Boiler MACT Economic Impact Evaluation

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Introduction

This Technical Memorandum summarizes the economic evaluation of the cumulative, nationwide financial impacts of switching from landfill gas (LFG) to natural gas at facilities currently using LFG as boiler fuel, if this were to occur in response to the requirements of the currently promulgated Boiler Maximum Achievable Control Technology (MACT) rule. The facilities used for this evaluation were those included in a database spreadsheet provided by USEPA's Landfill Methane Outreach Program (LMOP) by email to Waste Management on September 26 of this year.

This analysis is limited to the projected financial costs for existing projects utilizing landfill gas in boilers that would be affected by the Boiler MACT rule if it became effective. Additional economic impacts including projected loss of jobs have been projected by LMOP. Still more economic impacts would result from the inability to develop new projects that would use landfill gas in boilers. LMOP estimates there are over 500 landfills capable of development into landfill gas-to-energy projects. However, the number that would use LFG in boilers and the investments and returns for these prospective projects are too uncertain to estimate the financial impacts.

Results

Table 1 lists the estimated financial impacts of switching from LFG to natural gas for all LFG-fired boilers in the United States listed in USEPA's LMOP database. Costs in Table 1 are rounded to the nearest million dollars

TABLE 1.
Summary Costs for Converting LFG Boiler and Boiler Steam Turbine Projects to natural gas

Type of Project	NPV of Natural Gas Supply Minus LFG O&M Costs	NPV of Lost Royalty Payments	Capital Cost (2011 dollars)	Abandoned Value (Depreciated Value of Capital Cost)
Boilers	$797,000,000	$62,000,000	$156,000,000	$78,000,000
Boiler Steam Turbines	$190,000,000	$15,000,000	$94,000,000	$9,000,000
Combined TOTAL (Boiler and Steam Turbine)	$987,000,000	$77,000,000	$250,000,000	$87,000,000

The order-of-magnitude estimate of the total direct financial impact of fuel-switching from LFG to natural gas for the list of sites provided by LMOP is thus estimated to be $1.064 billion, the sum of the NPV of natural gas costs in excess of LFG O&M costs, and the NPV of lost royalty payments to landfill owners.

The costs for utilizing natural gas to replace the LFG were calculated for each project. These costs were computed as the net present value of the cost differences between natural gas supply and estimated LFG operations and maintenance (O&M) costs over the remaining life of the project. Lost royalty payments to landfill owner and/or developer were estimated based on the amount of BTUs for which royalty payments would no longer be paid over the remaining life of the system.

In addition to direct revenue impacts, project owners will lose the value of LFG processing and transport equipment that must be abandoned when switching from LFG to natural gas. To estimate this impact, the capital costs associated with constructing compressor systems and pipelines for utilizing LFG in the boiler projects were estimated

for each project in the LMOP database, as described below under Methodology. The costs were depreciated based on the age of the project to estimate the depreciated value of the installed system that would be abandoned. These sunk costs must be written off as stranded assets before they are fully depreciated. The total estimated capital assets lost for all existing project is $87 million.

In addition, Waste Management has estimated they could lose $4 to 5 million annually in revenue from third party developers and directly from large industries. This loss of revenue is likely only a portion of the total revenue that could be lost when all other factors such as end user costs are also factored.

Methodology

A list of projects that use LFG as boiler fuel was generated by LMOP. LMOP is a voluntary program of the U.S. Environmental Protection Agency that is intended to help reduce methane emissions from landfills by encouraging the recovery and beneficial use of LFG as an energy resource. LMOP maintains a database of projects that use LFG as boiler fuel. This database was downloaded to an Excel file and used as the basis for this financial evaluation. The database contains, among other data, the landfill name, location, start-up date, quantity of LFG used, and the length of pipeline used to pipe the LFG from the landfill to the boiler location (i.e. project site). This data was sufficient to form the basis for an order-of-magnitude estimate of the total capital costs, depreciated capital costs (that would be abandoned upon switching to natural gas), annual O&M costs for the LFG-to-boiler fuel projects and lost royalty payments. Additional tabs were added to the LMOP database Excel file to aid in conducting the evaluation.

A “Base Project” capital cost estimate was prepared and used as the basis to extrapolate the capital costs for compressing, chilling, and transporting LFG to the receiving boiler for each of the projects in the LMOP database. The Base Project construction cost is based on previous CH2M HILL projects for LFG compressor systems at landfills and the pipelines between the landfills and the gas use site. O&M costs for the base project were similarly estimated based on previous projects. The O&M costs for the LMOP sites were calculated based on the LFG flow which was used to compute compressor power requirements. Labor and materials O&M costs were assumed based on previous project experience.

Once the costs for each system were extrapolated from the base project, additional project costs (engineering, administrative, etc) were added based on a percentage (Table 2) of the subtotal capital costs to estimate the grand total based on 2011 dollars.

The grand total cost calculated for 2011 was then used to estimate the current year cost for construction of the compressor, chiller, and pipeline reflective of the startup date presented for each project in the database. This was done by multiplying the grand total base project cost by the ratio between the historic (i.e. date of startup) and current ENR (Engineering New Record) City CCI values. This value was then depreciated to 2011 using the straightline method and an assumed project life of 20 years to estimate the abandoned value of the LFG system and pipeline that would occur upon switching to natural gas.

The loss in royalty payments was calculated based on the amount of BTUs that would no longer be utilized by the end user over the remaining life of the LFG system and pipeline, multiplied by a factor that approximates typical royalty payments to landfill owners for landfill gas-to-energy projects. The total cost reported in Table 1 is the net present value of payments projected over the remaining life of the project if fuel-switching had not occurred.

The cost for utilizing natural gas instead of landfill gas was calculated by subtracting the displaced cost of operating and maintaining the landfill gas processing and transport system from the cost for purchasing natural gas. The total natural gas cost that would be paid in lieu of the landfill gas was then calculated based on Net Present Value (NPV) using the remaining life of the system assuming a 20 year project life and a real interest rate of 7%, which is assumed to approximate the private sector cost of capital. Although many of the landfills are publicly owned, almost all of the boiler operations using the gas are privately owned and would bear the cost of switching to natural gas.

Assumptions

The following assumptions were made in conducting this economic evaluation.

1) The capital cost for the base project compressor and chiller system was estimated at $675,000 for a 750 cfm compressor system. The costs for systems that had flows less than or greater than this range were extrapolated from the base project using an extrapolation exponent of 0.75. The ratio of a given project capacity to the base project capacity is raised to the exponent and the result multiplied by the base project cost to estimate the given project cost.[1]

2) The capital costs for the base project pipeline were estimated at $2/in diameter-ft of pipeline for flows less than 2000 cfm and $6/in diameter-ft of pipeline for flows greater than 2000 cfm. Therefore, the installation, including labor and materials, of a 4 inch pipeline at 1000 cfm would be $8/ pipeline ft or approximately $42,000 per mile plus other additional costs as described below.

3) If pipeline information was not listed for a project on the LMOP database, the median pipeline length (3.30 miles) obtained from the boiler project tab was used. Just over half of the boiler site projects did not include pipeline length information. It is noted no pipeline information was provided on the Boiler-Steam Turbine Tab.

4) Project capital costs in addition to construction were added to the capital costs based on a percentage of the subtotal (compressor and pipeline) costs (Table 2).

TABLE 2.

Additional Costs added to Capital Cost for Compressor System and Pipeline (Subtotal)

Item	Percent Addition to Cost
Road Crossing (s)	10%
Engineering	10%
Permitting	3%
Administration and Legal	5%
Construction Management	8%
Mobilization/Demobilization	12%

5) The cost of natural gas was assumed to be the latest available average U.S. retail natural gas price for industrial users of $5.40 per MMBTU, as published by the U.S. Energy Information Agency. (http://38.96.246.204/totalenergy/data/annual/showtext.cfm?t=ptb0608)

6) The price per kilowatt-hour for Operation and Maintenance (O&M) of the LFG system was assumed to be the latest available average U.S. retail electricity price for industrial users of $0.0679/kw-hr, as published by the U.S. Energy Information Agency. (http://38.96.246.204/totalenergy/data/annual/showtext.cfm?t=ptb0810)

7) The pipeline costs for transporting natural gas from a high pressure supply pipe line to the project site were considered minor (i.e. a trivial distance between the project site and supply pipeline); therefore, they were not estimated or considered in this evaluation.

8) Regional costs for capital investments including labor were not considered as part of the evaluation. It was assumed that the costs for varied capital and labor costs across the United States, which is covered by the LMOP program, would average out. Royalty payments were estimated at $0.75/MM BTU.

9) The life cycle of the LFG project was assumed to be 20 years.

[1] Whitesides, Process Equipment Cost Estimating by Ratio and Proportion (http://www.pdhonline.org/courses/g127/g127content.pdf)

10) The 20 City Construction Cost Index (CCI), which is calculated annually by The Engineering News Record (ENR), was used to calculate the capital costs of the landfill gas compressor and chiller based on the startup date from the estimated 2011 dollars (Grand Total) derived from the base project. The CCI values used in this estimation were an average of the 20 cities listed in the CCI.
11) The energy content of natural gas was assumed to be approximately 1000 BTU/ft^3.
12) The methane content of LFG was assumed to be 50%; therefore, the energy content was assumed to be 500 BTU/ft^3.
13) The Net Present Value (NPV) was estimated based on an inflation rate of 3% and a nominal discount rate of 10%. Therefore, the 'real discount rate' is 7%.
14) For projects older than twenty years, it is assumed there is no economic impact to fuel-switching. Projects at the end of their useful project lives are assumed to be replaced or abandoned in the near future.