PREPARING YOUR LANDFILL FOR GREENHOUSE GAS EMISSIONS REDUCTION TRADING

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ABSTRACT

Since the development of the Kyoto Protocol in 1997, the landfill industry has recognized the potential to capitalize on greenhouse gas (GHG) emissions reductions via collection and control (combustion) of landfill gas (LFG). For a variety of reasons, however, the GHG emissions market has been slow to develop and few US landfills have succeeded in selling emissions reductions. The current year (2003) has witnessed a significant increase in GHG emission reduction projects internationally, and activity in the US may soon be stimulated by the Chicago Climate Exchange (CCX), a new cap and trade program similar to the Acid Rain Program. The CCX is to begin trading in October this year.

The focus of this paper is to present the background and status of GHG trading and recommend steps that landfill owners can take now to possibly benefit from future trading opportunities. Such steps are both administrative (understanding trading mechanisms and "contracts") and technical (hardware and recordkeeping).

INTRODUCTION

Greenhouse gases are a group of atmospheric gases with a potential for global warming by virtue of their ability to absorb infrared radiation. GHGs include carbon dioxide, methane, nitrous oxide, hydrocholorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), ozone, perfluorocarbons (PFCs), and sulfur hexafluoride. These gases are produced by both natural and manmade processes. The burning of fossil fuels, for example, is one of the most significant sources of increased carbon dioxide emissions over the last century.

The "potency" of individual GHGs is expressed by their global warming potential, i.e., their ability to trap heat radiated from the earth. Methane, for example, has a global warming potential approximately 21 to 23 times greater than that for carbon dioxide. This fact is significant because it increases the beneficial impact of LFG control – each ton of methane capture equates to 23 tons of carbon dioxide. In other words, 1 ton of methane is 23 tons of CO_2 equivalent, expressed as CO_2e.

GHG TRADING BACKGROUND

The United Nations Framework Convention on Climate Change (UNFCCC) adopted in Rio de Janeiro in 1992 and subsequent developments, including the Kyoto Protocol were the driving force leading to the current efforts towards GHG trading (Rosenzweig). And these efforts have become numerous, including state, regional, national, and international programs. Others have presented summaries of various programs initiated and in effect around the globe (see, for example, The Emerging International Greenhouse Gas Market published by the Pew Center on Global Climate Change). For US landfills, the more relevant programs include state initiatives in Massachusetts, New Hampshire, and Oregon, and the private initiative by the CCX.

The Clean Air Act Amendments of 1990, particularly the SO_2 allowance trading under Title IV, set the stage for the approach largely pursued by the GHG trading programs. In a nutshell, the strategy is to achieve GHG reductions by allowing industries (or nations) that need to reduce emissions to do so by purchasing offsets from projects that can achieve reductions most cost effectively.

STATUS OF THE INDUSTRY

Much has been published about the emerging GHG market, but actual trading has been slow to develop. Part of the reason for this slow development is that the compliance period for the Kyoto Protocol is 2008 to 2012. Also, the United States is not a signatory to the protocol. Hence, efforts by US landfills to market their GHG emission reductions have been mostly frustrated.

On the international scene, several mechanisms have stimulated significant activity in the past year or so. These include the Prototype Carbon Fund (PCF) administered by the World Bank and the Clean Development Mechanism (CDM) feature of the Kyoto Protocol. The PCF program is intended to stimulate the GHG market by investing in select projects and creating industry experience with active transactions and the mechanisms (measurement, verification, etc.) associated with the same.

The CDM (defined under Article 12 of the Kyoto Protocol) is aimed at developing projects in nations with developing economies. Certified emission reductions from these projects contribute towards the compliance of signatory parties with their reduction commitments. Neither the PCF nor the CDM have a direct impact on potential projects in the US; however, any such program that stimulates an active GHG trading market internationally can indirectly benefit this industry domestically simply by maturing market experience and advancing the industry towards more widely acceptable protocols. As transactions occur, "bugs" in the system will be identified and worked out. We can benefit from the same.

Similarly, state programs in Massachusetts and Oregon are creating a market for GHG reduction projects. Both programs target power plants by requiring mandatory purchase of CO_2e offsets. The CCX, on the other hand, involves a variety of industries who have voluntarily and contractually agreed to limit their GHG emissions. Emissions above the limit require the creation of internal offsets or purchase of the same from other participants. Participants in the CCX that supply such offsets include the landfill industry.

QUALIFICATIONS FOR EMISSION REDUCTIONS

Before one decides to pursue participation in the GHG trading market, it is important to know what make such reductions tradable. In general, the following important factors must be satisfied to qualify GHG emissions reductions:

- The reductions must be **real**; i.e., they must be specific and identifiable. For LFG projects, this is usually a low hurdle. Other GHG reductions that have been explored, such as dietary changes to bovines to reduce methane emissions, may have a more challenging demonstration of real reductions.

- The reductions must be **surplus**. They can not result from projects required by regulation. For example, landfills that must comply with the New Source Performance Standards (NSPS) can not normally market their emission reductions as surplus.

- The reductions must be **"new."** Reductions resulting from "old" projects have little to no value. The key is the baseline year against which emissions reductions are measured as defined by the program creating the market. For example, 1990 is a common baseline year (as established by the UNFCCC in the 1992 Rio de Janeiro conference) before which projects are not counted. For all practical purposes, this date has been superceded by later dates. For example, the CCX requires projects to be placed in service after 1/1/99. The year in which reductions are achieved is referred to as their vintage.

- **Ownership** of the reductions must be clear and uncontested. This parameter can be confusing at landfills where the gas rights have been sold to a third party for LFG utilization. Most gas rights agreements are silent on the ownership of emissions reductions, whether for GHG or other emissions commodities such as VOCs or NOx. Today's contracts should address this issue regardless of the apparent likelihood of emissions trading.

- Emissions reductions must be **measurable and verified**. The beauty of LFG projects is that methane reductions measurements are relatively straightforward given the ability to measure gas flows (to the flare or energy conversion device) and methane content. Even projections of future emission reductions can be reasonably estimated with models employing industry experience. Carbon sequestration through timber growth, for example, is more difficult to measure and predict.

If your landfill gas project compares favorably to the above criteria, what can you do to position your facility to gain from emissions trading? The first step is to understand the technical and administrative (or contractual) issues that will be involved in the transaction as discussed below.

TECHNICAL ISSUES

Regulations

The first hurdle is determining the regulatory status of your landfill. If your landfill is compelled by NSPS to collect and control LFG (because non-methane organic compound [NMOC] emissions exceed 50 metric tons/year) then reductions likely will not qualify for trading. One exception to this would be early action, such as system expansion into newer landfill areas that have not reached the waste age threshold requiring gas collection (2 years for areas at final grade and 5 years for areas at interim grade). In such cases, flow from the applicable area must be separately monitored.

Age

The second hurdle is whether the emissions reductions can be counted as new. LFG systems that have been collecting gas since the '80s have no value in this market because the emissions reductions commenced prior to the baseline year of 1990 or later. Such reductions were theoretically already accounted for in the inventory of GHG emissions against which reductions are measures. For GHG trading, the rule of thumb is: the newer the better.

Gas Flow

The foremost technical issue involves measuring the quantity of emissions reductions you are trying to sell. The two parameters to measure are flow and methane content, unless some surrogate measure (such and kW-hrs of power sold) can be used to back calculate methane consumption. Some LFG systems employ in-line flow meters and recorders. This equipment is essential for an emissions reduction transaction. If your facility does not have flow metering, install it now to document gas flows. The various emissions trading programs have protocols for flow measurement. Typical requirements include:

- Accuracy, precision per established standards;
- Initial and periodic calibration;
- Capability to record flow every 15 minutes; and
- Means to correct for temperature and pressure.

Methane Content

Although continuous monitoring of the methane concentration of recovered LFG would be optimal, it is not often practical given the instruments available to the LFG industry currently. Unlike LFG flow rates, methane concentrations are not likely to vary dramatically over short time periods. Daily field measurement of methane concentrations is desirable, but may be somewhat burdensome, particularly since landfill personnel are often busy with site operations and are often absent on weekends. For these reasons, an appropriate frequency of methane measurement is at least weekly.

If methane measurements are not routine at your facility, begin monitoring and recording now. Monitoring should be conducted upstream from the flare or other control device.

Energy Production

Energy recovery facilities that use LFG as a fuel to generate electricity typically have detailed records of electrical generation rates in kilowatt-hours (kWhr) that can be used to calculate methane combustion rates. Information on the heat rate of the combustion unit in Btus per kilowatt hour (Btu/kWhr) can be used to calculate Btus of methane combusted. Typically, the high heating value of methane (1,012 Btus per cubic foot) is used to convert to a methane flow rate. The calculation can be summarized as follows:

> Methane recovery (ft^3) = [kWhr of electricity produced from the LFG fuel] x [heat rate in Btu/kWhr] / [1012 Btu/ft^3 (HHV of methane)]

For estimating annual methane combustion rates, use the amount of electricity generated over a one year period in the equation above. The heat rate used in the calculation should be from the most recent source test for the combustion device. If no source test information is available, the heat rate per the manufacturer's specifications should be used.

This method for calculating methane combustion rates at energy recovery facilities is preferred over the standard method applicable to other facilities (i.e., flares) because it does not rely on periodic methane concentration measurements and is therefore more accurate.

Listed below is the type of information that an emissions trading program may require regarding the measurement of methane combustion at energy recovery facilities:

- Type, make, and model number of combustion unit(s);
- Number of combustion units that exclusively use LFG as fuel;
- Heat rate of combustion device(s) per manufacturer's specifications;
- Copy of a summary table from the most recent source test showing the measured heat rate of combustion device(s);
- Summary tables showing kWhr of electricity produced from LFG per month over the annual period;
- Type of electrical metering device; and
- Accuracy, precision, and calibration information on the metering device per manufacturer.

ADMINISTRATIVE ISSUES

Perhaps the major obstacle to entering the GHG marketplace, particular for municipal landfill owners, is unfamiliarity with the whole process. This is understandable since the process is new, and even large corporations such as Norsk Hydro are being applauded for "learning by doing". (WRI) However, an effort to educate the appropriate decision makers can be worthwhile. Such decision makers can include legal, procurement, finance, and business parties within the firm or organization.

Actually, the process itself will be changing as programs at the state level and/or private efforts such as the CCX are implemented. To date in the US, transactions have been largely unregulated and buyer driven, often assisted by an emissions broker. Such transactions involved a term sheet to present the offer of the seller to the buyer. Notwithstanding the current changes in the market, certain elements of a GHG emissions reduction transaction will remain that require understanding before participating.

The first element is proof of ownership. Again, this may not be a challenge unless a gas rights agreement has been entered into with a third party. If so, and the agreement is silent on ownership, initiate dialog now to establish a written understanding.

Another element of the transaction is ability to "deliver" the goods. For example, if a buyer pays a landfill owner for 100,000 metric tons (tonnes) of CO_2e for 2006, then come time, the landfill owner needs to be able to verify that this amount of emissions reductions was accomplished and assign credit therefrom to the buyer. If the purchase price was already paid and the emission reductions for whatever reason are not realized, then a refund is required. For public landfill owners, this can be a difficult concept to be accommodated both from budgeting and risk perspectives. Establishment of a separate trust in which to deposit funds until delivery is made is one way to address this potential concern.

Lastly, what price should reductions be sold for? The Northeast Maryland Waste Disposal Authority reported their efforts to market future stream GHG emissions reductions from their member jurisdictions' landfills at $0.50/tonne for years prior to Kyoto compliance (Thomson). Others project prices at $3.00 and above depending on the timeframe relative to Kyoto.

Natsource, LLC, an emissions broker based in New York, conducted a study in 2002 to estimate the potential market price for GHG emission reductions. In their executive summary, they make this statement regarding unknowns on pricing and other factors, "Drawing on differing sets of assumptions, recent economic modeling and engineering studies suggest that the Kyoto Protocol costs could range from virtually nothing to massive." (Natsource) Despite the level of uncertainty, they predict prices below $5 per tonne prior to 2008 and between $5 and $11 after.

In order to evaluate whether efforts to prepare for GHG trading are worthwhile, a sense of potential revenues needs to be established. Even with a low assumption of $1 to $2 per tonne, the potential revenues can easily justify the relatively minor investment to prepare for this market.

RECOMMENDED ACTIONS

1. Determine the applicability of NSPS to your landfill facility and when, if ever, it may impact you.
2. Quantify potential GHG emissions reductions with your existing LFG collection system by the following formula:

   CH_4 combusted (Mg/yr) = [CH_4 recovery (ft^3/yr)] x [16 (molecular weight of CH_4)] x [1Mg/10^6 g]* [1mol/24.04L @ STP] x [28.32L/1cf]

   The resulting number needs to be multiplied by 23 to obtain Mg (same as tonne) per year of

CO_2e. Note that this multiplication factor will vary depending on whether the CO_2 resulting from the combustion of LFG is subtracted out. The CCX for example, uses a factor of 18.25.

3. Establish ownership if there is a question about it due to existing agreements, particularly with a gas developer.

4. Determine installation dates of initial LFG collection and control system and any expansions.

5. Discuss the process with appropriate decision makers. Retain the services of a consultant, if necessary.

6. Install flow measuring and recording instrumentation and commence regular (at least weekly) methane measurements of collected LFG.

7. Make contact with potential marketers or programs that can execute a trade. Again, use the services of a consultant as appropriate.

REFERENCES

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