Developments in Renewable Natural Gas:

The Promise of RNG

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EPA Gas STAR

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The Promise of RNG

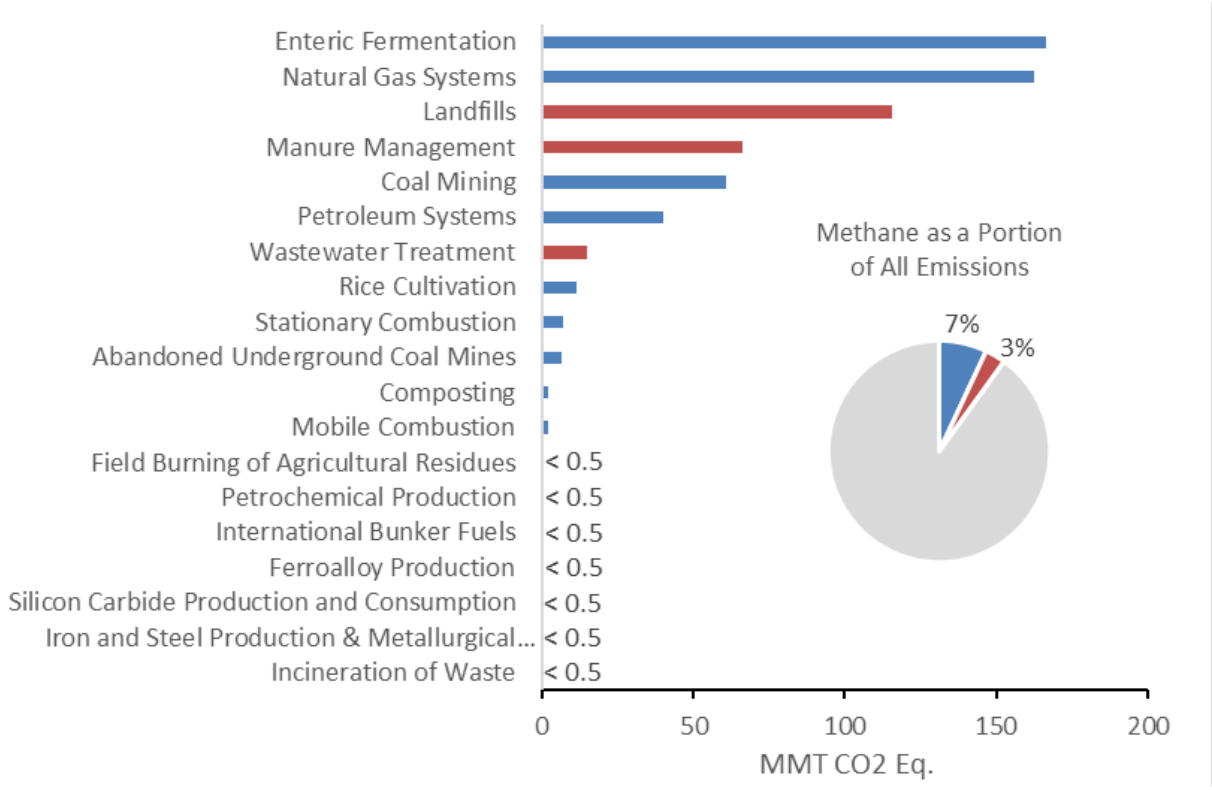
1. RNG can help capture and reduce methane
2. Case Studies demonstrate wide variety of RNG projects and uses – *including decarbonizing pipelines*
3. RNG Policy and Market Forces pose Challenges…
4. But Project Developers and Users are Rising to the Challenge

Why is RNG relevant to Methane Emissions?

- **Answer:** Because *capturing and using* methane from landfills, manure, food waste, other organic waste and water treatment helps reduce methane emissions

Sources of methane emissions 2015

RNG Potential: Landfills, Manure, Wastewater



1. Case Studies

- *Originally presented at EPA-AGA RNG Workshop, Boulder CO (Sept. 26, 2017)*

- National Grid Newtown Creek RNG from Wastewater Digester in Brooklyn NY
- Southern California Gas – RNG from Anaerobic Digester
- Duke Energy RNG from Livestock Waste Digesters in Missouri & NC
- Southern Company Gas – RNG from processed Landfill Gas

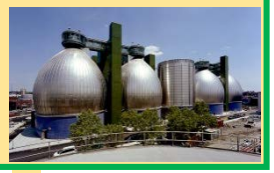
- *The following slides are used with permission from their authors*

National Grid's Journey

2010

NEWTOWN CREEK DEMONSTRATION PROJECT

Partnership with NYC-DEP to convert New York City's waste water into a source of clean energy



RFS – RECOGNITION OF ENVIRONMENTAL ATTRIBUTES

Educating stakeholders on EPA's Renewable Fuel Standards (RFS) program and helping customers by facilitating transactions to monetize the environmental attributes

CURRENT STAKEHOLDER ENGAGEMENT

Facilitating Customer Projects

- Working with customers, project developers, technology providers and consultants

Education & Advocacy

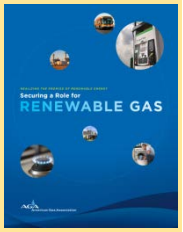
- Associations, policy makers and regulators

RNG RESEARCH & WHITEPAPER

Outlined the value of RNG as an alternative energy source. Analyzed the potential for RNG by feedstock and technology in NY, MA, RI & NH. Paper also provides a vision for a sustainable gas network and a roadmap on how to get there

NATIONWIDE RNG REPORT

Partnership with AGA & AGF to determine the national potential for RNG



NEW YORK STANDARD INTERCONNECTION GUIDELINE

Collaborative effort to develop a revolutionary interconnection guideline. The purpose of this effort is to specify gas quality standards and streamline the process of connecting RNG projects to the gas distribution network

2017

Newtown Creek Demonstration Project

- Public-private partnership with NYC Department of Environmental Protection
- Largest wastewater treatment plant in NYC
- The project will inject enough RNG into the distribution network to heat ~2,500 homes
- Reduce CO2 emission by about 16,000 tons annually
  - Equals ~3,000 car reduction for one year
  - NYC is introducing an additional feedstock, food waste, which will boost biogas production

Newtown Creek wastewater treatment plant in Brooklyn, NY

Source: New York City Department of Environmental Protection

Slide used with permission from author Don Chahbazpour, National Grid

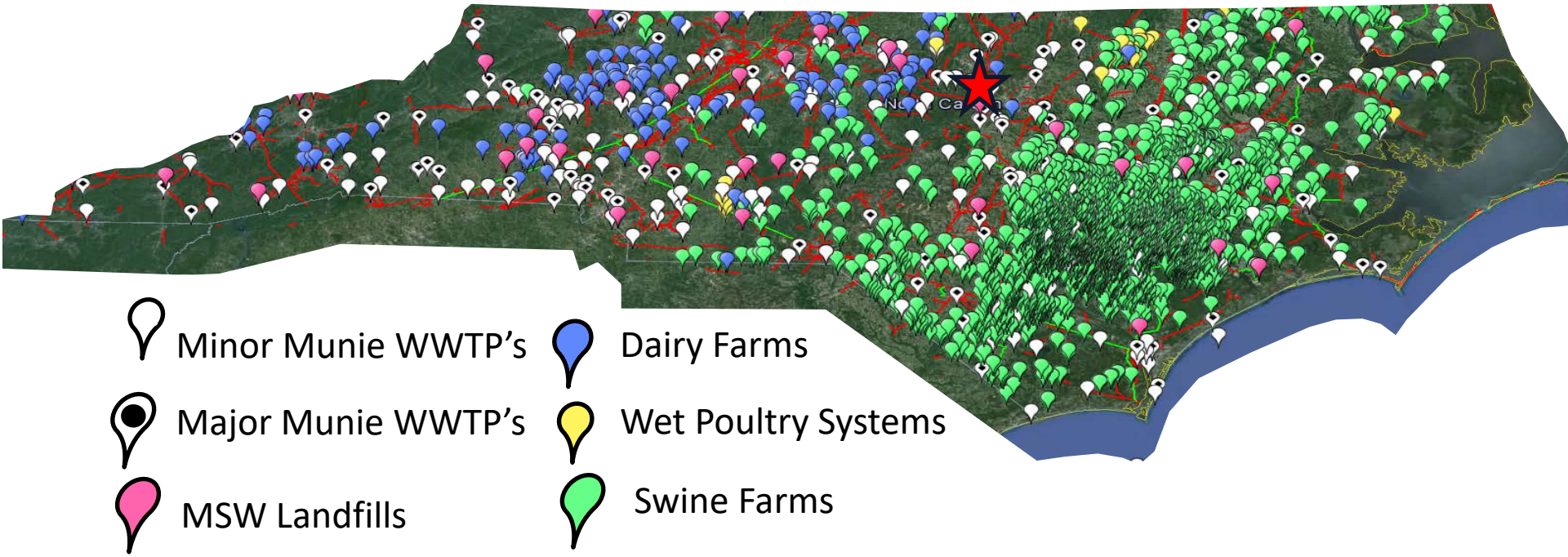
SoCalGas®® Biogas Upgrading Demonstration Project at the Hale Avenue Resource Recovery Facility (HARRF)

HARRF Information

- Wastewater treatment facility located in Escondido, CA
- Average Daily Flow ~ 15.6 MGD
- Biogas was being flared prior to start of demonstration project
- Biogas Production ~ 95 million cubic feet per year
- Biogas contains enough energy to supply ~1,200 homes

Source of photo: www.escondido.org/water-treatment-plant.aspx

North Carolina
"All Bioenergy" Facilities Map (with NG Pipelines)



Swine Farm Locations are Mainly in Eastern NC – Potential for ~ 80 MW of projects

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North Carolina's Renewable Statute

- North Carolina Renewable and Energy Efficiency Portfolio Standard or "REPS"
  - Enacted in 2007 and became law 1/1/2008
- Mandate: Renewable energy must equal 12.5% of a utility's sales by 2021
  - A portion must be met with "set-aside" resources: solar, swine, poultry
  - A portion of the requirement may be met through energy efficiency programs
  - A portion (25%) may be met through purchases of out-of-state Renewable Energy Certificates
- Obligation increases over time: stair-steps in 2012, 2015, 2018, and 2021
- Costs are borne by utility customers

North Carolina's RPS is the only statute with animal waste-to-energy requirements.

NC Project Status

Piedmont Alternative Gas Specifications

- Current stakeholder process being held with NC Public Staff to determine a recommendation on specs for the NCUC – *Expect to finalize this by November*
- These specs will automatically go into Duke Energy's contracts for RNG (First Biogas Injections in NC)

NC Based Projects

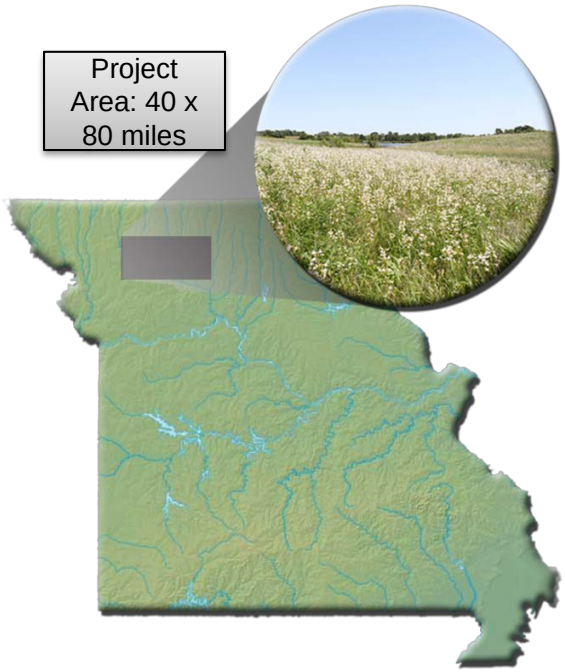
- Optima KV – Farm based swine project - ~80,000 MMBtu/year – Q1 2018
- Carbon Cycle –Adjacent to a swine processing facility - ~1,825,000 MMBtu/year (550,000 MMBtu Swine – Also includes Poultry and General Biomass) – Q3 2018
- Exploring additional RNG projects in NC with Roeslein and other developers

Production Process

- Open lagoons covered with an 80 mil HDPE / LDPE impermeable cover
- Impermeable cover captures the biogas normally vented to atmosphere, which is flared, used to make heat / power, or purified for pipeline injection
- Precipitation stays above cover and is managed as storm water

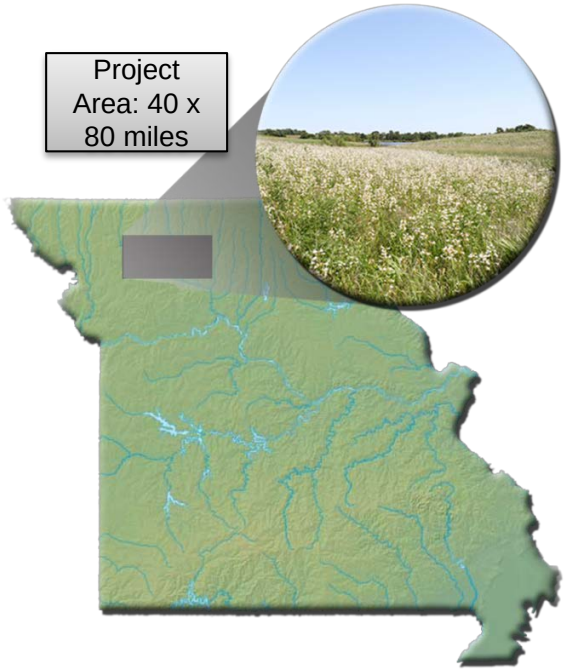
Project Overview – Horizon One Smithfield Hog Production of MO

- Hog Manure to renewable natural gas
- Projected up to 2 million finishing hogs per year
- Project Value up to $120M
- Start of Construction, April 2014
- Completion – Q4 2020
- First renewable natural gas injected into natural gas pipeline system, June 2016 – Ruckman Farm



Project Overview – Horizon One Smithfield Hog Production of MO

- Anaerobic Digestion
  - Covering 88 Existing Lagoons
  - Producing More Than 25 Million ethanol gal. equiv. per year, or **2.2 million MMBtu per year**
- Environmentally sustainable solutions
  - At hog barns, hog lagoons, and elimination of land application of hog manure
  - Improved nutrient management systems
  - Cleaner water



Southern Company – Athens, TN
Meadow Branch Landfill Gas (LFG)

Treatment Facility

- Commissioned in 2011• LFG to High BTU/Pipeline Quality Gas
- Production Currently: 1200 DThm/Day
- Processing Capability: 4,000 scfm of raw landfill gas

Landfill

- Owned by Waste Connections
- Opened in 1980
- Design Capacity ~10,000,000 tons

RNG Marketing & Policy Challenges & Incentives

Regulatory Policy – Remove Barriers to RNG

- Provide Clear RNG Gas Quality Standards
- Ensure RNG gets full credit under Federal Renewable Fuel Standards (RFS) for fueling natural gas vehicles (NGVs)
- Allow RNG credit toward State Renewable Portfolio Standards for grid power
- Give RNG credit when injected in distribution lines
- Remove utility least cost restrictions - Allow and facilitate options for RNG project funding

Market Forces

Main Challenge – Making the numbers work for RNG (Beyond Vehicles)

- Natural Gas – abundant supply driving low, stable prices

  (Traded in range of $2.82 to $3.03 per MMBtu in early October 2017)

- RNG costs have declined, but still higher than natural gas – absent credits

Market Forces

What's the answer?

1. **Vehicle Fuel Credits make RNG *Very* Attractive** - RNG used for vehicle fuel currently eligible for EPA Renewable Fuel Standard (RFS)- California provides additional credits

   Example – Waste Water Treatment RNG can earn @ $39 per MMBtu more with RFS – adding California credits, RNG can earn total of **$48 per MMBtu**

2. **Why just vehicle fuel? -** Need similar incentives for using RNG for power and injecting into gas distribution – available in some states, not others

3. **Price differential is getting smaller -** Some commercial customers will pay a premium for RNG as renewable energy

4. **Invest in the Future to reduce RNG costs –** Fund research and commercial demonstration projects

- Thank You!
- Questions?

AGA

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