INTRODUCTIONS

- Mark E. Miller, Mnrgy, Inc.
- Ronald F. Turco, Jr., Purdue University
- Michael Hudson, I Power Energy Systems LLC
- Norma McDonald, Phase 3 Developments & Investments, LLC

OUTLINE

- Digester technology overview (Turco)
- Clinton County (Turco)
- Benton County (Hudson)
- Decatur County (McDonald)
- Where do we go from here?
- Questions

KEY POINT: WASTE *CONTAINS* ENERGY

- Most currently used biowaste handling methods do not capture the energy they contain.
- A rethinking of biowaste management to achieve "*energy retention*" must be undertaken and encouraged.
- "Don't waste your waste"

ANAEROBIC DIGESTION (KEY METHOD)

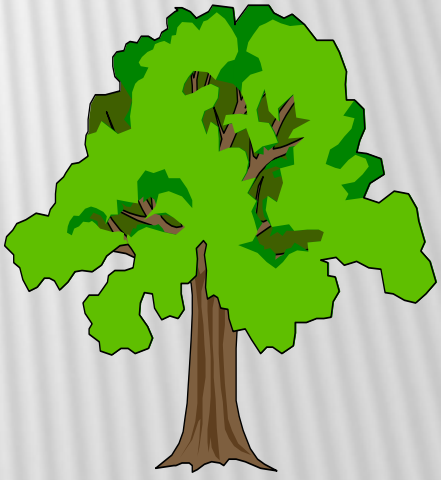
- Anaerobic digestion is not new (10th century)
- Anaerobic digestion is a natural process
- Anaerobic digestion will occur when organic material decomposes in the absence of oxygen
- Thousands of successful digesters are working around the world
- The U.S. lags the world in use of this renewable energy resource

BENEFITS OF ANAEROBIC DIGESTION

- Odor reduction: digestion stabilizes degradable organic matter
- Digested manure retains its nutrient/fertilizer value
- Digestion minimizes release of methane to atmosphere during later storage <greenhouse gas reduction>

ENVIRONMENTAL BENEFITS

- Reduces odor from land application
- Protects water resources
- Reduces pathogens
- Weed seed reduction
- Fly control after digestion
- Green Energy



Complex Materials

Plants, Food Waste
Animals Residues
Household Waste

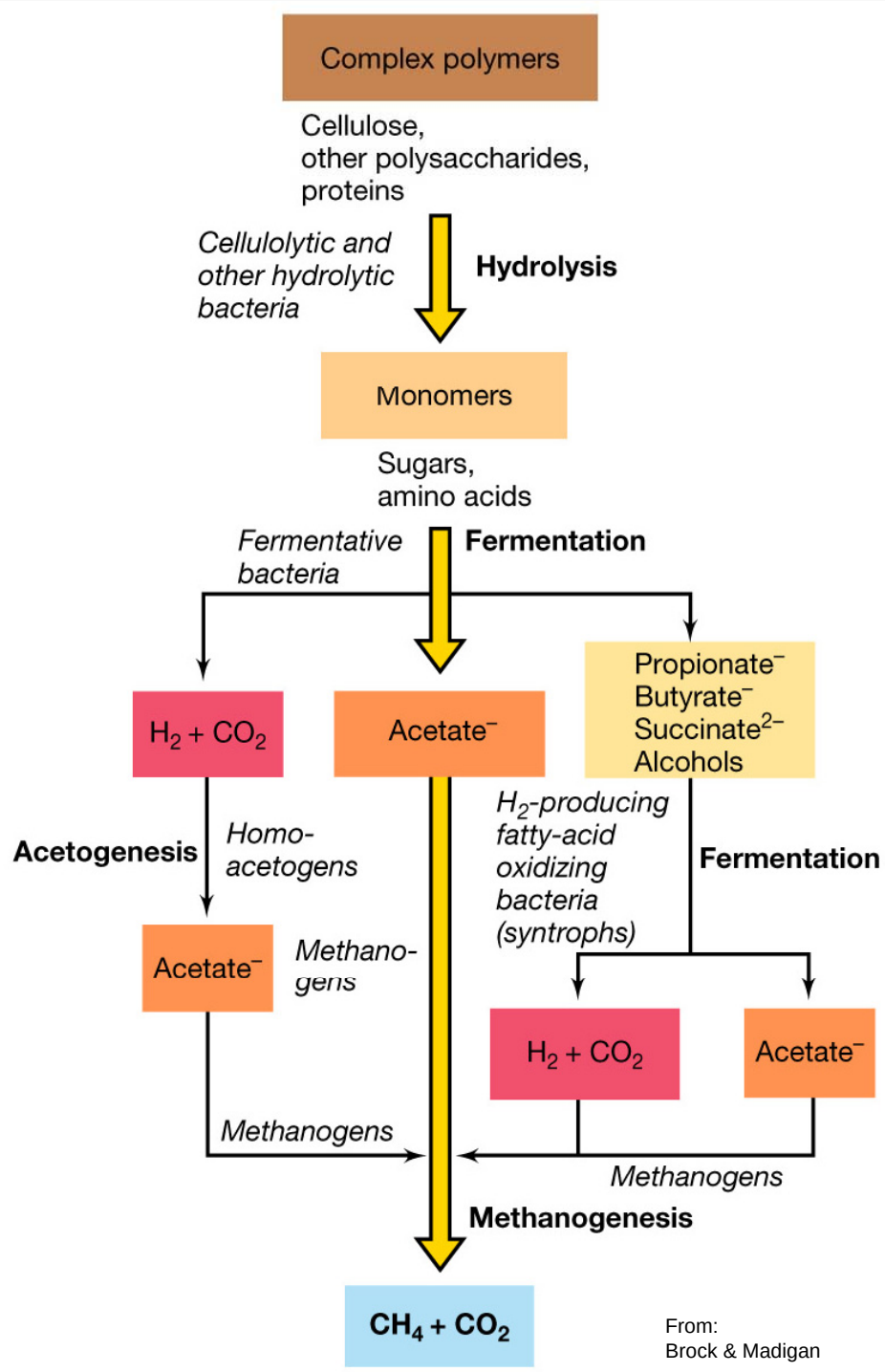
Simpler Materials

Sugars, Fatty Acids

Acids

Acetate (CH_3COO^-)

CH_4

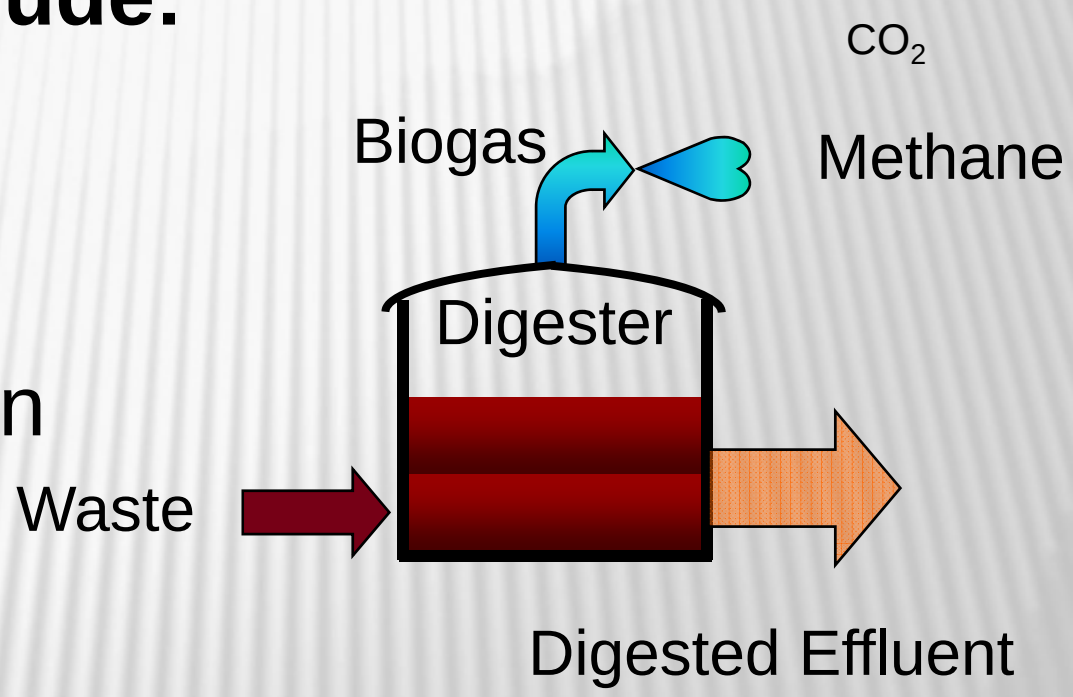


From:
Brock & Madigan

ANAEROBIC DIGESTION

Systems can include:

- Digester
- Fixed Film
- Covered Lagoon



WASTE VALUES (AVERAGE)

Animal	Biogas (ft^3/1000 lbs)	Energy (kWh/day)
Dairy Cow	39	1.21
Swine	28	0.96
Poultry (layer)	37	1.33
Poultry (broiler)	51	1.78

EPA

SYSTEM REQUIREMENTS

- Identify key information necessary to evaluate for potential methane production:
  - Type of business (e.g., farm, food waste)
  - Amount of waste (e.g., animal number)
  - Waste handling system (manure and waste collection and treatment facilities)
- Energy production expenses & offsets
- Energy buy back regulations

REGIONAL SYSTEMS

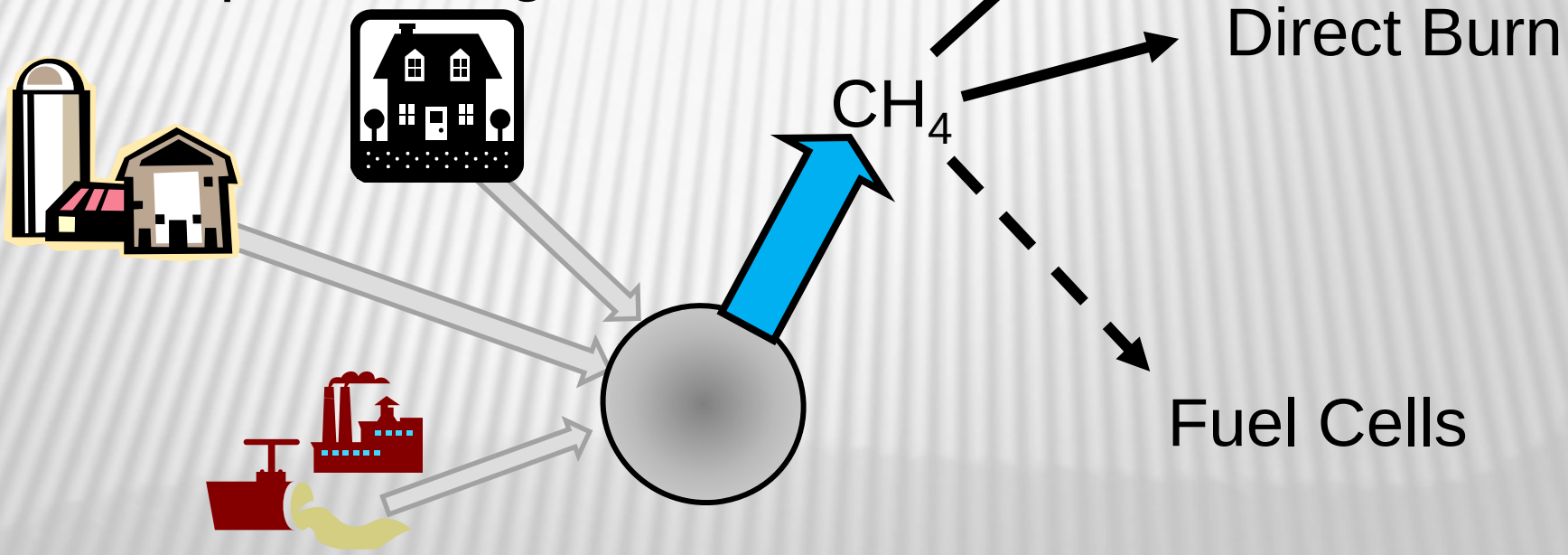
<u>Regional Sources</u>

Animal Waste

Human Waste

Food Waste

Bioprocessing Waste



Quadra

Photo by Above All Aerial and Specialty Photography

Quadra Initiative | Clinton County, Indiana

A LOCAL INITIATIVE WITH GLOBAL OPPORTUNITIES

Clinton County Economic Development Corporation
259 East Walnut Street | Frankfort, IN 46041
765.654.5507 | www.clintoncountyed.com
Contact: Gina Sheets; gina@ccinchamber.org

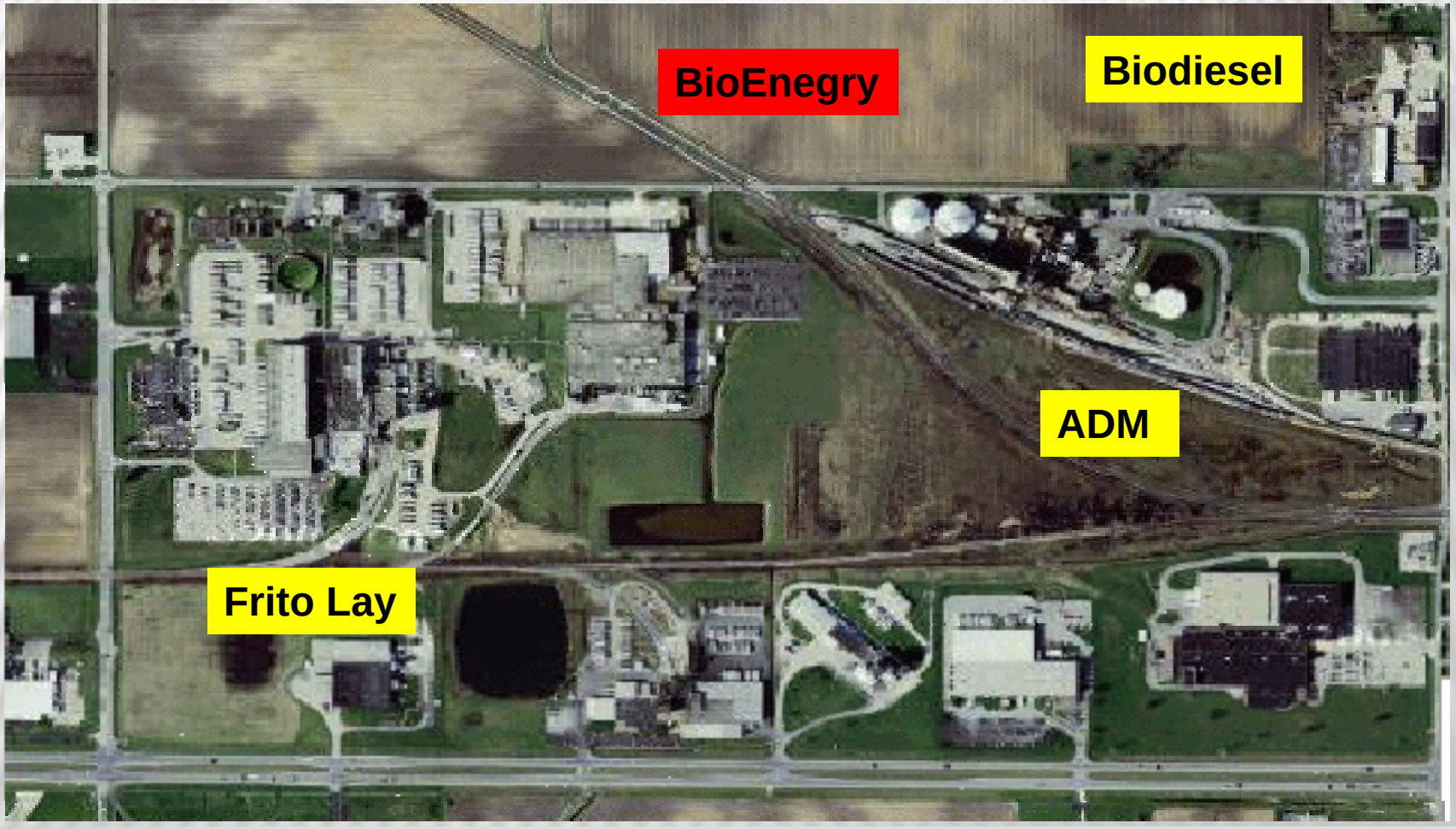
Clinton County is centrally located and moving forward

- Population: 34,000
- Land: 405 mi²
- Frankfort, County Seat
- Strong local leadership
- Strong local interest

ClintonCounty

INDIANA

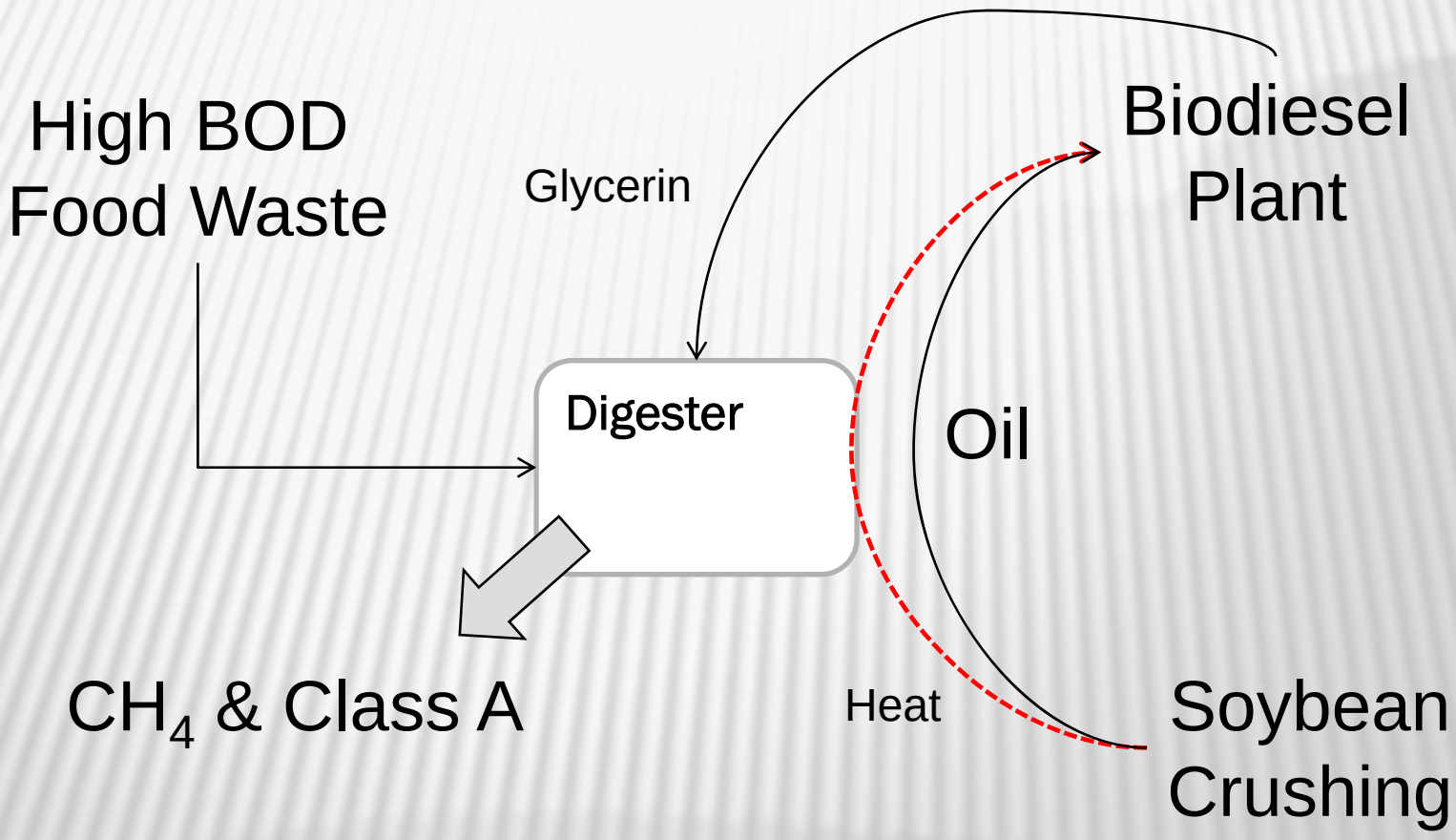
Waste from food processing and others sources will be used to create an energy supply



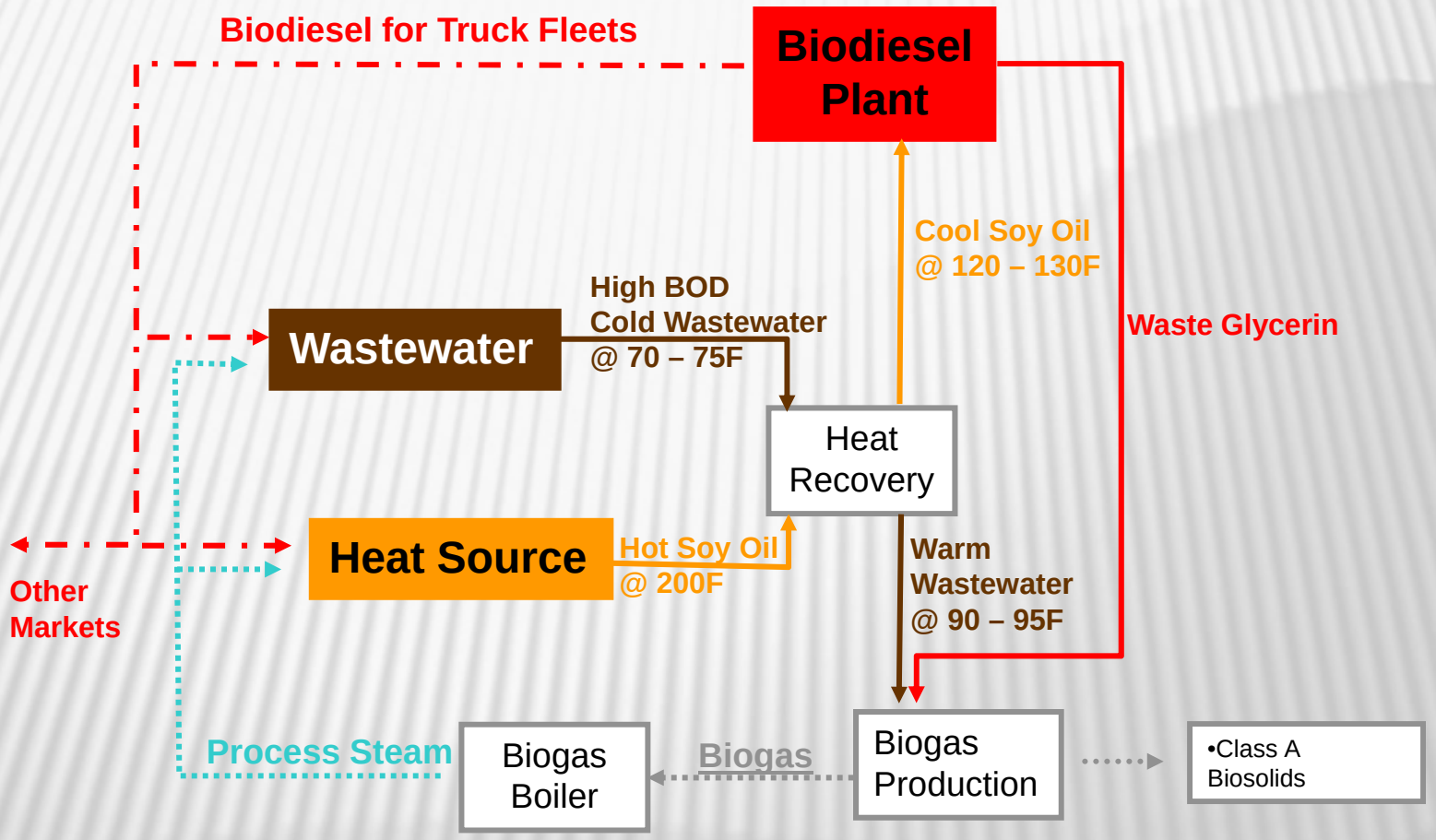
1000 feet

Total Park Earnings=$103M 2004

Powering the industrial symbiosis is a sharing/exchange of waste materials



Material Flow Diagram for "Industrial Symbiosis"



Current 1,500,000 GPD
BOD 28,400 lb/day

COST AND PAYBACK

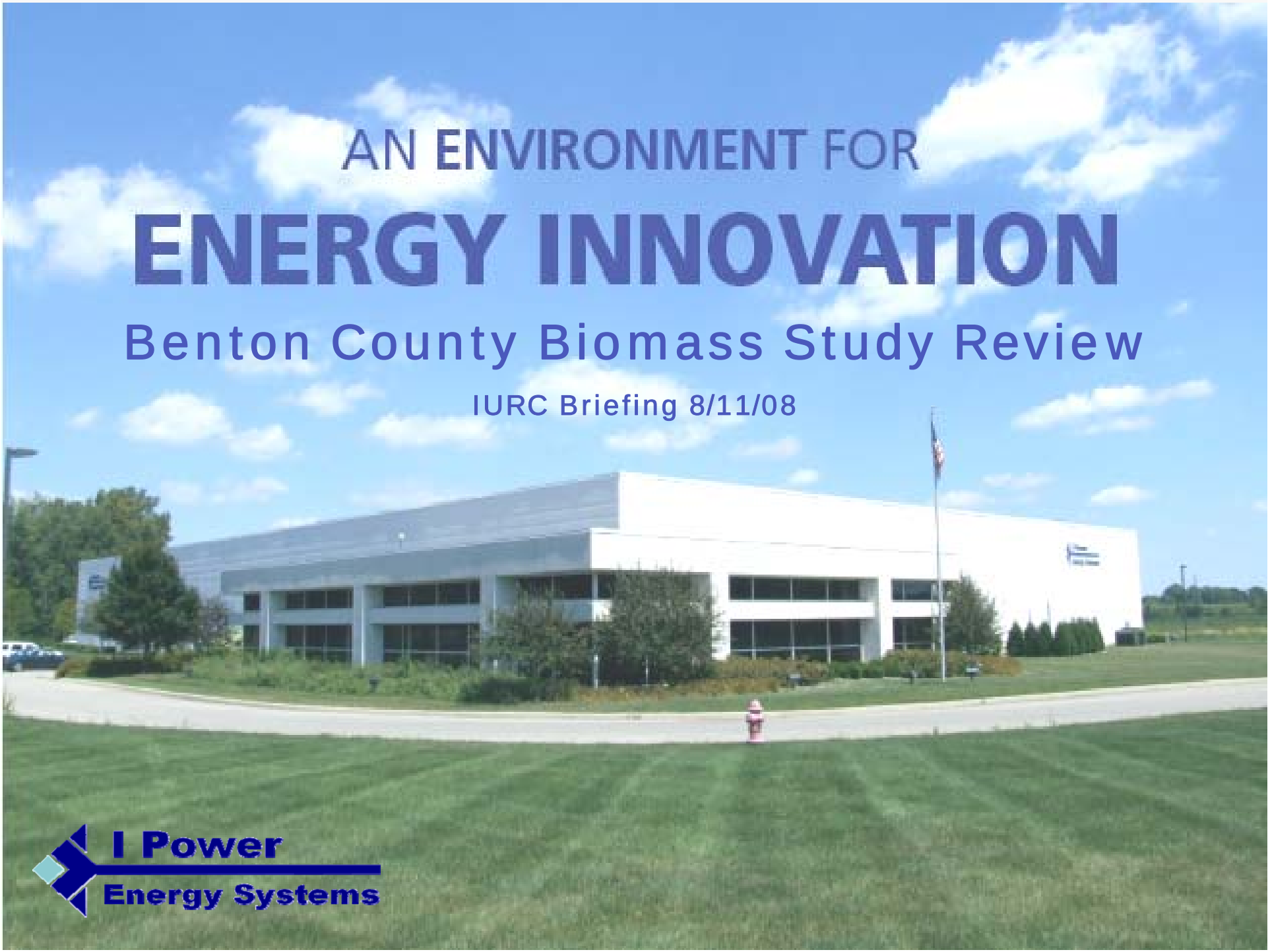
Example layout of an Agro Zone using a central digester

Current Operations

2.5 mile 8” pipe

Central Digester

COST AND PAYBACK



AN ENVIRONMENT FOR

ENERGY INNOVATION

Benton County Biomass Study Review

IURC Briefing 8/11/08

I Power
Energy Systems

INDIANA OFFICE OF ENERGY & DEFENSE DEVELOPMENT

BIOMASS FEASIBILITY STUDY GRANT PROGRAM

The Indiana Office of Energy & Defense Development (OED) grant program provides cost share grants to Indiana's public, non-profit, and business sectors for the production of feasibility studies investigating the use of biomass for energy.

The purpose of the grant program is to develop technically and economically feasible biomass to energy projects. These studies serve as a foundation for applications for federal farm bill funding through the USDA Section 9006 program.

I Power
Energy Systems

I POWER BIOMASS FEASIBILITY STUDY PROJECT

I Power Energy Systems teamed with Phase 3 Renewables to conduct this Indiana Biomass Feasibility Study Project. The study addressed:

- Providing a roadmap for Benton County and the State
- Economic development and environment issues
- Farm-based biomass-to-energy facilities
- Steps to grow the State's agriculture industry
- Environmental and quality of life concerns

The project identified viable anaerobic digestion biomass-to-energy projects at three farming installations:

- Existing swine facilities,
- New swine facilities, and
- Cattle facilities.

The project explored the symbiotic relationships between anaerobic digestion biomass-to-energy facilities and a variety of industrial entities.

I Power
Energy Systems

TYPICAL INSTALLATIONS

AD system on 8,000 space hog facility

Biogas Generator

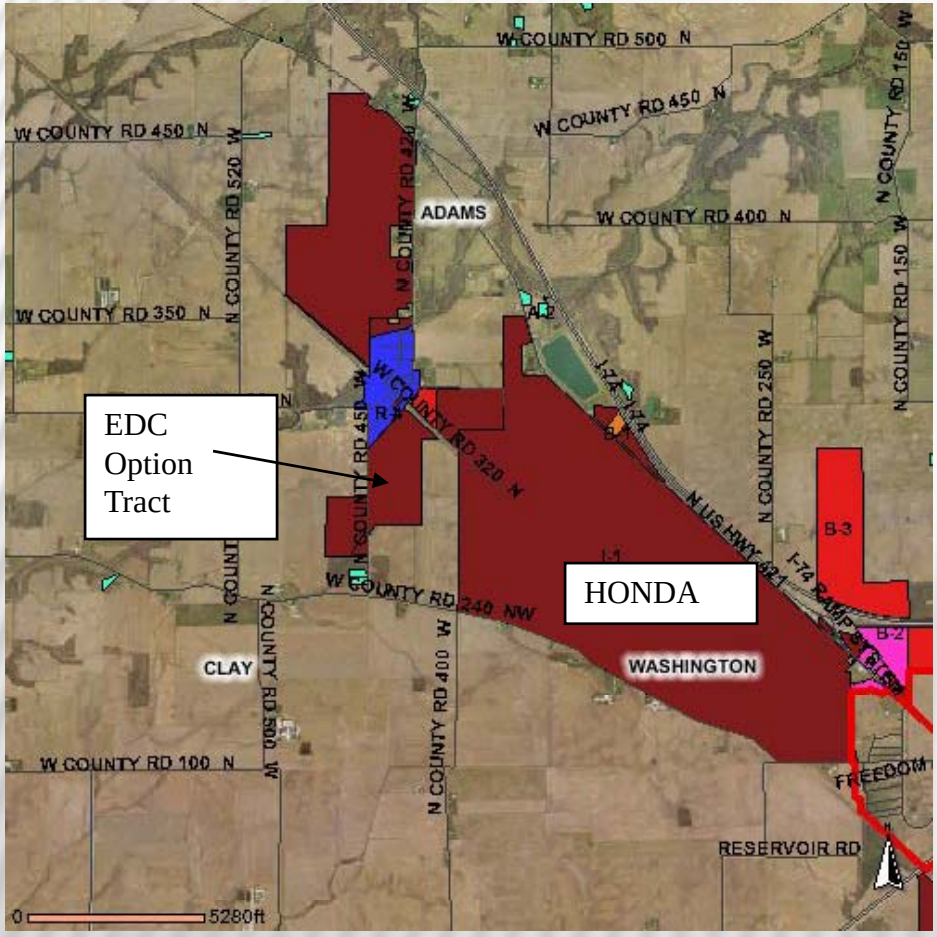
AD system on 2000 cow

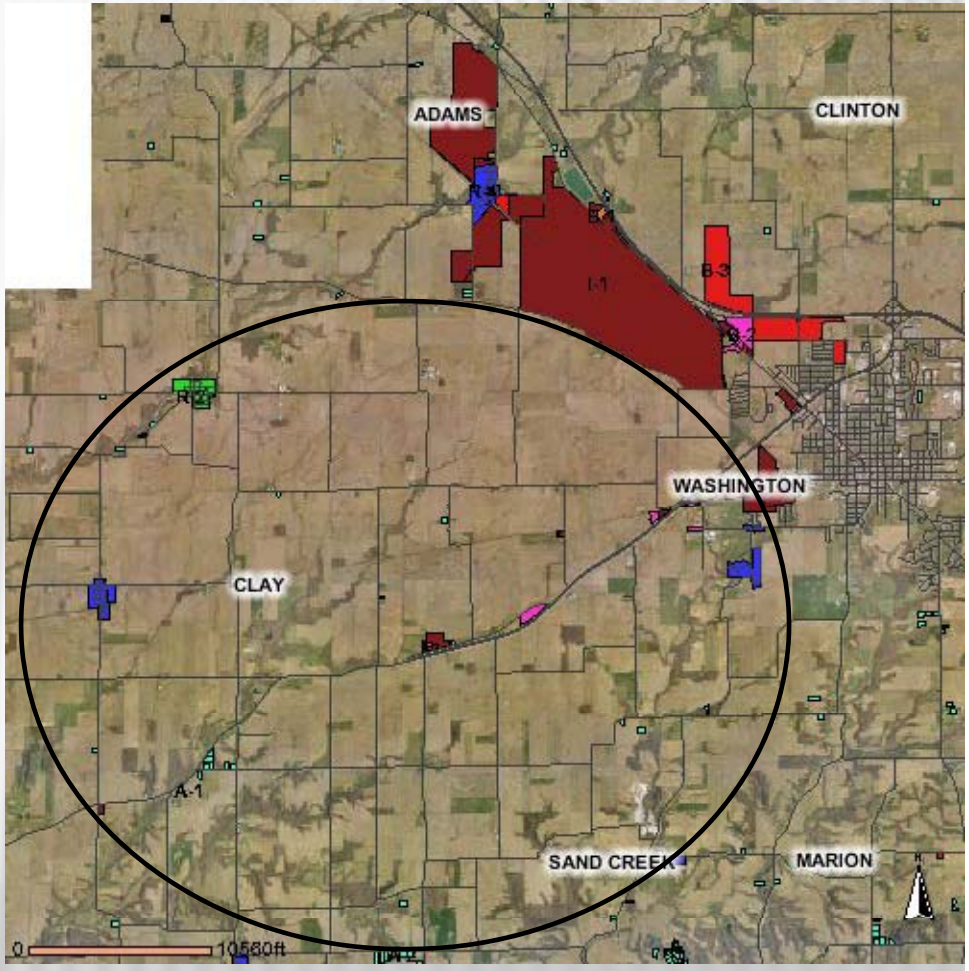
BENTON COUNTY BIOMASS STUDY FARMS

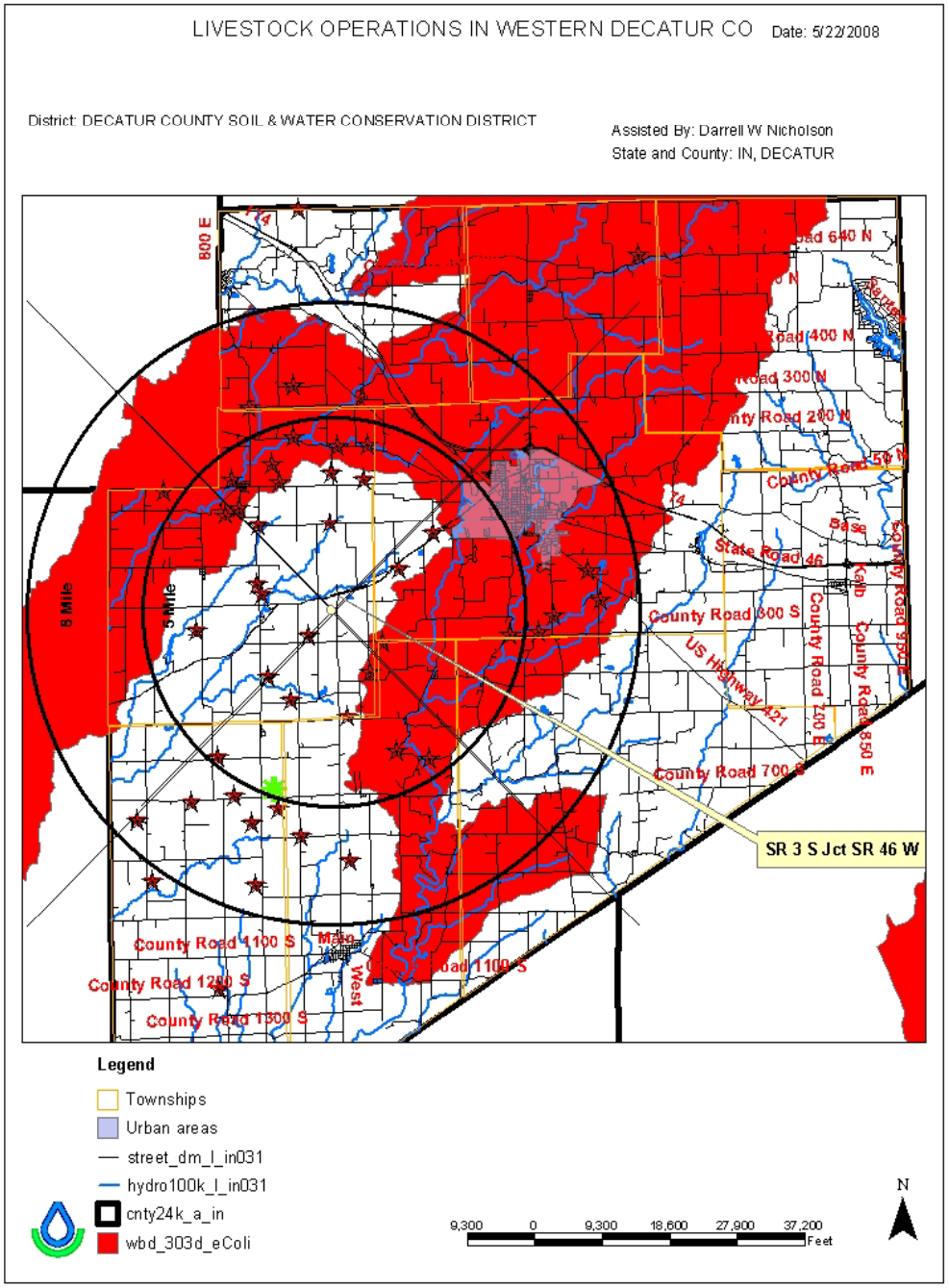
STUDY CONCLUSIONS

- Such systems are technically feasible for each type of farm installation.
- The systems could be incorporated into existing or new facilities.
- On-farm biogas plants are not “get rich quick” schemes in Indiana since they require substantial initial investment and the current cost of energy is low.
- Grant dollars 9USDA Section 9006) were included in the analysis for two of the farms and made the investment reasonably attractive from a payback perspective.
- Manure management is typically considered a cost of doing business, and not a profit center; more detailed analysis is need prior to a project launch decision.
- The effluent from the digester has significantly less odor than untreated manure; thus significantly reduce the odors associated with transport and land application.
- By capturing methane and replacing fossil fuels, the farms would qualify for emission reduction (carbon) credits.
- The system mineralizes the nutrients to the inorganic form, making them more available for first year crop uptake, allows the material to be used on growing plants without burning crops, and decreases susceptibility of fields to a build up of excess nutrients and run-off.
- Other attributes of the digestion process include pathogen reduction, weed seed kill, fly larvae kill, homogeneous product,, and pumpable, spray irrigate.
- The opportunity to develop “associate” business e.g. integrated greenhouse vegetation facilities and retail organic fertilizer processing require more detailed analysis.

DECATUR COUNTY SITING ASSESSMENT

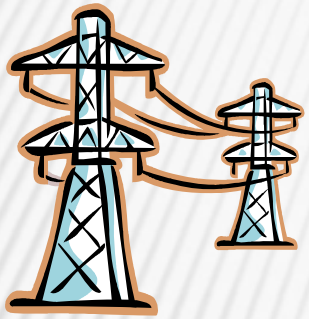






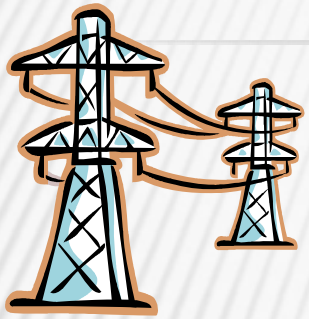
CURRENT E COLI CONCENTRATIONS IN DECATUR COUNTY

DECATUR COUNTY BIOGAS VALUE POTENTIAL



25 mil GPY	65 mil GPY
10,950 MWh	25,776 MWh
1.25MW	2.9MW
$0.55 mil @ $0.05/kWh	$1.3 mil @ $0.05/kWh
Scrub & Replace	Scrub & Replace
106,525 MCF NAT GAS $0.96 mil @ $9/MCF	225,466 MCF NAT GAS $2.03 mil @ $9/MCF
Upgrade & Inject	Upgrade & Inject
88,031 MCF NAT GAS $0.79 mil @ $9/MCF	186,322 MCF NAT GAS $1.7 mil @ $9/MCF
Upgrade/Compress/Replace	Upgrade/Compress/Replace
627,372 GGE $2.2 mil @ $3.50/gal	1,327,864 GGE $4.6 mil @ $3.50/gal
599,970 GDE $2.7 mil @ $4.50/gal	1,269,865 GDE $5.7 mil @ $4.50/gal

DECATUR COUNTY BIOGAS CONVERSION LOADED COSTS



25 mil GPY	65 mil GPY
10,950 MWh	25,776 MWh
1.25MW	2.9MW
$0.041/kWh	$0.023/kWh
Scrub & Replace	Scrub & Replace
106,525 MCF NAT GAS $2.80/MCF	225,466 MCF NAT GAS $1.32/MCF
Upgrade & Inject	Upgrade & Inject
88,031 MCF NAT GAS $6.16/MCF	186,322 MCF NAT GAS $5.32/MCF
Upgrade/Compress/Replace	Upgrade/Compress/Replace
627,372 GGE $1.01/gal	1,327,864 GGE $0.92/gal
599,970 GDE $1.05/gal	1,269,865 GDE $0.96/gal

CREATE CONDUCIVE REGULATORY FRAMEWORK

AREA	KEY ELEMENTS
Feedstocks	Farm residuals (manure, spoilage, crop residue), including multiple farms Organic residuals approved for animal feed or land application Let biochemistry dictate co-feeding levels No additional transportation restrictions/requirements Exclude only named substrates/compounds & require annual verification
Process	Recognize as BACT for BOD/COD reduction, odor & pathogen control Recognize as Agricultural Process and/or Farming Equipment
Effluents	Maintain consistency with CNMP or IDEM rules for compost and organic fertilizer
Air Emissions	Recognize as BACT for GGE reduction No permit for small systems with minimal SO2
Energy Production & Sale	Encourage self-sufficiency Ensure free and fair market access Limit interconnection costs to those assets renewable energy producer will own
Siting	As close to feedstocks as practical, balanced with proximity to energy customer

WHERE DO WE GO FROM HERE?

- Cooperative concept
  - Treat central digesters as public utilities
- IURC Regulation
  - Limited regulatory oversight on rates and distribution
- Right of way authority
  - Authorize eminent domain power for r/w acquisition

WHERE DO WE GO FROM HERE?

- Renewable Energy Credit Standard
  - 21 state and District of Columbia
  - Study existing state standards
  - Adopt a REC standard to facilitate Indiana's goal to become a net energy exporter