

Determining the Economic Feasibility of Anaerobic Digestion in Colorado: Guidelines for Animal Farm Producers¹

The purpose of this article is to provide guidance to animal farm producers about whether anaerobic digestion is likely to be economically feasible for their operation.

Overview of anaerobic digestion projects

Anaerobic digestion is a biological process by which microorganisms convert organic material into biogas, containing methane and carbon dioxide. Biogas produced by this process can be utilized to generate electricity or can be cleaned up and supplied to natural gas lines. Anaerobic digestion is often considered an environmentally desirable waste management solution. In the digestion process, organics are removed as they are converted to methane while nutrients (nitrogen and phosphorus) are conserved. The end product is a low odor, high nutrient, stabilized waste suitable for land application as fertilizer. The greenhouse gases can be captured and used for energy, rather than simply released into the atmosphere.²

There are many complexities involved with anaerobic digestion installation and operation.

Before considering the financial aspects, it is important to first determine whether anaerobic

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² Readers interested in learning more about anaerobic digestion technology in general should consult Sharvelle and Loetscher (2011).

digestion is even a technically feasible option at one's operation.³ The type of technology required will also affect the total project cost. Therefore, a detailed financial analysis will be necessary in order to appropriately calculate the revenues and costs that might be associated with an anaerobic digester at a particular location.

In summary, this document should be used as a screening tool to assess whether or not an anaerobic digester could be economically feasible at one's operation, and whether or not to proceed with a detailed financial analysis. Information contained within this report is specific to the intermountain west where the arid climate, scarce water resources, and energy policies affect the economic viability of anaerobic digesters differently than other areas of the nation. Readers interested in learning more about the economic viability of anaerobic digestion at their operation are encouraged to review references provided at the end of the document, and are welcome to contact the author.

General Cost Information: The economic feasibility of an anaerobic digester is directly linked to how well the costs are contained. This section provides an overview of three types of costs: capital costs, operating costs, and demand charges.

Capital costs: According to EPA Ag Star (<http://www.epa.gov/agstar/>), the capital cost of an on-farm anaerobic digester ranges from approximately \$400,000 to \$5,000,000 depending upon the

³ More information about the technical feasibility of anaerobic digestion can be found in Sharvelle and Loetscher (2011).

size of the operation and technology used. The typical on-farm anaerobic digestion unit costs approximately \$1.2 million. Costs vary, depending upon the size of the unit, design, and features. The type of anaerobic digester necessary for one's operation (and therefore the cost of the anaerobic digester) also varies according to the number of livestock and technical considerations like temperature. For example, the type of unit installed in Weld County in northern Colorado would likely differ from a digester installed in Otero County in southeastern Colorado. The Weld County digester would require additional features to facilitate the heating process during cold weather, and would likely involve a higher cost.

Most digesters are semi-customized by the technology producer, so capital outlay and operating/maintenance costs differ considerably. Many capital costs for building an anaerobic digester can be subsidized by grants or low cost loans. The Ag Star website is updated frequently with information about federal and state funding opportunities for anaerobic digestion projects. Due to the capital-intensive nature of anaerobic digestion, it is recommended that operators thoroughly understand the parameters of any funding programs prior to investing in a digestion system. Operators may wish to discuss any loan risk associated with a methane digester with an agricultural loan officer to ensure that additional debt will not compromise one's ability to access capital for the existing operation.

Operating Costs:

Annual operation and maintenance costs (like maintenance, repairs, parts, labor, and insurance), must also be included when considering the cost of an anaerobic digestion system. The AgSTAR website provides a good overview of expected costs and revenues. However,

Coloradoans pay lower electricity prices compared to other regions in the country, and should be particularly wary of relying on anaerobic digestion to generate revenues by selling electricity to the utility.

To further elaborate, one should determine the extent to which costs will be offset by generating revenues and/or reducing energy expenditures over the life of the digester. Utility contracts can vary considerably throughout rural communities. Most electric utilities have “net metering” policies, where small energy generators (like those with an anaerobic digester), can offset their energy consumption by producing their own electricity. However, the value of the offset differs by utility. Colorado’s electricity generation, transmission, and distribution infrastructure is very complex and policies vary by region.⁴ Some utilities will credit net-metered power at the retail rate, meaning that there is a direct offset for every kilowatt-hour of electrical production. Other utilities credit net-metered power at a discounted or wholesale rate.⁵

Ag producers should thoroughly understand their utility’s net metering policy. Be aware that the utility may not be willing to purchase the power. One should also check to see if there are contractual terms that might be problematic. Some utilities require a guaranteed amount of power be supplied in a given time period. Others require notice of changes in electrical production. These considerations should be taken into account as one considers possible revenue

⁴ Interested readers may learn more about Colorado’s energy infrastructure through the Colorado Governor’s Energy Office 2010 REDI Report:
http://www.rechargecolorado.com/index.php/programs_overview/renewable_energy_development_infrastructure

⁵ Colorado Revised Statutes C.R.S. 40-9.5-118(2009) outlines net metering policy, but these policies may differ throughout rural communities, where most farm animal operations are built. As follows are links to Colorado’s revised statutes:
<http://www.dsireusa.org/documents/Incentives/CO26R2.htm> and
<http://www.dsireusa.org/documents/Incentives/CO26R1.htm>

generation from anaerobic digestion power sales. In order to increase profitability, producers should focus on reducing operation and maintenance costs, as well as offsetting energy usage with the anaerobic digester system.

Demand Charges:

“Demand charges” are also referred to as “power charges”. The demand charge is a measurement of the rate at which energy is used during a month. Most energy providers measure the customer’s highest amount of energy used in a 15-minute time interval during a billing cycle, and charge the customer based upon that 15-minute period of time. The implication is that if an animal farm operation is relying on an anaerobic digester to reduce energy usage, the operator will still pay a power demand charge. This charge could be high if the digester is offline for even 15 minutes during a month during a time of peak energy use, like the late afternoon.

Animal farm producers should expect that they will frequently pay monthly demand charges. Research by Keske (2009) found the maintenance involved with cleaning and servicing on-farm anaerobic digestion units frequently required unexpected unit shut-down time of at least 15 minutes per month, resulting in monthly demand charges. Demand charges are not usually offset in net metering, but can comprise up to half of one’s electrical expense.

In summary, while in the process of selecting a digester technology, an operator should outline expected costs and revenues over the life of the digester. If the project progresses to a point where a technology provider is contacted, more detailed analysis will be required.

Five Indicators of Economic Feasibility

Although it is important to actually crunch the numbers, five indicators can suggest whether an anaerobic digester might be economically feasible at a farm animal operation. As previously stated, these indicators should be viewed as a screening tool. The indicators can help determine whether one should pursue a comprehensive feasibility study. These criteria have been selected based upon studies conducted in the intermountain west by Keske (2009), Sharvelle and Keske (2011), and Keske (2011). If an operation meets *at least two* of the criteria, it might be worth the time to conduct a more detailed spreadsheet analysis. The indicators are as follows:

1. Operation meets the definition of a Confined Animal Feeding Operation (CAFO).
2. There is a waste stream that could be combined with the waste stream of another operation or business. That is, there is potential for “co-digestion”.
3. Operation receives frequent and/or credible complaints about odor.
4. Operation produces swine or chickens.
5. Operation incurs more than \$5,000 in average electricity or heating expenditures per month.

Discussion of the Five Indicators

- 1) *The operation meets the definition of a CAFO.* CAFOs must comply with state and federal laws governing waste management practices. An anaerobic digester might complement a CAFO’s plan for air emissions, nutrient, or waste management.



Bella Holstein in Platteville, Colorado. Photo courtesy of Luke Loetcher.

2) Co-digestion potential

When animal farm operators and related industries (eg. food manufacturers) or municipal waste treatment facilities are located nearby, there may be efficiencies that can improve the economic viability of a project.

Feasibility studies have shown that co-digestion projects might be economically viable in the intermountain west (Stewart Environmental, 2008; Keske, 2009; City of Greeley and Symbios, 2009). Interested readers should review one of the reports in the reference section for more information about co-digestion.

3) Operation receives frequent and/or credible complaints about odor.

Anaerobic digestion units can provide a measurable reduction in odor, which can help to improve neighbor relations and mitigate nuisance lawsuits. The financial risk associated with an odor-related nuisance lawsuit can be difficult to estimate because information about damage awards is not readily available. The majority of cases are settled outside of court and insurance companies typically pay a portion of the settlements. Most verdicts and settlements are not publicly reported.

However, a summary of some recent settlements is provided below, published in Keske (2011).

The table lists the year, state, type of operation, plaintiff and award amount.

Summary of Financial Awards from Agricultural Nuisance Suits

Claims Awarded in Nuisance Suits				
Year	State	Award	Plaintiff/Case	Operation
1991	NE	\$375,600	Kopecky v. National Farms, Inc.	Swine
1996	KS	\$12,100	Settlement—plaintiff/respondent both undisclosed in news article.	Swine
1998	KS	> \$15,000	Twietmeyer v. Blocker	Beef feedlot
1999	MO	\$5,200,000	Vernon Hanes et al. v. Continental Grain Company	Swine
2001	OH	\$19,182,483	Seelke et al. v. Buckeye Egg Farm, LLC and Pohlman	Egg/Poultry
2002	IA	\$33,065,000	Blass, McKnight, Henrickson, and Langbein v. Iowa Select Farms	Swine
2004	OH	\$50,000,000	Bear et al. v. Buckeye Egg Farm, Anton Pohlman and Croton Farms, LLC	Egg/Poultry
2006	AL	\$100,000	Sierra Club, Jones, and Ivey v. Whitaker and Sons LLC	Swine
2006	MO	\$4,500,000	Turner v. Premium Standard Farms Inc.; Contigroup Co., Inc.	Swine
2007	IL	\$27,000	State of Illinois (Plaintiff). Respondent undisclosed.	Swine

Avoiding a lawsuit and the potential financial liability may help justify the capital expenditure of an anaerobic digestion project.

4) Operation produces swine or chickens

Many nuisance claims involve swine or poultry operations. These operations have also involved high punitive damage awards. This history may encourage swine and poultry producers to consider adoption of anaerobic digestion units as a management practice to reduce the risk of a nuisance claims. The exact cause leading up to these nuisance lawsuits is not clearly established; however, it is likely related to the strength and persistence of odor. The history of nuisance lawsuits involving swine and poultry operations indicates that even operations located in rural communities with very few neighbors could still be vulnerable to a lawsuit. An anaerobic digester could be used for conflict mitigation.

5) Operation incurs more than \$5,000 in electricity or heating expenditures per month, on average

An operation's ability to offset average monthly energy costs affects whether a digester might be economically feasible. At this writing, in the intermountain west, an anaerobic digester might be economically feasible if a producer has the potential to offset a minimum of \$5,000 in electricity or heating costs for an entire operation.

Electricity and heating expenditures reflect a specific category of operating expenses that an anaerobic digester could offset. These expenditures include propane, natural gas, and/or electricity. If an operation has more than \$5,000 in average energy costs each month, a detailed financial analysis should still be conducted to determine whether those costs could really be

offset by implementing a digester. Naturally, the type of digester necessary for an operation will also affect the economic feasibility.

The most cost-effective means of utilizing energy from the digester is in direct use of biogas as a replacement to natural gas. If a feeding operation is incurring over \$5,000 in energy costs per month, the potential exists for many of these expenses to be off-set with use of the biogas – rather than focusing on converting the methane gas to electricity. This is because additional costs are incurred when converting methane gas to electricity. Avoiding such costs will yield a higher net economic impact compared to any potential revenues that might be generated from supplying electricity to the grid (Keske, 2009). As examples of additional costs required for electrical generation, a generator is required to convert methane gas into electricity, making it more expensive to operate. In addition to the extra capital outlay for a generator, operations need to plan on maintenance, labor costs, and back-up electricity resources. An operation that strictly uses biogas would likely incur fewer expenses.

Low electricity costs make it more difficult to justify a digester investment. Return on investment is longer when electricity costs are low and there is greater value to selling excess electricity produced, to offsetting consumption. In the intermountain west, electricity costs are generally lower than the eastern United States. This is primarily due to relatively inexpensive coal and hydroelectric resources that are available for electricity generation in the intermountain west. While the environmental damages resulting from burning coal could be factored into future energy policy, the current price per KWh of electricity is low compared to other regions of the country (Keske, 2011; Keske, 2010; Keske, 2009; Leuer, Hyde, and Richard, 2008).



Electrical generator for an anaerobic digester in Wheatland, Wyoming. Photo courtesy of Catherine Keske

Other Considerations for Economic Feasibility

The intermountain west presents unique environmental issues that might affect economic feasibility for a digester. For example, low humidity and scarce water resources result in low water and high solids content in manure. This means that additional expenses would likely be incurred for water and pre-treatment for rock and other solids. Likewise, it is may be more

expensive to add water necessary for microbial function, compared to eastern dairies. Most anaerobic digestion feasibility studies that are currently available are relevant to the eastern United States, where electricity prices are relatively higher and water resources are more readily available. As follows are considerations for a budget analysis:

- Include the cost of water in the spreadsheet.
- Do not count on revenues from greenhouse gas offsets to fund the system. These markets are voluntary in the United States and have shown considerable price volatility and low prices in recent years.
- Review state guidelines to determine waste transport policies for on- or off-site locations, before calculating potential tipping fees.
- Account for maintenance and labor costs, in addition to the capital outlay of an electricity generator.
- Account for monthly demand charges and periodic use of non-farm generated power, in the event that the system is down for maintenance.
- Understand state and utility company policies about net metering and energy buy-back programs.
- Be sure to consider all of the costs associated with storing and transporting manure (including extra storage buildings).
- Consider the location of the digester relative to utility infrastructure. The cost to tie into the grid, for example, can be high depending on the operation's proximity to the utility infrastructure.

- Include potential costs associated with handling or using end products after the waste has been digested. While some solid and liquid end products which can be land applied, there may costs associated with handling these products.
- Estimate the methane generation potential and maintain a realistic perspective of energy costs that might be offset.
- Factor in risk. Prices can vary considerably. Be sure to look at the most likely, and the worst case scenarios.

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