What is Biogas, and what is it used for?

Biogas refers to a gas made from anaerobic digestion of agricultural and animal waste. The gas, a mixture of methane and CO₂, is used

1. for direct combustion in cooking or lighting applications;
or
2. to power combustion engines for motive power or electricity generation.

The technology is particularly valuable in agricultural, waste treatment or animal processing units where there is excess manure (e.g. pig, cattle, chicken, human) or farm waste.

Biogas Digesters

With biogas technology, waste (called slurry) is stored in specially constructed containers while being digested. There are a number of technologies used to accomplish this:

- **Batch type digesters** treat a large amount of material at once. They are used for large scale application
- **Continuous flow units** add and remove waste material on a daily or regular basis. They are best suited for small-scale domestic applications.

Besides producing the fuel gas, biogas digesters have the added benefit of producing a high nutrient digestate which can be used as fertilizer.

**Digester types:**

- Fixed dome
- Floating drum
- Balloon

Digester temperature is an important factor in maintaining the bacteria necessary for digestion.

This is one reason why fixed dome digesters tend to be more successful in areas with extreme temperature fluctuations.

Gas production is dependent upon digester temperature, fermentation or retention time and the feedstock material.

Small scale farmers that keep zero-grazed pigs (>10) or dairy cows (>3) are good candidates for installing household biogas units. However, a biogas unit will only yield good results if it is properly planned, constructed, operated and maintained. Regular supply of water is essential for operation of biogas plants.

Information required to design and install a biogas digester include:

- Size of family and daily cooking (and lighting) requirements.
- Availability and amount of feedstock (water, number and type of cows, pigs etc)
- Materials available on site (bricks, etc) for construction of digester.

Using this information, the type of digester, the required digester volume and retention time can be determined.
slurry fertilizer and encouraging better sanitation on farms.

A 'continuous flow' biogas digester

The table below gives the digester sizes and feedstock requirements.

<table>
<thead>
<tr>
<th>Size of family</th>
<th>No. of cows</th>
<th>Digester volume (m3)</th>
<th>Gas storage volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>6</td>
<td>8.4</td>
<td>1.44</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>10.8</td>
<td>1.92</td>
</tr>
</tbody>
</table>

Return to Household Energy Options page
Limitations -

1. **Cost:** Investment cost of the fixed dome and floating drum digesters are usually high ($800 and $1,700) for rural farmers. This restricts the technology to farmers who can raise the capital needed to meet the basic requirements to ensure a successful operation of the plant.

2. **Feedstock and water:** The technology is limited to locations where the organic feedstock and water are readily available. The potential for biogas technology is therefore limited to agricultural areas with access to sufficient water supplies, since regular supply of water is essential for the operation of biogas plants.

3. **Utilization:** Given digester sizes have different rates of biogas generation. This means that utilization is restricted by the rate of production. However, when properly designed and sized, digesters should be able to supply gas continuously.
Biogas in Kenya

Biogas technology was introduced in Kenya in the mid 1950s by white settler farmers. By 1958, a private company Tunnel Technology limited was constructing biogas plants in different parts of the country. The company had installed about 150 units by the early 1980s.

Institutions that have played an active role in the promotion of biogas include:

- Special Energy program (SEP), a joint effort between GTZ, Ministry of Energy, Ministry of Livestock Development and Kenya Industrial Estates (KIE)
- Kenya woodfuel and Agroforestry Project (KWAP)
- Christian Intermediate Technology Center (CITC)
- Tunnel Technology Ltd.
- Biogas Africa
- Kentainers Ltd.

Biogas is most commonly used for cooking and lighting. Slurry is largely used as manure and is appreciated by the users. The most widely disseminated plant in Kenya is the floating drum.

Biogas technology is a cost-effective investment if plants are properly constructed, effectively operated and well maintained. Only an estimated 25% of the installed biogas units in Kenya are operational, giving the technology a negative image.

Continued use of the plants is linked to the dissemination strategy adopted by the promoting institution. A high level of use is observed in areas where the dissemination was followed with planned monitoring and support to the end users.

The potential for agriculture is limited to agricultural areas with high population densities and is further restricted to farmers who can afford the high initial costs associated with biogas plants.

Major constraints to biogas technology dissemination include:

- High initial investment costs compounded with lacking credit schemes
- Negative image caused by failed biogas plants
- Limited private sector involvement

To increase viability the following avenues must be explored:

1. Resources should be directed to promoting the technology in high potential areas.
2. Private sector involvement in promotion and dissemination is necessary for successful adoption of the technology.
3. There is need to counter the already negative image of the technology that exist by promoting proven designs and providing post installation support.
4. Cheaper low costs designs need to be developed to lower the cost entry barrier
5. Access to credit for end-users and small enterprises promoting biogas
6. Promoting entities should develop sufficient capacity to advice potential users on available options.

Return to Biogas Digesters page
Biogas success worldwide

Leading countries include China, India, and Brazil. In the East African region, Tanzania has had the greatest success where CARMATEC successfully promoted and installed fixed dome biogas digesters. More than 1,000 digesters have been installed and are being maintained by a cadre of trained local technicians. The fixed biogas digesters cost between $800 and $1,300 for a local Tanzanian NGO is now promoting a simple low cost Tubular Plastic Biogas digester costing approximately $150. The gas produced is mainly used for cooking and lighting. These costs are likely to vary for other countries depending on labor and material costs.

African Case Studies

KENYA

UGANDA