Turning Trash Creating Value from

by Steven Giles

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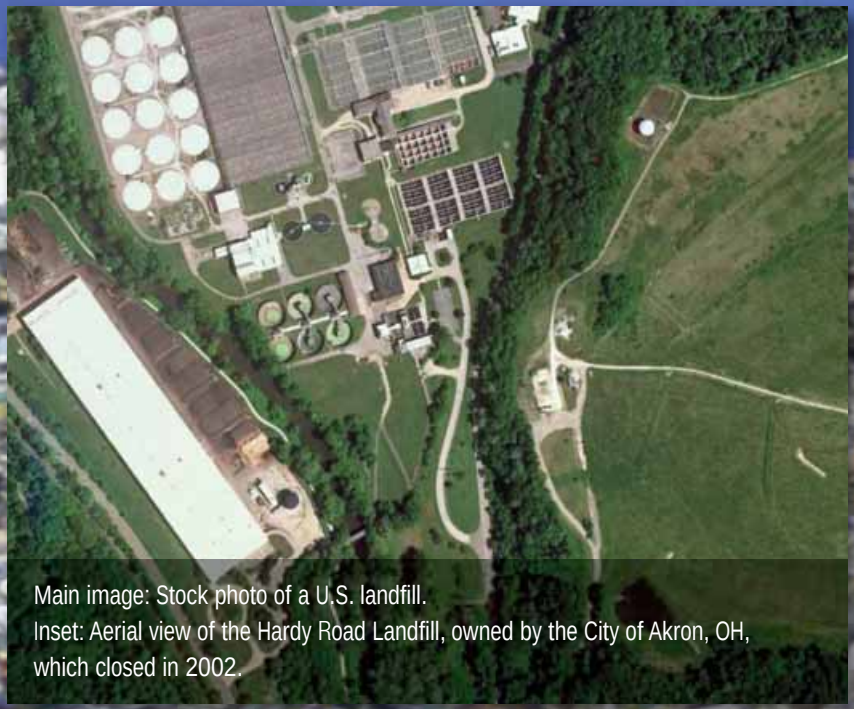
A case study outlining the City of Akron's involvement in capturing landfill gas and converting it to usable, saleable energy.

Municipal solid waste landfills are the largest source of human-related methane (CH_4) emissions in the United States. At the same time, CH_4 emissions from landfills represent a lost opportunity to capture and use a significant energy resource. Landfill gas (LFG) is created as solid waste decomposes in a landfill. This gas consists of approximately 50% CH_4, the primary component of natural gas.

The Hardy Road Landfill, owned by the City of Akron, OH, was closed in 2002. Spanning 103 acres adjacent to the Cuyahoga Valley National Park, the landfill took in approximately 2,100 tons of waste daily at its peak of operations; approximately 900 tons coming daily from Akron and 1,200 tons daily from the Cleveland area. When the landfill closed, it was covered with a clay-dirt-synthetic cap more than 5-feet thick. To manage the landfill, two plumbing systems were installed below the cap: one for gases and one for landfill liquids.

On the environmental side, the site includes seven groundwater monitoring wells, 13 piezometers to monitor groundwater levels, 42 gas extraction



Main image: Stock photo of a U.S. landfill.
Inset: Aerial view of the Hardy Road Landfill, owned by the City of Akron, OH, which closed in 2002.

into Energy a Closed Landfill

wells with two miles of buried pipelines that draw and capture the landfill gas from the site, and 18 probes to make sure the CH_4 does not migrate off the site. In addition, the plumbing system collects leachate to protect groundwater. All leachate is then removed and processed accordingly. Since its closing, landfill gas at the Hardy Road Landfill has been flared off. Previous investigations into methods to reuse the landfill gas proved unsuccessful, until now.

Project Deveopment

Hull & Associates Inc., an Ohio-based project development, energy, and engineering consulting firm with 30 years of experience in providing technical engineering services, particularly in the landfill industry, and the City of Akron agreed to evaluate the opportunity to develop a landfill-gas-to-energy project at Hardy Road, performing the initial evaluation at no cost to the city.

The Waukesha APG 1000 1.1-MW energy generator (genset) was selected the for use at the Hardy Road Landfill.

One of the key aspects of developing a landfill-gas-to-energy project is to develop an accurate projection of the available LFG. The CH_4 produced at a landfill declines over time, normally at a rate of less than 4% per year, and can be impacted by the volume and types of waste that were disposed of in the landfill. Additionally, the LFG production can be impacted by moisture, temperature, and barometric pressure on a daily or even hourly basis. Hull's modelling process consisted of landfill gas production models, and actual on-site testing. Site data were evaluated and monitored to help validate the desk-top analysis.

Determining the fuel production curve and understanding its variability is critical to sizing the prime technology for the project: the engine and generator (also known as the "genset"), which will produce the electricity. To maximize the economic value of the project, the utilization of the genset must also be maximized in order to recover the capital costs. Hull evaluated the curve and selected the Waukesha APG 1000 for the Hardy Road Landfill; a 1.1-MW genset manufactured in the United States with one of the highest efficiency ratings in its class. The APG 1000 was specially equipped with a fuel management system designed for landfill gas, which has a lower heating value than natural gas.

Based on the fuel production curve and genset fuel requirements, the genset should be able to operate at full-load for at least five years before the LFG volume declines. In its initial years of operation, Hull forecasts that the unit will produce more than 8,500,000 kWhs per year, allowing for downtime for routine maintenance. The project is expected to have at least a 15-year life span.

Another key aspect is the ability to deliver and sell the electric energy that is produced from the project. The genset will produce far more energy than is required to operate or maintain a landfill. Also, landfills are often located in isolated areas and do not have adequate electric infrastructure to handle the amount of electricity being produced. In the case of the Hardy Road Landfill, the electric infrastructure on-site was not suitable to transmit the electric energy; however, the neighboring Akron Water Pollution Control facility is located on a contiguous property approximately 3,000 feet away with an electrical base load of about 3 MWs. It became the perfect end use for this energy project.

The project design called for constructing the gas conditioning and blower equipment at the site of the existing flare. The conditioned gas is then transported via pipeline to the engine, which is housed in an existing structure at the Akron Water Pollution Control Facility. The Akron Water Pollution Control Facility operates its own substation and distributes the electricity at 13,200 volts to its various operating facilities. As part of this project, the power from the genset was connected to a step-up transformer to elevate the voltage to 13,200 volts, which was then interconnected to the distribution side of the substation. Significant amounts of computer programming and monitoring is incorporated into the system, which communicates directly with protection and relay equipment to ensure that changes in power flow or outages by the genset or the local electric distribution company do not pose any safety concerns or risk of equipment damage.

Project site work, including constructing the fuel delivery system to transport the gas, began late in 2011; the unit was successfully commissioned in August 2012.

Energy Sales and Financial Structure

As part of the project development, Hull and the City of Akron worked though ownership issues and financing. A separate entity was formed to own the asset—Urban Renewables III, LLC—and then a long-term Power Purchase Agreement (PPA) was negotiated to provide the city with a reduced energy rate compared to their current electric purchasing arrangements. The ability to negotiate a PPA enabled Urban Renewables III to raise the capital for the project, which cost approximately $2.7 million. The project was funded with 45% private equity, and 55% commercial debt.

Project Risk and Benefits

The investors in the project will earn their return though the sale of the energy to the City of Akron, as well as the sales of renewable energy certificates (RECs) generated by the project. While the energy sales are reasonably predictable, the renewable energy market is still evolving and creates some financial risk. Hull Energy, an affiliate of Hull & Associates, manages the project on behalf of Urban Renewables III and interacts with potential buyers of RECs, such as Ohio's investor-owned utilities and certified retail electric suppliers.

Additionally, fuel production risk is present in any landfill gas project, as well as the operational risk inherent in operating a genset. The process to determine the fuel supply analysis, financial modelling, and equipment selection took these various risk factors into account.

Overall, the City of Akron was able to reduce its energy cost and carbon footprint without an up-front capital investment, while utilizing a valuable energy source that until now was being wasted. As a result, the project was able to offset fossil fuel generation and the city reduced its carbon footprint by 5,200 tons of carbon dioxide per year. em