LANDFILL METHANE

OVERVIEW OF A HIGH-IMPACT DRAWDOWN SOLUTION

Landfills are a major source of methane emissions. This GHG is created from anaerobic digestion of municipal solid waste in landfills. The gas can be captured and then used to generate electricity. This process can prevent methane emissions and replace conventional electricity-generating technologies such as coal and natural gas.

TECHNOLOGY AND MARKET READINESS

The technology is mature and market ready. Landfill gas can be extracted from landfills using wells and a blower/flare system. The system transports the gas to a central point where it can be processed and treated according to the ultimate use for the gas. Landfill gas can be used to generate electricity through different process like reciprocating internal combustion engines, fuel cells, turbines, microturbines and cogeneration. The electricity generated can be used on site or sold to the grid. Nearly 72% of operating landfills in the U.S. generate electricity. Currently in the United States, landfill methane is collected from 352 landfills, producing 11 billion kWh of electricity, or 0.3% of electricity production [1]. Landfill gas can also be directly used to replace another fuel like natural gas or coal in a boiler, dryer or other thermal applications. About 18% of operating landfills use landfill gas to offset the use of other fuels. Lastly, landfill gas can be upgraded to renewable natural gas by increasing its methane content through treatment processes. Renewable natural gas can be used as compressed natural gas, pipeline-quality gas or liquified natural gas. Around 10% of operating landfills upgrade landfill gas [1].

Landfill Methane has been in use for decades and there are ample sites that are candidates in the United States and in Georgia for potential implementation of this technology. Given the high global warming potential of methane (34 CO2-e), opportunities to capture methane can produce significant CO2-e reductions.

LOCAL EXPERIENCE AND DATA AVAILABILITY

In 2019, Georgia had 92 landfills totaling more than 495 Mt of waste. The landfills are categorized as: operational (25), candidate (20), future potential (5), low potential (23), construction (1), planned (1) and shutdown or unknown (17). The operational landfills in Georgia have in total 239 Mt of waste. The one with the most waste has 21 Mt while the one with the least has 1 Mt in place. Out of the 25 operational landfills, 18 generate electricity, 4 use landfill gas directly and the other 3 upgrade landfill gas to renewable natural gas. The total installed capacity of the operational landfills that generate electricity is 66 MW [2].

There are several active landfill-to-gas retrofit projects in Georgia (e.g., Seminole Road MSW Landfill in DeKalb County, and Macon Bibb Walker Road MSW Landfill in Bibb County). There are EPA data available for landfills in Georgia, including potential for future landfill gas-to-energy retrofits. The EPA defines a candidate landfill as "one that is accepting waste or has been closed for five years or less, has at least one million tons of waste, and does not have an operational, under-construction, or planned project; candidate landfills can also be designated based on actual interest by the site [2]

TECHNICALLY ACHIEVABLE GHG REDUCTION POTENTIAL

The GHG reduction potential is high. Based on data from EPA's Landfill Methane Outreach Program [2], there are 25 landfills categorized as "Future Potential" or "Candidate" for landfill gas-to-energy retrofitting in Georgia. Preliminary analysis based on this data indicates that a typical 5 MW retrofit at each facility could abate approximately 0.25 Mt CO2-e annually per facility. Retrofitting just 4 of the 25 landfills could abate 1 Mt CO2-e annually.

COST COMPETITIVENESS

This is a potentially cost-effective solution, based on global Project Drawdown® estimates and EPA data (EPA, 2013; Harmsen et al. 2019). Review of other literature indicates mixed results on cost-effectiveness, especially in the absence of a carbon tax [5]. Preliminary analysis suggests that the 6.3 MW Georgia Landfill Gas Oak Grove Plant produces electricity at a LCOE of 9.6 cents per kWh. We will explore Georgia-specific cost effectiveness during the next phase of research.

BEYOND CARBON ATTRIBUTES

Social benefits of this solution include improvement of air quality by reducing GHG (mainly methane) and toxic gas emissions. Additionally, the utilization of landfill gases (LFG) for electricity generation can offer an offset to the use of non-renewable sources [4,5,6]. Moreover, the capture and use of LFG to generate electricity mitigates the possible health risks associated with the release of non-methane organic compounds (including hazardous air pollutants and volatile organic compounds (VOCs)) that are present at low concentrations in uncontrolled LFG. An added economic benefit, LFG energy projects provide a source of revenue from the sale of captured gas and can create local jobs associated with the design, construction, and operation of energy recovery systems [7]. The Landcaster Landfill in Pennsylvania, for example, created over 100 temporary construction jobs, while an LFG project in Virginia resulted in 22,000 hotel stays for project workers [8]. Additionally, waste management and landfill businesses stand to benefit from the expansion of this solution by reducing their environmental compliance costs that is mandated by the Clean Air Act [9].

Potential concerns center around high upfront costs for installation of the landfill gas-to-electricity system. Also, decreasing landfill waste can be considered a challenge for the adoption rates of this solution.

References:
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Endnotes:
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5. Environmental and Energy Study Institute Landfill Methane Fact Sheet: https://www.eesi.org/papers/view/fact-sheet-landfill-methane
6. Agency for Toxic Substances & Disease Registry Landfill Gas Control Measures https://www.atsdr.cdc.gov/HAC/landfill/html/ch5.html
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