

Agricultural Anaerobic Digesters

January 24, 2017

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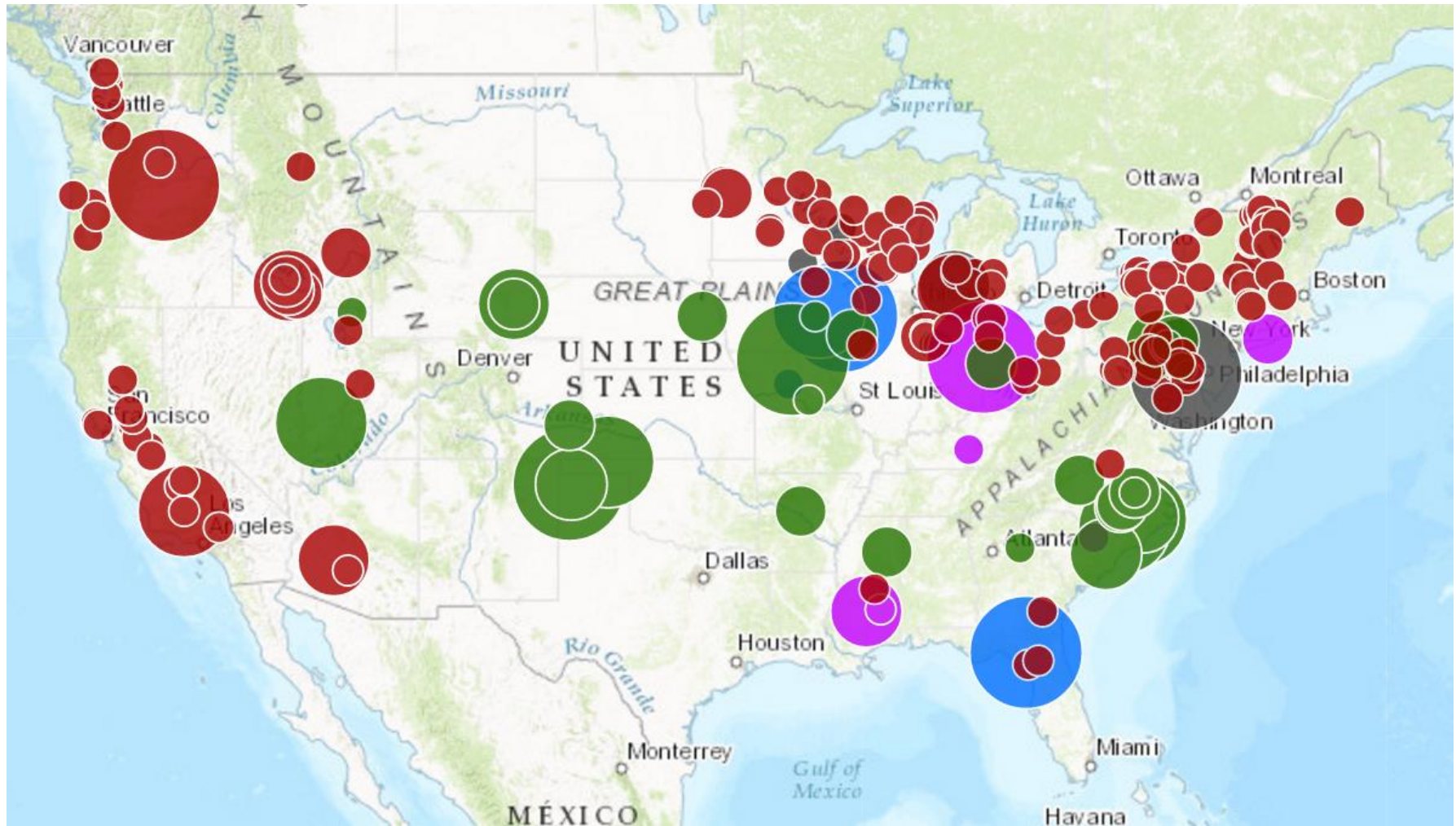


Methane burning off a manure storage in central Pennsylvania

Anaerobic Digesters



Agricultural Digesters in the U.S.



● Dairy ● Hog ● Poultry ● Beef ● Mixed

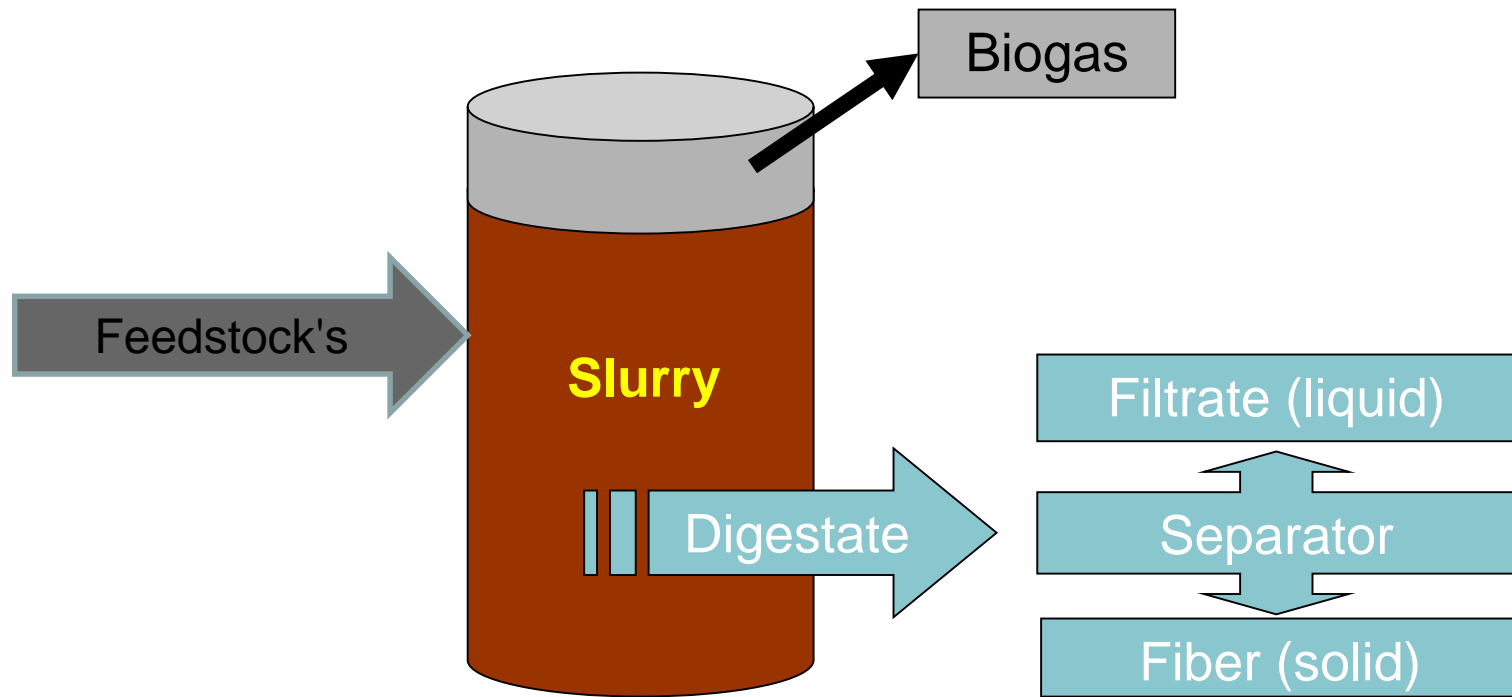
USEPA AgSTAR, 2017

Agricultural Digesters in Wisconsin

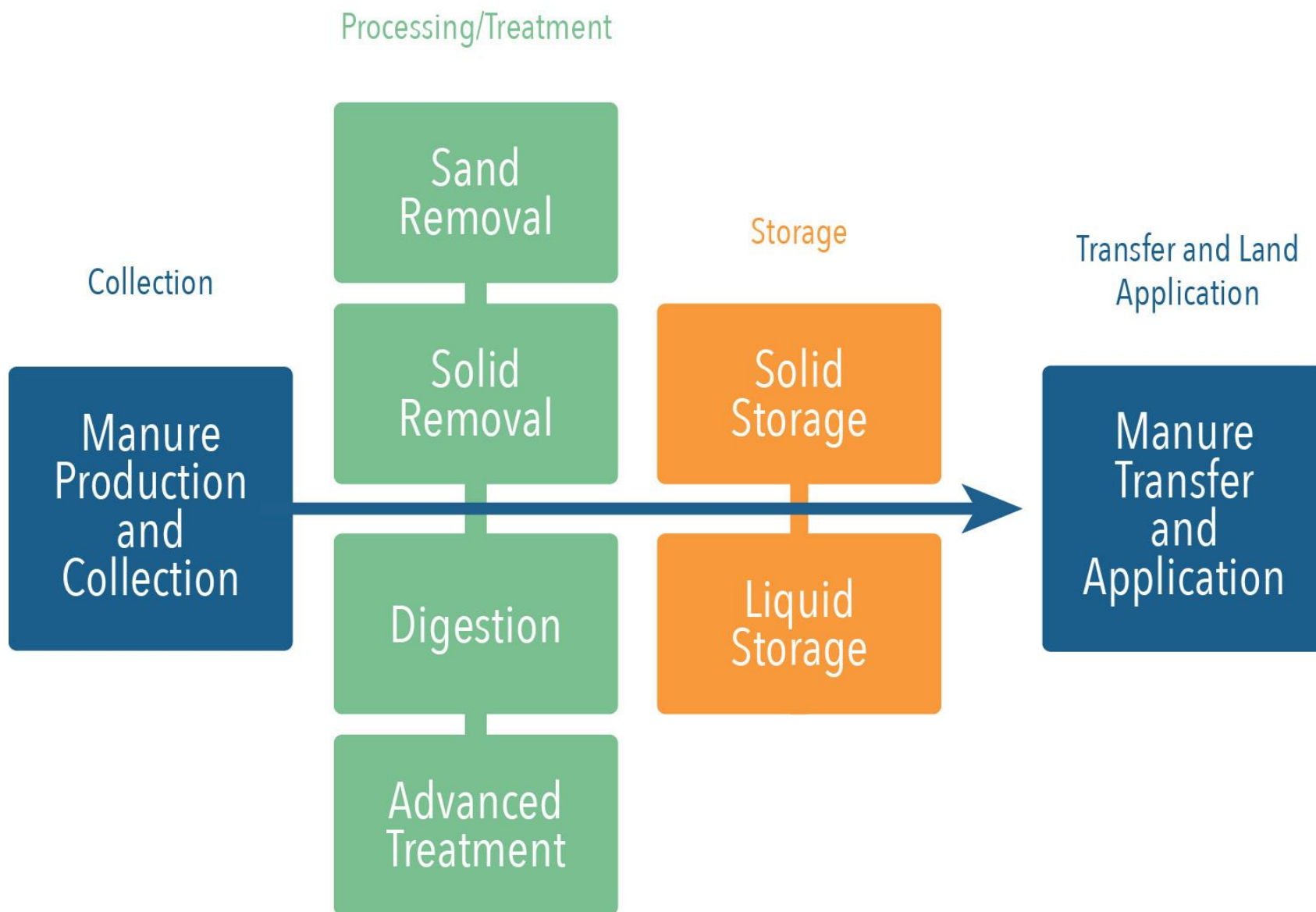
- 247 digesters in the U.S.
- 37 in Wisconsin
 - 35 different facilities
 - All dairy facilities
 - All liquid manure based systems
- ~300,000 metric tons CO₂ eq/year removal
 - Equal to:
 - ♦ 63,000 passenger cars, or
 - ♦ 322 million lbs of coal burned, or
 - ♦ 83 wind turbines
- 229 WI dairy CAFO (>1,000 animal units) facilities
 - ~12% have digesters

Animals (No. of head)	Operational
< 1,000	9
1,000-2,000	9
> 2,000	19

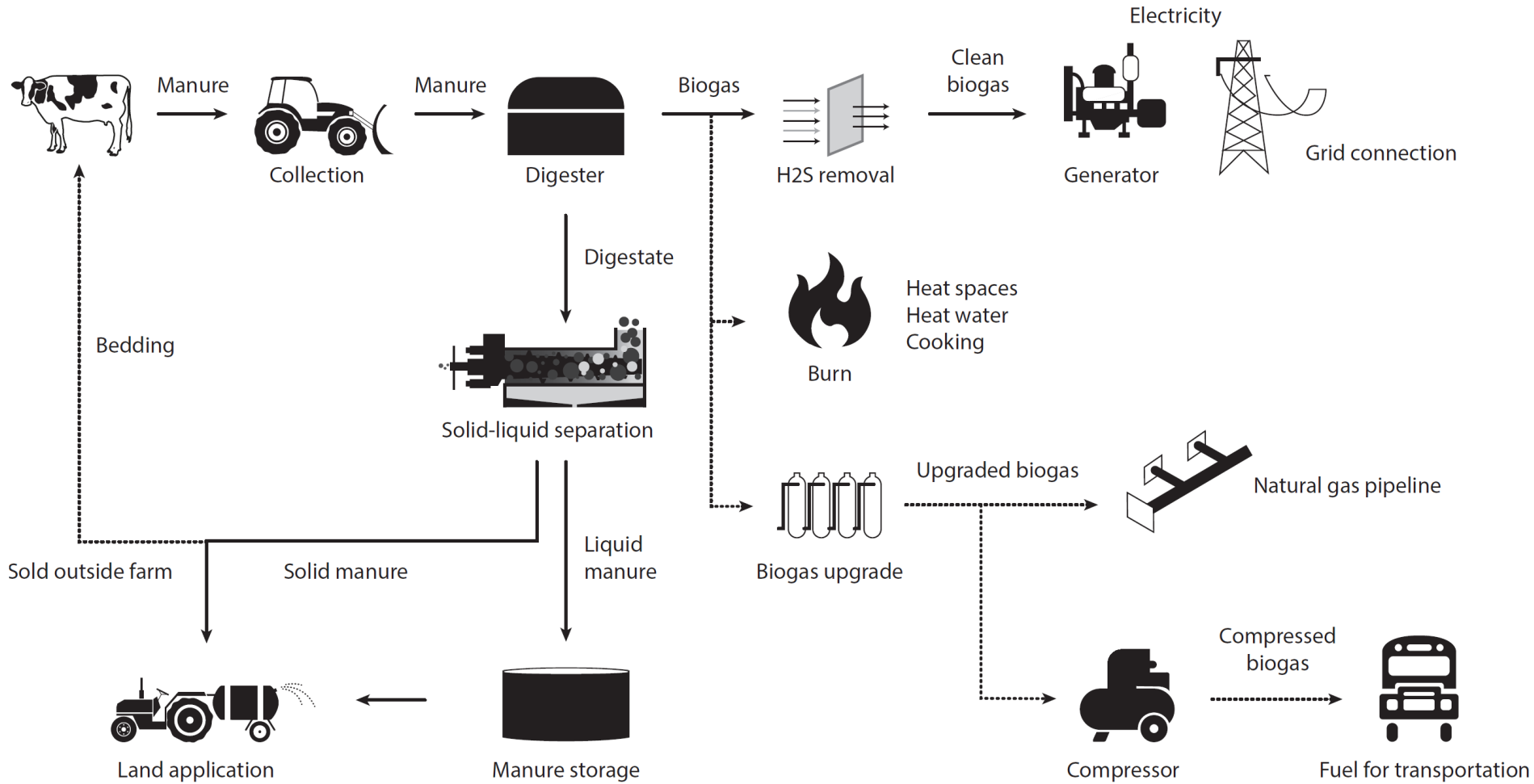
Anaerobic Digestion Process Flow



Manure Systems



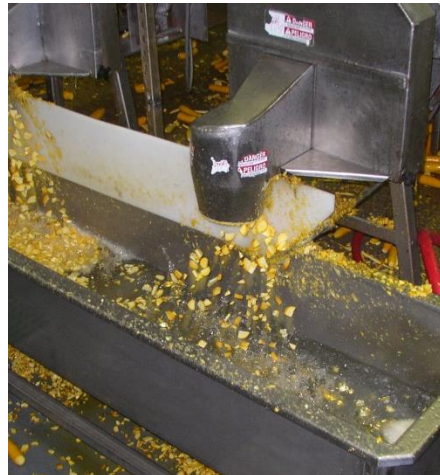
Agricultural Digestion System



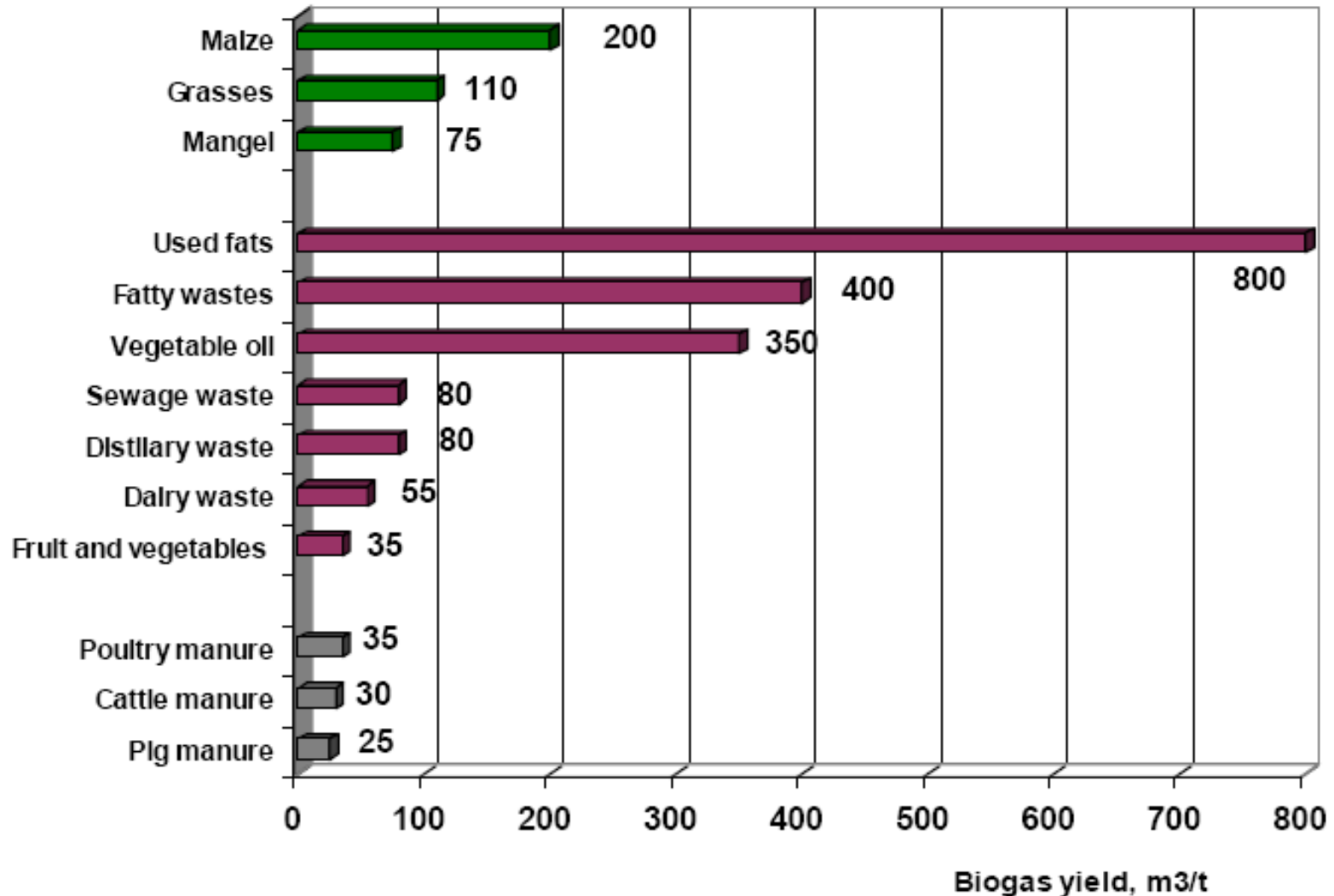
AD Research - Feedstocks



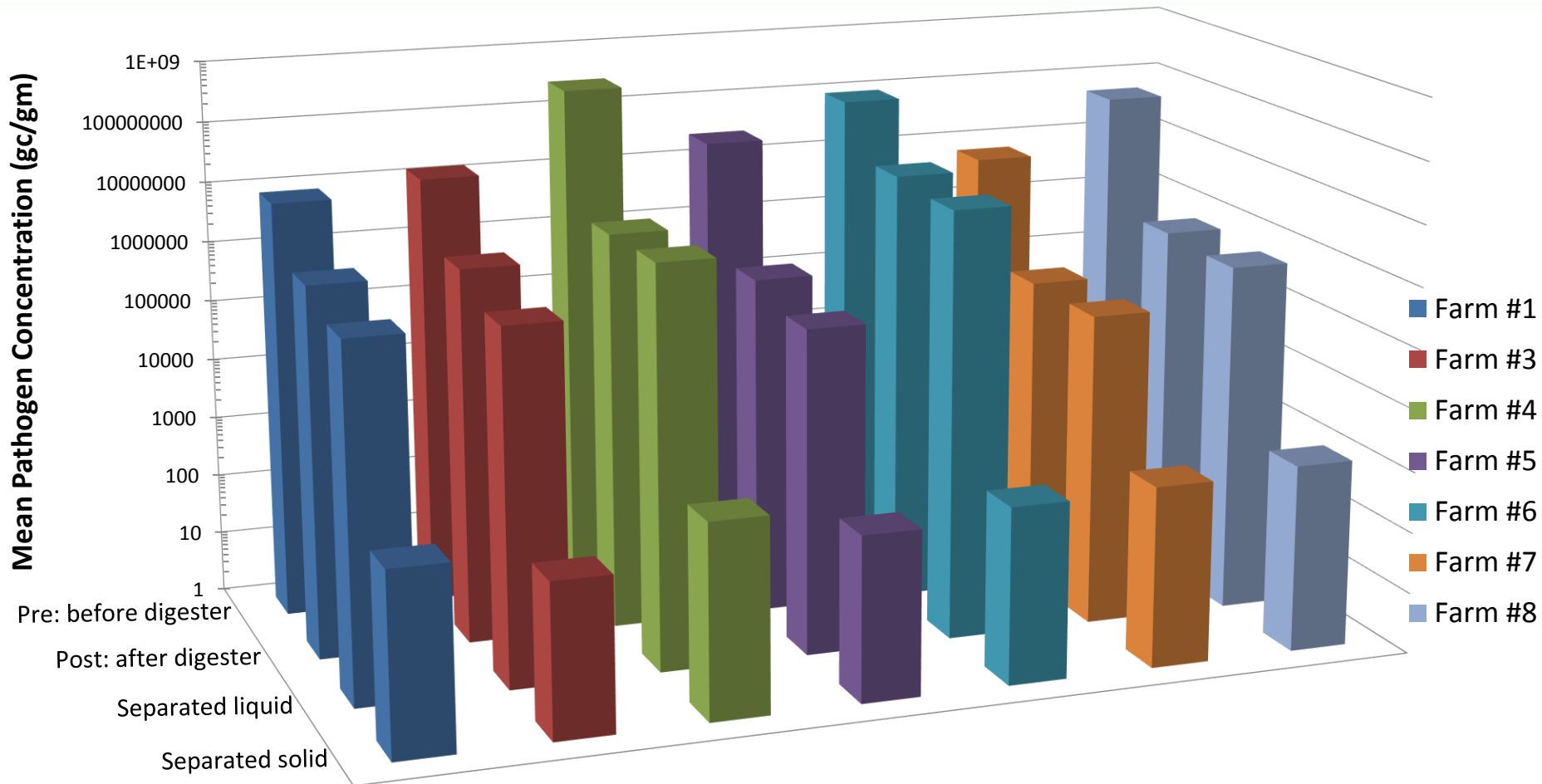
Cheese Whey **Yard Clippings** Cattle Manure
Cucumber Waste Food Processing Waste Municipal Organics Dairy Manure
Human Waste Grasses Swine Manure
Vegetables



Biogas Yield



Pathogen Reduction

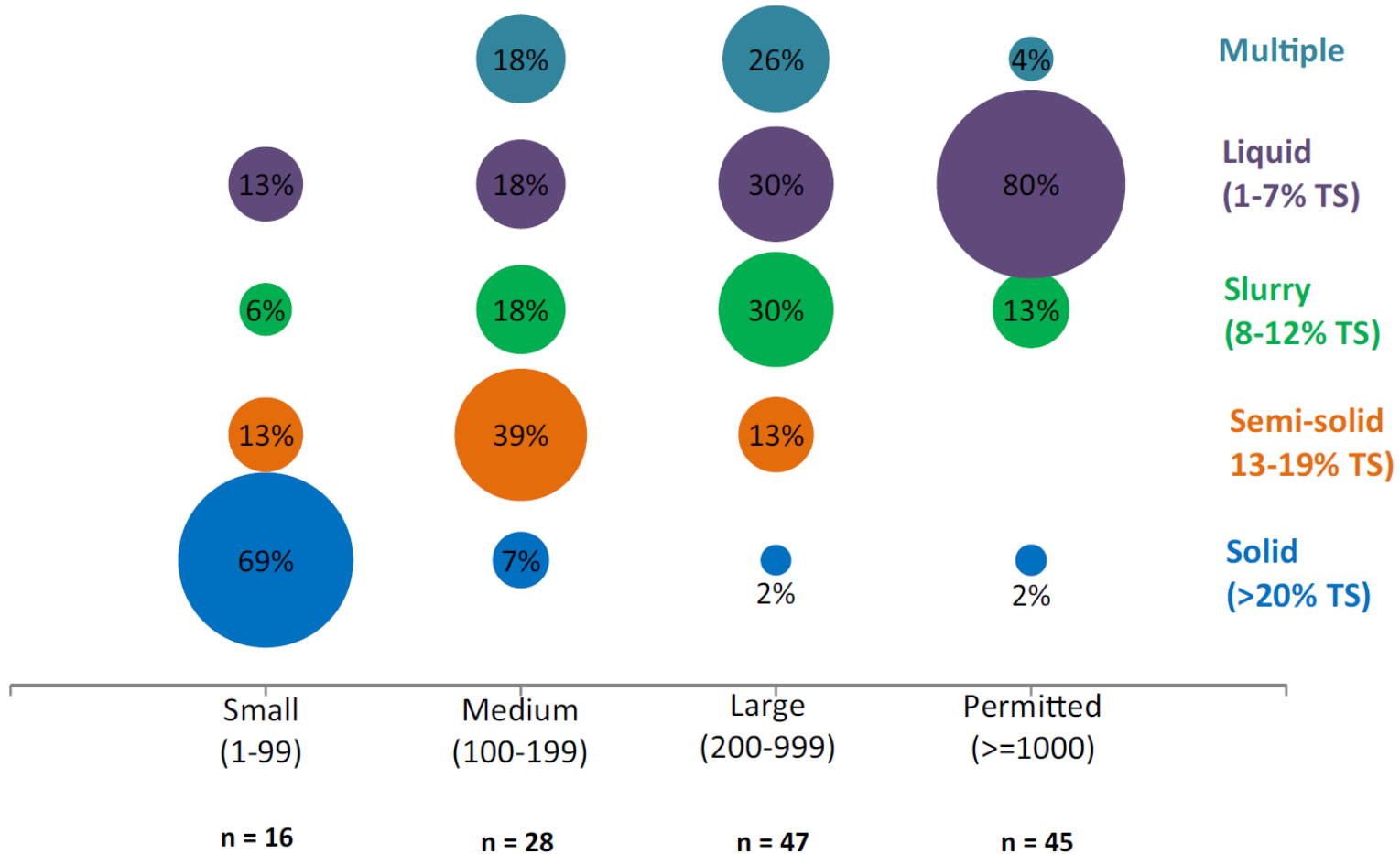


Bovine Polyomavirus

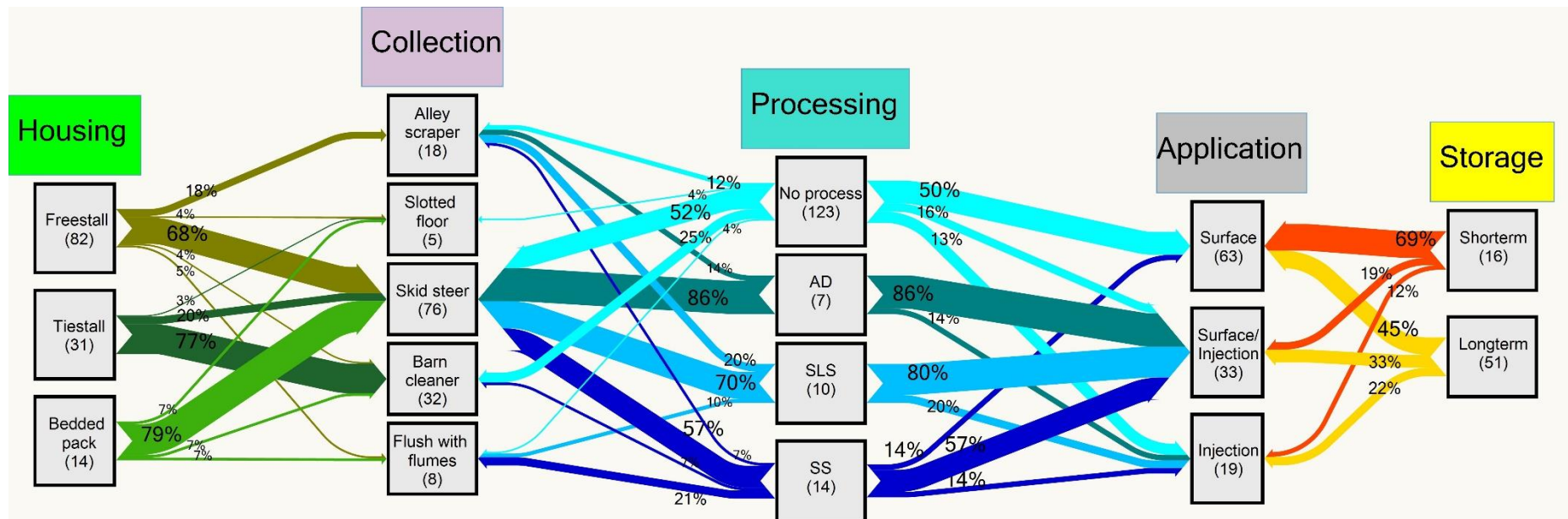


Surveys and Assessments

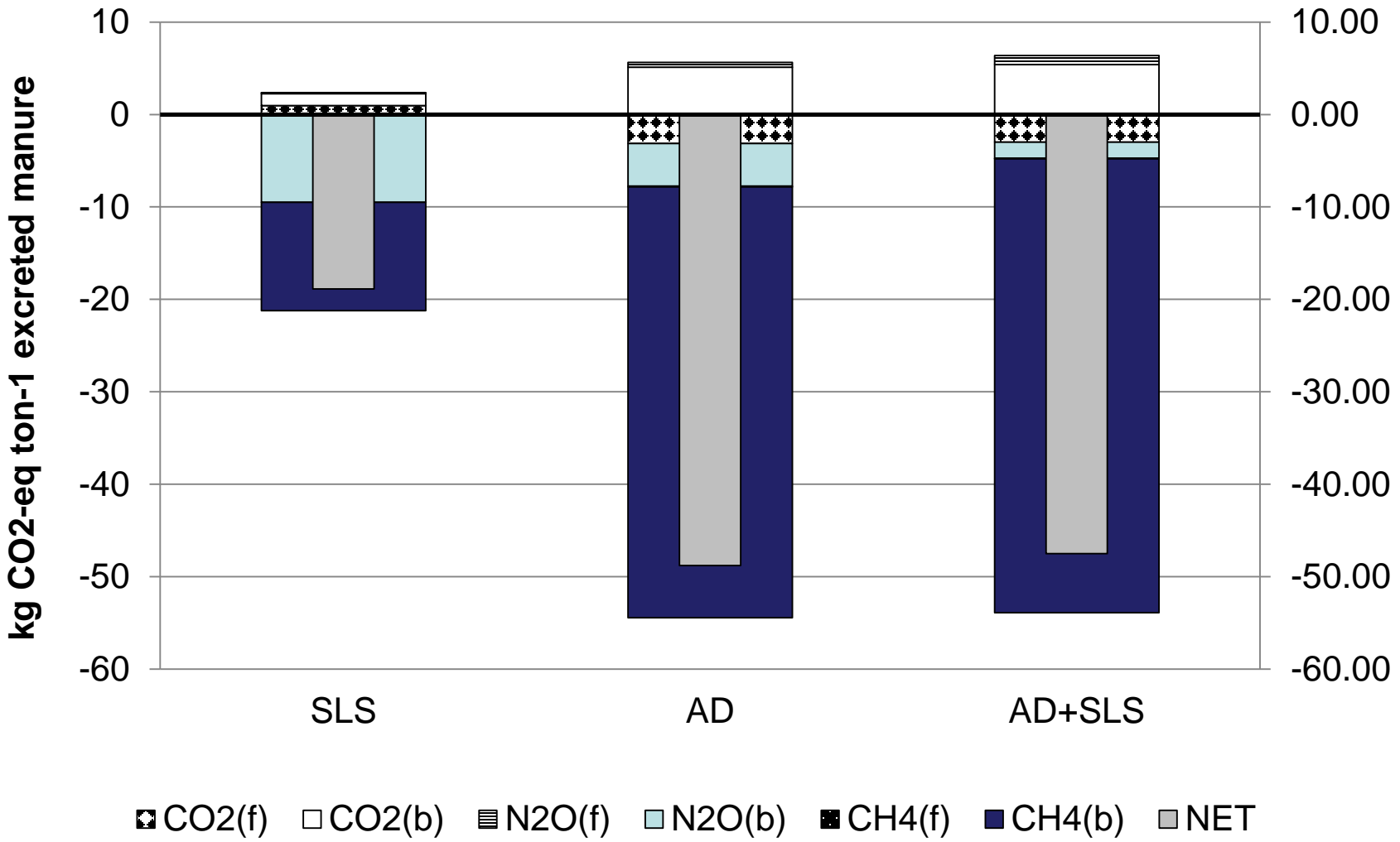
H.A. Aguirre-Villegas, R.A. Larson / Journal of Cleaner Production xxx (2017) 1–11



Understand Manure Systems

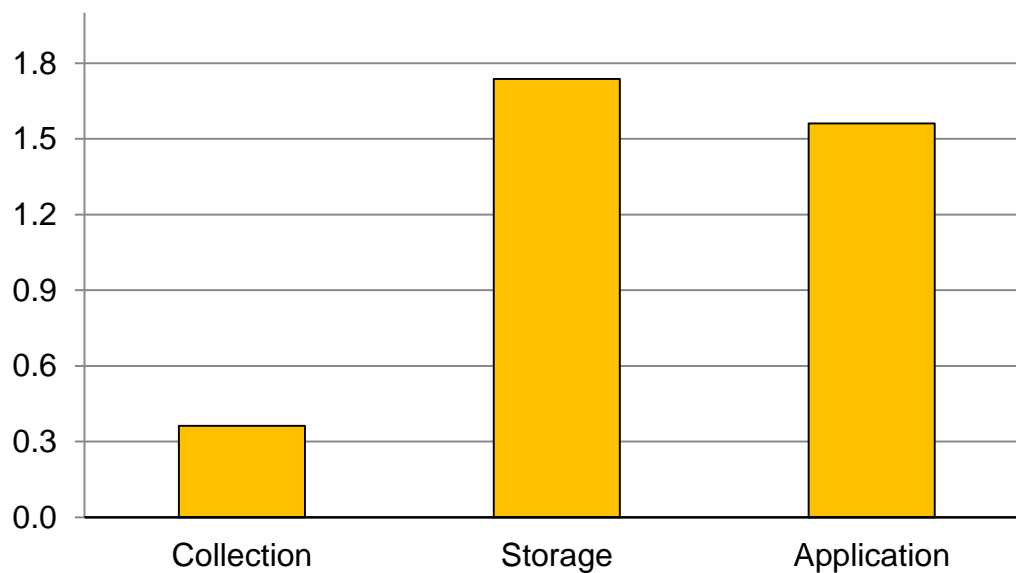
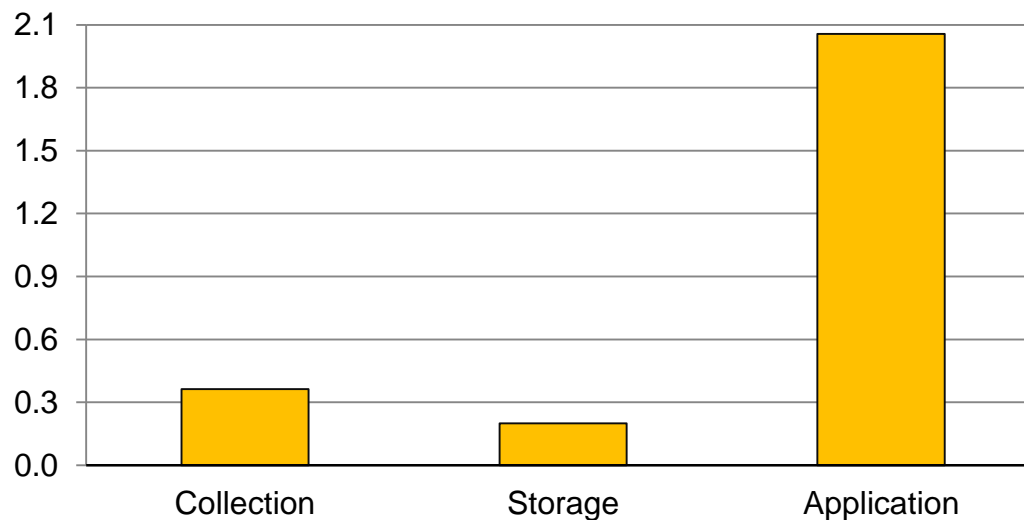


Global Warming Potential

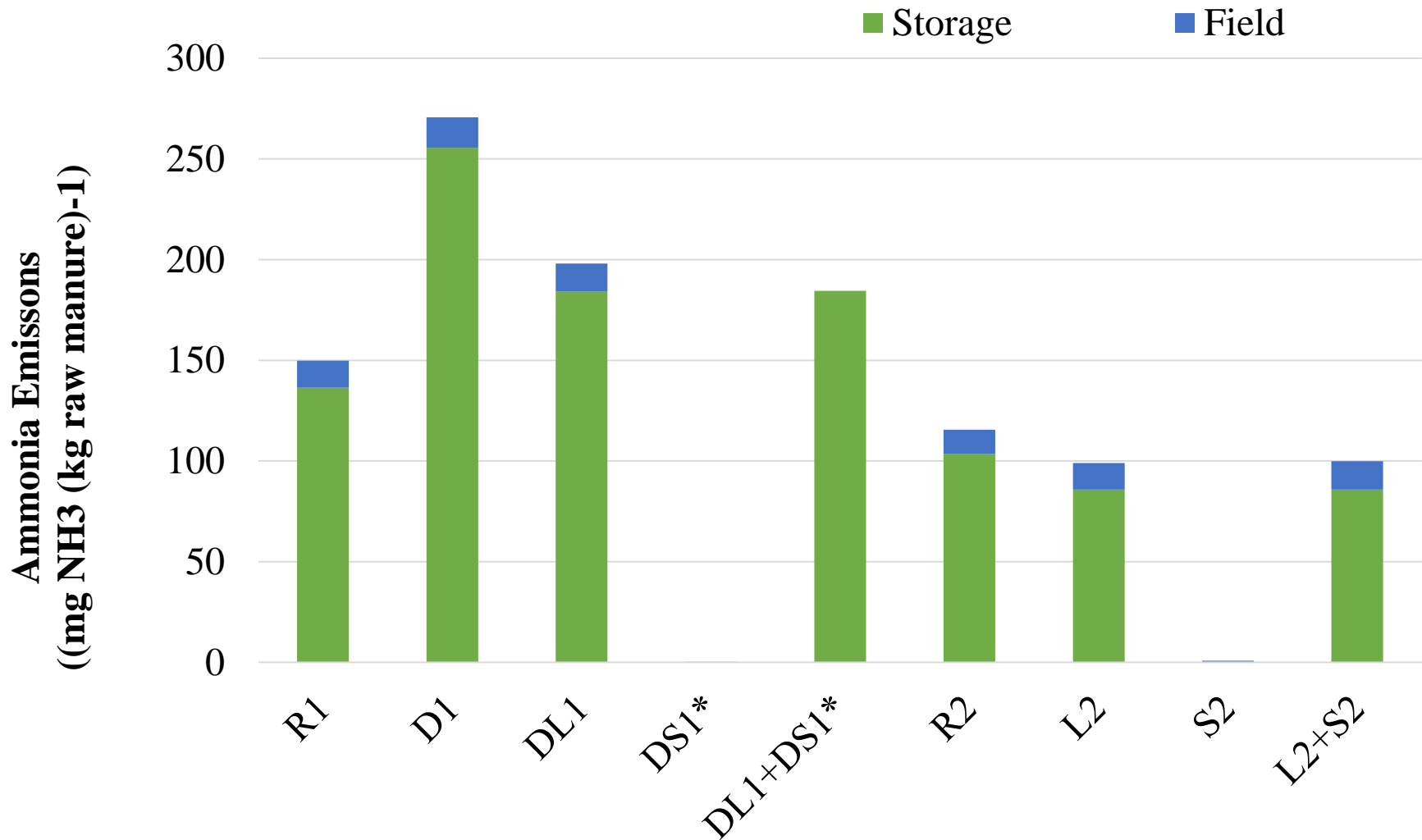


Ammonia Emissions

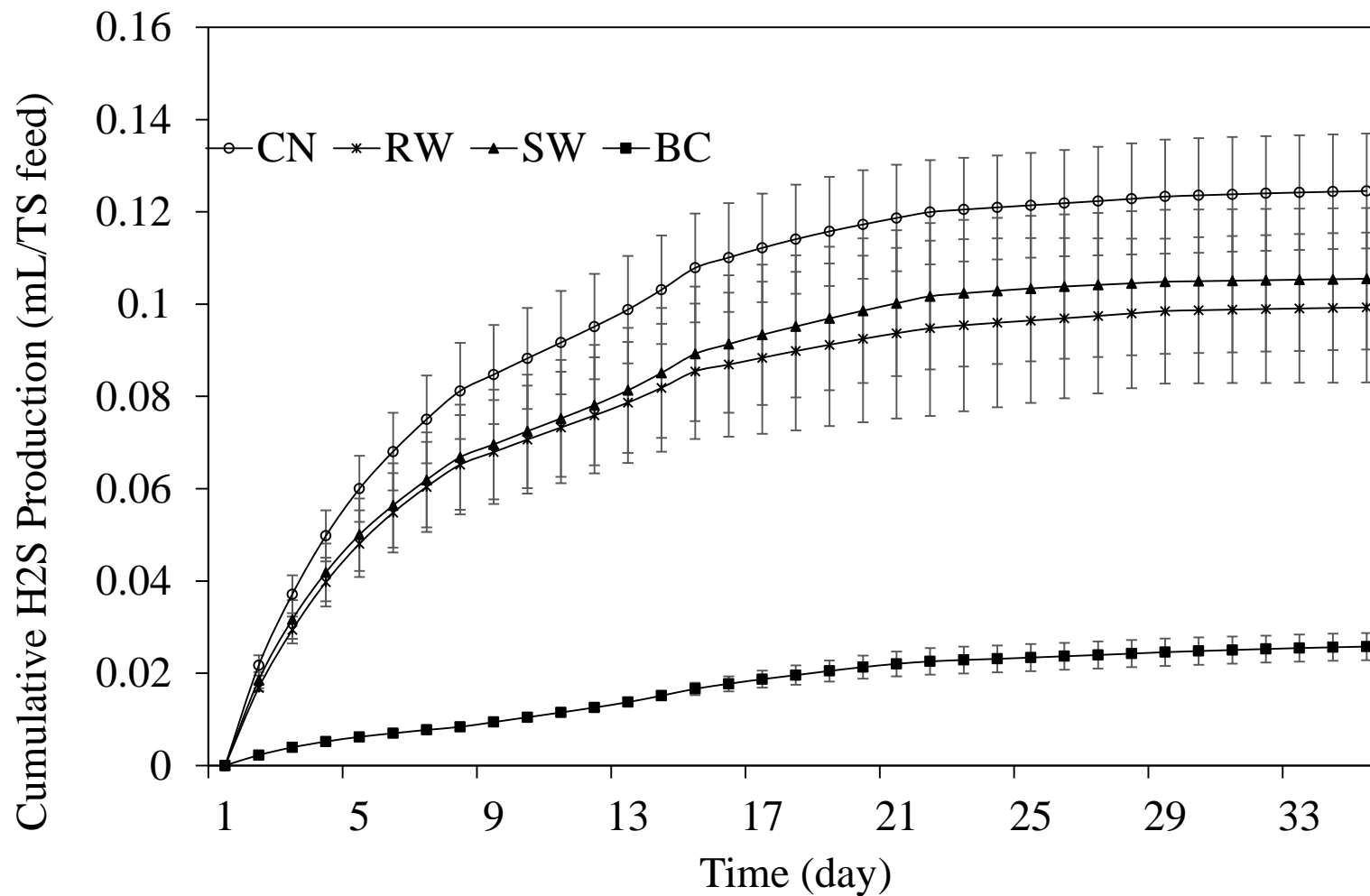
NH₃ emissions (kg NH₃ per ton of excreted manure)



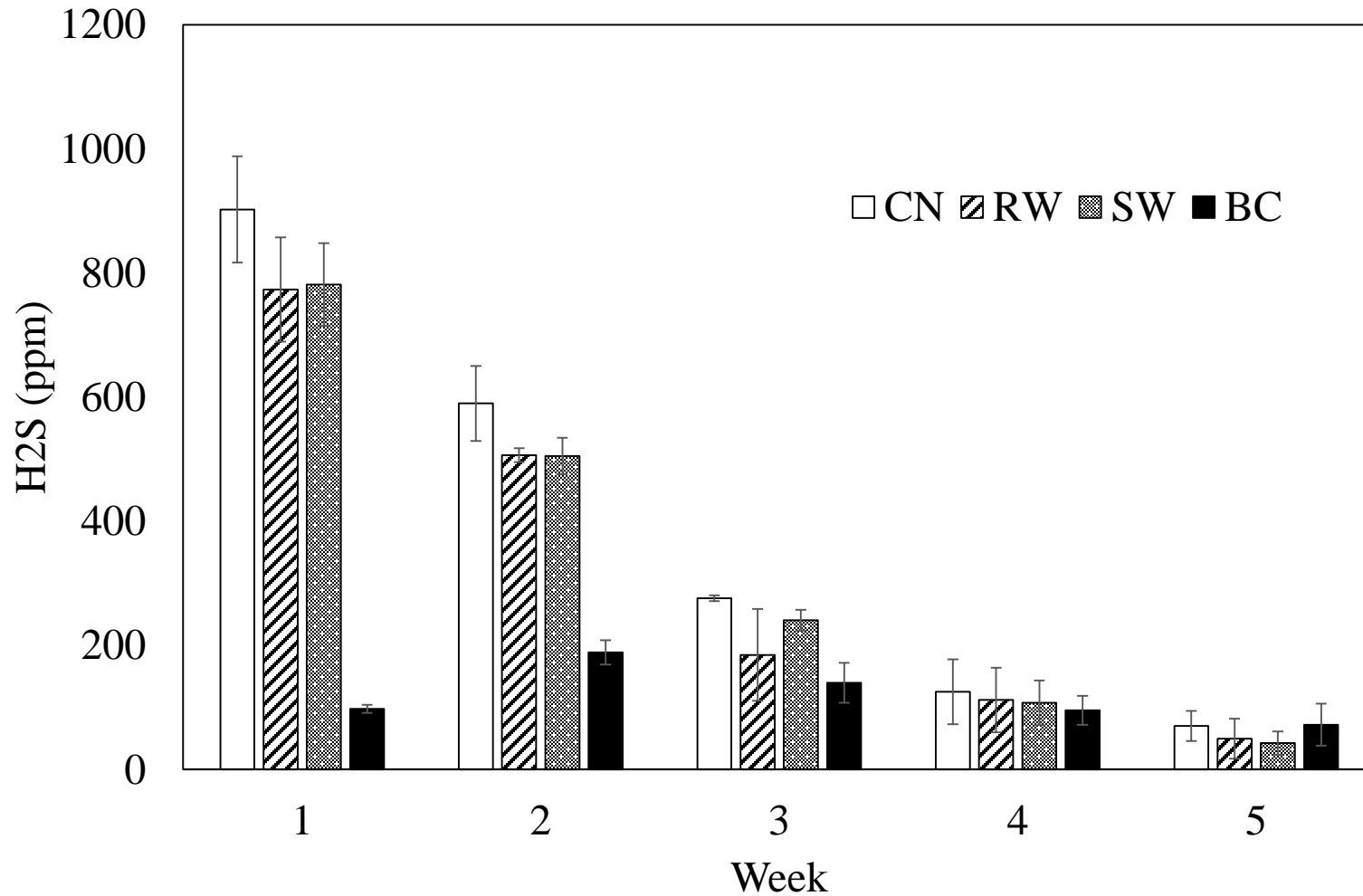
Ammonia Emissions Measurements



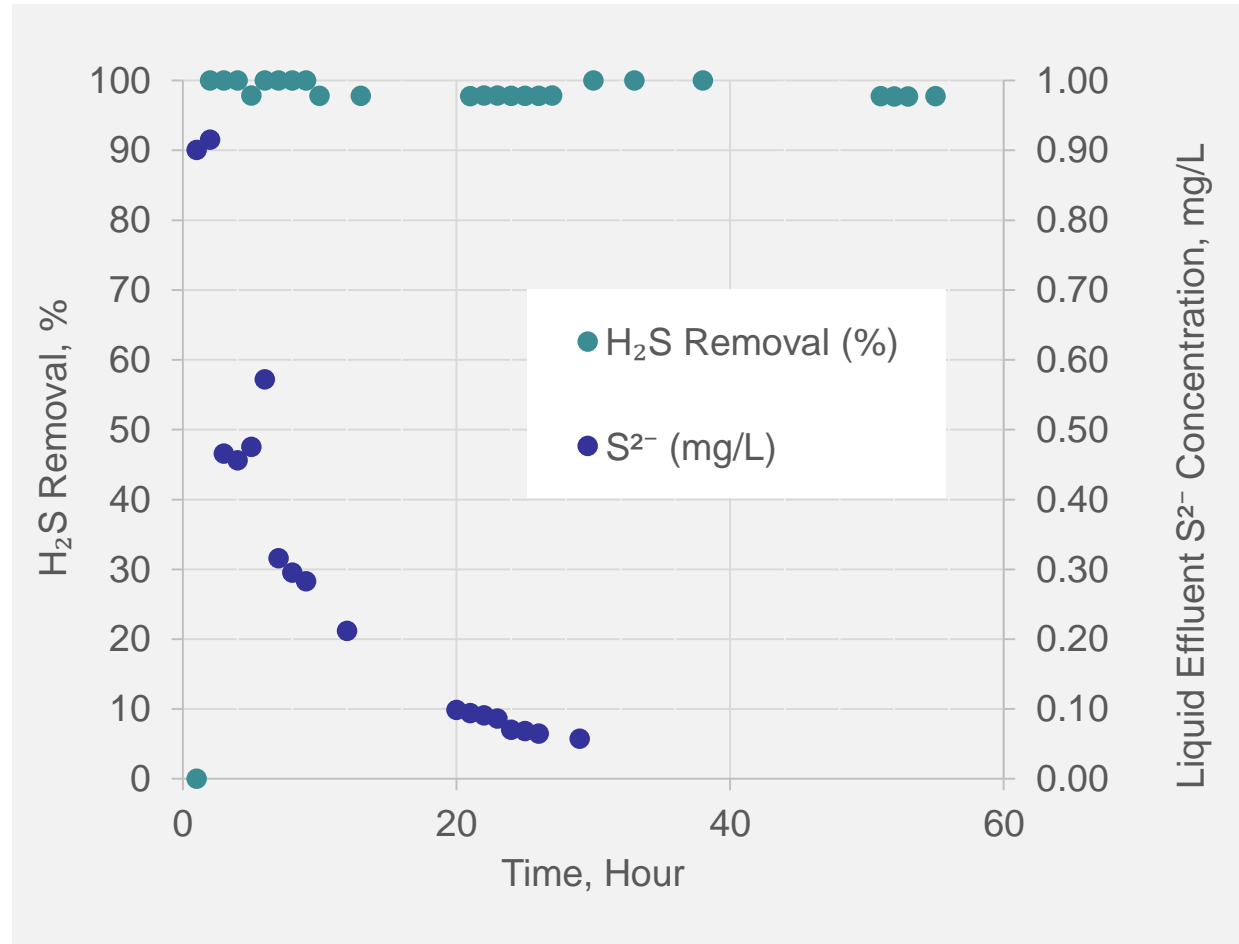
H₂S Research - Biochar



H₂S Research - Biochar



H₂S Research – Microbial Treatment



Fact Sheets and Online Training



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Sustainable Dairy Fact Sheet Series

Dairy Anaerobic Digestion Systems and their Impact on Greenhouse Gas and Ammonia Emissions

An Overview

Introduction

Anaerobic digestion is a process in which microorganisms degrade organic material, such as dairy manure, in the absence of oxygen to produce biogas and digestate. Biogas is composed mostly of methane and carbon dioxide. The degraded organic material contains nutrients that can be used to change form, then used as fertilizer (in biogas). Anaerobic digestion produces renewable energy when combined with antibiotics, and other products. As of 2015, there are over 1000 anaerobic digesters in the United States.

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BIOENERGY Training Center
ENERGY INDEPENDENCE BIOENERGY GENERATION AND ENVIRONMENTAL SUSTAINABILITY

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Home » Online Modules » Course 3: Anaerobic Digestion

Course 3: Anaerobic Digestion

Our third series contains **seven modules** focused on the use of anaerobic digestion technologies. Details of the process are introduced, as well as factors that influence start-up, operation and control of anaerobic digesters at different scales.

ANDIG 1: Introduction to Anaerobic Digestion

- Unit 1 – The Anaerobic Digestion Process
- Unit 2 – Applications of Anaerobic Digestion
- Unit 3 – Products from Anaerobic Digestion
- Unit 4 – Environmental Benefits and Concerns: Placing Anaerobic Digestion into Context

ANDIG 2: Factors that Affect Manure Digestion

TRAINING

Online Modules »

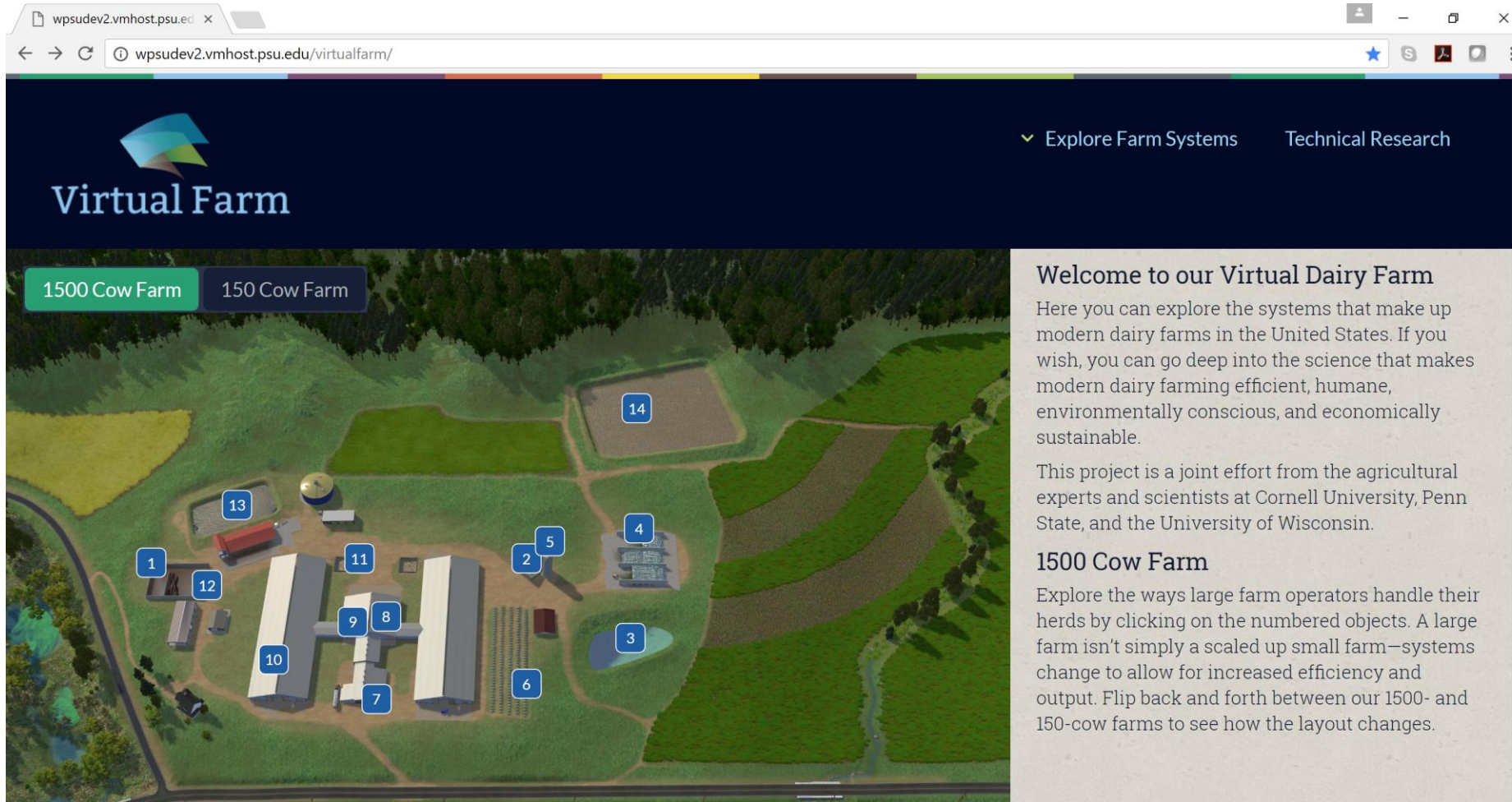
- Course 1: Bioenergy & Sustainability
- Course 2: On-farm Energy Conservation & Efficiency
- Course 3: Anaerobic Digestion

Instructor Led Sessions

Face-to-Face Training

TOOLS

Virtual Farm Development



wpsudev2.vmhost.psu.ed x

wpsudev2.vmhost.psu.edu/virtualfarm/

Virtual Farm

Explore Farm Systems Technical Research

1500 Cow Farm 150 Cow Farm

Welcome to our Virtual Dairy Farm

Here you can explore the systems that make up modern dairy farms in the United States. If you wish, you can go deep into the science that makes modern dairy farming efficient, humane, environmentally conscious, and economically sustainable.

This project is a joint effort from the agricultural experts and scientists at Cornell University, Penn State, and the University of Wisconsin.

1500 Cow Farm

Explore the ways large farm operators handle their herds by clicking on the numbered objects. A large farm isn't simply a scaled up small farm—systems change to allow for increased efficiency and output. Flip back and forth between our 1500- and 150-cow farms to see how the layout changes.

AD Training and Tours

LOCATION

Radisson Hotel & Conference Center
2040 Airport Drive
Green Bay, WI 54313

A block of room has been reserved. Single rate is \$82. Double rate is \$92. Reserve by January 30, 2017 and mention the Midwest Manure Summit to get these rates. Call 1-800-333-3333 to book your room.

REGISTRATION

Conference early-bird registration is \$225. Registration fees increase to \$300 after February 6th and to \$350 on the day of the event. Registration includes Wednesday lunch, Thursday breakfast and lunch, daily refreshments, and conference proceedings.

Pre-Conference Trainings

Tuesday, February 21

For complete agendas, visit www.midwestmanure.org

CHOOSE 1: TRACK A (Digesters) or TRACK B (Safety)

A. WI Anaerobic Digester Program (9:00 am—5:00 pm)

- Updates on National & WI Agricultural Biogas Outlook
- UW-Oshkosh Perspective (operating 3 digesters)
- Innovative solutions and current issues
- CHP Maintenance
- Upgrading to CNG
- Limiting H2S production & post-production removal
- Digestate Standard
- Safety Equipment Showcase

B. Developing Safety Plans for Manure Storage and

2017 Midwest Manure Summit

February 22 – 23, 2017



Midwest Manure Summit

February 22 and 23, 2017



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2017 Pre-Summits

****Participants can only attend one Pre-Summit track****

****Attendees must choose between Track A (Anaerobic Digesters) and Track B (Safety)****

TRACK A

Wisconsin Anaerobic Digester Pre-Summit Program

February 21, 2017

REGISTRATION DEADLINES

Early Bird Deadline - February 6th

Pre-Summit - \$150 per person

Summit - \$225 per person

After February 6th

Pre-Summit - \$200 per person

Summit - \$300 per person

Day of the Event

Summit - \$350 per person

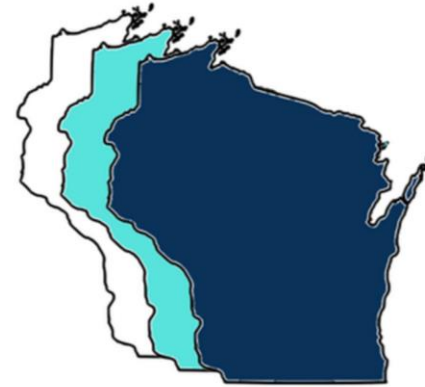
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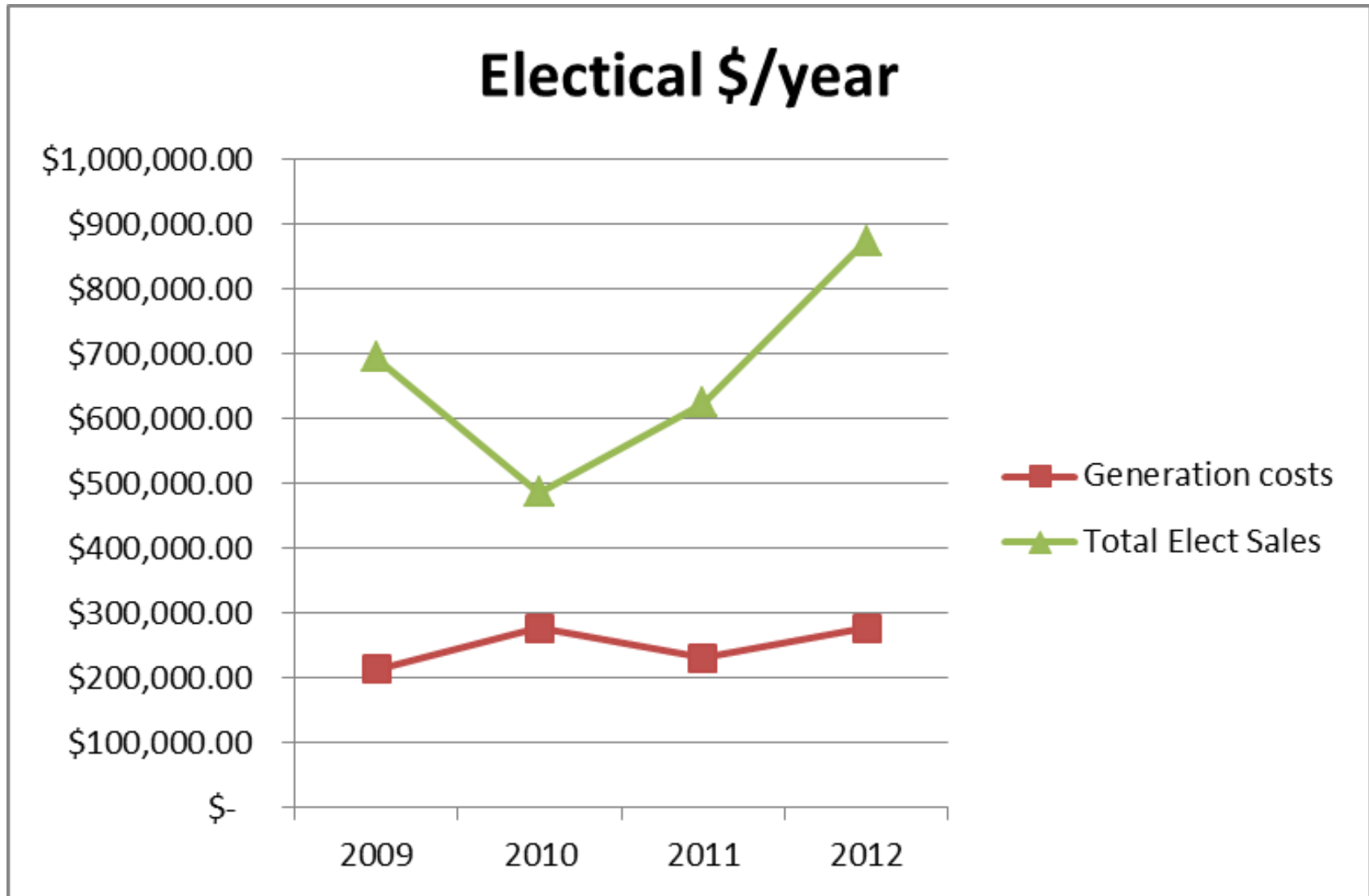
OSHKOSH



**Wisconsin
Biogas Council**



Economics and System Operation



Bob Nagel, 2013 Midwest Manure Summit

Biogas Use – Problems Remain



Biogas Alternative Uses



European Anaerobic Digestion Systems

- Over 13,000 digesters installed in European nations
- Nearly 10,000 in Germany alone
- Increased revenue for energy due to policy
- Many facilities have upgrading technology



Small Scale Digesters – Need Improvements



Nutrient Movement - Economics



Micro Scale Digestion - Africa



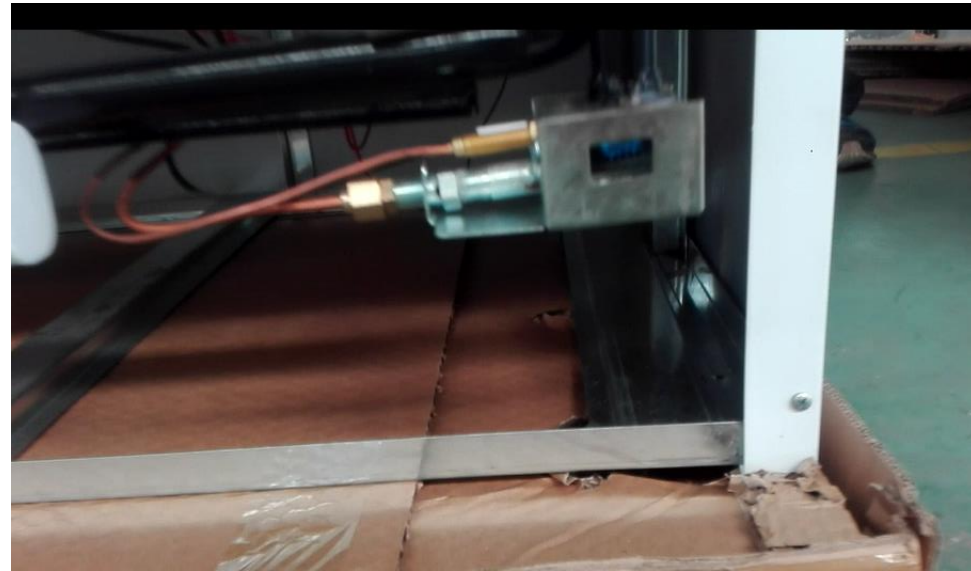
Digester Design Bolivia



Biogas Use - Cooking



Biogas Use – Absorption Chiller



Thank You!



**Biological Systems
Engineering**

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University of Wisconsin-Extension



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