A Review of Regulatory and Industry Greenhouse Gas Reporting Cooperation

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INTRODUCTION

This abstract will review and discuss the cooperation between the U.S. Environmental Protection Agency (EPA) and solid waste industry stakeholders (Stakeholders) in developing, revising, and implementing the landfill reporting requirements under the EPA program that requires landfills to report greenhouse gas (GHG) emissions as part of the federal GHG Reporting Program (GHGRP) (40 CFR Part 98). The abstract will review Stakeholder outreach in early stages of the GHGRP development through recent decisions to utilize GHG emissions data from the GHGRP in the EPA's current draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015 (GHG Inventory).

This paper also discusses initial implicit assumptions made by both the EPA and Stakeholders, using the reporting of "back-up devices" and the calculation of the fraction of time a destruction device was operating as an example of the assumptions made and an illustration of how those assumptions were implemented implicitly in the GHGRP. The abstract will discuss how Stakeholders have reached out to the EPA to address incorrect or misleading assumptions.

The paper will summarize how Stakeholders have worked to provide the EPA with additional data necessary to justify changes to the regulation, including revisiting oxidation factors that were rejected in the initial GHGRP and reducing methane measurement frequency at landfills. It will discuss how these changes have improved landfill reporting under the GHGRP to make it more representative of actual emissions and more reflective of the sites that are reporting. It will also discuss the unintended consequences of Stakeholder outreach and revisions to the GHGRP for landfills.

This paper will focus on federal regulation and not interactions at the state level.

STATE OF THE INDUSTRY 2007

In 2007, GHG emissions from landfills were calculated as part of state and federal GHG inventories using a series of uniform default values. Landfills with gas collection were assumed to collected 75 percent of generated methane, ten (10) percent of the methane passing through cover was oxidized to carbon dioxide, and destruction devices destroyed 99 percent of methane

captured. Stakeholders identified this approach as a potential problem for three major reasons. First, the basis for those default values was not rigorously sourced and did not accurately represent individual landfills. Second, the use of a default collection efficiency to calculate methane emissions based on methane recovery incentivized collection of less methane. Third, if later GHG regulations required the reduction of methane emissions from landfills, the use of default values would not allow landfills to show reduced methane emission if practices changed to improve methane capture.

The involvement of industry in developing reporting methodology began in part as a response to the GHG Inventory prepared by the EPA and in preparation for the likely development of later regulations that would require the reporting of GHG emissions. Examples of this preparation are the Solid Waste Industry for Climate Solutions (SWICS) White Papers describing what industry saw as shortcomings in the current GHG calculation methodologies for landfills used by the EPA. SWICS represents a group of academics, solid waste companies, municipal waste management districts, and technical experts, including SCS Engineers. In 2007, prior to the development of the GHGRP, SWICS created two White Papers describing what it saw as improved GHG emission calculation methodologies for landfills.

DEVELOPMENT OF THE GHGRP

On April 10, 2009, the EPA published the draft version of the GHGRP, which included mandatory GHG reporting requirements for landfills in Subpart HH of the regulation. Included in those GHG emission reporting requirements were calculation methodologies that relied on the same collection efficiency, oxidation rate, and destruction efficiency the EPA used in its GHG inventory calculations.

Stakeholders submitted comments on the proposed GHGRP for landfills, including members of the SWICS group. Those comments proposed the use of the methodologies and the values in the SWICS document and Stakeholders noted the SWICS values served as a refinement of the proposed default values. Other commenters noted the potential lack of available historical data for older landfills, which resulted in the EPA allowing additional methodologies for estimating historical waste placement at landfills. Stakeholders also raised the issue of the frequency of sampling for methane concentration at landfills that collected gas, noting that the EPA's proposed sampling frequency was a substantial burden and that many landfills already conducted monthly sampling due to existing regulation.

The EPA responded to five general comments in the preamble to the revised GHGRP. Overall, the revisions to the landfill reporting requirements created less of a one-size-fits-all approach for landfills. The changes included adoption of the SWICS approach to collection efficiencies but a rejection of the SWICS-proposed oxidation rates and destruction efficiencies. The oxidation rates were rejected on the basis overreliance on laboratory data and not field tests, and the EPA indicated in the preamble that it was open to revision of the oxidation rate if more appropriate data were available. These changes were necessary from an industry perspective due to the wide range of types of landfills required to report under the GHGRP, which included relatively small

municipal landfills, and landfills that opened as far back as the 1940s and 1950s, as well as large regional landfills and large municipal landfills.

The final version of the GHGRP, promulgated October 30, 2009, included several calculation methodology changes that were not discussed in comments, such as the inclusion of factors to account for periods where gas collection at a landfill is not operating (f_{Rec}) and for periods when destruction devices are not operating (f_{Dest}).

IMPLICIT ASSUMPTIONS AND IMPROVED UNDERSTANDING

The first promulgated version of the GHGRP included revised calculation methods with implicit assumptions that the EPA failed to recognize as not applicable to all sites. Equitation H-8, reproduced below, provides an illustration of several of these assumptions.

HH-8 (2010 version):

$$Emissions = \left[\left(\frac{R}{CE \times f_{Rec}} - R\right) \times (1 - OX) + R(1 - (DE \times f_{Dest})\right]$$

where:

R is the quantity of recovered methane,
CE is the collection efficiency,
f_{Rec} is the fraction of hours the recovery system was operating,
OX is the oxidation fraction of methane in the landfill cover,
DE is the destruction efficiency of methane destruction devices, and;
f_{Dest} is the fraction of hours the destruction device was operating

There are several implicit assumptions about the collection and destruction of methane at landfills built into this equation. The equation assumes that:

The f_{Rec} factor assumes that there is only one gas collection system at a site. This will be true in most cases, but it is not always the case. The f_{Dest} factor assumes that only a single device and possibly a back-up device operate at the site and that methane is always being sent to the device. The EPA defines f_{Dest} as the device operating hours divided by 8670 hours or as one (1) when a back-up device is present. This definition effectively assumes that when a device is not operating, methane is collected and vented to the atmosphere if there is no device designated as a backup device, but most destruction devices have permit conditions that require that the device be operating when gas is sent to the device.

Practice at many landfills is far more complicated. Some landfills have landfill gas to energy (LFGTE) facilities with six or more engines burning landfill gas with a single designated backup flare. Other facilities have multiple high capacity flares with no clearly designated back-up device. An early frequently asked question (FAQ) response issued by the EPA how facilities with multiple destruction devices should treat multiple destruction devices, which was to use a f_{Dest} equal to the number of hours the device operated divided by the number of hours gas flowed

to the device. This change effectively removed the venting emissions, but it was only guidance from the FAQ and not part of the official regulation. Technical corrections to the GHGRP in 2010 did not address the issues created by the EPA's definition of f_{Rec} and f_{Dest}, but changes were made when the EPA made major changes to Subpart HH in 2013.

The draft 2013 revisions included changes to equations used to calculate GHG emissions from landfills that no longer included the implicit assumption that landfills had only a main device and a potential back-up device. Equation HH-8 from the 2013 regulation is below.

HH-8 (2010 version):

$$Emissions = \left[\left(\frac{1}{CE}\left\{\sum_{n=1}^{N}\left[\frac{R_n}{f_{Rec,n}}\right]\right\} - \sum_{n=1}^{N} R_n\right) \times (1 - OX) + \sum_{n=1}^{N}\left\{R_n \times \left(1 - \left(DE_n \times f_{Dest,n}\right)\right)\right\}\right]$$

Where:

R_n is the quantity of recovered methane for location n,
CE is the collection efficiency,
$f_{Rec,n}$ is the fraction of hours the recovery system associated with location n was operating,
OX is the oxidation fraction of methane in the landfill cover,
DE_n is the destruction efficiency of methane destruction device associated with location n, and;
$f_{Dest,n}$ is the fraction of hours the destruction device associated with location n was operating.

Overall, these changes allow the calculation of GHG emissions from landfills with any number of independent gas collection systems with any number of destruction devices. This modification removed the necessity of determining whether a "back-up device" was present. The back-up device language was removed between the draft of the 2013 revisions and the final version based on Stakeholder comments. The changes also included revisions to the definition of f_{Dest} that changed it to be consistent with the approach in the FAQ and removed emissions calculated as venting emissions when the device was not operating and methane was not sent to the device.

Throughout the process of changing the equations, Stakeholders worked with the EPA to help the EPA understand the implications of the equations in the regulation and how those implicit implications were different from practice at many landfills.

BIG DATA

Stakeholders have also worked with the EPA to provide additional data on the oxidation rate of methane in the landfill cover and the variability of methane concentration in collected landfill gas at individual sites over time. Stakeholder goals were to move away from inaccurate default values and to reduce monitoring burden under the GHGRP, and the EPA had the goal of maintaining the integrity of the reported regulation.

As previously noted, the EPA rejected initial Stakeholder requests to use non-default oxidation rates for methane in the landfill surface because the SWICS document relied too heavily on laboratory data. Between 2007 and 2013, the SWICS group revised the oxidation analysis of their White Paper. The revised version included additional field data, which the group then

submitted to the EPA during the process of revising the GHGRP. SWICS proposed using cover material as the basis for determining the methane oxidation rate in landfill cover, but the EPA's review of the data led them to the conclusion that the methane flux rate through cover was a better indicator of the methane oxidation rate. The EPA implemented a flux-based oxidation rate in the 2013 revision to the GHGRP. While the EPA's decision was not the solution Stakeholders had proposed, the EPA's revision was generally positively received.

Similarly, Stakeholders had requested that methane measurement frequencies under the GHGRP be made consistent with monthly methane measurement frequencies under existing regulations. The EPA's initial reaction was concern that monthly methane measurements would not be sufficient to capture methane variability at sites and required weekly methane measurements, a compromise from the initially proposed continuous monitoring requirement.

Stakeholders compiled 20,000 weekly methane measurements from almost 400 landfills and analyzed the distribution of the methane measurements. That analysis determined that the variability in methane concentration followed a normal distribution with a standard deviation of about 1.75 percent and concluded that methane variation by week was not significant and that the variation was not biased high or low. Stakeholders concluded that weekly methane measurements did not result in an improvement in the quality of the data reported to the EPA. The EPA reviewed the data themselves and came to the same conclusion as the Stakeholders. Consequently, the EPA reduced the methane monitoring frequency for landfills from weekly to monthly in the 2013 revisions to the GHGRP.

These changes were possible through collection of data by Stakeholders and review of that data by the EPA.

CONCLUSIONS

Industry can work to educate the EPA, which can lead to both improvements in the accuracy of reported data and a reduction in the regulatory burden on the regulated industry. The EPA rarely has the understanding of an industry that the industry itself does, and Stakeholders can reach out to provide information they have but the EPA does not. By keeping open lines of communication between Stakeholders and the EPA, both parties have been able to improve the quality of GHG emissions data reported under the GHGRP while reducing the monitoring burden.

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