The Big Picture

PCD Credit: **Effective Utilization of Recovered Methane**

(1-2 Points, Reciprocal)

Credit Summary

The purpose of this credit is to minimize greenhouse gas emissions from landfills through the effective utilization of recovered methane.

Impact Summary

Methane is a highly potent greenhouse gas and is a key contributor to anthropogenic climate change. Methane capture and utilization is beneficial to the environment and can improve the revenue stream of municipalities.

Submittal Summary

Using the EPA's Greenhouse Gas Reporting Tool and the US Greenhouse Gas Reporting Rule 40 CFR Part 98 Subpart HH, applicants can calculate and report on landfill gas emissions. Required documentation includes reports on landfill gas generated, methane content, and CO2e in tons per year.

To meet the requirements of the credit, applicants must then show that at least 90 percent of methane emissions from the landfill are captured and utilized. For Tier 1, applicants must demonstrate that at least 90 percent of landfill gas collected is utilized in place of conventional fossil fuels. For Tier 2, applicants must demonstrate that at least 90 percent of landfill gas collected is converted to a functional use through non-burn landfill gas management methods.

Case Studies and Benefits

Both local government and industry landfill gas energy projects have proven to be successful methods of capturing and repurposing methane emissions. Methane based electricity generation projects can reduce corporate greenhouse gas emissions and save money on energy costs. Direct use projects can contribute to the local economy through infrastructure development. Additionally, landfill gas can be used to power local vehicle fleets, increasing the sustainability of waste management systems and other city vehicle services.

Additional resources, such as referenced standards and relevant definitions are available.

SUPPORTING MATERIALS

Intent and Requirements

Intent
To minimize greenhouse gas emissions from landfills.

Local Government & Industry Requirements
Utilize the methodology outlined in the US Greenhouse Gas Reporting Rule, 40 CFR Part 98 Subpart HH to calculate landfill gas generated by landfills covered by this rule that are owned, controlled or utilized by the Local Government or Company. Report calculated values for:

- Landfill gas generated
- Methane content
- CO2e in tons per year (Equation A-1)

Demonstrate that non-methane toxic organic compounds, halogenated compounds, and dioxins and furans have been removed from the gas and properly disposed of. And, meet either Tier One or Tier Two requirements.

Why We Care

Landfill gas is roughly 50 percent methane and 50 percent carbon dioxide. Methane is one of the most potent greenhouse gases, with a global warming potential 28 to 36 times greater than carbon dioxide over a 100 year period.[1] Landfills are the third largest source of methane emission in the world.[2] Effective strategies for utilizing methane recovered from landfills can create revenue streams how for solid waste municipalities, increase access to cleaner energy, and mitigate climate change.

Landfill gas energy projects are one of the most common and effective uses for collected landfill gasses. Landfill gas energy projects capture between 60 and 90 percent of methane emitted from landfills (range depends on system design and maintenance).[3] The end use of the landfill gasses is dependent on the level of purification they undergo. There are three main levels of methane treatment: primary (moisture removal), secondary (impurity removal), and advanced (CO_2, N_2, O_2, and VOC removal). Secondary treatment methane can be used for electricity generation or as direct use of medium-Btu gas. Advanced treatment methane can be used as high-Btu vehicle fuel or for pipeline injection.[10]

How to Meet the Requirements

****Requirements from the standard itself are outlined, while additional details and recommendations to aid in certification are written without underline below the segment to which they apply.*

Utilize the methodology outlined in the US Greenhouse Gas Reporting Rule, 40 CFR Part 98 Subpart HH to calculate landfill gas generated by landfills covered by this rule that are owned, controlled or utilized by the Local Government or Company. Report calculated values for:

- The EPA's Greenhouse Gas Reporting Tool
- For a comprehensive checklist of what must be monitored by landfills under the US Greenhouse Gas Reporting Rule, 40 CFR Part 98 Subpart HH, see this PDF.
- All facilities must report:
    - "Information on the landfill's operating status, first and last year the landfill accepted waste, anticipated closure date, capacity, and whether leachate recirculation is used.
    - Waste disposal quantity for each year of landfilling and the method used to estimate it.
    - Waste composition for each year of landfilling in percent by weight.
    - Values of all parameters used in the methane generation calculations, including degradable organic carbon (DOC) and decay rate constant (k).
    - Fraction of CH4 in landfill gas and how this fraction was determined (measured or default values).
    - Surface area of the landfill containing waste and cover types used.
    - Annual modeled CH4 generation.
    - Annual CH4 generation adjusted for oxidation (which equated to CH4 emissions for landfills without gas collection), the oxidation fraction used in the calculation and whether passive vents or passive flares are present at the landfill."

Landfill gas Generated

Gas emissions can be calculated using measured or estimated values of historic annual waste disposal quantities.

Methane Content

Landfill owners and operators must report on modeled methane generation and emissions from the landfill, as well as methane destruction from gas collection and combustion.

CO2e in Tons Per Year (Equation A-1)

Demonstrate that non-methane toxic organic compounds, halogenated compounds, dioxins and furans have been removed from the gas and properly disposed of.

Potential Strategies

Follow the criteria calculation methodology described in the Certification Manual

Tier 1: (1 point)

Demonstrate that at least 90 percent of landfill gas collected is utilized in place of conventional fossil fuels.

Landfills with gas collection systems must report:

- "Total volumetric flow of landfill gas collected for destruction, annual average CH4 concentration, monthly average temperature, pressure and moisture content, if required.

- An indication if destruction occurs at the facility, off-site, or both. If destruction occurs at the facility, the number of destruction devices associated with each measurement location and the annual operating hours of the gas collection system associated with that measurement location. For each destruction device associated with a measurement location, the destruction efficiency and the annual operating hours where active gas flow was sent to the destruction device.
- Annual quantity of CH4 recovered.
- Description of the gas collection system (manufacture, capacity, number of wells, etc.), surface area, waste depth and cover type for areas within the landfill.
- The gas collection efficiency used in emissions calculations.
- Annual CH4 generation adjusted for oxidation and the oxidation fraction used in the calculation.
- CH4 emissions calculated using each of the two estimation methods described above and the oxidation fractions used with each method.
- Annual facility CH4 emissions for the subpart. (Facilities with landfill gas collection systems must choose which of the CH4 emissions from the two estimation methods best represents emissions from the landfill.)"

Potential Strategies:

- Process heat
- Electricity generation
- Combined heat and power
- Compressed fuel for mobile equipment and or collection vehicles
- Selling gas to distribution network

Tier 2: (+1 point)

Demonstrate that at least 90 percent of landfill gas collected is converted to a functional use through non-burn landfill gas management methods.

Potential Non-burn Strategies:

- Creation of methyl alcohol as an industrial feedstock
- Creation of dry ice from CO2

Required Documentation

Report calculated values for:

- Landfill gas generated
- Methane content
- CO2e in tons per year (Equation A-1)

Case Studies & In-Depth Information

Landfill Gas Energy Projects

A typical 3-megawatt electricity generation project is equivalent to:[4]

- The amount of carbon sequestered by 178,000 acres of US forests in a year
- Preventing carbon dioxide emissions from burning 830 railcars of coal
- Preventing carbon dioxide emissions from using more than 17 million gallons of gasoline
- Powering 1,900 homes

Electricity Generation Case Study: BMW Manufacturing Landfill Gas Energy Project[6]

The BMW Manufacturing Landfill Gas Energy Project generates 6.5 megawatts of energy (with an 11 megawatt rated capacity) from landfill gas collected at the Palmetto Landfill in Greer, South Carolina. The landfill gas is used to power two gas turbine cogeneration units (with a total 11 megawatt capacity) and to recover 72 MMBtu per hour of hot water. The turbines meet about 25% of the plant's electrical needs and all of its thermal needs. Nearly 70 percent of BMW's energy comes from landfill gas. BMW built a 9.5-mile, 4800 standard cubic feet per minute pipeline across complicated terrain, showing that landfill gas is a potential energy source for companies and municipalities that are not located right next to landfills. Reduced BMWs carbon dioxide emissions by the equivalent of driving 105 million miles per year. The project also stabilized BMWs energy prices, as they were able to contract with the local landfill to keep prices stable for a 20-year contract.

A typical 1,000 standard cubic feet of landfill gas per minute direct-use project is equivalent to:[5]

- The amount of carbon sequestered by 163,000 acres of US forests in a year
- Preventing carbon dioxide emissions from consuming more than 322,000 barrels of oil
- Preventing carbon dioxide emissions from using more than 15.6 million gallons of gasoline
- Heating 3,900 homes

Direct Use Case Study: Lanchester Landfill Gas Energy Project[7]

The Lanchester Landfill Gas Energy Project was a partnership between the Chester County Solid Waste Authority, Energy Developments, the Pennsylvania Department of Environmental Protection, and the Landfill Methane Outreach Program (LMOP). The project operates at 3,800 standard cubic feet of landfill gas per minute (meaning a 3.8 multiplier for all benefits listed previously). Landfill gas collected from this project is used to power boilers, thermal oxidizers, and ovens for multiple customers. The project, and its related pipeline, contributed millions of dollars to the local economy through job creation.

Vehicle Fuel Case Study: Vogel Disposal Vehicle Fuel Projects[8]

The Vogel Disposal Vehicle Fuel Project uses membrane and pressure swing absorption technologies as part of its landfill gas purification process. In 2018, Vogel expanded its project to fuel its own 38 waste collection vehicles using landfill gas. The renewable compressed natural gas they use is called Lego-V and has been made available to other local fleets, such as bus and delivery services. Note: Opening a public fast-fill station for renewable compressed natural gas allows the landfill operator to ensure excess fuel is used and creates a revenue stream. This is helpful in meeting Tier 1 of this credit, as it increases the likelihood that 90% or more of gas collected will be used in place of fossil fuels.

Referenced Standards

US Greenhouse Gas Reporting Rule, 40 CFR Part 98 Subpart HHUS Greenhouse Gas Reporting Rule, 40 CFR Part 98 Subpart HH.

Definitions

Landfill Gas
EPA Definition: a natural byproduct of the decomposition of organic material in landfills. LFG is composed of roughly 50 percent methane (the primary component of natural gas), 50 percent carbon dioxide (CO2) and a small amount of non-methane organic compounds.

Dioxins
EPA Definition: Dioxins refers to a group of toxic chemical compounds that share certain chemical structures and biological characteristics (see figure 1). Several hundred of these chemicals exist and are members of three closely related families:

- Chlorinated dibenzo-p-dioxins (CDDs)
- Chlorinated dibenzofurans (CDFs)
- Certain polychlorinated biphenyls (PCBs)

Furans
EPA Definition: Dioxins and furans is the abbreviated or short name for a family of toxic substances that all share a similar chemical structure. Dioxins, in their purest form, look like crystals or a colorless solid. Most dioxins and furans are not man-made or produced intentionally, but are created when other chemicals or products are made. Of all of the dioxins and furans, one, 2,3,7,8-tetrachloro-p-dibenzo-dioxin (2,3,7,8 TCDD) is considered the most toxic.

Halogenated Compounds
ScienceDirect Definition: Halogenated compounds constitute one of the largest groups of environmental pollutants. Halogenated compounds, such as methyl chloride (CH3Cl), methyl bromide (CH3Br) and methyl iodide (CH3I) are a major source of halogens in the atmosphere, and subsequently form sources of reactive species capable of catalytically destroying ozone.

Non-burn Landfill Gas Management Methods
Proper handling of landfill gas that does not result in it’s combustion. A non-burn landfill gas management method typically involved the collection of these gases and the putting them towards heating a boiler, powering a gas turbine or internal combustion engine, etc. Do not burn it.