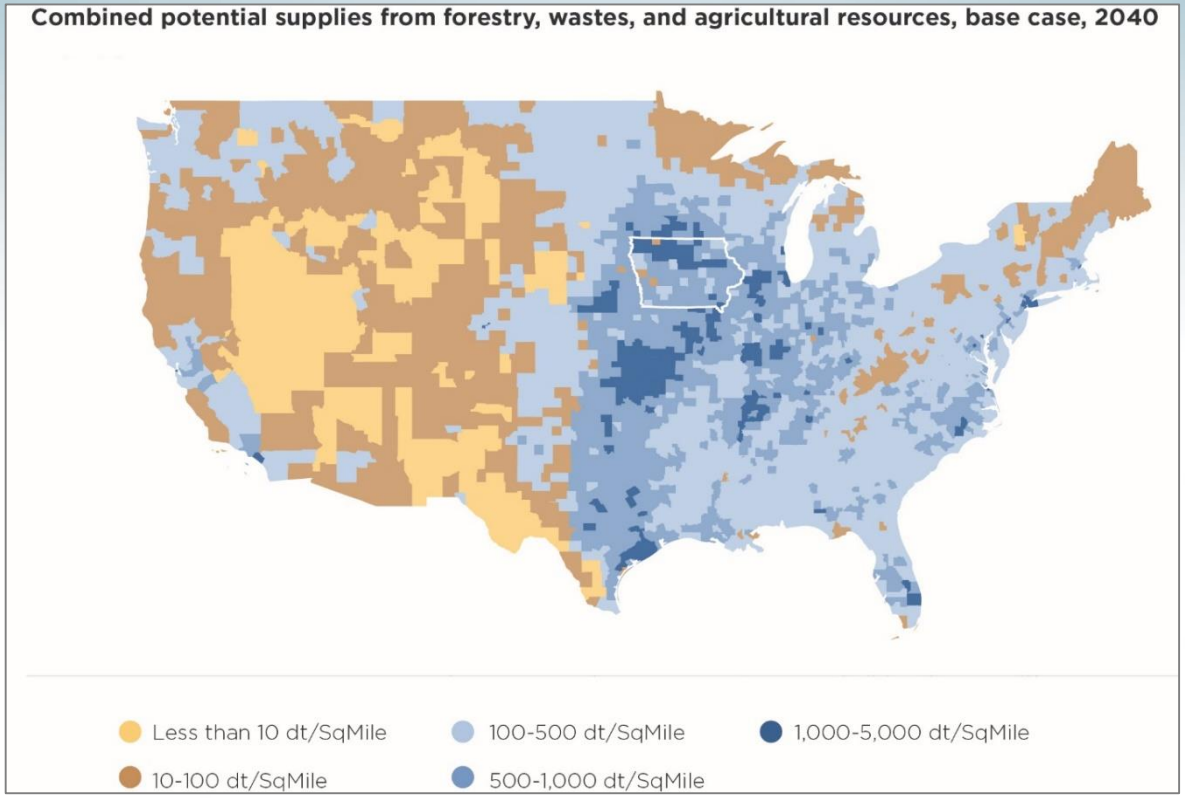
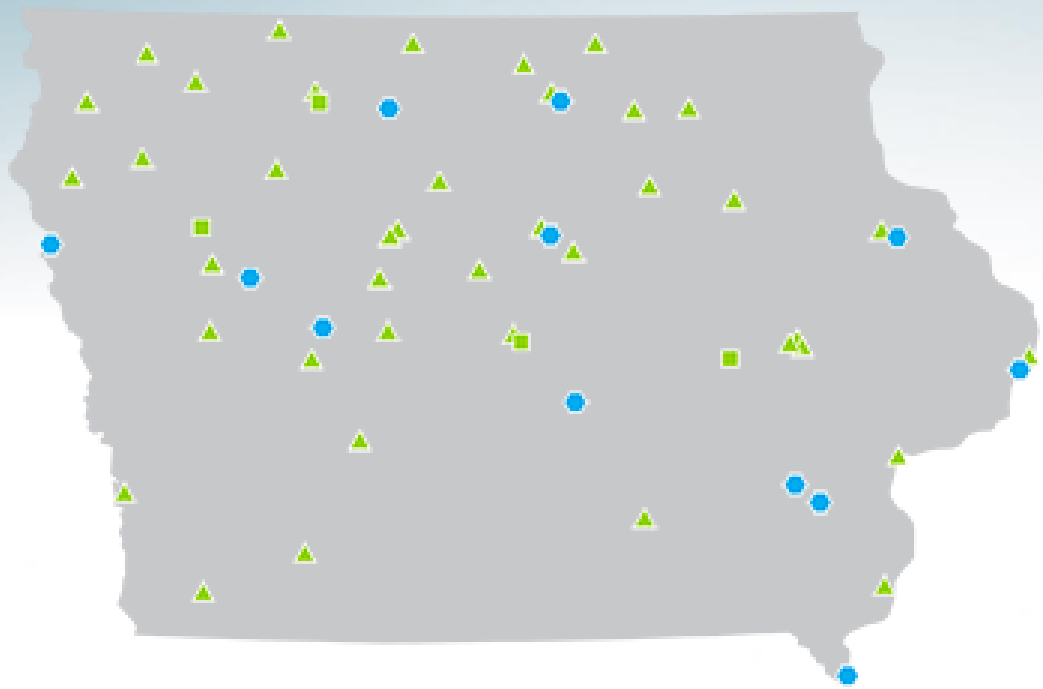
Iowa's Biomass Potential



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

Biomass Success: Ethanol and Biodiesel



Jobs

- Ethanol supports **12,512 jobs** in the state of Iowa
- Biodiesel supports 3,059 jobs in the state of Iowa

Ethanol

- Leads the nation- **27% of total U.S. production**
- 42 facilities
- 4 next-generation cellulosic facilities

Biodiesel

- Leads the **nation- 16% of total U.S. production**
- 11 refineries

Biomass Success: Other

~3 on-farm digesters producing electricity from biogas

~10 wastewater treatment plants with CHP

~3 landfills with CHP from methane

Biomass (energy crops, oat hulls) as coal substitute at University power plant (CHP)

Miscanthus grass

Oat hulls

Biomass Stakeholder: Food Processing Industry

- 36 of the largest 100 food manufacturers and processors
- #1 in nation in corn, soybean, pork and egg production
- 21% of Iowa's manufacturing GDP in food processing
- $997M in capital investment (2013)
- 900 processors produce $35B in food products annually

Biomass Stakeholder: Livestock Industry

- $38B animal agriculture output
  - Hog industry alone $26.7B
  - 21M hogs
  - 3.9M head of cattle
- $1.2B in state and local taxes
- 160,000 jobs

Biomass Stakeholder: Iowa Agriculture Water Alliance

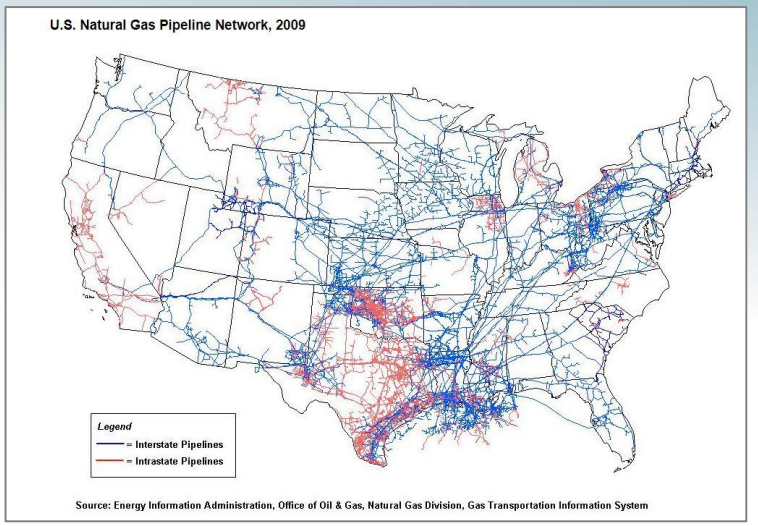
- Mission
  - Increase the pace and scale of farmer-led efforts to improve water quality

- Founding organizations
  - Iowa Corn Growers Association
  - Iowa Pork Producers Association
  - Iowa Soybean Association



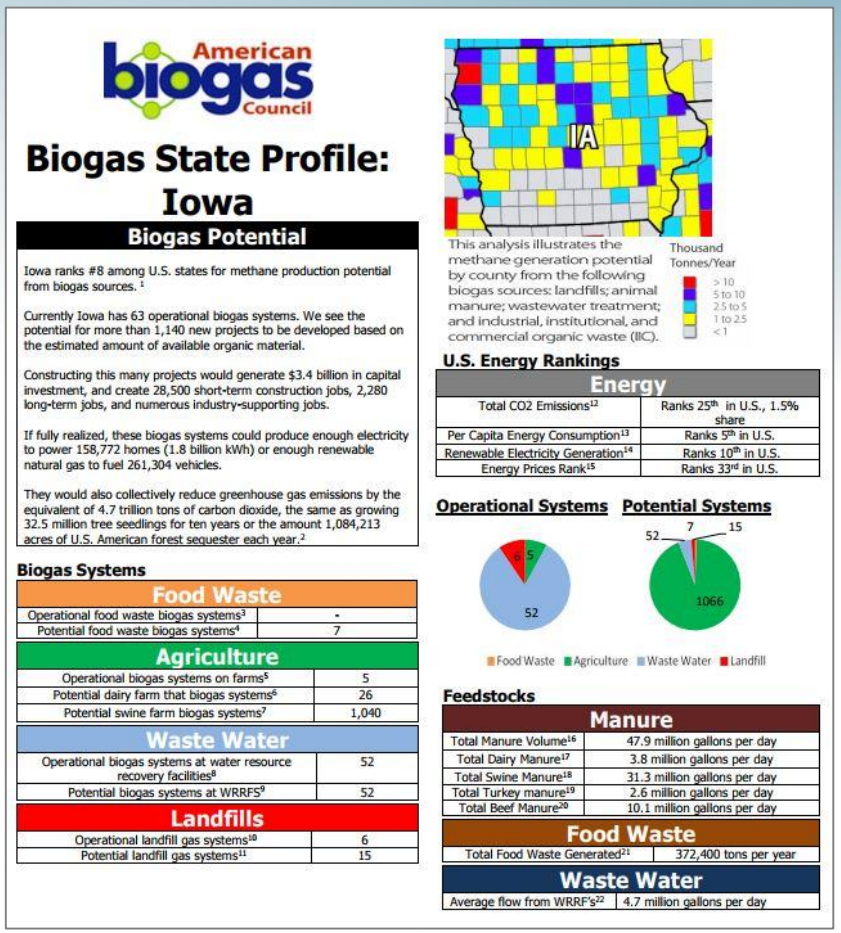
Biogas Potential: Infrastructure

- 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
- RNG for transportation fuel expected to triple between 2015-2018



Biogas Potential: ABC data

- 8th for methane potential
- 1,140 potential projects
- Power for 158,000 homes
- 2,280 jobs
- $3.4B investment



American biogas Council

Biogas State Profile: Iowa

Biogas Potential

Iowa ranks #8 among U.S. states for methane production potential from biogas sources. [1]

Currently Iowa has 63 operational biogas systems. We see the potential for more than 1,140 new projects to be developed based on the estimated amount of available organic material.

Constructing this many projects would generate $3.4 billion in capital investment, and create 28,500 short-term construction jobs, 2,280 long-term jobs, and numerous industry-supporting jobs.

If fully realized, these biogas systems could produce enough electricity to power 158,772 homes (1.8 billion kWh) or enough renewable natural gas to fuel 261,304 vehicles.

They would also collectively reduce greenhouse gas emissions by the equivalent of 4.7 trillion tons of carbon dioxide, the same as growing 32.5 million tree seedlings for ten years or the amount 1,084,213 acres of U.S. American forest sequester each year.[2]

Biogas Systems

Food Waste	
Operational food waste biogas systems[3]	-
Potential food waste biogas systems[4]	7

Agriculture	
Operational biogas systems on farms[5]	5
Potential dairy farm that biogas systems[6]	26
Potential swine farm biogas systems[7]	1,040

Waste Water	
Operational biogas systems at water resource recovery facilities[8]	52
Potential biogas systems at WRRFS[9]	52

Landfills	
Operational landfill gas systems[10]	6
Potential landfill gas systems[11]	15

This analysis illustrates the methane generation potential by county from the following biogas sources: landfills; animal manure; wastewater treatment; and industrial, institutional, and commercial organic waste (IIC).

Thousand Tonnes/Year
> 10
5 to 10
2.5 to 5
1 to 2.5
< 1

U.S. Energy Rankings

Energy	
Total CO2 Emissions[12]	Ranks 25th in U.S., 1.5% share
Per Capita Energy Consumption[13]	Ranks 5th in U.S.
Renewable Electricity Generation[14]	Ranks 10th in U.S.
Energy Prices Rank[15]	Ranks 33rd in U.S.

Operational Systems **Potential Systems**

Feedstocks

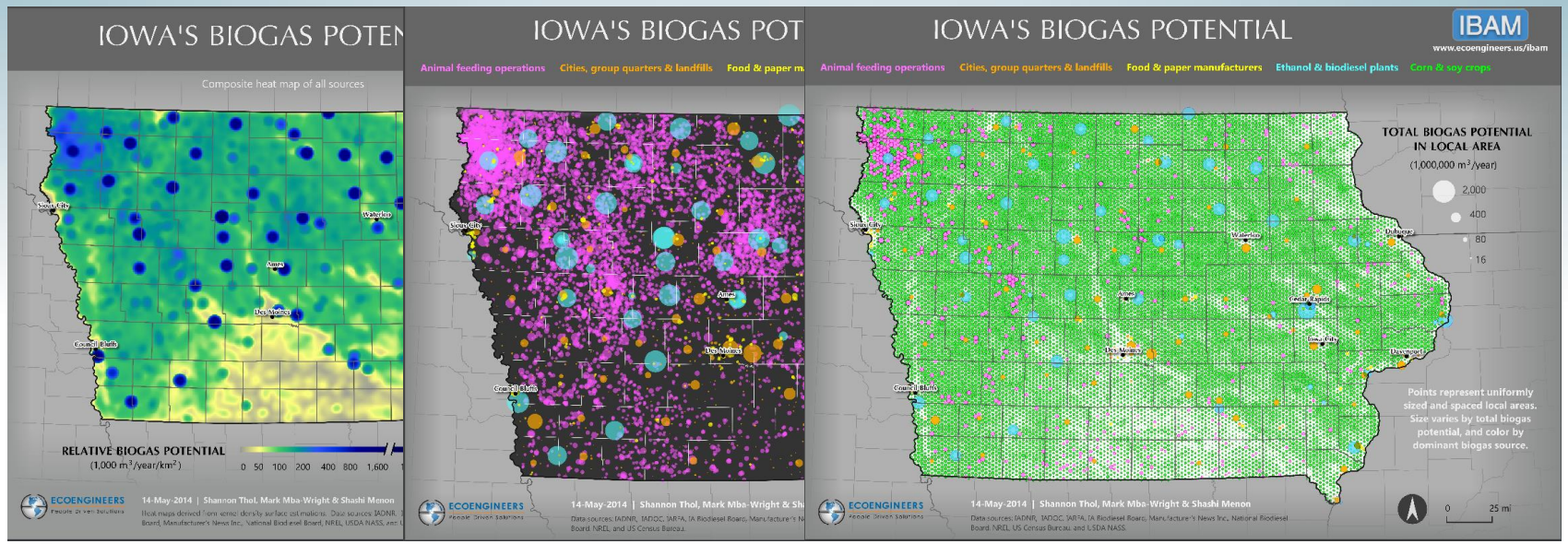
Manure	
Total Manure Volume[16]	47.9 million gallons per day
Total Dairy Manure[17]	3.8 million gallons per day
Total Swine Manure[18]	31.3 million gallons per day
Total Turkey manure[19]	2.6 million gallons per day
Total Beef Manure[20]	10.1 million gallons per day

Food Waste	
Total Food Waste Generated[21]	372,400 tons per year

Waste Water	
Average flow from WRRF's[22]	4.7 million gallons per day

https://www.americanbiogascouncil.org/stateprofiles.asp

Related Effort: Iowa Biogas Asset Mapping (IBAM)



- Designed to give a general analysis
- Provides a view of raw materials and economic potential of biogas
- Combines mapping data with an economic spreadsheet that makes it easy to identify facility location and obtain first approximation of the cost of a facility

Related Effort: Biogas Study

Related Effort: Biogas Study (cont.)

$8 million

Investment of $8 million to construct an anaerobic treatment facility and gas upgrading could result in

97 jobs

Created during the construction phase and 7 jobs created from the project operations / 2 jobs dedicated to Miscanthus cultivation

$1.6 million

Increase in tax receipts over project life

211 million

BTUs per day per site (1850 GGEs)

$1.9 million

Gross annual revenue

$69.5 million

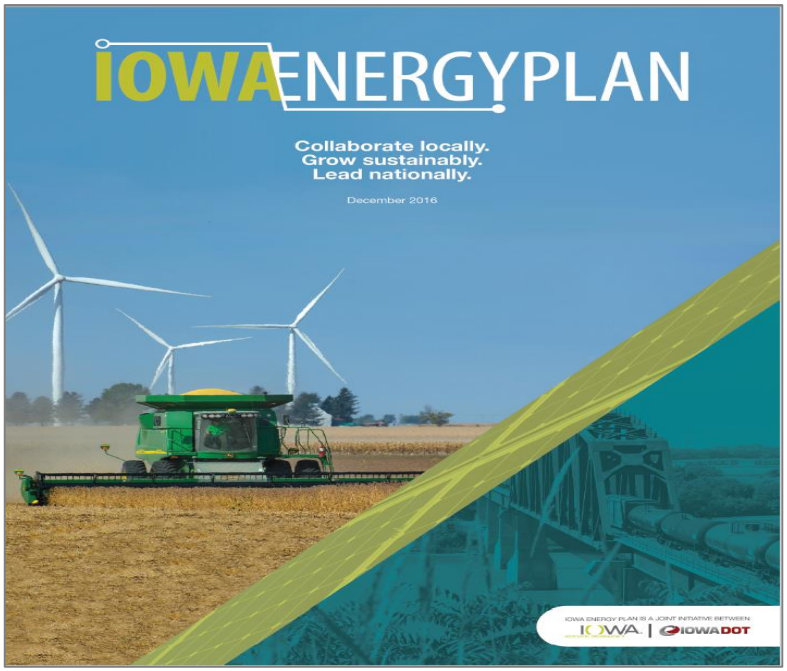
Total economic output over 20 -year project life

$528,000

Will annually flow through to Miscanthus suppliers.

Iowa Energy Plan

Developed by Governor Reynolds (then Lt. Governor), Iowa Partnership for Economic Progress (IPEP), Iowa Economic Development Authority (IEDA)and Iowa Department of Transportation (DOT)



Iowa Energy Plan: Focus Areas

In total; 45 strategies make up the Energy Plan.

Further, **key themes were identified:**

Economic Development and Energy Careers	Iowa's Energy Resources	Transportation and Infrastructure	Energy Efficiency and Conservation
✓ Energy workforce development	✓ Biomass conversion potential	✓ Natural gas expansion	✓ Access to energy efficiency in underserved areas
✓ Technology-based R & D (e.g. energy storage pilot projects)		✓ Grid modernization vision	
		✓ Alternative fuel vehicles	

Iowa Energy Plan: Biomass Action

- Productive agricultural state; **Iowa has great potential to further benefit economically & environmentally** through the conversion of biomass (bioenergy, biofuels, biochemical, etc.)

- Per the Energy Plan; **IEDA was to lead the establishment** of a Biomass Conversion Committee.

  - **Bring together a diverse mix of experts to identify action items** needed to further realize value-added attributes of biomass conversion.

Biomass Conversion Committee: Members

State agencies

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

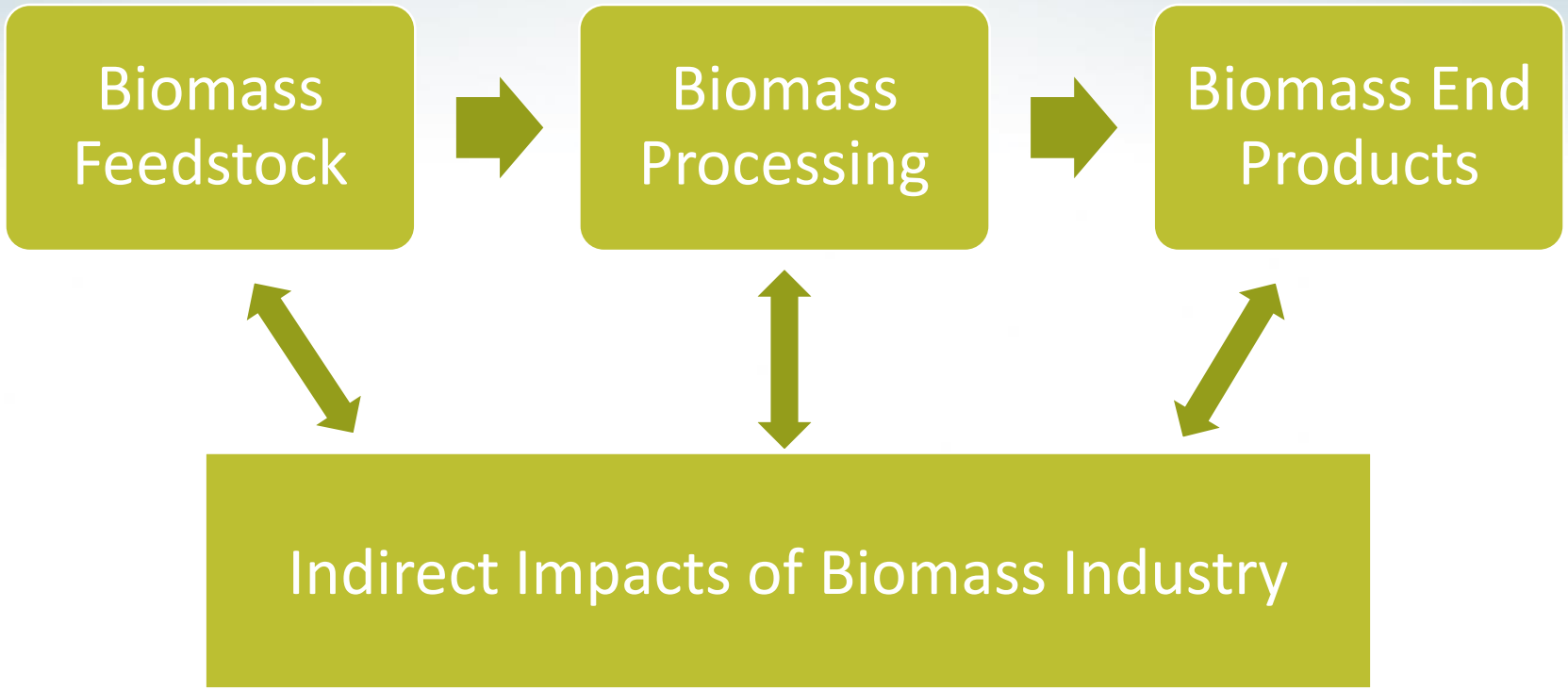
Other

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

Biomass Conversion Committee: Role

- **Accelerate deployment of biomass conversion in Iowa by:**
  - Coordinating existing biomass-to-energy efforts
  - Aligning financial support mechanisms
  - Developing solutions to remove barriers
  - Expanding overall use of biomass resources to produce energy
- **Complete Action Plan by end of 2017**

Biomass Conversion: Action Areas



Biomass Considerations: Feedstocks

- **Crops (row/cover/energy)**
  - Plant, harvest, store, transport
- **Manure**
  - Collect, store, transport
- **Industrial**
  - Locate organics, confidentiality/QA concerns, variability
- **Municipal (solid waste, sewage)**
  - Collect, store, transport

Biomass Considerations: Processing

- **Design (Anaerobic digestion, gasification, pyrolysis)**
  - Qualified designers, system standards
- **Permitting**
  - Streamlined state and local requirements
- **Operation**
  - Qualified operators
- **Financing**
  - Availability of tax credits and loans, public vs. private ownership

Biomass Considerations: End Products

- **Energy (Electricity, pipeline, vehicle fuel)**
  - Integrate into supply chain
- **Co-products (Fertilizer, biochar)**
  - Market development
- **Biochemicals**
  - Market development

Biomass Considerations: Indirect

- **Water quality**
  - Correlate improvements to projects, monetize benefits
- **Air quality**
  - Correlate improvements to projects, monetize benefits (RINS)
- **Economic development**
  - Project direct and indirect benefits, connect stakeholders

Biomass Feedstock Considerations

Biomass Feedstock Considerations				
Action area/comments	Crops (row, energy, cover)	Manure	Industrial	Municipal
Current Status	# acres of energy crops # acres prairie	# large animal operations 3 on farm digesters		# of POTW with digesters
Key Stakeholders	ISU Agronomy and Extension, Tallgrass Prairie Center	DNR, Pork Producers	Iowa Waste Exchange	DNR, IAMU
Unmet Needs	Equipment to plant/harvest Storage facilities			$2.5B infrastructure upgrade statewide
Action Items	To be determined	To be determined	To be determined	To be determined

Initiatives in Other States

- Minnesota: MN signed an MOU with Sweden (2013) to collaborate on biogas development - Swedish suppliers trying to expand market in U.S. help promote projects; St. Paul district energy system accepts wood/tree waste. Proposal to establish Renewable Thermal Incentive Fund to diversify heating fuel supply and increase energy security and accessibility.
- Connecticut: Ban commercial food waste from landfill (2011) if more than 104 tons/yr or 2 tons/week, and within 20 miles of a permitted recycling facility. First plant online in November 2016 (also, NY, TX, VT, MA).

Initiatives in Other States

- North Carolina: Carve out for biogas in Renewable Portfolio Standard requires IOUs to generate 0.07% of energy from swine waste, ramping up 0.2% in 2021; legislation guarantees a market for electricity from farm digesters.
- Wisconsin: American Biogas Council operator training; phosphorous water quality trading to meet NPDES permit limits; $20M Integrated Anaerobic Digester System Program RFP for demonstration ag/energy project(s).
- Missouri: Third Party Ownership model: Smithfield hog waste digester project driven by Roeslein Energy and their environmental goals. Emphasis on water quality/flood control through native prairie energy crops.

Initiatives in Other States

- Arizona: Private/Public partnership – Ameresco to build, own and operate biogas at City of Phoenix WWTP.
- Vermont: Green Mountain Power “Cow Power” program, $.04/kWh environmental benefits voluntary customer service rider.
- California: Low Carbon Fuel Standard (LCFS) adopted by Air Resources Board (2009); CPUC set-aside 20% of R&D budget to fund bioenergy projects (2012); 2012 Bioenergy Action Plan.

Initiatives in Other States

- Sacramento Municipal Utility District (SMUD): Municipal Utility invests in dairy farm digesters as renewable energy source.
- New York: State agencies to reduce methane emissions by 40%. Plans with bioenergy aspects include NYSERDA coaching projects that develop on-farm digesters.

Federal Initiative: Agricultural Environmental Stewardship Act of 2017

Amend Internal Revenue Code to allow energy tax credits through 2021 for investments in: (1) qualified biogas property, or (2) qualified manure resource recovery property

S 998 (Senate version)

- Introduced April 27, 2017 by Senator Brown (OH)

HR 2853 (House version)

- Introduced June 8, 2017 by Congressman Kind (WI)

Agriculture Environmental Stewardship Act of 2017
https://www.congress.gov/bill/115th-congress/senate-bill/988
https://www.congress.gov/bill/115th-congress/house-bill/2853

Recent legislative efforts

Iowa Senate Study Bill 1065

Provide credit for both thermal and electrical energy from a CHP system (including biomass powered)

Failed to make it out of committee in 2017 session

Iowa Senate Study Bill 1034

Provide Water Quality Infrastructure Fund

Governor's bill to allocate $229 Million

Failed to make it out of committee in 2017 session

Key Points from Biomass Committee

- Short term and Long term approaches may look quite different
- Success stories can drive change
- Layer existing programs (flood control, water quality, energy, economic development)
- Developing middleman in supply chain is critical
- Need a set of measures to account for ecosystem services in the business model

Biomass Actions to Date

Action Plan

Biomass Conversion Action Plan completed end of year

DNR Waste Conversion Rules

Biomass committee provided comments on draft rules that include bioenergy

Regional Discussions

MGA and others on regional efforts

Promote pilot projects and R&D

Collaborate with universities and developers

Midwest Food Recovery Summit

UNI Iowa Waste Reduction Center/BioCycle/EPA

September 6-8, Des Moines

- https://iwrc.uni.edu/foodrecoverysummit
- Track on anaerobic digesters, to include discussion on Biomass Conversion Action Plan

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