Renewable Energy from LANDFILLS

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Americans produce about 4.4 pounds of waste per capita every day, according to the latest information from the US Environmental Protection Agency (EPA). About 65 percent of that waste—a total of about 164 million tons each year—is disposed in landfills. But is burial in a landfill the end of the story? Not at all. The organic matter in landfills is eventually broken down by bacteria. This process produces an abundance of gases, including methane. In fact, landfills represent the third-largest source of methane emissions in the United States. Methane is a potent greenhouse gas and thus a concern—but it increasingly is being captured and used to power homes and other establishments.

The first landfill gas energy projects started operation in Wilmington and Sun Valley, California, in 1979. Today, more than 630 US landfill gas energy projects generate 16.5 billion kilowatt hours of electricity per year—equivalent to the electricity consumption of 1.5 million homes—and deliver 317 million cubic feet per day of landfill gas to direct-use applications. EPA has identified an additional 450 landfill sites for the potential development of energy projects.

However, these projects come at a price. Between 1991 and 2010, the average cost for a landfill gas energy project to generate a kilowatt hour of electricity was 4 to 5 cents. The wholesale electricity price was 2.5 to 3 cents during that same period.

Given the important energy and environmental benefits of these projects—and the potentially prohibitive price tag—state and local governments use various policy tools to encourage municipal landfills to adopt them. But do these incentives work?

To answer this question, we conducted the first in-depth analysis of the factors that affect project adoption, primarily using two datasets: a database of potential landfill sites for landfill gas energy project development from EPA's Landfill Methane Outreach Program and a database of state tax incen-

tives and renewable portfolio standards from the Database on State Incentives on Renewable Energy and Efficiency, maintained by North Carolina State University. We looked at policy variables, the physical characteristics of landfills, and energy prices. Our focus was on four types of government policies that offer incentives to landfill gas energy projects: renewable portfolio standards, production tax credits, investment tax credits, and state grants.

Of the four policies, our analysis shows that only two—renewable portfolio standards and investment tax credits—have positive and statistically significant effects on the development of landfill gas energy projects.

Renewable portfolio standards—adopted in 30 states—require utility companies to supply a designated portion of their electricity from eligible renewable energy sources. Most states also allow utilities to use renewable energy credits to satisfy their requirements. When a landfill gas energy facility is included as an eligible technology, it can obtain revenue from the electricity it sells and the sale of renewable energy credits.

Investment tax credits are granted for installation of a renewable energy facility, usually as a percentage of the cost to construct the system. In the seven states that have adopted such a policy, the rate ranges from 10 percent (in Kansas) to 100 percent (in Kentucky), with an average of 35 percent.

These two policies account for the development of 13 of the 277 landfill gas energy projects built during our data period (1991 to 2010). In turn, those 13 projects have led to an estimated 10.4 million metric tons of carbon dioxide–equivalent reductions in greenhouse gas emissions. If these emissions reductions are valued at the official US social cost of carbon, they represent a net benefit of $41.8 million.

How Do Landfills Generate Energy?

Landfill gas is generated from a chain of microbial decomposition, volatilization, and chemical reaction processes. The most important of these is the anaerobic decomposition of organic waste, which takes place over the course of 10 to 50 or more years. This process emits gases composed of 40 to 45 percent carbon dioxide and 50 to 55 percent methane, which is a primary constituent of natural gas and an important energy source.

To generate energy, landfill gas energy projects first collect gas from the waste in extraction wells distributed throughout the landfill. A gas collection pipe connects the wells and directs the gas to a central point for processing and treatment tailored to the ultimate use of the gas—for example, electricity generation, cogeneration, or direct use as a replacement for natural gas.

What factors have spurred development of the remaining projects? Not surprisingly, high natural gas prices help. Other factors include landfill age, weather, amount of waste, proximity to the electricity grid, and public versus private ownership. In particular, privately owned landfills are more likely than publicly owned ones to adopt landfill gas energy projects. This may reflect stronger incentives among private proprietors to pursue additional sources of income compared to public officials operating local landfills for waste management only. ●

FURTHER READING

Li, Shanjun, Han Kyul Yoo, Jhih-Shyang Shih, Karen Palmer, and Molly Macauley. 2014. Assessing the Role of Renewable Energy Policies in Landfill Gas Energy Projects. Discussion paper 14-17. Washington, DC: RFF.