UTAH CLEAN ENERGY

Landfill Gas to Energy

Description:

Landfill Gas to Energy (LFGTE) is process by which gas is collected from Municipal Solid Waste (MSW) landfills to generate energy. At the same time this process also reduces methane & CO_2 emissions, which are greenhouse gases that contribute to global warming. Methane emissions from MSW landfills account for about 25% of human-related methane emissions, and were the largest source of methane emissions in the US in 2004.[1] While we cannot eliminate MSW landfills, we can capture the emissions released from them and use them to our advantage.

Converting landfill gas to energy is a matter of collecting gases released from solid waste and organic matter as it decomposes. A special type of vacuum system and a series of pipes buried within the landfill are use to collect the gas. The gas may then be processed and treated depending on what the ultimate end use is. Many landfills currently just flair the gas off to avoid a buildup of flammable gasses. Instead the gas can be used for a number of applications, including electricity generation with a gas turbine, direct-use for industrial applications, cogeneration for heat & electricity, or it can be converted into an alternative fuel like natural gas.

There are many landfill gas projects currently operational; as of 2006 there were 425 in the US, and potentially 560 more landfills that could be used to generate energy. Currently in Utah there are three operational projects:

Landfill	Energy Conversion Type	Capacity (MW)	Methane Emissions Reductions (short tons CH_4/yr)	Emissions Reductions (short tons CO_2 E/yr)
Davis County Solid Waste Management	Reciprocating Engine for electricity	1.2	2,390	57,320
Salt Lake Valley Landfill	Reciprocating Engine for electricity	3.0	5,976	142,198
Weber County Landfill	Reciprocating Engine for electricity	1.0	1,992	47,400

Table 1 Current Landfill Gas to Energy Projects in Utah[2]

These three projects alone reduce the equivalent of 246,918 short tons of CO_2 equivalent per year, 10,359 short tons of methane per year and 29,620 short tons of avoided CO_2 per year. This reduction in emissions is equivalent to removing over 43,300 vehicles from the road. And these three landfills also generate enough electricity to power 3,300 homes.[3]

For a potential site to be economically viable for electricity generation, the facility would need to generate power at 5-6 ¢/kWh to make a profit. A good site for development will also be around 50 acres and 100 ft. deep. (Generally speaking an 80 acre site and 100 ft deep of MSW

[1] Overview of Landfill Methane Outreach Program (LMOP). US EPA. http://www.epa.gov/lmop/overview.htm March 14, 2004.
[2] Emission reduction calculations derived from "Emissions Reductions and Environmental and Energy Benefits for Landfill Gas Energy Projects," created by the US EPA Landfill Methane Outreach Program. URL: http://www.epa.gov/lmop/res/calc.htm.
[3] See reference 2.

will generate about 3 MW of power.) Smaller facilities though should not be discounted as they can process gas for fuel, or generate electricity for onsite or nearby use.[4]

Benefits:

LFGTE projects both directly and indirectly reduce greenhouse gas emissions. Landfills are the largest human-generated source of methane emissions. And as methane is 21 times more potent than CO_2 as a greenhouse gas it is important to reduce these emissions as much as possible directly through collection at landfills. LFG projects are estimated to capture 60-90% of the methane emitted from the landfill. Once burned, the methane is turned into water and CO_2, which is less potent than methane.[5]

Indirectly, LFGTE projects eliminate the need to use other fossil fuels for energy generation. If the landfill gas was not used, other fuel would be bought, burned and greenhouse gases emitted, along with the original methane emissions from the landfill. Using landfill gas to generate energy is a win/win situation. Not only are harmful emissions from the landfill reduced, but emissions from other fossil fuels are completely avoided. The following table outlines the emissions reductions from 1 MW worth of power generated from a LFGTE project, which would power about 640 homes.[6]

	Short tons CH_4/yr	**Short tons CO_2/yr**	**Short tons CO_2E/yr**
Direct Reductions	1,992	-	41,888
Avoided Reductions	-	5,696	5,512
Total Reductions	1,992	5,696	47,400

Table 2 Emissions Reductions from a 1 MW Landfill Gas to Energy Project

Additionally, a 1 MW project would be equivalent to any one of the following:

- Removing emissions equivalent to 8,339 vehicles, or
- Planting 11,882 acres of forest, or
- Offsetting the use of 213 railcars of coal, or
- Averting electricity usage of 77,917 light bulbs.

Other benefits to LFGTE projects include improved air quality and odors in the surrounding area, it reduces the risk of explosions & safety hazards, and it also provides a benefit to the local economy. Landfill gas is a local resource that is not imported and would otherwise be considered a waste if not used. Environmental compliance costs will also be reduced as a result of the LFGTE project.

In Utah, there are currently 6.6 MW that could still be generated from landfills currently in operation.[7] If only 6 MW of that power was developed and utilized, over 285,000 short tons of CO_2E could be reduced per year.

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[4] Personal Conversation with Scott Salsbury of Landfill Energy Systems, the developer of the Salt Lake County landfill gas plant, on August 1, 2006. www.landfillenergy.com

[5] CO_2 emissions from MSW landfills are not considered to contribute to global climate change because the carbon was contained in recently living biomass. The same CO_2 would be emitted as a result of the natural decomposition of the organic waste materials outside the landfill environment.

[6] Calculations for equivalent reductions are based on the Landfill Gas to Energy (LFGE) Benefits Calculator as part of the EPA LMOP. http://www.epa.gov/lmop/res/calc.htm

[7] This figure was calculated using LMOP's Landfill Gas Emmission Model (LandGEM), Version 3.02. Assuming Methane Generation Rate, k = 0.02; Potential Methane Generation Capacity, Lo = 100; and 50% Methane by Volume.

Costs

Costs for LFGTE projects will vary with landfill size, depth and quality of waste, but generally speaking a facility to generate electricity will cost $1,200/kW and can generate that electricity at 5-7 ¢/kWh.[8] A 1 MW plant would then cost around $1.2 million, would reduce 47,400 tons of CO_2E, and would cost $25.32/ton CO_2E. The following table shows total costs for an additional 6 MW of power.

Total Capacity	Cost of Facilities	Total CO_2E short tons reduced per year
6 MW	$7.2 million	285,168

Table 3 Costs & Emissions Reductions for 6 MW of potential power from LGFTE facilities in Utah

Implementable:

LFGTE technology has been in use for many years and is both economically and technologically viable. With over 400 facilities currently producing, there has been a considerable amount of experience and improvements in the field. Examples of successful facilities abound throughout the country, and Utah has 3 of its very own to draw experience from. Many case studies can be viewed on the EPA LMOP site, (http://www.epa.gov/lmop/res/index.htm).

The timeframe to implement projects at these potential sites is dependent on developers and the quality of the landfill site. Larger landfills will be developed first and then the smaller ones later. Depending on the size of the project and generation capacity, some new transmission lines may need to be added. As three projects are already in operation in Utah, it is unlikely that any new laws or regulations will need to be passed to accommodate for new facilities.

Impacts:

These facilities will most likely be paid for through private investment or possible public funds through the landfill itself. These projects are unlikely to affect tax payers as the cost of the facilities can be financed from the sell of electricity.

LFGTE facilities will actually reduce associated risks with landfills by helping to actively collect the flammable gas and burn it in a more controlled environment. By reducing gas, especially methane, into the atmosphere, these facilities would also improve air quality around them.

These facilities will not affect competitiveness in any way, instead, they will help diversify the generating mix, and reduce the dependence on fossil fuels. And there is also a significant potential for local economic development. These facilities will create jobs for the design and operation, and they will generate revenue from the sell of electricity or fuel.

And assuming 75% conversion of Gas to combustion; 506 BTUs/ft^3 of LFG at 50% methane; 60 min in an hour; and 10,800 BTUs per kWh for IC engine efficiency. Potential sites could produce greater than 0.5 MW of power.

[8] Personal Conversation with Scott Salsbury of Landfill Energy Systems, the developer of the Salt Lake County landfill gas plant, on August 1, 2006. www.landfillenergy.com