Technology: Landfill Gas Recovery

Definition and Description

Landfill gas (LFG) is the gaseous product of organic waste decomposition in a landfill. LFG is 40 – 60% methane (CH_4) with the remainder being primarily carbon dioxide (CO_2), nitrogen, water and a mix of other trace gases (e.g. hydrogen sulphide). Landfill gas recovery or utilisation is the process of collecting and processing the LFG, and using it as a vehicle fuel or for cooking, space heating/cooling (absorption chillers) or combusting it to produce electricity.

After about its first year of operation, a landfill will move from aerobic to anaerobic digestion and starts to produce LFG. Leachate can be re-circulated to speed up decomposition and the production of LFG, and operate the landfill like a bioreactor (wet cell)[14]. This LFG is collected either passively (vents) or actively by a series of pipes and blowers (under vacuum). The collected LFG is either flared (converted into CO_2) or is treated for energy recovery.

Moisture (the gas is saturated with water which has to be removed prior to use), particulates and other impurities (e.g. siloxanes, hydrogen sulphide and sulphur dioxide) may be removed using condensers and filters. The cleaned gas may be compressed if fed into a pipeline (e.g. mixed with natural gas). The type of treatment applied to the LFG depends upon the intended end use.

Potential in Grenada

Grenada produces approximately 100 tonnes of municipal solid waste (MSW) per day. According to Grenada's NDC[15], approximately 10% of national emissions is from anaerobic decomposition of waste in the national landfill. This would equate to approximately 25,000 tonnes of CO_2 equivalent per year, or converting to methane would equate to approximately 1,000 tonnes of methane per year. Using typical conversion rates from other data sources (i.e. approximately 120 kg of methane produced per tonne of MSW[16]), would equate to ~ 4,400 tonnes of methane per year. Therefore, Grenada's NDC may be underestimating the amount of methane being generated by MSW.

However, the national landfill at Perseverance has caught fire on several occasions over the last decade, which may have reduced the amount of stored LFG. There is currently no collection (passive or active) of LFG at Perseverance nor is there any history of LFG recovery.

[14] https://www.epa.gov/landfills/bioreactor-landfills

[15] Grenada, 2015. Nationally Determined Contribution

[16] Lohila, Annalea, et. al. "Micrometeorological Measurements of Methane and Carbon Dioxide Fluxes at a Municipal Landfill." Environmental Science & Technology, 41.8 (2007): 2717-2722.

Mitigation to Climate

As the sides of the landfill are not lined with a material of low permeability to gases, some LFG would continue to escape even if a collection system was constructed. Assuming a 50% collection efficiency, the mitigation potential of this technology is estimated at ~ 12,500 tonnes of CO_2 equivalent per year (using the emissions estimate from the NDC).

Advantages

- Reduces odour and increases safety at the landfill
- Reduces the environmental impact of the landfill
- LFG is available even after the landfill closes
- Can be used to meet both baseload and peak electricity demand

Disadvantages

- Difficult to model the amount of LFG that is available
- Economic feasibility usually linked to the price of natural gas
- Some environmental groups (e.g. Sierra Club) are opposed to accelerated decomposition of waste and are concerned about increasing fugitive methane emissions.

Costs and other financial requirements

Collecting and combusting LFG is one of the simplest and cheapest ways of recovering energy from MSW. Particularly, if the landfill operator is bound by regulation to at least collect and flare the LFG. It is noted that there is no such regulation in Grenada. The cost of a LFG to Energy project vary depending on the type, size and layout of the landfill. The LFG can be used in an internal combustion engine, gas turbines or microturbines. Installation cost estimates for using an internal combustion engine are between $1,700/kW and $2,300/kW. The EPA estimates that a privately owned and operated project with a 3 MW turbine and no previously installed capture system would cost approximately $8.5 million to install[17].

Status of the Technology in Grenada

Currently, there is no deployment of landfill gas collection, recovery and/or utilisation technology in Grenada.

[17] http://www.eesi.org/papers/view/fact-sheet-landfill-methane