

LANDFILL GAS

AN INCREASINGLY POPULAR ENERGY SOURCE

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The decomposition of waste in landfills represents both a problem and an opportunity for municipal landfills. Landfills produce a gas that is composed of about 50 percent methane – the primary component of natural gas – about the same amount of carbon dioxide (CO₂), and a small amount of non-methane organic compounds.

Methane is a potent greenhouse gas, and municipal solid waste landfills are the largest source of human-related methane emissions. Methane's contribution to global warming is 21 times that of carbon dioxide. Also, volatile organic compounds and nitrous oxides – which may be present in landfill gas – can react to form ozone, a primary cause of smog. It's estimated that more than 25 megatonnes of CO₂ equivalent are being generated annually from Canadian landfills, equal to five and a half million cars on the road.

Methane is also potentially hazardous since it is explosive in concentrations between five and 15 percent by volume.

In addition to the environmental and safety issues, landfill gas has very small amounts of other contaminants that



Installation of a gas well on the BraeBen Golf Course.

cause unpleasant odours and poor local air quality, potentially resulting in landfill complaints from neighbours.

Harnessing the Energy

But landfill gas can be converted into a reliable energy source, used to generate electricity, fuel industry, and heat

buildings. By using landfill gas as an alternative to traditional non-renewable energy sources, such as coal or natural gas, landfills can be harnessed to provide a valued commodity – energy!

Landfill gas is extracted through a series of vertical or horizontal wells drilled into the landfill. The wells are typically constructed of perforated plastic pipe, and are connected via a network of pipes, much like a municipal sewer system.

The gas is collected in the pipe system by exerting a vacuum in the wells, using a blower or compressor. This device sucks the gas out from around the



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wells, and brings it to the plant, compressing it to a pressure appropriate for the fuel user. Just prior to injecting the gas into a mover – typically a boiler, engine, or turbine – the gas is cooled to the dew point to allow moisture to condensate out of it. The gas is filtered and then reheated. It is then fed into the mover as a fuel for this device. The gas can then be used to generate electricity or steam.

Municipalities that have successfully undertaken landfill gas to energy projects either take on the projects themselves, hire consultants to provide assistance or enter into public-private partnerships, whereby a private company assumes part or all of the responsibilities of the landfill gas project. Services offered by private companies range from simply providing expert consultation to actually financing, building, and operating the plant, with royalties paid back to the municipality.

The following is a list of items to be

addressed by municipalities wishing to convert landfill gas to energy.

1. Feasibility analysis

A review of the operating history of the landfill is required. Lifespan, receiving history, and size of the landfill all affect the level of landfill gas produced. If a review of these factors indicates that there is the potential for a landfill gas utilization project, landfill gas testing can proceed at the site.

2. Testing

A temporary landfill gas flaring system will assess the quantity and quality of landfill gas produced. This system will draw landfill gas through a temporary collection system.

3. Approvals

Approvals are required from public agencies related to the collection, flaring, and utilization of landfill gas. Managing the approvals process includes submitting applications, responding to

agency concerns, and ultimately acquiring approvals.

4. Utilization

Potential utilization projects in the vicinity of the landfill site are investigated. Possible projects include direct use at a neighbouring facility or generation of electricity for sale. Aspects of the utilization project include the design and construction of the landfill gas recovery system, financing, negotiation of a purchase agreement, and operation of the landfill gas utilization system for the life of the project.

For some landfills, landfill gas utilization remains unfeasible due to the small size, remoteness, or age of the landfill. However, a municipality may still desire a landfill gas collection system due to odour or safety issues.

5. Power purchase agreements

Regardless of the type of utilization, most projects will require a long-term agreement for the purchase of the

power. This commitment to purchase the power is necessary to justify the capital investment in the system. The negotiation of long-term power purchase agreements can be complex and lengthy. By assessing the risk profiles of the purchaser and the project, agreements with both public and private sector clients for the energy can be successfully negotiated.

6. Operations and monitoring

Operations and monitoring services include remote supervisory control and data acquisition, regular visits to the site, monitoring of gas levels through the collection system, adjustment to the wellfield, and scheduled maintenance of the entire system.

7. Greenhouse gas emission credits

Although emission reduction credit trading systems have not yet been developed by the governments of Canada and the United States, many companies have participated in emissions trading as part of their risk mitigation program. Emission reduction credit agreements must be negotiated and implemented, including documenting credit verification. Most emission reduction credit agreements require a long-term commitment.

Successful Landfill Gas Projects

One example of a successful landfill gas utilization project is the Britannia Landfill Gas to Energy Project in Mississauga, Ontario. Closed in 2002, the Britannia Sanitary Landfill received over 10 million tonnes of waste. The City of Mississauga operates the BraeBen Golf Course on the finished surface of the landfill, while the Region of Peel uses the landfill gas to generate electricity. The landfill gas to energy plant was designed, constructed, and operated in a public-private partnership with the Region of Peel.

The wellfield is designed to avoid the fairways of the golf course, while maximizing the collection of landfill gas. Wells are strategically located along the driving ranges and cart paths, as well as on the perimeters of fairways. The system includes approximately 55 wells, and is designed to collect approximately

2,500 cubic feet per minute of landfill gas. The electricity generation plant is located off-site from the landfill, so that it has no impact on the golf course. Gas is delivered to the plant through an 800-metre dedicated pipeline.

The plant comprises a gas processing plant with two two-stage compressors and gas drying equipment, and a generation plant that includes three reciprocating engines. The total generating capacity of the plant is 5.5 MW – enough to power more than 5,000 homes. The plant, which began operating in 2005, will continue to generate electricity for at least 20 years.

Another municipality with a successful landfill gas to energy program is the Trail Road Landfill Gas to Energy Facility in Ottawa. The plant at the City of Ottawa's Trail Road Landfill reduces annual greenhouse gas emissions by up to 180,000 tonnes compared to levels emitted at the site in 1990. The facility began producing "green" power in January 2007. Prior to this, the landfill gas was collected and flared. It produces 5 MW of power and will have an operating life of at least 20 years. The project generates a royalty payment to the City of Ottawa of about \$150,000 per year.

On the Horizon

Regulations may soon force municipalities to at least collect and flare their landfill gas, even if they do not put in place a system of converting it to energy. Ontario's Ministry of the Environment is contemplating regulations to require landfill gas collection and control for operating, expanding and new sites that exceed 1.5 million cubic metres in capacity.

Environment Canada estimates that if half of all landfill gas produced in Canada was combusted, it would mean a greenhouse gas reduction equivalent to six million tonnes of carbon dioxide annually. While municipalities are making great strides in reducing waste and directing what waste is generated away from landfills, there will always be a need for some wastes to be landfilled. It simply makes sense that the landfills that continue to exist are as clean and green as possible.