Sierra Club

LANDFILL GAS TO ENERGY TASK FORCE

Frequently Asked Questions and Answers about Landfill Gas to Energy

1. What is landfill gas?

Landfill gas is a complex mixture of gases that are generated when wastes decompose in modern landfills.

If the decomposition of organic wastes (e.g., food scraps, yard waste, and more) occurs under natural conditions in the open air, or in well-run composting operations with easy access to oxygen, the primary gaseous by-product is carbon dioxide (CO_2). When decomposition occurs under the oxygen poor conditions in today's covered landfills, large amounts of methane (CH_4) are produced instead.

Landfill gas is typically about 35-60% methane, with much of the remainder being CO_2. It also contains varying amounts of nitrogen, oxygen, water vapor, sulfur and hundreds of other contaminants, some of which are toxic. Inorganic contaminants like mercury are also known to be present in landfill gas. Sometimes, even radioactive contaminants such as tritium (radioactive hydrogen) have been found.

2. Why is landfill gas control important?

The methane in landfill gas is highly flammable and a potent contributor to global warming -- 25-72 times more powerful than CO_2, depending on the methods used to estimate potency.[1] A significant portion of that gas will be released to the atmosphere. In addition, landfill gas can result in fires and explosions, cause offensive odors, contribute to regional smog, and increase health risks for nearby residents.

---

[1] Intergovernmental Panel on Climate Change, *Fourth Assessment Report: Chapter 2 Changes in Atmospheric Constituents and Radiative Forcing* (2008), at Table 2.14. The 25× multiplier pertains when calculated over 100 years, and 72×, over 20 years.

The EPA has identified at least 94 trace compounds, in addition to methane, in landfill gas, including such toxic compounds as benzene, toluene, chloroform, vinyl chloride, carbon tetrachloride and others.[2]

3. How does the Sierra Club suggest that we deal with the problems caused by landfill gas generation and release?

We can solve the problems in the future arising from methane generation by keeping our decomposable organic wastes out of landfills, thus preventing the formation of methane from buried organic discards in the first place. The transition to separation and better treatment for organic wastes will take time, but it is already beginning to happen in some communities[3] and it can and should happen everywhere.

In the meantime, while this transition takes place, and at landfills where we have already discarded these problem wastes, landfill gas should be collected and treated to minimize global warming impacts, avoid the release of toxic gases into nearby communities, and prevent other problems caused by the unfortunate and unnecessary generation and release of landfill gases. That will require greatly improved regulation of landfill gas emissions.

4. Is landfill gas currently regulated? How?

Yes, in some respects, though significant improvement is long overdue.

Since the EPA's landfill air regulations were promulgated in 1996, some very large landfills have been required to install some level of active gas collection, but the rule is very limited in

---

[2] EPA *1991 report, "Air Emissions from Municipal Solid Waste Landfills - Background Information for Proposed Standards and Guidelines."*

[3] Center for a Competitive Waste Industry, Expanding Composting in the Residential Sector: Recycling's Next Frontier (upcoming report to EPA Region 9), which conducted a survey and found 123 programs that divert food scraps and soiled paper from landfills in North America, 68 in the U.S., and 55 in Canada.

its impact.[4] The design and effectiveness of these collection systems is left largely to the discretion of the landfill operator.

There are no explicit limits on emissions of methane or any of the other problem constituents in landfill gas.

These deficiencies exist primarily because landfills are non-point sources of air pollution. There is no stack or similar central collection point at which measurements can be taken and where emission limits might be imposed, nor is there any reliable means to estimate emissions.

These generalized and mostly ineffective rules apply to very large landfills, whether they generate electricity or just flare off the gas they are able to collect. They do nothing to prohibit or regulate the management changes that typically occur at LFGTE landfills. These changes are usually designed to increase and accelerate the production of methane in order to increase the volume and energy content of the gas, but they also increase methane releases into the atmosphere.

Landfill gas generated at smaller landfills is not regulated.

5. How is landfill gas controlled?

At landfills where gas is collected, the captured portion of the gas is then burned. The gas collection system consists of collection pipes within the waste pile and vacuum pumps to pull the gas out. Typically, a controlled flare or some other burner is used to combust the gases.

At the majority of landfills with LFGTE systems, internal combustion engines or turbines burn the gas to produce electricity. Alternatively, other energy recovery systems produce liquid biofuels or use the gas directly in nearby industrial boilers.

---

[4] **Error! Main Document Only.**The EPA rule covers landfills designed to hold greater than either 2.76 million tons or 3.3 million cubic yards of waste (or large enough to bury about 7 to 10 years of household and commercial discards from a city with about a half million people), *and also* generate more than an estimated 50 tons per year of volatile and hazardous gases, generally less than 1% of landfill gas volume. (**40 CFR 60.752**). That additional 50 ton requirement has been estimated to exempt from coverage 25%-45% of the landfills that otherwise would be covered by the rule. See, for example, **Don Augenstein, Landfill Operation for Carbon Sequestration and Maximum Methane Emission Control Controlled Landfilling Demonstration Cell Performance for Carbon Sequestration, Greenhouse Gas Emission Abatement And Landfill Methane Energy. Final Report 2001, at p. 10.**

It is worth noting that flares are typically more effective at oxidizing the methane and some other pollutants in the collected landfill gas than are the internal combustion engines usually used in almost all sites that generate electricity.

It is important to note that active collection systems usually are not installed until several years after waste disposal begins and are usually shut down not long after the landfill or cell closes. The LFGTE facilities usually will be shut down when gas volumes and heating values decline and the operator no longer considers energy recovery to be economically attractive. As a result, landfill gas is typically allowed to escape to the atmosphere without any attempt at collection both before and after the collection system is functional.

6. *How effective is landfill gas control?*

Even the best landfill gas collection systems are able to capture only a portion of the gas generated. While the amount of landfill gas that is captured can be measured, there is currently no way to measure directly the amount of gas generated within the accumulated waste or the amount that escapes uncontrolled to the environment.

Guesstimates of gas collection efficiency vary widely, usually from as low as 20% to as much as 75%, and sometimes even greater than 90%.

Assuming the best collection systems, only during the time that active collection is occurring, EPA estimates 75% collection efficiencies, and IPCC[5] notes studies predicting efficiencies as high as 90% and higher. When estimates consider the entire gas-producing life of the landfill -- including the time when most gas is generated, yet little or no gas is being collected, in addition to the times when typical collection systems are in operation -- then the IPCC reports that lower collection efficiencies -- as low as 20% -- are indicated.

If the estimator chooses to evaluate (as the EPA did) the results that might be expected from the best collection systems only during the time that active collection is occurring, higher

[5] Intergovernmental Panel on Climate Change

efficiencies are predicted. If the estimator evaluates results expected from average collection systems operating over the entire gas-producing life of the landfill (as IPCC referenced for the low end of their range), then predicted efficiencies are lower.

7. Why is landfill gas sometimes used to produce energy?

High levels of methane (which is the chief component of natural gas) makes the collected portion of the landfill gas potentially attractive as a source of energy and, for the landfill operators, as a source of revenue from the sale of energy to utilities and other customers.

In addition, some states have laws that classify electricity produced from landfill methane as renewable energy, satisfying renewable portfolio requirements. That, along with other subsidies and inducements, can increase the value of produced energy for the operator to such an extent that LFGTE becomes a significant profit center.

8. If some very large landfills install systems intended to capture and remove landfill gas, how can using that gas to produce energy result in increased GHG emissions?

As discussed in detail in the Task Force Report, if the only thing to change at the landfill was the replacement of a controlled flare with an energy-making device, there would be only small differences between flaring & LFGTE from a global climate change perspective. However, that substitution is rarely, if ever, the only change that occurs when landfills begin to produce energy.

Operators of landfills with energy devices almost always change operational practices in order to maximize the energy production value of the landfill gas. They usually attempt to "rehydrate" (i.e., increase the moisture content of) the accumulated waste and to reduce oxygen infiltration. Adding moisture and controlling oxygen infiltration tend to optimize methane production, as does delaying installation of the cover to let more rainfall infiltrate the wastes.

That makes the operation of the engines used to produce energy more efficient and more profitable, but it also increases the amount of methane that escapes from the landfill.

9. *Why shouldn't energy produced from landfill gas be treated favorably in laws and regulations intended to encourage more renewable energy production and reduced GHG emissions?*

In some states, energy produced from landfill gas qualifies as a renewable source or as an offset for other GHG emissions on the premise that this is "carbon free" energy that can reduce GHG emissions from fossil fuel sources. However, neither assumption is necessarily accurate.

First of all, the energy from landfill gas may compete with cleaner renewable energy sources, instead of with fossil fuels.

In addition, in most instances, especially electricity generation, recovery of energy from LFG results in greater methane emissions from the landfill than simple flaring and always increases emissions compared with not landfilling decomposable waste in the first place.

Hence, the net effect of such policies is very likely increased GHG emissions (and other emissions as well), contrary to the misguided conventional wisdom that LFGTE is an emissions reduction method.

10. *What does the Sierra Club recommend?*

The Sierra Club recommends

a. That waste management practices that result in the unnecessary generation of landfill gas, notably landfill disposal of decomposable organic wastes, be phased out as quickly as possible;
b. That landfill management practices that enhance landfill gas generation, such as rehydrating and delayed covering, be prohibited;
c. That no new landfill gas to energy facilities be constructed at landfill sites where the above practices continue; and
d. That legislation, regulation and other policy initiatives be avoided if they subsidize or otherwise encourage new landfill gas to energy projects where the above practices continue.
e. That current woefully inadequate landfill gas emissions rules be substantially strengthened.