ALTERNATIVE ENERGY: BIOGAS

How to Install and Use a Floating Biogas System



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From Organic Waste to Renewable Energy



Today we will learn about:

- What biogas is
- How a biogas system works
- How to install a floating biogas system

- How to operate and maintain the system
- Basic safety considerations
- How biogas can contribute to sustainable communities

Learning Objectives

By the end of this session, participants will be able to:

1. Explain the basic concept of biogas and anaerobic digestion.
2. Identify the main components of a floating biogas system.
3. Understand the main steps of installation.
4. Explain why each important installation step is necessary.
5. Identify basic operation, maintenance, and safety practices.
6. Discuss how biogas can support waste management, renewable energy, agriculture, and climate action.



What is Alternative Energy?

Alternative energy refers to energy sources that provide alternatives to conventional fossil fuels.

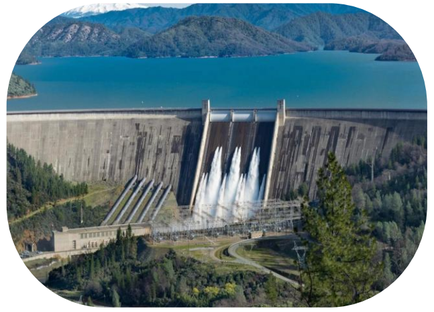
Examples include:



Solar Energy



Wind Energy



Hydropower



Biomass Energy



Biogas



Geothermal Energy







What is Biogas?

Biogas is produced when organic materials are broken down by microorganisms without oxygen in a closed system.

Possible materials include:

- Animal manure
- Food waste
- Agricultural residues
- Other suitable organic materials

Biogas mainly contains:

- Methane (CH_4) – the main combustible component
- Carbon dioxide (CO_2)
- Small amounts of other gases

Biogas can be used for:

- 🔥 Cooking
- 🔥 Heating
- ⚡ Energy generation in suitable systems

HOW DOES A BIOGAS SYSTEM WORK?



From Organic Waste to Energy

From Organic Waste to Energy

The basic process:

Organic Waste
↓
Digester / Fermentation Chamber
↓
Anaerobic Digestion
↓
Two Useful Outputs

Biogas

→ Used as an energy source

Digestate

→ Collected and appropriately managed for agricultural use

WHAT HAPPENS INSIDE THE DIGESTER?

What is anaerobic digestion?

Anaerobic digestion is a natural biological process in which microorganisms break down organic matter without oxygen.

Inside the digester:

1. Organic material enters
↓
2. Microorganisms break down the organic material
↓
3. Anaerobic digestion takes place
↓
4. Biogas is produced
↓
5. Digestate remains

Why is the digester closed?

A closed digester helps maintain the conditions needed for anaerobic digestion and allows the biogas to be collected.



THE FLOATING-DRUM BIOGAS SYSTEM

How the Main Parts Work Together



Main parts:

1. **Fermentation chamber / digester**: where organic material is decomposed
2. **Inlet:** where organic material enters
3. **Outlet:** where digestate leaves
4. **Floating gas holder:** collects and temporarily stores biogas
5. **Gas pipe:** carries biogas to the gas-use point
6. **Gas-use point:** for example, a suitable burner or cooking stove





How does the floating gas holder work?

When biogas is produced:
More gas → Holder moves upward

When biogas is used:
Less gas → Holder moves downward

The movement of the holder provides a simple way to store and use the biogas.







WHY USE BIOGAS?

Waste Management

Organic waste can be collected and treated instead of being left unmanaged.

Agriculture

The remaining digestate can potentially be used in agriculture when properly managed.

Community Benefits

Biogas can provide useful energy from materials that are already available locally.

Renewable Energy

Biogas provides a locally produced source of energy.

Environmental Benefits

Biogas systems can connect waste management, energy use, and environmental protection.

BEFORE INSTALLATION

What Should We Consider Before Installing a Biogas System?



Before construction, we should consider:

- What type of organic waste is available?
- How much feedstock is available?
- Where will the digester be located?
- Where will the biogas be used?
- Is there enough space for construction and maintenance?
- Is water available?
- How will the digestate be managed?
- Can the system be operated safely?

Key principle:

Good planning is the first step toward a successful biogas system.

MAIN COMPONENTS

Main Components of the System



Fermentation Chamber

The main space where organic material is decomposed.



Inlet

The entrance for manure or other suitable organic material.



Outlet

The exit for digested material.



Floating Gas Holder

Collects and temporarily stores the biogas.



Gas Pipe

Carries biogas from the system to the place where it will be used.



Gas-use Point

For example, a suitable burner or cooking stove.

Construction Materials and Equipment for External Pit Using Concrete Rings

No.	Item Description	Quantity
1	Cement	4 bags
2	Gravel/rocks	½ cubic meter
3	Sand (Coarse)	½ cubic meter
4	Concrete Ring (Diameter: 1.00 m, Height: 0.50 m)*	5 rings
5	Concrete Ring (Diameter: 1.50 m, Height: 0.50 m)**	2 rings
6	PVC Pipe (Diameter: 4 inches, Length: 4 m)	1 length
7	Steel/ Iron Drum (Diameter: 1.20 m, Height: 1.20 m)	1 drum
8	Steel Nipple (½ inch)	1 piece
9	Socket/Elbow joint (½ inch)	1 piece
10	Open/ Close Valve (½ inch, Ball Valve type)	1 piece
11	Steel Hose Barb Connector, Male Thread (Hose Tail, ½ inch)	1 piece
12	Biogas Accessories/ Gas Fitting / Connection Kit	1 set

Footnotes: Concrete rings in some areas are only 0.40 meters high; these can still be used, but 6 rings will be required (5 rings for the digester pit and 1 ring for storing slurry/liquid waste).
In some areas, concrete rings with a diameter of 1.50 meters and height of 0.40 meters (mostly used for water tanks) can be found; these can be used as a substitute.

INSTALLATION PROCESS

Installing the Floating Biogas System



Each step helps prepare the system for safe and effective operation.

The main steps:

Step 1 – Prepare and measure the site

↓

Step 2 – Excavate the wells

↓

Step 3 – Position the fermentation chamber

↓

Step 4 – Assemble the digester structure

↓

Step 5 – Seal and waterproof the chamber

↓

Step 6 – Prepare the inlet and outlet areas

↓

Step 7 – Install the floating gas holder

↓

Step 8 – Connect the gas pipe

↓

Step 9 – Test the system

↓

Step 10 – Start feeding the digester

↓

Step 11 – Monitor and maintain the system

Step 1: Measure and Prepare the Site





Measuring the stake
(20 cm. away from the edge of the manure, 50 cm. above from ground)

What are we doing?

- Select a suitable location.
- Mark the location of the digester.
- Measure the required dimensions and distances.
- Mark the positions of the inlet and outlet.
- Prepare the area for excavation.

Why are we doing this?

Accurate measurement helps ensure that:

- The components fit together correctly.
- The digester has the required space and depth.
- The inlet and outlet are correctly positioned.
- The system can be maintained in the future.

Step 2: Dig the Wells



- Dig a first hole (2 diameter and 1.20 meters depth) for well A
- Dig a small well with a radius of 60 cm. to a depth of and 2.10 meters depth for well B then dig the entrance and exit channel

What are we doing?

- Dig **Well A** according to the approved design and measurements.
- Dig **Well B** according to the approved design and measurements.
- Construct the inlet and outlet channels.
- Check the depth, size, and alignment before continuing.

Why are we doing this?

The wells provide the space needed for:

- The fermentation chamber
- The floating gas holder
- The inlet and outlet connections

‘These measurements are for this specific installation design. Other systems may require different dimensions.’

Step 3: Position the Fermentation Chamber





- Put the cement tank into the well then drill the entrance and exit hole
- Insert the PVC pipes, measuring from the top of the ground

What are we doing?

- Place the cement tank into the prepared well.
- Position the tank correctly.
- Check that it is properly aligned.
- Prepare the inlet and outlet openings.
- Install the pipes according to the system design.

Why are we doing this?

The fermentation chamber is the main space where organic material is decomposed without oxygen.

The :

- **Inlet** allows organic material to enter.
- **Outlet** allows digestate to leave.

What should we check?

✓ Correct position
✓ Correct alignment
✓ Secure pipe connections
✓ No visible gaps or damage

Step 4: Assemble and Position the Digester Structure



Join all four cement tanks according to the system design.



Fill soil around the structure as required, up to the planned level.



Place the larger cement tank over the smaller tank in Well B.

What are we doing?

- Join the cement tanks according to the system design.
- Check all connections and joints.
- Fill the surrounding area with soil as required.
- Place the larger cement tank over the smaller tank in Well B.

Why are we doing this?

The different components must work together as one stable and enclosed system.

Correct positioning helps to:

- Support the structure
- Protect the components
- Provide the space needed for the floating gas holder
- Allow the gas holder to move correctly

Step 5: Seal the Fermentation Chamber





- Pour a concrete base into the bottom of well B
- Plaster the inside and outside of the fermentation chamber with a thin layer of cement to prevent leakage



What are we doing?

- Prepare the concrete base where required.
- Plaster the inside of the fermentation chamber.
- Plaster the outside where required.
- Seal joints, openings, and pipe connections.

Why are we doing this?

A properly sealed chamber helps to:

- Prevent unwanted liquid leakage.
- Keep the digestion chamber enclosed.
- Prevent biogas from escaping.
- Maintain suitable conditions for anaerobic digestion.

Step 6: Prepare the Inlet and Outlet Areas





- At the mouth of the entrance pipe, construct a container well to hold waste
- Fill in the (leak-free) area between the well and the fermentation chamber with water

What are we doing?

- Construct the inlet area at the entrance pipe.
- Prepare the area to receive manure or other suitable organic material.
- Ensure that the outlet allows digested material to leave the system.
- Fill the designated water-sealed area according to the system design.

Why are we doing this?

- The inlet provides a controlled pathway for organic material to enter the digester.
- The outlet provides a controlled pathway for digestate to leave.
- The water-sealed area shown in this system helps maintain the required separation and sealing.

What should we check?

✓ Inlet is accessible
✓ Flow is not blocked
✓ Outlet is clear
✓ Connections are secure
✓ No visible leakage

Step 7: Install the Floating Gas Holder





- Place the steel tank into the well
- Set 2 pillars to ensure the tank remains in the well, even when the gas is pushing it up from below

What are we doing?

- Place the steel gas holder into Well B.
- Position it correctly.
- Install the supporting/guide pillars.
- Check that the gas holder can move vertically.

Why does it float?

When biogas is produced, the gas collects underneath the holder and pushes it upward.
When gas is used, the holder moves downward.

The floating holder provides two important functions:

1. Gas storage
It temporarily stores the biogas.

2. Simple gas-volume indication
Its position gives a visual indication of the amount of gas stored.

Step 8: Connect the Gas Pipe







Install the gas pipe with PVC from the fermentation chamber to the kitchen

What are we doing?

Connect the gas pipe from the gas collection area to the gas-use point.

Gas holder / gas collection area

↓

Gas pipe

↓

Kitchen / gas-use point

Why are we doing this?

The gas pipe provides a controlled pathway for transporting biogas from the system to where it will be used.

What should we check?

- Connections are secure
- The pipe is protected from damage
- The gas line is correctly connected
- There are no visible leakage points
- The system follows the appropriate technical design

Before Using the Biogas



Check the system:

- ☐ Digester is properly sealed
- ☐ Gas holder moves correctly
- ☐ Pipes and connections are secure
- ☐ Gas line is checked for leakage
- ☐ Inlet and outlet are clear
- ☐ Burner/stove is properly connected
- ☐ Cooking area has good ventilation
- ☐ Operators understand basic safety procedures

Why is testing important?

Testing helps identify problems before the system is put into regular use.

Check first. Use later.

How Does Biogas Production Start?



Once manure or other input enters the digester, the average time for breaking down and fermentation is 20 – 30 days

Once manure or other suitable organic material enters the digester:

Organic material enters
↓
Microorganisms break down the material
↓
Anaerobic digestion takes place
↓
Biogas is produced
↓
Biogas is collected in the gas holder

How long does the process take?

The original training material indicates an expected digestion/fermentation period of approximately:

20–30 DAYS

Remark: The actual time needed for biogas production may vary depending on the type of feedstock, temperature, feeding conditions, and system conditions.

WHAT COMES OUT OF THE DIGESTER?



The digestion process produces two useful outputs:

🔥 BIOGAS

Biogas can be collected and used as an energy source, such as for cooking.

↓

🌱 DIGESTATE

Digestate is the remaining material after anaerobic digestion. It can be collected and appropriately managed for agricultural use.

From waste to useful resources

Organic Waste

↓

Anaerobic Digestion

↓

Biogas + Digestate

USING BIOGAS FOR COOKING

Biogas as Cooking Fuel





Biogas can be transported through the gas pipe to a suitable burner.

The energy pathway:

Organic Waste
↓
Biogas Digester
↓
Biogas
↓
Gas Holder
↓
Gas Pipe
↓
Burner
↓
COOKING ENERGY

Why is this useful?

The system allows locally available organic waste to become a useful energy resource.

OPERATION AND MAINTENANCE

Biogas as Cooking Fuel



Why is maintenance important?

Regular maintenance helps to:

Prevent problems → Improve performance → Extend system life → Increase safety

A biogas system needs regular care.

Operators should:

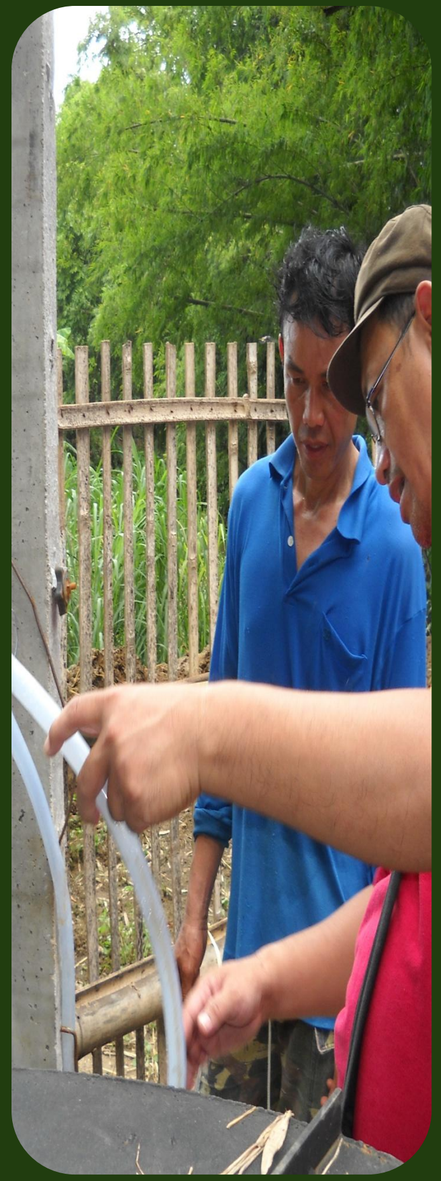
- Check the digester and gas holder regularly.
- Check pipes and connections.
- Look for possible gas or liquid leakage.
- Keep the inlet and outlet clear.
- Monitor gas production and use.
- Check for damage or corrosion.
- Keep the surrounding area clean and safe.
- Record important observations when possible.

If gas production decreases, check:

- Is there enough suitable feedstock?
- Is the inlet blocked?
- Is there a possible gas leak?
- Is the gas holder moving normally?
- Are the pipes or connections damaged?
- Has the feeding routine changed?







BIOGAS SAFETY

Biogas contains flammable methane and may also contain gases that can be harmful to people.

Always remember:

- 🚭 No smoking near the system
- 🔥 Keep flames away from suspected gas leaks
- 💨 Ensure good ventilation
- 🔧 Check pipes and connections regularly
- 🚫 Never use a flame to find a gas leak
- ⚠️ Do not enter enclosed spaces without proper safety procedures
- 👷 Only trained people should carry out technical maintenance

Key message:

Safety must always come
before energy production.







BIOGAS AND CLIMATE ACTION

How Can Biogas Support Climate Action?

Biogas can connect several areas of sustainable development:

Waste Management

Organic waste is collected and treated instead of being left unmanaged.

Sustainable Agriculture

Digestate can be appropriately managed for agricultural use.

Community

Local resources can be used to meet local energy needs and support community-based solutions.

Renewable

Biogas can provide a locally produced energy source and may replace some conventional energy use.

Climate Action

Capturing and using methane from managed organic waste can help reduce uncontrolled methane release.

Thank You

From Organic Waste to Renewable Energy

What can we do in our own YMCA, school, community, or organization?

Start with local resources.

Take action.
Create a more sustainable future.



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