FUTURE OF HOG WASTE TO RNG

CASE STUDY: OPTIMA KV

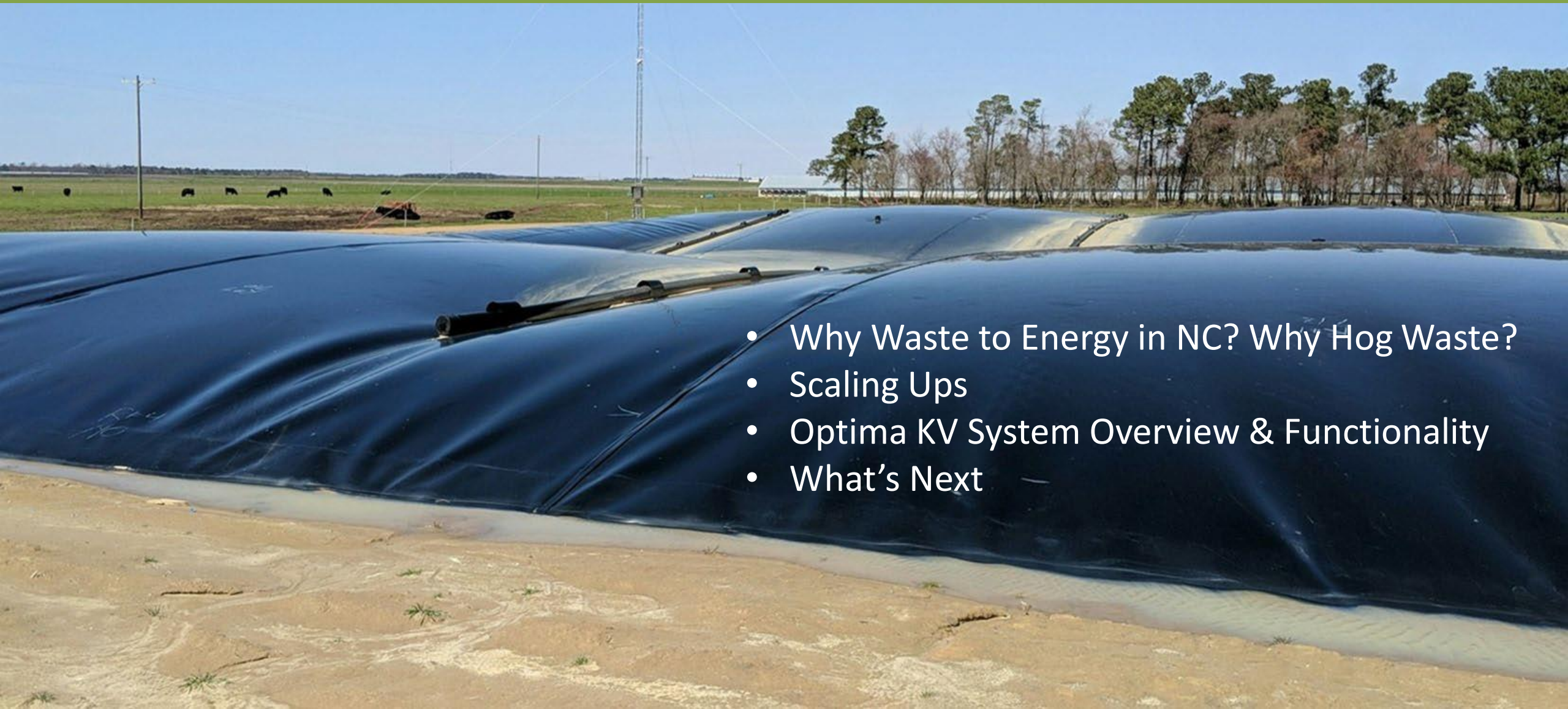
CAVANAUGH

Stewardship Through Innovation

Presented by: Gus Simmons, P.E.

AgSTAR Webinar, March 27, 2019

Discussion Points



- Why Waste to Energy in NC? Why Hog Waste?
- Scaling Ups
- Optima KV System Overview & Functionality
- What's Next

Two recent industry revelations are shaping the future of hog waste to RNG:

#1 Smithfield Foods Announces Landmark Investment to Reduce Greenhouse Gas Emissions

Smithfield RENEWABLES

Smithfield Renewables set an ambitious goal to reduce its carbon emissions 25% by 2025.

- This will create manure-to-energy projects across 90% of Smithfield hog finishing spaces in NC and Utah and some of Missouri
- Converting anaerobic treatment lagoons to covered digesters, or construction of new covered digesters to capture biogas
- Shrinking Smithfield's environmental footprint

(Excerpt from Smithfield's Press Release)

"These projects, whether on a farm or at a plant, strengthen two key industries in North Carolina: energy and agriculture. Smithfield is leading the charge in expanding the state's renewable energy portfolio while creating new economic and environmental benefits for the agriculture industry."

Excerpt from Duplin Times

Duplin Times photo/Abby Cavenaugh

Gus Simmons, director of bioenergy for Cavanaugh Associates, stands in front of the Optima KV refinery facility, which converts hog waste into renewable energy. The project is the first of its kind in North Carolina.

#2 Formation of Align RNG

Dominion Energy and Smithfield Foods Partner to Transform the Future of Sustainable Energy

- Dominion Energy and Smithfield Foods form joint venture, Align Renewable Natural Gas (RNG)℠
- Initial projects announced in North Carolina, Virginia and Utah will capture waste methane from hog farms and convert it into renewable natural gas to heat homes and power local industries
- Transformational partnership will dramatically reduce methane emissions from the agriculture and energy industries in support of state greenhouse gas reduction initiatives
- RNG enhances fuel diversity for natural gas utilities and provides a waste management solution and new revenue stream for family farmers

Reduction in GHG emissions

Increased domestic energy production

Improved waste management

New revenue source for American farmers

(Excerpt from Dominion Energy Press Release)

NC Bioenergy Potential Map

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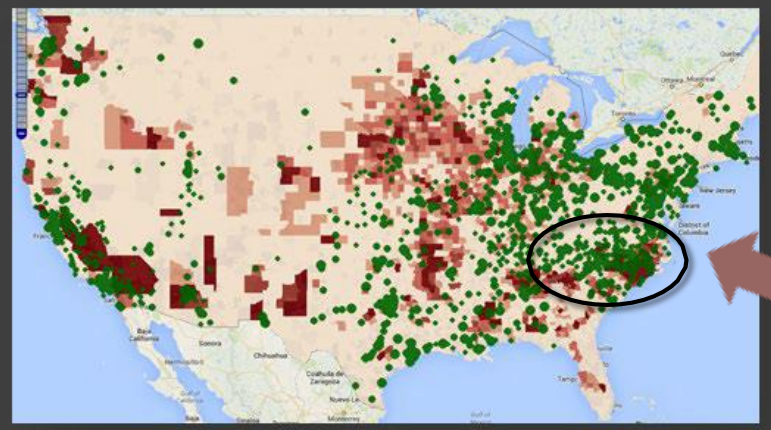
NC "All Bioenergy" Facilities Map (with NG Pipelines)



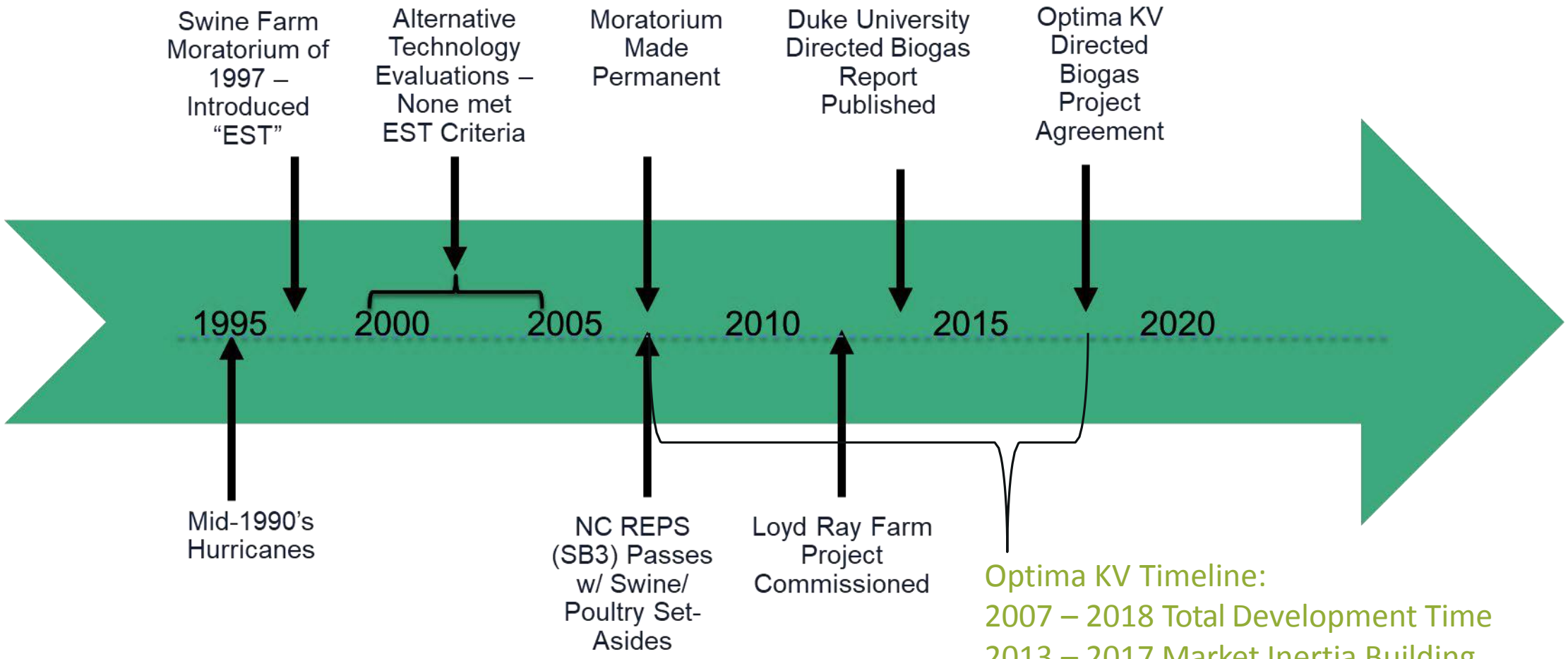
- Hog Farms
- Dairy Farms
- Munie WWTPs
- Landfills
- Wet Poultry

Potential for 900 projects!

3rd richest bioenergy resources in the Country!

According to NREL and the American Biogas Council

So, how did we get here?



Optima KV Timeline:

2007 – 2018 Total Development Time

2013 – 2017 Market Inertia Building

2015 – 2018 Design/Permit/Construct

2018 Commissioning

Optima KV:

- 2nd Directed Biogas deal inked by Duke Energy in NC
- 1st Pipeline Interconnection Test

"This is a major breakthrough for renewable energy in North Carolina. This project allows for the capture of emissions from hog operations and converts the renewable natural gas to electricity for customers. ***We look forward to continuing our work on future projects***."

- David Fountain,
Fmly North Carolina President
Duke Energy

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Duke Energy inks second innovative swine waste power deal in 2016

May 24, 2016

- **Company to buy captured methane gas from swine farms in Duplin County, North Carolina**
- **Gas to be used at two Duke Energy power plants to generate carbon-neutral renewable energy**

CHARLOTTE, N.C. -- Duke Energy announced today it has finalized a second deal in 2016 to buy captured methane gas derived from swine waste. The planned project will be at farms in Kenansville, N.C.

The project will use captured methane gas to generate carbon-neutral renewable electricity at two power stations. Optima KV will construct a digester at each farm and pipe the captured methane gas to a centralized facility where it will be cleaned to pipeline quality specifications and injected into the natural gas pipeline system.

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Duke Energy donates $100,000 to firefighters battling Western Carolinas wildfires

National conservation program gets $500K boost from Duke Energy

Duke Energy Progress rates drop for North Carolina customers on Dec. 1

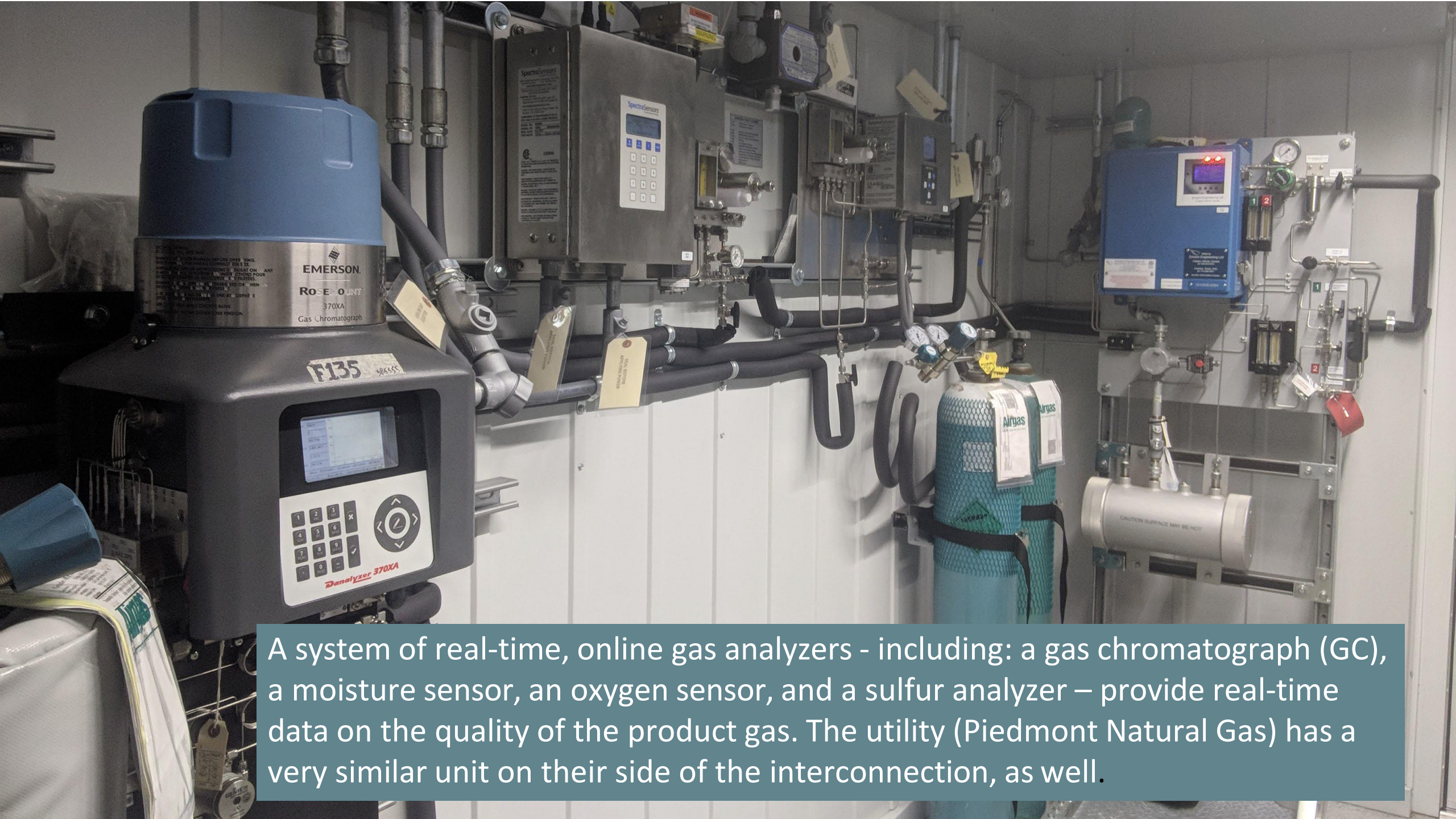
The Optima KV RNG Project Vision: Biogas Aggregation

Manure and wastes from the animal barns are flushed into the digesters, which produce biogas from the anaerobic digestion of the swine manure. Biogas production varies by season and pig age.

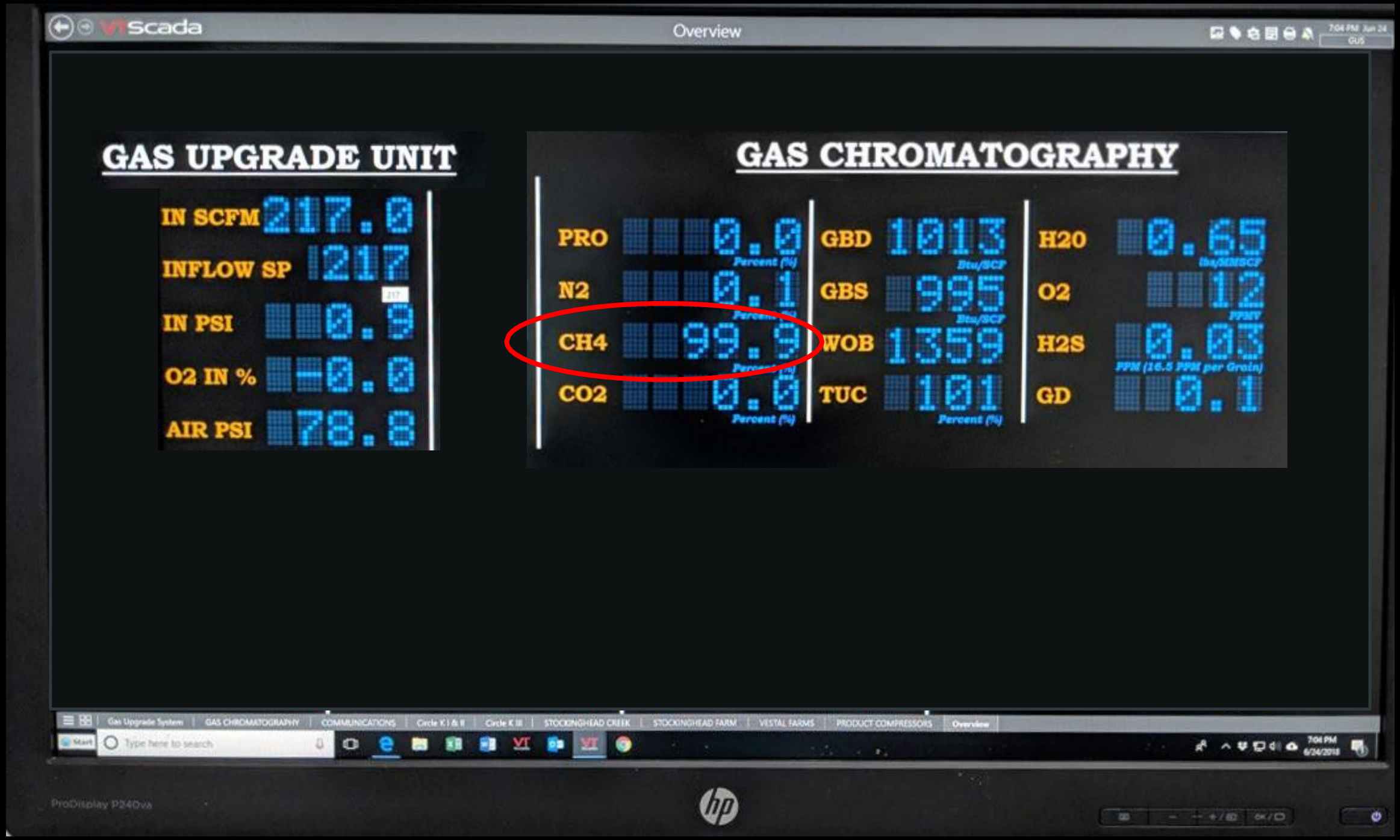
65% to 70% CH_4

The biogas is aggregated to a **gas upgrading system**, or “GUS” for short, which removes unwanted constituents from the biogas, yielding a natural gas stream that is nearly pure methane.

Conventional, geologically-derived pipeline natural gas is typically only about 95% methane, and contains other hydrocarbons.



A system of real-time, online gas analyzers - including: a gas chromatograph (GC), a moisture sensor, an oxygen sensor, and a sulfur analyzer – provide real-time data on the quality of the product gas. The utility (Piedmont Natural Gas) has a very similar unit on their side of the interconnection, as well.


VTScada
Overview
GAS UPGRADE UNIT
IN SCFM 217.0
INFLOW SP 217
IN PSI 0.9
O2 IN % 0.0
AIR PSI 78.8
GAS CHROMATOGRAPHY
PRO 0.0 Percent (%)
N2 0.1
CH4 99.9
CO2 0.0 Percent (%)
GBD 1013 Btu/SCF
GBS 995 Btu/SCF
WOB 1359
TUC 101 Percent (%)
H20 0.65 lbs/MMSCF
O2 12 PPMV
H2S 0.03 PPM (16.5 PPM per Grain)
GD 0.1
Gas Upgrade System
GAS CHROMATOGRAPHY
COMMUNICATIONS
Circle K I & II
Circle K III
STOCKINGHEAD CREEK
STOCKINGHEAD FARM
VESTAL FARMS
PRODUCT COMPRESSORS
Overview
Type here to search
7:04 PM
6/24/2018
ProDisplay P240va

Laboratory Testing

Delivery Temperature:		
Methane:	✓	>94%.
Heating Value:		980 - 1100 Btu/SCF
Interchangeability: WOBBE		1290 - 1370.
Hydrogen Sulfide (H2S):	✓	< 0.25 grain/100 SCF.
Mercaptan:		< 0.5 grain/100 SCF.
Total Sulfur:		< 10 grain/100 SCF, including H2S
Water:	✓	<7 pounds/MMSCF
CHDP:	✓	<20°F.
Carbon Dioxide (C02):		<2% by volume
Nitrogen:	✓	<2% by volume
Oxygen:	✓	< 0.2% by volume
Carbon Monoxide (CO):		<0.1% by volume.
Total Inerts:		<3.2% by volume
Hydrogen:		<600 ppm.
Solid Particle Size:		remove 99.99% >3 microns
Dust, Gums & Solid Matter:		0
Biologicals:		<4 x 10^4 count/scf active bacteria
Organic Silicon (Siloxanes):		<0.40 mg of SJ/Nm^3
Odorization Masking/Fading Agents (VOC):		0
VOC:		0 dioxins.

Arsenic	0.48 mg/m^3 (0.15) (ppmv)
p-Dichlorobenzene	140 mg/m^3 (24) (ppmv)
Ethylbenzene	650 mg/m^3 (150) (ppmv)
n-Nitroso-di-n-propylamine	0.81 mg/m^3 (0.15) (ppmv)
Vinyl Chloride	21 mg/m^3 (8.3) (ppmv)
Antimony	30 mg/m^3 (6.1) (ppmv)
Copper	3.0 mg/m^3 (1.2) (ppmv)
Lead	3.8 mg/m^3 (0.44) (ppmv)
Methacrolein	53 mg/m^3 (18) (ppmv)
Alkyl thiols (mercaptans)	(610) (ppmv)
Toluene	45,000 mg/m^3 (12,000)

Mark Malone of OptimaBio, the Developer of the project.
Photo credit: NCPC

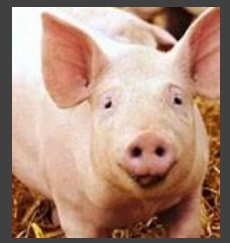
America's Top Producing Pig Counties
2012

Rank	State	County	Inventory
1	North Carolina	Sampson	1,858,801
2	North Carolina	*Duplin	1,733,026
3	Oklahoma	Texas	1,204,159
4	Iowa	Sioux	1,176,751
5	Iowa	Washington	986,774

Optima KV Summary

- 2 Farm Owners, 3 Participating Farms, 5 Digesters
- 60,000+ pigs
- First project in N.C. to inject renewable natural gas *(from any source)* into the natural gas pipeline *[and this source is from pig manure]*

- 15 year agreement with Duke Energy
- ~ 80,000 $MMBtuy^{-1}$
- ~ 11,200 $RECy^{-1}$
- High-purity Biomethane



Like More Information?

Read the full article and case study:

https://www.biocycle.net/2018/06/07/swine-manure-biomethane/

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