RNG from a Dairy Perspective

If it is too good to be true – it isn't

NOVILLA RNG

Webinar Series #5

Mark Hill
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Novilla RNG is an independent company that helps match viable dairy Renewable Natural Gas (RNG) projects with competent developers

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- Staff with over a decade of RNG experience
- Owner has personal experience developing, constructing, and operating eight dairy RNG projects
- Evaluations on over thirty dairy projects completed

Novilla RNG will not offer a letter of intent or contract until a full, transparent evaluation has been done for the dairy farm and a developer willing to execute on the project is found. Our business model is blunt honesty on whether a project will or won't work (many won't work).

DTE's Newton, WI interconnect where RNG is upgraded from local dairies and unloaded from remote projects across Wisconsin*

*Novilla RNG is not affiliated with DTE – photo is for illustrative purposes

Being able to understand the economics of a dairy project will help a dairy farm sort the pretenders from the true developers

If you own a large CAFO there has been a parade of smiling salesmen coming through your door wanting your manure rights

Most “developers” in the RNG industry haven’t developed a project and are interested in:

- Signing a contract or letter of intent and then selling the contract to a larger company interested in investing
- Amassing enough contracts to attract capital investors (they currently lack the capital to execute on the project)
- May have a genuine desire to develop a project but don’t have the experience or resources to do it
- Don’t understand the economics of a project and are over-promising royalties

The goal of this presentation is to inform dairy farmers what due diligence they should be doing before selecting an RNG developer

Agenda

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How Renewable Natural Gas works

The value of Renewable Natural Gas to a developer

Contractual best practices

Top questions to ask a developer to separate the pretenders

Renewable Natural Gas (RNG) is pipeline quality natural gas refined from the breakdown of volatile solids through anaerobic digestion

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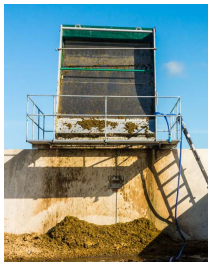
Manure conveyance system

Sand removal (for sand bedding)

Anaerobic Digester



Fiber separation (optional)

Lagoon

RNG Upgrading Plant

Interstate Pipeline

CNG Filling Station

Manure anaerobic digesters are typically plug flow or complete mix systems that produce a gas consisting of 55-60% methane, CO2, and hydrogen sulfide

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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 – propellors on shaft
- Homogeneous mixing – easier to co-digest
- Can be steal or concrete
- NSRC recommends minimum 17 day retention time
- Heated to ~101 degrees F

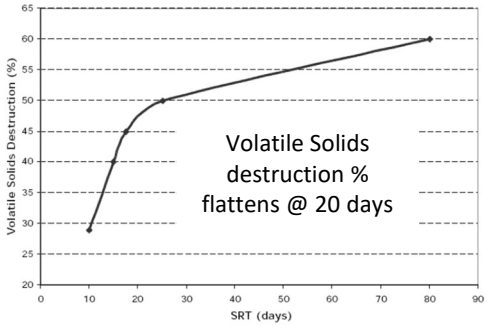
Plug Flow Digester

- "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
- NSRC recommends minimum 23 day retention time
- Heated to ~101 degrees F

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

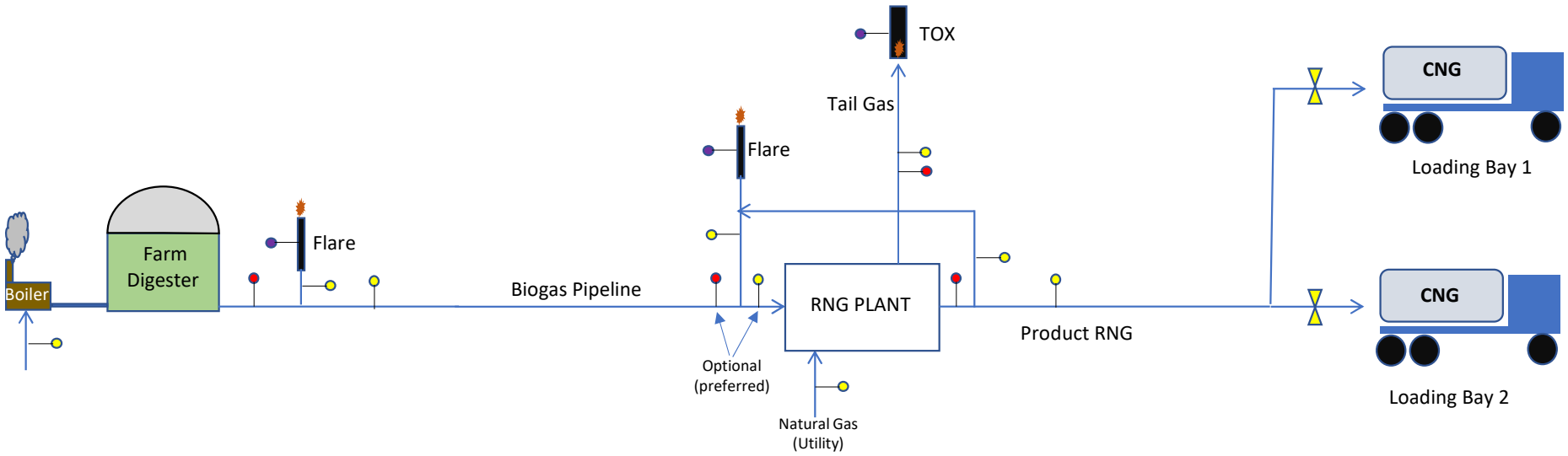
Total Manure Gallons
÷
Digester Capacity

Retention Time



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

Once biogas is produced, the carbon dioxide, water, and hydrogen sulfide must be removed to meet pipeline specifications. It then can be compressed into a trailer or pipeline



Several technologies exist to refine the biogas, which one your developer choses is important to the lease area and aesthetics of your dairy

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Membrane

Biogas is compressed through membranes that have tiny tubes that allow smaller molecules to permeate through membranes. Methane is separated from CO2, H2O, and H2S and compressed. Tail gases should be destroyed in thermal oxidizer

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

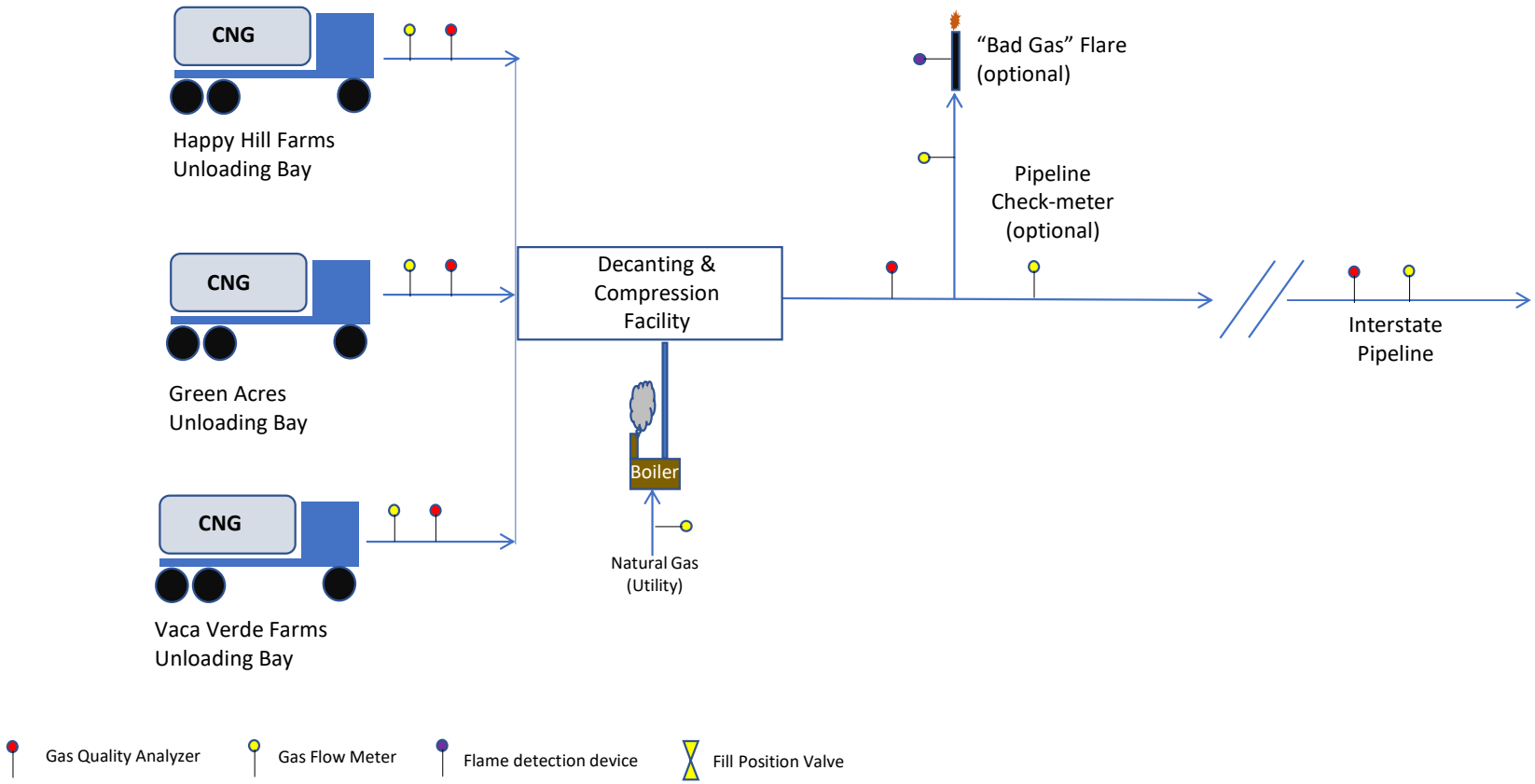
Amine /Solvent

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. Tail gases should be destroyed in a thermal oxidizer

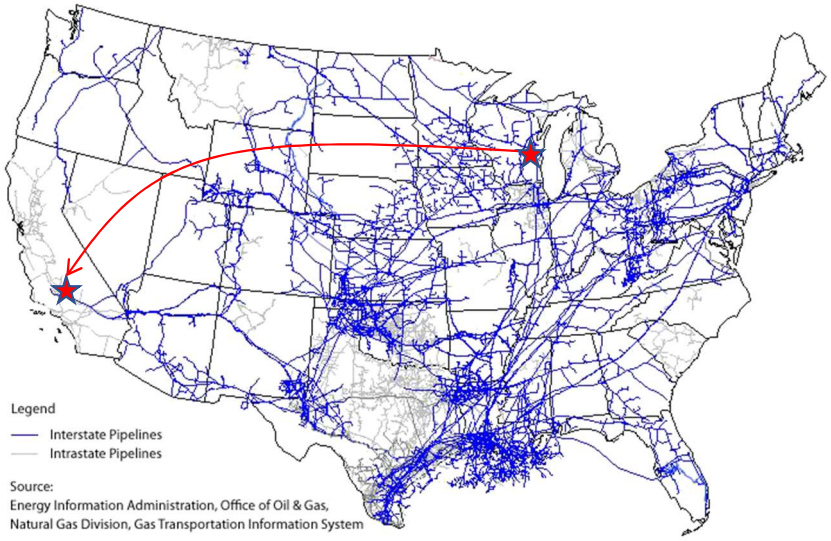
Water Wash

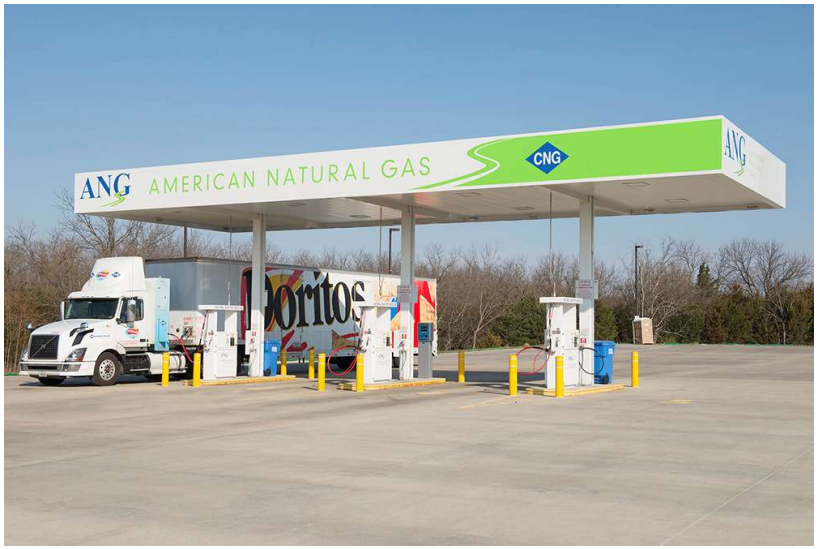
Biogas bubbles through towers filled with water that absorbs carbon dioxide and hydrogen sulfide. As the temperature/ pressure of the water changes, it releases the carbon dioxide and hydrogen sulfide. Tail gases should be destroyed in a thermal oxidizer

Once biogas is produced, the carbon dioxide, water, and hydrogen sulfide must be removed to meet pipeline specifications



Once in an interstate natural gas pipeline, the vast majority of RNG makes its way to a California CNG filling station and into a CNG powered vehicle





At this point RINS (Federal Program) and LCFS (California Low Carbon Fuels Standard) are generated

Agenda

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How Renewable Natural Gas works

The value of Renewable Natural Gas to a developer

Contractual best practices

Top questions to ask a developer to separate the pretenders

There are three value drivers behind selling gas into California's LCFS with each value varying wildly based on market rates and the calculated CI score

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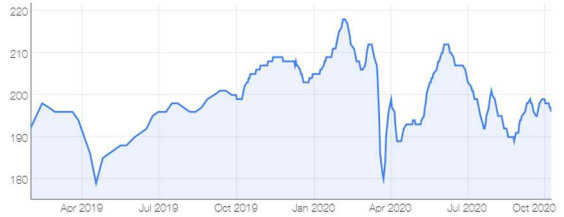
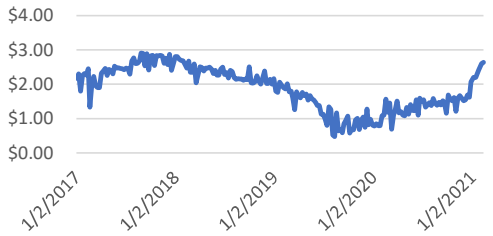
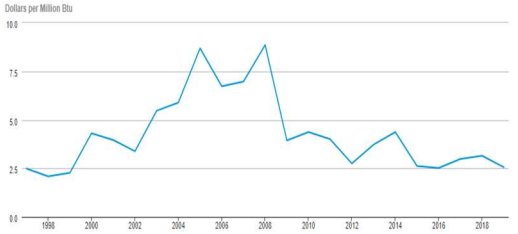
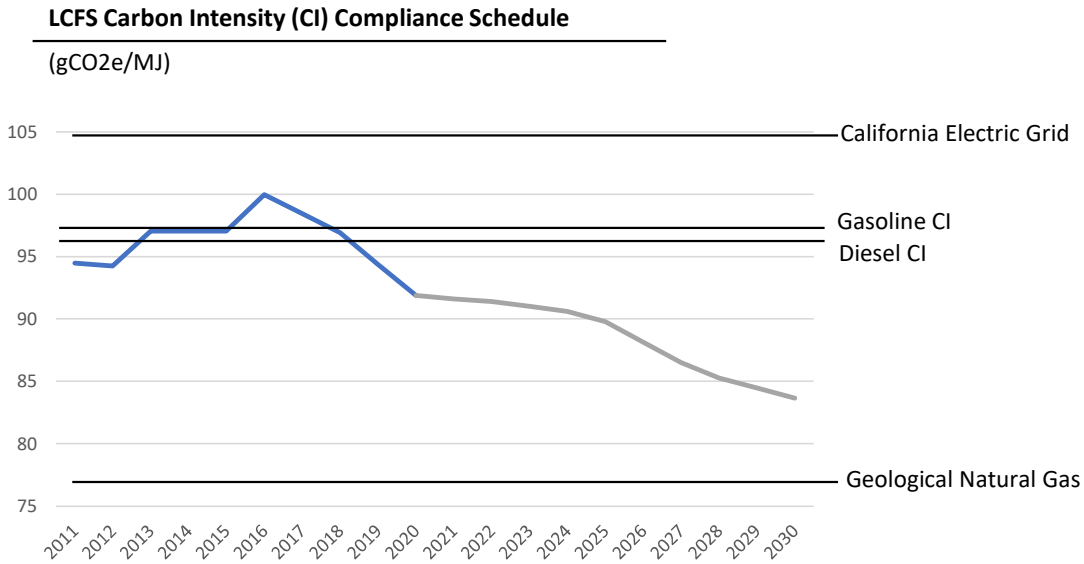
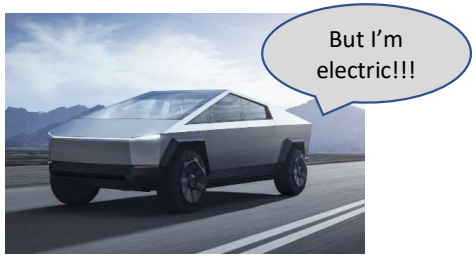
		Price per MMBTU	
California Low Carbon Fuels Standard (LCFS)	California program to reduce overall carbon intensity of its transportation fleet. Law changes in 2024. Dairy manure derived RNG typically has a negative score (0 to -532), meaning that it has a high price premium. CI score varies considerably based on project and farm RNG must be dispensed into an on-highway vehicle in California	$14 - $125	
Cellulosic D3 RIN	Federal Program tied to the Renewable Fuels Standard – must be used in on-highway vehicle in USA Refiners must purchase certain amount of credits per year	$5 - $35	
Natural Gas Pricing	Replacement for geological (non-renewable) natural gas	$2 - $3	

The Low Carbon Fuel Standard is a California Air Resources Board administered program that is designed to lower on-highway vehicle greenhouse gas emissions



- LCFS attempts to achieve emissions reduction by using lower carbon intensity fuels. Fuel producers in CA are required to buy credits to hit an LCFS target
- Because fuel produced from animal-based manure prevents methane emissions from lagoons, it has a negative carbon intensity (methane is approximately 25x more potent greenhouse gas than carbon dioxide)
- CNG in California achieved negative carbon intensity in Q2 2020 (first fuel ever to achieve this) through rapid growth of animal manure based renewable natural gas

RNG means that a “boring” CNG powered UPS truck in California is more environmentally friendly than Tesla’s



The LCFS formula rewards developers who “fix” farms that are the largest emitters of methane

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Because the LCFS value is determined using avoided emissions, farmers who have practices that 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 the methane avoidance calculation, there are several 15,000 cow farms that don’t make economic sense for an RNG project, whereas there are 4,000 cow farms that do make economic sense

The Carbon Intensity (CI) Score is a measurement of avoided emissions, subtracting for the energy needed to produce the gas, divided by the amount of RNG produced

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Hypothetical CI Calculation for Dairy RNG
All Manure to Lagoon, No cleanouts
(gCO2/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 CNG vehicles per MJ consumed
-210	CI Score per MJ consumed

Hypothetical CI Calculation for Dairy RNG
Fiber separation, minimal lagoon storage
(gCO2/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 CNG vehicles per MJ consumed
-15	CI Score per MJ consumed

The LCFS value per MMbtu is dependent on the Carbon Intensity (CI) score assigned to the project

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CI Score*	LCFS Credit Price**	$/mmbtu
0	$100	$ 7.14
0	$200	$ 14.28
0	$220	$ 15.71
-150	$100	$ 22.97
-150	$200	$ 45.93
-150	$220	$ 50.53
-250	$100	$ 33.52
-250	$200	$ 67.03
-250	$220	$ 73.74
-500	$100	$ 59.89
-500	$200	$ 119.78
-500	$220	$ 131.76

Making the best estimate of the CI score, before investing millions into a project, is crucial. Several factors go into the CI score and the score itself can be misleading

*g CO2e/MJ

**$/Metric ton

Calculations per https://americanbiogascouncil.org/resources/rin-calculator/

Due to the RNG production being a denominator, projects that flare a significant amount of gas will end up with a more negative CI score

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Hypothetical $10,000,000 LCFS pool on 200,000 MMbtu's of RNG production and no flaring = $50/MMbtu

Hypothetical $10,000,000 LCFS pool on 100,000 MMbtu's of RNG production and 100,000 MMbtu's of flaring = $100/MMbtu

For RNG projects selling into LCFS, the CI score may improve (get more negative) the less you produce and the more that is flared. Thus the incremental revenue tends to be limited to RIN's and geological gas replacement

RIN values are based on a simple value per GGE and are part of a federal Renewable Fuel Standards program. Fuel is required to be sold into an on-highway vehicle in the USA

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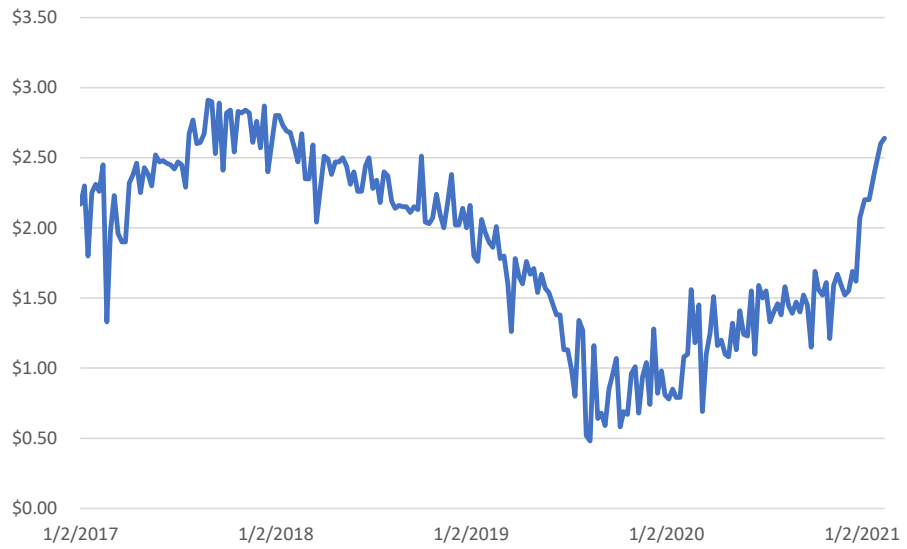

The D3 RIN value currently stands at $2.60, or $33/MMBtu

RFS requires refiners to have a certain percentage of their vehicle fuel as renewable. Historically this was met using ethanol.

This value has dipped as low as $8/MMbtu in recent history as the EPA exempted small refiners

Federal, not California, requirement

Geological natural gas replacement value has been historically low, and will likely remain low, due to the development of fracking in the past decade.

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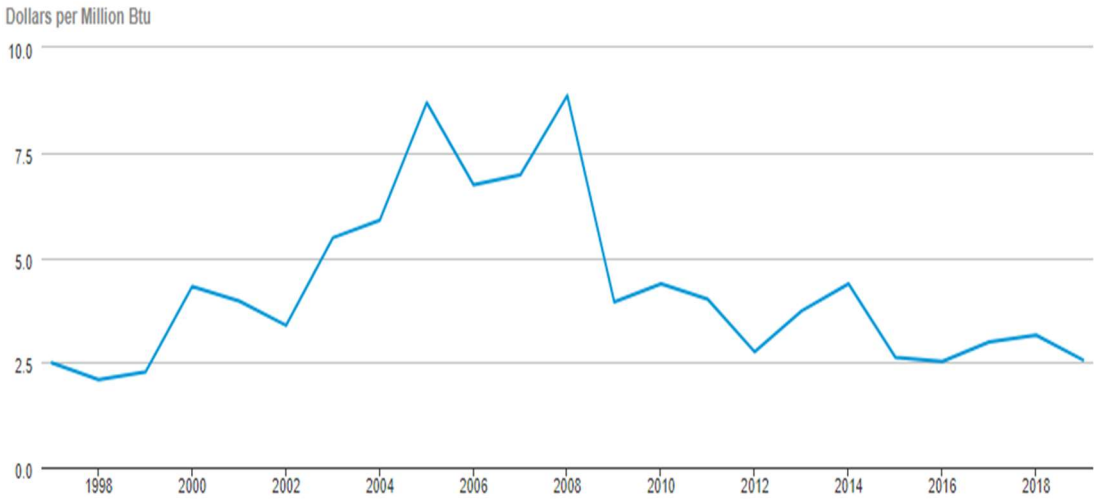

Occasionally local “city gate” prices, which some projects contract on, diverge significantly from the standard Henry Hub pricing, particularly in peak demand periods

The summation of the three sources of revenue is not necessarily what the developer receives, nor is always received in a timely manner

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- CNG station operators and renewable attribute brokers may take ~20% of the fuel value
- Renewable attributes may not be received for over a year during the initial validation process
- Fixed price multi-year contracts are available, although at a discount to the spot market
- California is not the only market for RNG. Oregon and British Columbia, to name a few places, have similar programs. Additionally, private companies and organizations have carbon neutrality initiatives and demand for RNG

Greenfield (new development) projects require a significant amount of capital to build a new RNG project and the capital is not linear with the size of a project

	Generic Capital Costs $MM - Interstate Pipeline Connection - Manure Upgrades Needed		
	2,500 Cow Farm into interstate Pipeline	5,000 Cow Farm into interstate pipeline	10,000 Cow Farm into interstate pipeline
Digesters and manure handling	$ 4	$ 7	$ 13
RNG Plant with tools and spares	$ 5	$ 7	$ 10
3 mile pipeline and interconnect	$ 5	$ 5	$ 5
Total	**$ 14**	**$ 19**	**$ 28**
Annual MMbtu's sold	50,000	100,000	200,000
CAPEX $ per annual MMbtu	$ 280	$ 190	$ 140

Every site is very different! This is for illustrative purposes only!

While there have been RNG projects built on small farms with existing digesters, the economies of scale associated with larger projects make them much more attractive.

Kinnard Farms (8000+ Cows)

Rosendale (8000+ Cows)

New Chester (8000+ Cows)

Ideal candidate farms will have a series of attributes that will minimize operating CAPEX and OPEX, while maximizing the LCFS value

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The "Ideal Farm" for an RNG project

- 10,000+ Milking Cow Equivalents
- All manure directly placed into lagoon with infrequent cleanouts
- All manure deposited on concrete
- Existing digester that has not taken carbon credits
- Fiber bedding if there is an existing digester, mattresses otherwise
- Scrape or vacuum manure collection with total solids % around 8%
- Nearby access to an interstate pipeline with reasonable specifications and costs
- Cooperative local zoning boards
- Cooperative state air emissions and permitting boards
- Reasonable lease area
- Financially stable dairy with opportunities for growth
- Concentrated dairy area to create a "pod" of dairies
- Available skilled labor force in area
- Utility natural gas, electricity, and internet available
- Good farming family/company that is willing to make changes to farm to make an RNG project work

The Holy Grail of Dairy RNG has yet to be found, but dozens of press releases make it sound like it has…

What does this all mean to the farmer? Because of the risks involved to the developer, they will want returns well into the double digits. Some projects will not attract smart developers.

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	2,500		5,000		10,000	
CI Score	-210	-15	-210	-15	-210	-15
Placeholder CAPEX (millions)	$14		$19		$28	
MMBTU's/ Year Sold	50,000		100,000		200,000	
$ LCFS/MMBtu	$54	$17	$54	$17	$54	$17
$ RIN/MMBtu	$30		$30		$30	
$ Henry Hub/MMBtu	$3		$3		$3	
Broker fee @ 20%	$17	$10	$17	$10	$17	$10
Net revenue/MMBtu	$69	$40	$69	$40	$69	$40
Total Revenue (millions)*	$3.5	$2.0	$6.9	$4.0	$13.8	$7.9
*Significant operating costs exist						

A large dairy, near a pipeline, with a good CI score could potentially earn over a million dollars in annual royalties. A small dairy should concentrate on the non-monetary advantages of an anaerobic digester.

Some projects simply won't be viable

Agenda

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How Renewable Natural Gas works

The value of Renewable Natural Gas to a developer

Contractual Best Practices

Top questions to ask a developer to separate the pretenders

Several forms of royalty structure exist in the marketplace today

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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 – 10,000th cow is worth far more than the 1,000th 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

Novilla RNG prefers the sharing of revenue with floors in place to make sure the farmer receives enough revenue to cover costs associated with the project

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Hypothetical Scenario:
Herd count: 10,000 MCE Holstein
Milk production: 90lbs/day
CI Score: -200
Digester retention time: 20 days
Methane loss and downtime: 10%
Broker and transportation fees: 18%
Revenue sharing with Farm: 12.5%
Royalty Floor of $750,000/year

Modeled Annual Output:
Digester production: 225,000 MMBtu's/775 SCFM Biogas
MMBtu's sold: 202,000 MMBtu's
Flared Biogas: 23,000 MMBtu's

January 21 RIN/LFCS pricing
D3 RIN @ $2.30 = $29.87/MMBtu
LCFS @200.25 = $56.56/MMBtu
Henry Hub @ $2.60/MMBtu
Revenue Received per MMBtu after broker fees = $73

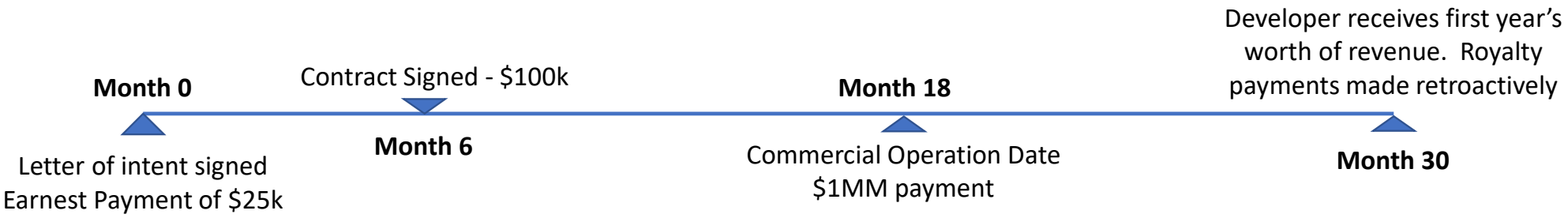
Royalty to farmer (Millions USD)

Low Price Case $40	
Revenue	$ 8.1
Royalties	**$ 1.0**

Current Prices $73	
Revenue	$ 14.7
Royalties	**$ 1.8**

High Price Case $95	
Revenue	$ 19.2
Royalties	**$ 2.4**

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.

Contracts should anticipate future expansions of the dairy as well as new affiliated dairies nearby.

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- The 10,001st cow is far more valuable than the 1st cow since most of the fixed infrastructure is already in place (this is also why a per cow royalty makes no sense)
- Expansions should be anticipated and a higher rate of royalty given for them
- New affiliated dairies within the manure conveyance range should be included in the contract, potentially at a higher royalty rate

The division of responsibility should concentrate on strengths of the farmer and RNG developer, while avoiding finger pointing if things go wrong

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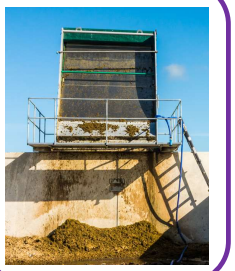
Manure conveyance system

Sand removal (for sand bedding)

Consider: Sand Into Digester, Mastitis Outbreaks

Anaerobic Digester

Consider: Is this a legacy digester?



Fiber separation (fiber bedding)

Consider: Mastitis outbreaks – where will fingers be pointed

Lagoon

RNG Upgrading Plant

Interstate Pipeline

CNG Filling Station

Regardless of responsibility, the developer should bear the costs of improvements needed for an RNG project (which can be included in the royalty payments)

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Typical necessary improvements to the dairy for an RNG project

- Sand Removal System or Fiber bedding arrangement
- Manure and digestate line installation
- Change from barn flush to scrape or vacuum system
- Air permits and manure storage permits
- Upgrades to existing digesters
- Removal of any water intrusion

Milestones are essential to keep the Developer on track

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Developer milestones after signing LOI

- Regulators should be met with to discuss air permits, manure storage permits, construction permits, etc. Note – permits will likely not be received by the time the developer signs the contract, and there may need to be outs if permits are not received by a certain date
- Meetings with township to discuss conditional use permit/zoning
- Confirmation of lease area and utility right of ways.
- Funding of project

Developer milestones after signing contract

- *Have a COD date defined in the contract with substantial penalties for exceeding the target date that match expected royalties*. Developer should have waivers if delays are due to farm missing milestones (such as installing a sand removal system).
- Construction start date should be included in contract
- Commercial operation should defined. Novilla typically defines it as a set MMBtu amount injected into a pipeline in a calendar month.

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How Renewable Natural Gas works

The value of Renewable Natural Gas to a developer

Contractual best practices

Top questions to ask a developer to separate the pretenders

Top questions to ask developers

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

Why: Several developers claim to we 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 quiz developers on (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

Finally…some personal advice

Avoid developers claiming to be constructing dozens of projects and are releasing weekly press statements

Building 2 or 3 new RNG projects a year is difficult and there are only so many qualified people who can do it. If a company claims to have "signed up 70 dairies", you need to ask them how are they going to execute on 70 projects?

The reality is there probably aren't 70 top-tier RNG projects in the USA– let alone all going to one developer.

Novilla RNG works with developers that are interested in executing on a couple of good projects per year and have the capabilities to do so.

RNG project under construction – imagine trying to do 70 of these in the next year

Novilla RNG has a business philosophy of up-front honesty and transparency so that contracts don't need to be renegotiated

Contact us for a free evaluation:

info@novillarng.com

www.novillarng.com

We are ready to help your dairy partner with the right developer