



Roeslein Alternative Energy & Duke Energy - Missouri Swine Waste Green Gas Project

September 2017

Why Duke Purchases Power from Ag Projects

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.

REPS Requirements

	% of Prior-Year NC Retail Sales											
		2012			2015			2018			2021	2022
Total REPS Requirement		3%			6%			10%			12.5%	
Set Asides	2010	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Solar	0.02%	0.07%			0.14%			0.20%				
Swine Waste							0.07%		0.14%			0.20%
Poultry Waste (MWhs – state goal)				170k	170k	170k	700k	900k				

* Energy Efficiency Credits can be used to meet 25% of the Total REPS Requirement through 2020, and up to 40% thereafter

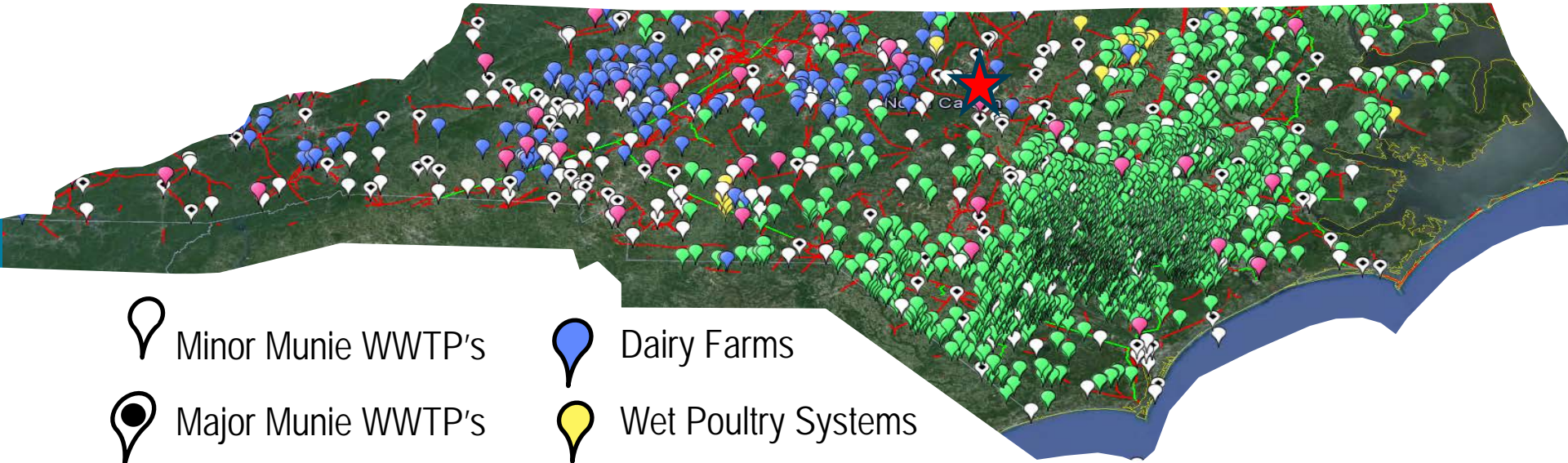
Piedmont Alternative Gas Specifications

- 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

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



- Minor Munie WWTP's
- Major Munie WWTP's
- MSW Landfills
- Dairy Farms
- Wet Poultry Systems
- Swine Farms

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

Partnership with Roeslein Alternative Energy

Project in Missouri

- Generates NC In-State Swine RECs
- Biogas to be transported to one of Duke Energy's Combined Cycles in Transco Zone 5
- Roeslein to provide monthly attestation that certifies % of swine derived biogas
- Utilizes Murphy Brown as a supplier – Large NC presence
- Plan to leverage the relationships and lessons learned on future NC RNG projects

Roeslein Alternative Energy

Mission and Vision

- ***Provide sustainable solutions for livestock production and renewable energy generation***
 - Using residues for bio-energy production and nutrient replenishment
 - Incorporates ***native prairie restoration***
- Substantial decrease in carbon footprint
- ***Provide ecological services for people, wildlife, and the environment***

Vertically Integrated Business Model

- We are a full solutions developer of business, finance, and technical / regulatory solutions
- Design, build, own, and operate (DBO) facilities

RAE – Who we are

Design / Build / Own / Operate (DBO)

Produce and Market RNG, CNG, and LNG

- Produce and market RNG, CNG, and LNG biofuel generated from industrial, livestock, cover crop, and native prairie biomass, for vehicle fuel and power generation

Economic Development

- Orchestrate business, finance, and technical aspects of all phases of project development from business opportunity identification through facility operations

Produce and Market Environmental Credits

- US EPA D3 Cellulosic Biofuel Renewable Identification Number (RIN) and LCFS
- California Carbon Offsets (CCO) and other carbon credits
- Water quality, nutrients, erosion, habitat, and native landscape restoration

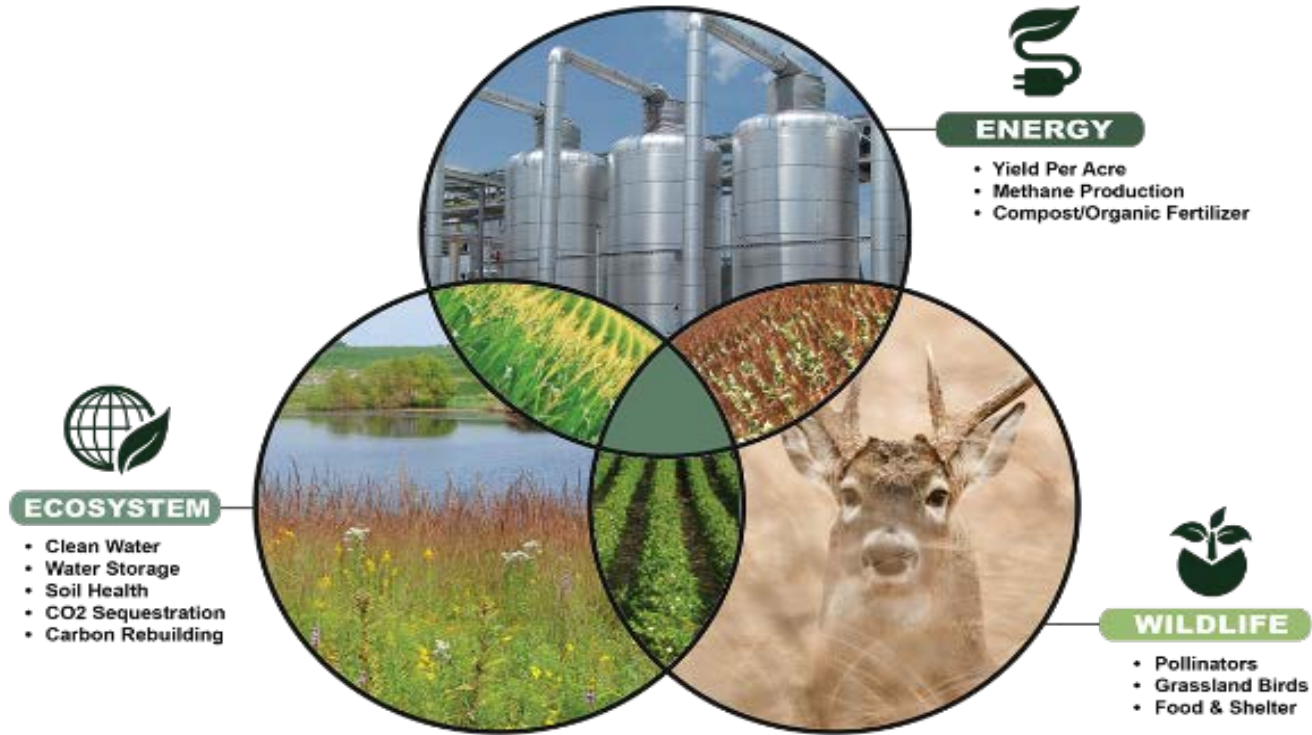
Cover Crops on Agriculture Production Land

- Increase land asset utilization during fallow months.
- Combines marketable biomass with land stewardship.

Native Prairie Grasses Restoration

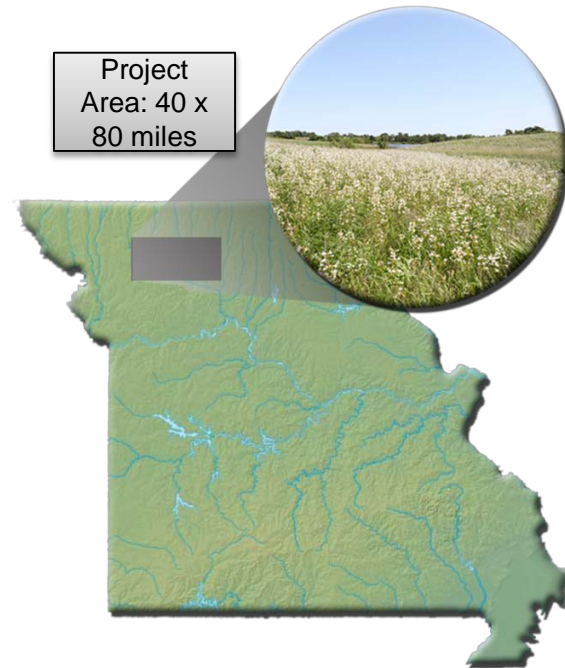
- Science, Technology, and Agriculture Production of native prairie grasses on Highly Erodible Lands

Energy, Ecosystem, and Wildlife Objectives in Balance



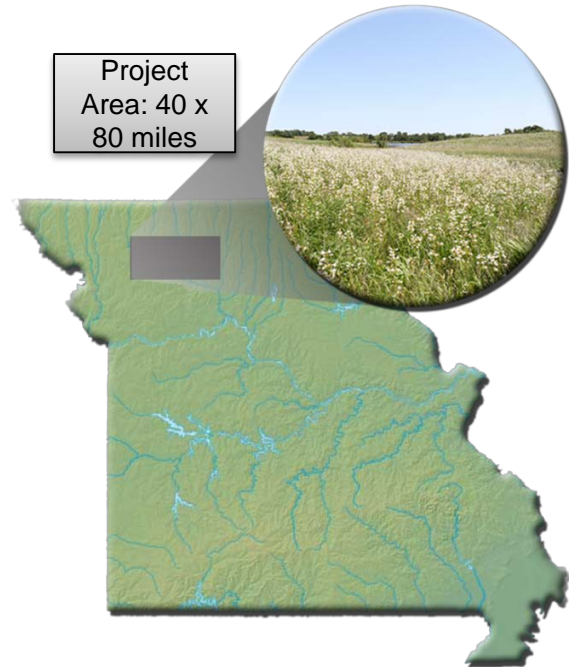
Project Overview – Horizon One Smithfield Hog Production of MO

- 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



Project Overview

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



Ruckman Farm

- 9 lagoon system
- 1350 SCFM PSA system
- Onsite Power Generation
- Interconnect with ANR interstate pipeline
- Flare systems at each lagoon for emergency backup.



Locust Ridge

- 4-5 lagoon system
- 400 SCFM
- Simplified design
- Modular, shop fabricated and assembled
- CNG loading and delivery to Ruckman Interconnect



Valley View Farm

- 400 SCFM Roeslein/Air Liquide Membrane skid
- Gas quality requirements achieved
- Modular, shop fabricated and assembled
- CNG loading and delivery to Ruckman Interconnect



Gas Quality Control

- All interconnects, including Milan, copied from Ruckman TP3 ANR requirements
- Same quality

ANR Tariff Quality

Heat Content	> 967 Btu / cf, < 1200 Btu / cf
H ₂ S	< 4 PPM
Total Sulfur	< 20 grains / 100 cf
Oxygen	<1%
Water	<7 pounds / million cf
Carbon Dioxide	< 2%
Nitrogen	< 3%





Thank You