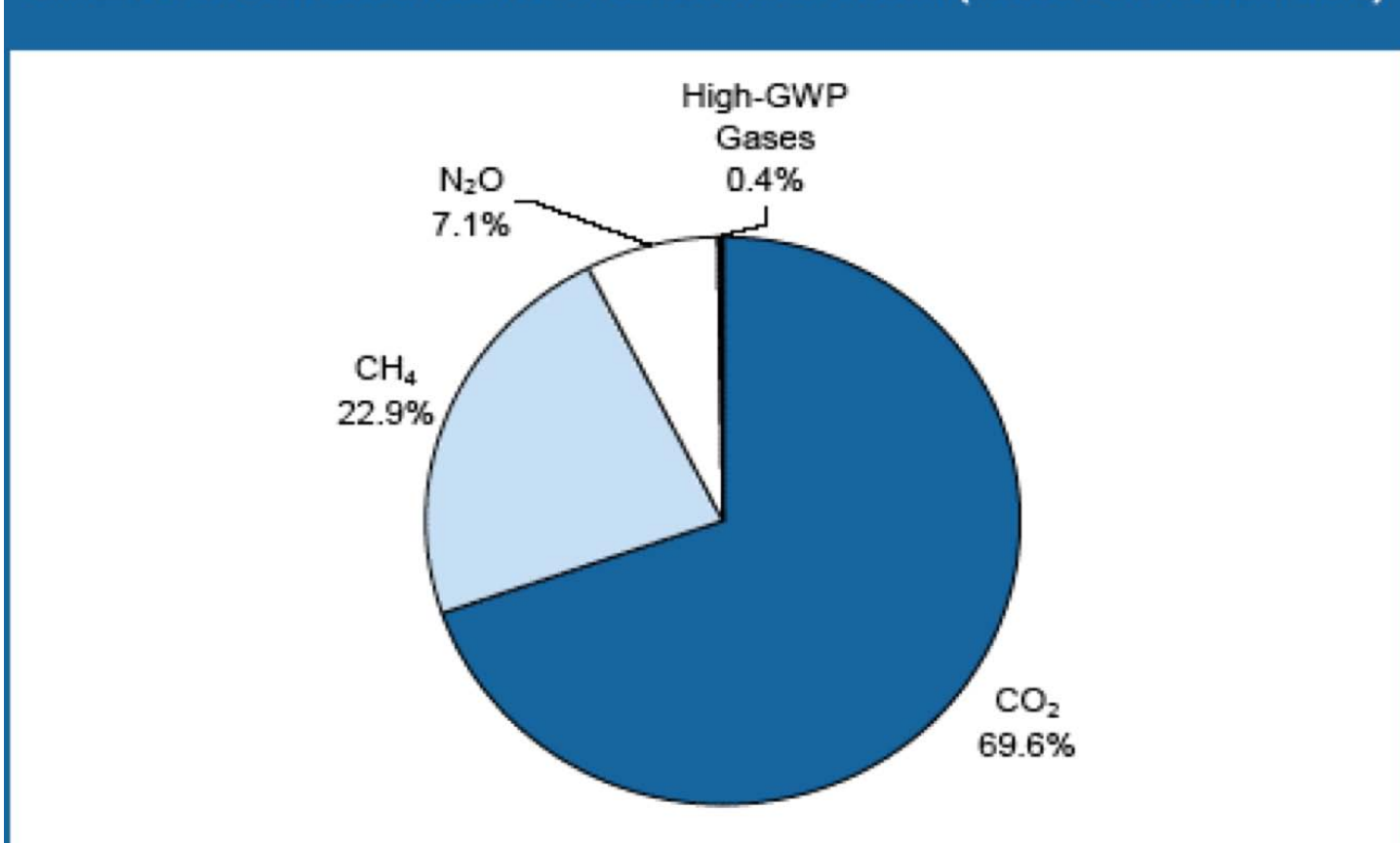


Energy Crisis Solved by Our “Gassy” Landfills

A Simple Introduction to Methane Gas

One may wonder as they pass a landfill, why there is a blue flame constantly burning day and night. This flame is powered by landfill gas, a by product of decomposing garbage. This gas consists of about 50 percent methane (CH₄), the primary component of natural gas, about 50 percent carbon dioxide (CO₂), and a small amount of non-methane organic compounds. As a greenhouse gas, methane is less abundant than carbon dioxide, but 21 times as harmful to the atmosphere. Municipal solid waste landfills are the largest source of human-related methane emissions in the United States, accounting for about 25 percent of these emissions in 2004. By allowing methane to escape from landfills, we are not only damaging the atmosphere but also wasting a potential energy source. Over the last three to four decades, technology has been developed to capture landfill gas and use the methane to generate electricity. The gas is never released to the atmosphere, and a new source of energy is made available for use. Palos Verdes landfill in southern California was the first to utilize a “gas-to-energy” system, and as of December 2007, there are 435 operational systems, and some 500 more potential candidates, in landfills across America.

Figure 1: Contribution of Anthropogenic Emissions of Greenhouse Gases to the Enhanced Greenhouse Effect from Preindustrial to Present (measured in watts/meter²)



Background on The Landfill Gas Project

In 1994 the EPA created the Landfill Methane Outreach Program (LMOP) to significantly reduce the methane emissions released from landfills. LMOP forms partnerships with communities, landfill owners, utilities, power marketers, states, project developers, tribes, and non-profit organizations to overcome obstacles to project development by helping assess the project feasibility, financing, and market the benefits of project development to the community. Landfill gas (LFG) energy is beneficial for many reasons:

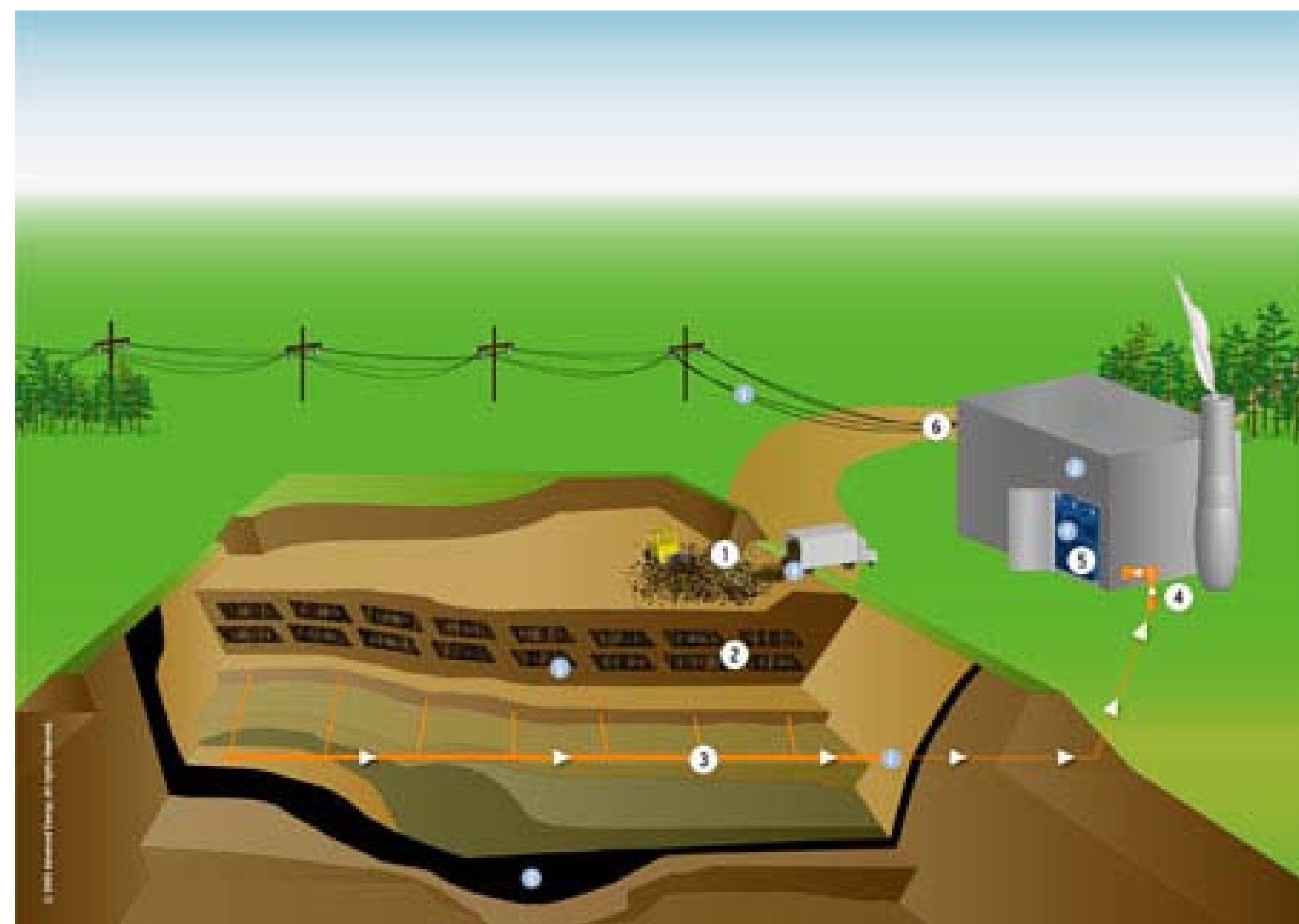
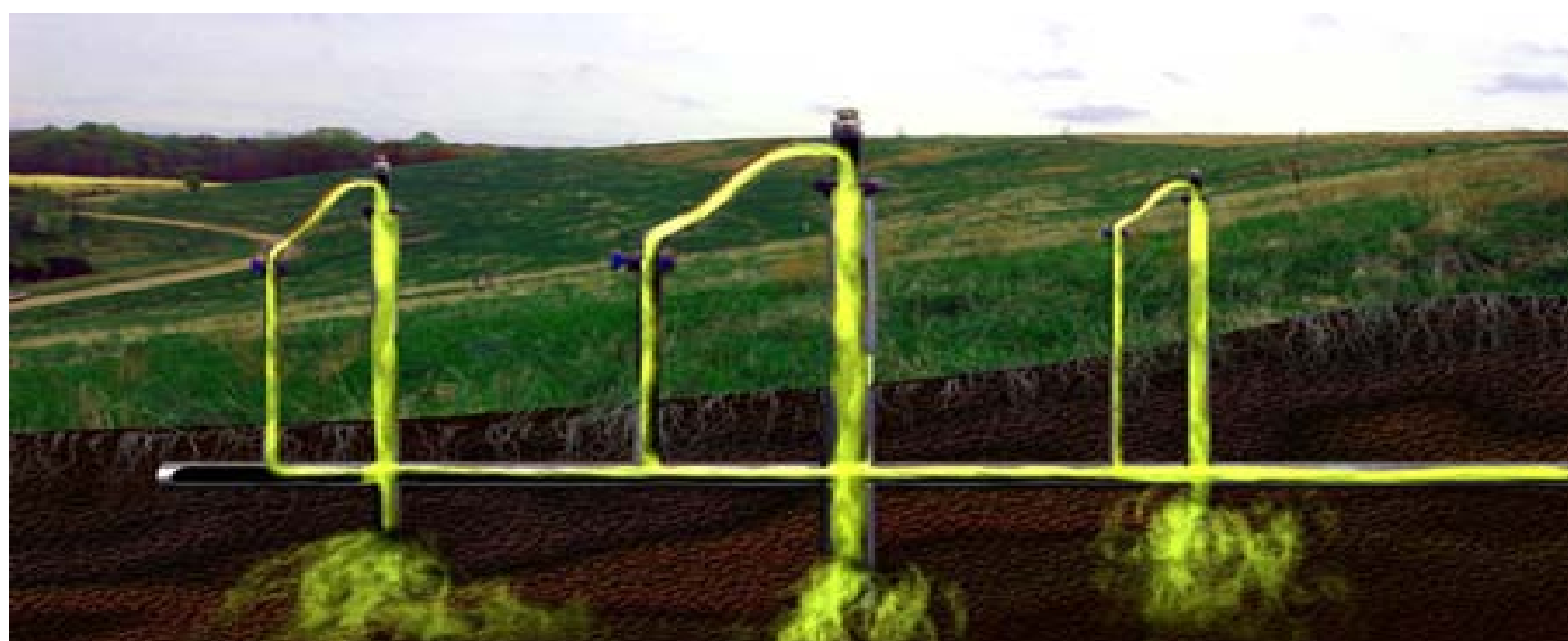
- Projects help destroy methane, a potent heat-trapping gas, and offset the use of non-renewable resources such as coal, natural gas, and oil.
- There are many cost-effective options for reducing methane emissions while generating energy.
- Projects help reduce local air pollution.
- Projects create jobs, revenues, and cost savings.

Landfill gas is extracted from landfills using a series of wells and a blower/flare (or vacuum) system. This system directs the collected gas to a central point where it can be processed and treated depending upon the ultimate use for the gas. From this point, the gas can be simply flared or used to generate electricity, replace fossil fuels in industrial and manufacturing operations, fuel greenhouse operations, or be upgraded to pipeline quality gas. One of the ways used for recovery of methane gas is through a polyethylene piping system that is installed as the landfill is created. Horizontal ditches are placed 100 feet apart, which are lined with fabric and bedded with 2 inch drain rock. The polyethylene is fused together and punctured in order to allow the permeation of gas. Polyethylene is specifically used because it is resistant to the chemicals found in landfills and will last longer than the life of the landfill. With every 20 feet of refuge, a new pipeline grid is fused together and laid out and another 20 feet of refuge is piled on top. The gas prefers the path of least resistance; thus, enters the pipe through the holes. The gas is then suctioned out and transported to generators to be converted into alternative energy.

The generation of electricity from LFG makes up about two-thirds of the currently operational projects in the U.S. Electricity for on-site use or sale to the grid can be generated using a variety of different technologies:

- Internal combustion engines
 - Turbines, and microturbines
- Technologies still under development are:
- Stirling engines (external combustion engine)
 - Organic Rankine Cycle engines
 - Fuel cells

The vast majority of projects use internal combustion (reciprocating) engines or turbines, with microturbine technology being used at smaller landfills and in niche applications.



How Power is Created from Landfill Waste

1. Garbage is collected, delivered to the landfill and compounded.
2. Decomposition of the garbage causes the release of gases.
3. Pipes underneath the landfill remove the gases (mostly methane).
4. Gases are pumped to an engine.
5. The engine powers a generator.
6. The generator creates electricity, which is then added to North Carolina's power supply.

The Uses of Converted Methane

The EPA has been involved in attempting to partner the world in an effort to reduce the amount of methane gas produce worldwide. The project is called the Methane to Market Partnership. So far the U.S., Australia, India, Italy, Japan, Mexico, the Ukraine, the United Kingdom, and most recently Canada, have become partners in the program. Each country tries to reduce its methane by recovering it.

Now that we have gone global with this project, what are the applications of our abundant renewable resource of methane gas?

If it is properly filtered it can have countless uses. Directly using LFG to offset the use of another fuel (natural gas, coal, fuel oil) is occurring in about one-third of the currently operational projects. This direct use of LFG can be in a boiler, dryer, kiln, greenhouse, or other thermal applications. It can also be used directly to evaporate leachate, which is another byproduct of landfills. Innovative direct uses include firing pottery and glass blowing kilns; powering and heating greenhouses and an ice rink; and heating water for an aquaculture (fish farming) operation. Current industries using LFG include auto manufacturing, chemical production, food processing, pharmaceutical, cement and brick manufacturing, wastewater treatment, consumer electronics and products, paper and steel production, and prisons and hospitals, just to name a few.

At least 424 operational projects in 42 states supplying were creating 10 billion kilowatt hours of electricity and 75 billion cubic feet of LFG to direct-use applications in 2006. The estimated annual environmental benefits are equivalent to planting 20,000,000 acres of forest, or preventing the use of approximately 170,000,000 barrels of oil, or removing emissions equivalent to approximately 14,000,000 motor vehicles. It is estimated that these facilities could power over 780,000 homes and heat nearly 518,000 homes annually.

The some 500 candidate landfills could generate a potential of 700 million cubic feet per day (~14,800 MMBtu/hr) OR electric potential of 1,370 MW (~11 million MWh/yr). If projects were developed at all these landfills an estimated annual environmental benefit would be equivalent to planting approximately 16 million acres of forest OR removing the emissions from approximately 11 million vehicles on the road. It is estimated that it would be equivalent to powering 870,000 homes OR heating 1.5 million homes annually.

In Summary

Methane recaptured from landfills is an important energy source that is not actively being converted into useful energy. Currently, there are numerous landfill candidates with collection systems already in use, that are not converting their methane to electrical energy needed to power several aspects of our daily lives. Not only would a useless garbage byproduct be converted into a valuable resource, but the environment also benefits holistically. As technology advances, the cost of establishing methane recapturing facilities will decrease significantly; thus, producing more facilities that will ultimately reduce the amount of environmentally harmful greenhouse gases worldwide.