Making More Compostable Trash Will Help Solve Global Energy Problems – Part 2 of 2

How Compostable Plastics can Assist Green Energy Initiatives

By Laura Mauney

From beginning to end, MHG's PHA compostable biopolymers are born from and returned to the biosphere.

Microorganisms both create and destroy MHG PHA, migrating along a sustainable, "closed loop" path with a positive environmental impact that goes far beyond plastic trash mitigation.

In 2014, the U.S. Food and Drug Administration (FDA) approved MHG PHA as safe for food contact (http://www.accessdata.fda.gov/scripts/fdcc/?set=FCN&sort=FCN_No&order=DESC&startrow=1&type=basic&search=meredian) and classified it to be, after disposal, "nonhazardous solid waste" (http://www.fda.gov/Food/IngredientsPackagingLabeling/EnvironmentalDecisions/ucm394989.htm).

The classification means that when MHG PHA biodegrades, it leaves no toxic trace and does not require special handling. In fact, the simple solids and gasses that result from PHA breakdown – just as with all other biological waste – can be repurposed in several eco-friendly ways:

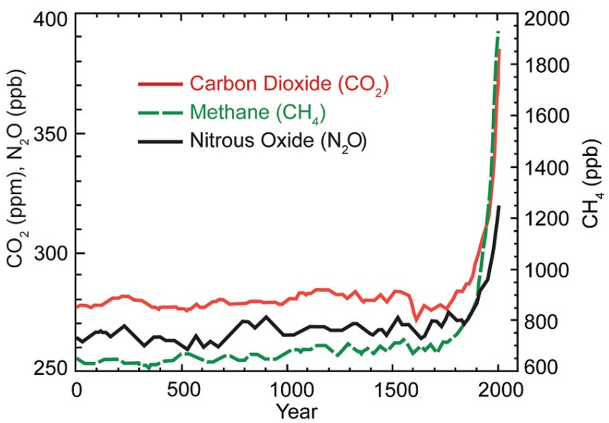
- Aerobic and anaerobic (http://www.mhgbio.com/replacing-plastic-waste-stream-aerobic-anaerobic-decomposition-work/) composting produces either nutrient rich humus or digestate. The substances are non-toxic and can be repurposed in gardens and farm fields as non-toxic mulch, fertilizer, natural pesticide, and even as a resource for additional bioplastic production.
- Anaerobic biodegradation produces methane (CH_4), a biogas that can be repurposed to fuel vehicles, fire cook stoves, heat homes, and generate electricity.

Methanogens and Methanotrophs

Did you know that the decomposition of bio-matter produces most of the natural gas mined out of the ground?

In a process called "methanogenesis," anaerobic "methanogens" in soil, wetlands, and oceans have created methane natural gas for millennia. 90% of methane lies buried in Earth's crust, with the majority trapped in the permafrost of the Polar Regions. Methane is also stored in water, and in rock. Much of the natural gas "fracked" from shale is methane, in fact.

As many know, methane is considered to be a greenhouse gas, capable of trapping heat inside Earth's atmosphere the way glass traps heat inside a greenhouse.



(http://www.epa.gov/climatechange/science/causes.html)

For this reason, atmospheric methane buildup caused by human (anthropogenic) activity during the industrial age has become a concern for scientists, environmental advocates, governments, and waste managers.

The increase in methane production is directly related to population growth and industrialization.

Poorly maintained cross-country natural gas pipelines, for example, expanded in response to growing energy demands, leak methane into the atmosphere.

Rice plants channel methane naturally out of water into the air, but as global populations increase, so do rice paddies, thus more methane is released by rice plants.

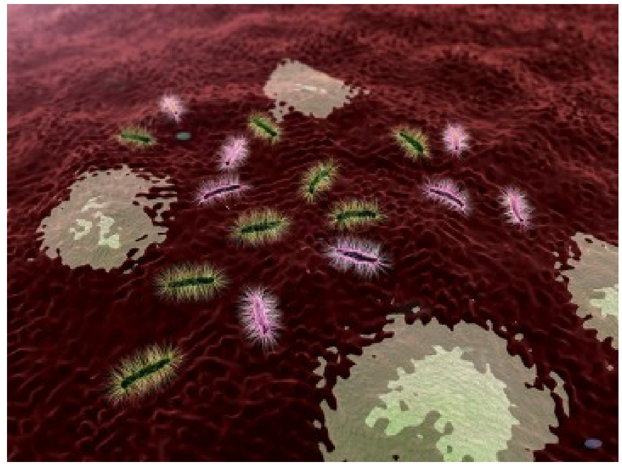
Other sources of increased anthropogenic methane are livestock yards and landfills, the expansion of which also hold a direct relationship to population growth.

Although methane buildup contributes to global warming, the natural chemical processes that keep the world turning include very efficient methods of methane oxidation:

- Heat and light from the sun oxidizes methane that reaches the stratosphere.
- Aerobic bacteria in soils, wetlands, salt marshes, oceans, and landfills oxidize methane as it escapes Earth's surface.

In his article for MSW Management Magazine (Municipal Solid Waste Management) called "Methane Oxidation: a Comprehensive Study," (http://www.mswmanagement.com/MSW/Articles/Methane_Oxidation_a_Comprehensive_Study_14706.aspx) Florida State University Scientist Dr. Jeff Chanton, of the Department of Earth, Ocean, and Atmospheric Science, discusses how landfill methane oxidation occurs:

> "Bacteria that consume methane live within the soil over a landfill… Landfill soil cover methane oxidation is carried out by a kind of bacteria called a methanotroph. The methano part of the term denotes methane, and troph means food. The bacteria essentially eat the methane, combining it with oxygen to produce carbon dioxide, water, and, of course, more bacteria. They function only in the upper layer of the landfill cover where methane and oxygen overlap…" – Dr. Jeff Chanton



> (http://www.mswmanagement.com/MSW/Articles/Methane_Oxidation_a_Comprehensive_Study_14706.aspx)

Landfill Biogas Facilities and Renewable Energy Production

Repurposing methane biogas from the anaerobic digestion of food scraps, urban and agricultural vegetation, and livestock manure provides an ecologically efficient way to eliminate waste while generating energy in a safe, localized fashion.

Recycled biological waste is already in play as a sustainable and renewable resource for energy production in Europe, the United States, and Asia.

Biogas facilities are used on farms, at landfills, and at food processing plants to produce electrical and thermal energy, piped natural gas, low emissions vehicle fuels, and even hydrogen fuel cells.

Two types of biogas capture are possible:

1. Pipeline networks laid within landfills capture landfill gas (LFG), which typically consists of about 50% methane and 50% carbon dioxide. In this scenario, the gasses are either flared off or trapped and transferred to biogas facilities.
2. Biodigesters compost bio-waste to produce biogas that can be up to 90% methane. Many farms and waste management facilities are now set up to compost organic waste via biodigesters. Decomposition occurs inside sealed containers designed to prevent methane escape. The high temperatures required break down decomposing matter into gas and nutrients, and purify it by killing pathogenic organisms.

In the United States, the USDA, EPA, and DOE are collaborating to offer incentives to farms, businesses, and institutions to facilitate expansion of biodigesters. In August, 2014, the agencies jointly published a Biogas Roadmap (http://www.epa.gov/climatechange/Downloads/Biogas-Roadmap.pdf) that provides information about the program.

The authors of the Biogas Roadmap state that:

> "Currently in the United States… [Biogas] Projects range from small scale farm or community driven initiatives to multimillion-dollar private investments. Nearly 11,000 additional projects like these could be developed with the sources of biogas currently available in the United States."

As of this writing, according to the EPA, about 600 U.S. landfills actively collect biogas for use to make electricity or upgraded natural gas (cleaned landfill gas to pipe into homes and public buildings).

State	LFG Electricity Producing Facilities	LFG Cleaned Natural Gas Production Facilities	Total
CA	84	2	86
NY	44	2	46
PA	43	11	54
MI	53	4	57
WI	41	2	43

Of the top five states, California operates the highest number of LFG energy production facilities. More notably, four states in the Great Lakes region, where winters are coldest, operate the highest number per capita (http://www.epa.gov/outreach/lmop/projects-candidates/index.html).

Biogas facilities also supply energy directly to many private businesses and manufacturers, including Cargill, Disney World, General Motors, Johnson & Johnson, Mars Snackfoods, NASA, Ocean Spray, Tropicana, and Waste Management, Inc.

The Environmental Impact and Risks of Using Biogas for Energy Production

Methane oxidation breaks up the CH_4 molecule into one part carbon dioxide (CO_2), and two parts water (H_2O).

The environmental gains of using biogas for energy include reducing methane release into the atmosphere and offsetting the CO_2 impact of more damaging fossil fuels, like petroleum and coal.

According to the U.S. Energy Information Administration (EIA) (http://www.eia.gov/tools/faqs/faq.cfm?id=73&t=11), methane, when burned, converts to about 50% of the CO_2 produced by the burning of coal, and 72% of what is produced by the burning of home heating oil.

Although CO_2 is also considered to be a greenhouse gas, it is naturally converted by vegetation into pure oxygen and carbon.

Methane biogas is odorless and non-toxic. However, if it over-dominates oxygen in an enclosed environment, such as a house sealed up for the winter, it can cause asphyxiation. Methane that builds up in an enclosed space can also explode. Explosions in coal mines caused by methane buildup are common, for example.

The risk of asphyxiation and explosion are two reasons natural gas providers add a stinky smell to methane natural gas before piping it into homes and public buildings. Just as with natural gas pipelines, gas leaks in homes should be sealed promptly.

The Environmental Impact of PHA Bioplastic on Methane Mitigation

The ability to repurpose organic waste into energy is dependent on the ease with which such waste can be tapped.

From Canola to compost: MHG's closed-loop, renewable, sustainable, and 100% biodegradable PHA plastic positions the company as one of the leading biotech companies worldwide.

Though repurposing waste produced by livestock and agriculture, or during food processing, into biogas is fairly straightforward, repurposing organic landfill waste is complicated by the proliferation of petro-plastics in packaging, storage and disposal.

Manufacturing packaging, storage, and disposable products out of PHA bioplastic will, by contrast, create a more efficient scenario. Biopolymer textiles, single-use food service items, carryout bags, and any organic matter contained in bioplastic can be dumped straight into a biogas digester.

The EPA estimates that over 12% of landfill trash consists of petro-plastic. Replacing most or all of that 12% with compostable bioplastic will make landfill decomposition more efficient, help reduce methane emissions from landfills, and make more biofuel available for renewable energy production via biogas facilities.

Please read Part 1 of this series: Making More Compostable Trash Will Solve Mountains of Landfill Problems (http://www.mhgbio.com/making-trash-compostable-will-solve-mountains-landfill-problems/).

Does Your Company Manufacture Plastic Products?

*Please visit **MHGBio.com** (http://www.mhgbio.com/), to find out more about how biodegradable plastics from MHG can be adapted to a wide range of product manufacturing and packaging requirements.*

***Learn more** (http://www.mhgbio.com/mhg-sustainability/mhg-certifications/) about how MHG's biodegradable PHA plastic is **Certified** (http://www.mhgbio.com/mhg-sustainability/mhg-certifications/) for all six levels of biodegradability and compostability.*

To learn more about Biogas Facility Incentives, check out the Biogas Roadmap PDF:

U.S. Biogas Roadmap (http://www.epa.gov/climatechange/Downloads/Biogas-Roadmap.pdf).

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