RNG Metering and Gas Analysis

For LCFS and RIN Verification

NOVILLA RNG

Webinar Series #1

Mark Hill
October 5, 2020

With over a decade of experience in Renewable Natural Gas (RNG), we are ready to help you achieve success

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Operations Consulting

- Process design review and optimization
- Digester optimization and gas production estimates
- Plant optimization recommendations
- Financial review of plant costs with recommendations
- Technology review and recommendation
- Metering layout and review in relation to CARB/EPA verification

Acquisition and Greenfield Due Diligence

- Technology review
- Maintenance schedule with OPEX and downtime estimates
- Production estimates, including gas curves, downtime, and parasitic loss
- Financial modeling of Project
- Metering setup review and CI score optimization
- Employee skill set interviews

Farmer Representative for Awarding of Gas Rights

Disclaimer

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Agenda

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The Importance of Metering in your RNG plant

Metering Layout/Flow Tracking

Flow Meter Types

Gas Analysis Devices

Common Mistakes in Metering/Gas Analysis

Meters are your cash register; if you don't have verifiable metering of the methane flow, you won't get paid

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- CARB requires the flow and methane % to be tracked from the digestion source, through the plant, and to each destruction device
- In order to get verified, 90 days worth of quality data will need to be submitted to a verifier, followed by a full year's worth
- If the data is suspect (large gaps, out of range data, repeating data) the facility may not get its verification
- If the methane balance (methane produced from digesters vs destroyed or injected) is off by more than 2%, the carbon intensity score will be adversely affected

Typical Data Needed for Verification (in 15-minute intervals)

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Happy Hill Farms Historian Data

Time	Date	Farm A Digester Boiler NG usage (mmbtu)	Farm A Digester electric Usage (kwh)	Farm A Digester Flow to plant (SCF)	Farm A digester flow to flare (SCF)	Farm A flare Temp (F)	Farm A methane digester %	Farm B Boiler NG usage (mmbtu)	Farm B I Usage (kwh)	Farm B Digester Flow to plant (SCF)	Farm B Digester Flow to flare (SCF)	Farm B Digester Methane % to plant	Plant NG usage (mmbtu)	Plant electric usage (kwh)	Plant Inlet Flow (SCF)	Plant Inlet Methane	Flow to TOX (SCF)	TOX Methane %	TOX Temp (F)	Product Gas Flow	Product Gas Methane %	Plant Flare Flow (SCF)	Plant Flare Temp (F)	Interconnect Flow	Interconnect Methane %
1315	8/1/20	4.3	21.0	5339	-	83	56.2%	2.2	10.5	3421	0	55.5%	1.1	124.16	8792	55.9%	3957	5.20%	1441	4836	98.7%	0	83	4787	99.7%
1330	8/1/20	4.4	22.0	5105	-	85	56.2%	2.2	11.0	3769	0	55.5%	1.2	113.13	8946	55.9%	4026	5.60%	1438	4920	98.8%	0	85	4871	99.8%
1345	8/1/20	4.6	24.2	4878	-	86	56.2%	2.3	12.1	3376	0	55.6%	1.2	121.98	8313	55.9%	3741	5.30%	1435	4572	98.7%	0	86	4526	99.7%
1400	8/1/20	4.7	26.0	5247	-	86	56.2%	2.4	13.0	3755	0	55.6%	1.3	113.63	9059	55.9%	4077	6.70%	1432	4983	98.8%	0	86	4933	99.8%
1415	8/1/20	4.4	27.0	4898	-	86	56.2%	2.2	13.5	3305	0	55.6%	1.1	113.46	8256	55.9%	3715	8.20%	1439	4541	98.7%	0	86	4496	99.7%
1430	8/1/20	4.3	28.8	5007	-	87	56.2%	2.2	14.4	3406	0	55.6%	1.2	123.43	8429	55.9%	3793	5.20%	1434	4636	98.8%	0	87	4589	99.8%
1445	8/1/20	4.4	30.4	5070	-	88	56.2%	2.2	15.2	3543	0	55.6%	1.2	114.20	8616	55.9%	3877	5.60%	1433	4739	98.7%	0	88	4691	99.7%
1500	8/1/20	4.6	28.4	5113	-	88	56.2%	2.3	14.2	3306	0	55.6%	1.3	123.61	8477	55.9%	3814	5.30%	1434	4662	98.8%	0	88	4616	99.8%
1515	8/1/20	4.7	33.6	5116	-	88	56.1%	2.4	16.8	3758	0	55.6%	1.1	119.65	8896	55.9%	4003	6.70%	1438	4893	98.7%	0	88	4844	99.7%
1530	8/1/20	4.4	35.2	5158	-	89	56.1%	2.2	17.6	3667	0	55.8%	1.2	118.53	8902	56.0%	4006	8.20%	1439	4896	98.8%	0	89	4847	99.8%
1545	8/1/20	4.3	28.6	5171	-	88	56.1%	2.2	14.3	3668	0	55.8%	1.2	113.02	8919	56.0%	4014	5.20%	1441	4906	98.7%	0	88	4856	99.7%
1600	8/1/20	4.4	25.4	5071	-	88	56.1%	2.2	12.7	3733	0	55.6%	1.3	116.78	8854	55.9%	3984	5.60%	1431	4870	98.8%	0	88	4821	99.8%
1615	8/1/20	4.6	24.7	5131	-	87	56.1%	2.3	12.4	3399	0	55.4%	1.1	114.07	8601	55.8%	3870	5.30%	1437	4730	98.7%	0	87	4683	99.7%
1630	8/1/20	4.7	27.8	1115	3,712.00	870	56.1%	2.4	13.9	3702	0	55.4%	1.2	112.86	4817	55.8%	2168	6.70%	1439	2649	98.8%	0	89	2623	99.8%
1645	8/1/20	4.4	28.8	0	5,102.06	1,245	56.1%	2.2	14.4	3323	0	55.4%	1.2	118.58	3323	55.8%	1495	6.70%	1438	1828	98.7%	0	90	1809	99.7%
1700	8/1/20	4.4	28.3	0	4,876.53	1,230	56.1%	2.2	14.2	3354	0	55.4%	1.3	120.04	3354	55.8%	1509	5.80%	1437	1845	98.8%	0	90	1826	99.8%

The above data is for a simple RNG project. If this data isn't being collected, verified for accuracy, and having the methane balance within 2%, significant RIN or LCFS revenue will be lost – potentially all of it.

Agenda

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The Importance of Metering in your RNG plant

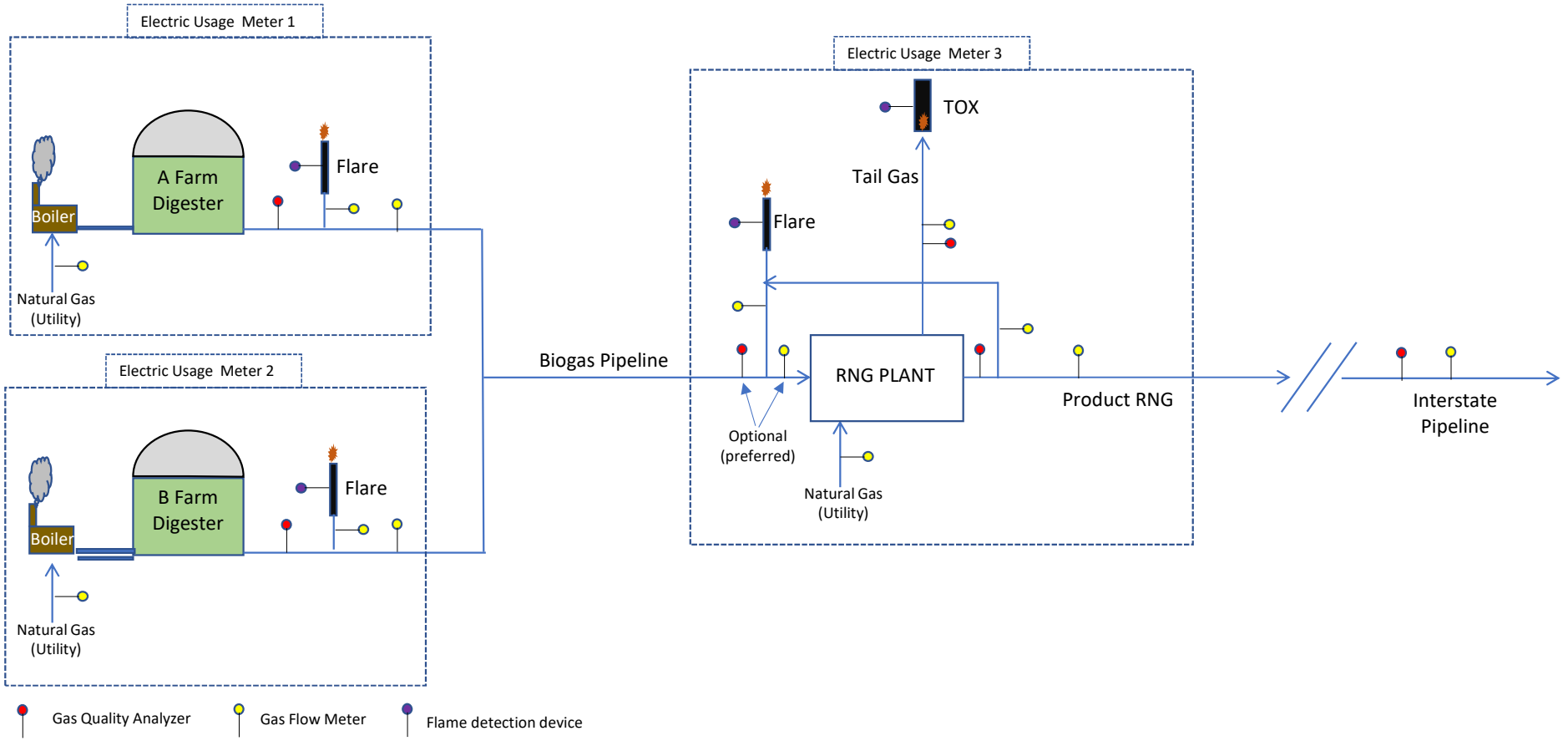
Metering Layout/Flow Tracking

Flow Meter Types

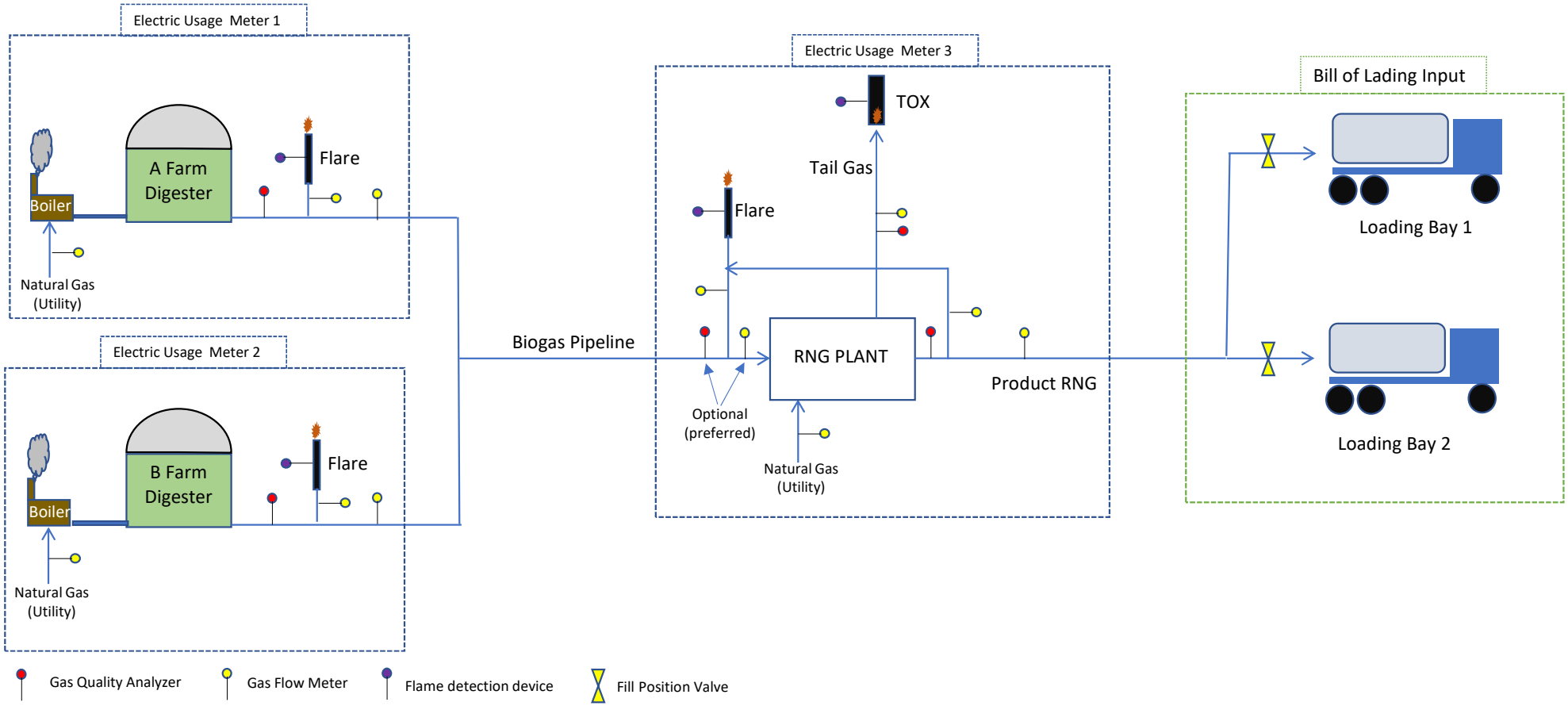
Gas Analysis Devices

Common Mistakes in Metering/Gas Analysis

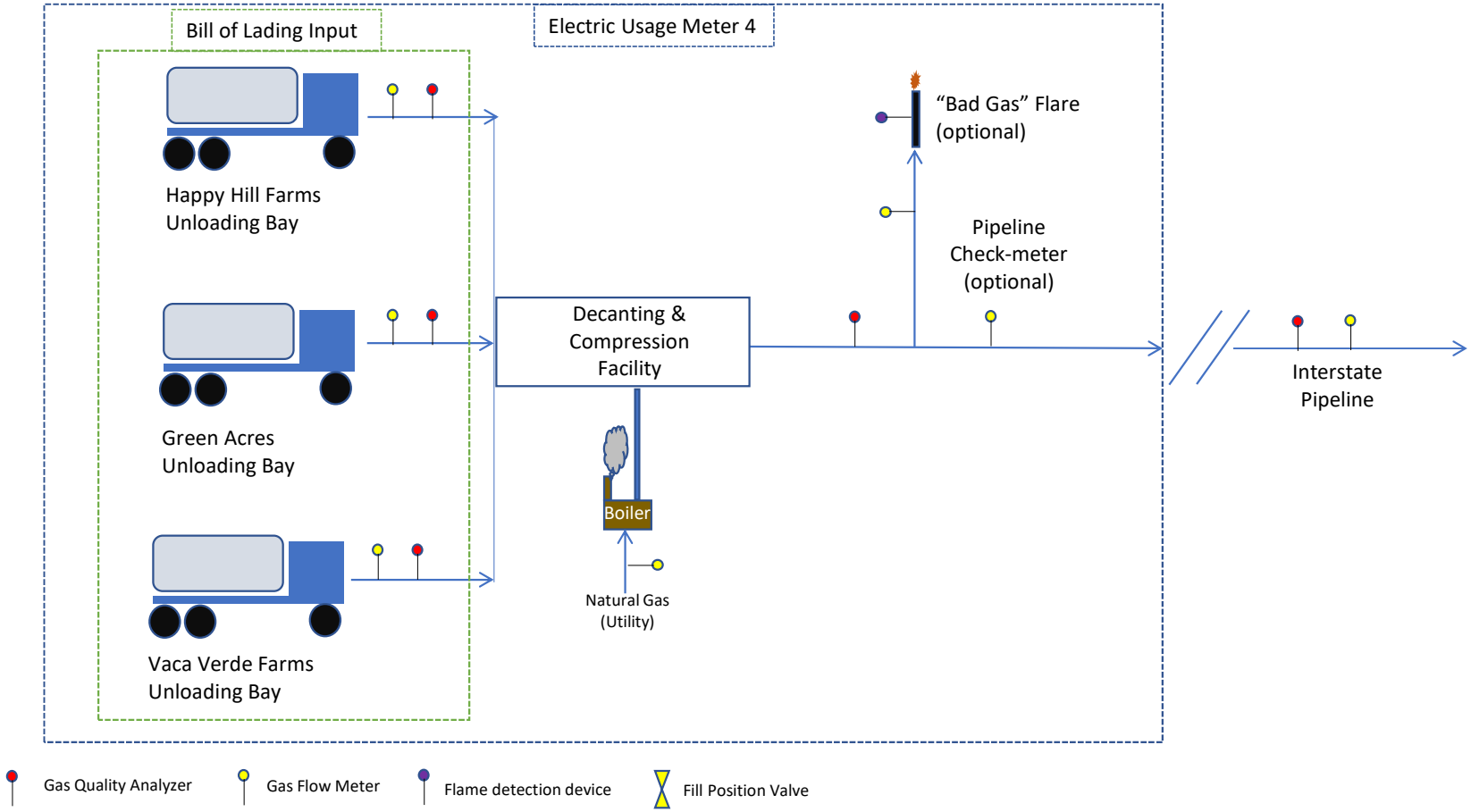
Metering layout from Happy Hill Farms direct pipeline injection, which has two separate farms feeding it



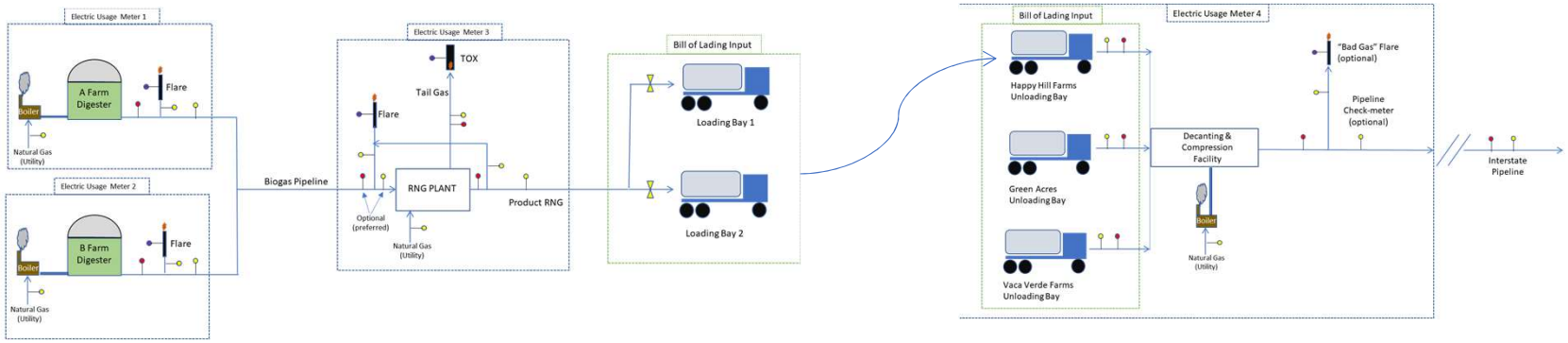
Same two farm scenario, but now with a virtual pipeline



Virtual Pipeline Unloading Facility



If you think that RNG metering and analysis is complicated, it is……



- Setting up and maintaining the metering and gas analysis is a full-time job that needs to be led by a competent individual. Allowing multiple independent contractors to perform pieces of the installation, setup, and integration with the PLC and Historian will lead to major issues.
- Methane balance needs to be looked at daily to ensure it is within 2%. Issues with meters or gas analysis need to be caught and addressed as soon as possible.
- If the data isn't recorded, you aren't paid. Back up the data!
- Have spares on hand, ready to insert in the event of a failure

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Flow meters for RNG

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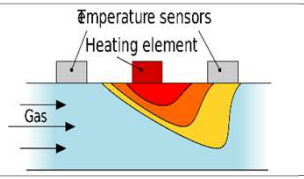
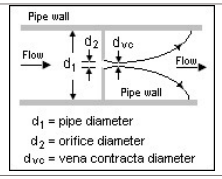
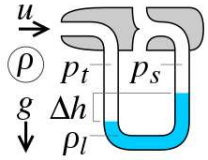
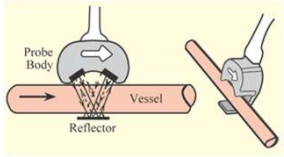
	Thermal Mass	Orifice Plate	Annubar/Pitot Tube	Ultrasonic	Coriolis
					
How it works					
Advantages	Inexpensive, little pressure drop, good turn-down capacity	Accurate, simple premise	Similar to the orifice plate premise, but with less pressure drop	Moveable, does not need to be inserted into pipe	Does not need a straight run of pipe, very accurate
Disadvantages	Needs straight run of pipe, certain models adversely effected by moisture	High pressure drop at higher velocities, liquid or deposits can alter flow measurements, needs straight run of pipe	Deposits greatly alter flow, straight run of pipe necessary	Can be less accurate, moisture can throw off readings	Vibrations or liquid/film build up can throw off measurement, more expensive

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Common Gas Analysis devices in biogas/RNG

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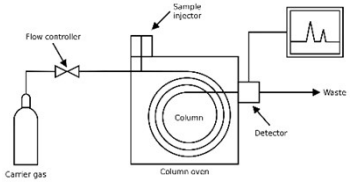
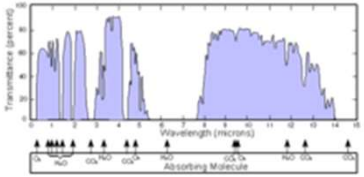
	 Gas Chromatograph	 Infrared or Ultraviolet	 Electrochemical	 Portable
How it works	 Gases are separated and exit the column at different times, at which point they are electronically detected	 Measures what light is absorbed and emitted	Gases pass over a membrane to an electrode where they are oxidized. The chemical reaction produces electricity, which is measured	Multiple Technologies
Advantages	Very accurate. Can detect Nitrogen. Wide range of gases can be detected with customized columns	Moderate pricing, near instantaneous readouts, limited calibration needed	Inexpensive with little maintenance	Can spot check other gas analyzers. Very little gas conditioning needed. Instantaneous read outs
Disadvantages	Expensive, takes several minutes for a result, needs gas conditioning, requires supply of carrier gas – typically helium. Typically, but not always, used for product gas.	Can't read nitrogen, limited amount of gases that can be analyzed Needs gas conditioning	Needs separate cell for each kind of gas. Cells can get "sleepy" if not exposed to the gas	Can't record continuous data, frequent calibration, limited gases can be analyzed

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Common Mistakes in Gas Metering and Analysis

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Meter Placement

- Flow meters should be set along a straight run of pipe, free from liquid or material build up. Turbulence is the worst enemy of flow metering and will give a phantom readings or incorrect readings.
- Some flow meters, such as thermal mass, should be mounted at ~120-degree angle in wet environments so that water build up drips away from the thermal probes.
- Do your operators a favor and place the meters in a place they can access them. Placing a meter 20 feet in the air, or in spaghetti of piping, makes access dangerous and discourages proper maintenance.
- On thermal mass meters, ensure the probe is centered in the pipe. Gas tends to move slower around edges of pipe, faster in the middle.

Common Mistakes in Gas Metering and Analysis (Part 2)

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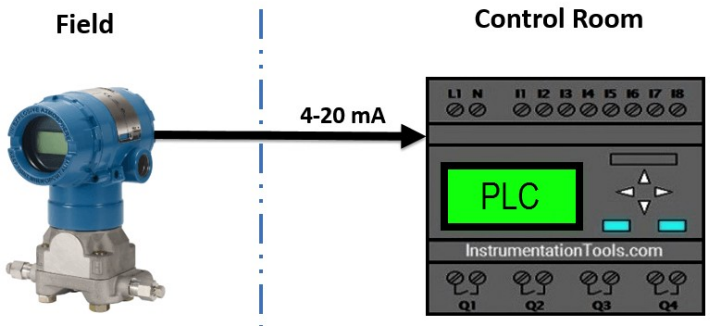
Meter Programming

80% of the problems with flow meters are NOT calibration related, they are related to the setup of the meter. The following are common problems:

- Wrong pipe size. An 8" pipe does not mean it has an 8" internal diameter. It varies by schedule – look it up. A ¼" difference in internal diameter makes a big difference.
- Wrong gas density. Look up the specific gravity of the gas you are measuring. If it frequently changes, you may need calculations in the PLC that compensate.
- 4-20ma signal from meter does not match the PLC (wrong scaling)
- Have a totalizer! In case of communications loss, a totalizer on the meter itself will give an indication of what the flows were during the lost data timeframe
- Turn down and max flow. Make sure your flow range is within the range of the meter itself, particularly in a turn down scenario.
- Low flow cutoff: Make sure a low flow cut off is programmed in so you don't get false flow reading during a zero flow scenario. Conversely, too high of a low flow cutoff may hide true flows.



Common Mistakes in Gas Metering and Analysis (Part 3)

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Gas Analyzers

- They can drift from actual reading. Make sure to have a portable gas analyzer on hand to check against the fixed mount gas analyzer. Also make sure to have the correct autocalibration for the analyzer

- They break. Make sure to have spares on hand. For gas chromatographs, have spare columns available.

- You can't flow water through them. This may seem self-evident, but a surprising number of gas analyzers don't have conditioning systems on the front end and free liquids build up in the analyzer.

- They are sensitive to pressure swings. Ensure a pressure regulator is installed or the unit will be likely to drift.

- Hydrogen Sulfide can damage the unit – particularly electrochemical cells. You may need a carbon filter on the unit to prevent poisoning of the sensors.

- Gas chromatographs vary between 4 and 12 minutes of cycle time. It's essential your cycle time is under 15 minutes for CARB , and every minute matters if you are out of sales due to a quality issue and are waiting for the next GC update to get back into sales.

Novilla RNG's staff have helped major companies overcome metering obstacles and receive accurate CI scores

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Questions?