

# Anaerobic Digestion & The **Water** **Energy** Nexus 2016





Audits of  
**Over 150**  
Biofuel Plants  
in **20 Countries**



Over  
**1.7 Billion**  
Gallons of Biofuel Capacity  
Under Management



Over **50**  
**Producers**  
have enrolled in the  
**RIN Compliance**  
Program

## Why EcoEngineers?

Assisted  
Registration  
& Preparation  
for more than  
**60 LCFS**  
Pathway Projects

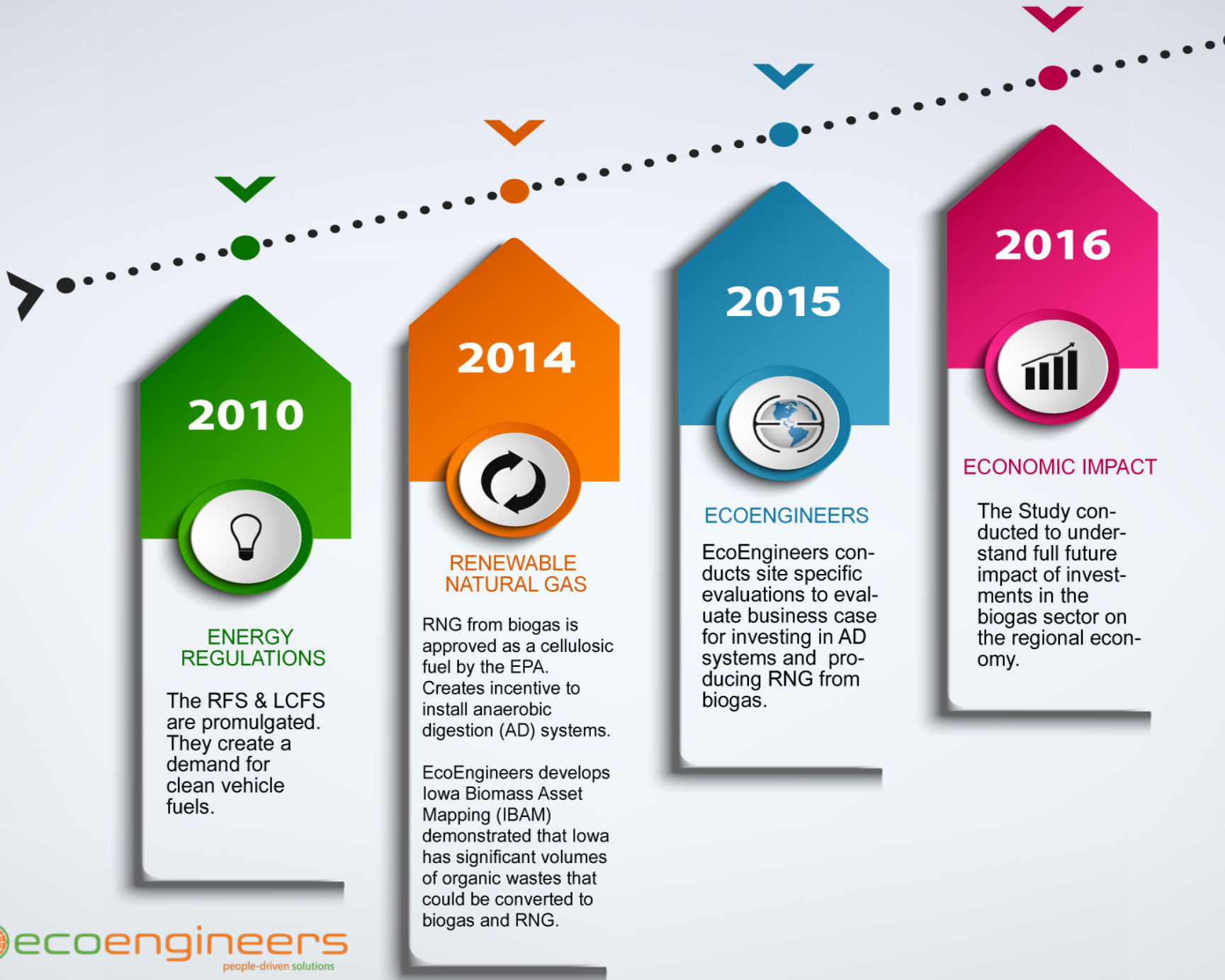
Transacted over  
**3.6 Billion**  
RINs in 2016



**9.9 Million RINs**  
Processed each day  
on our automated platform

One of the **FIRST**  
**USEPA** Recognized  
RIN Quality Assurance  
Programs





**2010**



**ENERGY REGULATIONS**

The RFS & LCFS are promulgated. They create a demand for clean vehicle fuels.

**2014**



**RENEWABLE NATURAL GAS**

RNG from biogas is approved as a cellulosic fuel by the EPA. Creates incentive to install anaerobic digestion (AD) systems.

EcoEngineers develops Iowa Biomass Asset Mapping (IBAM) demonstrated that Iowa has significant volumes of organic wastes that could be converted to biogas and RNG.

**2015**



**ECOENGINEERS**

EcoEngineers conducts site specific evaluations to evaluate business case for investing in AD systems and producing RNG from biogas.

**2016**



**ECONOMIC IMPACT**

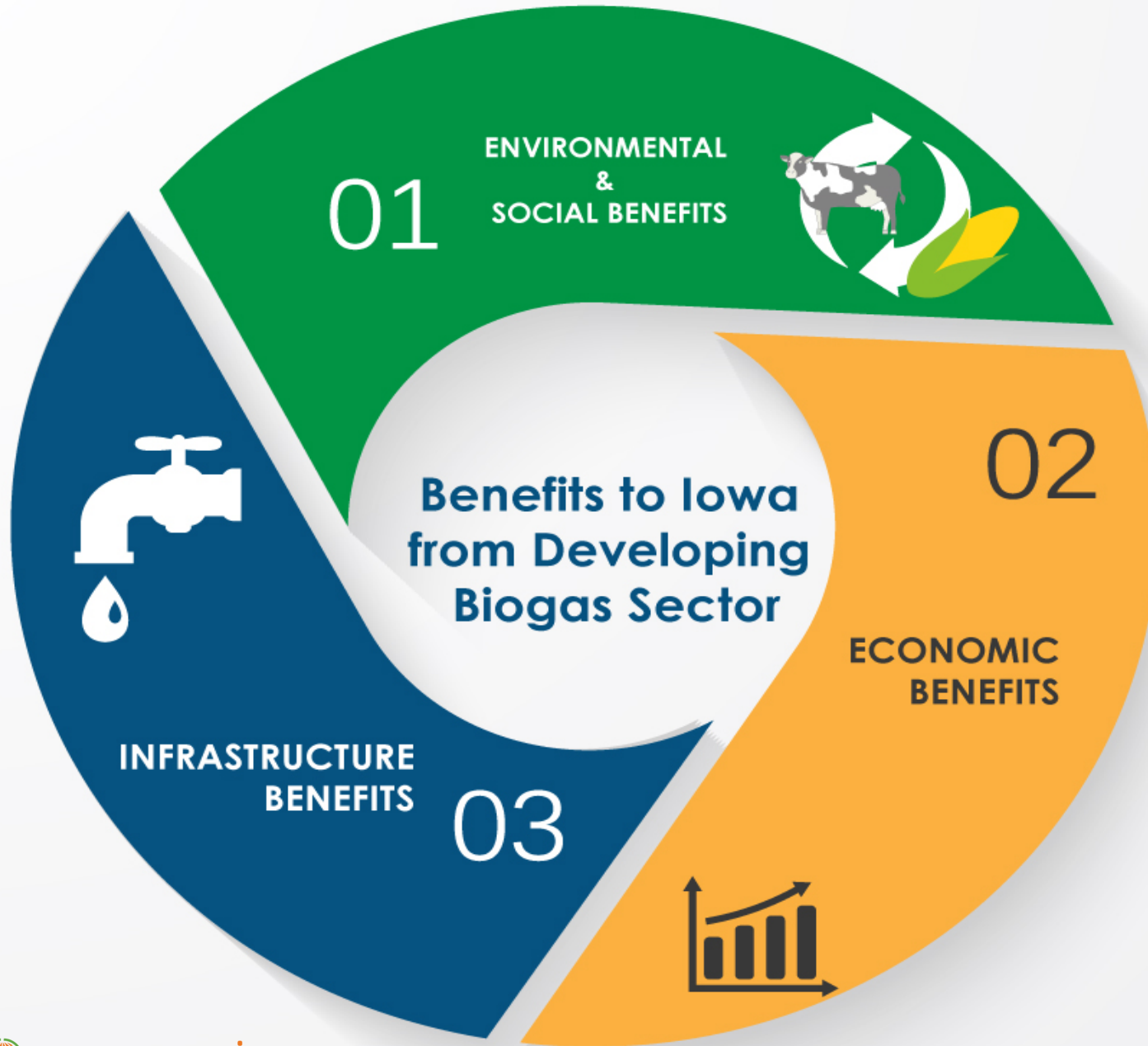
The Study conducted to understand full future impact of investments in the biogas sector on the regional economy.

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# Purpose

1. Evaluate the potential economic impacts of installing anaerobic digester (AD) systems and producing pipeline quality renewable natural gas (RNG) from biogas
2. Quantify the environmental impacts resulting from AD systems
3. Identify the resources and reasons for Iowa to invest in AD systems and produce biogas

# Potential Benefits to Iowa of Developing a Biogas Sector



## 01 Environmental and social benefits:

- Improved soil and water quality from planting perennials and cover crops
- RNG substituted for diesel decreases air pollutants
- Reduced odor and watershed pathogen /nutrient levels from manure digestion
- Recreational use of the watersheds and increase in property values

## 02 Economic benefits:

- Job creation and money circulation from Infrastructure investments
- Local production of renewable fuel and fertilizer
- Market for energy crops such as perennial grasses or cover crops - Increased revenues to farmers
- Industrial expansion from lower wastewater treatment costs

## 03 Infrastructure benefits:

- Robust regional wastewater treatment systems for area industries and communities
- Distributed energy production & delivery – part of emergency planning
- Potential to create superior network of gas pipelines in underserved areas

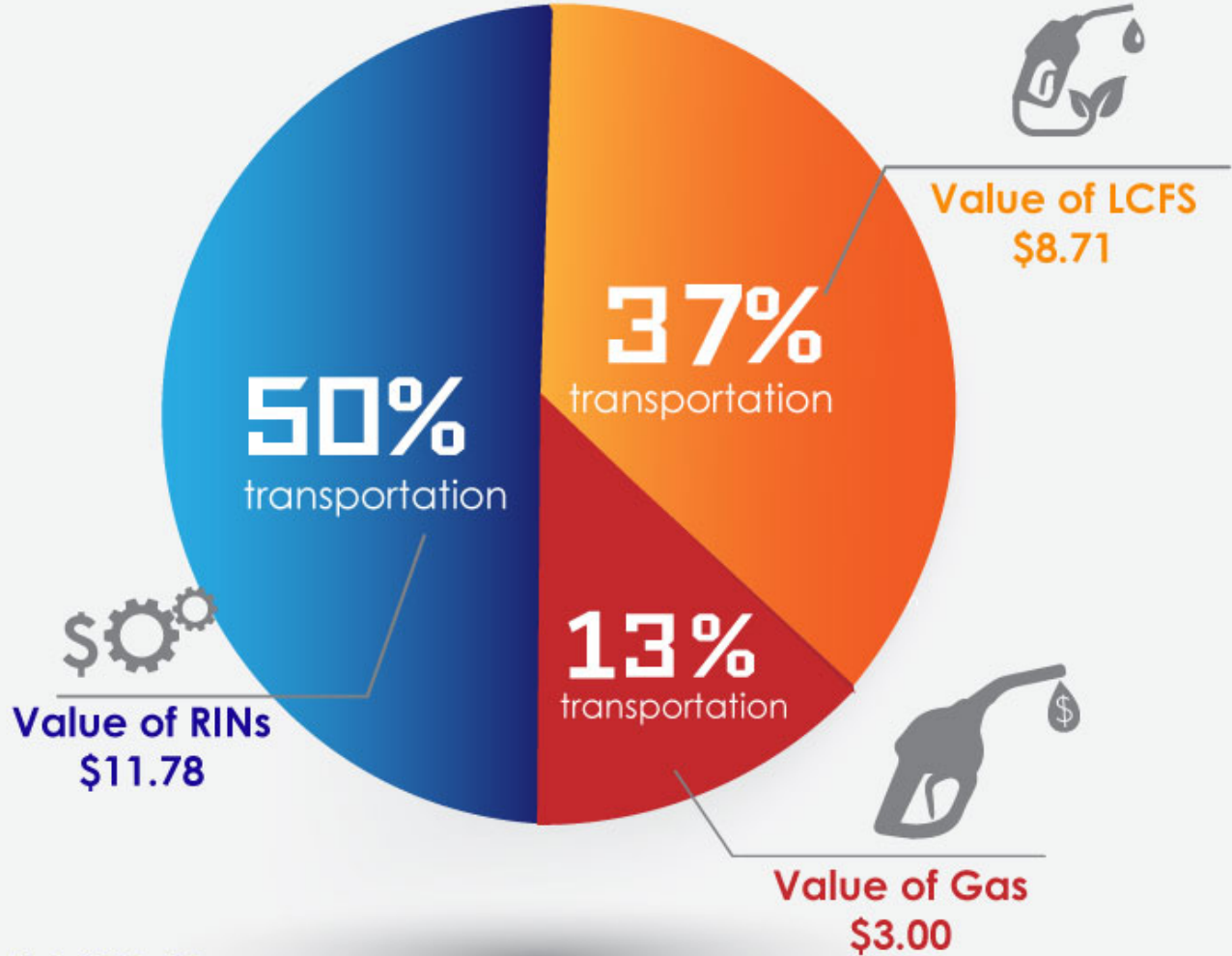


# Anaerobic Digestion & Wastewater Treatment is at the Center of Water-Energy Nexus



- AD systems are robust municipal wastewater treatment facilities and can accept separated organics
- AD systems can process high strength waste streams from regional industry
- AD systems can create a market for energy crops grown on marginal lands and/or cover crops
- AD systems can offer a superior manure management system for CAFO's

# Energy Regulations Are Driving Investments into the AD Sector



**Total \$23.49**  
**100%**  
transportation

Biogas or Renewable Natural Gas (RNG) used for transportation can realize \$20-\$40 per million BTUs.



# Anaerobic Digestion Is Already Implemented at Multiple Locations to Treat Municipal and Industrial High Strength Wastewater

- Des Moines
- Dubuque
- Muscatine
- Estherville
- Ames
- Ottumwa
- Davenport
- Decorah
- Etc...







**72%**  
**Nitrate-N**  
**Reduction**

“There is substantial Nitrate-N reduction potential [from growing energy crops], with the research summary indicating 72% Nitrate-N reduction with conversion from row-crop production.”  
- Science Assessment Team Report

**Energy Crops on  
Marginal Lands is  
Effective  
Non Point Source  
Nutrient  
Reduction  
Strategy**

# What is the Economic Impact of Installing Regional AD Systems in Iowa?

## Methodology:

- Actual costs to upgrade or Install new Anaerobic Digestion Systems were estimated at each site by EcoEngineers.
- The boost to regional economy from investments and revenue was conducted using IMPLAN's I-RIMs model by Goss & Associates.

Four Sites were selected

- 1 industrial
- 2 municipal
- 1 agricultural





Goss & Associates



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Goss & Associates performs economic studies and analysis to help organizations and businesses make decisions based on current or future scenarios, expenditures, business development, and investment. Goss and Associates Provides:

Economic and fiscal Impact Studies

Economic Development Studies

Feasibility Analysis

Tax policy analysis

Healthcare policy analysis

Energy Policy Analysis

**\$17.6 million** 

*To construct an AD facility and gas upgrading Primary Feedstock is high strength industrial waste*

**188 jobs** 

*Created per site during construction phase  
9 permanent jobs*

**\$2.7 million** 

*per site in tax receipts over project life*

**462 million** 

*BTUs per day per site (4000 GGEs)*

**\$4.3 million** 

*Gross annual revenue*

**\$158 million** 

*Total economic output over 20 -year project life*

# Average Economic Impacts of Installing Municipal – Industrial AD Systems in Iowa





**\$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*

## Average Economic Impacts of Installing an Agricultural AD System in Iowa

**\$528,000**

*Will annually flow through to Miscanthus suppliers*

# Environmental Attributes at Agricultural Site Includes Nutrient Run-off Mitigation

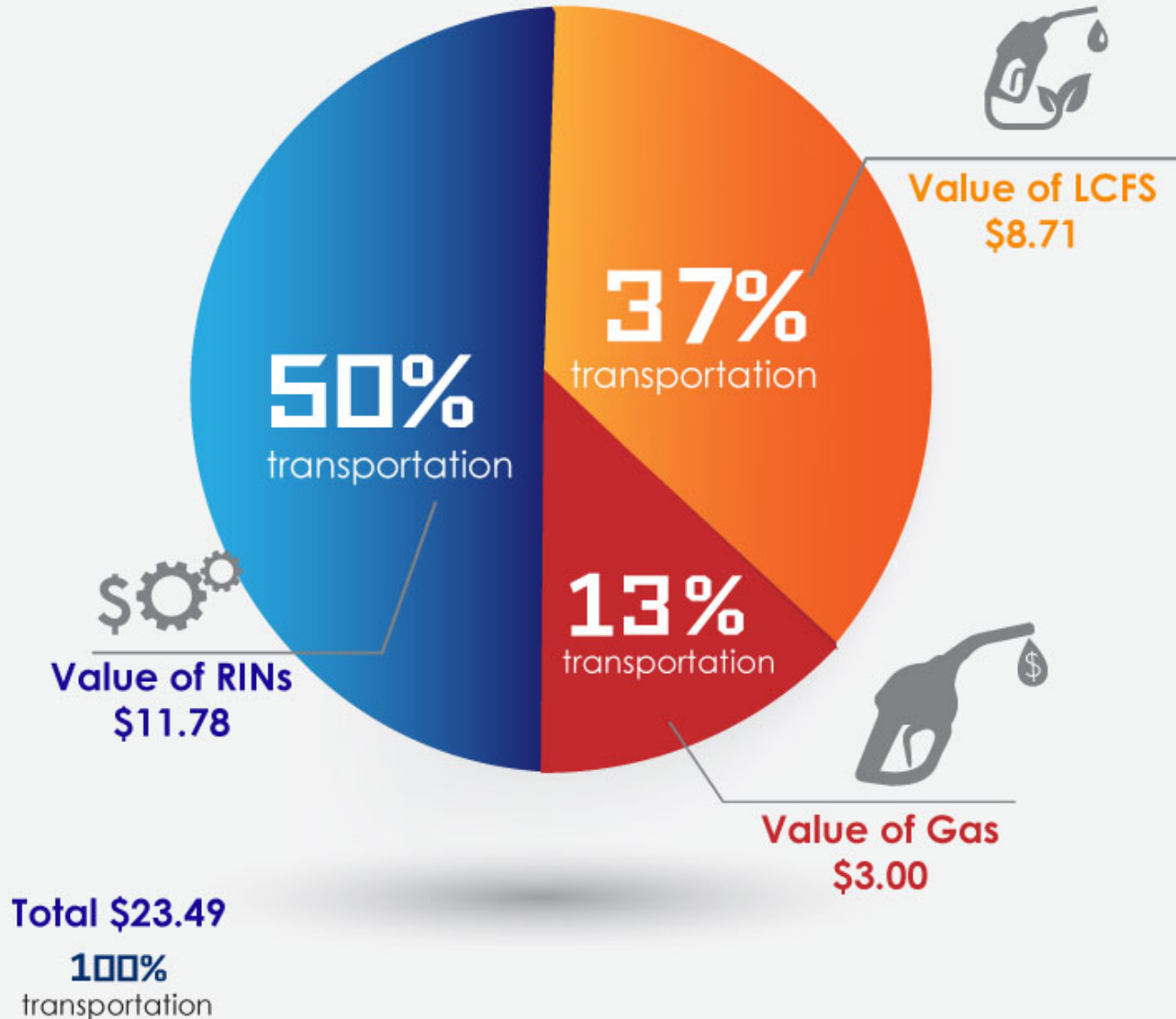
- AD systems can create a market for energy crops and cover crops
- Strategically planted energy crops reduce nitrate runoff
- 1,200 acres of sub-profitable farmland around the site converted from corn / bean production into Miscanthus production
- A range of \$5 - \$20 per lb. of Nitrogen was assumed for study purposes
- Nitrogen removal credits could provide additional \$7.9 million to \$23.7 million to farm economy.
- All the benefits of monetized nutrient credits go to the grower.
- Growers also realize revenues from biomass sales.



**\$23.7 million  
to farm economy  
with a market for  
biomass and a  
nutrient trading  
program**

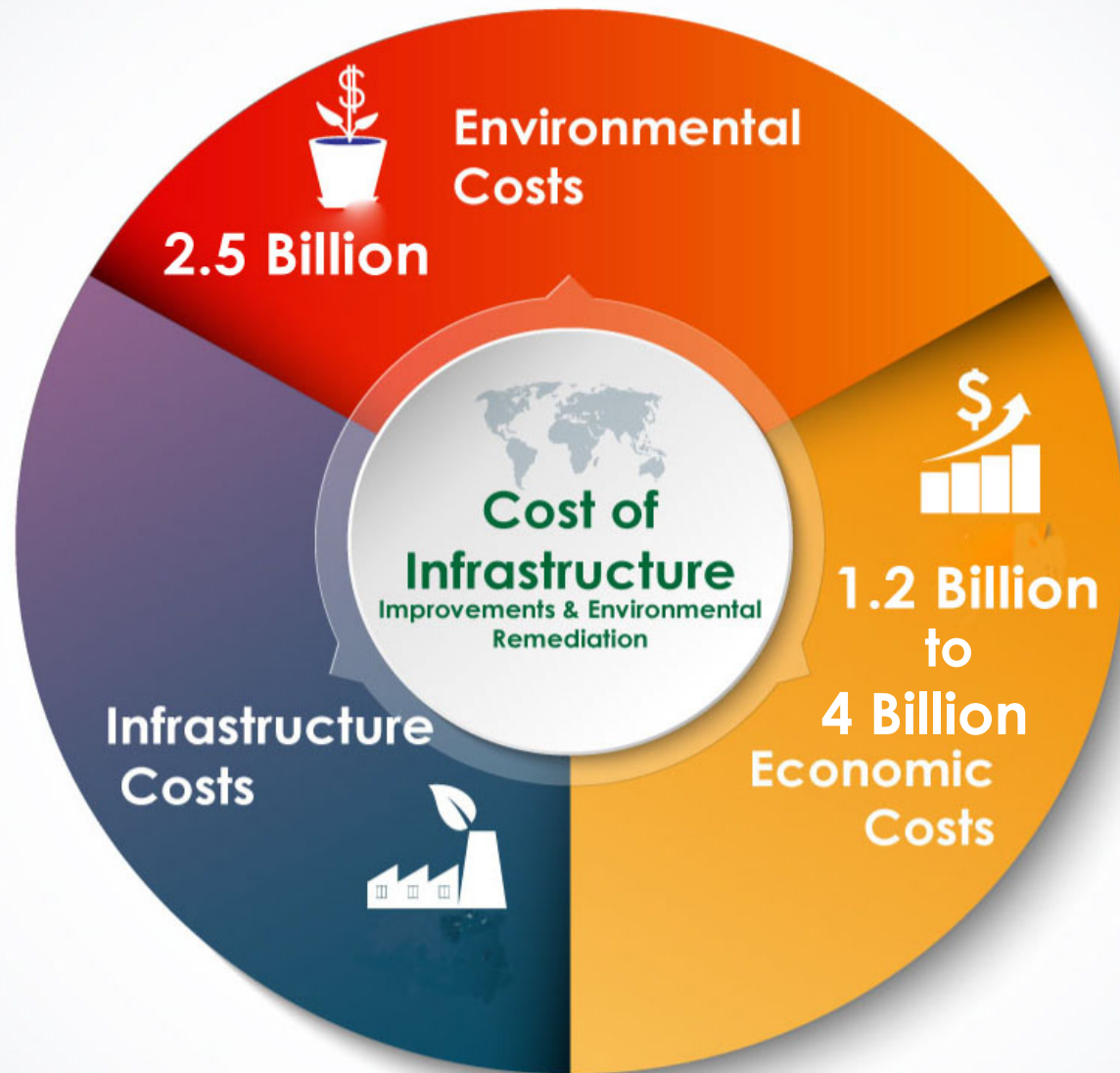


# Majority Of Revenues Are Currently From Clean Fuel Environmental Attributes



Federal and State incentives to reduce tailpipe emissions can add \$20-\$40 value to a million BTUs of purified biogas used as CNG (\$2.30-\$4.50/GGE)

# Iowa's Pending Cost of Infrastructure Improvements



\$2.5 Billion to Upgrade Municipal Waste Water Facilities (2012 EPA)

\$1.2 billion to \$4 billion For Non-Point Source Nutrient Mitigation Practices (IA NRS)

Economic Costs of Inaction

- Lower industrial growth
- Lower watershed quality
- Lost revenues to the State



# Conclusion: AD Systems are at Heart of Water Energy Nexus

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- Municipal Wastewater Treatment Facilities face up to \$2.5 billion in capital projects
- Watersheds face nutrient mitigation costs of up to \$4 billion
- There is a business case for installing regional AD systems to address above needs
- Installing AD systems and maximizing revenues from environmental attributes can reduce payback periods
- Revenues from biomass sales, fuel sales, environmental attributes and lower waste water costs are cash injections into local economy

# Next Steps

Midwest Biomass Potential	Conversion Technology	Outputs	Environmental Benefits
Cover crops & energy crops	Anaerobic Digestion	<ul style="list-style-type: none"> <li>• Biogas (RNG)</li> <li>• Organic fertilizer</li> <li>• Recycled nutrients</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce nutrient leakage into watersheds</li> <li>• Reduce pathogen leakage</li> <li>• Reduce CAFO odor issues</li> <li>• Produce clean fuel</li> <li>• Distributed energy for emergency planning</li> <li>• Reduce landfill methane leakage</li> <li>• Reduce demand on landfills</li> <li>• Reduce operational costs for industries</li> <li>• Increase revenues to municipalities</li> </ul>
Manure			
Municipal wastewater			
Separated organics			
Industrial waste water			

How to create programs that monetize environmental benefits & spur investments in rural infrastructure?



# Available Policy Structures

Policy	What it Does	Potential Weakness	Action to be Taken
Federal RFS	<ul style="list-style-type: none"> <li>Requires oil refiners to blend clean fuels such as RNG</li> <li>Provides strong incentives</li> </ul>	Need greater stability and longer term outlook	<ul style="list-style-type: none"> <li>Lobby EPA and Congress for stable RFS with biogas carve out</li> </ul>
California LCFS Cap & Trade	<ul style="list-style-type: none"> <li>Requires oil refiners and emission point sources to use clean fuels such as RNG</li> <li>Provides strong incentives</li> </ul>	Midwest dependent on Western states' climate policies	<ul style="list-style-type: none"> <li>Lobby western states for stable policies with biogas carve out</li> <li>Explore Midwest LCFS/Cap-Trade</li> </ul>
Low-interest loans, loan guarantees, tax credits, etc.	<ul style="list-style-type: none"> <li>Reduces cost of capital</li> <li>Attracts private investment</li> </ul>	Not always designed to support AD projects and nutrient reduction	<ul style="list-style-type: none"> <li>Design policies specific to AD projects &amp; nutrient reduction</li> </ul>
BCAP, crop insurance, NRCS, etc.	<ul style="list-style-type: none"> <li>Creates incentives for farmers to grow biomass</li> </ul>	Not always designed to support biomass to AD projects and nutrient reduction	<ul style="list-style-type: none"> <li>Explore policy structures specific to rural AD projects</li> </ul>

**A stable policy regime is best way forward**

# Potential New Policies

Policy	What it Can Do	Potential Weakness	Action to be Taken
Organic fertilizer designation for digestate	<ul style="list-style-type: none"> <li>Will create reliable revenue streams from digestate in commercial "organic" crop production</li> </ul>	no weakness	<ul style="list-style-type: none"> <li>Endorse current petition to USDA National Organic Program</li> </ul>
Recycled Nutrient Standard Nutrient Cap & Trade	<ul style="list-style-type: none"> <li>Will create standardized instruments and criteria for nutrient trading</li> <li>Market for recycled nutrients</li> </ul>	no weakness	<ul style="list-style-type: none"> <li>Design policy</li> <li>Region-wide adoption of Wisconsin's Adaptive Management Option for Phosphorus?</li> </ul>
Organic Diversion (existing programs in VT, MA, CT, RI and CA)	<ul style="list-style-type: none"> <li>Will reduce loads and methane leakage at landfills and waste</li> </ul>	Possible implementation challenges / decrease in landfill revenues	<ul style="list-style-type: none"> <li>Design policy and evaluate cost-benefit</li> </ul>

**A stable policy regime is best way forward**

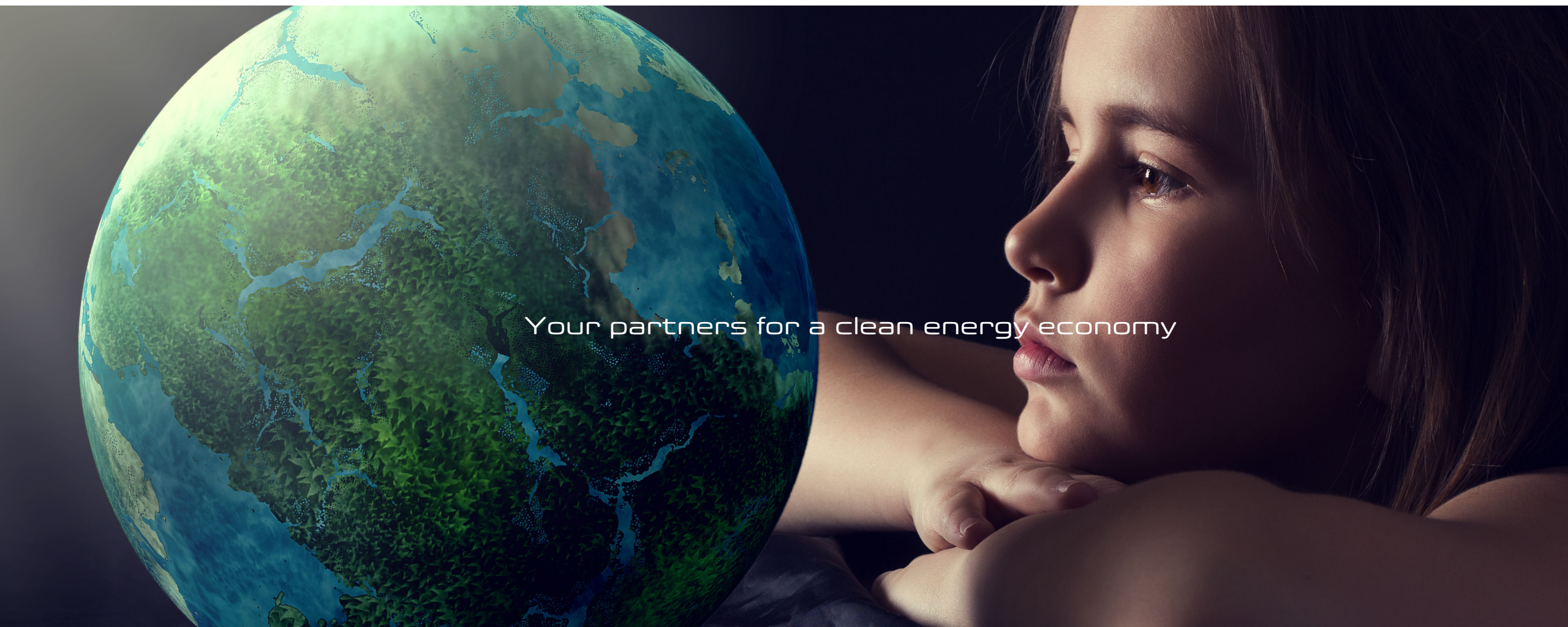
Thanks to Prof. Timothy M. Baye @ Univ. of Wisconsin for his help with these slides!



# Credits

Iowa Economic Development Authority  
Goss & Associates  
Iowa State University  
HDR  
Nero Engineering  
Iowa Department of Natural Resources  
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Timothy Baye

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Your partners for a clean energy economy

Shashi Menon: [smenon@ecoengineers.us](mailto:smenon@ecoengineers.us)