Chapter 2 Preliminary Screening for Project Opportunities

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This chapter presents a preliminary screening process for livestock producers, developers, or others considering biogas recovery to determine if their livestock facility is a candidate for a biogas project. In general, facilities that collect large amounts of manure daily, or at least weekly, should consider biogas technology.

The screening criteria are as follows:

1. **Is Your Confined Livestock Facility (Dairy or Hog) "Large"?** For screening purposes, livestock facilities with at least 500 head of dairy cows/steers or 2,000 sows or feeder pigs in confinement, where at least 90 percent of the manure is collected regularly, are potential candidates. Facilities of this size produce enough manure to generate the biogas required to support a financially viable project. It should be noted, however, that this size criterion is <u>not</u> absolute. Smaller confined facilities could potentially support successful recovery projects, given certain site-specific and market conditions.

Note: "Large" is referred to here for purposes of biogas assessment, and does not pertain to any other agency definition or program.

2. **Is Manure Production and Collection Stable Year-Round?** Animal facilities that have little variation in the daily confined animal populations have predictable manure production. This will ensure that a consistent amount of manure is available for collection year-round.

3. **Is Your Manure Management Compatible with Biogas Technology?** Biogas technology requires the manure to be: managed as liquid, slurry, or semi-solid; collected at one point; collected regularly (daily or weekly); and free of large quantities of bedding and other materials (e.g., rocks, stones, sand, straw). Farms with such manure management practices provide an opportunity to install a biogas system.

4. **Is There a Use for the Energy Recovered?** The potential to use the recovered biogas for energy plays a significant role in determining the cost-effectiveness of the biogas project. Both on-farm energy requirements and the possibility of selling energy off-site should be considered. In general, any piece of equipment that uses propane or natural gas as a fuel source can potentially be operated using biogas.

5. **Will You be Able to Manage the System Efficiently?** Biogas systems are a management responsibility. Efficient system management requires the owner/operator to:

    1. pay regular attention to system operations;

    2. provide necessary repair and maintenance; and,

    3. have the desire to see the system succeed.

Each of the steps in the assessment is discussed in turn. This chapter concludes with a summary of the overall appraisal.

2-1. Is the Confined Livestock Facility "Large"?

Confined animals produce collectable manure for digestion consistently all year round. Large livestock facilities generally produce enough manure to support a biogas project. Such farms have predictable biogas yields available to offset energy usage.

2-1.1 Is the Livestock Facility "Large"

Livestock facility size is a primary indicator of whether biogas recovery will be economically feasible.

Although there are many factors that influence biogas production from livestock manure, the amount of manure collected determines the amount of biogas that can be produced. The amount of manure produced by a livestock facility will be directly related to the number of animals in the facility. However, biogas can only be produced from fresh manure collected on a regular schedule, with a minimum amount of contamination. With this in mind, the number of animals (dairy cows or hogs) in a facility can be used as an indicator of whether that

operation generates, or has the potential to generate, a significant amount of biogas. The number of animals and proportion of the manure collected can be used to indicate whether more detailed technical assessments should be undertaken.

As a general rule of thumb, manure collection *equivalent* to the total daily manure production from **500 dairy cows or 2,000 sows or feeder pigs** is the minimum size to be considered. This rough estimate takes into account the general manure production rate and manure composition of these animals. This minimum value is not absolute. Other factors, such as climate, diet, value of energy, odor and other environmental concerns, and existing manure management system can affect this minimum value. The software tool, FarmWare contained in this handbook allows you to evaluate the impact of these factors in terms of farm costs and benefits.

2-1.2 Is Manure Production and Collection Stable Year Round?

In addition to a minimum number of animals from which manure is collected, candidate facilities should have relatively constant animal populations year round. This will ensure that a consistent amount of manure is available for collection year round. Knowing the amount of collectible manure is critical in sizing the digester and gas use components. If the daily manure produced is greater or less than the digester capacity, there will be additional costs of manure management or loss of revenues and/or savings from under-utilization.

For example, in a free-stall dairy where the animals remain confined in a free-stall barn throughout the year, manure can be collected consistently - allowing the digester to be fueled all year round. Alternatively, animals that are pastured in summer and housed in a barn in winter will not provide a steady supply of manure to the digester year round.

2-2. Is Your Manure Management Compatible with Biogas Technology?

Biogas production is best suited for farms that collect liquid, slurry, or semi-solid manure with little or no bedding regularly. This requires the facility to collect manure:

- as a liquid, slurry, or semi-solid;
- at a single point;
- every day or every other day;
- free of large amounts of bedding or other materials (e.g., rocks, stones, straw, sand)

These conditions ensure consistent digester feedstock and continued biogas production. Each condition is discussed in turn.

Exhibit 2-3 presents a simple checklist for manure

Exhibit 2-1 Checklist for Facility Characteristics

1.	Do you have at least 500 cows/steer or 2,000 pigs at your facility?	Yes ❑	No ❑
2.	Are these animals in confinement all year round?	Yes ❑	No ❑
3.	The average animal population does not vary by more than 20% in a year?	Yes ❑	No ❑

If the answer is **YES** to all the above questions, your facility is in good shape. Proceed to the next section. If the answer is **NO** to one or more of the above questions, the production and utilization of biogas as a fuel may not be suitable for your facility. For biogas production and utilization to succeed, a continuous and relatively consistent flow of biogas is required. However, collecting and flaring biogas can reduce odors. Therefore, also proceed to the next section if you have the need for an effective odor control strategy.

management conditions favoring biogas technology.

2-2.1 What Type of Manure Is Collected?

Livestock facilities that collect manure as a liquid, slurry, or semi-solid are the best candidates for biogas recovery projects. At such facilities, farm operators will know the daily operational management requirements for these materials and it is likely that the manure can be digested to produce biogas.

Whether manure is handled as a semi-solid, slurry, or liquid at a particular facility depends on its total solids content. Exhibit 2-2 shows the manure characteristics and handling systems that are appropriate for specific types of biogas production systems.

Manure handled as a liquid has a total solids content of less than 5%; a manure slurry has a solids content of 5% to 10%; and semi-solid manure has a solids content of 10% to 20%. Liquid, slurry, and semi-solid systems have high biogas production potentials and offer substantial greenhouse gas reduction potential. These management systems are widely used on swine and dairy operations, and under some conditions can produce undesirable odor events. Drylot housing or manure packs produce manure with total solids above 25%. These high solid systems do not promote anaerobic conditions that lead to biogas production, and should not be considered as inputs to a biogas system.

Facilities that handle solid manure will find it difficult to adopt biogas technology. They will need to incorporate a new manure handling system and routine. Such changes can be expensive. In these situations, other effective manure management options (e.g., composting) should be considered.

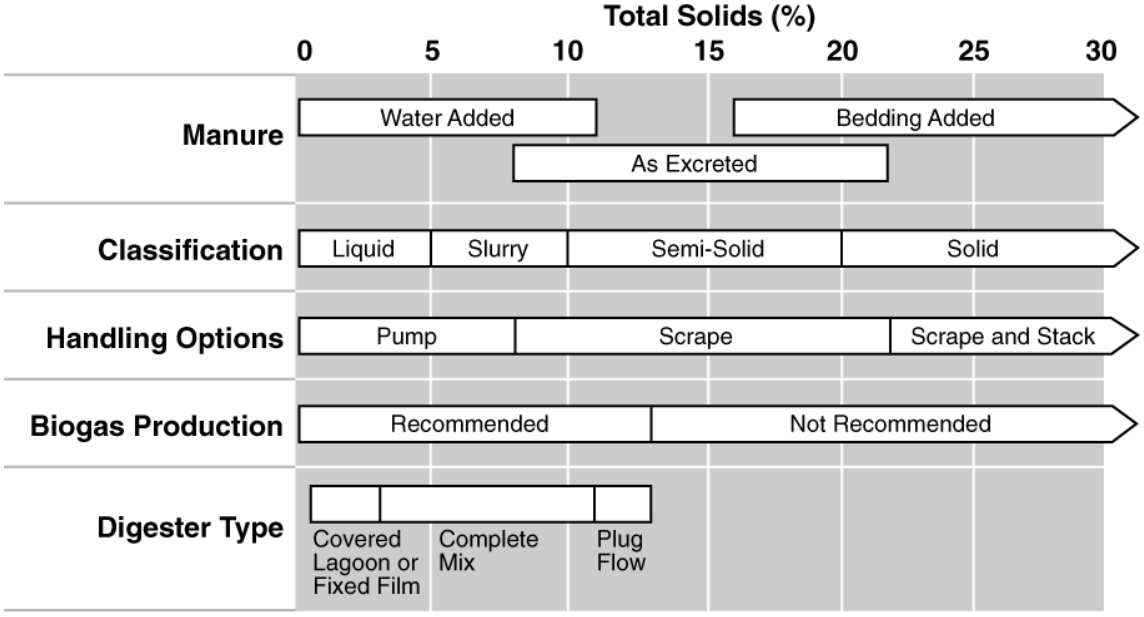
2-2.2 Is the Manure Collected at One Point?

Generally, most confined facilities collect manure at one point. Facilities that collect and deliver manure to a common point every day or every other day are better candidates for biogas technology. The common point may be a lagoon, pit, pond, tank, or other similar structure.

Collecting manure at a common point makes it easier to load the digester. At this point, the manure may be pre-treated before entering a digester. Pre-treatment adjusts the total solids content as required by digesters. This may include adding water, separating solids, manure mixing, or manure heating.

If the facility does not collect manure at a common point, you should assess the feasibility of altering current practices to do so. If there are only two or three points of collection, it may be possible to use a

Exhibit 2-2 Appropriate Manure Characteristics and Handling Systems for Specific Types of Biogas Digester Systems



digester at the largest of these points.

2-2.3 Is the Manure Collected Daily or Every Other Day?

Manure is the feedstock for a digester system. While an occasional daily feeding of a digester might be missed with little consequence under normal operations, not feeding a digester for a week can lead to a loss of biogas production. More importantly, feeding the digester in irregular intervals can disrupt the biological process and cause the system to work inefficiently or stop entirely. Therefore, most digesters are designed to be fed daily. With continuous feed and discharge of material from the system, the bacteria work efficiently and higher volumes of manure are processed.

Daily manure collection is also efficient in terms of conserving the nutrient values of the manure and preserving its gas production potential. Any decomposition of organic material outside the digester will reduce biogas production. Therefore, it is best to feed fresh manure to a digester.

If you do not collect manure daily, you should consider converting to daily manure collection.

2-2.4 Is the Manure Free of Large Amounts of Bedding?

The manure should be free of large quantities of bedding and other materials such as sand, rocks, and stones. Only a small amount of bedding can be tolerated by most digesters.

Bedding materials (e.g., sawdust, straw) often end up in the manure. Clumps of bedding will clog influent and effluent pipes of the digester and hinder operation. Small amounts of bedding will not be a problem and minimizing bedding addition to digesters is relatively simple, in most cases.

Other materials such as feed additive including antibiotics and equipment cleaning and maintenance compounds (e.g., detergents, acids, halogens, etc.) may be harmful to anaerobic bacterial action. The typical use of these materials has not been found to be a problem in full scale digesters. However, threshold levels for these compounds have not been established, so operators should be careful not to release large quantities of such materials into the manure before it is fed to the digester.

Exhibit 2-3 Checklist for Manure Management

1.	Do you collect manure as a liquid/slurry/semi-solid?	Yes ❑	No ❑
2.	Is the manure collected and delivered to one common point?	Yes ❑	No ❑
3.	Is the manure collected daily or every other day?	Yes ❑	No ❑
4.	Is the manure sand relatively free of clumps of bedding and other material, such as rocks, stones, and straw?	Yes ❑	No ❑

If the answer is **YES** to all the above questions, manure management criterion is satisfied. If the answer is **NO**, to any of the questions, you may need to change your manure management routine. See text.

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2-3. Is There a Use for Energy?

The most cost effective biogas projects are those where the energy in the biogas can be used or sold. In many cases, the value of the energy produced from the gas can more than offset the cost of collecting and processing the gas, thereby making the project cost effective on its own. The purpose of this step is to assess whether it is likely that there are suitable uses for the gas recovered from the livestock facility manure.

There are two main gas use options: (1) generation of electricity for on-site use or sale to the power grid; and (2) direct use of the gas locally, either on-site or nearby.

The biogas can be used to fuel a reciprocating engine or gas turbine, which then turns a generator to generate electricity. Modern mechanized dairies and swine facilities typically require a significant amount of electricity to operate equipment. For example, dairies operate vacuum pumps, chillers, feed mixers, and fans. Swine facilities typically operate heat lamps and ventilation equipment. If the electricity is not required on-site, it could be sold to the local power grid.

On-farm use of the gas is often simple and cost-effective. The biogas can be used to fuel boilers or heaters, and in most processes requiring heat, steam, or refrigeration. Dairies and swine farms generally require hot wash water for cleaning and other operations. However, most farms can produce far more gas than they require to replace on-site gas needs.

Other energy use options may present themselves on a case-by-case basis. For example, a specialized need for gas nearby, or a simple flare may be used to control odor and reduce greenhouse gas emissions. Exhibit 2-4 presents a checklist to assess whether energy use options are likely to exist.

2-4. Can You Manage a Biogas System Effectively?

Good design and management is key to the success of a biogas system. Many systems have failed because operators did not have the technical support, the time, the skills, or the interest required to keep the system operating. The owner should realize that a digester requires regular attention, but not much time. If the owner is committed to seeing a digester succeed, generally it will. Effective management requires the following:

- **Technical Support.** There are key components of a digester system with which the owner must become familiar. Operation and maintenance of the digester and biogas use system should be taught by the designer to the owner. Competent technical support from the digester designer or a designer consultant may be needed occasionally to solve rare or unusual problems.
- **Time.** System operation requires a time commitment. Daily maintenance and monitoring of

Exhibit 2-4 Checklist for Energy Use

1.	Are there on-site uses (e.g., heating, electricity, refrigeration) for the energy recovered?	Yes ❑	No ❑
2.	Are there facilities nearby that could use the biogas?	Yes ❑	No ❑
3.	Are there electric power distribution systems in your area that could or do buy power from projects such as biogas recovery?	Yes ❑	No ❑

If the answer is **YES** to any of the above questions,
the energy use criterion is satisfied for initial screening purposes.

a system require approximately 15-30 minutes. Additionally, infrequent blocks of time for repair and preventive maintenance are required. The time required for these tasks ranges from approximately 10 minutes to 10 hours, with most maintenance tasks requiring 30 minutes to 2 hours. The need for (and lack of) infrequent major repairs has led to the failure of many systems.

- **Technical skills.** A biogas system will require some maintenance. In addition to the general mechanical skills found at most farms, an individual skilled in engine repair and maintenance is invaluable. This does not imply that a full-time mechanic is required. Rather, an individual with some mechanical knowledge and ability is sufficient. Typical skills required include engine repair, maintenance, and overhauls; troubleshooting and repair of electrical control problems; plumbing; and welding. Additionally, repair parts and services should be easily accessible. These services are often available through equipment dealers. Access to these services is an important consideration when making a decision on equipment purchases.

- **Desire.** The owner must accept the system as his/her own and want to operate it. Owners should understand how the technology works and be committed to seeing the system succeed. Systems where the management was left to seasonal farm labor or third parties often failed because of lack of motivation and incentive.

  In the ideal management scenario, a trained person would spend approximately 30 minutes to 1 hour a day operating the system. This person would understand the fundamentals of anaerobic digestion and would be involved in the operation and maintenance of the system. Additionally, this person would possess the technical acuity to understand and operate mechanical equipment. Ideally, this person would be part of the planning and construction of the system. In cases where the operator is not the owner, operating incentives such as bonuses based on system "up time" may be considered.

Exhibit 2-5 Checklist for Management

1.	Is there a "screw driver friendly" person on the farm that can operate and maintain the technical equipment?	Yes ❑	No ❑
2.	If YES, can this person spend about 30 minutes a day to manage the system and 1 to 10 hours on occasional repair and maintenance?	Yes ❑	No ❑
3.	Will this person be available to make repairs during high labor use events at the farm?	Yes ❑	No ❑
4.	Is technical support (access to repair parts and services) available?	Yes ❑	No ❑
5.	Will the owner be overseeing system operations?	Yes ❑	No ❑

If the answers are **YES** to the above questions, the management criterion is satisfied. In general, if the owner is committed to seeing the system succeed, it will.

2-5. Initial Appraisal Results

Using the information from the above four steps, the initial appraisal can be performed. Exhibit 2-6 lists the questions addressed by the four steps.

Even if one or more questions cannot be answered "Yes," there may be opportunities for biogas recovery under certain circumstances.

Special Conditions

The following types of special conditions would favor gas recovery from livestock manure facilities:

- **Severe Odor Problems.** At some farms, the odors associated with livestock manure impair air quality, are a nuisance to neighbors, and may become grounds for lawsuits. In areas where odor related problems are significant, the installation of a biogas recovery system will be favored, as it removes offensive manure odors. Using digesters primarily for odor control is cost-effective if the costs of not controlling odor are substantial.
- **Environmental Problems.** The Federal Clean Water Act requires zero discharge of contaminated run-off because manures are a source of agricultural pollution, affecting waterways, soil, and groundwater. Biogas recovery systems can help reduce this pollution by giving the owner a point of control and revenue from manure management.
- **High Energy Cost.** High energy costs favor biogas recovery projects. In high cost environments (e.g., electricity costing more than $0.08 per kWh), smaller sites (e.g., 200 cows) could potentially support profitable gas recovery projects.
- **High Cost of Commercial Fertilizer.** High costs of commercial fertilizers favor biogas recovery projects. In the process of biogas recovery, the organic nitrogen content of the manure is largely converted to ammonium, a higher value and more predictable form of plant available nitrogen.

Exhibit 2-6 Initial Appraisal Results Checklist

1.	Are there at least 500 cows/steers or 2,000 hogs in confinement at your facility year round?	Yes ❑	No ❑
2.	Is your manure management compatible with biogas technology?	Yes ❑	No ❑
3.	Can you use the energy?	Yes ❑	No ❑
4.	Can you be a good operator?	Yes ❑	No ❑

If the answer is **YES** to all questions, there are promising options for gas recovery. Proceed to Chapter 3, where the project technical and economic feasibility will be determined. If you answered **NO** to any of the questions, you may need to make some changes. Read the relevant section, evaluate the cost of changes required, if any, before proceeding.

- **Compost, Potting Soil, and Soil Amendment Markets.** Digested dairy manure solids can be used to replace purchased bedding or can be sold alone and in mixes for potting soil and garden soil amendments. Regional markets exist for soil products. Digested solids have been sold to wholesale and retail customers.

- **Niche Applications.** Options for utilizing the by-products of anaerobic digestion may present themselves. For example, the digester effluent may be used to stimulate the growth of algae in fishponds and thereby provide feed for fish. These niche options must be evaluated on a case-by-case basis.