GREENHOUSE GAS EMISSION REDUCTIONS FROM U.S. LANDFILL GAS UTILIZATION PROJECTS: LANDFILLS TO THE RESCUE

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ABSTRACT

The landfill gas-to-energy (LFGTE) industry has experienced significant activity over the past two years as projects rushed to take advantage of the Section 29 tax credits prior to their expiration. Todate, there are more than 200 landfills economically using LFG nationwide, with an additional 500 landfills large enough to support a project if an energy customer could be secured. There are approximately 200 in various stages of development. With the Section 29 tax credits expiration on June 30, 1998, the successful LFG utilization project developers will be those who recognize that these changes are permanent departures from past practices, and those who will seek to exploit opportunities created by these changes.

LFGTE and LFG control projects can provide cost effective GHG emission reductions. With landfills being the country's leading controllable methane source, and methane being 21 times more potent a GHG gas than carbon dioxide (CO2), controlling LFG can bring large dividends.

This paper will quantify the GHG emissions reductions potential from LFGTE projects. Estimates of CO2 equivalent reductions from operating and projects under development, as well as other sites large enough to technically support a utilization project will be prepared. The cost per ton of CO2 equivalent controlled will be provided for LFGTE projects. A summary of activities being conducted by the Solid Waste Association of North America (SWANA) to quantify the LFG industry's potential contribution to the national GHG emission reduction effort will be presented.

With Global Climate Change issues receiving both national and international action, landfill methane control may prove to be one of the best strategies to help meet these objectives.

Keywords: **greenhouse gas, landfill gas, landfills, methane, section 29 tax credits, 1605(b) reporting**

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BACKGROUND

The economics viability of future LFGTE projects will be negatively impacted by the lack of an extension to the Section 29 tax credits. These credits ($1.06/MMBtu in 1996) have stimulated much of the development activity experienced by the LFG industry over the past several years.

If a mechanism was created to monetize the environmental benefits of LFGTE projects, additional project development would be stimulated.

1605(b) Reporting

In the Climate Change Action Plan, President Clinton outlined a series of voluntary programs aimed at returning U.S. emissions of greenhouse gases (GHG) to their 1990 levels by the year 2000. Section 1605 (b) of the Energy Policy Act of 1992 established one element of this plan: the Voluntary Reporting of Greenhouse Gases Program (GHG Program). The GHG Program is administered by the Energy Information Administration (EIA) of the U.S. Department of Energy.

The six major greenhouse gases are:

- Carbon Dioxide (CO2)
- Methane (CH4)
- Nitrous Oxide (N2O)
- Hydorflorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- SF6

Under the GHG Program, any individual, business, or group can report details and results of any projects or programs they have established to reduce GHG emissions. As the name suggests, the GHG Program is voluntary. Principal benefits for participating include:

- Gaining recognition for environmental stewardship.
- Establishing a record of emissions for public reference.
- Demonstrating support for voluntary approaches to meeting national environmental objectives.
- Obtaining new information on emission reduction methods through technical exchanges between Program members.
- Informing the public debate about activities aimed at achieving GHG emissions reductions.

- Demonstrating progress towards meeting commitments to reduce GHG emissions via a voluntary program.

Methane Emissions Reductions from Landfills

The United States Department of Energy (DOE) has produced a guidance document entitled "Sector Specific Issues and Reporting Methodologies Supporting the General Guidelines for the Voluntary Reporting of Greenhouse Gases under Section 1605(b) of the Energy Policy Act of 1992." Section 3.8 of the guidance document is entitled "Estimating Methane Emissions Reductions from Landfills." Entities can reduce methane emissions from landfills through two general approaches:

- Modifying waste management practices to reduce the amount of waste landfilled.

- Recovering methane and using it as an energy source or flaring it. Using or flaring recovered methane is the only method currently available for reducing emissions from current landfills and from landfills that will contain degradable waste in the future.

Landfill methane emission reductions can be reported by the landfill owner if the owner undertakes emission reduction projects, or if the owner contracts with a third party to collect and market the recovered gas. In the latter case, an agreement on which party will report the reductions is needed (to track possible multiple reporting).

Establishing the Reference Case--The guidance documents state that there is no reliable method for estimating landfill methane emissions which would have been emitted from a landfill in the absence of emission reducing projects. Therefore, a reference case is not required for landfill emission reduction projects. Emission reductions can be estimated directly as the quantity of methane recovered by the system.

Estimating Emission Reductions--The most accurate method for estimating methane reductions is actual field measurements. By measuring the quantity of LFG and its methane concentration, accurate estimates of emissions reductions are possible. These types of field measurements can easily be accomplished by installing a flow meter and methane meter at the blower/flare station.

In some cases, engineering estimates of methane emissions avoided can be determined, based on the fuel requirements of the utilization project.

The guidance documents recognize that the measured methane emission reductions is a overestimate of actual methane reduced. In the absence of a LFG collection system, some methane produced is oxidized as it migrates out of the landfill. Withdrawing the gas with a collection system reduces the amount of oxidation. Since no single oxidation adjustment factor is available at this time, the actual quantity of methane collected should be used as the estimate of emissions reduced.

Kyoto Protocol

The parties to the United Nations Framework Convention on Climate Change agreed to a Protocol to reduce GHG emissions by harnessing the forces of the global marketplace to protect the environment.

Parties agreed to reduce their GHG emission below 1990 emission levels over a 5 year period from 2008 to 2012 as follows: [2]

- European Union - 8 percent.
- United States - 7 percent.
- Japan - 6 percent.

U.S. GHG Emission Reduction Goals

The U.S. GHG emission levels in MMT (million metric tons) are as follows: [2]

Gas	1990 MMT Carbon Equiv.	1990 MMT CO2 Equiv.
Carbon Dioxide	1,373	5,034
Methane	187	686
Nitrous Oxide	38	139
HFCs and PFCs	19	70
Total	1,617	5,931

Using the above emission levels as a baseline, it was assumed that U.S. emissions would increase 36 percent by the year 2008 to 2012 with no reduction measures taken. The estimated 2010 U.S. emissions would be 2,200 MMT Carbon equiv. which would equate the U.S.'s goal of 7 percent reductions to 154 MMT Carbon equiv.

GHG EMISSION REDUCTIONS FROM LANDFILLS

GHG emission reductions from U.S. LFGTE projects have not been well documented by the industry. As part of SWANA's efforts to support an extension to the Section 29 tax credits, an estimate of the GHG emission reductions from LFGTE projects was prepared. As shown on Table 1, estimates from both existing and planned projects are presented.

Existing LFGTE Projects

The last survey of the LFG industry identified 152 operating LFTE projects nationwide. [4] Characteristics of these LFGTE projects are compiled based on their end use (electrical generation or gas sales). To estimate their GHG emission reductions, the following assumptions were used:

- Plant Availability - 90 percent on-line at the facilities capacity, i.e.,

assume no LFG production shortfalls.

- Average Heat Rate - 12,000 Btu/kWh LHV.
- Average LFG Quality - 450 Btu/cf LHV.
- Global Warming Potential - 21.

Assuming all of the 152 projects are operating at their rated capacity, the following energy production and GHG emission reductions, are generated:

- Electrical Generation Capacity - 517 MW.
- Direct Gas Sales - 82 Mmcfd.
- Electrical Generation - 4,100,000 MW/yr.
- Methane Consumed - 1,300,000 tons CH4/yr.
- CO2 Equivalent - 32,000,000 tons.
- Carbon Equivalent - 8.7 million metric tons (MMT).

Note that many of these projects came on line prior to 1990. In subsequent analyzes, emission reductions from pre-1990 projects will not be included.

Assuming that the cost for the GHG reductions for the GHG emission reductions at the same rate ($1.06/MMBtu) that the Section 29 tax credits are value. The cost/ton for the CO2 equivalent emissions is $2.02/ton CO2.

Planned Projects

A similar analysis is presented for planned LFGTE projects. 203 LFGTE projects were identified to be in various stages of development. [5] Assuming all of the 203 projects are developed and operated at their rated capacity, the following energy production and GHG emission reductions, are generated:

- Electrical Generation Capacity Potential - 494 MW.
- Direct Gas Sales - 210 MMcfd.
- Electrical Generation - 3,900,000 MW/yr.
- Methane Consumed - 1,600,000 tons CH4/yr.
- CO2 Equivalent - 40,000,000 tons.

- Carbon Equivalent - 11.0 million metric tons (MMT).

Future Potential Projects

In addition to the existing and planned projects, with proper economic incentives, most landfills with over 1,000,000 tons of waste in-place are large enough to support a project. EPA's LMOP estimates 400-500 landfills may be large enough to support such an effort.

Assuming 400 additional LFG projects were implemented from 1999 through 2008, all 755 LFG projects could provide over 1,600 MW of electrical capacity, and 32 MMT of carbon equivalent reductions. With a U.S. reduction goal of 154 MMT of carbon by the year 2010, LFG utilization projects with some economic incentives could provide approximately 20 percent of the U.S. national reduction goal.

RECOMMENDATIONS

Several recommendations follow from this analysis:

- The LFG industry needs to develop a database of LFGTE and LFG control projects nationwide. EPA's LMOP has undertaken this effort. The industry needs to support EPA's activities for accurate and timely informational support.
- Support SWANA's efforts to monitize GHG emission reductions.
- Report GHG emission reductions via EIA's 1605(b) reporting system.
- Support renewable energy legislation efforts.

With the support of the LFG industry, landfills may become one of the nation's best GHG emission reduction strategies.

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