

GHG Project Case Study

Heat and Power from Landfill Gas: Johnson & Johnson's Experience

To address volatile, escalating energy prices and concerns about climate change, many large energy consumers look for stable, nonpolluting sources of energy. Although solar and wind power usually capture the headlines, landfill gas (LFG) also is an economically viable renewable resource but is often overlooked.

When solid waste decomposes in a landfill, it creates LFG, which consists of about 50 percent methane (CH₄), the primary component of natural gas and also a potent greenhouse gas (GHG). The other 50 percent of landfill gas is carbon dioxide (CO₂), the most significant GHG in terms of global emissions. When allowed to escape into the atmosphere, landfill gas not only contributes to climate change but also represents a lost economic opportunity.

As of 2006, more than 400 LFG projects are operating in the United States, and the Environmental Protection Agency (EPA) has identified another 600 landfills that could support LFG projects. As the U.S. population and consumption continue to rise, the potential for landfill gas projects rises as well.

Johnson & Johnson's LFG Project

Johnson & Johnson (J&J) committed to reducing its GHG emissions by 7 percent below its 1990 levels by 2010. Each of the company's business units has an emissions target whose progress is tracked annually.

ALZA Pharmaceuticals, a division of J&J, needed to reduce its GHG emissions by 21.5 million pounds per year or risk failing to meet their target. For the energy

manager at ALZA, a cost-effective solution was right around the corner—literally. ALZA's research and development facilities in California are adjacent to the Shoreline Landfill, which was closed in 1993 and redeveloped as a public recreation center. The 150-acre facility is located next to San Francisco Bay and contains a golf course, clubhouse, and the Shoreline Amphitheater.

The LFG produced in the Shoreline Landfill by decaying waste was captured and flared in accordance with EPA regulations for large landfills. Although the flaring protected the recreational visitors from offensive fumes, it wasted a valuable source of clean energy. Accordingly, ALZA contacted the landfill's owner, the city of Mountain View, to propose a project that would use the landfill gas at three of its nearby research and development facilities. The city was interested in a clean energy project and, after some minor modifications, accepted ALZA's proposal in February 2004.

ALZA and the city of Mountain View signed a 15-year contract for the sale of the gas, which ALZA uses to power three 970-kilowatt generators at each of its research and development buildings in the area. Electricity from the generators powers the buildings, and the heat captured from the exhaust is used to provide hot water. The gas purchase agreement sets a fixed price with cost of living adjustments for inflation over the term of the contract, which ALZA may extend for an additional five years.

The System

ALZA takes possession of the gas before the existing flare and processes it on-site

at the landfill using a standard moisture elimination system. Three 60-horsepower blowers maintain the gas at a pressure of 6 pounds-per-square-inch (psi) as it passes through a chiller. The temperature of the gas at the inlet is 70°F, and when it is exposed to the colder temperatures in the chiller, the moisture in the gas condenses and falls out of the gas as droplets. The system removes 90 percent of the moisture in the gas and is capable of processing 1,300 standard cubic feet of gas per minute. ALZA negotiated to locate the cleanup station at the landfill so it could send the waste liquids right back to the landfill. To provide a smooth and safe operation of this system, a very small portion of the LFG is still flared. This will protect the environment if there is a sudden interruption in LFG consumption.

The processed gas is injected into a 1.25-mile pipeline made of high-density polyethylene (HDPE), which is flexible yet strong enough to withstand the forces created as the landfill settles. The pipeline also is maintained at 6 psi and has sections of 6-inch, 8-inch, and 10-inch diameters with fused-seal connections. Four isolation valves enable the operators to close sections of the pipeline either in an emergency or under normal operating conditions. ALZA had to secure the pipeline's right-of-way from the city of Mountain View and a private landowner.

The pipeline delivers the gas to three GE-Jenbacher generators located in three separate buildings. The generators are rated at 970-kilowatt prime capacity when burning LFG, and the system's total net capacity is 2,910 kilowatts, or 2.9 megawatts. The units are configured for the combined heat and power operation, with the electric output used to power the buildings and the waste heat from the exhaust captured and used to provide hot water.

Although the landfill generates gas continuously throughout the year, ALZA's electricity needs vary, and sometimes during the winter months the system

generates more electricity than the buildings need. In addition, the generators run in parallel with the grid, but the local utility (Pacific Gas & Electric) does not offer a net metering tariff for landfill gas generated electricity, which means that ALZA cannot sell the excess power to the utility. Consequently, ALZA will need to find a client to take the excess generation during this time.

The system is expected to generate 24,000 megawatt-hours of electricity per year and displace 1,500 MMBtu per hour of natural gas consumption.

The operation and maintenance of the system have been outsourced to Shaw Environmental Services. The contract is a fixed-price, five-year term with a performance incentive linked to annual availability, or the percentage of time that the system is up and running.

Business Case and Economics

From a business perspective, this project is a solid winner. It was approved in 2003 with a pro forma annual pretax savings of \$900,000 and a 15 percent internal rate of return (IRR) based on energy price projections of electricity and natural gas. Unexpectedly high energy prices since 2003, however, have driven the return on the project above a 20 percent IRR.

The actual capital costs were \$11 million. Although ALZA also received approval for three grants from Pacific Gas & Electric Corporation totaling \$2.5 million, it has not yet requested payment, pending air permit approvals, which are expected soon.

The project will save an estimated 16 million pounds/year (7,256 tonnes/year) of CO₂ emissions through avoided electricity and natural gas consumption, representing 71 percent of ALZA's annual GHG reduction target. ALZA could assign a value to the CO₂ reductions, for example, based on what the company would have paid for emissions offsets on the market

for tradable “carbon commodities.” For example, if the market price for carbon offsets were \$5/tonne, ALZA could recognize an additional value of \$36,280 per year. However, at this time, ALZA has no plans to sell the emissions offsets.

Major Challenges and Keys to Success

As with any major project, ALZA encountered several challenges along the way that had to be addressed:

- The project was delayed because of difficulties meeting the emissions limits for another pollutant, carbon monoxide. Fortunately for ALZA, it negotiated to have GE-Jenbacher guarantee the equipment’s emission limits. In fact, ALZA used the exact language from the Air District Emissions Requirement in its purchase contract for the GE-Jenbacher generators. To resolve the problem, the GE-Jenbacher team replaced the pistons and sleeves for each unit with a product designed for low emissions.
- ALZA ran into complications with its landlord, who was unfamiliar with landfill gas and uncomfortable with the technology. Consequently, ALZA was forced to spend additional resources to get the landlord’s approval to use an LFG generator on-site. Although this obstacle was difficult to foresee, ALZA learned that it should explain earlier to its landlords the risks and rewards of LFG projects.

ALZA also discovered some keys to a successful LFG project:

- Developing a relationship with the city of Mountain View was critical. The city council agreed that the project had high priority. As a result, city employees and regulators were responsive and flexible throughout the project, and

the environmental approval process, right-of-way negotiations, and building appraisal processes all went smoothly.

- ALZA was able to secure internal approval for the project in less than five weeks, largely because it had sought buy-in from key interests within J&J, particularly the finance department and the energy management department.
- ALZA asked for assistance from the EPA’s Landfill Methane Outreach Program (LMOP) when negotiating its gas contract with the city of Mountain View. As this was the city’s first landfill gas project, it knew little about its value, but the LMOP team was able to provide price comparisons from projects around California.
- Securing a guarantee from the manufacturer of the generators proved to be an important factor in meeting the carbon monoxide emissions targets. GE-Jenbacher assessed the problem and then, at no charge, replaced the existing pistons and sleeves with a new, low-emission design.
- ALZA relied heavily on internal and external counsel to negotiate the easements and right-of-way, air-quality permits, environmental reviews, and gas purchase contract.