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Economic Impact Analysis for the Supplemental to the Municipal Solid Waste (MSW) NESHAP

Final Report

ECONOMIC IMPACT ANALYSIS FOR THE SUPPLEMENTAL TO THE NESHAP FOR MUNICIPAL SOLID WASTE (MSW) LANDFILLS

CHAPTER 1. BACKGROUND

This economic impact analysis is in support of a regulatory action in a supplemental to the national emission standards for hazardous air pollutants (NESHAP) for municipal solid waste (MSW) landfills. On November 7, 2000, EPA proposed NESHAP for MSW landfills and requested comments on bioreactors. Based on comments to the proposed rule and additional information and analyses, EPA is adding a definition of bioreactors to the rule and is issuing timely control for bioreactors located at MSW landfills with a design capacity greater than or equal to 2.5 million Mg and 2.5 million m^3.

This analysis is intended to provide information on the impacts of this supplemental on directly affected entities, as well as some information on the impacts on indirectly affected entities such as governments and communities. Included also is a profile of landfills and the use of bioreactors at landfills.

1.1 Background on the Supplemental

Section 112 of the CAA requires us to list categories and subcategories of major sources and area sources of HAP and to establish NESHAP for the listed source categories and subcategories. On July 16, 1992, we published a list of source categories, which included MSW landfills, that emit one or more of these HAP. We must promulgate standards for the control of emissions of HAP from both new and existing major source MSW landfills. For "major" source MSW landfills (those that have the potential to emit greater than 10 tons per year (tpy) of any one HAP or 25 tpy of any combination of HAP), the CAA requires us to develop standards that require the application of MACT.

Under section 112(k) of the CAA, EPA developed a strategy to control emissions of HAP from area sources in urban areas, identifying 33 HAP that present the greatest threat to public health in the largest number of urban areas as the result of emissions from area sources. Municipal solid waste landfills were listed as one of the 29 area source categories on July 19, 1999 because 13 of the listed HAP are emitted from MSW landfills (64 FR 38706).

Section 112 of the CAA requires that we establish NESHAP for the control of HAP from both new and existing major sources. The CAA requires the NESHAP to reflect the maximum degree of reduction in emissions of HAP that is achievable. This level of control is commonly referred to as the maximum achievable control technology (MACT).

The MACT floor is the minimum control level allowed for NESHAP and is defined under section 112(d)(3) of the CAA. In essence, the MACT floor ensures that the standard is set at a level that assures that all major sources achieve the level of control at least as stringent as that already achieved by the better-controlled and lower-emitting sources in each source category or subcategory. For new sources, the MACT floor cannot be less stringent than the emission control that is achieved in practice by the best-controlled similar source. The MACT standards for existing sources can be less stringent than standards for new sources, but they cannot be less stringent than the average emission limitation achieved by the best-performing 12 percent of existing sources in the category or subcategory (or the best-performing 5 sources for categories or subcategories with fewer than 30 sources).

In developing MACT, we also consider control options that are more stringent than the floor. We may establish standards more stringent than the floor based on the consideration of cost of achieving the emissions reductions, any health and environmental impacts, and energy requirements.

On November 7, 2000, we proposed NESHAP for MSW landfills. The proposed rule fulfills the requirements of section 112(d) of the Clean Air Act (CAA), which requires the Administrator to regulate emissions of HAP, and helps implement the Urban Air Toxics Strategy developed under section 112(k) of the CAA.

In the proposal notice (65 FR 66680), we described differences in emission rates over time from landfills operated as bioreactors as opposed to conventional landfills. We also requested additional information on emissions from bioreactors. We solicited comments on requiring installation of collection and control systems sooner after waste is deposited in bioreactor cells.

We received five public comments addressing bioreactors. The commenters agreed that because of the enhanced biodegradation of waste in bioreactors, they generate landfill gas including organic HAP at higher rates soon after waste placement. The industry commenters stated that research is ongoing and there is insufficient information to precisely estimate emissions from bioreactors. They recommended timely collection and control of bioreactors, but strongly suggested that EPA issue guidance rather than regulations until additional data are collected. Other commenters representing state agencies commented that many bioreactors have installed collection and control systems prior to initiating liquids addition and that the NESHAP should require installation of collection and control systems prior to initiating liquids addition for all bioreactors, regardless of landfill size.

We reviewed the public comments and other recent literature. We also gathered additional information on the number of bioreactors, their control levels, and the timing of collection and control system installation. The additional information and analyses are contained in the public docket for this supplemental proposal (Docket No. A-98-28).

1.2 Summary of Supplemental Requirements for Bioreactors

We are issuing requirements for timely installation of collection and control systems in bioreactors located at landfills with a total landfill design capacity of greater than or equal to 2.5 million Mg and 2.5 million m^3. These requirements would apply to bioreactors within landfills at both major and area sources if the landfill meets the design capacity criteria. The proposed supplemental control requirements apply only to active landfills (i.e., existing and new landfills that are still accepting waste as of the date of publication of the final rule or have the capacity to accept additional waste and are not permanently closed). The requirements would not apply to bioreactors at permanently closed landfills.

If you own or operate a bioreactor at a landfill that is a new affected source, then you would be required to install the gas collection and control system in the bioreactor prior to initiating liquids addition, regardless of whether the landfill emission rate equals or exceeds the 50 Mg/yr emission rate criteria in the NSPS/EG. Startup of the collection and control system would be required within 90 days after initiating liquids addition.

If the bioreactor is located at a landfill that is an existing affected source, then you must install and begin operating a collection and control system for the bioreactor within 3 years after publication of the final NESHAP rule unless earlier control is already required by the NSPS/EG. You would be required to conduct a performance test and report the results within 180 days after startup of the bioreactor collection and control system. If an existing source landfill installs and begins to operate a bioreactor within the landfill at a date later than 3 years after the final NESHAP is published, then a collection and control system for the bioreactor would be required to be installed before the initiation of liquids addition. The control system would be required to begin operation within 90 days after the first date of liquids addition.

The timing for extending the collection and control system into new cells or areas of the bioreactor is also different from conventional landfills. Once control of your bioreactor is required, you would need to install collection and control systems in new areas or cells of the bioreactor prior to initiating liquids addition to that area, cell, or group of cells. Under this supplemental proposal, controls could be removed from the bioreactor portion of the landfill either: (1) when the criteria for control removal specified in the NSPS/EG are met, or (2) when the bioreactor is permanently closed, liquid addition has ceased, and liquids have not been added to the bioreactor for 1 year.

At some landfills, a portion of the landfill is a bioreactor, and the remainder is designed and operated as a conventional landfill. In these situations, the control requirements and the timing of control installation for the conventional portion of the landfill would not change. We are not proposing to revise the NSPS or EG. Thus, you would continue to use the equations and factors in the NSPS/EG to calculate the annual uncontrolled NMOC emission rate for your landfill as a whole (including the total waste placed in the bioreactor area and the conventional area). When your calculated uncontrolled NMOC emissions equal or exceed 50 Mg/yr, then you would install a collection and control system for the conventional portions of the landfill according to the schedule in the NSPS, or the applicable State, Tribal, or Federal plan that implements the EG.

1.3 Rationale for the Requirements for Bioreactors

Based on review of public comments and other available information, we have concluded that bioreactors are a distinct operation within MSW landfills, and that the appropriate timing of control for bioreactor operations within a landfill is different from that for conventional portions of a landfill. The design and method of operation of bioreactors is different from conventional landfills, resulting in different emissions characteristics.

Because of the rapid biodegradation of waste, landfill gas (including methane, NMOC, and organic HAP) is generated at a significantly greater rate in the first couple of years after waste placement in anaerobic and hybrid bioreactors compared to conventional landfills. For example, one study indicates that in approximately 90 days, bioreactor landfills generate gas at a rate similar to what a conventional MSW landfill generates at 2 years. Public comments and published studies confirm the greater landfill gas generation rates early in the life of anaerobic and hybrid bioreactors. Emission rates cited in the comments and literature range from 2 to 10 times as much as conventional landfills. After peaking at a higher generation rate near the time of landfill closure, bioreactor landfill gas generation declines more rapidly than conventional landfill gas generation. The total long-term amount of landfill gas from an anaerobic bioreactor is expected to be approximately the same as from a conventional landfill with the same amount of waste, because the total potential landfill gas generation depends primarily on the amount of material in the waste that can eventually be decomposed. But bioreactor landfill gas generation is significantly higher than conventional landfill gas generation prior to and shortly after closure and significantly lower in the later years. References indicate that a bioreactor shortens the period of waste degradation and stabilization, and thus the period of most of the gas generation, from 30 to 50 years for a conventional landfill to 5 to 10 years for an anaerobic bioreactor.

Because bioreactors generate significantly more landfill gas, including organic HAP, earlier in their life than conventional landfills, the methods used in the rule to calculate uncontrolled emissions and the required timing for collection and control system installation that apply to conventional landfills are not appropriate for bioreactors. The NESHAP, which refers to the NSPS control requirements, would require landfills to estimate their NMOC emissions using specified equations and procedures. After landfills reach or exceed 50 Mg/year of NMOC, they must install collection and control systems within 30 months. Gas collection must then be extended into each cell or area within the landfill within 2 years after waste is first placed in that cell or area (if the area is at final grade) or 5 within years if the area is still active.

For bioreactors, the 50 Mg/year NMOC uncontrolled emission rate would be reached sooner than calculated by the procedures in the NSPS/EG. Furthermore, because landfill gas generation rates from bioreactors are significantly higher in the early years after waste placement, allowing 30 months after uncontrolled estimated emissions reach 50 Mg/yr to install controls would allow a much higher proportion of total bioreactor emissions, including HAP, to be released uncontrolled. Modeling of a landfill in a non-arid location with a design capacity of 2.5 million Mg and a 20-year life indicates that the NSPS/EG Tier 1 procedures would not require control installation for 5 years. In this time, a bioreactor accepting the same amount of waste would have potentially emitted a total of 130 Mg of HAP and 680 Mg of NMOC. (This is based on a k value of 0.1 for the bioreactor, which may be conservatively low, so bioreactor emissions could be higher.) If the same landfill were in an arid climate, Tier 1 procedures would not require control installation for 8 years. In this time, a bioreactor accepting the same amount of waste would have potentially emitted 310 Mg of HAP and 1,600 Mg of NMOC. Due to the different emissions pattern of bioreactors, it is appropriate to require control at the start of bioreactor operation (initiation of liquids addition). Similarly, waiting to collect gas from a bioreactor cell or area until 2 years or 5 years after initial waste placement would allow a large portion of bioreactor emissions to be released uncontrolled.

The timing of control system removal for conventional landfills also is not be appropriate for bioreactor landfills. Because emissions decline more rapidly, a bioreactor would require control for a shorter length of time than a conventional landfill.

Because of the differences in technical design, operation, and emissions pattern over time, we have examined bioreactors as a distinct type of operation within an MSW landfill affected source, evaluated the MACT floor and MACT for bioreactor operations within MSW landfills, and are proposing supplemental requirements for bioreactors.

A landfill that is an affected source under the MSW landfills NESHAP may include an area designed and operated as a bioreactor and an area designed and operated as a conventional landfill. When there are distinct operations that have different emission characteristics within an affected source, EPA often examines these operations separately in determining the MACT floor for the source as a whole. This section describes how we determined the bioreactor portion of the MACT floor for existing MSW landfills. (The conventional landfill component of the MACT floor for existing landfills remains as described in the November 2000 proposal notice.) First, we reviewed the information available to identify specific bioreactors, determine which are located at major sources, and determine the level of control and the timing of installation of control systems at these bioreactors. We then determined the control level for the average (or median) of the best-performing five bioreactors, because there are fewer than 30 bioreactors at MSW landfills that are major sources. (Under the CAA, the MACT floor for existing sources is based on the best-performing 12 percent of sources in a category, or the best 5 sources if there are fewer than 30 sources in the category.) Details of the bioreactor MACT floor analysis are contained in Docket No. A-98-28.

Based on the available data, we identified 24 anaerobic bioreactors. We used information from the landfill NESHAP database and other data provided by contacts familiar with these landfills to determine which of the bioreactors are located at landfills with maximum uncontrolled emissions equal to or greater than major source levels for HAP (i.e., 10 tons per year of an individual HAP or 25 tons per year of total HAP.) We used this population of ten bioreactors to determine the MACT floor for bioreactors. This population includes both major and “synthetic area” sources. A synthetic area source is a source which would otherwise be a major source, if not for enforceable emission controls that have been installed. For example, some landfills with uncontrolled emissions above major source levels have installed controls to comply with the landfill NSPS or EG. Synthetic area sources are included in the population used to determine the MACT floor because to exclude synthetic area sources from the MACT floor determination would exclude the best-controlled sources in the industry. The CAA does not suggest that we should exclude a control technology from consideration in the MACT floor because it is so effective that it reduces emissions from a source such that the source is no longer a major source of HAP.

We identified the controls in use at the ten bioreactors with uncontrolled emissions at major source levels, and when these controls were installed. We found that all ten of these bioreactors have gas collection and control systems meeting the control levels in the NSPS/EG. We also found that at least five of these gas collection and control systems were or are being installed prior to initiating liquids addition to the bioreactor. These control systems were installed in the bioreactors sooner than required by the NSPS/EG. Therefore, we determined that the MACT floor level of control for bioreactor operations within existing MSW landfills at major sources is installation of a collection and control system that meets NSPS/EG requirements, and that these controls can be installed prior to initiation of liquids addition.

Under the CAA, the new source MACT floor is based on the best-controlled similar source. We reviewed the information to determine the best control technology in use at the ten bioreactors at major and synthetic area sources, and when the control system was installed. The best-controlled bioreactor installed a collection and control system that meets NSPS/EG requirements prior to initiation of liquids addition; therefore, this is the MACT floor level of control for bioreactor operations within new MSW landfills at major sources. Because there are no more stringent collection and control technologies and the supplemental proposal requires installation and operation of these technologies as soon as possible, no options beyond the floor currently exist for new or existing landfills.

For this supplemental, we examined what constitutes Generally Available Control Technology (GACT) for area source bioreactors. We determined that for bioreactors at landfills with design capacities greater than or equal to 2.5 million Mg and 2.5 million m^3, GACT is the same as MACT (i.e., timely installation of gas collection and control systems that meet NSPS/EG requirements). In reaching GACT decisions, we consider the control techniques that are generally available for area sources and factors such as the emission reduction, environmental impacts, and costs of these controls. Since bioreactors generate landfill gas at a faster rate, significant HAP emission reductions will be achieved by requiring timely control of bioreactor operations at MSW landfills with design capacities greater than or equal to 2.5 million Mg and 2.5 million m^3. This reduction in HAP will reduce health risks and environmental impacts associated with the HAP present in landfill gas.

The costs of requiring timely control for bioreactor operations at area source landfills with design capacities equal to or greater than 2.5 million Mg and 2.5 million m^3 were also considered in reaching the decision that GACT is the same as MACT for these area sources. These landfills would, at some point in their life, be required to install controls by the NSPS/EG because the estimated uncontrolled NMOC emission rates would reach the 50 Mg/yr NSPS/EG emission rate criteria. Requiring timely control of bioreactor operations means that costs will be incurred sooner and emission benefits realized earlier. In fact, as described in Chapter 3, an analysis of net present value (NPV) costs shows that timely control of bioreactors at a landfill with a design capacity of 2.5 million Mg is generally not more costly than controlling a conventional landfill according to the NSPS/EG schedule. In fact, if the landfill gas is used for energy, then NPV control costs for bioreactors are lower than for conventional landfills and result in greater HAP emissions reductions. For these reasons, GACT for bioreactor operations at area source landfills with design capacities greater than or equal to 2.5 million Mg and 2.5 million m^3 was determined to be the same as MACT.

For bioreactor operations at area source landfills with design capacities less than 2.5 million Mg or 2.5 million m^3, EPA had determined that GACT does not require control. Requiring bioreactors at landfills below the design capacity cutoff to install controls would result in additional control costs, because these bioreactor operations are not otherwise required to install control by the NSPS/EG. The 2.5 million Mg and 2.5 million m^3 capacity exemption excludes those landfills that can least afford the costs of collection and control systems, including small businesses and, particularly, municipalities. The supplemental proposal includes additional rationale for the GACT decision.

CHAPTER 2. PROFILE OF AFFECTED ENTITIES

This profile is meant to provide background information for the economic impact analysis for this supplemental. The analysis is being done under the authority of Section 317 of the Clean Air Act.

The demand for municipal solid waste (MSW) landfills flows from the demand for services that collect and dispose of the large volume and variety of wastes Americans produce. This chapter briefly looks into the market structure for these services: what sectors generate MSW (and thereby “demand” disposal services), and what sectors of society collect, transport, and dispose MSW (and thereby “supply” disposal services).

2.1 Generators

MSW generators demand-in the economic sense of the word-services that collect and dispose of MSW. These generators provide most of the demand for MSW landfill services. There are four broad categories of MSW generators:

- Residential or Household: Waste from single- and multiple-family homes.
- Commercial: Waste from retail stores, shopping centers, office buildings, restaurants, hotels, and other commercial establishments.
- Industrial: Waste such as corrugated boxes and other packaging, cafeteria waste, and paper towels from factories or other industrial buildings. Industrial MSW does not include waste from industrial processes, whether hazardous or nonhazardous.
- Other: Waste from public works such as street sweepings and tree and brush trimmings, and institutional waste from schools and colleges, hospitals, prisons, and similar public or quasi-public buildings. Infectious and hazardous waste from these generators are managed separately from MSW.

Households are the primary direct source of MSW, followed by the commercial sector. The commercial, industrial, and other sectors each directly generate smaller portions of MSW than households. The industrial sector manages most of its own solid residuals, whether MSW or industrial process wastes, by recycling, reuse, or self disposal. For this reason industry directly contributes only a small share of the MSW flow, although some industrial process wastes do end up as MSW.

Various underlying factors influence the trends in the quantity of MSW generated over time. These factors include changes in population, individual purchasing power and disposal patterns, trends in product packaging, and technological changes that affect disposal habits and the nature of materials disposed.

2.2 Collection and Disposal

Governments -local, state, and federal-continue to play a large role in regulating and operating MSW management systems. Governmental influence, however, is limited. Material, engineering, geographic, cost, and other technical and economic conditions spell out some of the limits.

In addition, all MSW management systems ultimately involve private decision makers. Households and private firms generate most MSW, collect and transport MSW, build and operate MSW disposal systems, provide financing, and provide markets for recycled material. In some settings these private activities compete with public operations; in others, they provide factors of production and demand for outputs from public operations. Whatever the case, these technical and market relationships are important factors in conditioning the influence of local governments on MSW management generally.

2.2.1. Collection

Local governments, especially in more urbanized areas, often take the lead in organizing MSW management and, in many cases, providing collection and disposal services. This is particularly true in the Eastern United States (Chartwell, 1998). A wide variety of reasons explain this involvement: concern for the public health threat of uncollected or improperly disposed MSW, natural economies of scale in organizing and performing MSW collection and disposal, and a concern for the negative externalities-litter, noise, smells, traffic-sometimes associated with private collection and disposal. These negative externalities are not necessarily unhealthy, but they are detractions from public welfare.

How extensive is the local government role? Four market structures for MSW collection predominate:

- Public monopoly-public agency collects all MSW.
- Private monopoly-private firm(s) collect(s) all MSW in a specific area under a franchise agreement and is (are) reimbursed by the local government.
- Competitive-public agency and private firm(s) both collect MSW.
- Self-service - generators haul their MSW to disposal sites.

Most residential refuse is collected under the first three market structures; about 50 percent is collected under the first. A large fraction of private service is provided by contractors selected by local governments. In such cases, the government plays a role in selecting the private collection firm, specifying the terms and conditions of collection, and paying the private collector for the service.

2.2.2. Disposal

Many factors justify the interest of government institutions, and local communities in particular, in playing a large role in leading MSW management. These factors include: MSW may pose a threat to the public health, improperly disposed waste may result in adverse environmental impacts, and problems such as noise, traffic, and odor may results from the disposal of MSW.

Table 2-1.
Industries potentially regulated by this supplemental:

Category	NAICS Code	SIC Code	Examples of potentially regulated entities
Industry: Air and water resource and solid waste management	924110	9511	Solid waste landfills
Industry: Refuse systems - solid waste landfills	562212	4953	Solid waste landfills
State, local, and Tribal government agencies	562212 924110	4953	Solid waste landfills; Air and water resource and solid waste management

About 64 percent of municipal landfills nationwide are publicly owned as of 1998. The most common owners of landfill facilities are county and city governments, who together own 52 percent of all landfills. The federal government owns 3 percent of existing landfills, which are mainly facilities on military bases and installations. State governments own less than one percent of landfills. The greatest proportion of public ownership is generally found in the Northeast, while the greatest proportion of private ownership is generally found in the West (Reason Public Policy Institute, 2000). Around 36 percent of landfills are owned by private entities, a percentage that has grown from only 17 percent in 1984.

Currently, over 3,000 MSW landfills operate in the U.S. The average life expectancy of landfills is 16 years. Local governments must continually choose between closure, expansion, and construction of new facilities. Of these 3,000 landfills, 52 percent are not only publicly owned but are publicly operated as well. Thirty-eight percent of the landfills are privately owned and operated, while remaining 10 percent are publicly owned and privately operated. Thus, 48 percent of all U.S. landfills are now privately operated, a sign that privatization is becoming a common choice of governments in dealing with the operation of landfills. This is particularly true among communities with more than 100,000 residents. Though private firms own only 38 percent of the total number of landfills for communities with over 100,000 residents, they dispose of 58 percent of MSW and own 67 percent of current total landfill capacity. This illustrates that the average size of privately owned facilities is larger than publicly owned facilities, and indicates that private firms may do a better job of managing and developing larger and newer landfills. Larger facilities are generally more efficient, regardless of whether they are publicly or privately owned, and can utilize economies of scale that enable operators to charge lower tipping fees. Cost savings appears to be a clear reason for governments to move toward privatization. According to a 1998 R.W. Beck survey, forty-four percent of respondents said that cost savings was the major reason for privatizing a landfill; with efficiency being the choice of 19 percent of the respondents (R.W. Beck, 1998).

As of 1998, the largest landfill owner was Waste Management, which handles 15 percent of all intake volume for landfills nationwide. The next two firms in terms of intake volume are USA Waste Service and Browning-Ferris Industries, with 8 and 7 percent of all intake volume nationally (Chartwell, 1998). The top 11 firms by intake volume handle 43 percent of volume nationally, indicating that the landfills private sector is not concentrated among a few firms. Since 1998, Waste Management and USA Waste Services have merged, and Browning-Ferris Industries and Allied Waste Industries have merged. Even after these large mergers, no single firm controls more than 23 percent of the market. Therefore, there is little fear of a firm acting as a monopoly in landfill ownership nationally, though specific jurisdictions may experience little real competition for landfill services.

2.3 Revenue Generation

The costs of developing and operating MSW landfills are ultimately covered by tipping fees, general tax revenues, or a combination of the two. Tipping fees ultimately reflect many aspects of MSW disposal. Population and economic growth, recycling rates, operating and transportation costs, land values, and legislation all contribute to how much waste disposal facilities charge for the privilege of waste disposal (Chartwell, 1998). As of 1998, the nationwide average tipping fee for MSW landfills was $31.59/ton waste volume (Chartwell, 1998). The range of average tipping fees is from a high of $57.34/ton in the Northeast to a low of $22.24/ton in the West. This rate is more than that for materials recovery stations, but less than that charged by incinerators, mixed waste sites, and transfer stations. Approximately 30 percent of landfills receive all their revenues from tipping fees, and approximately 35 percent of landfills receive all their revenues from taxes. The remaining 35 percent of landfills cover the costs of waste disposal through a combination of tipping fees and taxes. The use of taxes as a revenue source rather than tipping fees has implications on waste disposal services. First, when disposal costs are included in taxes, most people are not aware of the actual costs involved. Without an effective mechanism for transmitting cost information, waste generators have no incentive to reduce their generation rates. Second, tax-supported facilities are typically underfunded relative to actual disposal costs, resulting in poorer operation than fully funded landfills supported by tipping fees (U.S. EPA, OSWER, 1989).

Factors that influence the choice of revenue sources include landfill size and ownership. Landfills receiving small quantities of waste are likely to rely heavily on taxes for their revenue while larger landfills rely on both taxes and tipping fees. Not surprisingly, private owners of landfills rely heavily on tipping fees relative to other landfill owners. It remains unclear whether private landfills rely on tipping fees because they are larger, or larger landfills rely heavily on tipping fees because they are private.

A distinction must be drawn between tipping fees and the actual costs of landfilling. Communities often set tipping fees to cover current operating costs without regard to amortization of capital expenditures (capital equipment, land, closure, and long-term care costs). Similarly, the cost of disposal for the 35 percent of landfills supplementing tipping fee revenues with taxes is usually much higher than the fee charged.

In addition to tax subsidies, tipping fees do not cover the actual costs to society of disposal because landfill costs usually do not include three important social costs (U.S. EPA, OAQPS, 1991):

(1) Depletion costs of existing landfills (i.e., discounted present value of the difference in landfill costs today and the future costs of a replacement landfill),

(2) Opportunity costs of land used in landfills, and

(3) Environmental costs (risk of environmental damage from landfills).

It is important to note that given the lesser amount of land normally needed to operate a bioreactor instead of a conventional landfill, the opportunity costs of land as reflected in its potential value for other purposes (e.g., real estate, commercial office buildings, etc.) becomes less of an issue for bioreactor siting and operation. According to an analysis of bioreactor costs done by ERG, "bioreactor landfills require 15 to 20 percent less land than standard landfills storing the same quantity of waste as a result of greater decay and compaction rates"(ERG, October 2001). Given the expense of land, particularly in large urban areas, this is an important and beneficial difference between these two types of MSW treatment.

2.4 Bioreactors as Compared to Landfills

Conventional landfills are typically operated as "dry tombs" by minimizing the infiltration of liquids into the landfill. This can be accomplished by placement of bottom and side liners and by placement of a low permeability final cap over the waste. In addition, many sites install and operate leachate collection systems to remove leachate and thus, minimize groundwater contamination. This method also results in a slower biodegradation process and a reduced rate of landfill gas generation. Some conventional landfills recirculate a portion of the collected leachate. A typical moisture content of the waste in a conventional landfill is approximately 20%, but it may be lower in arid areas or where all collected leachate is removed and infiltration is minimized.

A bioreactor is an MSW landfill or portion of an MSW landfill where any liquid other than leachate is added in a controlled fashion into the waste mass (often in combination with recirculating leachate) to reach a moisture content of 40% by weight to accelerate or enhance the anaerobic (without oxygen) biodegradation of the waste. This includes hybrid bioreactors, which are managed so that the waste undergoes a short (e.g., 60 day) aerobic stage, after which the waste is covered over and operated as an anaerobic bioreactor for several years. The long-term operation, emissions pattern, and applicable control techniques for hybrid bioreactors are similar to anaerobic bioreactors. The rapid biodegradation of waste in a bioreactor leads to more rapid generation of landfill gas compared to a conventional landfill.

The vast majority of bioreactors are anaerobic or hybrid bioreactors, with at least 24 operating as of 2001. The EPA expects a large number of anaerobic bioreactors to start operation in the next few years because of their environmental and economic benefits. Operating a landfill as a bioreactor extends the use of current sites and reduces the need for new sites, reducing land use, environmental impacts, and land purchase costs. Bioreactors improve the quality of leachate resulting in reduced environmental impacts if any groundwater contamination were to occur. Economic benefits include avoiding the costs of leachate treatment, transport, and disposal. In addition, because bioreactors emit a similar total amount of gas as conventional landfills but emit it more quickly over a shorter amount of time, owners and operators can convert landfill gas to energy more economically.

Aerobic bioreactors are a relatively new concept, and EPA knows of no full scale aerobic bioreactors in operation in the U.S.[1] A very limited amount of information is available. In aerobic bioreactors, air and liquids promote aerobic decomposition of waste. The waste decomposes rapidly due to the presence of oxygen and moisture. The aerobic decomposition produces large amounts of gases including carbon dioxide. Compared to conventional landfills, the increased temperature and increased air flow through the waste may result in increased emission rates of organic compounds (including organic HAP) soon after the aerobic bioreactor begins operation. However, aerobic landfill data is insufficient to characterize HAP emissions from this type of operation. The gas composition from aerobic bioreactors is expected to have higher levels of carbon dioxide, nitrogen, and oxygen, and significantly lower levels of methane. This may result in the gas being more difficult to safely combust. In addition, the lower levels of methane generated in aerobic bioreactors make them less economic compared to anaerobic bioreactors since methane gas can be easily used in waste-to-energy projects, while the gases formed in aerobic bioreactors can not. Aerobic bioreactors are not included in the bioreactor subcategory in the supplemental proposal.

EPA is not expecting a significant number of aerobic bioreactors to be built in the next several years. Concerns over the increased potential for landfill fires and added power costs have deterred use of this technology. Some pilots have had odor concerns, and in some cases are no longer being operated. Given the lack of information on controls for aerobic bioreactors, and the fact that very few are in operation or expected to start-up in the near future, EPA has concluded that it is not necessary for this supplemental proposal to address aerobic bioreactors. Portions of a landfill that are operated as aerobic bioreactors would continue to be subject to the NSPS/EG and the landfill NESHAP requirements (proposed on November 7, 2000). If a landfill that includes an aerobic bioreactor meets the design capacity and uncontrolled NMOC emission rate criteria in the NSPS/EG, a collection and control system must be installed in the landfill, including the aerobic bioreactor area, according to the schedule in the NSPS/EG. Landfills with pilot scale aerobic bioreactors have had success in routing emissions from aerobic bioreactor and other landfill areas together for control in flares.

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[1] There are two aerobic bioreactor projects operational in Georgia, one in Tennessee and one which is a pretreatment activity in New York State. However, none of these projects are at full scale. The Yolo County landfill in California also has an aerobic pilot test area.

CHAPTER 3. ECONOMIC IMPACTS

The following section will explore further the possible impacts to major source landfills across the country.

3.1 Costs of the Standards

We expect a positive environmental impact and negligible economic impacts from the requirements of this supplemental proposal. One reason for the small economic impact is that this supplemental proposal will require gas collection and control for only the same landfills that are already required to install collection and control systems under the NSPS/EG and the proposed NESHAP. It will not change the number of landfills that must apply controls.

In the previous analyses a year ago for the proposed NESHAP, it was assumed that all landfills are conventional landfills and install and remove control systems according the schedule in the NSPS/EG. We did not distinguish between conventional landfills and bioreactors. To see if this supplemental proposal for bioreactors would increase emissions reductions, environmental, and cost impacts relative to those previously calculated for the NSPS/EG controls, we compared the emission reductions and costs for timely control of a bioreactor according to the schedule proposed in this supplemental notice with the emission reductions and costs for controlling a conventional landfill that accepts the same amount of waste and installs controls according to the NSPS/EG schedule. We found that greater emission reductions are achieved by timely control of the bioreactor landfill. A bioreactor landfill with a design capacity of 2.5 million Mg achieves an emission reduction of 1770 Mg of HAP over the period of control, compared to 1630 Mg HAP reduction for a conventional landfill receiving the same amount of waste. The bioreactor is controlled for 13 years less than the conventional landfill, yet achieves greater emission reduction. Similarly, a bioreactor landfill with a design capacity of 10 million Mg achieves an emission reduction of 7300 Mg of HAP, compared to 7040 for a conventional landfill receiving the same amount of waste. This bioreactor is controlled for 30 years less than the conventional landfill, yet achieves greater emission reductions. Additional information on this analysis, including additional cases examined and HAP and NMOC emissions reductions are contained in Docket No. A-98-28 (ERG, October 2001). This analysis leads to the conclusion that implementation of this supplemental proposal will achieve additional HAP emission reductions, which will minimize any health impacts from exposure to HAP in landfill gas emissions and lead to other environmental benefits associated with reduction in other landfill gas constituents including NMOCs, which contribute to photochemical formation of smog, and methane, a potent greenhouse gas. Odor problems will also be minimized.

The energy impacts of this supplemental will also be positive. Many bioreactors are expected to comply with the rules by recovering landfill gas to generate energy. Our analysis shows that a bioreactor with a design capacity of 2.5 million Mg can generate a greater profit than a similar conventional landfill from sale of landfill gas for direct use (such as combustion in nearby boilers to provide steam to an industrial process or to heat a building). Similarly, using a combustion control device, such as a stationary internal combustion (IC) engine, that generates electricity from the landfill gas is more profitable for a 10 million Mg bioreactor, where it may not be profitable for a similar size conventional landfill. The number of landfill gas direct use and electricity generation projects has grown in recent years, and industry commenters stated in the public comments on the proposed NESHAP that bioreactors provide an opportunity for economically feasible use of landfill gas to generate energy. To the extent that these energy recovery options are used instead of flares to comply with the supplemental proposal, this will result in the generation of additional electricity, offset the use of fossil fuels, and have a positive energy impact.

To determine if the cost of this supplemental would increase the control costs previously predicted for the NSPS/EG and proposed NESHAP, we analyzed the cost of control for bioreactors installing controls according to the schedule in this supplemental proposal compared to the costs for control of conventional landfills controlled according to the schedule in the NSPS/EG. We examined costs for flares and energy generation options (ERG, October 2001). The costs included those for capital, and annual costs such as operating and maintenance costs. For energy recovery options, revenues from the sale of landfill gas or electricity were included.

Costs were expressed on a net present value (NPV) basis because the costs of the landfill gas collection and control systems are highly variable over the life of the landfill. In addition, the timing of control system installation and the length of the control period will vary greatly based on landfill size, design, landfill gas flow rates, and gas composition. For these reasons of fluctuating costs over a variable but long life of the landfill control system, this cost analysis compares the costs between various landfills and control options based on NPV analysis. The NPV analysis adjusts for the effects of the varying costs and lifetimes by converting them into a single present cost value (or NPV) that is equal to the stream of costs that the landfill would experience over its full lifetime.

For the flare control options, the NPV costs to control the bioreactor were slightly greater than the costs to control a conventional landfill. This is because the bioreactor would have to install control sooner, and the NPV calculation weighs earlier expenditures more heavily to account for the time value of money. However, the bioreactor NPV control cost is only about 10 percent greater than the conventional landfill control cost for all but one of the smaller landfill cases examined. For an example bioreactor with a design capacity of 2.5 million Mg, the NPV costs for a gas collection and flare system were estimated to be $1.5 million, compared to $1.3 million for a conventional landfill with the same design capacity. Furthermore, bioreactors experience cost savings compared to conventional landfills due to factors such as the reduced amount of land space needed to hold the same mass of waste and reduced leachate treatment, transportation, and disposal costs. When such differences are considered, it is significantly less costly to build a bioreactor, even with the more timely control requirements, than to build a conventional landfill. This was true for all cases examined.

The examination of energy recovery NPV cost cases showed that the bioreactors are less costly, or more profitable, to control than conventional landfills in all of the cases examined. In many cases, timely control of a bioreactor using an energy generation option will result in a net profit rather than a net cost. For an example bioreactor with a design capacity of 10 million Mg that controls emissions by using an internal combustion engine that generates electricity for sale to the power grid, the revenues from the sale of electricity balance the costs of the gas collection and control system resulting in an estimated NPV cost savings (or net revenue) of approximately $0.1 million. A conventional landfill with the same design capacity is estimated to incur an NPV cost of approximately $5 million. Smaller bioreactors that can control emissions by collecting landfill gas and delivering it to a nearby industry, commercial establishment, or institution for direct use in a boiler, process heater, or other energy recovery system can also realize a greater net revenue than similar size conventional landfills.

In many cases, timely control of a bioreactor using an energy generation option will result in a net profit rather than a net cost. In fact, according to a February 2001 article in MSW Management,

> "The bioreactor landfill offers several well-known and proven processes to achieve rapid degradation, and thus stabilization, of the relatively rapid degradable organic waste materials within a relatively short term. Although it requires increased management and more environmental controls, the bioreactor landfill can result in enhanced performance, fewer long-term environmental risks, and higher potential revenue to help defray operational costs. Over the long term this should result in considerable environmental and cost savings."

Given that there are savings in bioreactor operation versus conventional landfills, and bioreactor practice has been known as a MSW treatment method for over 10 years, why has bioreactor operation not become more common? Among them are:

- limited regulatory awareness and negative perception
- dearth of site-specific performance quantification
- limited availability of project economic assessments
- lack of financing experience, and
- the need for more sophisticated management and monitoring than with a conventional landfill.

As the experience with operations increases, many of these barriers to bioreactor operation are likely to decrease given the potentially large savings in costs. Also, Subtitle D regulatory clarifications for bioreactors are expected, which will reduce regulatory uncertainties and issues. With these considerations in mind, it is likely that bioreactors will become a more common choice for MSW disposal in the future.

Given these results, we conclude that this supplemental will not increase the costs of control for most landfills compared to the previous cost analyses, and some landfills with bioreactors will experience reduced control costs.

3.2 Small Entity Impacts

The RFA generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedures Act or any other statute unless the agency certifies that the rule will not have a significant impact or a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

For purposes of assessing the impacts of today's supplemental, on small entities, small entity is defined as: (1) a small business that is primarily engaged in the collection and disposal of refuse in a landfill operation as defined by NAICS codes 562212 and 924110 (also defined by SIC codes 4953 and 9511) with annual receipts less than 10 million dollars; (2) a small governmental jurisdiction that is a government of a city, county, town, school district, or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.

After considering the economic impacts of today's supplemental for MSW landfills on small entities, I certify that this action will not have a significant economic impact on a substantial number of small entities (SISNOSE). This certification is based on the fact that this rule will impose minimal economic impact on any small entities, if any, already covered by the proposed MSW landfills NESHAP, and that there may be cost savings for most of these sources that install bioreactors as compared to using conventional landfill operations. Also, the design capacity exemptions of 2.5 million Mg and 2.5 million m^3 excludes smaller landfills that can least afford the costs of collection and control systems, which will include many landfills owned by small businesses and small municipalities. In gathering available data on the owners of the ten bioreactor projects that are the population of sources used to identify the MACT floor for this proposal, we found that none of the ten projects were owned by a small business or municipality (the bioreactor projects are shown in Appendix A). Given that no other bioreactor project from the available data was identified as a major source, this data provides evidence to support the determination that there is no SISNOSE associated with this action. We continue to be interested in the potential impacts of the rule on small entities and welcome comments on issues related to such impacts.

Although this NESHAP will not have a significant economic impact on a substantial number of small entities, EPA nonetheless has tried to reduce the impact of this rule on small entities. The design capacity criteria of 2.5 million Mg and 2.5 million m^3 in the supplemental proposal excludes smaller landfills that can least afford the costs of collection and control systems, including small businesses and, particularly, municipalities. We have performed a number of outreach activities to interact with small entities during this rulemaking effort. We have held formal stakeholder meetings. In addition, we have presented rule related information at national conferences sponsored by the trade organizations for these entities. Finally, we requested the establishment of an electronic link between the International City/County Management Association website and our rule development website. Through the efforts discussed above, small entities have been engaged in this rulemaking effort. We continue to be interested in the potential impacts of the rule on small entities and welcome comments on issues related to such impacts.

3.3 Unfunded Mandates

Title II of the 1995 Unfunded Mandates Reform Act (UMRA), Public Law 104-4, establishes requirements for Federal agencies to assess the effects of their regulatory actions on State, local, and tribal governments and the private sector. Under section 202 of the UMRA, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with "Federal mandates" that may result in expenditures by State, local, and tribal governments, in the aggregate, or to the private sector, of $100 million or more in any 1 year. Before promulgating an EPA rule for which a written statement is needed, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of regulatory alternatives and adopt the least-costly, most cost-effective, or least-burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least-costly, most cost-effective, or least-burdensome alternative if the Administrator publishes with the final rule an explanation why that alternative was not adopted. Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including tribal governments, it must have developed under section 203 of the UMRA a small government agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant Federal intergovernmental mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements.

The EPA has determined that this supplement to the NESHAP does not contain a Federal mandate that may result in expenditures of $100 million or more for State, local, and tribal governments, in the aggregate, or the private sector in any 1 year. Thus, the proposed rule is not subject to the requirements of section 202 and 205 of the UMRA.

3.4 Landfill Impacts

Landfill revenue and operating cost data is limited. A major component of the landfill's revenue is its tipping fee. These tipping fees are usually defined as the landfill's gate fees. As mentioned in Chapter 2, the national average tipping fee for landfills in 1998 was $31.59 per ton intake volume. It is assumed that the cost of the regulation will be passed on to the users of bioreactor landfills as reflected in a higher tipping fees, and this should lead to minimal increases in tipping fees as a result of the proposed regulation. In addition, it is likely that many bioreactor landfills will experience savings in costs due to sales of gases generated by the bioreactor and the potential for electricity generation on-site for delivery to the power grid. Hence, the possibility of new revenue sources may offset to a considerable degree the additional capital and annual expense related to bioreactor operation. Also, the potential for a new tax credit to landfill gas-to-electric generation projects that may this year be restored to Section 29 of the Windfall Profits Taxation Act of 1980, likely to be about $1/million British Thermal Units (MMBtu's), would encourage bioreactor development.

Based on the relatively small compliance cost and potential for cost savings to bioreactor operation as compared to conventional MSW landfill operation, the economic impact of this regulation is expected to be insignificant and potentially positive. There will not be a significant impact on a substantial number of small entities associated with this regulation.

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Major Source Landfills with Bioreactors

Bioreactor Name	Location	Ownership
Yolo County Central Landfill	Davis, CA	Yolo County (population 155,573)
Live Oak Landfill	Atlanta, GA	Waste Management Incorporated (WMI)
Outer Loop Landfill	Jefferson County, KY	Waste Management Incorporated of Kentucky (subsidiary of WMI)
Millersville Landfill and Resource Recovery Center	Anne Arundel County, MD	Anne Arundel County (population 489,656)
Monroe County Mill Seat Landfill	Monroe County, NY	Monroe County (population 712,419)
Lycoming County	Lycoming County, PA	Lycoming County (population 116,709)
Tessman Road Landfill	San Antonio, TX	Browning-Ferris Industries (BFI)
Maplewood Recycling and Waste Disposal Facility	Amelia County, VA	Waste Management Incorporated of Virginia (subsidiary of WMI)
King George County Landfill and Recycling Center	King George County , VA	Waste Management Incorporated of Virginia (subsidiary of WMI)
Waste Management Incorporated Landfill	Franklin, WI	WMI

Notes: WMI has 57,000 employees; BFI has 26,000 employees (employee data taken from 1999 estimates). Population data for affected municipalities is taken from 1999 Census Bureau estimates.

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