

# State of the Dairy RNG Industry

**MANY PROJECTS ANNOUNCED – FEW GENERATING REVENUE**

August 19, 2021



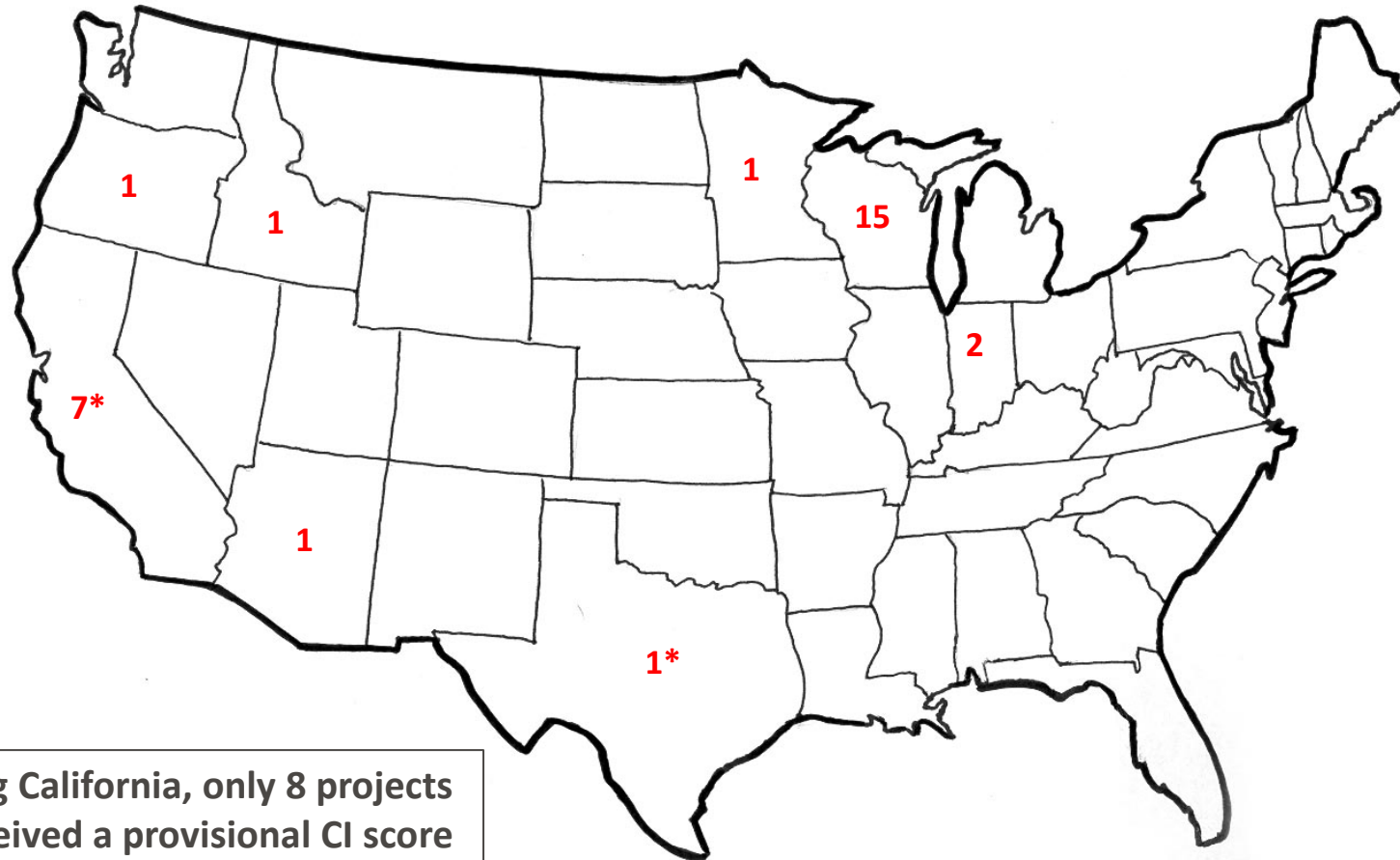
## State of the Dairy RNG Industry

**Dairy concerns when contracting RNG projects**

**Economics of Dairy RNG**

**Producing RNG – Technical Overview**

# Outside of California there are only 22 operational Dairy RNG projects

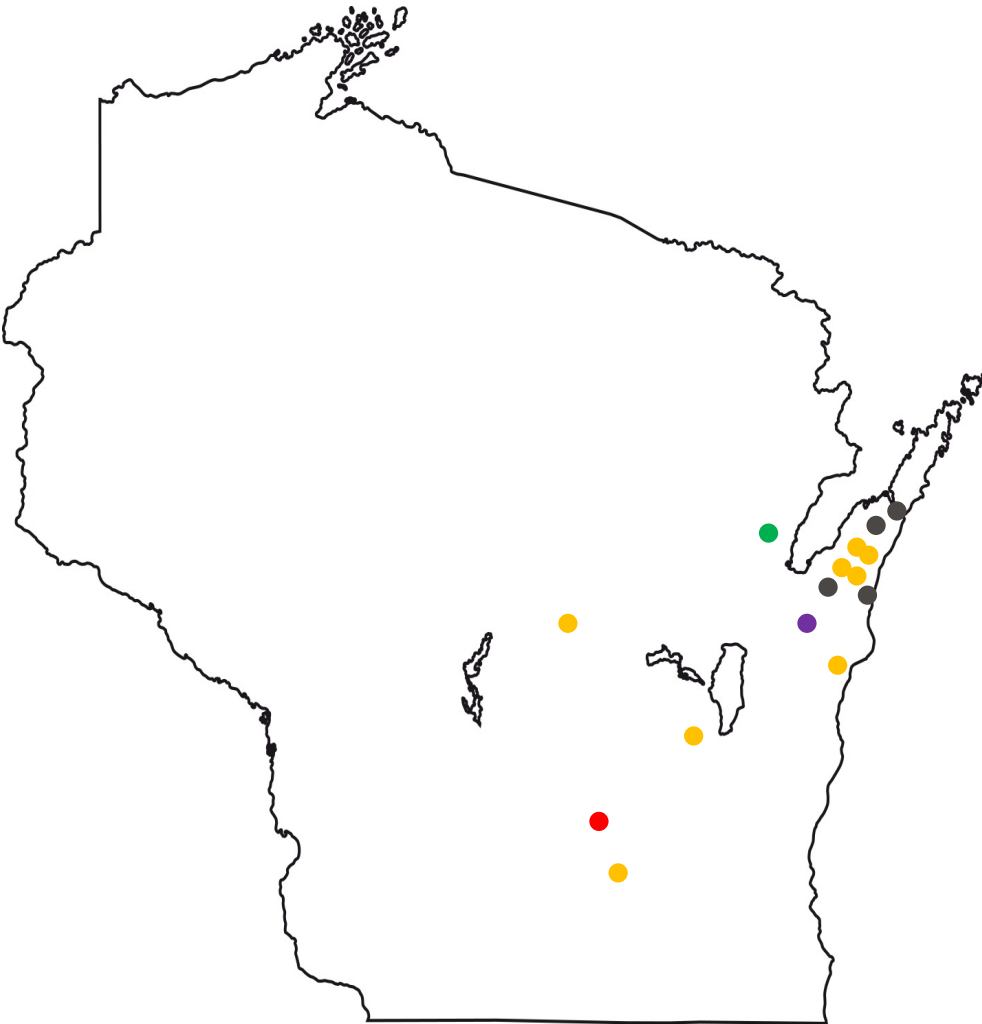


Excluding California, only 8 projects have received a provisional CI score (receiving full revenue)

Source: Agstar Database April 2021 and Coalition for Renewable Natural Gas

\*Several farms feed into combined upgrading plants

# Wisconsin has the most Dairy RNG projects operational in US, however only three have gotten provisional CI scores



Operational Dairy RNG projects producing renewable natural gas for pipeline injection in Wisconsin

Dairy	RNG Project Owner	Provisional CI Score
A	1	<u>Yes</u>
B	1	<u>Yes</u>
C	1	<u>Yes</u>
D	1	No
E	1	No
F	1	No
G	1	No
H	2	No
I	3	No
J	5	No
K	5	No
L	5	No
M	5	No
N	5	No
O	6	No

# Hundreds of projects have been announced but will be difficult to construct, operate, and achieve a CI score

## Beware developers who have a large number of dairies “signed up”

Two well-known developers have signed up over 90 dairies a piece.

The most RNG upgrading facilities a single developer has ever constructed in a year is four.

A large RNG project can cost more than \$25 Million dollars and take dozens of people to construct – if a developer is signing up 90 dairies, how will they pay for them and get the right people to build them?



RNG project under construction – imagine trying to do 90 of these in the next year

**Ask your potential developer how many projects they intend to complete each year. You have a feel for how difficult this is so don't be afraid to challenge them.**

**If the number seems unrealistic, it most likely is!**


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### Dairy concerns when contracting RNG projects

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## Economics of Dairy RNG

# Dairy Due Diligence on Developer (Letter of Intent Phase)

Common Mistake	Better Outcome
<p><b>Two-Year LOI Signed with Developer</b></p> <p><i>Developer can sit on LOI for 2 years and dairy receives no royalty stream</i></p>	<p><b>Six-month LOI Signed with Developer</b></p> <p><i>Developer should be able to complete key points of due diligence in six months – Dairy can find new developer if progress is slow.</i></p>
<p><b>Developer can re-assign LOI to third party</b></p> <p><i>Developer will shop around looking to sell the LOI to another developer – that's money that could have gone straight the dairy</i></p>	<p><b>Developer can re-assign LOI to affiliated party</b></p> <p><i>Developer can only re-assign LOI to pre-designated companies (such as parent company or project LLC)</i></p>
<p><b>Funding source has not been determined</b></p> <p><i>Most small developers find projects and then find funding. Often this funding partner (large company) may require more time to do due diligence or layers on extra costs and bureaucracy.</i></p>	<p><b>Dairy should meet with the funding partner</b></p> <p><i>Dairy should understand and approve of funding source</i></p>
<p><b>No Milestones</b></p> <p><i>No milestone incorporated into LOI – meaning developer has no pressures to execute quickly, may be in "back of line"</i></p>	<p><b>Milestones</b></p> <p><i>Series of development milestones incorporated into LOI. Developer has limited number of dairies "signed up"</i></p>
	<p><b>Beware the smiling salesmen</b></p> <p><i>There may be more profits in the dairy's manure rights than they are giving the dairy</i></p>

# Top Questions to ask a Developer

Q: How many renewable natural gas projects have you actually built and operated?

*Why: Several developers claim to be working with dozens of dairies while only purchasing small scale electric production projects that are going to struggle to become RNG projects*

Q: What do you think the CI score for my dairy is?

*Why: If they are offering you royalties, but don't understand the value of your gas, then they haven't done their homework and will likely need to renegotiate the contract*

Q: How much biogas do you expect to produce at my dairy? How much digestion capacity do you expect, what is the expected residence time, and what style digester.

*Why: The volume of gas produced will have a tangible impact on revenue*



Q: What kind of RNG upgrading technology will you be using and will you have a thermal oxidizer for the tail gas:

*Why: Technology has a large impact on the footprint and viability of the project. If there is hydrogen sulfide in the tail gas, not having a thermal oxidizer will lead to odors.*

# Top Questions to ask a Developer (Continued)

Q: Where are you going to sell your gas?

A: This is particularly important to know if the dairy is taking a % of revenue for a royalty. If the developer locks in prices at a lower price, lowering the royalty payment, the dairy should have a say in the placement of the gas

Q: How will this project be financed?

A: If they need to get loans through the USDA program or grant money, development will take longer



Q: What permits will you need and what do I need to change?

A: The developer should already be thinking about necessary changes to the Dairy's nutrient management plan, environmental permitting, and meeting with local zoning boards

# Developer Due Diligence (Letter of Intent Phase)

Task
Lease Area Identified
Lease Area Wetlands Delineation
Geotechnical Study Conducted
Lease Area Surveyed
General Layout of Plant Completed
Utility studies
CI interview completed
CI score calculated
Dairy Background/Financial Study Completed
Manure Sampling and corresponding digester sizing
Manure handling and sand handling upgrades defined
Sand handling upgrade quotes and schedule received
Project Engineer contracted for Phase I Engineering Study
Project Engineer Site Visits
Environmental Permits identified, process to approval started
Digester Technology package chosen
RNG Upgrading package chosen
Draft of Definitive Agreements Sent to Dairy
CARB Metering Package finalized
Historian report outline for CARB/RIN Validation
Interconnect and CNG Trucking agreements negotiated
Offtake Agreements Negotiated

*List above is abbreviated*



Simple things like sand analysis for sand removal efficiency should be done in the early phases of an RNG project.

# The key to a good marriage is a good contract and good royalty structure

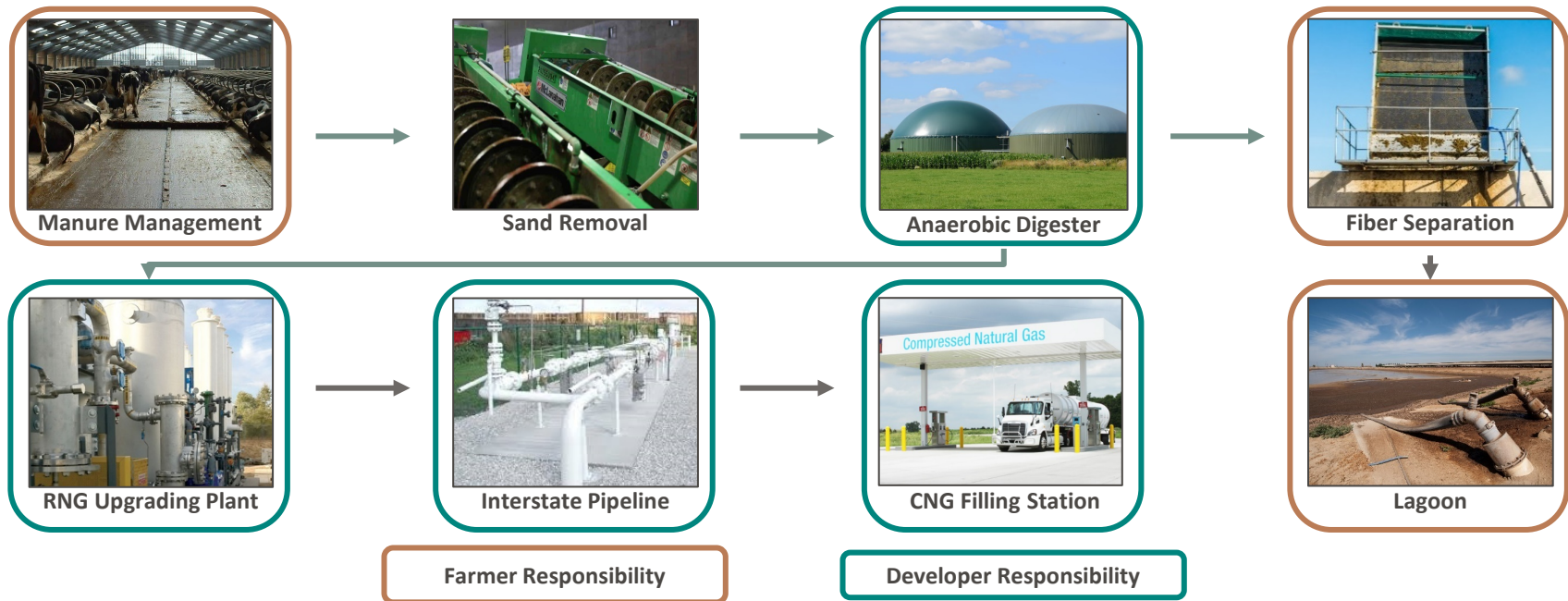


Structure	Advantages	Disadvantages
Fixed Annual Payment	Simple, reliable payment to farmer	No incentive to farmer to provide quality manure for digestion or to increase the quantity of manure
Per Cow Annual Payment	Simple calculation, encourages growth	No incentive to farmer to provide quality manure for digestion. Illogical – 10,000 <sup>th</sup> cow is worth far more than the 1,000 <sup>th</sup> cow
Per MMBtu Produced Payment	Protects farmer against plant down time, encourages quality manure delivery	Developer is at more risk if the LCFS or RIN price drops. Farmer does not have incentive to supply data for calculation of CI score
Per MMBtu Sold Payment	Easy calculation based on monthly sales invoice from pipeline company	Farmer is affected by Producer's plant run-time. Farmer is not incentivized to supply data for calculation of CI score. Developer benefits from LCFS that increases value the fewer MMBTU's sold
Percent of Revenue	Simple calculation based on checks received by developer. Farmer incentivized to supply data for calculation of CI score and deliver quality manure	Farmer is affected by changes in LCFS and RIN prices
Percent of Net Income	Very strong alignment of incentives to maximize revenue	Farmer is affected by developer plant performance, costs, and changes in LCFS and RIN prices. Net income can be manipulated
Equity Share	Near perfect alignment	Farmer takes on liabilities and risks of RNG project

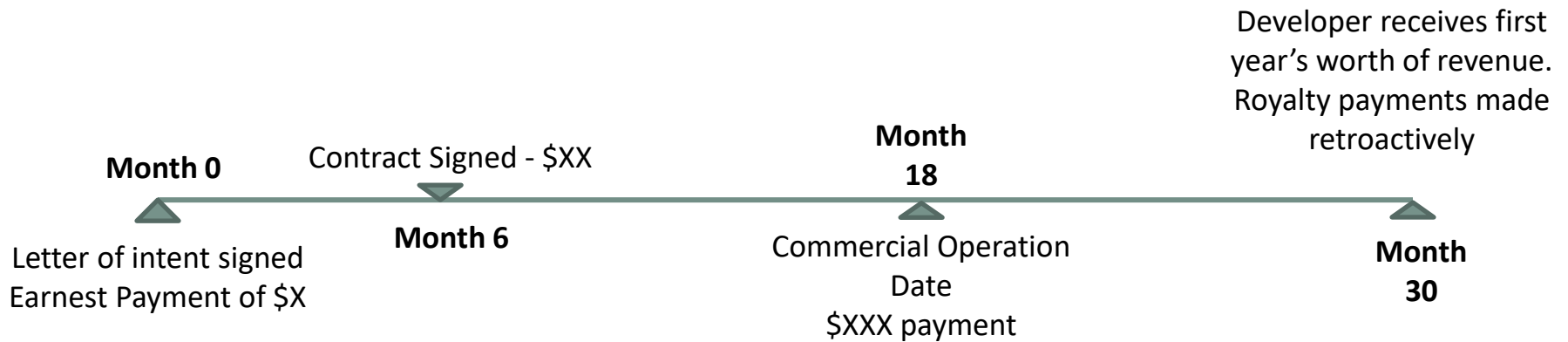
Percent of Revenue model insulates the dairy farm from cost over-runs, but helps with alignment to ensure farm is providing high quality manure to the digesters and the data required for CARB and RIN validation

# Logical separation of responsibilities leads to long term success

FARMER CONTINUES TO BE RESPONSIBLE FOR PROCESSES THEY CONDUCTED PRIOR TO DIGESTER INSTALLATION, WHILE DEVELOPER IS RESPONSIBLE FOR RNG OPERATIONS



# Because of the long construction time and up to a year of operation before the developer receives revenue, a series of defined payments makes sense



Without a series of contractually defined fixed payments, the farmer may have to **wait two and a half years before receiving a royalty payment**. For the sake of transparency and good relations between the developer and farmer, it is best to lay out this timeline during initial conversations.

Build in penalty payments if the developer doesn't reach Commercial Operations by a certain date

# Other Key Contractual Mistakes

- Lack of milestones

A reasonable COD should be established, with cushion for permitting issues. After that date, reasonable penalties should be paid to dairy.
- Consider future expansions

Expansions should be paid at a higher royalty rate than the base cow count
- What happens at the end of the project

Typically, digesters transfer over to the farm, as do buildings. RNG upgrading equipment goes with Developer
- Process for when things go poorly

Every project has issues – a reasonable process to solve those issues is necessary



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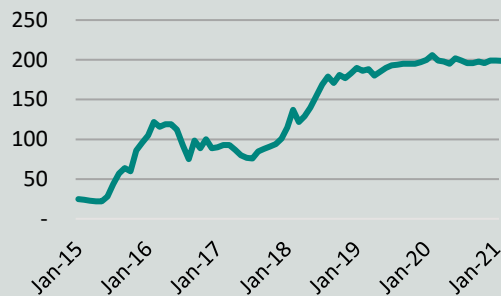
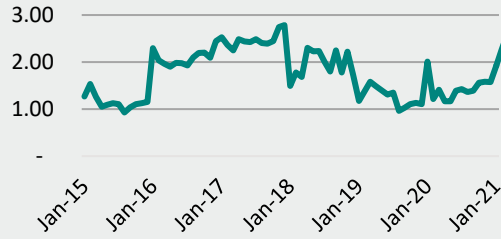
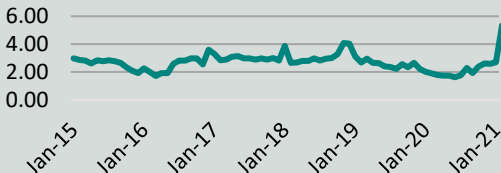
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# RNG Value Components

THERE ARE THREE VALUE DRIVERS BEHIND RNG WHEN SELLING GAS INTO CALIFORNIA'S CNG MARKET: THE LCFS CREDIT, THE RIN, AND THE COMMODITY (NATURAL GAS) VALUE

Value Component	Description	Historical Price Performance
<b>California Low Carbon Fuels Standard (LCFS) Credit</b>	<ul style="list-style-type: none"> <li>California program to reduce the carbon intensity of its transportation fuels               <ul style="list-style-type: none"> <li>RNG must be dispensed into a vehicle in California</li> </ul> </li> <li><u>CI score varies depending on project and will be one of the most important factors in RNG project viability</u></li> <li>LCFS changes expected in 2024 may make dairy CI scores less favorable</li> </ul>	<p>\$ / LCFS Credit</p> 
<b>Renewable Fuel Standard: D3 (Cellulosic) RIN</b>	<ul style="list-style-type: none"> <li>2005 federal program to reduce greenhouse gas emissions and reduce reliance on imported oil</li> <li><u>RIN credits are generated with each gallon of qualifying renewable fuels that are produced and is not reliant on carbon intensity</u></li> <li>Dairy RNG produces D3 (cellulosic) RINs</li> </ul>	<p>\$ / D3 RIN</p> 
<b>Natural Gas</b>	<ul style="list-style-type: none"> <li>Dairy RNG is identical to fossil methane (CH<sub>4</sub>) and can be injected into the same infrastructure as fossil methane</li> </ul>	<p>\$ / MMBtu</p> 

# Accurate Carbon Intensity Estimates are Crucial to the Success of a Project

## CALIFORNIA'S LCFS METHODOLOGY REWARDS DEVELOPERS WHO "FIX" FARMS THAT ARE THE LARGEST EMITTERS OF METHANE

- The LCFS Carbon Intensity ("CI") score is determined using avoided methane emissions
  - Farmers who have current practices that result in lower methane emissions will have a worse CI score
- The following practices, while being progressive, will damage the profitability of the project:
  - Separating solids for field application
  - Minimal lagoon storage
  - Open lot farms
  - Frequent cleaning of the lagoons
  - Smaller cows/less manure
  - Sawdust/straw bedding
  - Adding other organic materials to the manure stream



**As a result of California's methane avoidance methodology, there are several 15,000 cow farms that won't make economic sense for an RNG project, whereas there are 4,000 cow farms that will make economic sense**

# Illustrative Carbon Intensity Scores

THE CARBON INTENSITY (CI) SCORE IS A MEASUREMENT OF AVOIDED EMISSIONS, ADJUSTED FOR THE ENERGY NEEDED TO PRODUCE THE GAS, DIVIDED BY THE AMOUNT OF RNG PRODUCED

## Illustrative CI Calculation #1: All Manure to Lagoon, No Cleanouts (gCO<sub>2</sub>/MJ)

-325	Avoided methane emissions from the lagoon per MJ produced
+	
50	Carbon emissions from energy needed to produce transport RNG per MJ produced
+	
65	Tailpipe and fueling emissions from compressed natural gas vehicles per MJ consumed
=	
-210	CI Score per MJ consumed

**Illustrative Revenue / MMBtu: \$81.68 [1]**

## Illustrative CI Calculation #2: Fiber Separation, Minimal Lagoon Storage (gCO<sub>2</sub>/MJ)

-130	Avoided methane emissions from the lagoon per MJ produced
+	
50	Carbon emissions from energy needed to produce transport RNG per MJ produced
+	
65	Tailpipe and fueling emissions from compressed natural gas vehicles per MJ consumed
=	
-15	CI Score per MJ consumed

**Illustrative Revenue / MMBtu: \$44.53 [1]**

Notes:

1) Assumes \$200/LCFS Credit, \$2.00 / D3 RIN, and \$3.00/MMBtu natural gas price

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# Manure anaerobic digesters are typically plug flow or complete mix systems that produce a gas consisting of 55-60% methane, CO<sub>2</sub>, and hydrogen sulfide



Complete Mix  
Digester



- Big tank with inner and outer bladder – gas is stored in expandable inner bladder
- Gallon gets put in, gallon gets taken out. Theoretically some of the gallon taken out did not reach ideal retention time
- Mixing is typically done with mechanical agitators – propellers on shaft
- Homogeneous mixing – easier to co-digest
- Can be steel or concrete
- NRCS recommends minimum 17 day retention time
- Heated to ~101 degrees F

Manure from Cow  
+  
Urine and Slop Water  
+  
Parlor Water  
+  
Other Water

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Total Manure Gallons

÷  
Digester Capacity

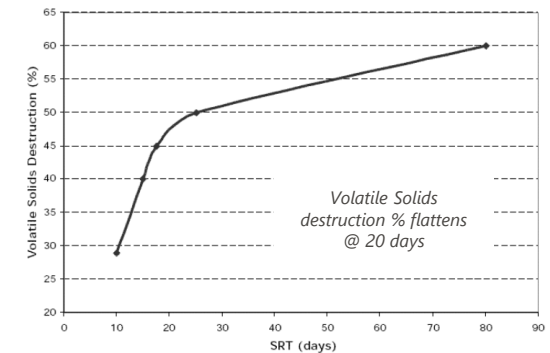
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Retention Time

Plug Flow  
Digester



- "Covered Swimming Pool" – manure follows a snaking path through the digester. Usually ~15' deep. Low visual impact
- Gallon comes in the front, a gallon gets pushed out the back – theoretically better retention time
- Concrete top makes gas storage difficult
- Mixing is primarily done by recirculating biogas gas
- NRCS recommends minimum 23 day retention time
- Heated to ~101 degrees F



Rough rule of thumb: 1000 lactating Holsteins = 80-85 SCFM of biogas @55% methane

# To make pipeline quality RNG there are several technologies available

## Membrane



Biogas is compressed through membranes that have tiny tubes that allow smaller molecules to permeate through membranes. Methane is separated from CO<sub>2</sub>, H<sub>2</sub>O, and H<sub>2</sub>S and compressed. Tail gases should be destroyed in thermal oxidizer

## Amine /Solvent



Biogas bubbles through contact towers filled with basic solvent that absorbs carbon dioxide and hydrogen sulfide. As the temperature of the solvent changes, it releases the carbon dioxide and hydrogen sulfide.

## Pressure Swing Absorption (PSA)



Biogas is compressed and put into vessels containing absorption media. As the pressure decreases, different gases are released at different times, with the methane release being captured and compressed. Tail gases should be destroyed in a thermal oxidizer

## Water Wash



Biogas bubbles through towers filled with water that absorbs carbon dioxide and hydrogen sulfide. As the temperature/ pressure of the water changes, it releases the carbon dioxide and hydrogen sulfide.

# Several logistics challenges exist to business developer's on-paper technical solutions



Trucking Manure to a Centralized Digester

## It can be done, but presents many challenges

- Costs of trucking manure can be considerable
- Public perception of increased manure trucks on the road
- Impact to CI score
- Difficulty calculating CI score due to multiple farms
- It just takes one farm's mistakes to mess up the entire project

**Consider piping manure if possible, or separate digesters at each farm and moving the biogas via pipeline**



Trucking Raw Biogas to centralized processing plant

## It is extraordinarily difficult to do

- Hydrogen Sulfide would need to be removed
- CNG trailers are not meant for liquids and carbon dioxide liquifies above ~1000 PSI.
- More logistics costs moving raw biogas than processed gas due to mass of carbon dioxide – trailers limited to ~1000 PSI and are only ~57% methane

**Consider raw biogas pipelines to a centralized processing facility**

**For more questions, please contact Novilla RNG below**



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