CESA Webinar

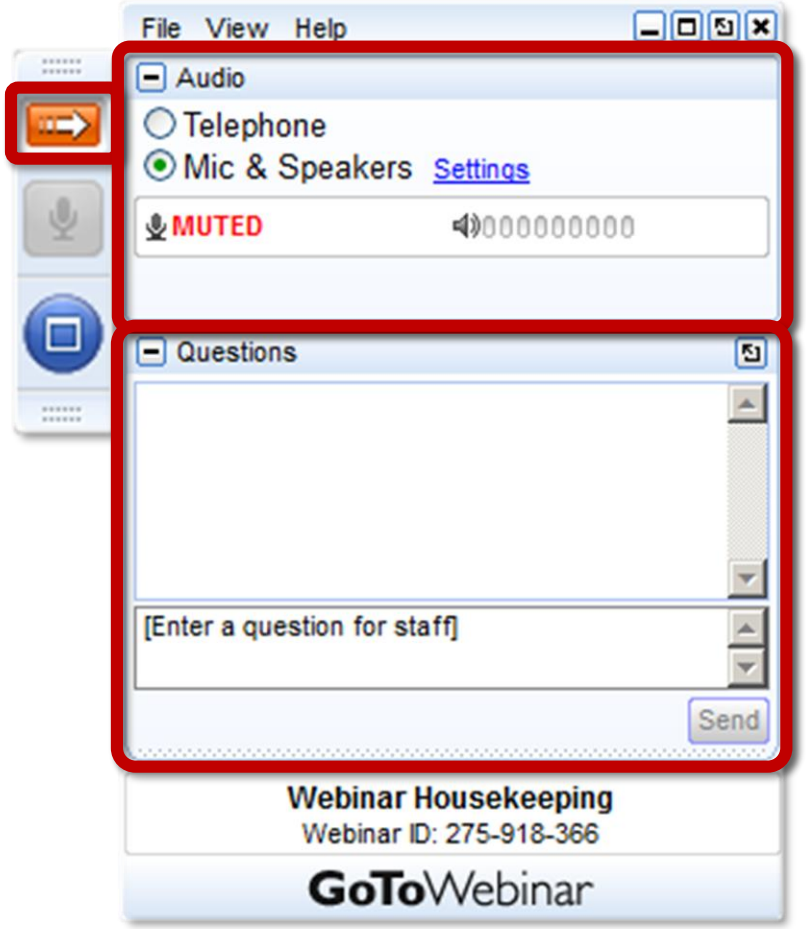
Iowa's Biomass Conversion Plan and Economic Assessment Tool

Hosted by
Val Stori, Project Director, CESA

November 13, 2018

Clean Energy States Alliance

Housekeeping



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Webinar Speakers

Shelly Peterson

Energy Office, Program Manager, Iowa Economic Development Authority

Mark Mba Wright

Associate Professor, Iowa State University

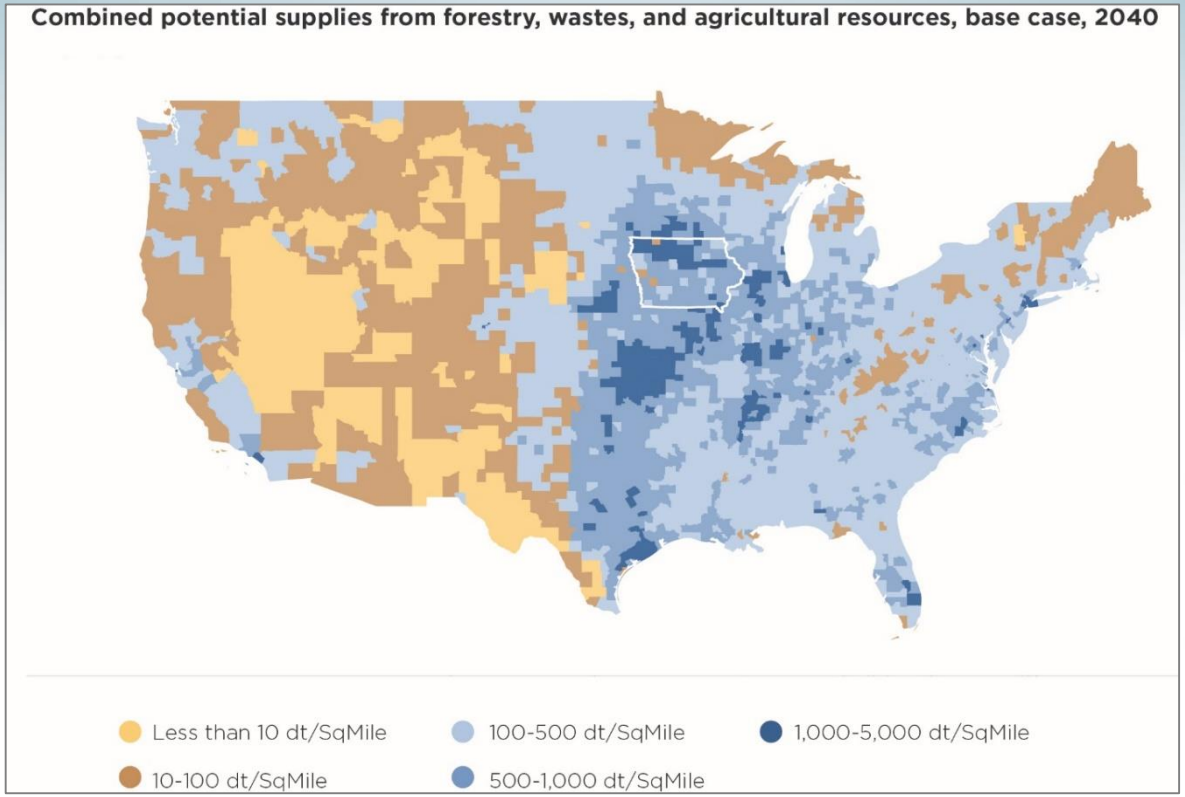
Bryan Sievers

Manager and Owner, AgriReNew; Chief Operating Officer, Sievers Family Farms

Val Stori

Project Director Clean Energy States Alliance (moderator)

Iowa's Biomass Potential



Billion Ton Report
https://energy.gov/eere/bioenergy/2016-billion-ton-report

1

Biomass Success

~3 on-farm digesters producing electricity from biogas

~12 wastewater treatment plants with CHP

~3 landfills with CHP from methane

~10 biodiesel refineries

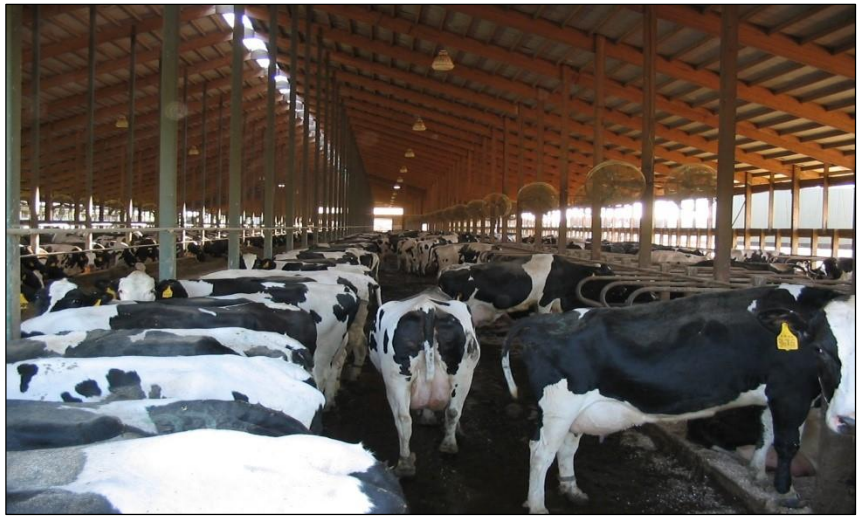
~42 ethanol plants/3 cellulosic ethanol plants

Biomass as coal substitute at University power plant (CHP)

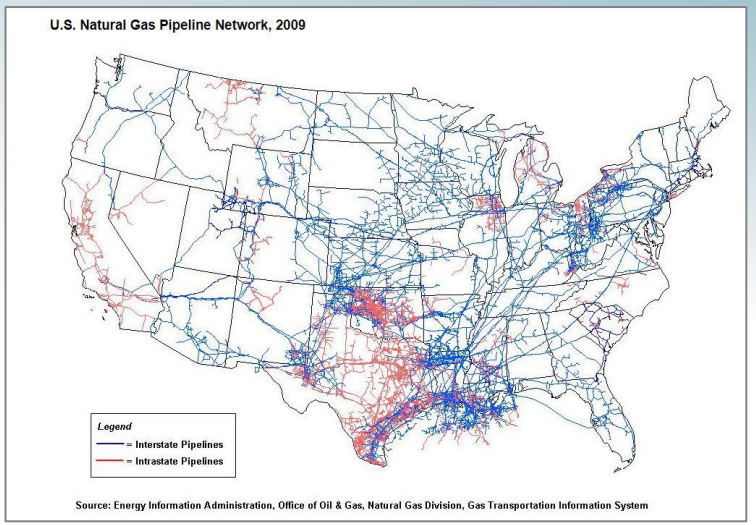
Miscanthus grass

Biomass Stakeholders

- 36 of the largest 100 food manufacturers and processors
- #1 in nation in corn, eggs and pork
- #2 in soybean and red meat production
  - 21M hogs
  - 4M head of cattle
  - 16B eggs annually

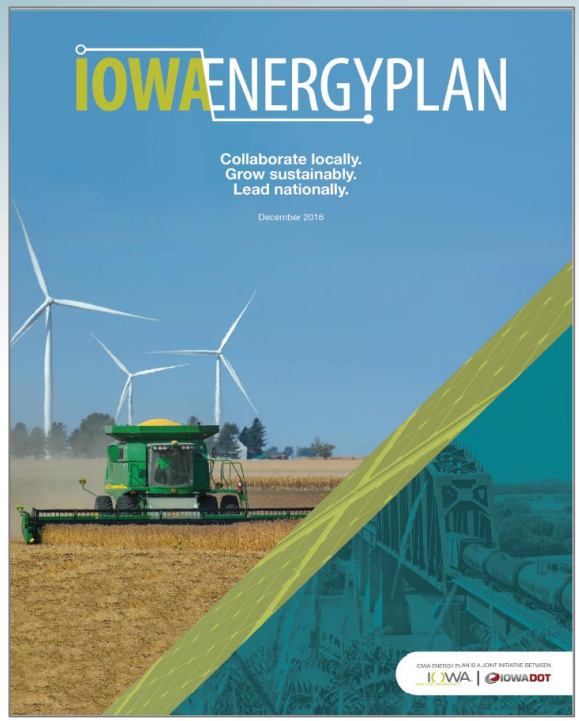


Biogas Potential: Infrastructure



- Natural gas provides 20% energy needs
- No in state production or processing
- 4 natural gas storage fields
- 5 interstate pipelines cross state
- Transmission system is broad but some areas of state lack adequate distribution system

Energy Plans

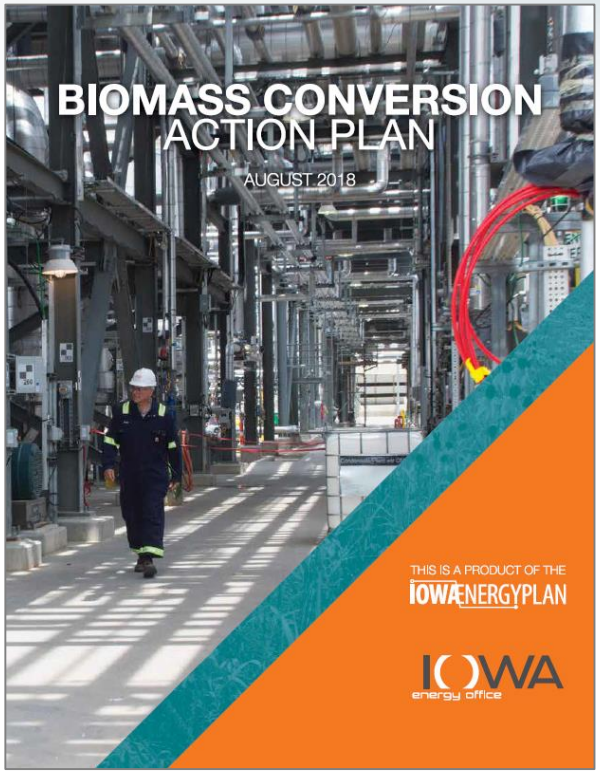


2016

www. Iowaenergyplan.org

www.iowaeconomicdevelopment.com/UserDocs/BiomassPlan_ExecSummary_082018.pdf

2018



Biomass Conversion Committee: Members

State agencies

- Iowa Utilities Board
- Department of Natural Resources
- Iowa Department of Agriculture and Land Stewardship

Other

- Municipal Wastewater Treatment
- Farmers/Digester Owner
- Agriculture Associations
- Utilities
- Ethanol producer/Co-op
- Consultants
- University
- Student

State Level Recommendations

- Optimize permitting/regulatory requirements
- Account for ecosystem services
- Develop distribution strategy
- Identify funding sources
- Create bioenergy information platform
- Optimize supply chain/resource utilization
- Establish state incentive program(s)

Federal & Regional Level Recommendations

- **Federal: Support federal policy initiatives**
- **Regional: Align regionally to promote biomass conversion**

Key Points from Biomass Committee

- Short and long term approaches may look quite different
- Success stories can drive change
- Layer existing programs (flood control, water quality, energy, economic development)

Contact Information

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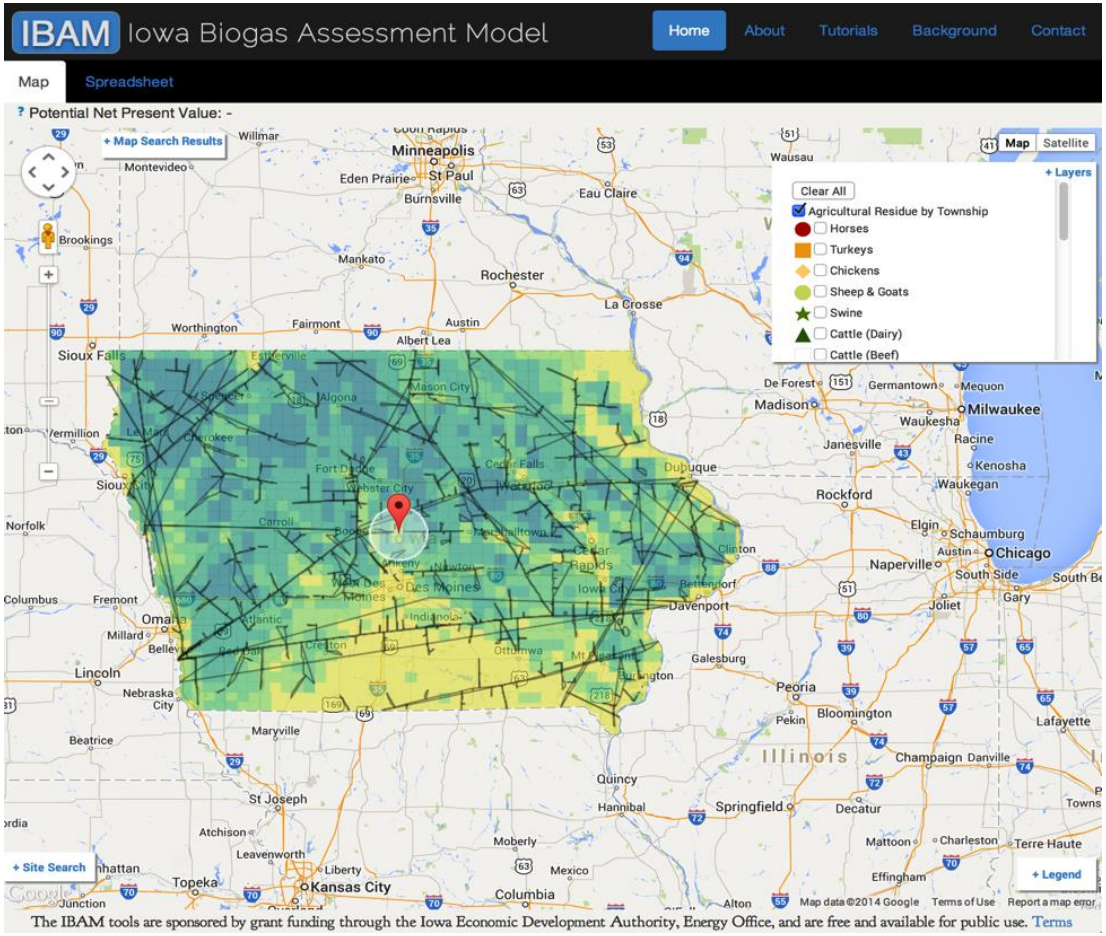
IOWA economic development

Iowa Biogas Assessment Model

A Life-Cycle Cost Assessment of Anaerobic Digesters

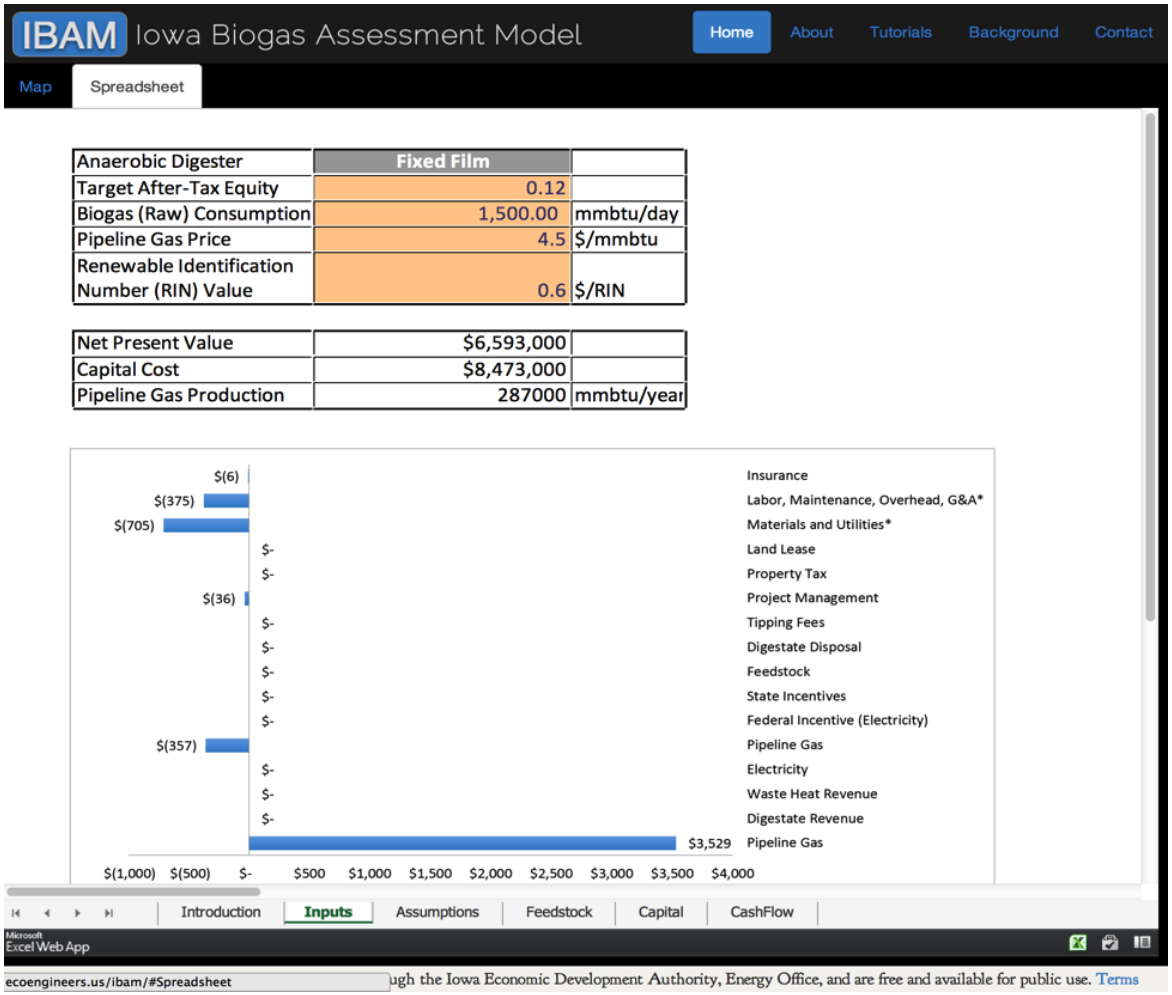
Mark Mba Wright
Mechanical Engineering
Iowa State University

Iowa Biogas Assessment Model



www.iowabiogasmodel.us

Iowa Biogas Assessment Model



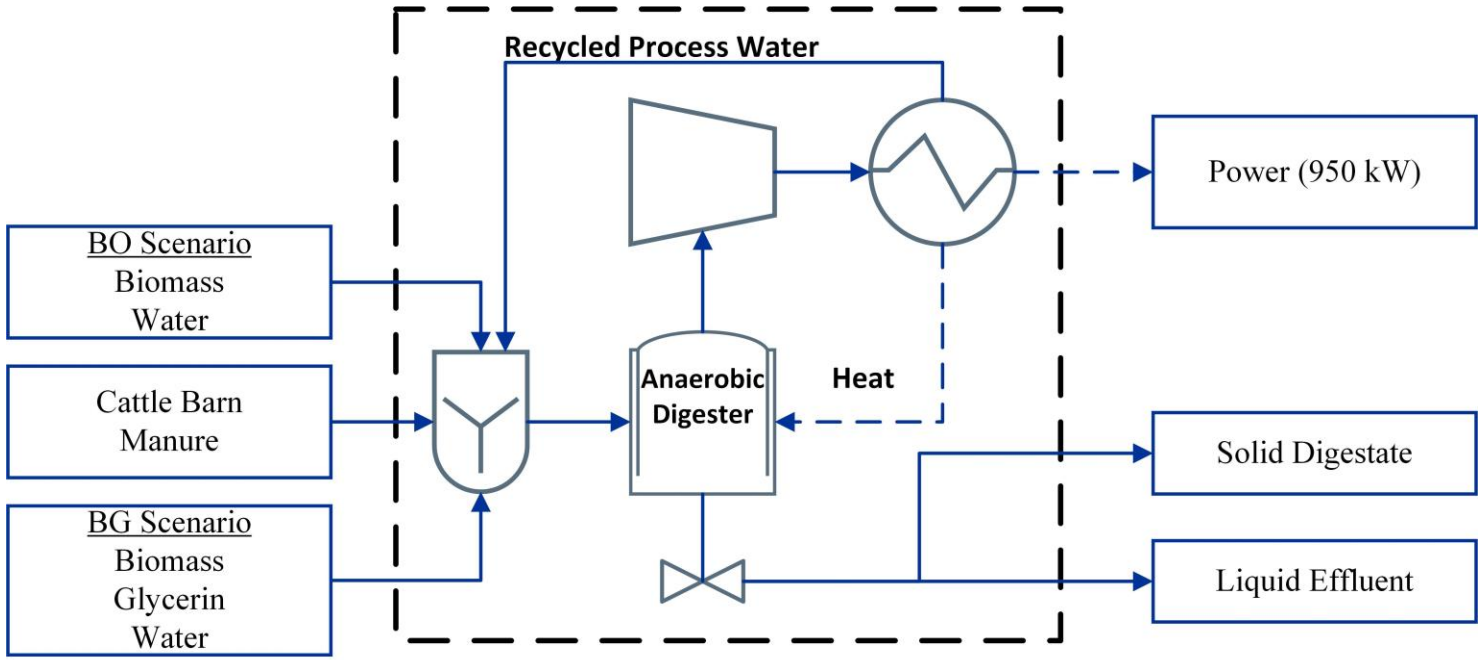
Motivation

To support and engage Iowa stakeholders in the development of biogas

Investors		Technology Leads		Policy Makers	
Project Suitability	Return on Investment	Energy Efficiency	Process Design	Investment	Incentives
Technology Development	Market Uncertainty	Environmental Impact	Infrastructure Requirement	Job Creation	Environmental Impact

Life-Cycle Cost Assessment

Anaerobic Digestion Process Design



Anaerobic Digestion Key Assumptions

- The model describes an on-farm digester
- Processes manure from 2400 head of cattle
  - Corn husk, rye, or wheat are mixed in at 5-26 wt.%
  - Glycerin is mixed in 10 wt.%
- The digester operates at mesophilic temperatures (20-40 °C)
- The gas turbine provides combined heat and power at 950 kWe capacity
- The solid and liquid digestate are recycled to offset nutrient costs

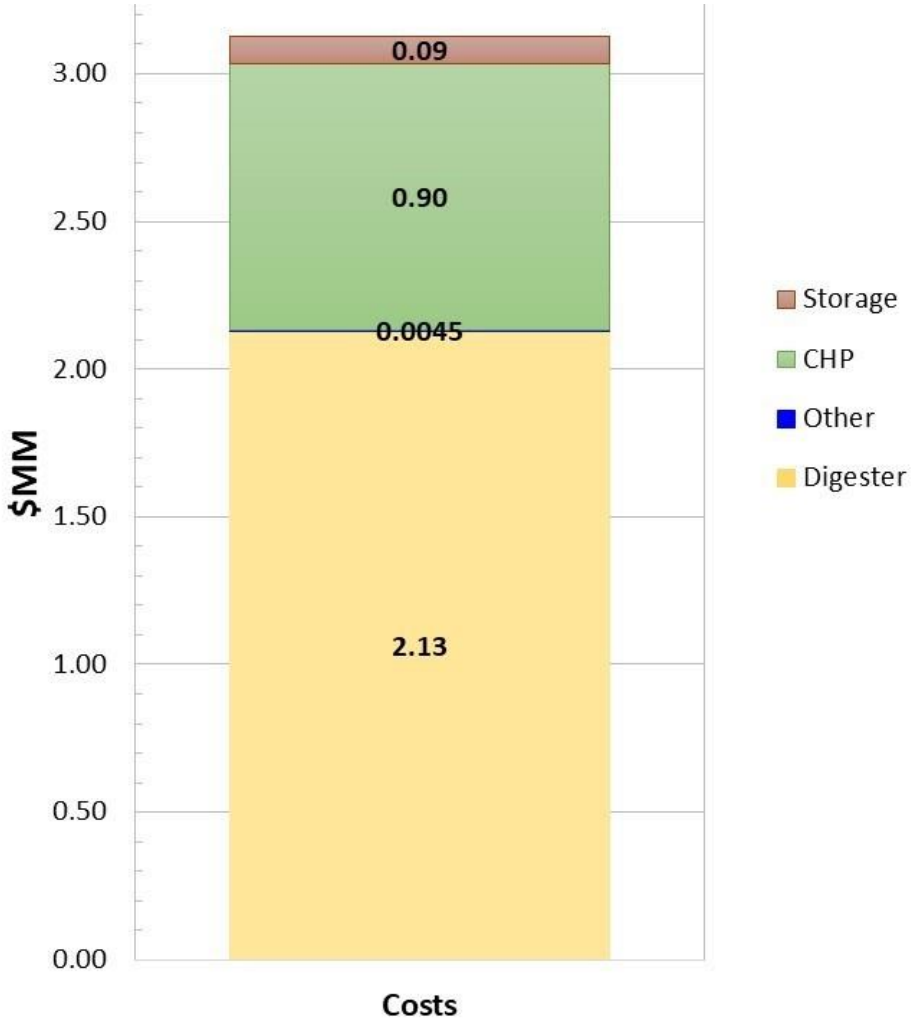
Anaerobic Digestion Feedstock

Feedstock	Moisture Content (%)	Volatile Solids (kg/kg)	HHV (MJ/ton)	Biogas Poten-tials (m^3/ton)	Methane Poten-tials (m^3/ton)	Carbon Content (%)
Manure	88	0.85	20000	333	200	0.39
Corn	60	0.94	18880	585	348	0.44
Rye	60	0.96	17020	387.5	232.5	0.49
Wheat	60	0.98	17678	405	243	0.43
Glycerin	-	1.00	16000	306	183.6	0.88

Capital Costs

Total Capital Costs are estimated at $3.12 million ($0.44/kWhe).

Costs are based on assessments by the National Renewable Energy Laboratory



Operating Costs

Parameter	Assumptions
Equity	40%
Plant Life	30 years
Construction Period	2.5 years
Depreciation Period	7 years, 200 DDB
Working Capital	15% of Fixed Capital Cost
Plant Salvage Value	0
Startup Time	0.5 years
Revenue & Cost during Startup (% of Normal)	Revenue: 50% Variable Cost: 75% Fixed cost: 100%
Interest Rate for Financing	7.5%/year
Income Tax Rate	39%
Electricity Price	$0.064/kWh

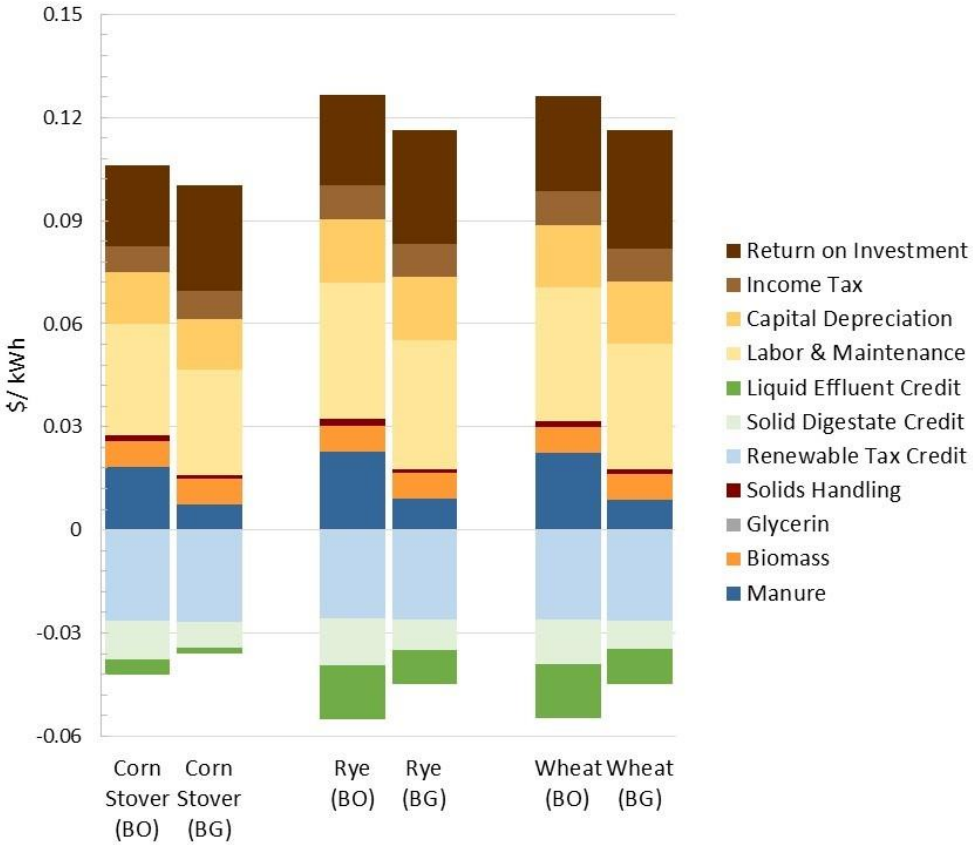
Operating Costs

Key Assumptions
Manure Cost: $5.0/tonne
Biomass Cost: $20/tonne
Glycerin Cost: $0/tonne

Solids Credit: $35.2/tonne
Liquids Credit: 2.64/tonne

Power Sale: $0.067/kWh
Renewable Tax Credit: $0.015/kWh

Internal rate of returns varied between 3.51% and 5.56%.

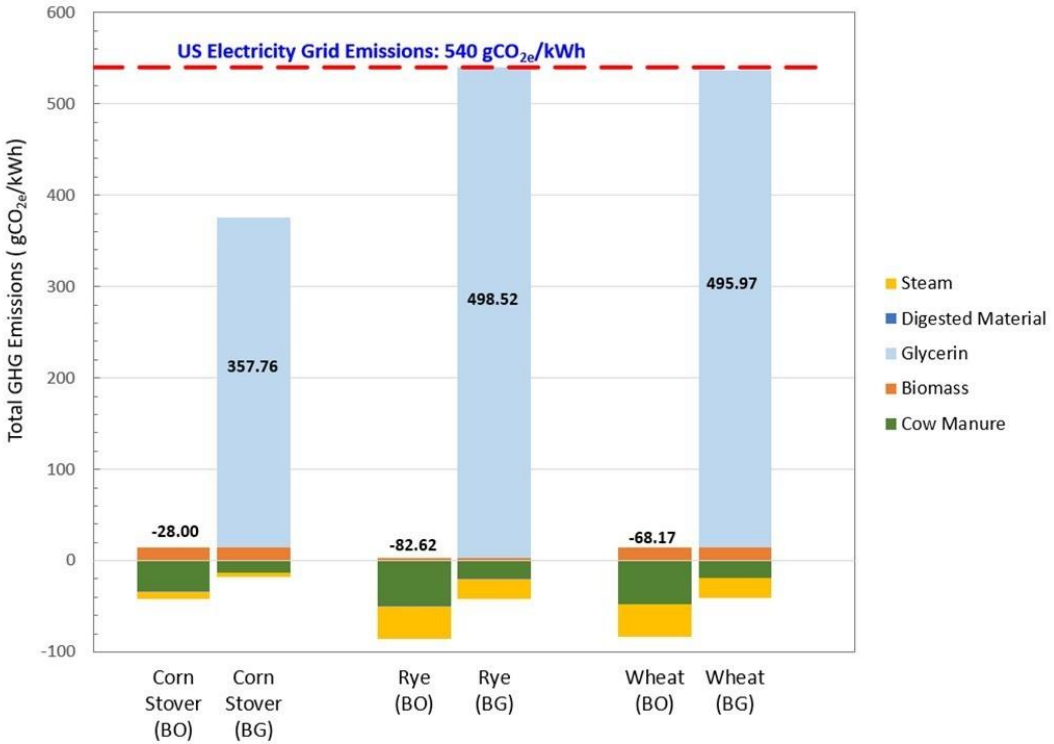


Lifecycle Analysis

Inputs	GHG emissions (kg CO_2e/ kg input)	Reference
Manure	-0.0741	Gao et al. (2014)
Corn	0.0377	SimaPro (2008)
Rye	0.00685	SimaPro (2008)
Wheat	0.0401	SimaPro (2008)
Glycerin	2.49	SimaPro (2008)

Lifecycle Analysis

Estimated emissions range between -82.6 and 498.5 g CO_{2e}/kWh.



Sensitivity Analysis

Variables	Pessimistic	Base	Optimistic
	Case	Case	Case
Power Efficiency (%)	33.4	42	50.4
Operating Capacity (%)	68	85	102
Capital Cost ($MM)	3.75	3.12	2.50
Waste per cattle (tons/day)	0.028	0.035	0.042
Manure Price ($/ton)	6	5	4
Solid Digestate Price ($/ton)	-28.20	-35.25	-42.30
Biomass Price ($/ton)	24	20	16
Glycerin Price ($/ton)	-10	0	10
Liquid Effluent Price ($/ton)	-2.11	-2.64	-3.17
Biomass Emission Factor(kg CO_2e/kg input)	*Varies by feedstock		
Glycerin Emission Factor(kg CO_2e/kg input)	1.992	2.49	2.988
Organic Matter Emission Factor (kg CO_2e/kg input)	-0.006	-0.0075	-0.009
Manure Emission Factor (kg CO_2e/kg input)	-0.059	-0.074	-0.089

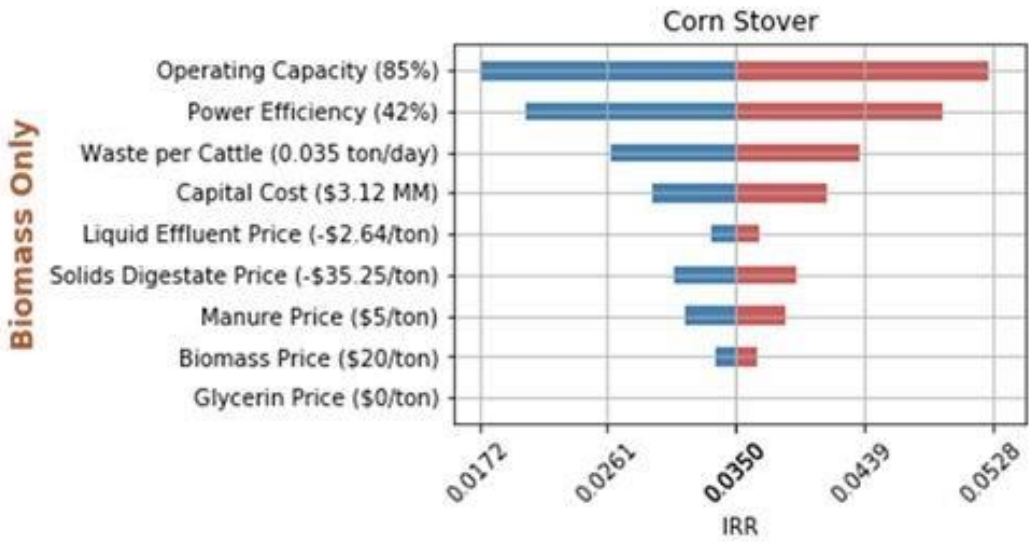
Sensitivity Analysis

Key economic factors:

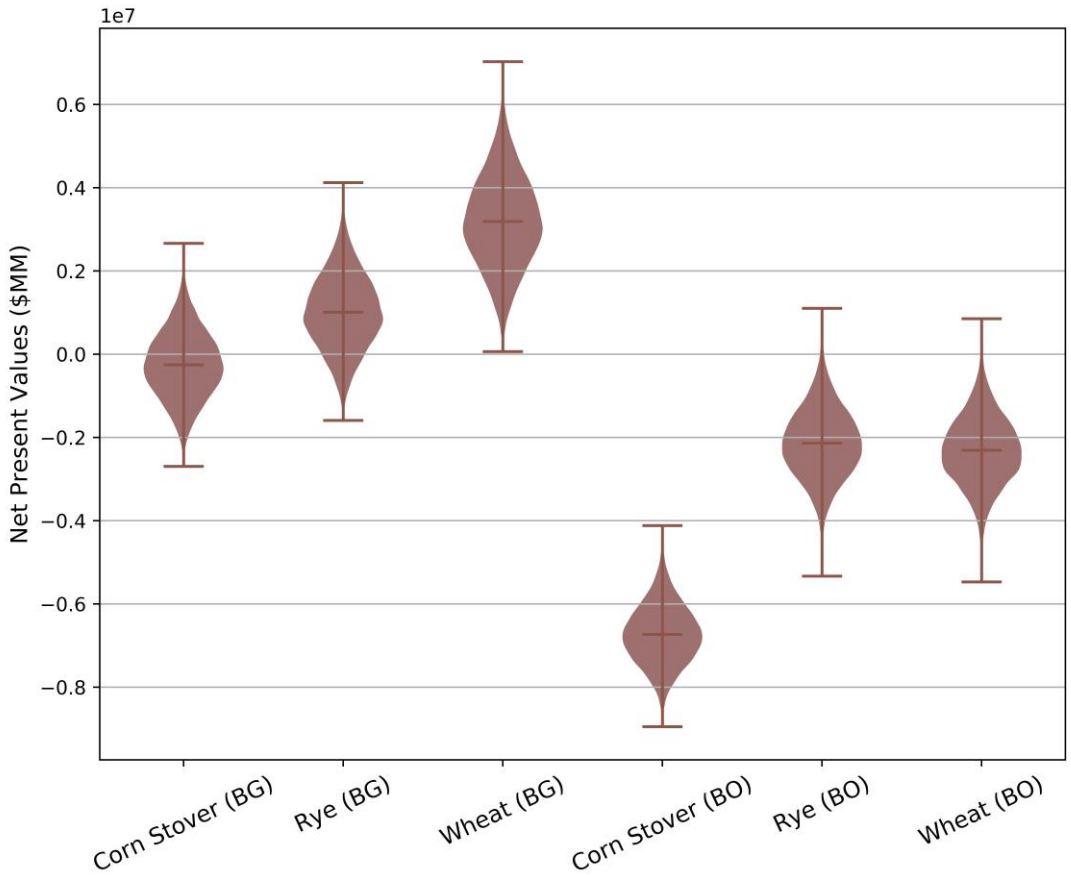
1. Operating Capacity
2. Power Efficiency
3. Waste per Cattle

Key environmental factors:

1. Power Efficiency
2. Glycerin Emission Factor
3. Waste per Cattle

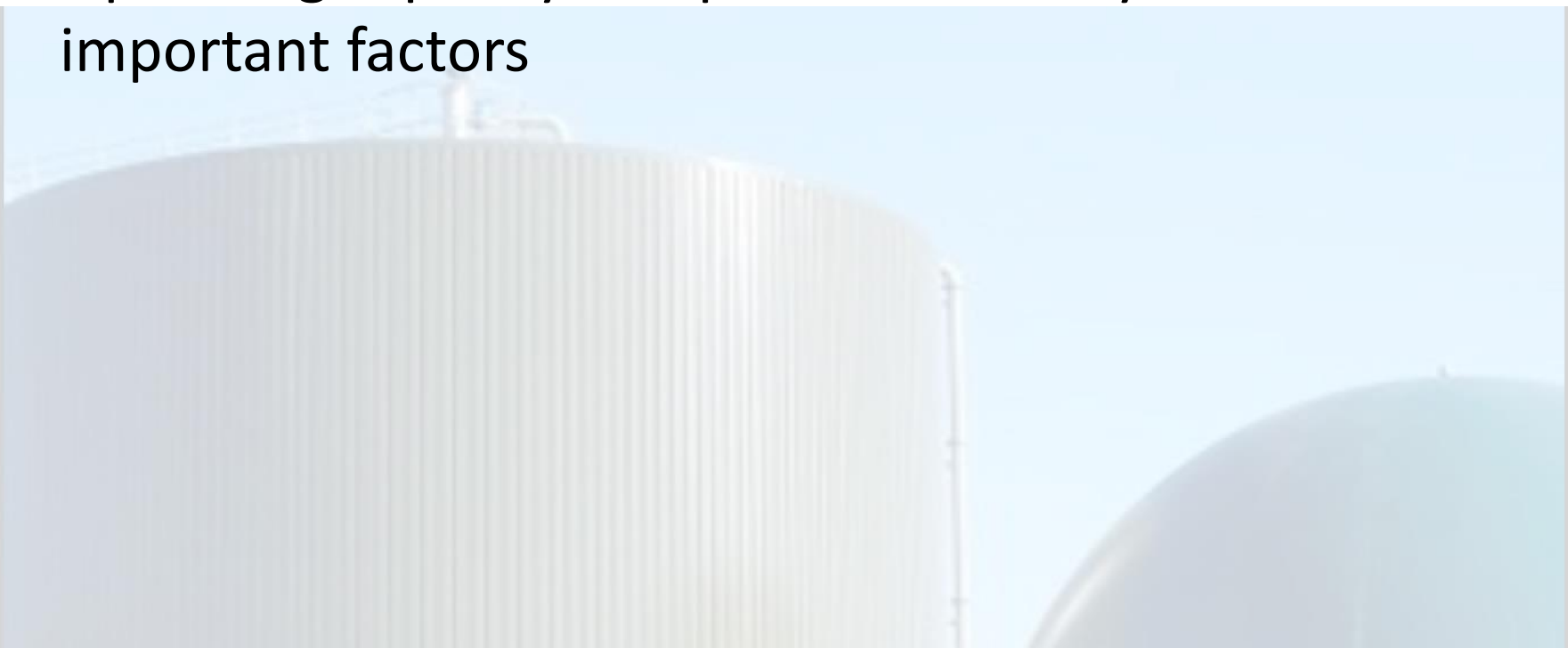


Uncertainty Analysis



Key Takeaways

- Iowa has various biomass resources that can be converted to biogas
- Anaerobic digestion can be profitable specially when co-located with a biomass resource
- Operating capacity and power efficiency are important factors



Acknowledgments

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- Bryan Sievers
- Shelly Peterson
- Iowa Economic Development Authority
- Bioeconomy Institute

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Report: http://www.iowabiogasmodel.us/Anaerobic_Digestion_LCA_Final_Report.pdf
Spreadsheet: http://www.iowabiogasmodel.us/IEDA_Anaerobic_Digestion.xlsm

Bryan Sievers
AgriReNew
And
Sievers Family Farms

CESA Webinar November 13, 2018

AgriReNew

Recycling Farm Nutrients and Agricultural Processing Waste for Energy Generation, Water Quality, and Soil Health

Primary Function of AgriReNew

- The primary function of AgriReNew, located near Stockton, Iowa, is to recycle farm nutrients, biomass, and other carbon-based substrates for energy generation and odor control. Specifically, the business recycles beef cattle manure, waste from agricultural and food processing, and biomass (crop residues) through anaerobic digesters. This process will produce renewable biogas, recapture nutrients used to grow the corn fed to the cattle, and produce positive environmental results.

- AgriReNew is a joint venture between Sievers Family Farms, LLC, Sievers Renewable Energy, LLC, and Davidson Renewable Energy, LLC. Sievers Family Farms and Sievers Renewable Energy are owned by Bryan and Lisa Sievers. Davidson Renewable Energy is owned by Dr. Bill Davidson III and his wife Judy.

- AgriReNew owns all structures needed for the processing enterprise. Structures include two anaerobic digesters, effluent storage structures, separated solids storage structures, biomass storage structures, separators, dosing units, pumps, etc. The facility is located between Stockton and New Liberty, which is in the northwest corner of Scott County, Iowa.

- Sievers Family Farms, LLC, established in February 2010 by Bryan and Lisa Sievers, owns the land where AgriReNew's complete-mix anaerobic digesters and facilities are located. Structures owned by Sievers Family Farms include two 1200 head cattle barns, commodity storage structures, and livestock nutrient handling equipment.

Sievers Family Farms Junior Executives

Your Iowa Waste Reduction Center Staff…

The anaerobic digestion of food waste has many benefits!

Climate Change Mitigation – Food waste in landfills generates methane, a potent greenhouse gas. Diverting food waste from landfills to anaerobic digesters and wastewater treatment facilities allows for the capture of the methane, which can be used as an energy source. In addition to decreased methane emissions at landfills, there are greenhouse gas emissions reductions due to the energy offsets provided by using an on-site, renewable source of energy.

Why Food Waste?

Food waste is the second largest category of municipal solid waste (MSW) sent to landfills in the United States, accounting for approximately 18% of the waste stream. Over 30 million tons of food waste are sent to landfills each year. Of the less than 3% of food waste currently being diverted from landfills, most of it is being composted to produce a fertilizer.

Manure Varies from Site to Site

Off-Farm High Solids Feedstocks

Soy-oil Waste, Glycerin , Animal Processing Waste

Biomass from Cover Crops

Double crop soybeans following cover crop harvest as biomass for digesters

AgriReNew
Current Level of Energy Production

Production	2016	2017	% Change
MMBTU (CH4)	58,909.80	97,517.69	65.54%
Electricity (kWh)	5,707,087	6,742,081	18.14%

MooPost™

AgriReNew
Current Level of Fertilizer Production

Fertilizer product	2016	2017	% Change
Digestate (gallons)	15,035,988	20,585,455	36.9%
Liquid Effluent (gallons)	12,329,510	16,880,073	36.9%
Bio fibers (pounds)	22,586,921	25,902,915	14.68%

AgriReNew

&

Sievers Family Farms

An innovative way to capture the beneficial aspects of renewable energy generation from biomass conversion, beef cattle production, and agricultural processing waste.

Thank you for attending our webinar

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CESA Project Director
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Renewable Thermal in RPSs: Examples from New Hampshire, Oregon, and Vermont
Thursday, November 29, 1-2pm ET

Americans' Changing Views of Renewable Energy Policies
Tuesday, December 4, 1-2pm ET

The Real Estate Industry and Selling Homes with Solar
Tuesday, December 11, 1-2pm ET

Read more and register at: www.cesa.org/webinars