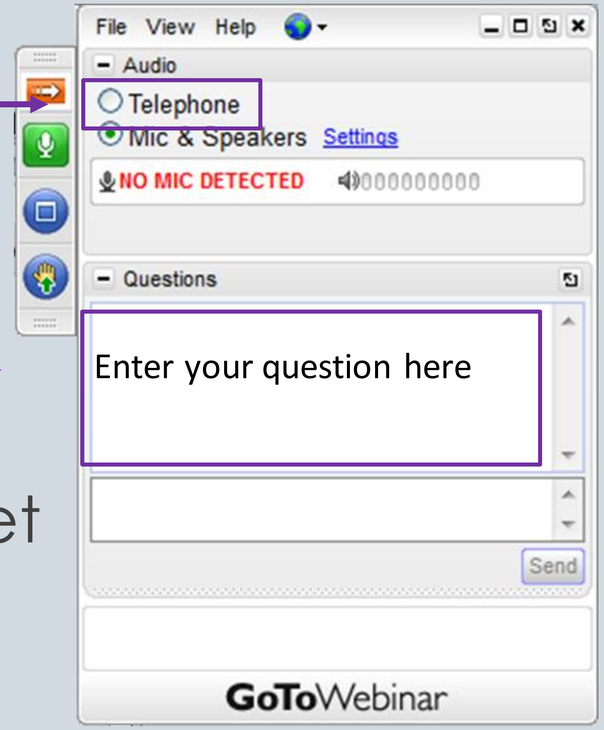
AgSTAR's Anaerobic Digester Project Development Handbook

May 27, 2020

Tips

- All participants will be muted at the beginning of the webinar
- When you join, audio will be through your computer
  - Use headphones, or
  - Choose telephone and follow the prompts to dial in
- Questions submitted during the webinar will be reviewed at the end of the webinar
  - Type a question here
- If you are experiencing technical difficulties, please let us know using the Questions pane on the right side



WHAT WE'LL SEE TODAY

- **Opening Remarks on the AgSTAR Project Development Handbook**
  Nick Elger, U.S. EPA AgSTAR
- **10 Keys to Digester Success**
  Keith Henn, Tetra Tech
- **Process Fundamentals and Technical Insights (Chapters 1- 5)**
  Dana Kirk, Michigan State University; Chris Noah, Tetra Tech
- **Establishing Successful Partnerships (Chapters 6-9 &11)**
  Keith Henn, Tetra Tech
- **Public and Community Outreach (Chapter 10)**
  Nora Goldstein, BioCycle
- **Questions and Answers**

AgSTAR Program

PARTNERSHIP PROGRAM

Collaborative program sponsored by EPA and USDA.

1 **Promote Anaerobic Digestion**

Advancing economically and environmentally sound livestock manure management.

2 **Strong Ties**

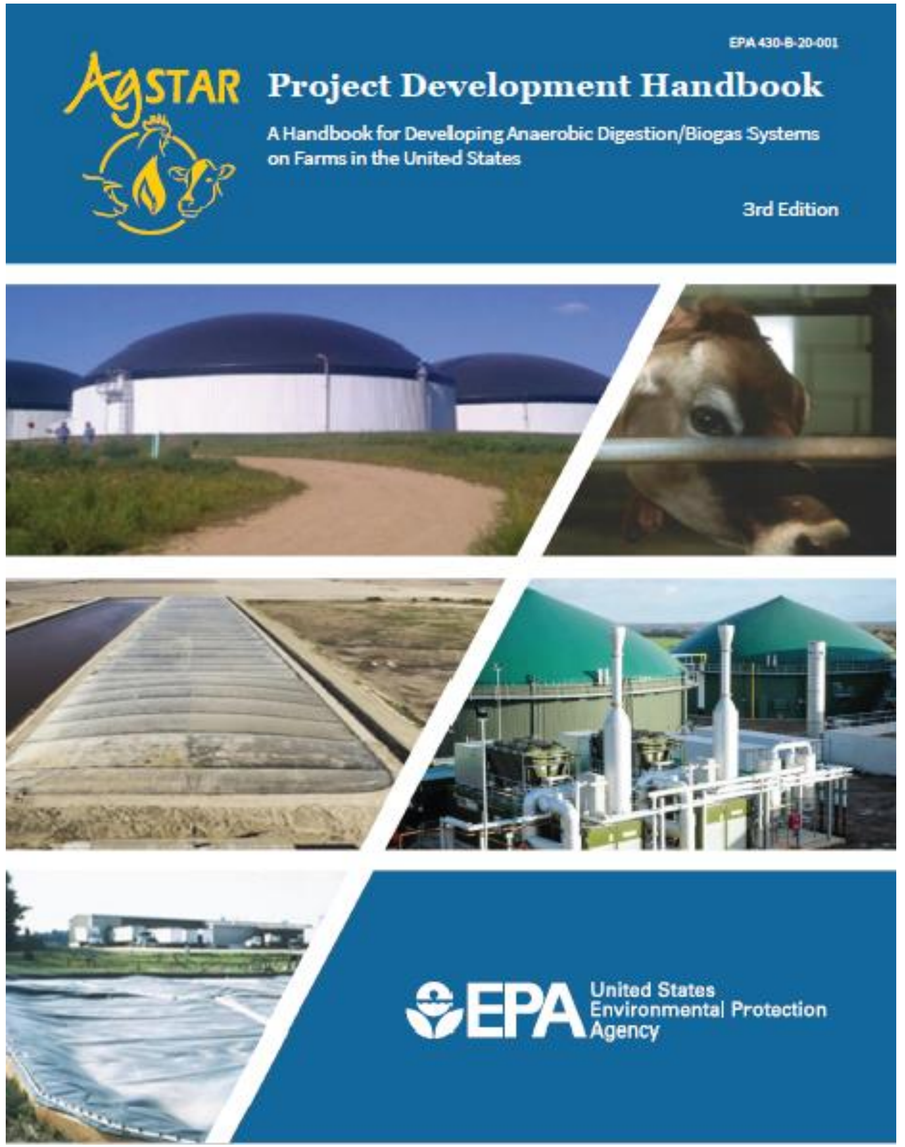
Working with industry, government, NGOs and university stakeholders.

3 **Helping Hand**

Assisting those who enable, purchase, or implement farm anaerobic digestion projects.

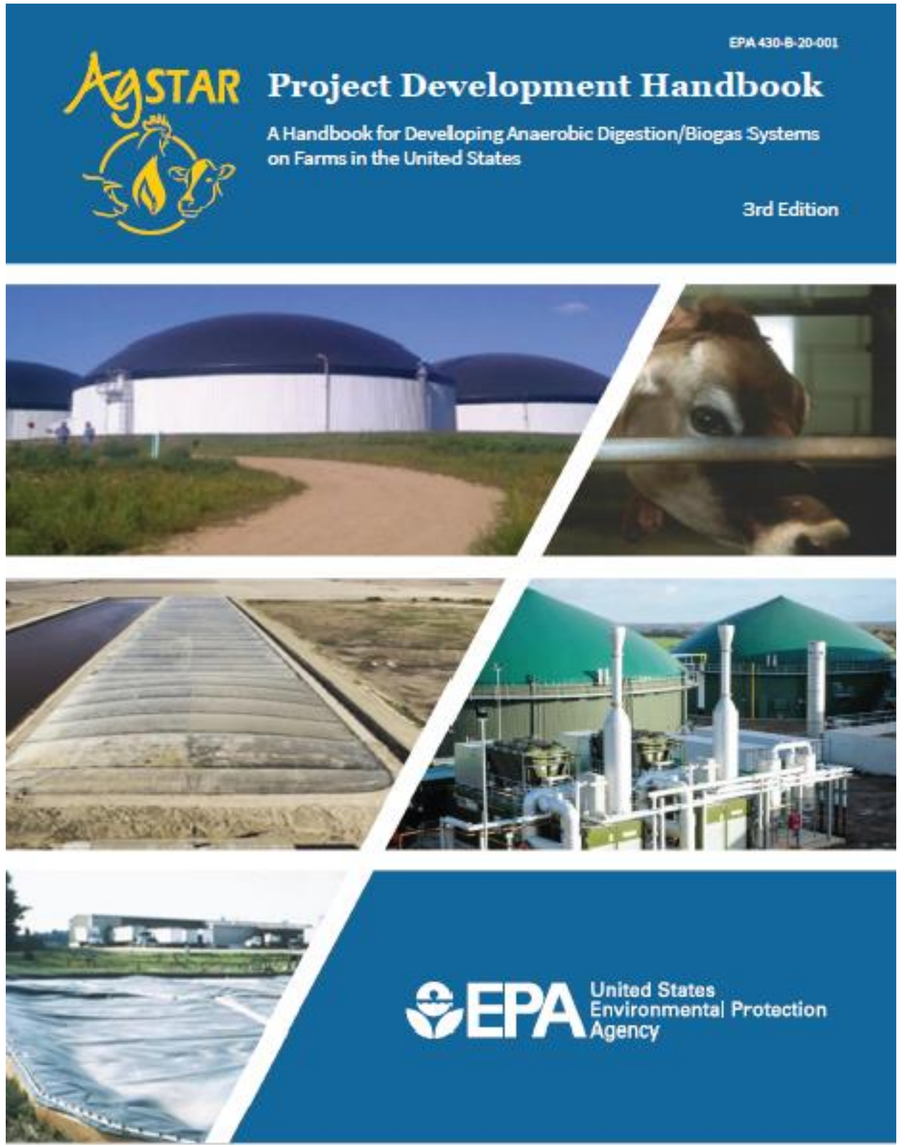
AgSTAR's New Anaerobic Digester Handbook

- A comprehensive compilation of the latest knowledge in the industry on best practices for anaerobic digestion (AD)/ biogas systems.
- Farm-focused, but concepts are applicable for all AD/biogas systems.
- Goal: ensure long-term success for AD/ biogas systems by providing a framework for project development.
- Audience: Anyone interested in AD/biogas systems as a farm manure management option
  - Policy makers
  - Farmers
  - Financiers/ investors
  - Private Developers



Handbook Overview

- 11 Chapters that outline key considerations for farm-based digester projects
  - ✓Process Fundamentals
  - ✓Digester Feedstocks
  - ✓Products and Equipment - Energy and Digestate
  - ✓Economic and Financial Factors
  - ✓Screening and Feasibility Assessments
  - ✓Business Relationships
  - ✓Permitting
  - ✓Public and Community Outreach
  - ✓Safety, Operations and Maintenance



10 Keys to Digester Success

1

Plan for success by identifying and defining clear project goals.

2

Recruit and secure an experienced and qualified project team.

3

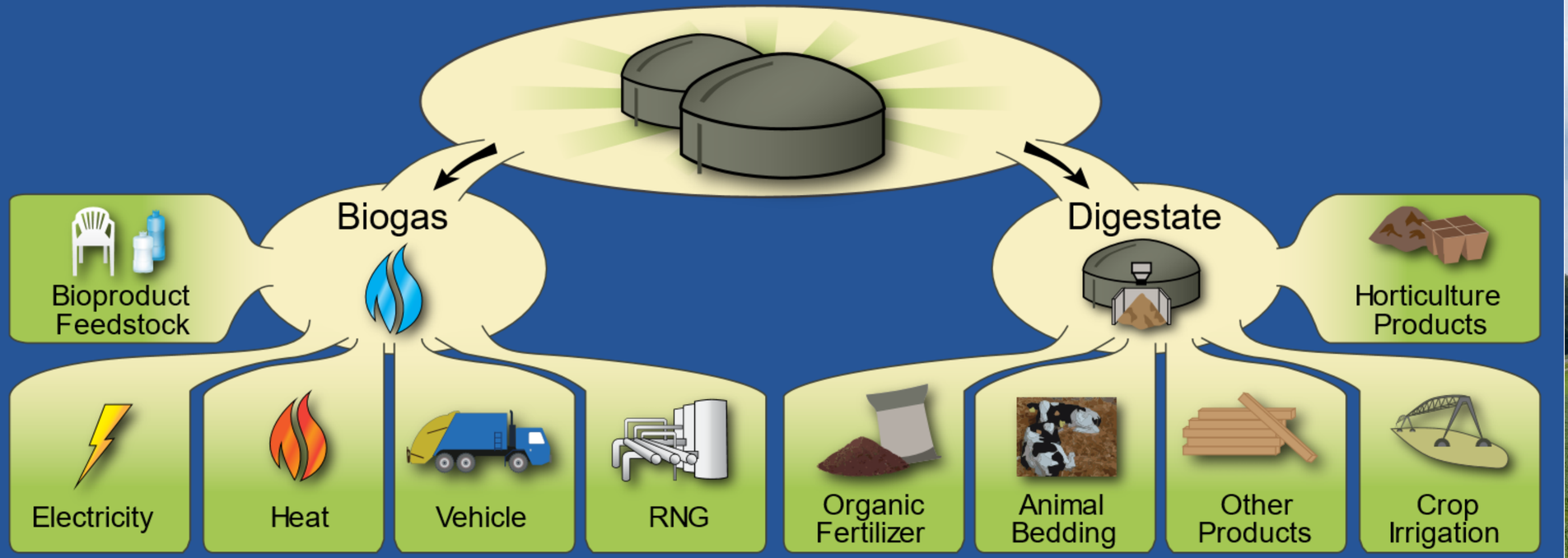
Develop a sustainable business model to meet financial goals.

4

Secure suitable feedstock supply and evaluate its characteristics.

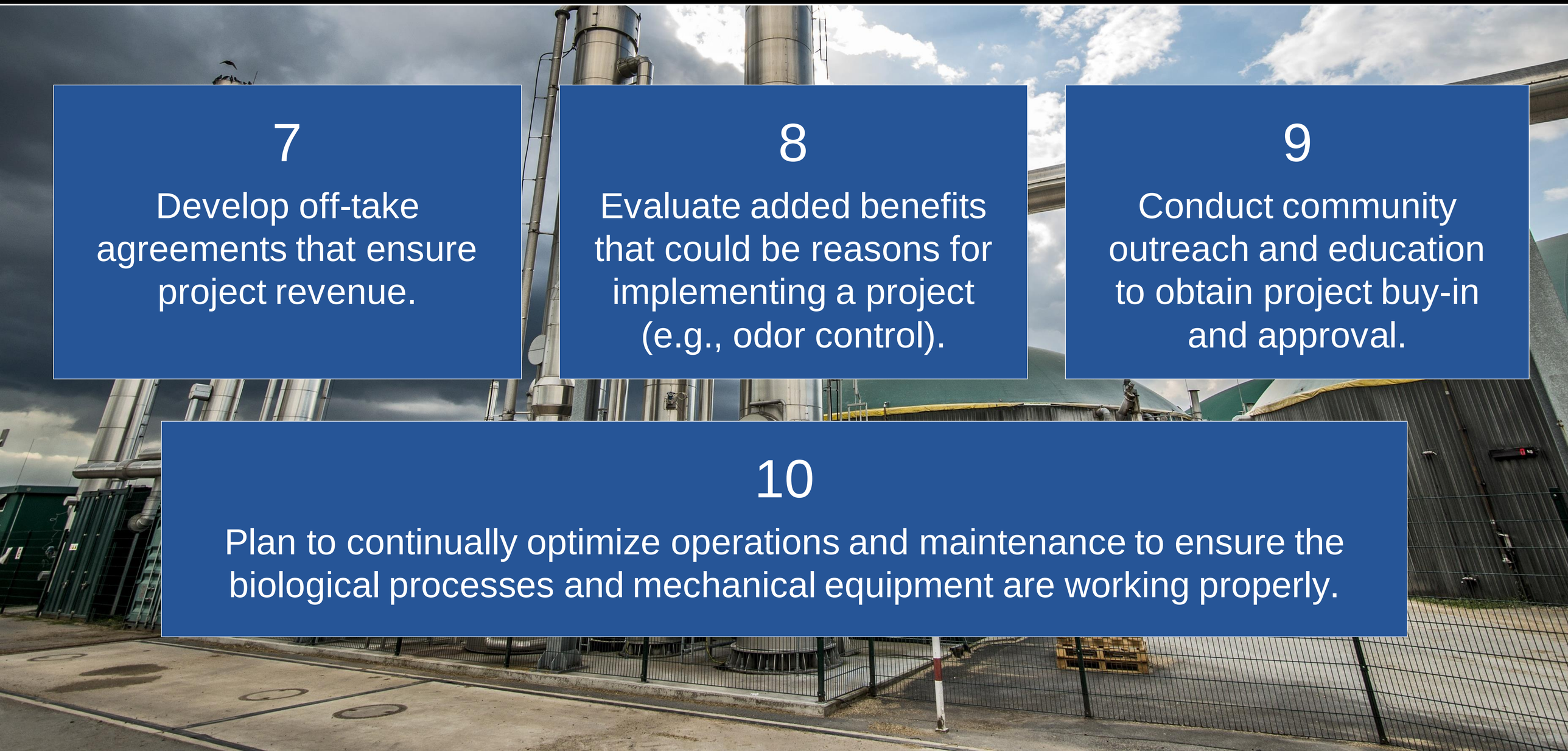
10 Keys to Digester Success

5 Use the most appropriate technology to match the type and amount of feedstock.



6 Analyze options for biogas and digestate use.

10 Keys to Digester Success



7

Develop off-take agreements that ensure project revenue.

8

Evaluate added benefits that could be reasons for implementing a project (e.g., odor control).

9

Conduct community outreach and education to obtain project buy-in and approval.

10

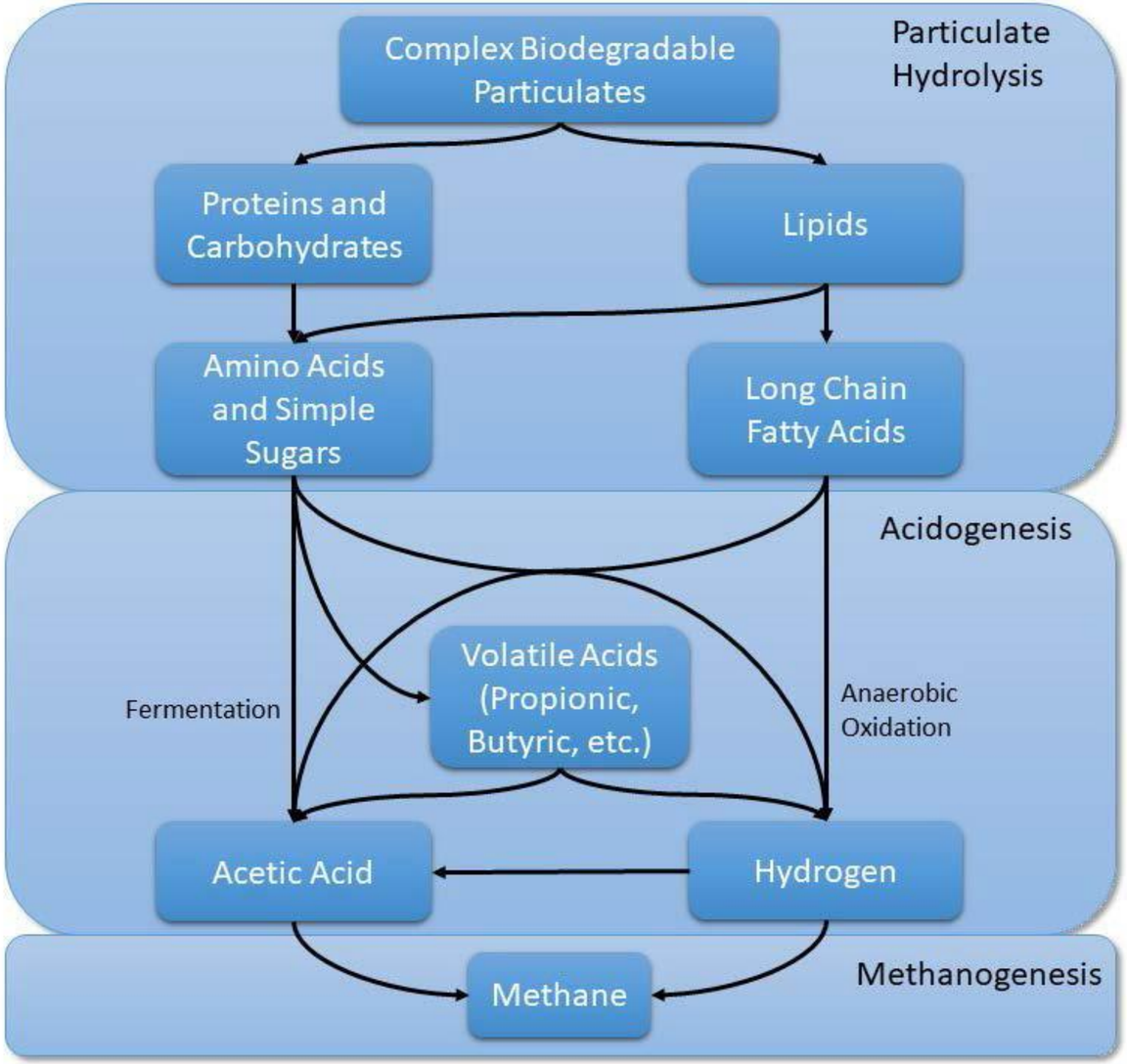
Plan to continually optimize operations and maintenance to ensure the biological processes and mechanical equipment are working properly.

Process Fundamentals

Making Biogas is Easy!

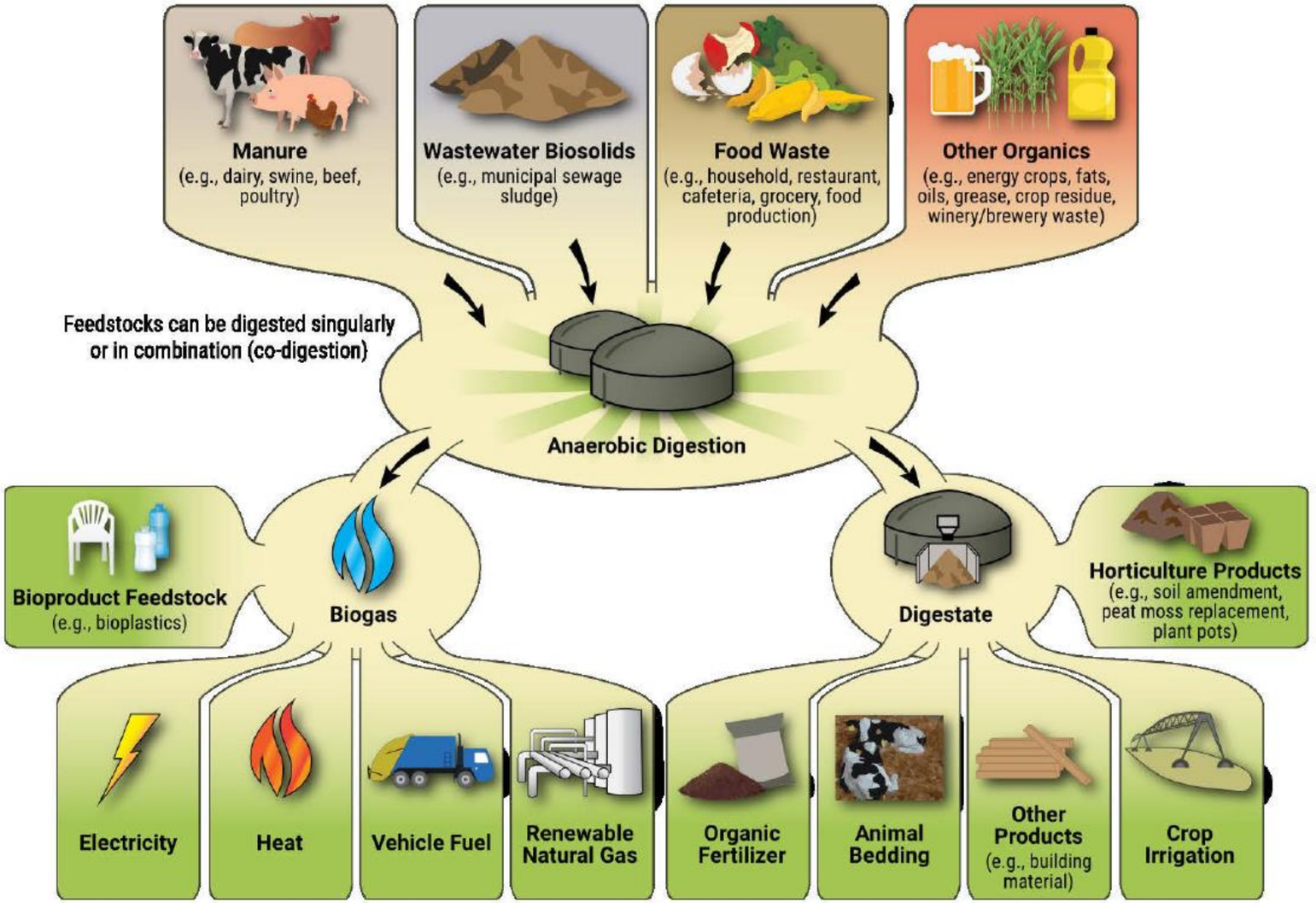
Just Add:

- Organic substrate (feedstock)
- Heat
- Bacterial consortium
- Time
- Eliminate oxygen



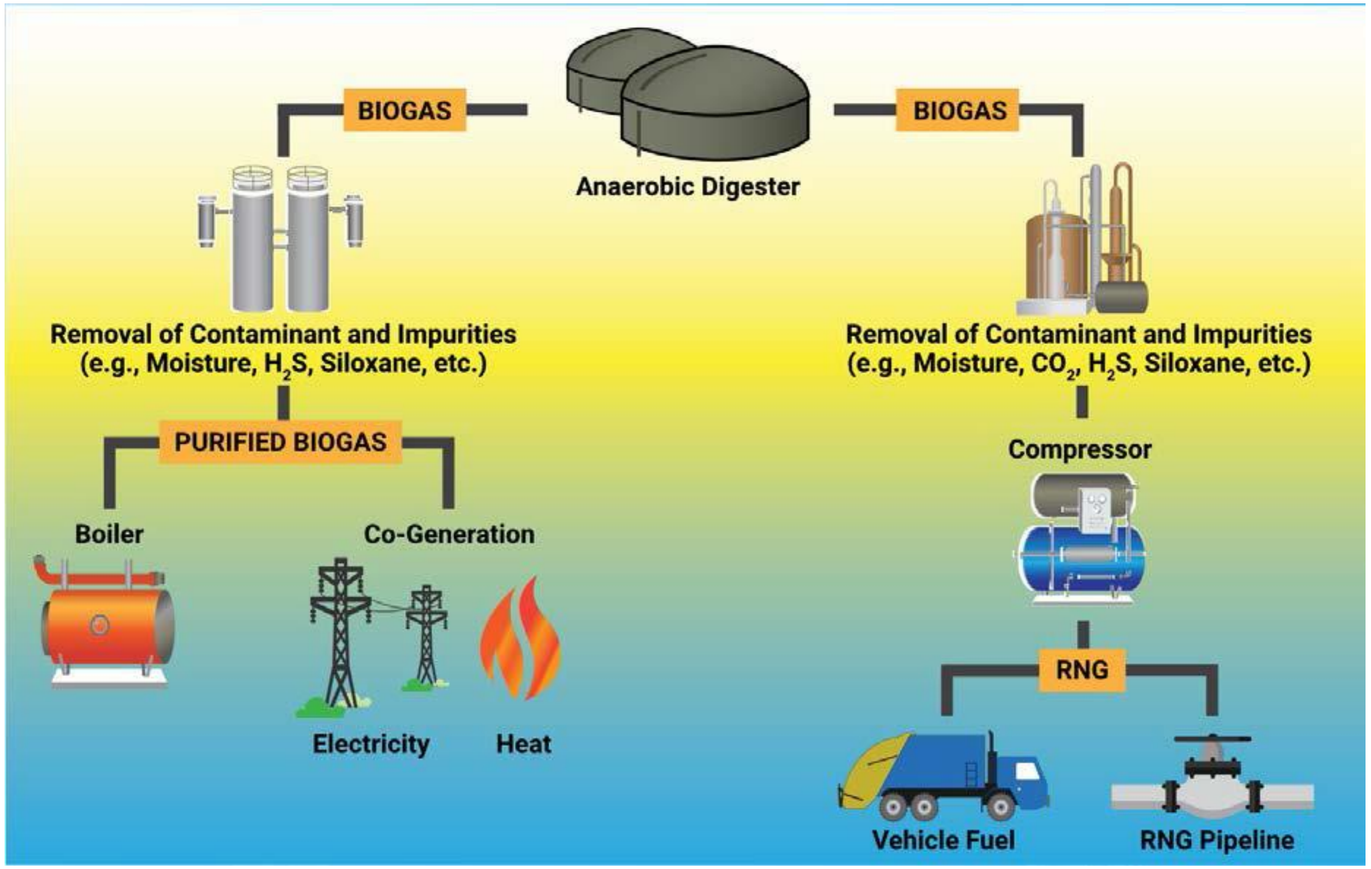
Anaerobic Digestion Overview

- Inputs (feedstock/substrate)
- Livestock manures
- Biosolids
- Industrial
- Food residuals



Benefits of Anaerobic Digester Systems

- Economic & financial
- Environmental
- Renewable energy
- Emissions mitigation
- Fertilizer generation
- Material stabilization
- Bio-products



Good Planning to Avoid Disappointment

- Inappropriate application of a technology
- Inadequate designs
- Inexperience of the practitioner
- A lack of understanding of basic process fundamentals
- Underestimated maintenance requirements
- Overestimated performance and uptime
- Inadequate operator training
- De-prioritization of operation and maintenance activities
- Inadequate operations, logistics, and financial planning

Key Design Concepts

Clearly Define:

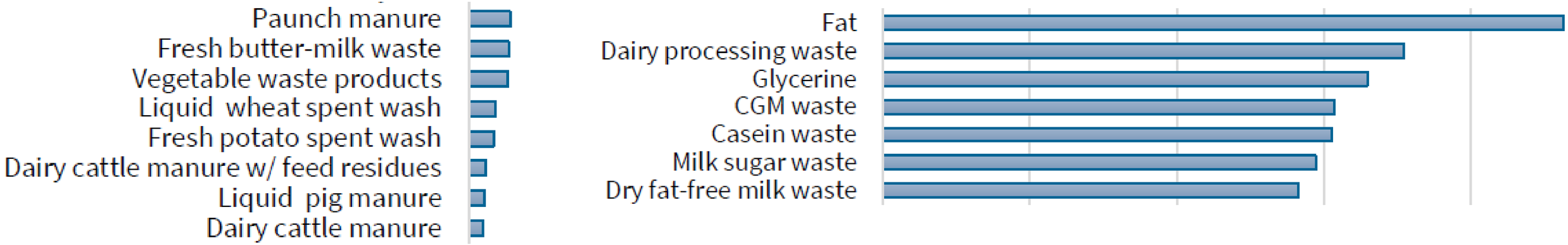
- Project goals
  - Integration into business
  - Financial goals
  - Long-term vision of the business
- Feedstock characteristics
  - Moisture content
  - Total and dissolved solids
  - Chemical composition
- Feedstock digestibility
- System complexity
  - Heating
  - Mixing

Digester Feedstocks

Feedstocks Provide Stability & Energy

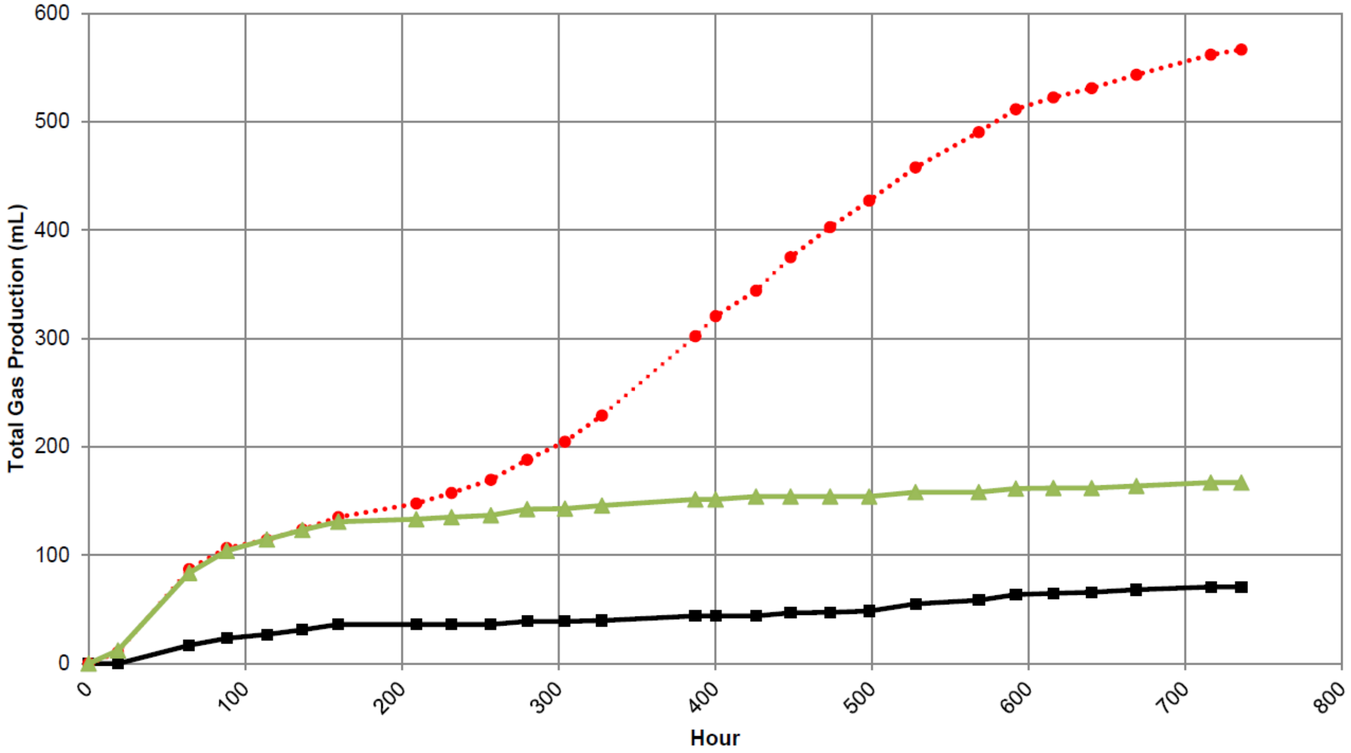
- **Manures**
  - Lower energy potential
  - Microbial population
  - Alkalinity
  - Nutrients

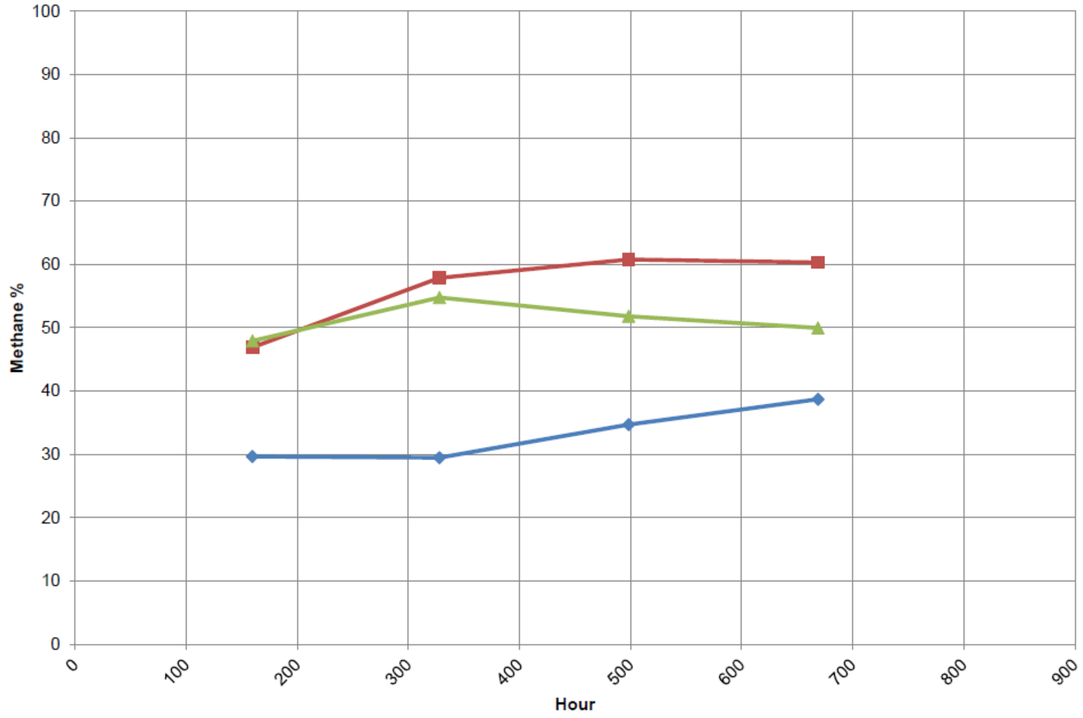
- **Other Feedstocks**
  - Higher to high energy potential
  - Limited buffering
  - Missing key nutrients



Bar chart shows methane potential per ton of feedstock (Figure 4.1)

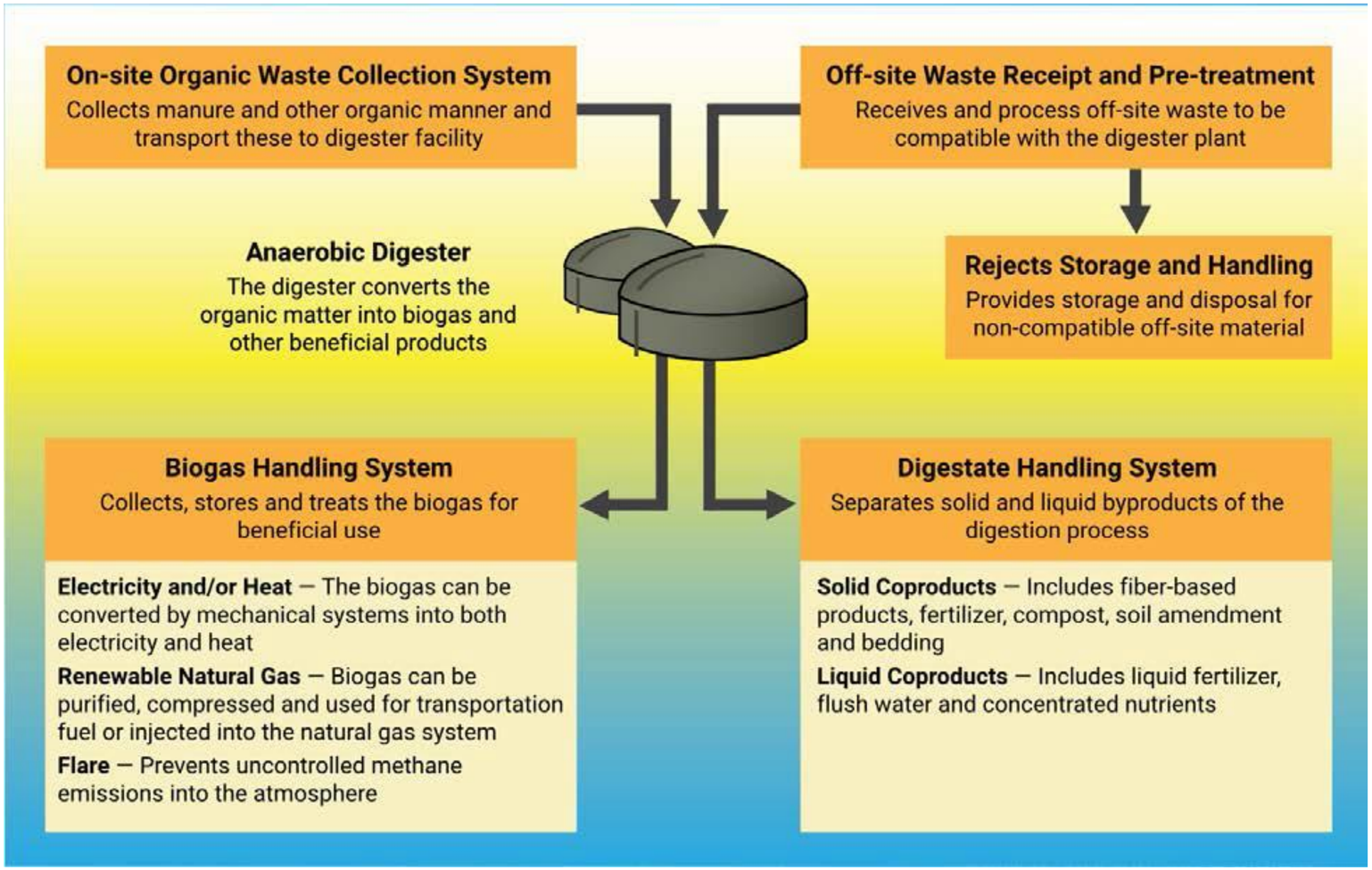
Determining Feedstock Productivity





AD/Biogas System Technology

- Feedstock collection
- Material handling
- Anaerobic digester (reactor)
  - Mixing
  - Heating
- Biogas utilization
- Digestate utilization
- Controls & automation



Digester Types


Covered lagoon


Agricultural complete mix

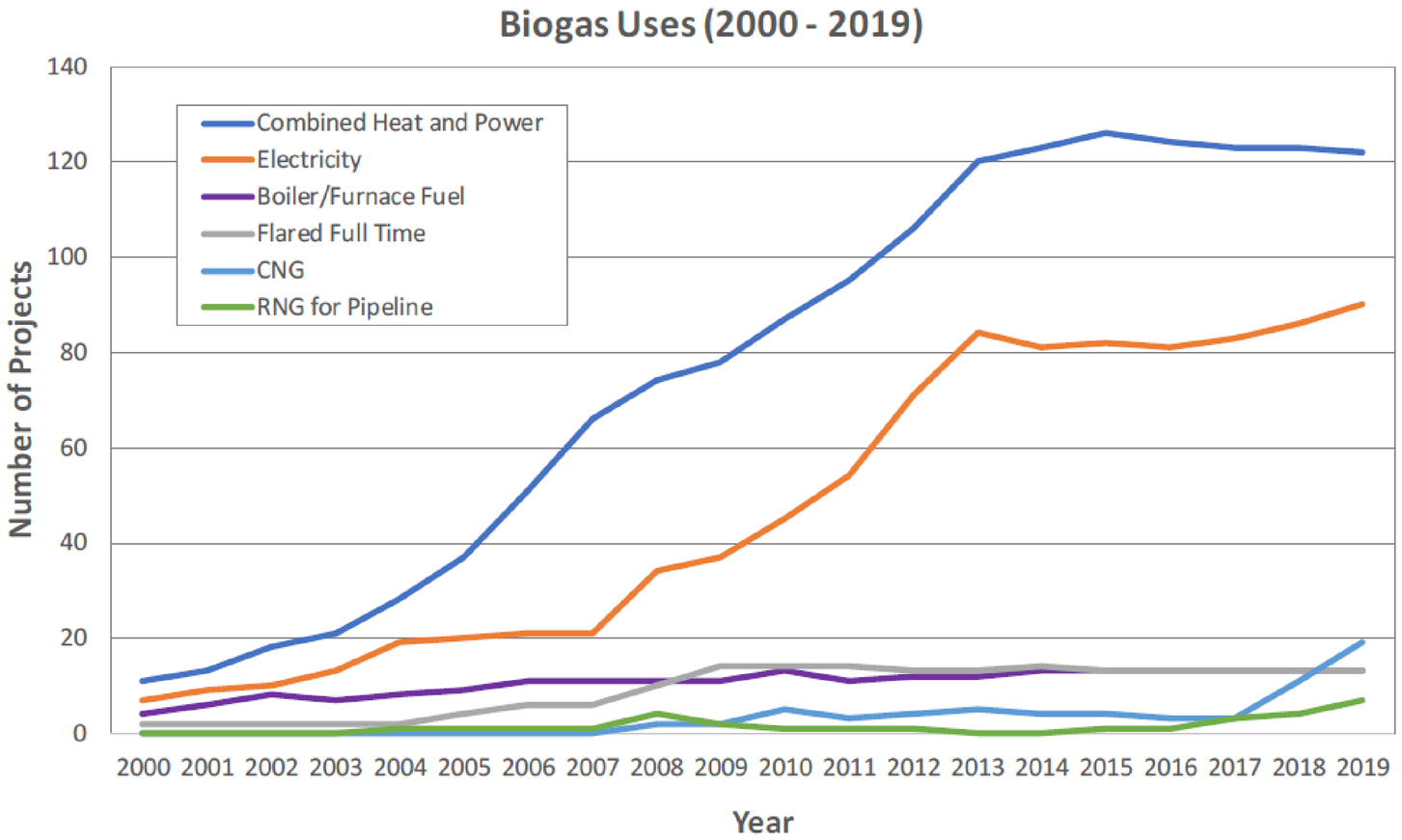

Municipal complete mix


Fixed film


Horizontal plug flow

Biogas Uses

- Biogas utilization
  - Electrical generation
  - Combine heat & power
  - Direct use
  - Flare
  - Renewable natural gas (RNG)



Digestate

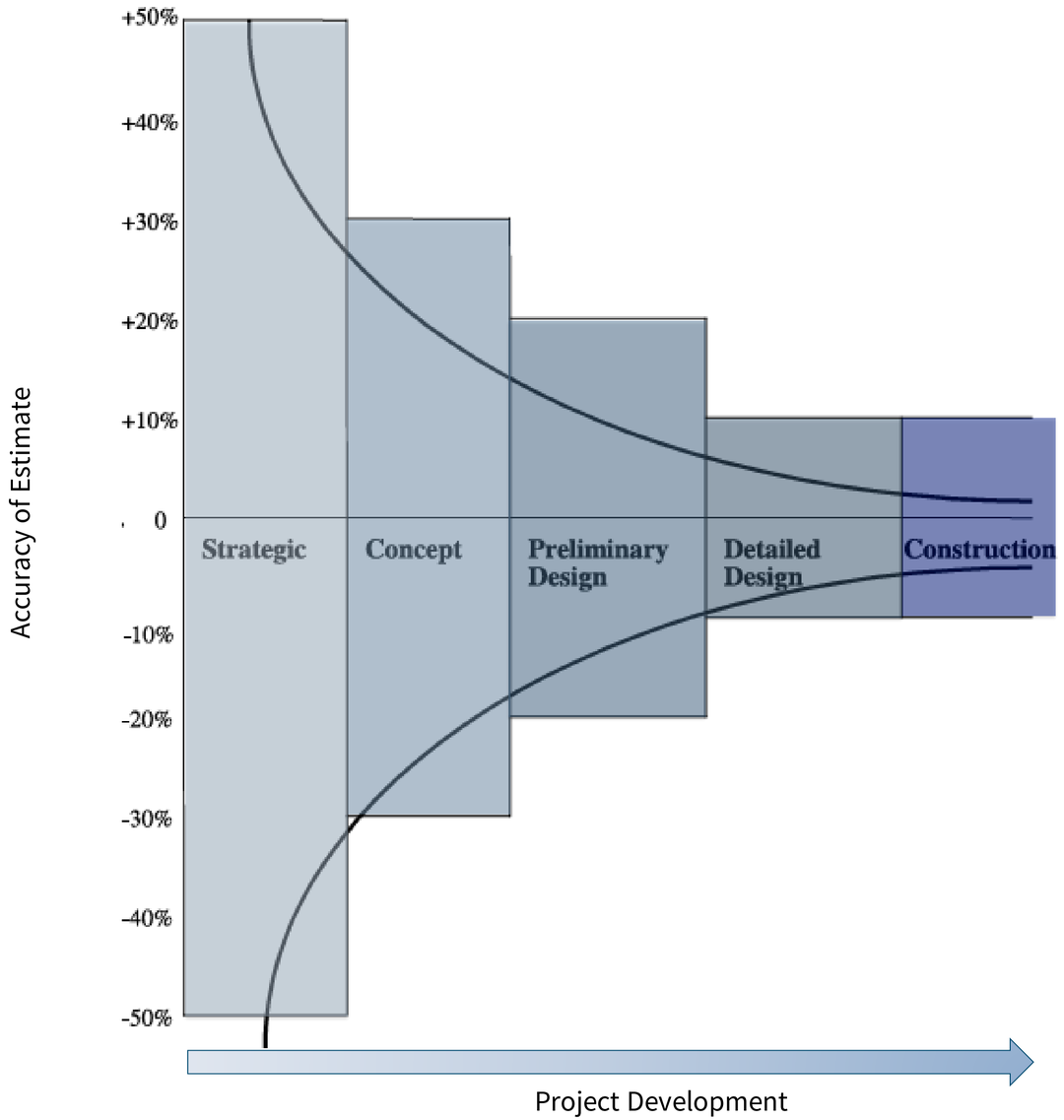
- Digestate utilization (manure)
  - Bedding
  - Whole digestate
  - Solid/liquid separation
  - Nutrient partitioning


Compost


Manure solids as bedding

Economic & Financial Factors

- Capital Investment
  - A first step in evaluating financial viability is to assess capital investment needed
  - A business plan is essential
  - Capital Investment includes 2 items:
    - Construction budget
    - Owner's budget
  - Numerous items to consider when developing an AD/biogas system
  - Graph illustrates technical and cost estimating refinement through a project cycle



Modified by Tetra Tech as of 2019 based on the "Estimating the Cost of Capital Projects". Canadian Journal of Civil Engineering, 2002, 29, 653-661.

Economic & Financial Factors

- Operating Expenses
  - Cost examples table shows lists of many of the operating expenses that are applicable to projects
  - Operational labor is frequently underestimated, which can significantly damage project economics.
  - Because the farm's primary purpose is to generate a product, often digester O&M becomes secondary to traditional farm responsibilities.
  - Key to assess all expenses to achieve success in project performance

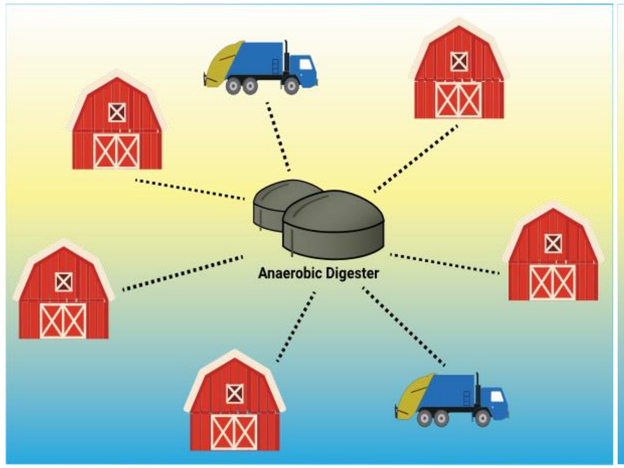
Examples of Operating Expenses

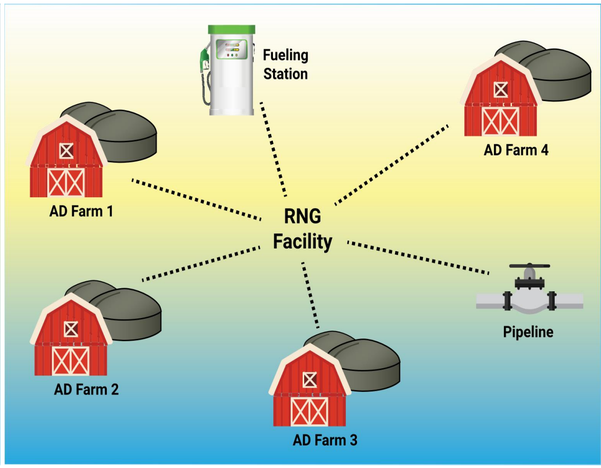
Expense	Units
Daily Labor, if needed	$/hour
Engine O&M	¢/kWh
AD/Biogas System O&M	$/day
H_2S Removal	$/year
Insurance	$/year
Outside Engineering & Other Services	$/year
Filtrate Management	¢/gallon

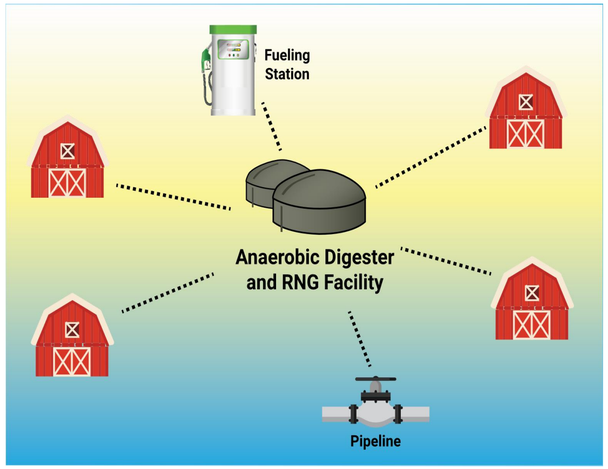
Types of Project Revenues

Owner & Operator Models

- Successful business models:
  - Involve partners along with value chain, such as co-ops, customers, suppliers, and processors;
  - Draw on strengths, such as marketing, contracting, permitting, energy, design, or operations;
  - Common goals (e.g., financial, public relations, or market expansion);
  - 3rd party investment, ownership, and operations;
  - Look to traditional cooperative models for use with manure solids, nutrients, energy, or fuel.
- General types of business model structures:
  - Farmer owned & operated
  - 3rd party owned & operated
  - 3rd party operated
  - Hub & Spoke (see figures)

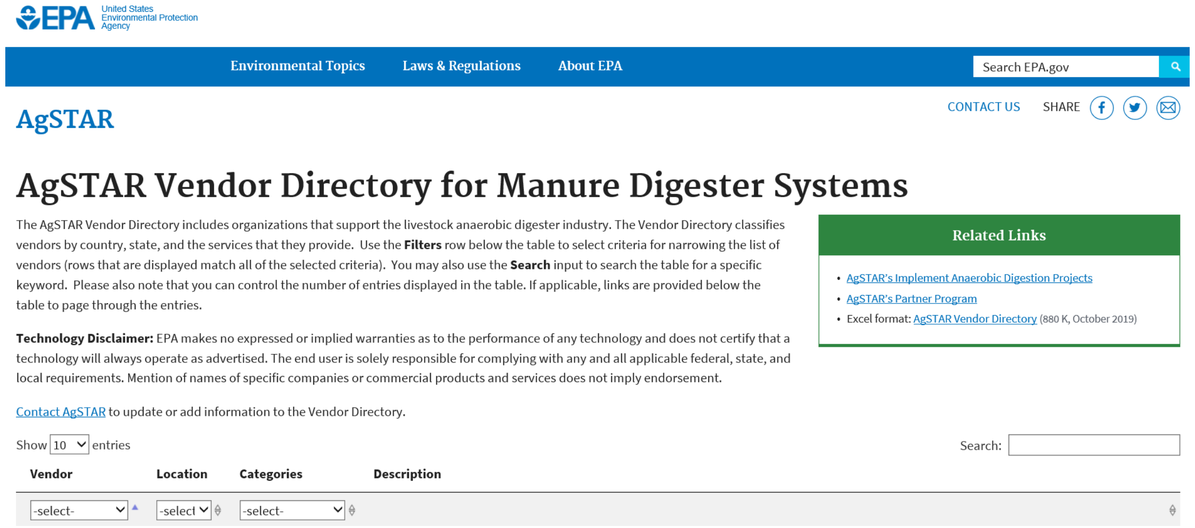






Project Finance & Assistance

- Owner Equity Financing vs. Debt & Equity Financing
- Financial Assistance Methods:
  - Grants
  - Cost-Sharing
  - Loan Guarantees
  - Industrial Revenue Bonds
  - AgSTAR website
    - AgSTAR Vendor Directory
    - Attracting Institutional & Impact Investors



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AgSTAR Vendor Directory for Manure Digester Systems

The AgSTAR Vendor Directory includes organizations that support the livestock anaerobic digester industry. The Vendor Directory classifies vendors by country, state, and the services that they provide. Use the **Filters** row below the table to select criteria for narrowing the list of vendors (rows that are displayed match all of the selected criteria). You may also use the **Search** input to search the table for a specific keyword. Please also note that you can control the number of entries displayed in the table. If applicable, links are provided below the table to page through the entries.

Related Links

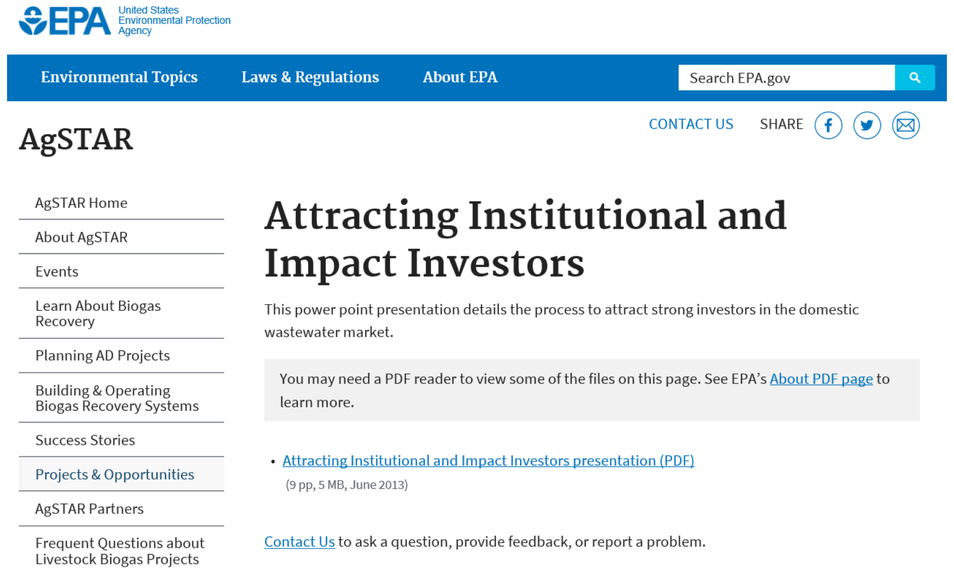
- AgSTAR's Implement Anaerobic Digestion Projects
- AgSTAR's Partner Program
- Excel format: AgSTAR Vendor Directory (880 K, October 2019)

Technology Disclaimer: EPA makes no expressed or implied warranties as to the performance of any technology and does not certify that a technology will always operate as advertised. The end user is solely responsible for complying with any and all applicable federal, state, and local requirements. Mention of names of specific companies or commercial products and services does not imply endorsement.

Contact AgSTAR to update or add information to the Vendor Directory.

Show 10 entries Search:

Vendor	Location	Categories	Description
-select-	-select-	-select-	



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Attracting Institutional and Impact Investors

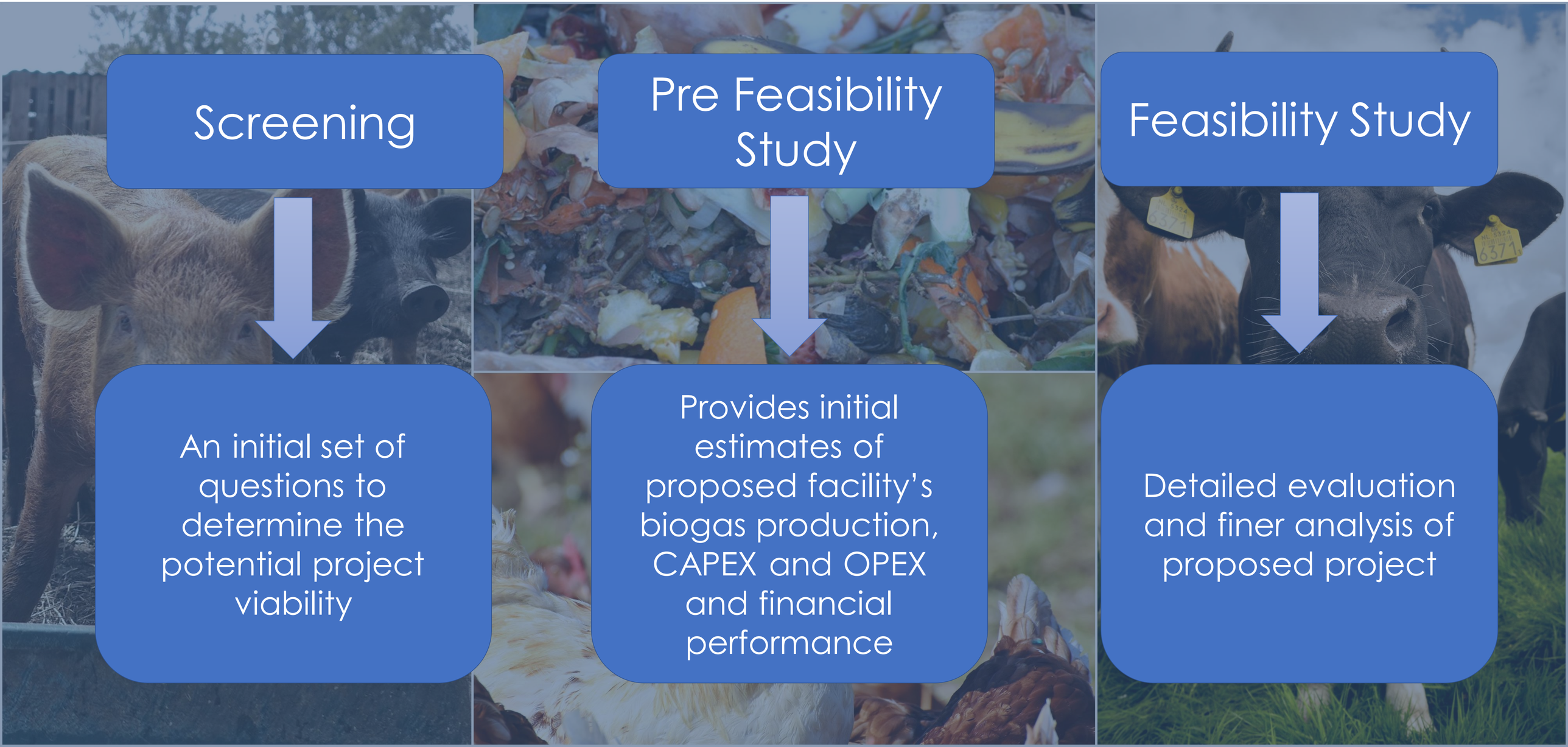
This power point presentation details the process to attract strong investors in the domestic wastewater market.

You may need a PDF reader to view some of the files on this page. See EPA's About PDF page to learn more.

- Attracting Institutional and Impact Investors presentation (PDF) (9 pp, 5 MB, June 2013)

Contact Us to ask a question, provide feedback, or report a problem.

Screening & Feasibility Study



Screening

An initial set of questions to determine the potential project viability

Pre Feasibility Study

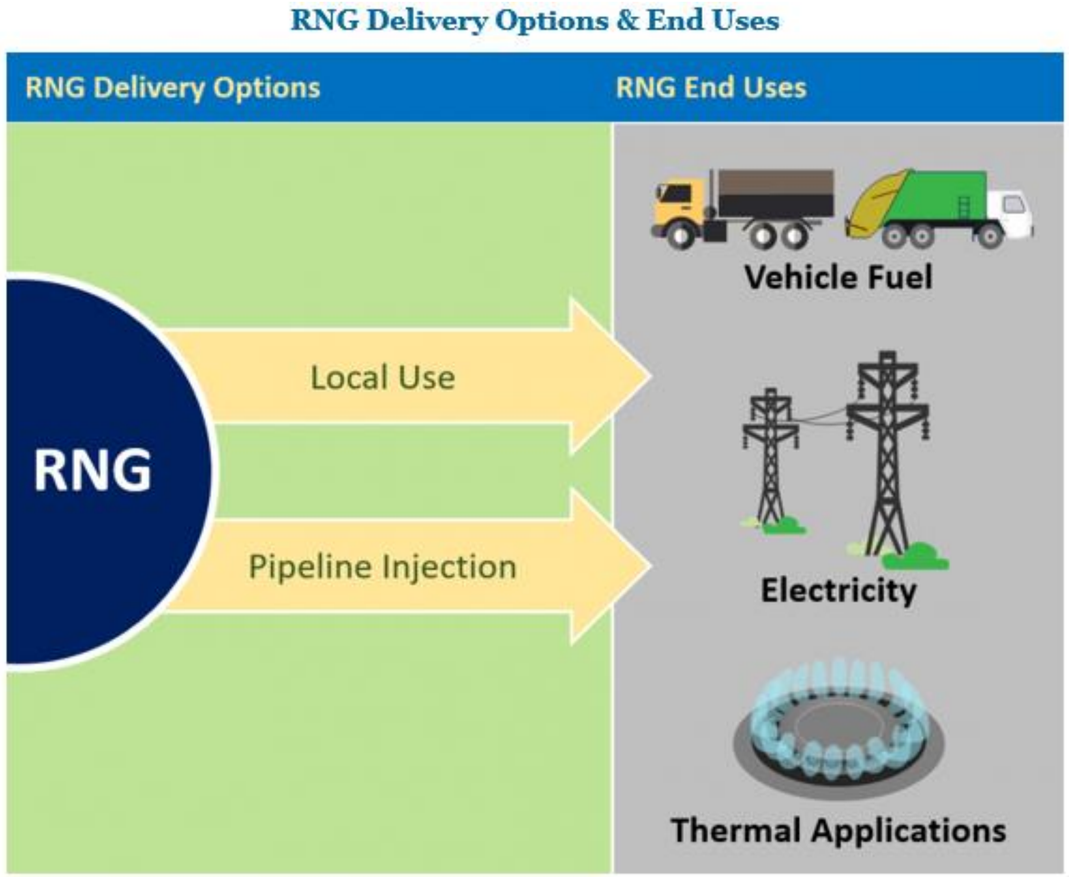
Provides initial estimates of proposed facility's biogas production, CAPEX and OPEX and financial performance

Feasibility Study

Detailed evaluation and finer analysis of proposed project

Business Relationships

- Interconnection Guidelines
  - Elements of Agreements
  - AD/Biogas System Utility Benefits
  - Energy Contracts
- Renewable Natural Gas (RNG)
- Organics Contracts
- Project Finance
- Construction Contracts
- Operational Contracts



EPA Landfill Methane Outreach Program, Renewable Natural Gas, https://www.epa.gov/lmop/renewable-natural-gas (accessed March 2020).

Permitting


Air Quality
Additional Permitting
Water Quality
AD/Biogas Permitting Requirements
Co-Digestion Feedstock
Water Supply
Land Use
Solid Waste

Public & Community Outreach

- Advent of RNG and codigestion has brought in new players and new activity beyond the farmer. Leads to new truck traffic and new faces. Very important to build trust between these individuals and neighboring farms, local businesses, lenders, and community leaders.

Crescent Farm, Haverhill, MA. Project developer is Vanguard Renewables

Public & Community Outreach Needs

- In some cases, need critical mass of manure. Again speaks to need to build trust, positive relationships and clear business deals.

- May need changes in zoning, so educate early and often — and have a line item in budget for outreach. Same goes for regulators. Consider having Lunch ‘n Learns.

- Off-site wastes may need to be stored for period of time before (or after) blending with manure and prior to AD. Make sure tanks are airtight so don’t have fugitive odors.

- Establish an odor management and response plan. Share with potentially impacted neighbors and local officials who may receive complaints.

- Similarly, establish a spill response plan — idea is to have protocols in place for any possible community nuisance.

- Communicate community benefits. And have tours once all systems are in place.

Check out the Handbook on AgSTAR's website!

www.epa.gov/agstar

THANK YOU

QUESTIONS?

www.epa.gov/agstar

NICK ELGER
Elger.Nicholas@epa.gov

VANESSA McKINNEY
McKinney.Vanessa@epa.gov