Technology: Biogas

Definition and description

Biogas is the product of an anaerobic (without air) process that breaks down biodegradable matter. Various types of microorganisms are involved in the process that finally produces biogas, a mixture of methane and carbon dioxide. Methane is also the main ingredient of natural gas. The methane when oxidized (burned with air) releases thermal energy that can be used for heating and cooking or when burned in a gas engine can produce electricity or propel vehicles. Biogas can be compressed for storage and transportation and it can be purified to increase the methane content to achieve natural gas quality. However, this only makes sense on a large scale as the process is energy intensive.

Methane has a very high global warming potential, which is 28 to 33 times higher than that of carbon dioxide. When burnt however, it becomes carbon dioxide. Since the organic matter can only release as much carbon (dioxide) as it previously took from the atmosphere, it is considered climate neutral and a form of renewable energy. This however, only applies if no more than 3 % to 4 % of the methane leaks from the closed system to the environment.

Digesters and fermenters, that is where the biogas is produced in, are available in all sizes making the actual production of biogas scalable. Certain utilizations however, are bound to minimum sizes in order to be economic. Gas engines and generators for example are not economic with small scale systems.

Potential in Grenada[32]

Grenada's agricultural sector produces a considerable amount of organic waste from manure, fruit and vegetable wastes and green cut to effluents of distilleries. However, most entities are, compared to international standards, are rather small. This makes it challenging to assess the potential and find proper applications. A joint project by the Ministry of Finance and Energy, the Ministry of Agriculture, Lands, Forestry, Fisheries, and the Environment, private sector partners Ökobit and Exled Caribbean (who provides the technology, and the installation and maintenance services) and the German Development Cooperation GIZ introduced small scale biogas digesters for farms and agro-processors. So far ten systems have been installed in total in Grenada. According to GIZ, the vision is to have 50 systems in operation in Grenada. The theoretical potential (entities producing sufficient amounts of waste) may be higher but will most likely not be much more than 100 systems.

Each of those small scale systems is supposed to produce 5 m^3 of biogas per day with a methane content of slightly more than 50 %. Provided the potential of 100 systems would be utilized, the methane production could reach approx. 100,000 m^3 per year.

[32] Due to the lack of detailed analyses the potential has been estimated based on available data and assumptions.

There is also potential for medium scale systems, for example with the distilleries. Feasibility studies and execution plans have so far been prepared for Grenada Distillers Ltd. but have not yet materialized. River Antoine Distillery have also expressed their interest in a biogas system. The larger farms in Grenada could also be suitable for medium sized systems.

The planed system for the Clarks Court Distillery was envisioned to produce approximately 200,000 m^3 and 250,000 m^3 of methane per year. Assuming that there may be potential for four other biogas systems half the size of Clarks Court, the methane production potential from medium sized systems could be in the range of 600,000 m^3 to 750,000 m^3 per year.

Mitigation to climate

Due to the size of the potential biogas systems, most if not all would be used for some kind of heating/cooking purpose. Consequently, in order to estimate the greenhouse gas mitigation potential the replaced amounts of LPG and diesel have to be calculated. Methane has a net heating value of approx. 10 kWh/m^3. LPG has an average net heating value of 12.8 kWh/kg and diesel's net heating value is approx. 10 kWh/l. Assuming that half of the biogas would replace LPG and the other half replaces diesel, the substitution potential for LPG is between 234,000 kg and 293,000 kg and for diesel between 300,000 l and 375,000 l per year. The emission factor is 3.03 kg of CO_2 equivalent per kg for LPG and 2.68 kg of CO_2 equivalent per kg for diesel. Consequently the total greenhouse gas emission reduction potential through the use of biogas is between 1.5 kT and 1.9 kT of CO_2 equivalent.

Advantage(s)

- Proven, mature and reliable technology
- Very good scalability
- Produces organic fertilizer as a by product
- Reduces pollution in waterways because organic waste is better managed by the biogas system and the recommended fertilizer management system

Disadvantage(s)

- Especially the operation of small scale systems is relatively labor intensive for a renewable energy source
- If more than 3 % to 4 % of methane leak into the environment there are no climate mitigation benefits

Costs and other financial requirements

Obviously the costs of a biogas system mainly depends on its size and the ancillaries like storage facilities, compressors or engines and generators. The small scale systems currently introduced in Grenada cost approx. 12,000 XCD. For a system as it was planned for Grenada Distillers Ltd. the cost would be in the range of 2 million XCD. Payback periods for this specific system would be approx. five years.

Status of the technology in Grenada

Biogas technology has been first introduced in Grenada in the early 1970's and 80's. However, those systems are not in operation anymore. Today several small scale systems are in operation.