Waste Management
FACTSHEET

BRITISH COLUMBIA | Ministry of Agriculture

Order No. 382.600-1
Revised November 2015

# AN OVERVIEW OF ON-FARM BIOGAS PRODUCTION

**This Factsheet provides information about on-farm biogas production through anaerobic digestion of manure and other organic byproducts.**

## Process Description

Anaerobic digestion is a natural process in which bacteria break down carbon rich material in the absence of oxygen. This process, popularly called the "biogas process" generates a mixture of methane and carbon dioxide - the biogas.

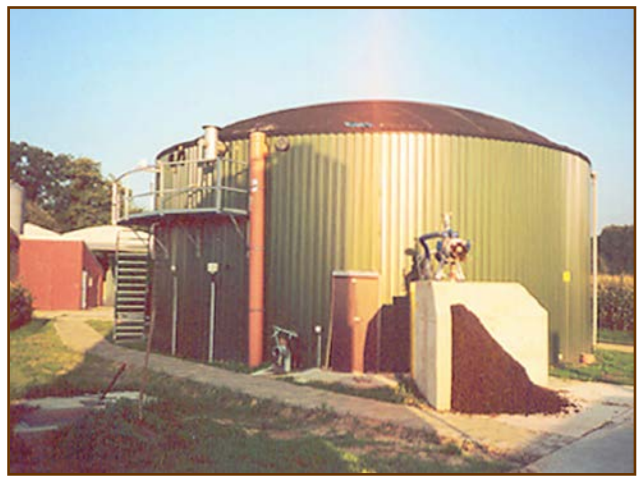
On-farm biogas production facilities typically utilize manure as the main substrate, but other materials such as food processing waste and crop residues can be added to increase biogas production. Anaerobic digestion technology is commonly employed as an integrated part of farming in Europe, the USA, and Asia.

Depending on the type of energy production, the biogas is normally utilized on-site to produce one of the following:

- space heat (gas furnace)
- renewable electricity (engine + generator)
- renewable natural gas (gas scrubber)

Source: RCM International, LLC Berkeley, California, USA

**Figure 1** A medium-scale on-farm "covered lagoon" biogas facility for manure on a US dairy farm.



Source: PlanET Biogastechnik, Germany

**Figure 2** A small-scale on-farm biogas production facility in Germany that digests dairy manure from 60 cows and 5 tonnes of corn silage per day.

The volume and nutrient content of the feedstock essentially remain constant during the anaerobic digestion process. However, nutrients do change form during the process, potentially increasing fertilizer use efficiency. Anaerobic digestion also produces valuable secondary products such as liquid fertilizer and livestock bedding material, as well as potentially marketable environmental attributes such as carbon offsets.

A biogas production facility is typically comprised of the following components:

- Pre-storage tanks and/or pads
- Grinder/mixer
- Reactor tank
- Biogas storage
- Gas utilization equipment
- Heat exchanger unit
- Liquid-solid separator
- Post storage tanks and/or pads

The majority of the small-scale agricultural biogas production facilities are operated at mesophilic temperatures (25 °C to 35 °C). Thermophilic temperatures (49 °C to 60 °C) are applied in medium and larger scale biogas production facilities with co-digestion when some of the inputs are from a non-agricultural origin. Higher temperatures are usually required for more stringent sanitation.

The footprint of an on-farm anaerobic digester depends on the scale of the facility. An average-sized on-farm biogas system, including the digester and biogas utilization equipment, will occupy less than a 1/4 hectare of space. Typically, a digester can be easily integrated into farm landscapes.

Source: Danish Institute of Agriculture and Fisheries Economics

**Figure 3** A tanker truck unloading non-agricultural waste into a sealed underground pre-storage tank (for odour control) at a large scale co-digestion biogas plant in Denmark run by a farm cooperative.

## Impacts of On-farm Biogas Production

The anaerobic digestion process breaks down volatile organic compounds, which reduces odour if due diligence is practiced for pre-storage of the feedstock, especially with non-agricultural wastes. Often, one of the main objectives of installing an on-farm anaerobic digestion system is to reduce odours, thereby facilitating good neighbour and community relations.

The process also generates other environmental benefits such as the reduction of greenhouse gases, pathogens, and the viability of weed seeds. It also reduces the potential for water pollution because it decreases biological oxygen demand.

Negative impacts include the potential for increased ammonia emissions and vehicle traffic. All anaerobic digestion projects should include provisions to mitigate such concerns. For example, adding a floating cover to the post-storage tank will reduce ammonia emissions and pumping manure through pipes to a digester will reduce the need to transport waste.

On-farm anaerobic digestion has the potential to generate energy security for the host farm, diversify farm income, and increase rural investment and employment opportunities.

Nutrient management planning is recommended with anaerobic digestion to ensure the integrity of the nutrient balance of the farm, especially if off-farm waste is being digested together with manure.

**TABLE 1 SUMMARY OF BIOGAS PRODUCTION IMPACTS**

| Positive Impacts | Potentially Negative Impacts |
|---|---|
| **Quantified** | |
| - Reduction of odour by 50% to 98%<br>- 100 to 1000-fold reduction in pathogens<br>- Reduction of viability of weed seeds 70% to 90% (resulting in less herbicide use)<br>- Greenhouse gas reduction by 2 to 4 tonnes $CO_2$ equivalent per cow per year<br>- Reduction in Biological Oxygen Demand by 40% | - Potential increase of ammonia emissions by 10% to 20% (can be mitigated through covered storage and sub-surface land application) |
| **Non Quantified** | |
| - Generation of green renewable electricity or renewable natural gas<br>- Diversion of solid and liquid organic waste from landfills and sewage treatment plants<br>- Rural development including investments, increased tax base, and job opportunities<br>- Additional revenue stream for agricultural producers and food processors<br>- Improved local air quality (especially if renewable natural gas is used to replace fossil fuels) | - Increased truck traffic<br>- Increased nutrient load on farmland (if off-farm waste is imported)<br>- Potential for increased noise in the immediate vicinity<br>- Emissions from biogas combustion (same as natural gas emission levels) |

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