DAIRY DIGESTERS

February 26, 2020

Photo by Ryan Song on Unsplash

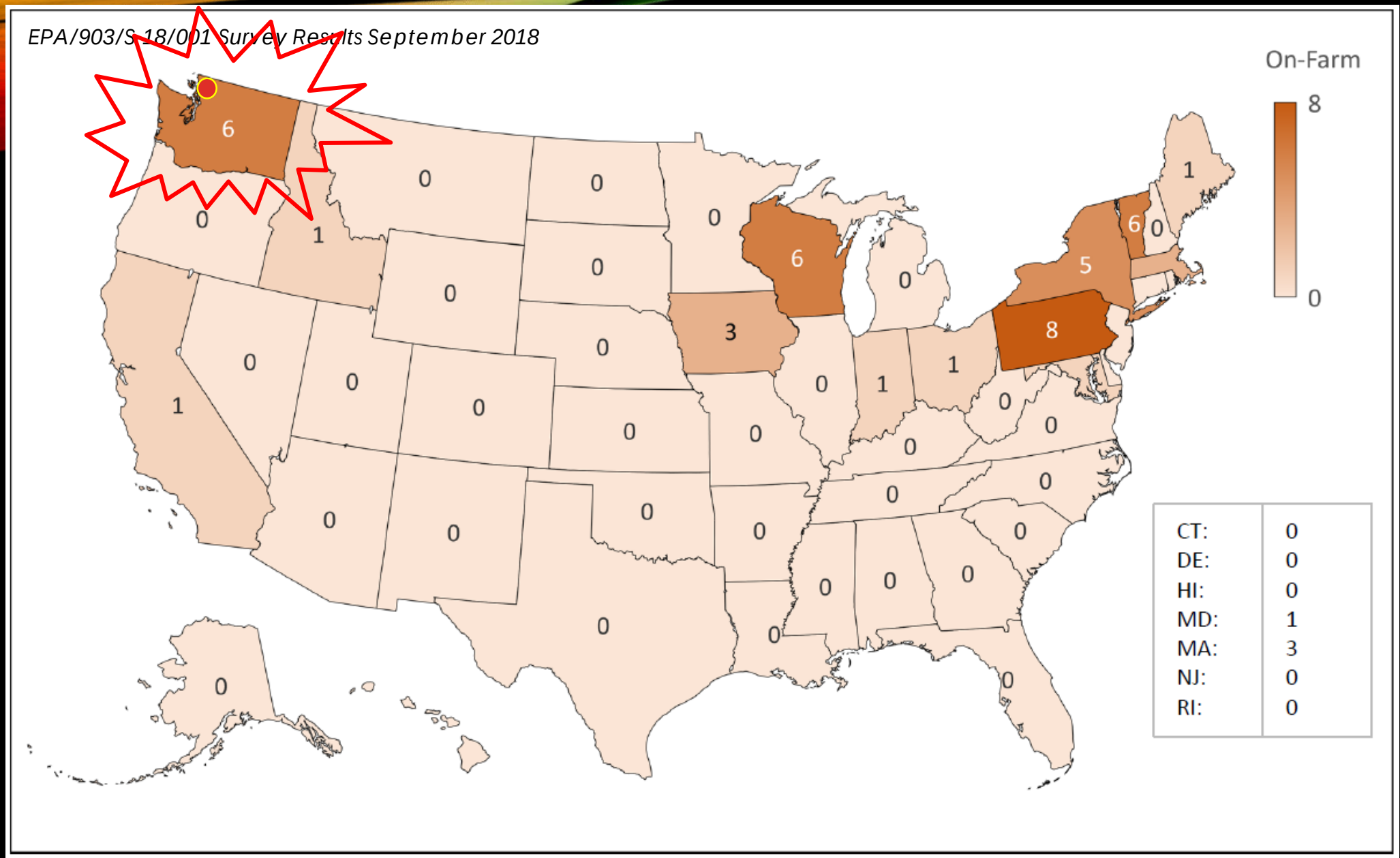


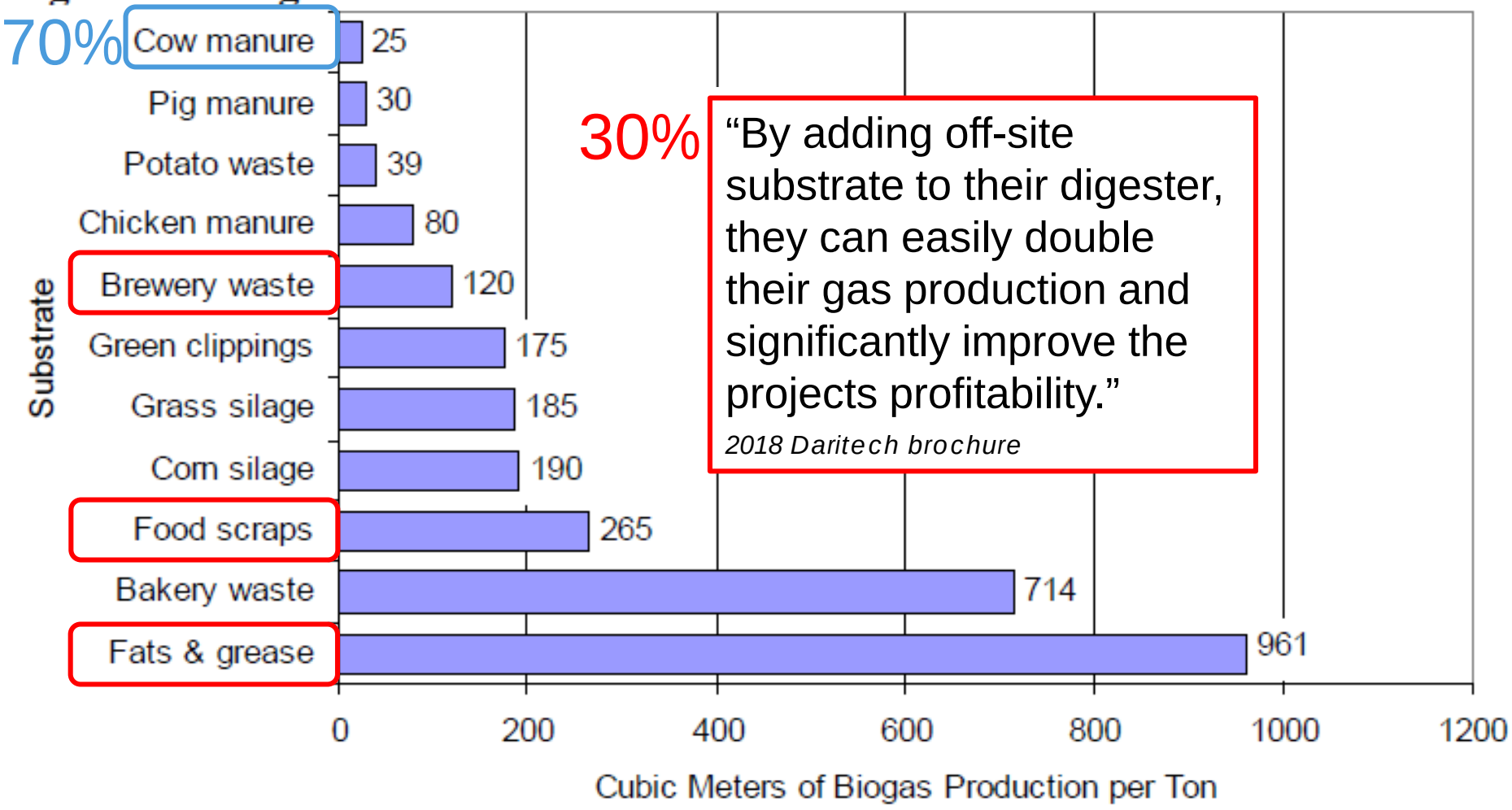
Figure 2: Operating On-Farm Food Waste Co-Digestion Systems by State (2015)

On-farm manure comprises 70% or more of waste

Photo from dairymaster.com

Off-site waste (e.g., food processing waste, restaurant grease) up to 30% of biomass

Figure 4 – Biogas Generation Potential of Substrates



30%

"By adding off-site substrate to their digester, they can easily double their gas production and significantly improve the projects profitability."

2018 Daritech brochure

Source: Data derived from www.biogas-energy.com, © 2007 Biogas Energy, Inc., translated from: Basisdaten Biogas Deutschland, Marz 2005,: Fachagentur Nachwachsende Rohstoffe e.V.

Excerpt from 12/09 Edition of Wisconsin Agricultural Biogas Casebook

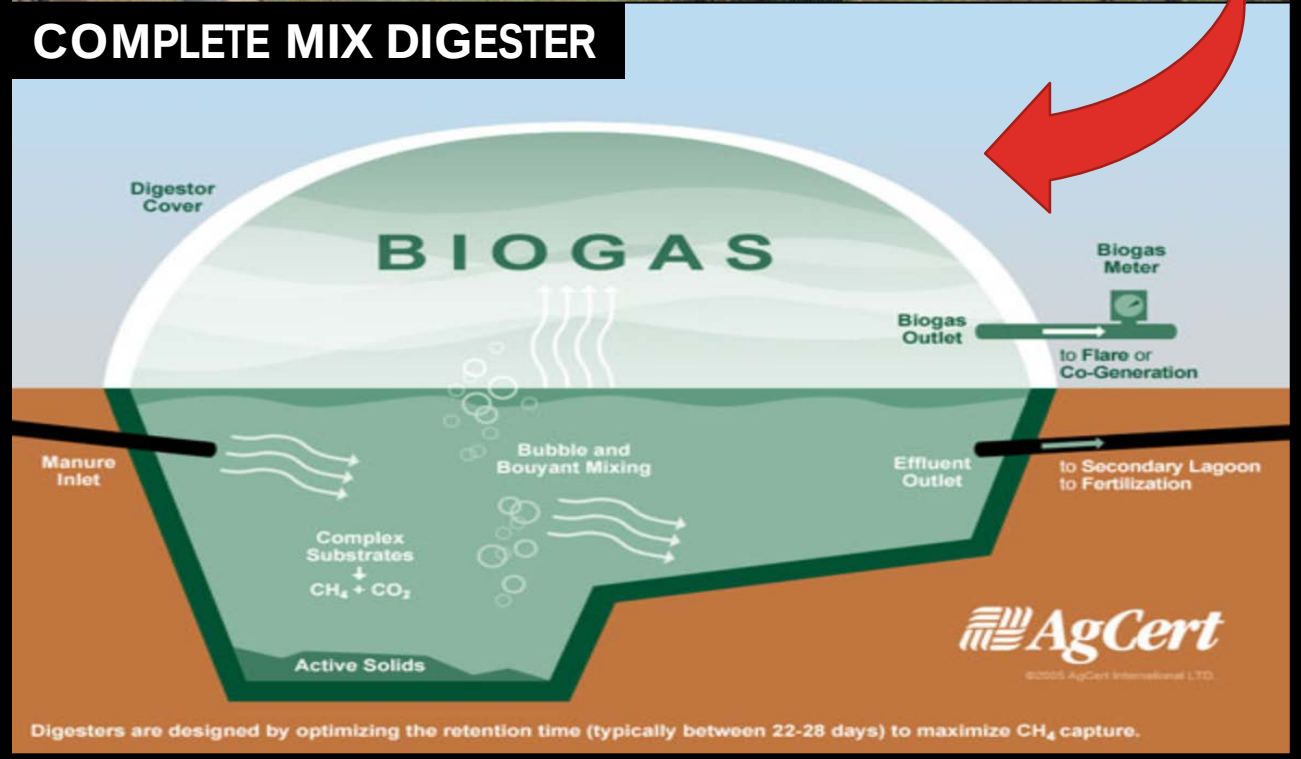
MAINTAIN BALANCE

DIGESTERS ≈ STOMACHS

cow manure

off-site feedstock

COMPLETE MIX DIGESTER



DVO'S MIXED PLUG-FLOW™

To preserve retention time, mixing occurs around the *axis of flow*. Waste slowly "corkscrews" its way through the digester.

https://mrec.org/files/2016/06/2016.Dvorak.WhereAreWeTodayWithDigesters.pdf

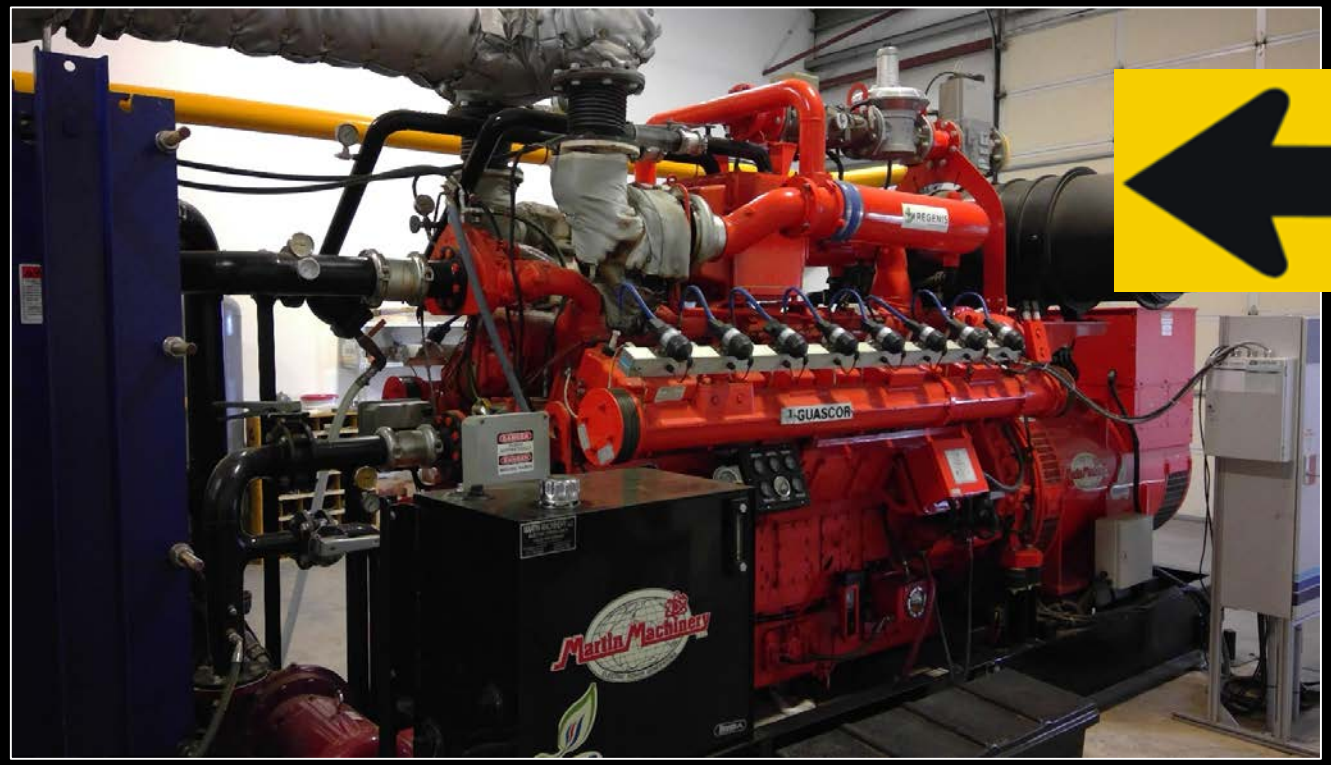

www.daritech.com/digesters.html

www.regenis.net

www.regenis.net

www.regenis.net

Biogas Production:
55%-70% methane
30%-45% carbon dioxide (CO_2)
Hydrogen sulfide (H_2S) in ppm



1,057 hp engine with 750 kWh generator

Average 527 kWh - power for 400+ homes

In Washington State:
$100 / MWh - decade ago
$35 / MWh - now

EMISSION COMPARISON

VOC, NOx, PM, SO2 *[used for registration fees]*

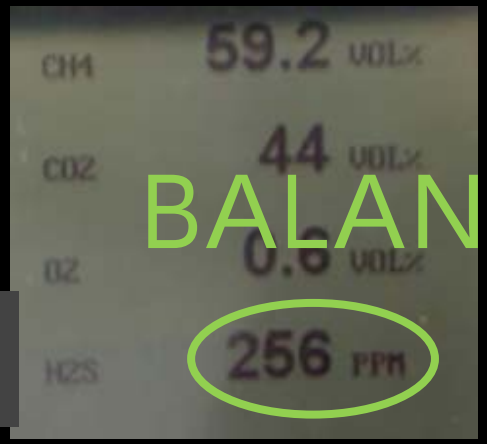
Examples of Registered Sources	Emissions (tons/yr)
Auto body shops - VOCs ▪ Small to large (e.g., Maaco)	≤ 2
University - NOx ▪ WWU - Boilers, generators, gas station, wood shop, spray booths, solvents	9
Gas stations (largest) - **VOCs** ▪ Safeway and Fred Meyers ▪ Costco	6-13 18-26
Wood products (mid-to-large) – **PM10** ▪ Interfor Cedarprime, South Everson Lumber Co., SOCCO Forest Products, Lynden Door, Brooks Mfg., Mount Baker Products, Metrie Inc.	12-22
Anaerobic digesters (largest) – **NOX & VOC** ▪ FPE Renewables LLC, Edaleen Cow Power, Farm Power Rexville & Lynden	21-28

PROBLEMS

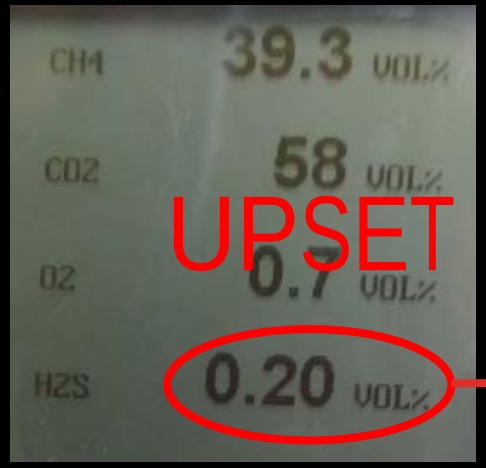
1. High H2S concentrations
2. Timely engine testing
3. Flaring issues
4. Digester roof failures
5. Equipment leaks

1. H2S CONCENTRATIONS

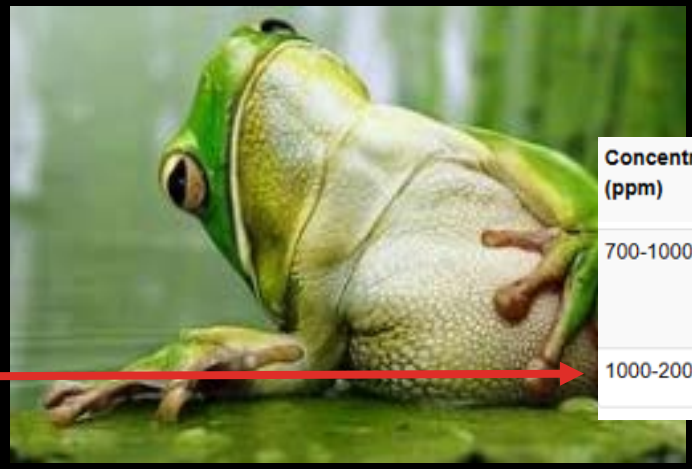
Anytime H2S Limit 550 ppm
30-day rolling limit 350 ppm



BALANCE



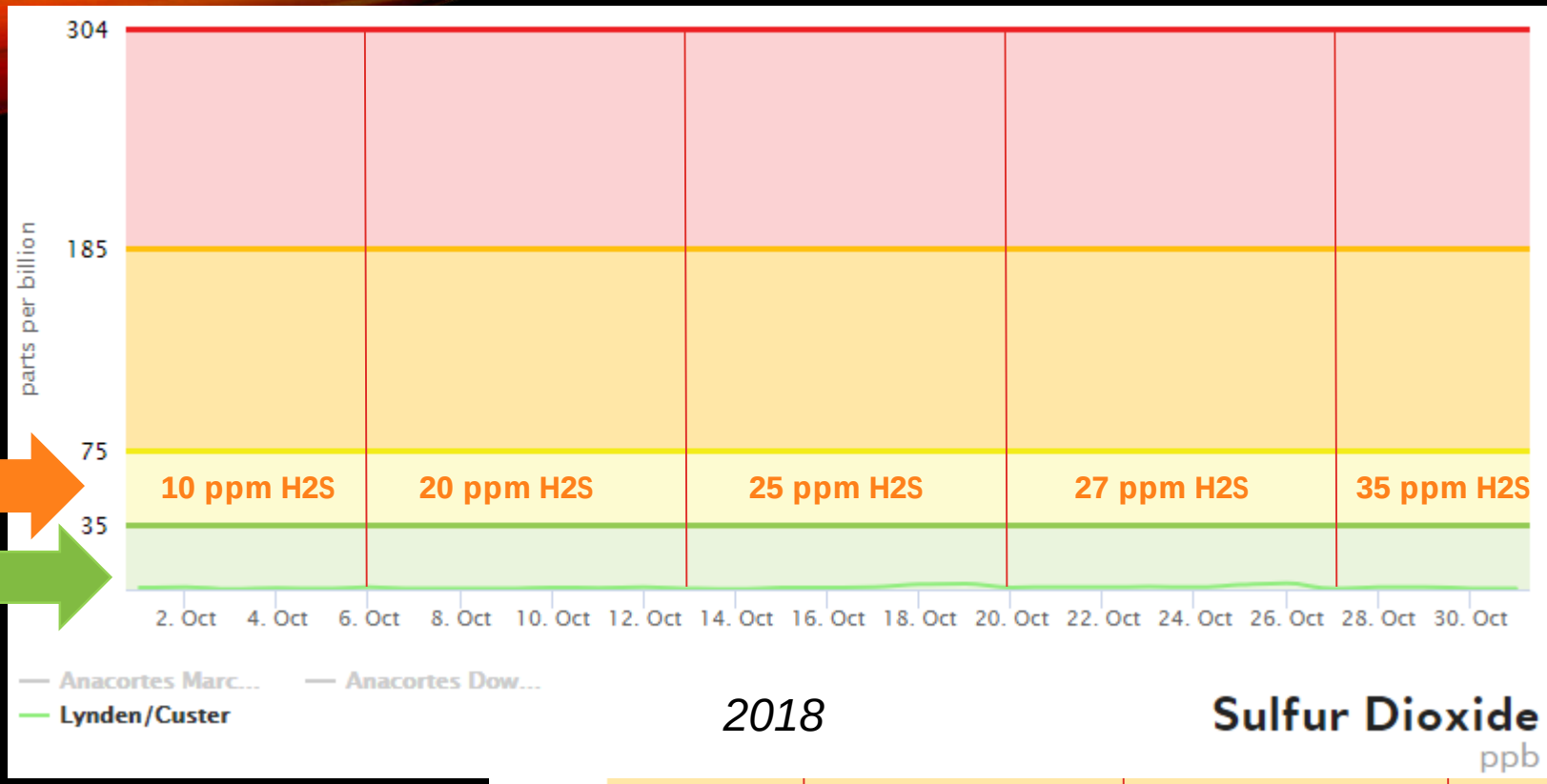
UPSET



Concentration (ppm)	Symptoms/Effects
700-1000	Rapid unconsciousness, "knockdown" or immediate collapse within 1 to 2 breaths, breathing stops, death within minutes.
1000-2000	Nearly instant death

H2S

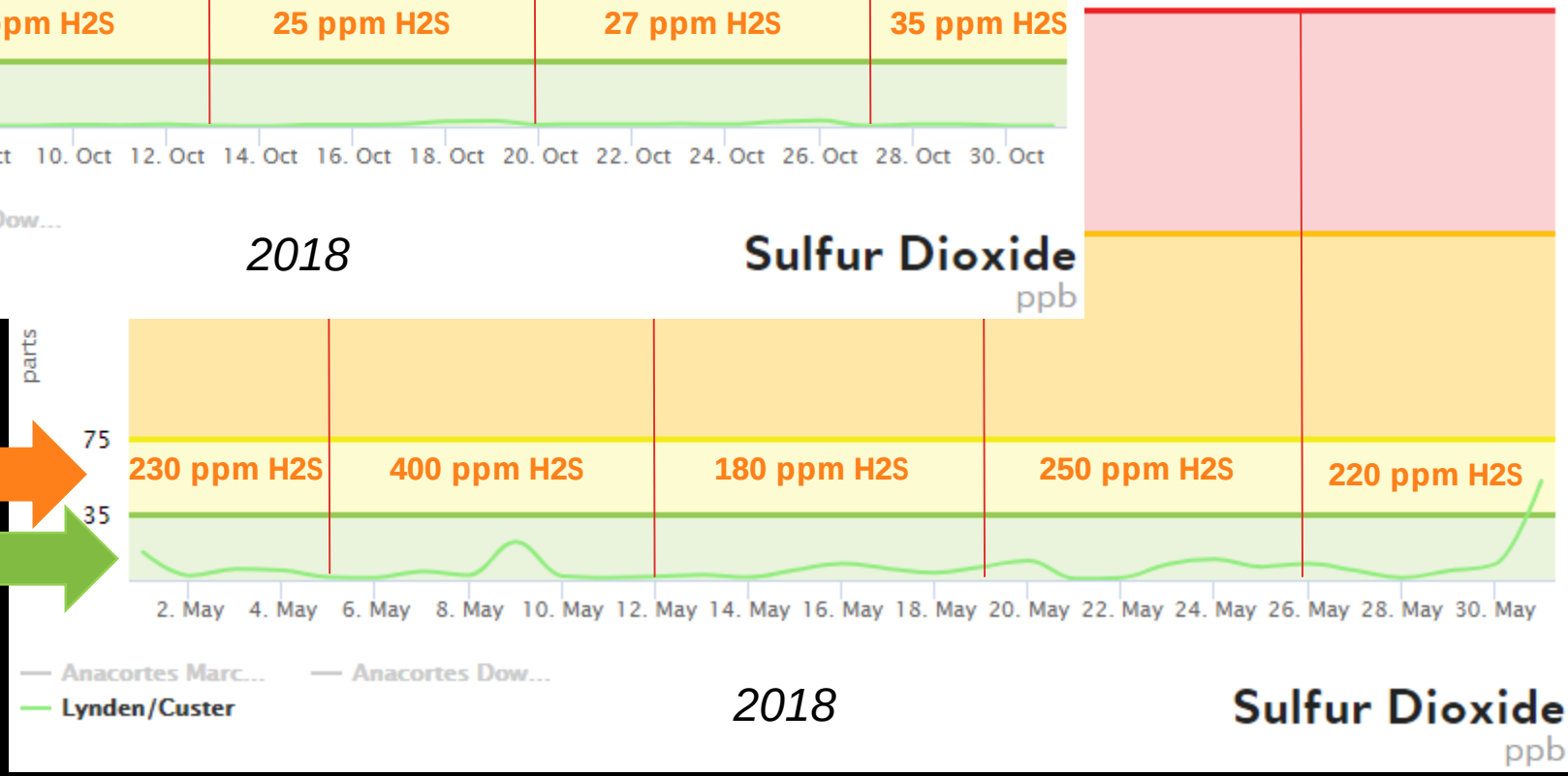
SO2



2018

Sulfur Dioxide

ppb



2018

Sulfur Dioxide

ppb

SO2 - BIOGAS VS NATURAL GAS

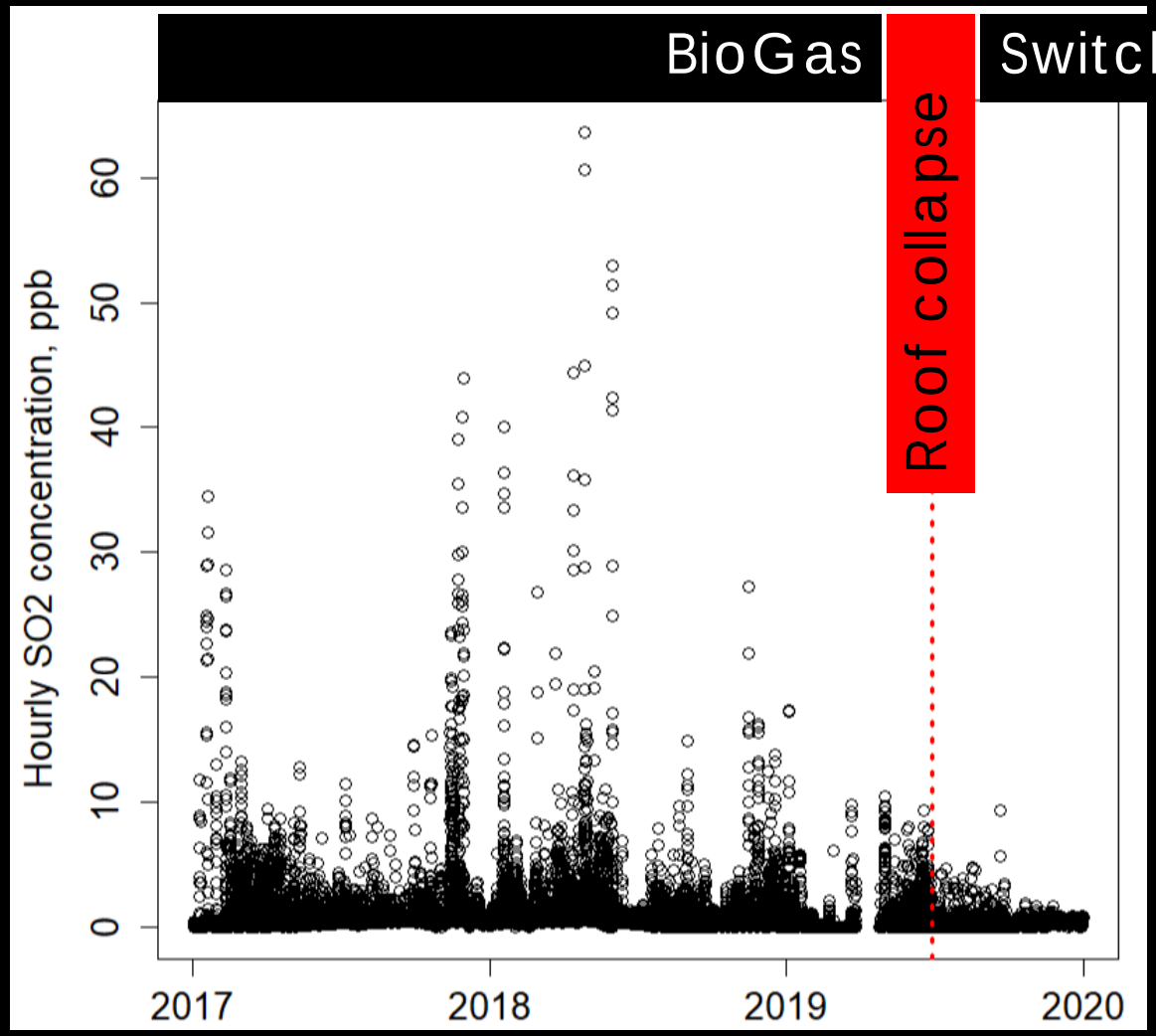


Chart courtesy of Ecology

2. TIMELY ENGINE TESTING

Performance Tests for Nitrogen Oxides, Carbon Monoxide and Volatile Organic Compounds

40 CFR § 60.4243(b)(2)(ii) – testing non-certified engines

Issue Date	Description/Notes
08/26/2019	1. Failure to perform required engine performance testing every 8,760 hours 2. Failure to combust all digester gas in the engine generator or the flare. NW 3. Based on information provided by the facility during a follow-up visit on 8/ 4. Failure to report a breakdown or upset of the inoperative flare which allowe 5. Failure to keep process and/or air pollution control equipment in good con 6. Failure to maintain records of all offsite materials used as feed for the anae 7. Failure to maintain a written log on a daily basis that included scf/day and s
11/01/2017	1. The test report documenting the May 25, 2017 source test was submitted t 2. The test report submitted to NWCAA on September 18, 2017 did not incluc
04/27/2017	Failure to perform required engine performance testing every 8,760 hours of
07/22/2015	Failure to perform required engine performance testing every 8,760 hours of You are required to take the following action: Within 30 days from the receipt of this NOV, a complete source test plan mus

3.A. FLARING ISSUES

No spark-ignition during power outages

3.B. FLARING ISSUES

Permit applications indicated flaring ≤ 10%

3.C. FLARING ISSUES

Flare ignition failures during normal operation – flow, but no flare

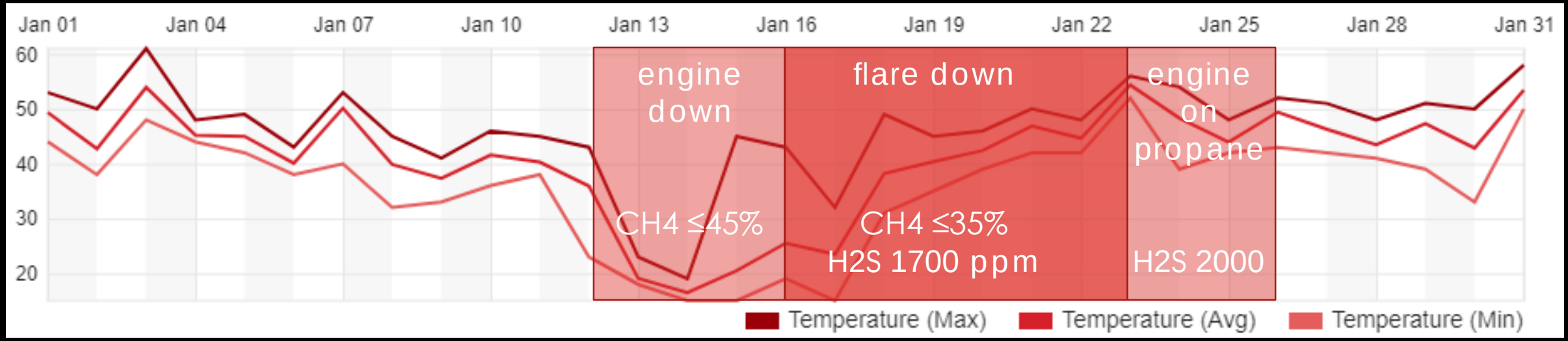
Date	Time	Flow over 15 min	Avg. CFM	FlareTemp
7/27/2019	8:00:00	3570	238	84
7/27/2019	8:	2598	173	80
7/27/2019		2970	198	84
7/27/20		685	179	77
7/27/20		76	165	78
7/27/201		2855	190	80
7/27/2019		2158	144	79
7/27/2019	9:45:00	2609	174	80
7/27/2019	10:00:00	383	26	73
7/27/2019	10:15:00	206	14	76
7/27/2019	10:30:00	207	14	76

No Flare Temp 18% of time

SCFM	Temp
197	1088
266	994
171	892
193	1277
203	766
278	1081
190	845
189	1310
180	1125
189	1259
183	1212

3.C. FLARING ISSUES

Flare ignition failure due to poor gas quality (e.g., an upset caused by freezing weather)



4. DIGESTER ROOF FAILURES

- Result in alternate operations (i.e. run commercial natural gas)


Edaleen Cow Power (built 2012)
Lid collapse October 2019

Van Dyk-s Holsteins (built 2011)
Lid split July 2018

5. EQUIPMENT LEAKS

- Leaking equipment

J:\FLIR IMAGES_RECORDINGS\EDITED VIDEOS\DIGESTER.MP4


FLIR
06/12/2015 11:16 N 48° 59.076' W 122° 27.408'


FLIR
06/12/2015

RESOLVED / TO BE RESOLVED

1. High H2S concentrations
   - Generally under control during normal operation
2. Testing uncertified engines
   - Most conducted in timely manner
3. Flaring issues
   - No ignition during power outages
     - Battery back-up units have been installed
   - Flaring more than 10% represented in permit applications
     - Re-permitting – cap volume of biogas production
   - Flaring without combustion (high wind, low flow, spark failure, low CH4)
     - Re-permitting – monitor and report flare temp and flow
4. Digester roof failures and upsets
   - Re-permitting - address the use of natural gas
5. Leaking equipment
   - Need further field evaluation to determine extent of leaks

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