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Landfill: Gas to Energy

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OVERVIEW

Maine's first landfill gas-to-energy project, located at Casella Waste Systems' Pine Tree Landfill in Hampden, broke ground in May of 2007 and by February 2008 was producing electricity using methane generated by the landfill as its fuel source. The rated capacity of the project is three megawatts (MW). Over the next 20 years, landfill gas-to-energy projects should become an integral part of Maine's electric power grid. Even more significantly, Casella is evaluating the feasibility of developing a far larger gas-to-energy plant at the Juniper Ridge Landfill in West Old Town by some time in 2009. At its peak, that facility could generate between 13 and 15 MW of power. Project life is estimated to be at least 30 years, and probably much longer. In addition to its electrical output, the West Old Town facility will also generate prodigious quantities of waste heat suitable for greenhouse development or other related activities.

LOOKING BACK

Until recently, solid waste management in Maine was largely a matter of cheap disposal. Thirty or 40 years ago it meant finding an isolated piece of land somewhere in town, often an abandoned gravel pit, and with no thought to soils type or proximity to groundwater, beginning to fill it with whatever waste residents and businesses wanted to be rid of. Not surprisingly, these practices posed the risk of significant ground- and surface-water contamination at hundreds of sites around the state. In addition, many of these sites, which also operated as open burning dumps, became major contributors to air pollution. Ultimately, more than $100 million in public funds were spent to close more than 300 municipal landfills.

By the 1980s, disposal practices had begun to change and improve. Unlined dumps gave way to so-called sanitary landfills, which in turn gave way to fully lined and monitored "secure landfills." By late in the decade, in part as a response to the Arab oil embargo of the early 1970s, co-generation, in the form of waste-to-energy facilities, became the favored vehicle for waste disposal in the Northeast, particularly in Maine. Not only did these "co-gen" plants offer the promise of continued cheap disposal (tipping fees were subsidized by electric ratepayers), they had the added virtue of reducing the volumes that required land disposal after combustion.

TODAY

A modern, secure landfill has become an essential piece of public infrastructure. While Casella's resource management strategy is founded on the tenet that a significant fraction of the waste stream can be recycled, the present reality is that no matter how comprehensive our recycling programs may be, a significant fraction of the waste stream still can not be reused beneficially. And Maine continues to rely upon waste-to-energy to handle roughly two-thirds of its municipal solid waste. How then, in a world demanding increased supplies of energy—especially recoverable energy—do we address concerns over global warming's impact on the planet?

LOOKING FORWARD

One answer lies in the very way we view the term "waste." If all we see in waste is discarded material without value, we miss the central point of the "resource transformation" model. Instead, the model Casella has embraced envisions:

- Waste reduction.
- Maximizing recycling efforts—including the advancement of single stream collection programs and processing systems.
- The transformation of waste to energy or liquid fuels.

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- The transformation of sludge into compost or energy.
- The recycling of construction and demolition (C&D) waste into a high-BTU fuel source.
- The capture and use of landfill gas (LFG) to generate electricity.

Accordingly, if waste-to-energy combustors (such as MERC [Maine Energy Recovery Company], PERC [Penobscot Energy Recovery Company], ecomaine, and MMWAC [Mid-Maine Waste Action Corporation]) are a first step in the generation of electricity from waste—the transformation of an unwanted and discarded item into something of value—then landfill gas-to-energy plants are a second step.

Modern landfills such as Pine Tree Landfill or Juniper Ridge are designed, built, and operated with barriers that eliminate the environmental impacts previously associated with landfills. These barriers are constructed with soil (usually clay) and synthetic liners that prevent leachate and landfill gases from escaping. As solid waste decomposes, it produces a blend of several gases, including methane. Methane is both a major greenhouse gas and a major constituent of natural gas; in the latter case, it can be a valuable source of energy. In the former, it can be a significant contributor to global warming.

In a gas-to-energy project, this landfill gas (LFG) is captured and removed by specially designed collection systems that operate continuously. These systems are comprised of a series of gas wells and horizontal headers, which are buried in the waste. As landfill gas is generated, large blowers create a vacuum that extracts the gas from the system. Depending upon the nature of the waste producing the gas, pre-treatment, usually to remove sulphur compounds, may be required before the gas can be used as a fuel. This "scrubbing" prevents damage to the engines.

At the Pine Tree Landfill, Casella has chosen to match gas generation with three GE-Jenbacher 20-cylinder internal combustion engines, each with a rated output of 1.05 megawatts (MW). Of added interest to the company is the evaluation of European technology that employs heat exchangers driven off the high-temperature exhaust gases to run micro-turbines that convert this exhaust heat into additional electrical power. This micro-turbine technology increases electrical output by another 10 percent to 15 percent without the use of any supplemental fuel, hence, its description as "free power." Using this technology would allow Casella to achieve almost 50 percent energy recovery from its source of fuel, which in this case is largely methane.

Casella's second landfill gas-to-energy project in Maine, at the Juniper Ridge Landfill in West Old Town, is in the conceptual stage and slated to break ground as early as 2009. Unlike the Pine Tree Landfill, which began life in the 1970s, long before energy recovery was a term associated with waste disposal, the Juniper Ridge Landfill is being constructed and operated with energy recovery an integral part of its design. Estimates put peak electrical generation in the 13- to 15-MW range, with power production—albeit on a declining scale—extending all the way out to at least the year 2035 and more likely past the year 2050.

These energy projects are consistent with Casella's broader vision for the future of resource management in Maine: providing an essential piece of public infrastructure combined with enhanced recycling, liquid fuel production, and the generation of electricity from landfill gas. Each of these steps is part of a resource transformation model that moves us closer to a more energy-independent future.