# USDA-NRCS Conservation Innovation Grant *(CFDA 10.912)*
# Capturing Available Renewable Energy Resources Through Improved Mitigation of Environmental Protection On-Farms
# Final Report Presentation

Sep 2011 to Dec 2013

Prepared by: Earth By Design

# Introduction & Motivation

- Unsafe and improper disposal of carcass and animal mortalities result in:
  - Land and surface & ground water pollution
  - Ammonia & Nutrient leaching
  - Noxious Gas emmissions, including $CO_2$
  - Odors
  - Lost Revenue and Renewable Energy Sources

The livestock industry provides opportunities for affordable, sustainable, and renewable energy, but requires a safer means of disposal over traditional methods such as composting and incineration

- Best Management Recommendations
  - The strategic decision to implement policies and new support for Renewable Energy Projects
  - Support for new and continued opportunities to implement the innovative PAD technology
  - Identified Benefits for agricultural producers implementing PAD technology

# Agenda

- Project Overview
- Project Objectives
- Environmental Analysis
- Economic Analysis
  - PAD Technology Innovation
  - On-Farm Economic Analysis
- Permitting Analysis
- Project Demonstration Strategies
  - Project Budget, Schedule & Scope
  - Project Results
- Best Management Practices Recommendations
- Acknowledgements

# Project Overview

- Anaerobic digestion (AD) is a biological process in which biodegradable organic materials are decomposed in the absence of oxygen to produce usable gases such as methane.
  - Direct benefits including soil amendments; clean, nutrient rich water for crop applications, and opportunities for heat and electricity
  - Indirect benefits including clean waters, clean air, disease control and other environmental factors that support healthier agricultural operations
- Portable Anaerobic Digesters (PAD) innovative technology provides previously unavailable access to AD
  - Lower capital costs
  - Smaller Footprint
  - Sizeable and Transferable technology

# Project Objectives

- Demonstrate PAD technology on-farm to identify best management practices based on feasibility and benefits
  - Analyze historical and current trends in capital and operational costs and develop a sizing tool specific to PAD technology for use by Ag producers
  - Analyze historical and current trends in environmental impacts across Wyoming and locally (at the project site) to identify and score benefits from operations
  - Analyze implementation strategies and restrictions including permitting and grid interconnection

# Environmental Analysis

- Environmental Considerations for Wyoming
  - As new risks from animal mortality disposal methods used across the nation have identified contamination, there are limited studies in Wyoming
  - Existing studies still show a growing trend in identified pollutants in soil, water, and other resources that can be directly attributed to agricultural operations (extending into wildlife disease control and management)
  - Current strategies for mortality disposal favor composting and incineration, both of which still contribute negatively to the environment and require strict procedures of operation that are difficult to oversee and enforce.
  - USDA-NRCS, WDEQ and other agencies are leading the way for encouraging Ag producers to adopt more environmentally sound disposal methods

| Pollutant | Number of TMDLs Completed | Number of Causes of Impairment Addressed |
|---|---|---|
| Fecal Coliform | 4 | 4 |
| Ammonia | 2 | 2 |
| Ammonia, Un-ionized | 2 | 2 |
| Chlorine | 2 | 2 |
| Total Residual Chlorine | 2 | 2 |

Table 1: Cumulative TMDLs by Pollutant, Upper Bear Watershed (since 1995) (U.S. EPA, 2010)

# Economic Analysis

- Economic Considerations Specific to AD
  - Traditional AD costs of implementation are unattainable by most Ag producers. This is worsened by downward trends in the economy
  - AD does not typically balanced provide opportunities for income vs. cost offsets. Net Metering policies by the power utilities make conversion to electricity (the best, identified economic opportunity), simple or cost effective
  - Even community AD facilities are challenged due to the high costs of transportation
  - Opportunities demonstrated in this project have identified these concerns and provided recommended strategies

**ELECTRICAL ENERGY PRICES**

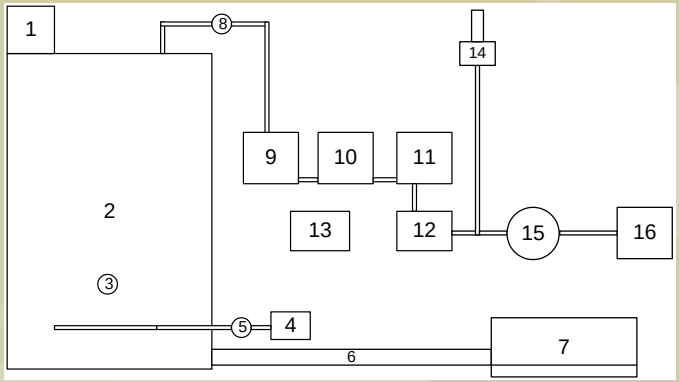
**NET METERING VALUE-**

**Source: ROCKY MOUNTAIN POWER[1]**

| | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|
| basic <500 kWh | 0.403 | 0.409045 | 0.4233616 | 0.4424128 | 0.4667456 |
| basic >500 kWh | 1.055 | 1.070825 | 1.1083039 | 1.1581775 | 1.2218773 |
| Demand <500 kWh | 2.45 | 2.48675 | 2.5737863 | 2.6896066 | 2.837535 |
| Demand >500 kWh | 6.331 | 6.425965 | 6.6508738 | 6.9501631 | 7.3324221 |

# PAD Technology Innovations

- Unique and Innovative Technology
  - Air-lock controlled feeding system for continuous loading with minimal to no affect on digester operations
  - Combination of motor and gas recirculation for stirring
  - Effluent containment provides de-watering, easy access, testing, and options for reversible chopper pumps can provide for re-digestion
  - Automated biogas measurement and flaring design in Grade A steel container minimizes labor and reduces risks
  - Conversion of biogas into usable natural gas can be utilized for direct injection into grid, electrical conversion or parasitic load – all automated
  - Portable design, small footprint and solar power offsets to electrical demands improve unit performance and increase productivity



# On-Farm Economic Analysis

- PAD Selection Tool
  - Provide customized selections such as quantity livestock mortalities per year, availability of co-digesting manure or other wastes, primary livestock selection, depreciation schedule, etc.
  - Analyze results using Pro-forma (Profit and Loss) tool, identifying Income off-sets, Operational costs, loan payback (financing options), and NPV of project
  - Negative NPV does not necessarily constitute a non-feasible opportunity. It provides a general guidance for considering the next step, which would be a feasibility study (which could possibly be funded by USDA-NRCS grants.

| Year: | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **INCOME/SAVINGS** | | | | | |
| Electricity Savings | $3,590 | $3,645 | $3,772 | $3,941 | $4,158 |
| Rendering Off-Set | $15,000 | $15,225 | $15,450 | $15,675 | $15,900 |
| Transportation Off-Set | $750 | $754 | $758 | $761 | $765 |
| Labor Off-set | $8,250 | $8,380 | $8,500 | $8,622 | $8,745 |
| Soil Savings | $127 | $128 | $129 | $129 | $130 |
| Water Savings | $120 | $121 | $121 | $122 | $122 |
| *escalator:* | *1.000* | *1.015* | *1.015* | *1.015* | *1.015* |
| *escalator:* | *1.000* | *1.005* | *1.005* | *1.005* | *1.005* |
| **Total Savings** | **$27,840** | **$28,250** | **$28,730** | **$29,250** | **$29,820** |
| **Operational Costs** | **$24,540** | **$24,760** | **$25,160** | **$25,655** | **$26,260** |
| **Net Profit/Loss from Operations** | **$3,300** | **$3,484** | **$3,570** | **$3,600** | **$3,565** |
| **Loan Payback** | -$37,115 | -$37,115 | -$37,115 | | |
| **Net Cash Flow** | **-$406** | **-$35680** | **-$34620** | **$2,520** | **$2,500** |

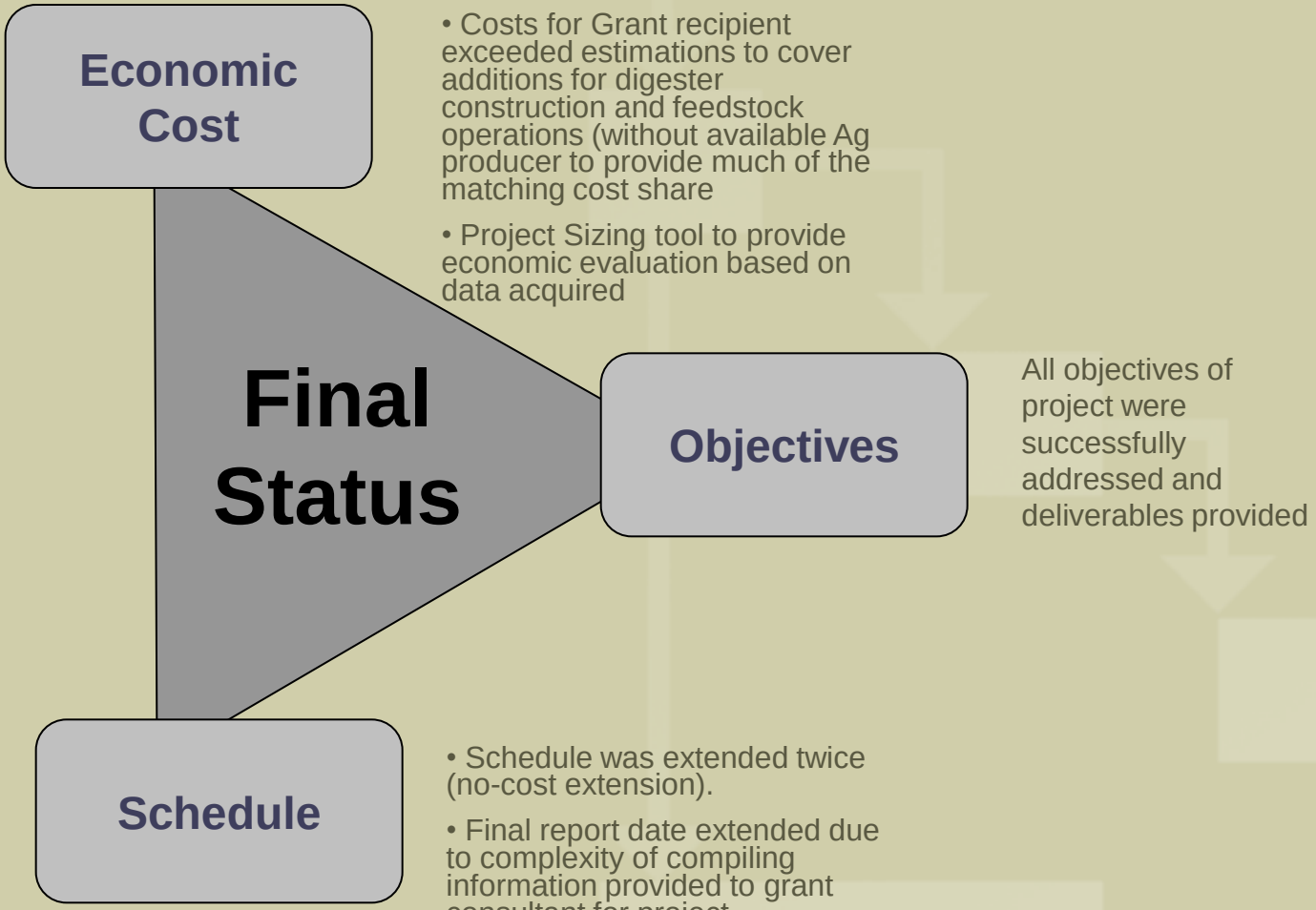
# Permitting Analysis

- Lack of AD projects have limited the opportunity for identifying permitting requirements and created undesirable complexity
  - Due to the biogas created in AD, flaring must be implemented for safety. Questions still exist as to whether or not WDEQ regulated incineration and possibly local County and City fire regulations permitting is required
  - Additional permitting regulations still in question include: Above ground gas storage tanks (AST), storm-water run-off, rendering (for pre-chopping of carcasses), soil applications, and others
  - Currently, WDEQ believes that permitting regulation changes will depend on a comprehensive review of the technology (requiring additional time and money)
  - New policy changes that support AD operations could include annual testing and performance records, obtained by Ag producers using certified testing methods, which could be easily uploaded into a database by agencies such as WDEQ and USDA-NRCS to determine compliance

# Project Demonstration Strategies

- **PAD Construction and Cost Analysis**
  - Obstacles Encountered
    - Timely implementation on-farms due to communications breakdown delayed on-site implementation
    - Two, no-cost extensions requested for this purpose. At time of final report, additional data is still being gathered to improve current recommendations
  - Lessons Learned
    - To fully analyze costs for transferability, new weatherization factors had to be implemented
    - Economics of interconnection did not originally include full interconnection tasks (as this was a discoverable during project operations)
    - Complexity of permitting introduced new factors to be considered before on-site implementation could occur.
    - Socioeconomic analysis needed an expansion into the questions being addressed to more fully understand neighboring concerns.

# Project Budget, Schedule, & Scope



# Project Results

- Economic Analysis
  - Project economics are a huge variable. Further studies to help support a better understanding of implementation opportunities will help narrow down these variations. Project demonstration indicates that small to medium sized producers could still benefit from PAD technology due to reductions in costs associated with current disposal methods (such as transportation, intake costs, etc.)
- Environmental Analysis
  - AD is a more sound environmental mitigation technology over most other methods. Water, soil and air quality was all improved using the PAD technology. Coliform bacteria was successfully destroyed to a significant level (especially over no treatment at all), providing improvements in disease control
- Socioeconomic and Regulations
  - There is an interest by the Ag community in new technology, supporting next step considerations for technology adoption
  - Next steps for regulations and permitting could be incorporated into new studies, or adopted with future, state legislation for AD in general, providing better support for PAD technology

# Best Management Practice Recommendations

- Permitting & Regulating Agencies
  - New policy implementation and consideration for review of PAD technology to further adopt low-cost permitting and compliance strategies
- Interconnection
  - New incentives and regulations to stabilize the net metering economics and support improved waste management infrastructure
- USDA-NRCS
  - Review of deliverables with commentary and recommendations for improvements and changes (internally and to grant recipient)
  - Considerations for opportunities to support AD operations based on environmental benefits and attributes, also supporting PAD technology to mitigate environmental protection and provide new opportunities for compliance ensurance
  - Continue to work with grant recipient to identify new opportunities for additional feasibility studies for Wyoming Ag producers and improve considerations for PAD implementation to further support USDA-NRCS efforts

# Acknowledgement


- This project was successful due to the combined support of several agencies:
  - Wyoming Farm Bureau Federation
  - Wyoming Department of Agriculture (WDA)
  - Wyoming Department of Environmental Quality (WDEQ)
  - Wyoming Game and Fish Department (WGFD)
  - University of Wyoming
  - U.S. Department of Agriculture, Natural Resources Conservation Service (USDA-NRCS)
  - And others
- Final Deliverables for this Project:
  - Final Project Report, PAD Sizing Tool, BEMP Brochure & Power Point Presentation

# Thank You

- PAD Technology Developer & Grant Recipient:

Earth By Design, Inc.
20407 Cady Way
Bend, OR 97701
Phone: 541-385-1135
jgrenewables@hotmail.com
www.earthbydesign.com*
*(*being updated as of the date of report submittal)*