexible in terms of scope of supply, client can more or less evaluate the best scope of supply and service in their own interest
- We prefer face to face, level the table
- Comfortable putting some risks on our side, fixing price, LDs for delivery, select construction timelines, guarantee's for performance
- Interfaces are crucial
- Clearly state assumptions, contingencies

EnviTec USA - Typical Offer



Mitigate risks/claims by eliminating interfaces!

EnviTec USA – Engineering, Construction, Equipment

- Engineering – full plan
  - Mechanical - size, type, layout for scope of supply
  - Electrical – conduit size, type
  - Safety chain/process engineering
  - Tanks, cover, heating systems, internal coils, agitators, revision openings, control panels, gas upgrading, sumps, pump, level, feed and return pumps, recirculation shafts, raw biogas treatment, O2 generator, H2S removal
  - Civil/geotechnical/balance of site utilities by others
- Construction – tanks, insulation, equipment setting
- Process Guarantees!

Derisking – Feedstocks

- Critical to understand the specifics of the waste streams
- Specifically, %DM and %VS, manure flow other waste stream characteristics
  - Balance data sheet then created
  - Tank sizing/HRT/Biogas recovery
- Location of plant
  - Informs heating demand
- Gas grid specifications
  - EnviThan design/O2 generation considerations → H2S

Above is merely indicative and requires lab data (analysis and BMP) for process guarantees!

Derisking – Balance Data Sheet

Balance data	Yearly Input Gal./ yr.	m³/yr.	Daily Input Gal. / d.	m³ / d.	Inputmixture %	DM %	oDM %	DM to./yr.	oDM to./yr.
Dairy cows slurry	138,408,000	523,931	379,200	1,435.4	100%	7.66	79.9	40,133	32,066
Water									
Water (cleaning / washing)	52,834	200	145	0.5	0%	0.0	0.0	0	0
Input mix		**524,131**		**1,436.0**	**100%**	**7.7**		**40,133**	**32,066**
Output		**509,660**		**1,396.4**		5.04	68.6	25,662	
Residue (Output)									
Residue without separation	1.0	509,660		1,396.3			=	**Customer information**	
Residue after separation	1.0	0		0.0			=	**Estimated Figures**	
Solid part	0.6	0		0.0					
Residue output total		**509,660**		**1,396.3**		5.04	68.6	25,662	

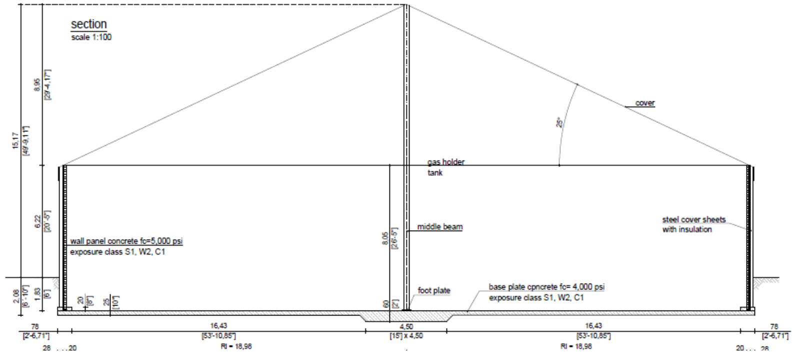
Derisking – Balance Data Sheet

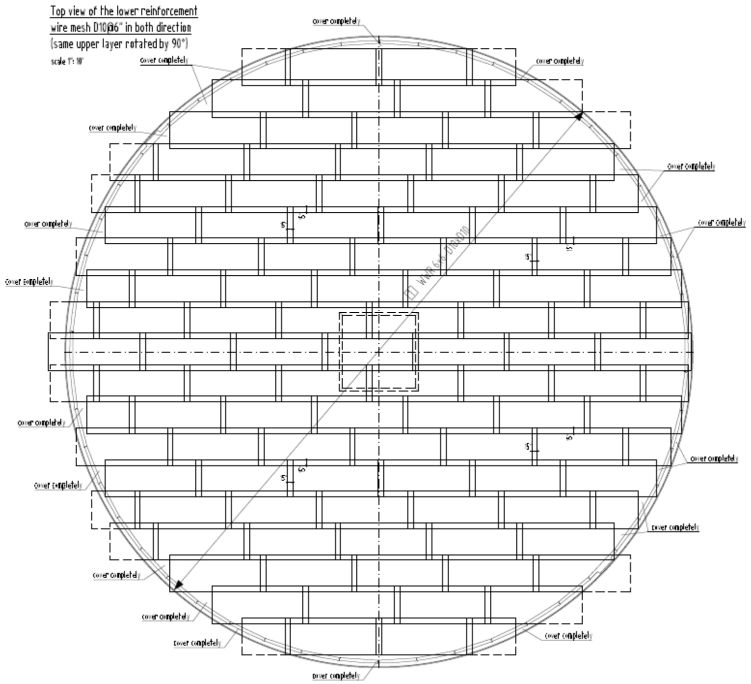
Yearly Gas Quantity ft³ / yr.	Daily Gas Quantity ft³ / d.	sp. Gas Quantity Nm^3/Mg_{FS}	sp. Gas Quantity ft^3/Mg_{FS}	sp. Gas Quantity Nm^3/Mg_{DM}	sp. Gas Quantity ft^3/Mg_{DM}	sp. Gas Quantity Nm^3/Mg_{oDM}	sp. Gas Quantity ft^3/Mg_{oDM}	Primary energy mmBTU / a	Primary energy mmBTU / d
407,669,193	1,116,902	22.0	778	288	9,870	360	12,713	216,632.74	593.51
		0		0		0			
407,669,193	**1,116,902**							**216,632.74**	**593.51**

- Need additional testing data (sulfur/BMP) to assure output and right size treatment
- Contract document!

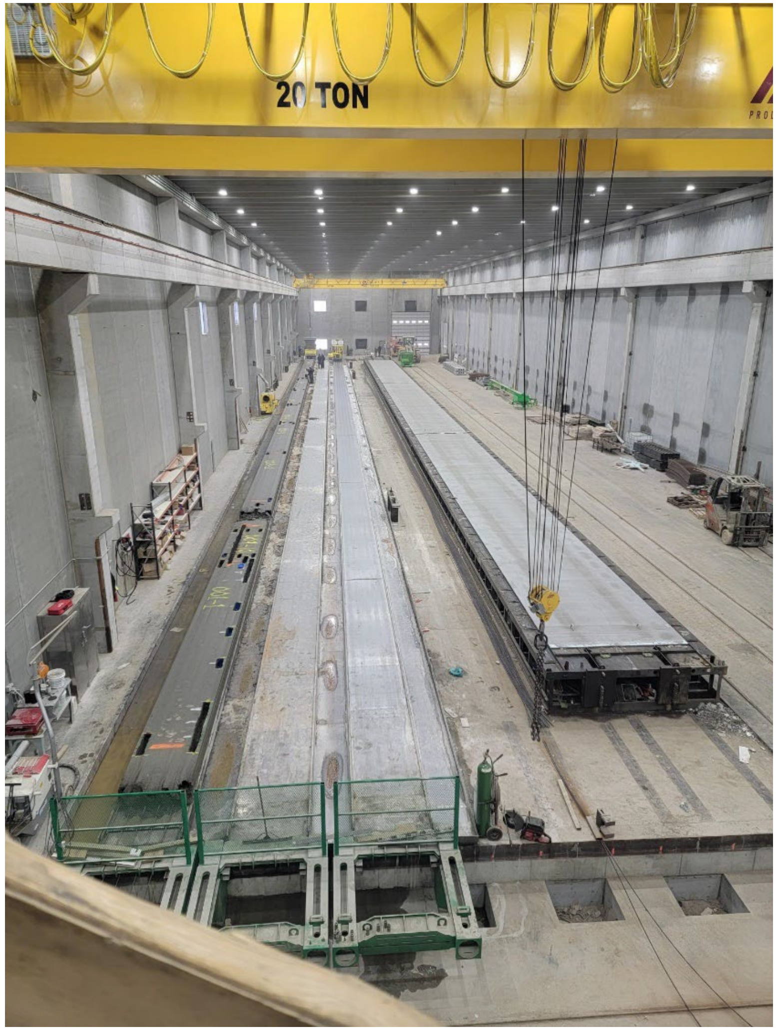
Tanks

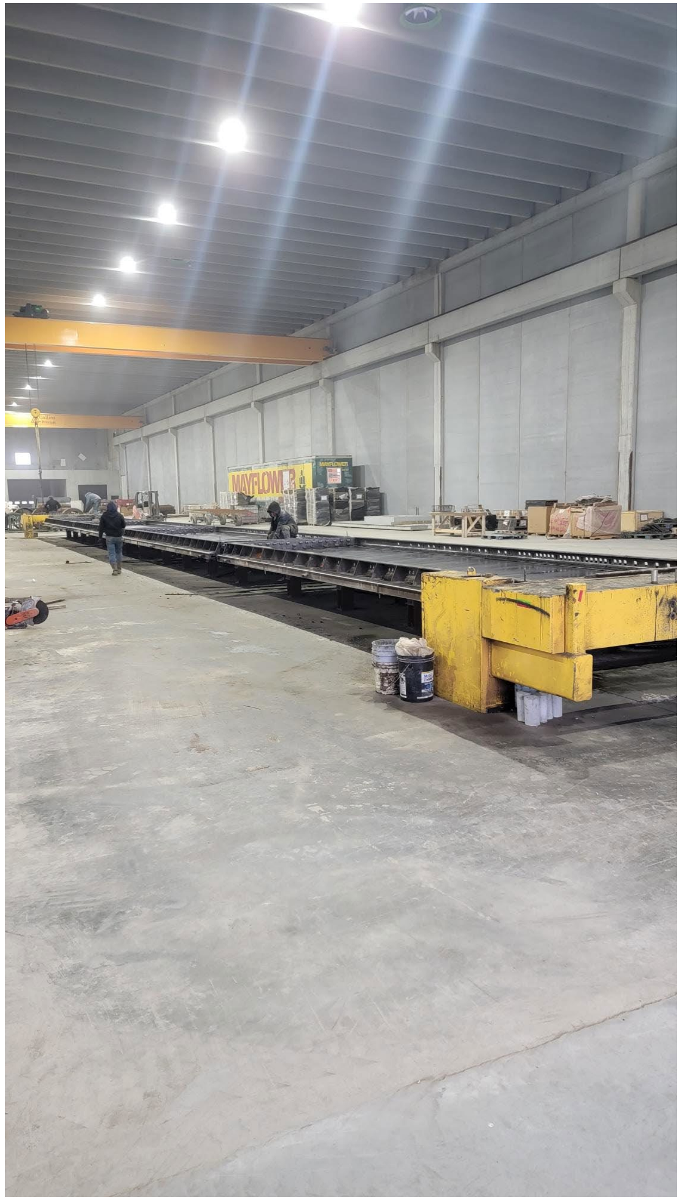
- Pre-stressed/post-tensioned concrete tank system
- >2,700,000 million gallons net volume
- Flexible sizing, can be made smaller to right size
- US Production capability cast/pour 1 tank week
- Base plates 1-2 weeks to tie and form, poured in 1 day
- Modular, easily assembled 2-4 days for erection
- Integrated with double membrane roof, i.e. no exposed concrete via level control
- >16,000 tanks built by EnviTec Biogas





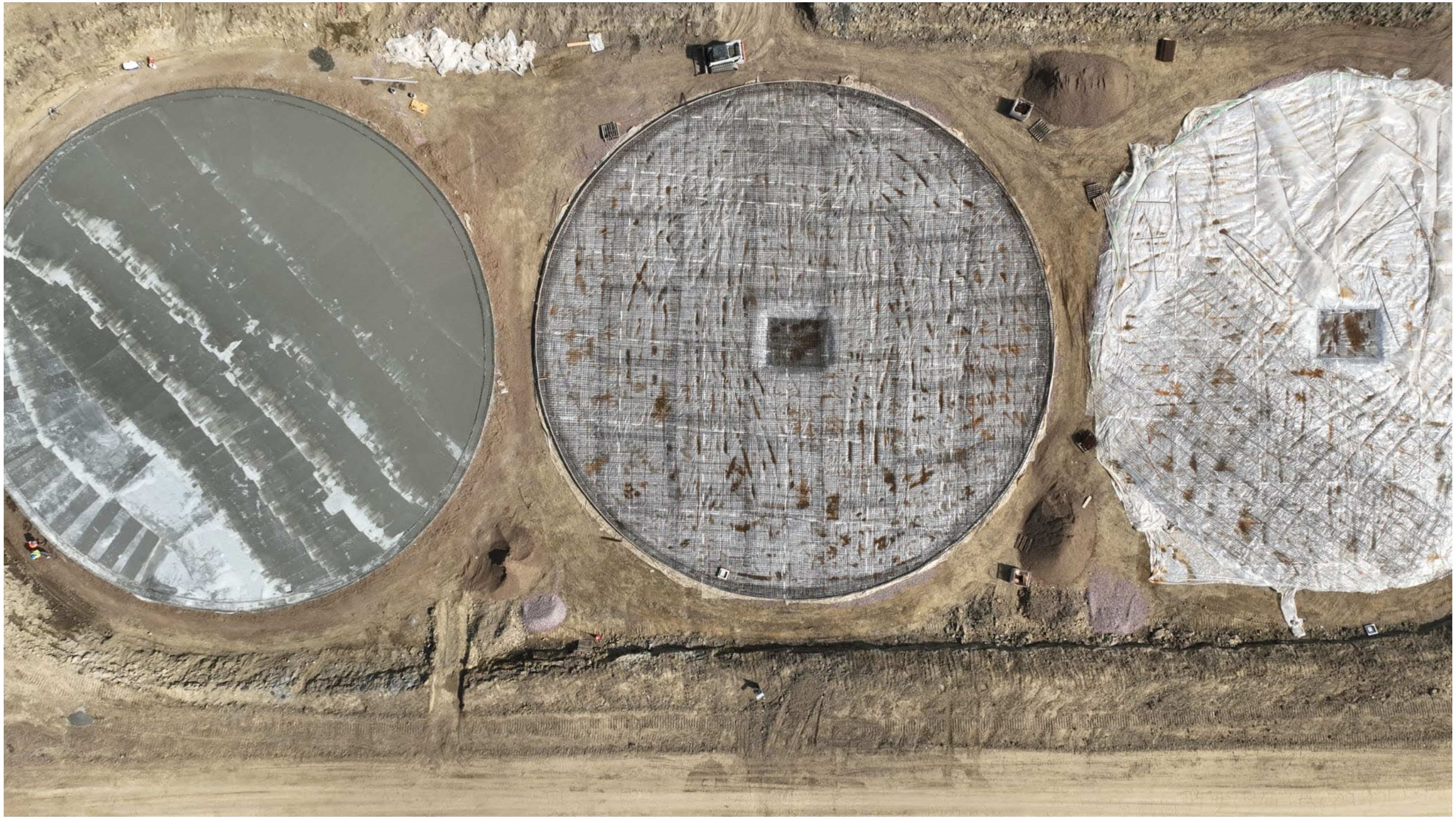
Tanks – Element Production





Tanks – Element Production

Tanks - Site



Sequenced for Efficiency

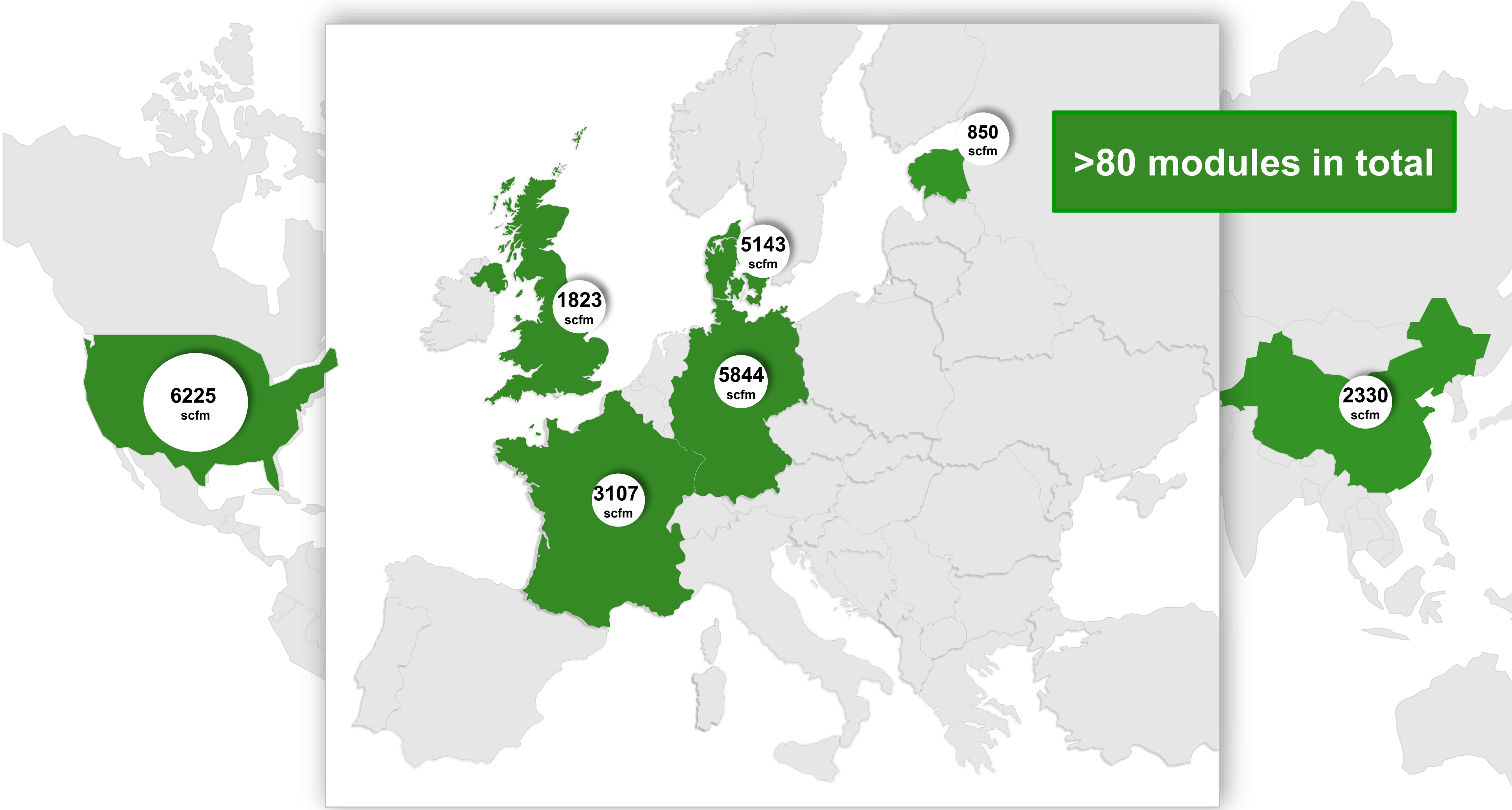
MST 8.0/50

- Tank was installed two days after being delivered
- 1.5 weeks after base plate poured

MST 8.0/50

EnviThan gas upgrading

A global success



>80 modules in total

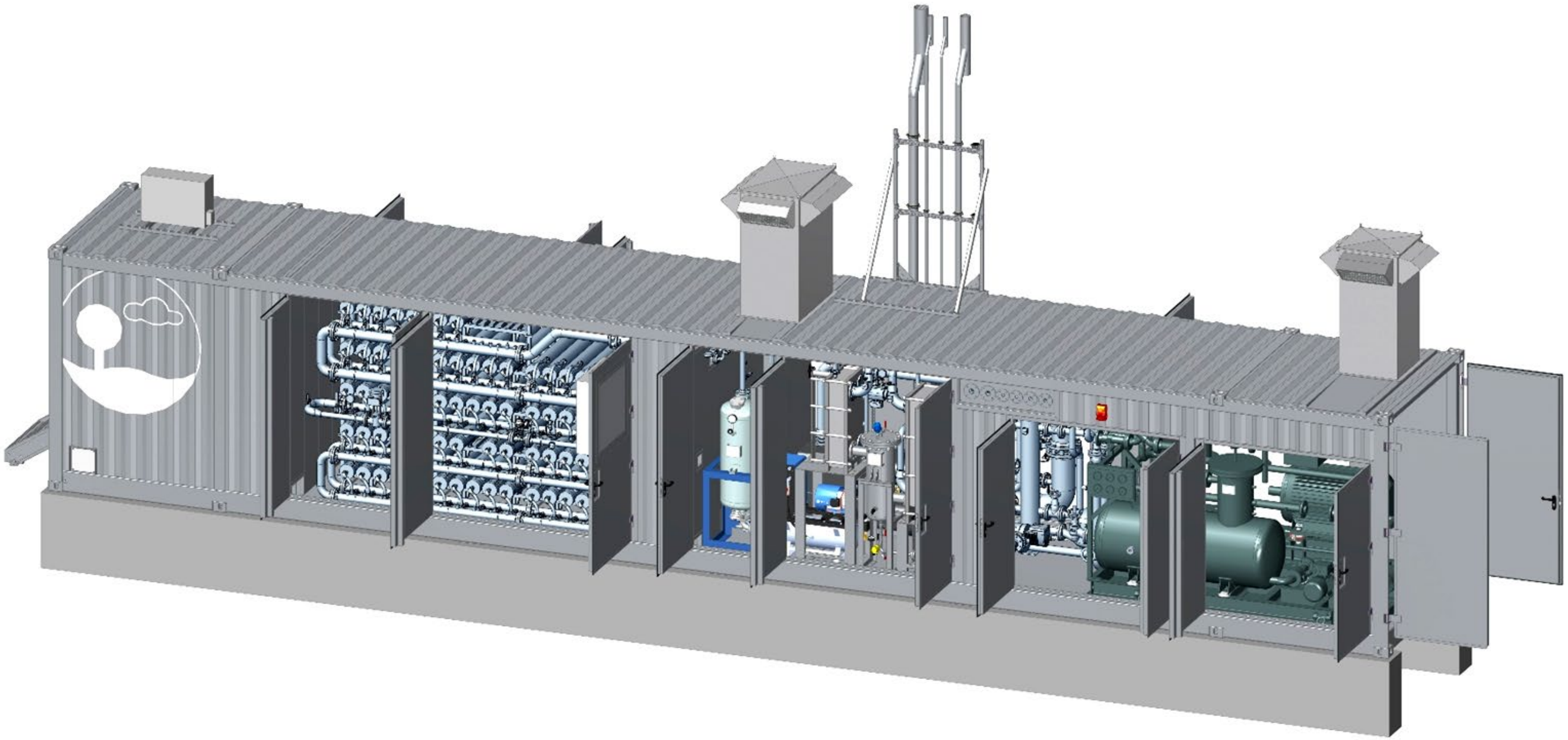
Total installed capacity:
20,000scfm RNG

- *Currently in fabrication for 10 AD/RNG projects in US representing > 6,.225 scfm of product gas*

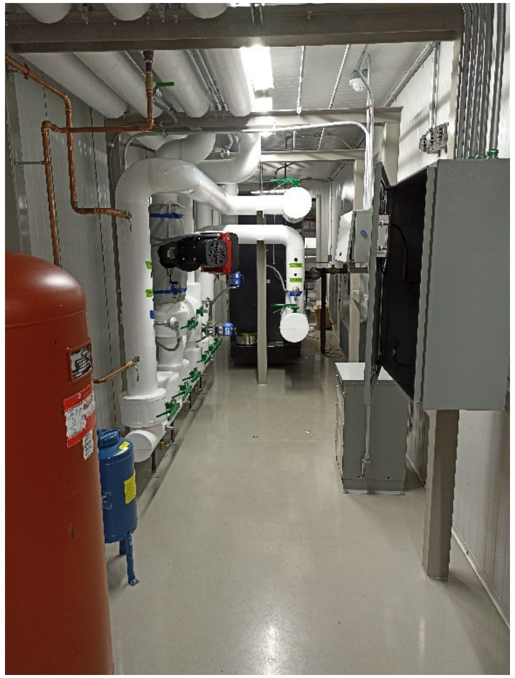
Our EnviThan plants provide more than **375,000 households** with renewable natural gas! (→ this is equivalent to a city such as Anaheim or Cleveland)

EnviThan Gas Upgrading

- Verification of inputs guarantees gas output from EnviThan
- 6,225 scfm under contract in the US



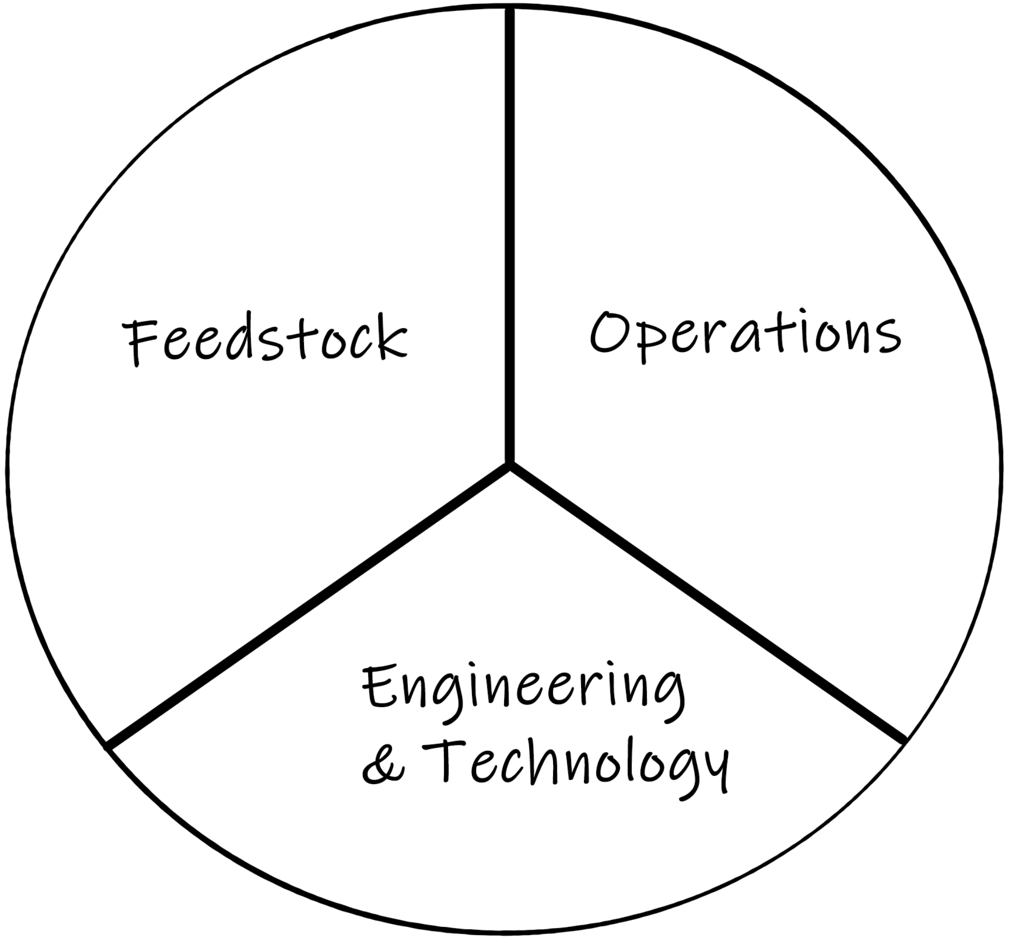
Heating Container / O2 Generator



Sign Glasses / Over/Under Pressure Guards

Single Tank Site in CT

Parts of Operational Pie



1/3 Feedstock / Biology

+

1/3 Engineering & Technology

+

1/3 Operation (Service / Maintainance)

=

<u>100% PROJECT SUCCES</u>

Lessons Learned

Summary

- Select technology that has been proven and operated by the group selling it
- Reduce Interfaces
- Feedstock - testing, testing, testing!
- Have a clear view on the operational pie
- Build out spare parts inventory
- Localize Service

Thank you for your attention!

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Discussion and Audience Q & A

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Networking Break

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RNG Market & Incentives/Policies

Emma Ingebretsen

Senior Project Manager - Decarbonization Projects, CenterPoint Energy

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Natural Gas Innovation Act & CenterPoint Energy's First Innovation Plan

Emma Ingebretsen, Sr. Project Manager
December 1st, 2022

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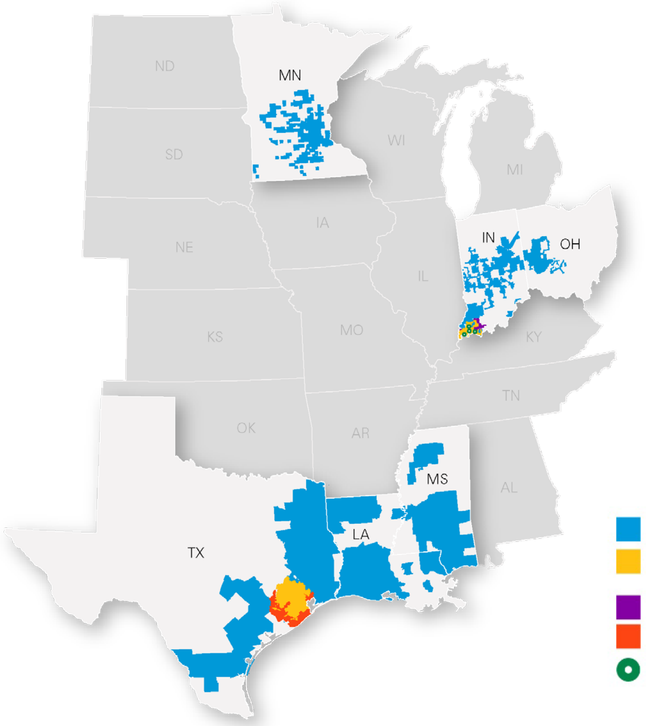
Where CenterPoint Energy operates



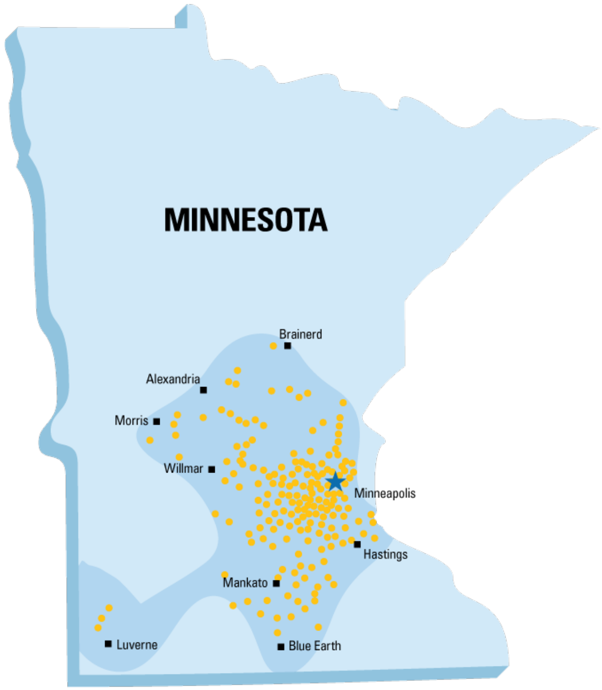
- Natural Gas Distribution
- Combined Electric Transmission & Distribution and Natural Gas Distribution
- Indiana Electric Transmission & Distribution
- Houston Electric Transmission & Distribution
- Indiana Power Generation

Natural Gas Distribution, Electric Transmission & Distribution and Power Generation

nearly
7 million
gas and electric metered customers

6
states

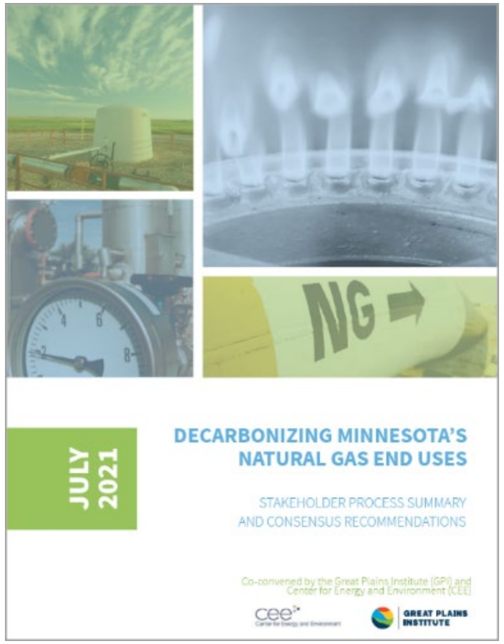
Deep roots in Minnesota

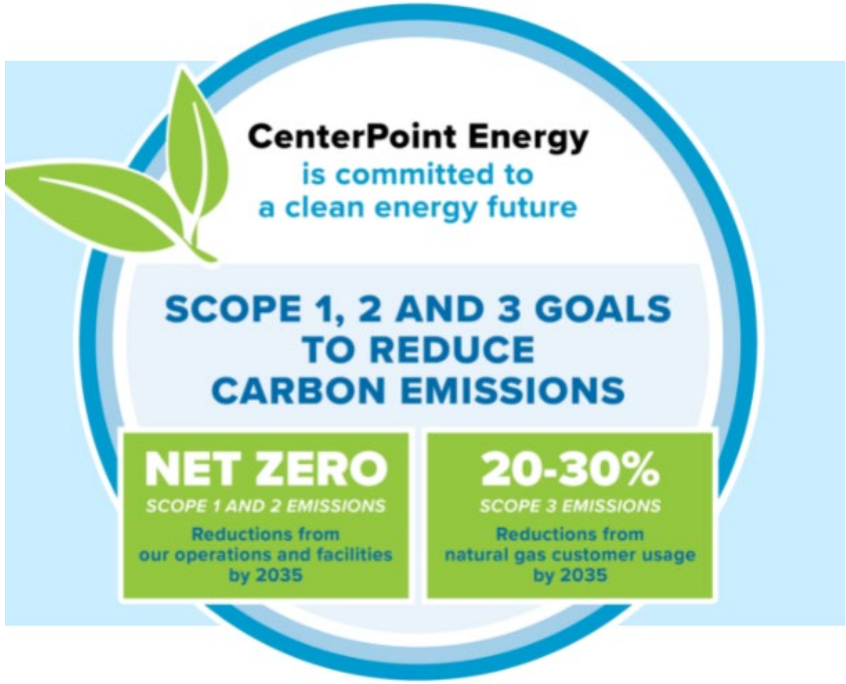


- **Founded 150+ years ago** near the Guthrie
- We're the **largest natural gas utility** in Minnesota
- **We serve 900,000** Minnesota homes/business in 260+ communities
- **1,200+ Minnesotans** employed

Focus on Carbon Emissions Reductions

Section 216H.02, subdivision 1: “It is the goal of the state to reduce statewide greenhouse gas emissions **across all sectors producing those emissions** to a level at least 15 percent below 2005 levels by 2015, to a level at least 30 percent below 2005 levels by 2025, and to a level at least 80 percent below 2005 levels by 2050…





Natural Gas Innovation Act

- Proposed by CenterPoint Energy
- Passed in June 2021 with bipartisan support
- Applies to investor-owned natural gas utilities in MN
- Establishes regulatory framework for deploying renewable energy resources and innovative technologies

NGIA Basics

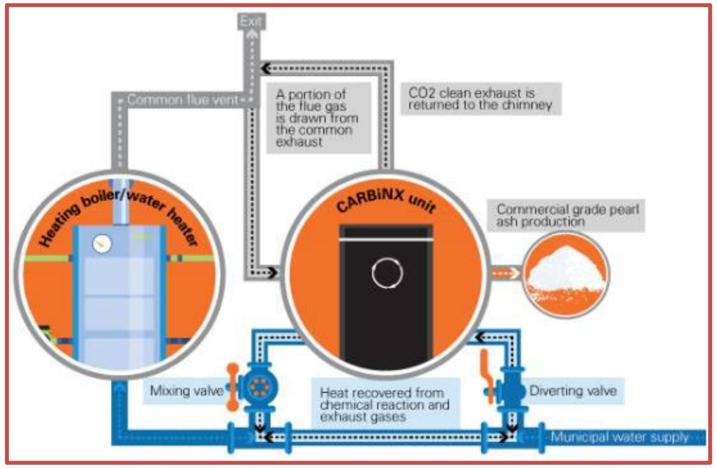
Under NGIA, gas utilities may file “**Innovation Plans**” for approval by PUC and, if approved, recover associated costs determined reasonable and prudent

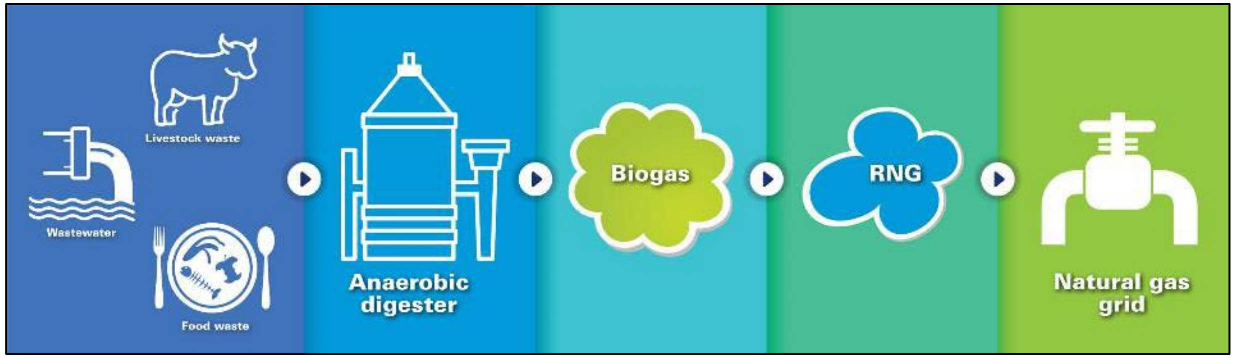
- **Innovation Plan**
  - a set of “**pilot projects**” that directly deploy and/or encourage the deployment of "**innovative resources**”
- **Pilot Projects**
  - can include a wide range of activities, including specific project development, programs and services offered to CenterPoint Energy customers, and research & development efforts

NGIA Basics

Innovative Resources

- "Gaseous Fuels"
  - Renewable natural gas/Biogas
  - Power-to-hydrogen (Green Hydrogen)
  - Power-to-ammonia (Green Ammonia)
- Other decarbonization strategies
  - Energy efficiency (emerging/innovative, beyond CIP)
  - Carbon capture
  - District Energy
  - Strategic electrification





Innovation Plan Content

New carbon capture technology lowers greenhouse gas emissions from heating

- Among other things, an innovation plan filing will include discussion of
  - Carbon intensity of resources included in the plan
  - Forecasted greenhouse gas emission reduction or avoidance
  - Whether the plan supports the state's agricultural and waste management goals
  - A description of third-party certifications of environmental attributes
  - Local economic development and job creation

Cost-Benefit Analysis Framework

- Broad view of costs and benefits
  - Environmental co-benefits
  - Economic development
  - Innovation and scalability

	Pilot 1	Pilot 2	Pilot 3
Perspectives			
NGIA Utility Perspective			
NGIA Participants Perspective (including specific impacts on low- and moderate-income participants)			
NGIA Nonparticipating Customers Perspective (including specific impacts on low- and moderate-income customers)			
Effects on Other Energy Systems and Energy Security			
Environment			
GHG Emissions			
Other Pollution (including any environmental justice costs or benefits)			
Waste reduction and reuse (including reduction of water use)			
Policy (e.g., natural gas throughput, renewable energy goals)			
Socioeconomic			
Net Job Creation			
Economic Development			
Public Co-Benefits			
Market Development			
Innovation			
Direct Innovation Support			
Resource Scalability and Role in a Decarbonized System			

Cost Caps/Allowed Budget

CenterPoint Energy

Cost Cap Over Time

	1st Plan	2nd Plan	3rd Plan
Cap as % GOR	1.75%	2.75%	4%
Cap per Cust	$20	$35	$50
Bonus Cap as % GOR	0.25%	0.75%	1.5%
Cap per Cust	$5	$10	$20

- Plans are cost capped as the lesser of a percent of a utility's gross operating revenue or dollars per customer
  - Cap is annual average of costs
  - Bonus money for certain kinds of RNG projects
- The cap increases over time if cost-effectiveness criteria are satisfied

- Estimated budget,1st plan =
  $20M per year for 5 years

Innovation Plan Development Process

CenterPoint Energy

Idea collection and initial screening

Complete

Q3 2022

- Collect ideas
- Conduct initial screening
- Select shortlist of ideas for further analysis
- Stakeholder meeting #1

Detailed analysis

In-Progress

Q4 2022 – Q1 2023

- Define GHG reduction potential
- Additional Benefits (e.g., job creation)
- Estimate costs
- Stakeholder meeting #2

Select final portfolio

Q1 – Q2 2023

- Select portfolio of projects that meets statutory requirements
- Develop details for selected pilot projects
- Stakeholder meeting #3

File plan

Q2 2023

- Write plan
- Produce required documentation and justifications
- File plan with Minnesota Public Utilities Commission
- Public Comment and Commission Review

Sample of potential pilot projects and studies (preliminary)

CenterPoint Energy

Innovative Resource	Potential Pilots or R&D
Renewable Natural Gas/Biogas	RNG purchases or assistance with project development Studies to support RNG project development Direct use of biogas R&D, thermal gasification R&D,
Power-to-Hydrogen/Power to Ammonia	Industrial facility direct use demonstration projects Additional pipeline blending projects Ammonia burner R&D
Carbon Capture	Industrial facility demonstration projects Rebates for carbon capture Industrial methane and refrigerant leak reduction
District Energy	Decarbonizing existing district energy systems New district energy systems or networked geothermal systems
Energy Efficiency	Gas heat pumps, neighborhood weatherization blitzes, Residential Deep Energy Retrofit and Air Source Heat Pumps
Strategic Electrification	Commercial Hybrid Heating, Industrial Electrification Incentives

Thank you!

Emma Ingebretsen, Sr. Project Manager

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Stay engaged: CenterPointEnergy.com/NGIA

RNG Market & Incentives/Policies

Todd Taylor, Attorney at Law

Impact Counsel,
Avisen Legal

auri
Agricultural
Utilization
Research
Institute

2022 Minnesota Renewable Energy Roundtable
The Renewable Gas Market – Incentives and Policies

Avisen Legal – Renewable Energy Lawyers

WHY BIOGAS?

Biogas systems protect our air, water and soil while recycling organic material to produce renewable energy and soil products. In cities, biogas systems recycle food scraps and wastewater sludge, reducing municipal costs and avoiding transport to disposal sites. In rural areas, biogas systems make agriculture more sustainable and create additional revenue streams for farmers. Since biogas systems prevent greenhouse gases, like methane, from entering the atmosphere, all biogas systems make our air cleaner to breathe and combat climate change, displacing fossil fuels. Biogas systems produce soil products that recycle nutrients, contributing to healthier soils and creating opportunities to eliminate nutrient runoff that pollutes our waterways. Waste management, renewable energy and fuels, clean air, healthy soils and crystal clear waterways—you can get all of this when you build a new biogas system.

AMERICAN BIOGAS COUNCIL

1211 Connecticut Avenue NW, Suite 650
Washington, DC 20036-2701
202-640-6595
info@americanbiogascouncil.org

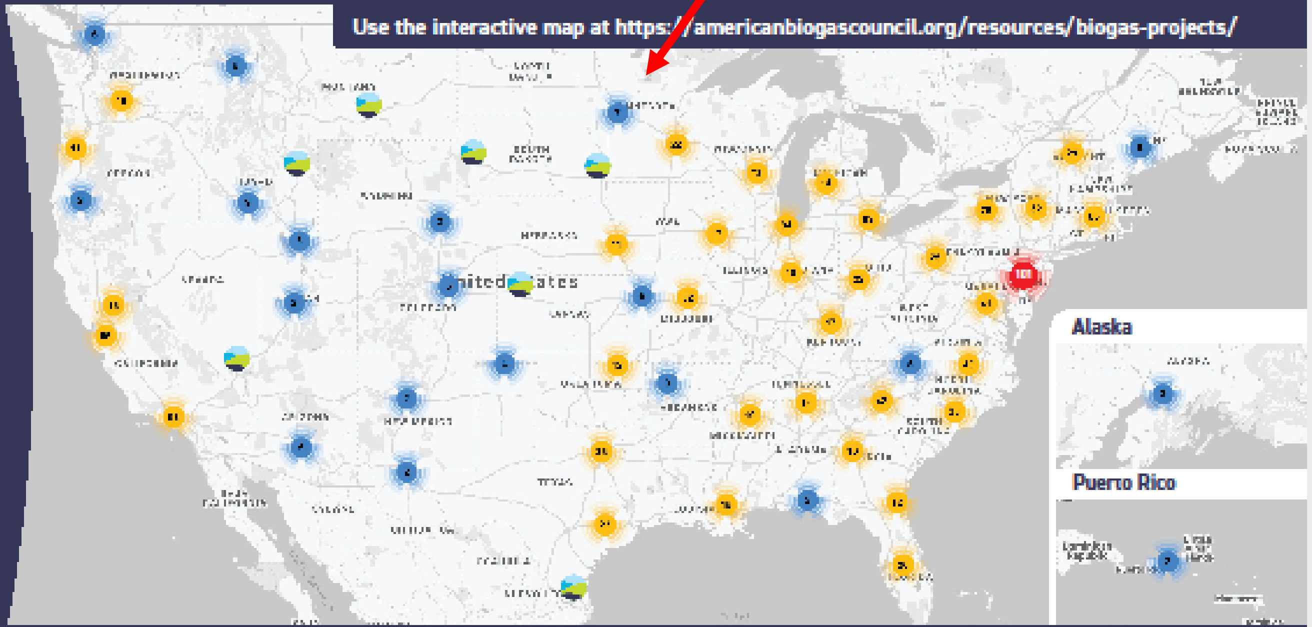
Operational U.S. Biogas Systems

The U.S. has over 2,200 sites producing biogas in all 50 states:

250 anaerobic digesters on farms, 1,269 water resource recovery facilities using an anaerobic digester (~860 currently use the biogas they produce), 66 stand-alone systems that digest food waste, and 652 landfill gas projects.

For comparison, Europe has over 10,000 operating digesters and some communities are essentially fossil fuel free because of them.

Use the interactive map at https://americanbiogascouncil.org/resources/biogas-projects/



Potential for U.S. Biogas Systems

The U.S. biogas industry has enormous growth potential.

We count 14,958 new sites ripe for development today: 8,574 dairy, poultry, and swine farms and 3,878 water resource recovery facilities (including ~380 who are making biogas but not using it) could support new biogas systems, plus 2,036 food scrap-only systems and utilizing the gas at 415 landfills who are flaring their gas. If fully realized, according to an assessment conducted with the USDA, EPA and DOE as part of the Federal Biogas Opportunities Roadmap, plus data from ABC, **these new biogas systems could produce 103 trillion kilowatt hours of electricity each year and reduce the emissions equivalent of removing 117 million passenger vehicles from the road.** These new biogas systems would also catalyze an estimated $45 billion in capital deployment for construction activity, which would result in approximately 374,000 short-term construction jobs to build the new systems and 25,000 permanent jobs to operate them. Indirect impacts along supply chains would be even greater.

For individual state profiles, visit: https://americanbiogascouncil.org/resources/state-profiles/

Sources: American Biogas Council, Biogas Opportunities Roadmap (USDA, EPA, DOE, 2014), EPA AgSTAR 2016, EPA LMOP 2017, Water Environment Federation "Enabling the Future", AcuComm. Last updated April 26, 2018

www.americanbiogascouncil.org

Minnesota Biogas

8th of 50 states for biogas potential. 46.91 billion cubic feet for renewable methane from biogas potential

- Potential for
  - 35 food waste (3 now)
  - 640 manure (3 now)
  - 50 wastewater (25 now)
- $2.19 billion in capital investments
- 1213 permanent jobs
- 3928 million kWh electricity and 1530 BTU/h heat
- 609.3 million gallon year gasoline equivalent

- Greenhouse gas potential
  - Removing 4,629,000 cars from the road
  - Growing 2070 million trees for 10 years
  - Divert 1.75 million tons of food waste from landfills per year

Definitions

Bonus credits

- **Base credit: 6%**
- Prevailing wage & apprenticeship (multiply base rate x 5)
  - Required for projects that have not commenced construction 60 days after IRS defines this requirement, and projects > 1MW output (for biogas-electricity)
- Domestic Content (+10% or +2% without paying prevailing wages)
  - Certain steel, iron, and manufactured products used in the facility must be domestically produced.
  - Can be waived if domestic
- Energy Communities (+10% or +2% without paying prevailing wages)
  - a brownfield site;
  - an area which has or had certain amounts of direct employment or local tax revenue related to oil, gas, or coal activities and has an unemployment rate at or above the national average; or
  - a census tract or any adjoining tract in which a coal mine closed after December 31, 1999, or in which a coal-fired electric power plant was retired after December 31, 2009.
- **Total: 6-50%**
- **Transferability**
  - Creates ability to sell tax credits (income from transferring credits is not taxed); will meaningfully expand tax equity market
- **Direct Pay**
  - Turns tax credits into refunds from Treasury for tax-exempt entities, state/local gov'ts, Indian tribal gov'ts, and entities using the clean hydrogen and CO_2 sequestration credits, for 5 years after placed in service. Can't be used after Dec. 31, 2032.
  - Only 90% available if domestic requirements not met, starting in 2024.

Timing

Electricity

Sec 45 PTC(+ITC): Renewable Electricity (Biomass)

Legacy credit structure
Begin Construction by:
12/31/2021

IRA Base Credit/Bonus structure
Begin Construction by:
1/1/2023
Begin Construction by:
12/31/2024

Sec 45Y Clean Electricity & Transportation Tax Credit or Sec 48E Clean Electricity Investment Credit

Placed in Service
1/1/2025
Expiration
12/31/2032 (or US carbon goals met)

RNG

Sec 48 ITC: Renewable Natural Gas

…Place in Service after:
12/31/2022
Begin Construction by:
1/1/2023
Begin Construction by:
12/31/2024
Placed in Service by
12/31/2028

Alternative Fuels Excise Tax Credit

Fuel must be produced before:
12/31/2024

Sec 45Z Clean Fuel Production Tax Credit

Fuel produced starting
1/1/2025
Expiration
12/31/2027

Hydrogen

Sec 45V: Clean Hydrogen

Begin Construction by:
12/31/2033

Biogas-Electricity Projects

Sec 45 PTC(+ITC): Renewable Electricity (Biomass)

Legacy credit structure

Begin Construction by: 12/31/2021

IRA Base Credit/Bonus structure

Begin Construction by: 1/1/2023

Begin Construction by: 12/31/2024

Sec 45Y Clean Electricity & Transportation Tax Credit or Sec 48E Clean Electricity Investment Credit

Placed in Service 1/1/2025

Expiration 12/31/2032 (or US carbon goals met)

- For electricity generated from landfill gas, open-loop biomass (e.g., biogas); After 2024, it's for the sale of domestically produced, zero-emissions electricity
- Production Tax Credit (PTC) for 10 years
  - Began Construction Pre-2022: credit is 1.3 cents/kWh. No bonuses.
  - Began Construction 1/1/2022-12/31/2032+: Base credit is 0.3 cents/kWh + potential bonuses.
- Investment Tax Credit (ITC) one time.
  - Began Construction Pre-2022: 30%. No bonuses
  - Began Construction 1/1/2022-12/31/2024: Base credit is 6% + potential bonuses.
- Bonus credits:
  - Base x 5 for paying prevailing wages, or < 1MW, or began construction < 60 days after Treasury publishes prevailing wage requirements.
  - +10% for domestic content; 2% if prevailing wage requirements not met
  - +10% for energy communities

Biogas-RNG/Heat Projects

Sec 48 ITC: Renewable Natural Gas

Sec 45Z Clean Fuel Production Tax Credit

…Place in Service after: 12/31/2022

Begin Construction by: 1/1/2023

Begin Construction by: 12/31/2024

Fuel produced starting 1/1/2025

Expiration 12/31/2027

- For investments in certain energy property, expanded to include energy storage property, qualified biogas property, linear generators, and interconnection property.
- Investment Tax Credit (ITC) one time.
  - Began Construction Pre-2022: if the project isn't placed into service until January 1, 2023, or later, the taxpayer CAN earn this Sec 48 ITC.
  - Began Construction 1/1/2022-12/31/2024: Base credit is 6% + potential bonuses.
- Bonus credits:
  - Base x 5 for paying prevailing wages, or < 1MW of electrical or thermal energy, or began construction < 60 days after Treasury publishes prevailing wage requirements.
  - +10% for domestic content; 2% if prevailing wage requirements not met
  - +10% for energy communities
- After 2024: see "Sec 45Z Clean Fuel Production Tax Credit"

Disclaimer – These notes are not provided as definitive counsel for projects. Please consult an attorney or lawyer for your own particular circumstances. This is a draft interpretation dated September 2022 and awaits formal interpretation and rule making by the Treasury Department on transaction specifics.

Biogas/RNG for Vehicle Fuel

Alternative Fuels
Excise Tax Credit

Fuel must be produced before:
12/31/2024

Sec 45Z Clean Fuel Production Tax Credit

Fuel produced starting
1/1/2025

Expiration
12/31/2027

- For alternative fuels and alternative fuel mixtures. Excludes clean hydrogen and carbon oxide sequestration facilities
- Per-gallon Tax Credit until expiration
  - Fuel produced before 1/1/2025: 50 cents/gallon
  - Fuel produced starting 1/1/2025: Base credit + potential bonus x emissions factor.
    - Base Credit: $0.20/gallon for nonaviation fuel
- Bonus credits (starting 2025): Base x 5 for paying prevailing wages
- Emissions Factor:
  - (50 kilograms of CO_2e global warming potential per mmBTU – emissions rate of fuel produced) / 50 kg of CO_2e per mmBTU
  - Treasury will publish tables of emissions rates for various fuel types that would be used in the calculation
  - Qualifying transportation fuel would be fuel with an emissions rate not greater than 50 kilograms of CO_2e per mmBTU

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This is a draft interpretation dated September 2022 and awaits formal interpretation and rule making by the Treasury Department on transaction specifics.

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https://www.avisenlegal.com/practice-areas/renewable-energy-practice/


Avisen

Discussion and Audience Q & A

Networking Lunch

auri
Agricultural Utilization Research Institute