From: jose carmona
<Jlcarmona_9@hotmail.com>
Sent: Tuesday, March 22, 2022 6:23 PM
To: Comentarios <comentarios@jrsp.pr.gov>
Subject: COMENTARIOS.

22 de marzo de 2022.

Trujillo alto, PR.

El Negociado de Energía de Puerto Rico.

Distinguidos Comisionados.

Saludos Cordiales:

Por medio de la participación ciudadana es posible aportar e insertarse en la discusión de los temas de generación de energía eléctrica. Existen programas federales que fomentan el uso del gas metano de los vertederos y las plantas de tratamiento de aguas usadas. Desde la pasada administración del expresidente Barack Obama, existía una orden ejecutiva presidencial que promovía el uso de fuentes de energía renovables para reducir o eliminar la dependencia del petróleo. Actualmente, existe el plan climático del presidente Joe Biden establecido luego de la pasada cumbre climática.

“El plan fue anunciado en el segundo y último día de la participación del presidente en la cumbre climática de Naciones Unidas en Glasgow, Escocia. Biden prometió trabajar con la Unión Europea y otras naciones para reducir las emisiones globales de metano en un 30% para 2030. “

“El metano es “uno de los gases de efecto invernadero más potentes que existen”, declaró Biden, y agregó que las nuevas reglas de Estados Unidos y el compromiso mundial “marcarán una gran diferencia”, no sólo en la lucha contra el cambio climático, sino para mejorar la salud, reducir el asma y otros problemas respiratorios.” (El Vocero).

La recomendación en de contactar las agencias federales para comenzar la adaptación de las calderas de las plantas de generación LUMA/AEE, a gas natural (metano) según la información provista en pdf. Estaríamos cumpliendo con el plan climático del presidente Joe Biden y al mismo tiempo, se eliminan las emisiones de CO_2 que provienen de la quema de petróleo, y el ajuste por combustible. Impactando la factura de la luz a nivel residencial, comercial e industrial, ocasiona un efecto positivo en la economía y el desarrollo económico.

Les comparto más información por e-mail separados por el tamaño de los documentos.

José Luis Carmona Villanueva.

LANDFILL METHANE OUTREACH PROGRAM

December 2009

Adapting Boilers to Utilize Landfill Gas: An Environmentally and Economically Beneficial Opportunity

Mallinckrodt, Inc. Raleigh, NC

Utilization of landfill gas (LFG) in place of a conventional fuel such as natural gas, fuel oil, or coal in boilers is an established practice with a track record of more than 25 years of success. In the United States, more than 60 organizations have switched to the use of LFG in their industrial, commercial, or institutional boilers, with more than 70 boilers operating with LFG, either alone or co-fired with other fuels. Boilers firing LFG range in size from 2 to more than 150 million British Thermal Units per hour (MMBtu/hr). Companies using LFG are saving money while protecting the environment. General Motors fires LFG in boilers at four of their manufacturing and assembly plants and reports that they have realized energy cost savings of about $500,000 per year at each of the four plants.

This fact sheet discusses the technical and engineering issues associated with using LFG in boilers designed to burn other fuels. The equipment and operational changes are relatively simple and use proven technologies, and dozens of firms can engineer and implement a conversion project.

Comparison of Landfill Gas and Natural Gas

Like natural gas, LFG's heating value is derived largely from methane, but unlike natural gas, LFG is comprised about 50 percent by volume of non-combustible gas, mostly carbon dioxide (CO_2). LFG is classified as a "medium Btu gas" with a heating value of about 500 Btu per cubic foot, about half that of natural gas. Therefore, the volume of LFG that must be handled by the fuel train and burner is twice that of natural gas. This means that modifications to the fuel train and burner are usually required to accommodate the higher overall gas flowrate for an equivalent natural gas heating value. The increased gas flow, however, does not have an appreciable effect on the design and operation of boiler components downstream of the burner. The added volume of non-combustible (inert) gas in LFG is equivalent to the inert gas entering a boiler when about six percent of the flue gas is recirculated to the boiler. Flue Gas Recirculation (FGR) is a widely applied technique for reducing nitrogen oxide (NO_x) emissions from natural gas-fired industrial and commercial boilers, and boilers can typically operate at recirculation rates of 20-25 percent without adversely affecting boiler heat transfer and efficiency. This comparison illustrates that the increased flow of LFG as compared to natural gas will not adversely affect boiler operation, although the burner, controls, and fuel train will require some modifications.

Burner, Control, and Fuel Train Modifications

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The equipment for retrofitting a boiler to burn LFG is commercially available, proven, and not overly complex. The decisions that must be made during engineering and design are, however, site-specific and may be somewhat involved. For example, some installations have retained the original burner but modified it for LFG (e.g., by installing separate LFG fuel train and gas spuds) while maintaining the existing natural gas fuel train and gas ring to permit LFG/natural gas co-firing. Other installations have replaced the entire burner, controls, and fuel train with a dual-fuel burner and dual-fuel trains specifically designed to handle medium Btu gas. In general, the decision to furnish all new equipment is made based on the owner's preference or because the existing burner and controls are nearing the end of their useful lives. Additional analysis may be required to determine the amount of LFG compression that is provided versus the modifications needed for the burner and gas train.

Because LFG is typically a wet gas often containing trace corrosive compounds, the fuel train and possibly some burner "internals" should be replaced with corrosion-resistant materials. Stainless steel has typically been the material selected.

The controls associated with fuel flow and combustion air flow need to be engineered to cope with the variable heat content of LFG. The complexity of the burner management system will depend upon whether the boiler is to be co-fired with natural gas or oil and whether the boiler is to be co-fired at all times or if there will be times when it will be fired with LFG only. Today's modern controls, fast-responding oxygen analyzers, and responsive flame sensors make it possible to fire LFG with the same level of safety that is characteristic of current natural gas systems.

Boiler Deposits and Boiler Cleaning

In recent years, a family of organo-silicon compounds, known as siloxanes, commonly found in detergents, shampoos, deodorants, and cosmetics, have gradually found their way into the solid waste stream and into LFG. Their quantity in LFG is small and varies with the age of the landfilled material. When LFG is burned, the siloxanes are oxidized to silicon oxide—the primary chemical compound in sand. After firing boilers for an extended period with LFG, operators report a thin coating of white powder, described as similar to talcum powder, on some of the boiler tubes and substantial accumulations of the white powder on portions of the boiler floor. Where the material collects and how much of it accumulates is likely to be a function of the velocity patterns in the boiler and the siloxane concentrations in the LFG. One firetube boiler operator reported no deposits at all, probably due to the high flue gas velocity that is characteristic of the firetube boiler configuration.

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Operators' experiences to date indicate that annual cleaning is sufficient to avoid operational problems related to silicon oxide accumulation. More frequent cleaning may be necessary as future installations encounter higher LFG siloxane concentrations or when low gas velocities exist in the boiler, either because of boiler design or continuous operation well below full capacity. In all cases, the silicon oxide powder is easily removed from surfaces by brushing or water washing.

Other Considerations

In designing and assessing the economic feasibility of projects utilizing LFG in boilers, several factors in addition to the boiler retrofit must be considered. For example, the quantity of LFG available must be considered and compared to the facility's steam needs and boiler capacities. Factors such as pipeline right-of-way issues and the distance between the landfill and the boiler will influence costs and the price at which LFG can be delivered and sold to the boiler owner. Because LFG is generally saturated with moisture, gas treatment is needed before the LFG is introduced into the pipeline and subsequently the boiler, to avoid condensation and corrosion. Additionally, condensate knock-outs along the pipeline are necessary as condensation in the main pipeline can cause blockages. Fortunately, the level of LFG clean-up required for boiler use is minimal, with only large particle and moisture removal needed. Other compounds in LFG, such as siloxanes, do not damage boilers or impair their function. Generally, LFG clean-up and compression systems are located at the landfill and are often installed by a developer rather than by the boiler owner. LFG compression provided at the landfill must be sufficient to compensate for pipeline pressure losses and provide sufficient pressure at the boiler to permit proper function of the fuel controls and burner. Proper attention to burner selection or burner modification for low-pressure operation can minimize the LFG compression costs.

Is My Boiler a Candidate for Landfill Gas Retrofit?

Virtually any commercial or industrial boiler can be retrofitted to fire LFG, either alone or co-fired with natural gas or fuel oil. The firing profile is a primary consideration, regardless of the boiler type, since the fuel cost savings associated with LFG must offset the costs of the LFG recovery (if a LFG collection system is not yet in place), the gas clean-up equipment, and the pipeline. Operation at substantial load on a 24-hour/7 day-per-week basis or something approaching continual operation is generally important to the economic viability of a potential project.

Both the smaller, lower-pressure firetube package boilers and larger, higher-pressure watertube package boilers are already in operation with LFG. Older field-erected brick set boilers have also been retrofitted for LFG fuel. Many major boiler manufacturers, such as Cleaver Brooks, Babcock &

Wilcox, Nebraska, and ABCO, are represented in the population of boilers that have been converted for LFG service. Similarly, leading burner manufacturers (e.g., Todd, North American, and Coen) have provided specially designed LFG burners or have experience modifying standard natural gas burners for LFG service.

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Examples of Successful Boiler LFG Energy Projects

NASA Goddard Space Flight Center. In early 2003, NASA's Goddard Space Flight Center in Greenbelt, Maryland, began firing LFG in two Nebraska watertube boilers, each capable of producing 40,000 pounds per hour of steam. The gas is piped approximately five miles from the Sandy Hill Landfill to the boiler house at Goddard. NASA modified the burners and controls to co-fire LFG, natural gas, and oil; however, LFG provides the total firing requirement for approximately nine months of the year. Later, a third boiler also began utilizing LFG. NASA estimates an annual savings of more than $350,000. Current NASA plans call for LFG use to continue for at least 10 years, with a possible extension to 20 years. LMOP Partners Toro Energy and CPL Systems developed and implemented the project.

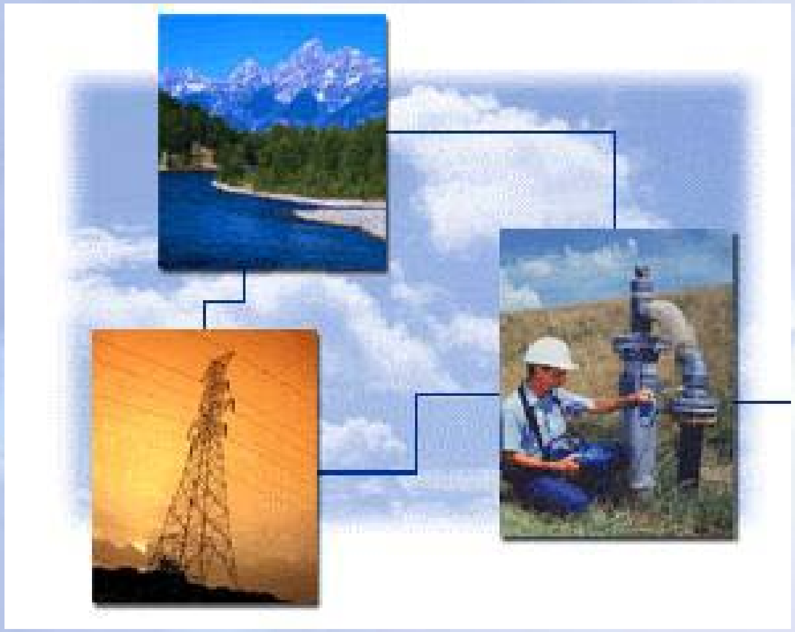
Cone Mills White Oak Plant. The LFG retrofit project at textile manufacturer Cone Mills' plant in Greensboro, North Carolina involved a very old (circa 1927) field-erected brick set boiler. In this instance, the developers chose to install two new, multi-fuel burners supplied by Coen Company, Inc. Full operation began in early 1997, with a steaming capacity of 30,000 pounds per hour from the LFG fuel. Additional steam is provided as needed by co-firing with natural gas or fuel oil. The gas is supplied to the Cone Mills plant via a three-mile pipeline originating at Greensboro's White Street Landfill. The project is a partnership between the City of Greensboro, Duke Solutions (now part of Ameresco, Inc.), and Cone Mills.

Information about additional projects can be found at the project profiles section of the LMOP website at www.epa.gov/lmop/landfill-gas-energy-project-data-and-landfill-technical-data. The photographs in this document depict a boiler retrofitted to burn LFG, courtesy of Mallinckrodt, Inc. in Raleigh, North Carolina.

Where Can I Obtain Further Information?

LMOP is a voluntary program that helps landfill owners, project developers, and communities develop LFG energy projects. LMOP offers technical support that includes finding a landfill, estimating gas generation, analyzing project economics, and providing other tools to help landfill owners and operators realize their facility's LFG use potential. For more information, visit the LMOP website at www.epa.gov/lmop.

An Overview of Landfill Gas Energy in the United States



U.S. Environmental Protection Agency
Landfill Methane Outreach Program (LMOP)

LANDFILL METHANE OUTREACH PROGRAM

Why EPA is Concerned about Landfill Gas

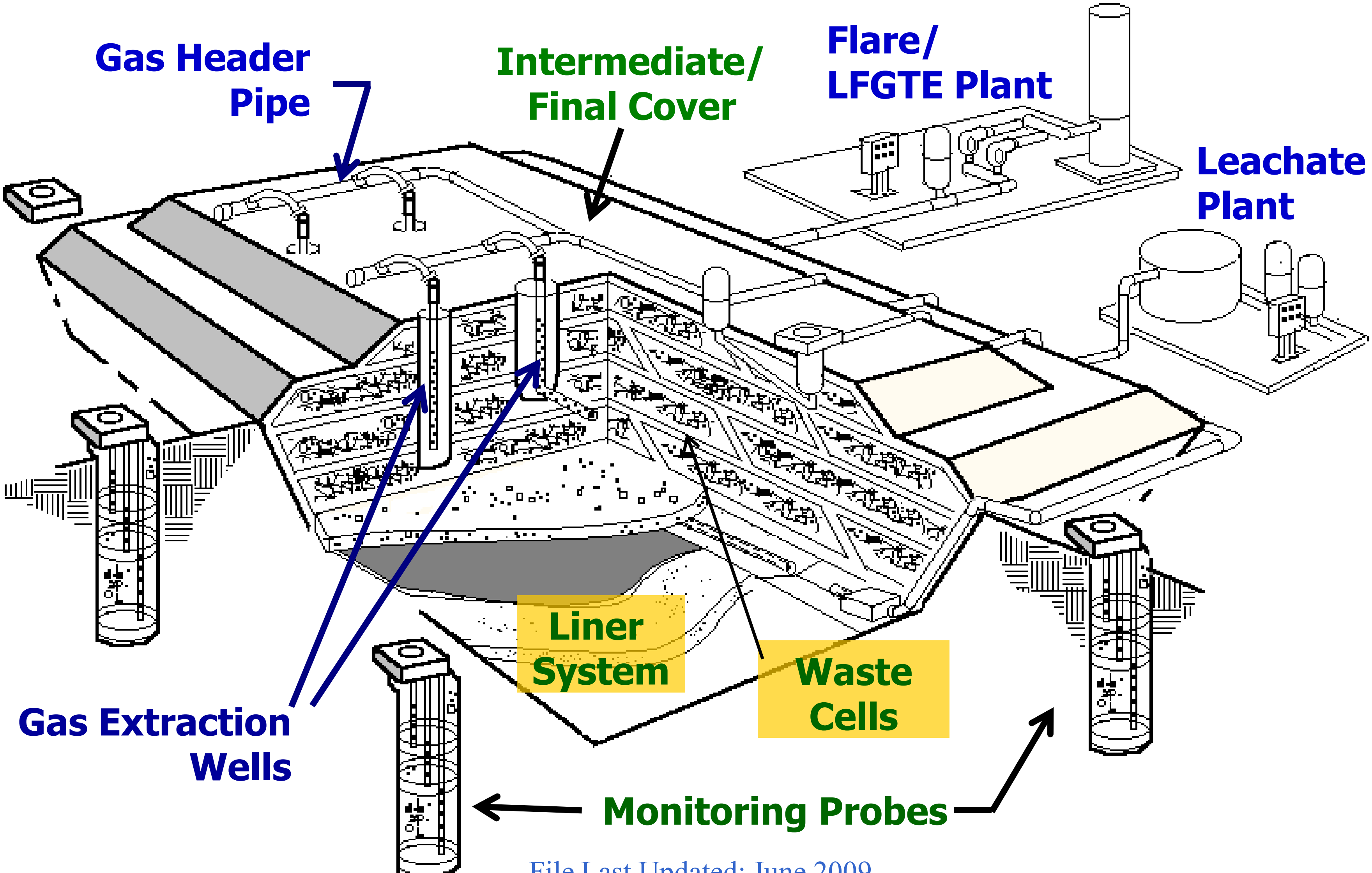
- Why is methane a greenhouse gas?
  - Methane absorbs terrestrial infrared radiation (heat) that would otherwise escape to space (GHG characteristic)
- Methane as GHG is over 20x more potent by weight than CO_2
- Methane is more abundant in the atmosphere now than anytime in the past 400,000 years and 150% higher than in the year 1750
- Landfills were the second largest human-made source of methane in the United States in 2007, accounting for 22.7% generated

EPA's Landfill Methane Outreach Program

- Established in 1994
- Voluntary program that creates alliances among states, energy users/providers, the landfill gas industry, and communities

Mission: To reduce methane emissions by lowering barriers and promoting the development of cost-effective and environmentally beneficial landfill gas energy (LFGE) projects.

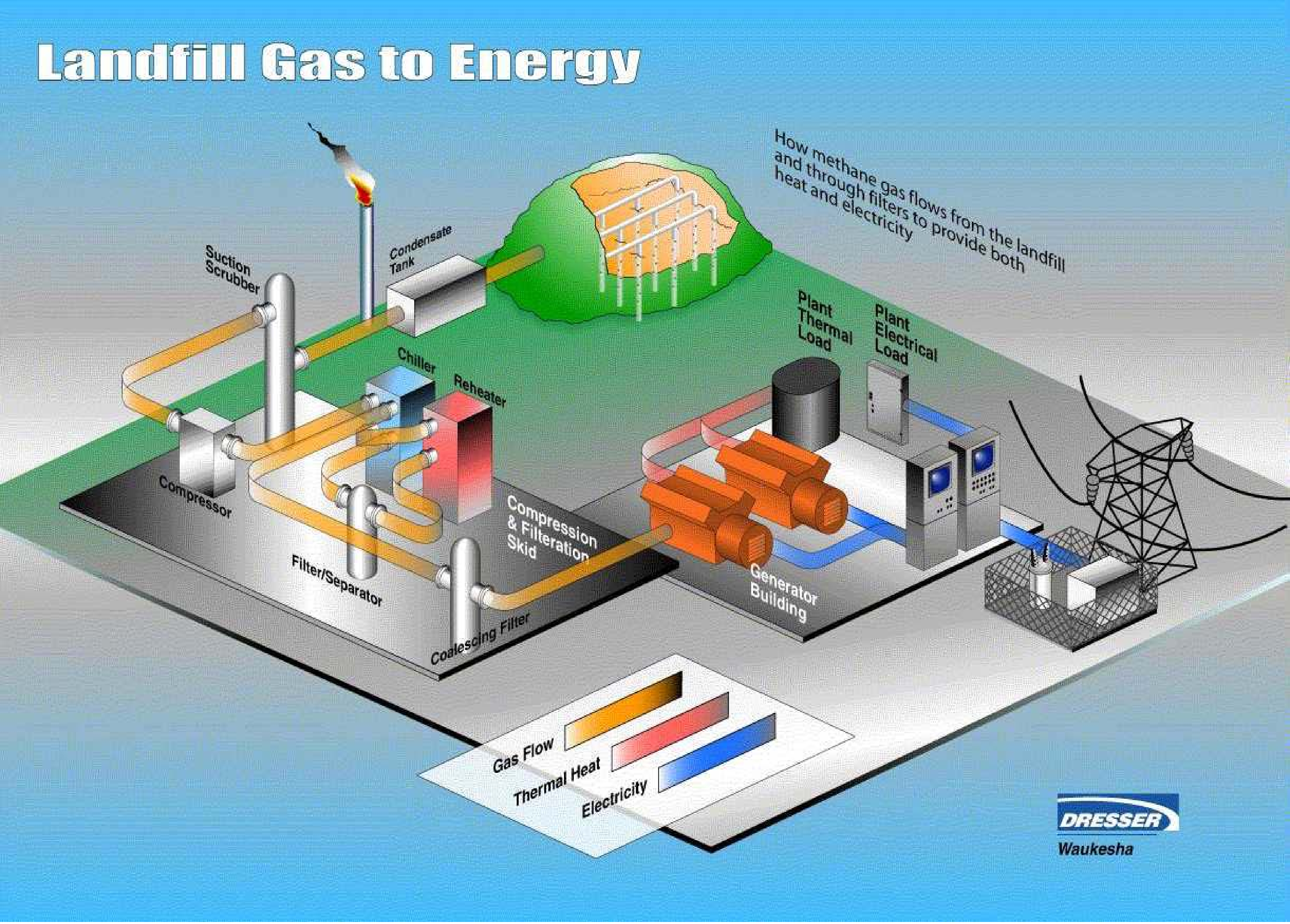
Modern Sanitary Landfill



LANDFILL METHANE
OUTREACH PROGRAM

Landfill Gas 101

- Landfill gas (LFG) is a by-product of the decomposition of municipal solid waste (MSW):
  - ~50% methane (CH_4)
  - ~50% carbon dioxide (CO_2)
  - <1% non-methane organic compounds (NMOCs)
- For every 1 million tons of MSW:
  - ~0.8 megawatts (MW) of electricity
  - ~432,000 cubic feet per day of LFG
- If uncontrolled, LFG contributes to smog and global warming, and may cause health and safety concerns



File Last Updated: June 2009

LANDFILL METHANE OUTREACH PROGRAM

Regulations that Affect LFGE

- LFGE projects may be affected by a variety of federal, state, and local air quality regulations. Applicable federal Clean Air Act regulations include:
  - New Source Performance Standards (NSPS) / Emission Guidelines (EG)
  - Title V
  - Maximum Achievable Control Technology (MACT)
  - New Source Review (NSR)
  - Prevention of Significant Deterioration (PSD)



Landfill Gas and Green Power
A Winning Combination

- Dual benefit → destroys methane and other organic compounds in LFG
- Offsets use of nonrenewable resources (coal, oil, gas) reducing emissions of SO_2, NO_X, PM, CO_2
  - LFG is a recognized renewable energy resource (Green-e, EPA Green Power Partnership, 35 states, NRDC)
  - LFG is generated 24/7 and projects have online reliability over 90%
  - LFG can act as a long-term price and volatility hedge against fossil fuels

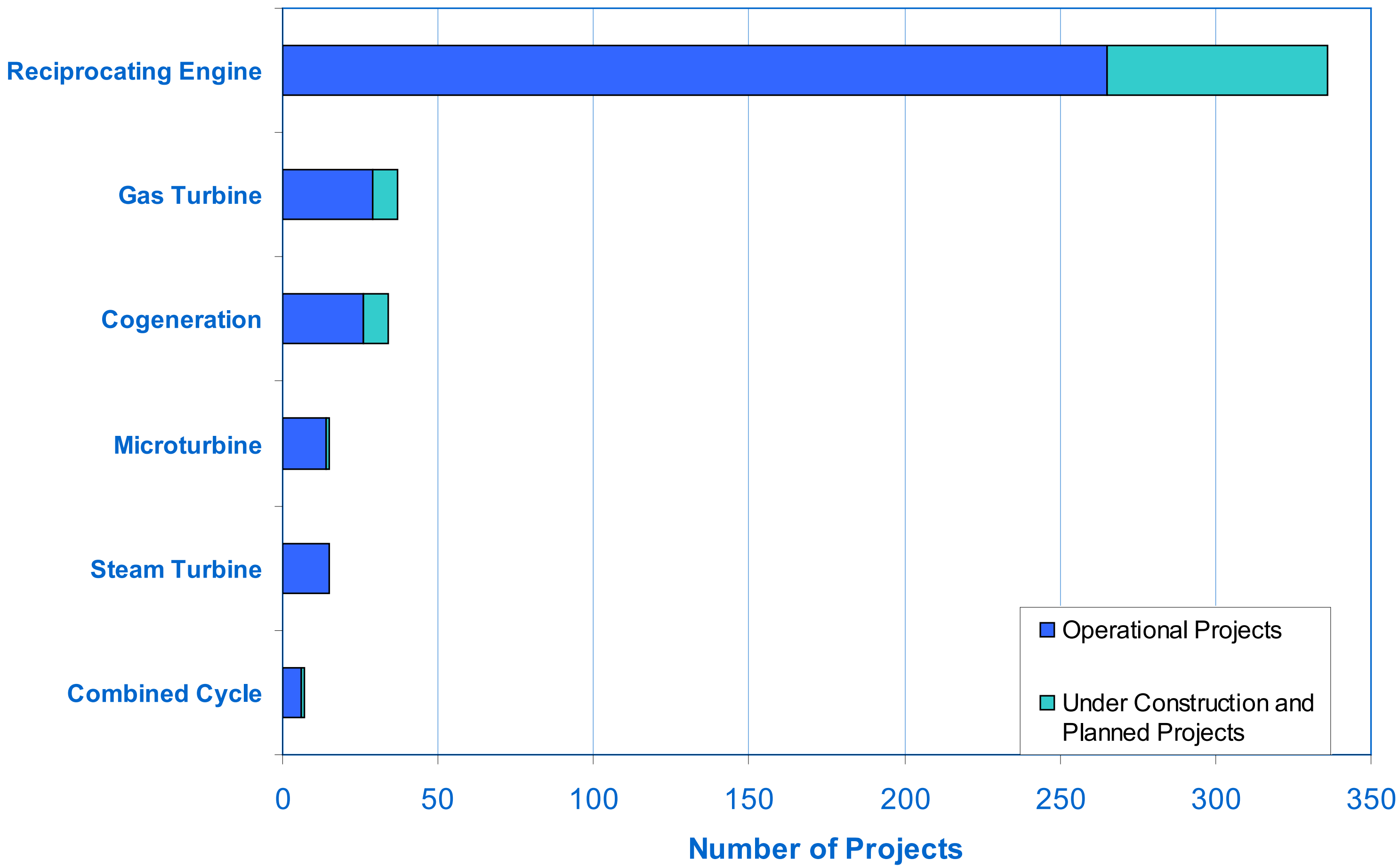
Diversity of Project Types
Electricity Generation

Internal Combustion Engine (range from 100 kW to 3 MW)

Gas Turbine (range from 800 kW to 10.5 MW)

Microturbine (range from 30 kW to 250 kW)

Technology Trends
Electricity Projects




Typical Electric Project Components & Costs

3 MW, engine, 15-yr project:

- Total capital cost = ~$5.15 million
  - Gas compression & treatment, engine, & generator = ~$4.89 million
  - Interconnect equipment = ~$255,000*
- Annual operation & maintenance cost = ~$526,000/year

*interconnect costs can vary widely

LANDFILL METHANE OUTREACH PROGRAM

Diversity of Project Types
Direct Use of LFG

- Direct-use projects are growing!
  - Boiler applications – replace natural gas, coal, fuel oil
  - Combined heat & power (CHP)
  - Direct thermal (dryers, kilns)
  - Natural gas pipeline injection
    - Medium & high Btu
  - Greenhouse
  - Leachate evaporation
  - Vehicle fuel (LNG, CNG)
  - Artist studio
  - Hydroponics
  - Aquaculture (fish farming)

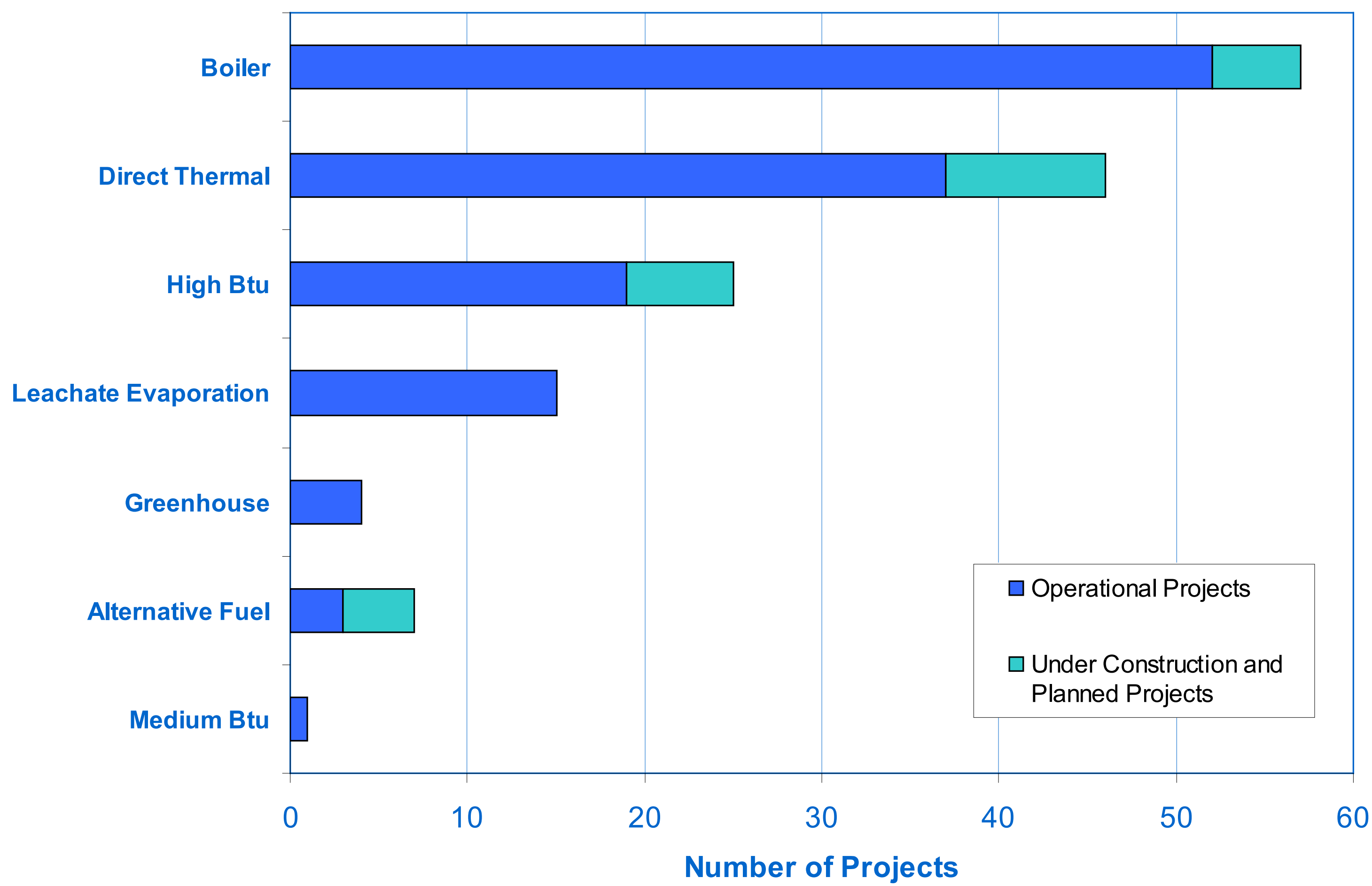
Greenhouse Burlington, NJ

Pottery Studio Sugar Grove, NC

LFG-fired Boiler Ft. Wayne, IN

File Last Updated: June 2009

Technology Trends
Direct-Use Projects



Typical Direct-Use Project Components & Costs

800 scfm, 5-mi pipeline, 15-yr project:

- Total capital cost = ~$2.5 million
  - Gas compression & treatment = ~$768,000
  - Pipeline = ~$330,000/mile
  - (Plus end-of-pipe combustion equipment retrofits, if needed)
- Annual operation & maintenance cost = ~$129,000/year

LANDFILL METHANE OUTREACH PROGRAM

LFG Has Helped Produce…

- Aluminum
- Alternative fuels (biodiesel, CNG, ethanol, and LNG)
- Aquaculture (e.g., tilapia)
- Arts & crafts (blacksmithing, ceramics, glass)
- Biosolids (drying)
- Bricks, cement, concrete
- Carpet
- Cars and trucks
- Chemicals
- Chocolate
- Consumer goods and containers
- Denim
- Electronics
- Fiberglass, nylon, and paper
- Furthering space exploration
- Garden plants
- Green power
- Ice cream, milk, and tea
- Infrared heat
- Juice (apple, cranberry, orange)
- Pet food
- Pharmaceuticals
- Pierogies and snack food
- Soy-based products
- Steel
- Tomatoes (hydroponic)
- **Taxpayer savings and increased sustainability!**

Look Who's Using Landfill Gas!

FUJIFILM

HILL AIR FORCE BASE, Utah
OGDEN AIR LOGISTICS CENTER

DART

NASA

GEO SPECIALTY CHEMICALS

Ford

Kimberly-Clark

GE

GM

SUNOCO

NUCOR

Rolls-Royce

New Holland Concrete
A Better Building Partner

Honeywell

Frito Lay

The Solae Company

BORAL

Anheuser Busch Companies

H.R. Ewell Inc.

LAFARGE

CYTEC

International

CONE corporate denim finishing jacquards

Stouffer's

AJINOMOTO

MARS snackfood US

SC Johnson A Family Company

DuPont The miracles of science

AFP advanced food products llc

Cargill

BMW The Ultimate Driving Machine

POET Energy inspired.

MALLINCKRODT

Tropicana

Dow

InterfaceFLOR

Tyson

Lucent Technologies Bell Labs Innovations

Jenkins Brick Company

L&S Sweeteners

CNH

Emerging Technologies: LFG for Vehicle Fuel

- Orange Co, CA – 1st commercial LFG-to-LNG facility online Jan. '07 – used in county waste trucks (Frank R. Bowerman LF)
- Franklin Co, OH is creating CNG from LFG for use in county fleet
- POET plant in Sioux Falls, SD uses LFG from local landfill to create ethanol
- Waste Management in CA produces 13,000 gal LNG per day for garbage trucks (Altamont LF)

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Jobs and Revenue Creation

- A typical 3 MW LFG electricity project is estimated to have the following economic & job creation benefits during the construction year:
  - Add more than $1.5 million in new project expenditures for the purchase of generators, and gas compression, treatment skid, and auxiliary equipment
  - Directly create at least 5 jobs for the construction and installation of the equipment
  - Ripple effect: increase the state-wide economic output by $4.3 million & employ 20-26 people throughout the state & local economies

LANDFILL METHANE OUTREACH PROGRAM

Jobs and Revenue Creation (cont.)

- A typical 1,040 scfm LFG direct-use project is estimated to have the following benefits (direct, indirect, and induced) during the construction year:

	5-mile pipeline	10-mile pipeline
New project expenditures	$1.1 million +	$2.2 million +
Direct installation jobs	At least 7	At least 14
Ripple effect – economic output & employed people	$2.9 million & 17-22 people	$5.3 million & 32 to 41 people

LANDFILL METHANE OUTREACH PROGRAM

Potential LFG Revenue

Potential Revenue Source	Electric	Direct-Use
Sale of electricity (6 – 11 cents/kWh)	X	
Sale of Renewable Energy Certificates (RECs)	X	
Premium pricing for renewables through RPS/RPG or voluntary green power markets	X	
Tax credits or incentives	X	
Clean Renewable Energy Bonds (CREBs)	X	
Sale of LFG (~$8.00 per MMBtu)		X
Greenhouse gas reduction credits	X	X
Energy cost savings	X	X

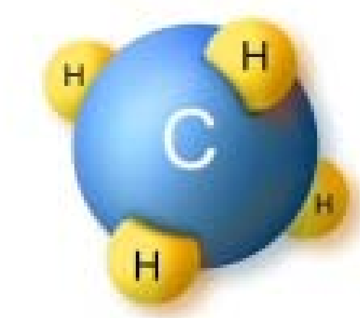
LFG and RECs

- Renewable Energy Certificates (RECs)
  - Equivalent to 1 MWh of renewable energy generation
  - From $5 to $50 per MWh (0.5 to 5 cents per kWh)
- Companies looking to reduce their environmental footprint purchase RECs from utilities using LFG (2002-03)
  - Alcoa – 100% of electricity at 4 corporate locations from LFG
  - Delphi Corporation – 100% of electricity at largest corporate office from LFG
  - DuPont – 170 million kWh/yr from biomass & LFG
  - Staples – 46 million kWh/yr of RECs, 90% from biomass & LFG

LANDFILL METHANE OUTREACH PROGRAM

Public and Private Entities Moving to Reduce GHG Emissions

- Voluntary Markets
  - Currently where most GHG activity occurs
  - Examples - Chicago Climate Exchange, Blue Source
- Compliance Markets
  - Rapidly evolving, will become the dominant market
  - Led by Massachusetts and California and regional efforts



LANDFILL METHANE OUTREACH PROGRAM

American Recovery and Reinvestment Act of 2009

- $71 billion for Clean Energy - $50 billion increase over FY 2008 spending
- State and Local Governments
  - $3.2 billion for Energy Efficiency and Conservation Block Grant Programs
  - $3.1 billion distributed under the State Energy Program
  - Talk to your State energy office

LANDFILL METHANE OUTREACH PROGRAM

American Recovery and Reinvestment Act of 2009 *(cont.)*

- Clean Renewable Energy Bonds (CREBs)
  - In lieu of interest, bond holders receive federal tax credits
  - $2.4 billion made available for FY 2009
  - In 2008, IRS granted issuance authorization to 45 entities for LFGE projects
- Section 45 Production Tax Credit (PTC)
  - Electricity generation – 1.1 cent/kWh
  - Placed in service by 12/31/13
  - 10-year window for credits
  - Short-term option to select a one time 30% investment tax credit (Section 48) or convert into a 30% cash grant


Other Financial Incentives

- Federal Renewable Energy Production Incentive (REPI)
  - Local/state government or non-profit electric co-op facilities
  - Online by 10/1/16
  - Payment for first 10 years of operation
- Many State grants, tax exemptions, and other funding mechanisms
  - LMOP funding guide: www.epa.gov/lmop/publications-tools/funding-guide/index.html
    - updated quarterly

LANDFILL METHANE OUTREACH PROGRAM

State of the National LFG Industry *(December 2009)*

- At least 510 operational projects in 44 states supplying:
  - 12 billion kilowatt-hours of electricity and 100 billion cubic feet of LFG to direct-use applications annually
- Estimated ‘09 **Annual** Environmental Benefits
  - Carbon sequestered annually by **~19,700,000 acres of pine or fir forests**, or
  - CO_2 emissions from **~215,000,000 barrels of oil consumed**, or
  - Annual greenhouse gas emissions from **~17,700,000 passenger vehicles**
- Estimated **Annual** Energy Benefit
  - Powering more than **925,000 homes** and heating nearly **735,000 homes**

LANDFILL METHANE OUTREACH PROGRAM

CHP and Direct-Use Case Study

BMW Manufacturing Greer, SC

LMOP 2003 *Project of the Year*

- 9.5-mile pipeline from Palmetto Landfill to BMW
- 2003 – 4 KG2 gas turbines retrofitted to burn LFG
  - 4.8 MW of electricity generated and 72 million Btu/hr of heat recovered
- 2006 – Converted paint shop to utilize LFG in oven burners & for indirect heating
- LFG accounts for nearly 70% of BMW’s energy needs
- To date, LFG has saved BMW an annual average of $5 million in energy costs
- 2009/2010 – 2 new gas turbines will replace 4 older ones & generate 11 MW

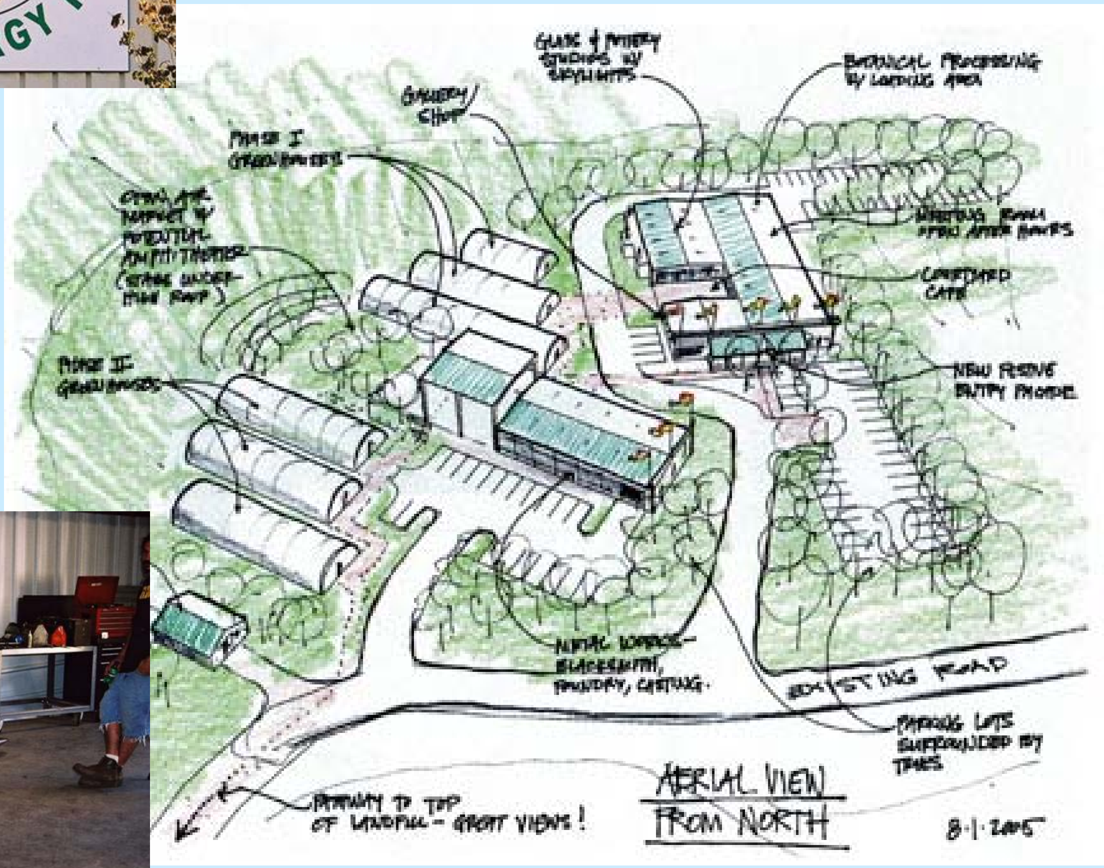
LMOP 2006
Energy End User Partner of the Year

Direct-Use Case Study

Jackson County Green Energy Park

Sylva, NC

LMOP 2006 *Project of the Year*



Enoree Landfill, Greer, SC

LANDFILL METHANE OUTREACH PROGRAM

- Selling: electricity (to Duke Energy), RECs (to Duke Energy), and carbon credits (through Sterling Planet)
- Carbon credits played a defining role in project - verified by Voluntary Carbon Standard
- Using Section 45 tax credits
- County benefit: $300K/yr

COUNTY OF GREENVILLE, S.C. 1786

CAT Financial

GC ENVIRONMENTAL, INC.

Greenville Gas Producers, LLC

Blanchard POWER SYSTEMS CAT

Golder Associates

- Generated & sold 90,000 tonnes of Verified Emission Reductions in first 5 months
- Expect to generate 120,000+ tonnes in 2009

Duke Energy

ENERDYNE

ADVANCE ONE DEVELOPMENT, LLC

File Last Updated: June 2009

Enoree Landfill, Greer, SC
(cont.)

- (2) Caterpillar G3520 engines generate 3.2 MW - 95% + online time at full capacity
- Built power line to the utility, could not sell to local coop

LMOP 2008 Project of the Year

- Connected to 25 leachate cleanouts in addition to drilling 51 gas wells
- Advanced gas treatment system for siloxanes, water, and many non-methane hydrocarbons

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High Btu Case Study

Veolia ES Greentree LF Kersey, PA

- Largest designed high Btu LFGE project in U.S. – can process 15.12 mmscfd LFG
- Cleaning: membrane technology, pressure swing absorption, carbon pretreatment, & H_2S removal
- 7-mile pipeline to combined cycle equipment

- Volume of LFG flared reduced by >90%
- Expect ~2 billion cf/yr product quality gas (<1% CO_2)
- Electricity
- RECs

LMOP 2007 Project of the Year

LANDFILL METHANE OUTREACH PROGRAM

Many Untapped LFG Resources

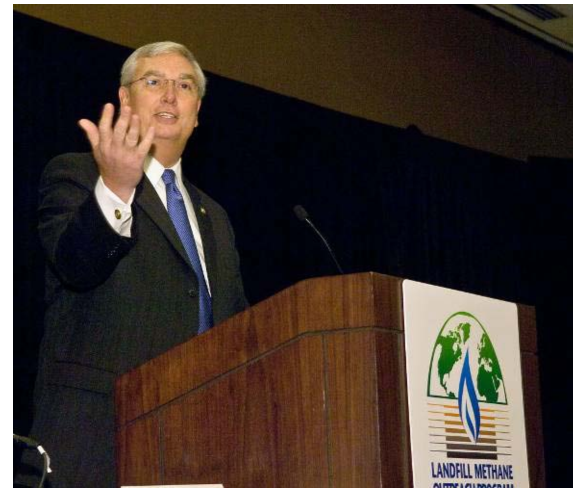
- Currently ~530 candidate landfills with a total gas generation potential of 230 billion cubic feet per year (~13,000 MMBtu/hr) OR electric potential of 1,200 MW (~10 million MWh/yr)
- If projects were developed at all these landfills, estimated
  - **Annual** Environmental Benefit =

    Carbon sequestered annually by ~10.9 million acres of pine or fir forests OR annual greenhouse gas emissions from ~9.7 million passenger vehicles, AND
  - **Annual** Energy Benefit =

    Powering 700,000 homes OR heating 1.4 million homes per year

LMOP Tools and Services

- Network of 800+ Partners (and growing)
- Newsletter and listserv
- Direct project assistance
- Technical and outreach publications
- Project and candidate landfill database
- Web site (epa.gov/lmop)
- Support for ribbon cuttings/ other PR
- Presentations at conferences
- State training workshops
- *LMOP 14th Annual Conference, Project Expo & Partner Awards – January 2011*



EPA Administrator
Stephen L. Johnson

Keynote Speaker
11th Annual LMOP Conference
Washington, DC

January 9, 2008

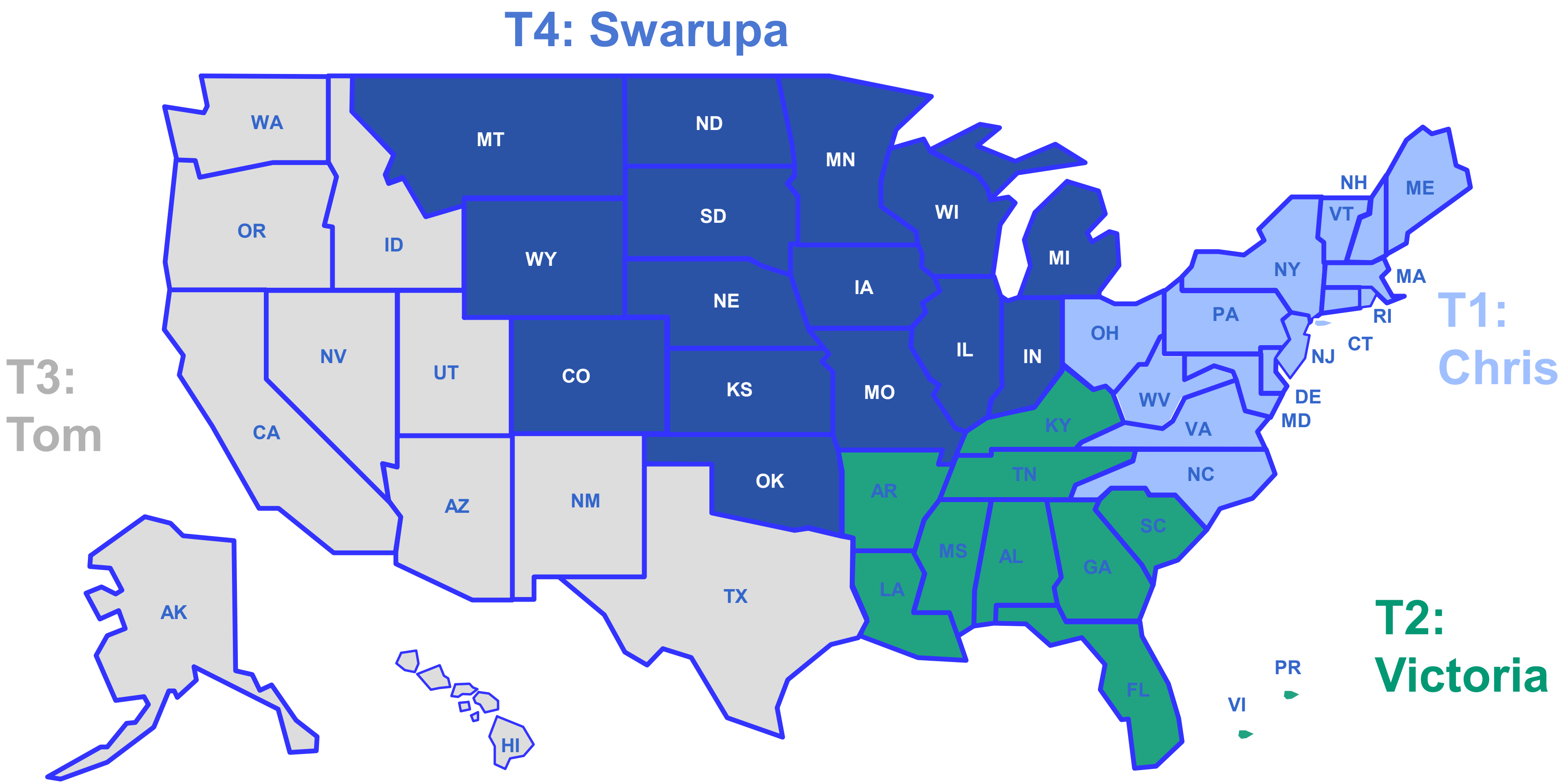
LANDFILL METHANE OUTREACH PROGRAM

How Can We Work Together? Direct Project Assistance

- Analyze landfill resource – gas modeling
- Identify potential matches – *LMOP Locator*
- Assess landfill and end user facilities
- Look at project possibilities
  - Direct-use (boiler, heating, cooling, direct thermal)
  - Combined Heat & Power (engine, turbine, microturbine)
  - Electric (engine, turbine, microturbine)
  - Alternative Fuels (medium or high Btu, LNG, CNG)
- Initial feasibility analyses – *LFGcost*

For More Information

www.epa.gov/lmop



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FEMP

Federal Energy Management Program

Biomass and Alternative Methane Fuels (BAMF) Super ESPC Program

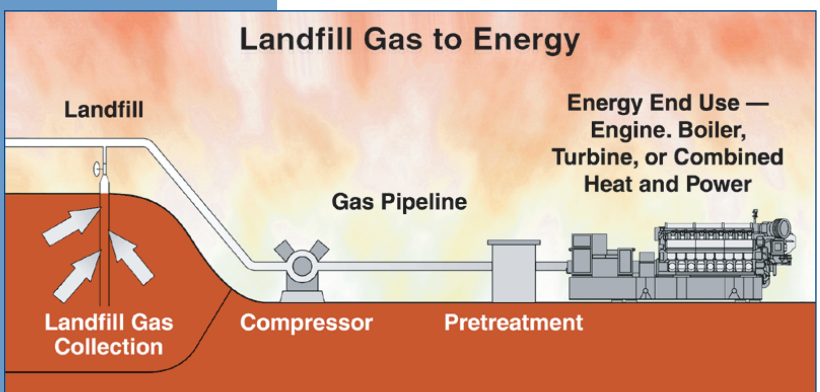
Fact Sheet

Leading by example, saving energy and taxpayer dollars in federal facilities

Landfill Gas to Energy for Federal Facilities

Industry Snapshot

Landfill gas (LFG) was first collected and used as a fuel in the United States in the late 1970s, and the technology to convert landfill gas to energy has developed steadily since then. This method of producing renewable energy is now regarded as one of the most mature and successful in the field of green power.



The U.S. Environmental Protection Agency (EPA) estimates that LFG is collected from more than 340 landfills in the United States and put to beneficial use. More than 1160 MW of electricity is produced from more than 230 LFG-to-energy projects now in operation. Additionally, more than 120 LFG projects are delivering useful thermal energy, either directly or as a byproduct of electricity generation. EPA estimates that another 600 landfills are good candidates for economical LFG-to-energy projects.

Applications

In a typical BAMF Super ESPC LFG-to-energy project, a pipeline is built from the landfill to the federal facility and end-use equipment is installed or reconfigured to use the resource.

A wide range of systems, including internal combustion engines, diesel generators, micro-turbines, and other technologies can use LFG to produce electricity; and most boilers can be reconfigured to burn LFG to produce hot water or steam.

LFG usually consists of about 50 percent methane and 50 percent carbon dioxide and can generally be used to supplement or replace natural gas. For some applications, the LFG must be conditioned first to increase its Btu content or filter out impurities.

Potential for Federal LFG-to-Energy Projects

Although piping distance in most projects is less than 10 miles, piping LFG up to 20 miles can be economically feasible, depending on gas recovery at the landfill and energy load at the end-use equipment. A FEMP assessment

The BAMF Super ESPC

Federal agencies can use energy savings performance contracts (ESPCs) to finance their energy projects, allowing them to reduce their energy use and costs without depending on Congressional appropriations to fund the improvements. Using FEMP's Super ESPCs, agencies can partner with prequalified, competitively selected energy services companies (ESCOs) and use an expedited contracting process to implement their projects quickly. Federal facilities worldwide can use the Technology-Specific BAMF Super ESPC, which offers financing and private-sector expertise specifically geared to using renewable BAMF resources.

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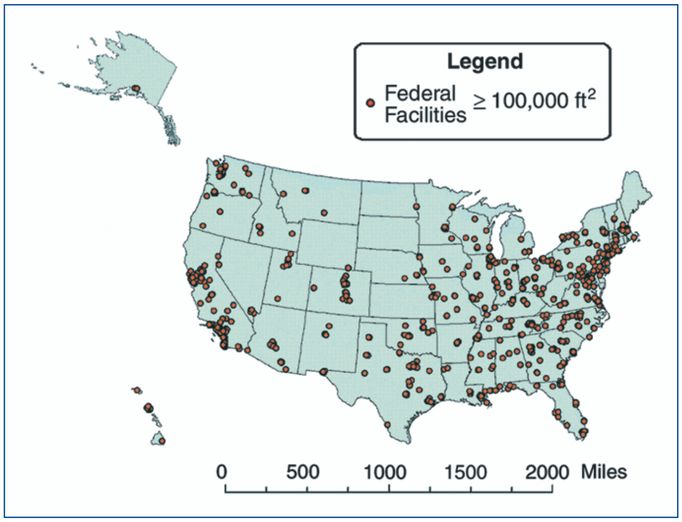
of BAMF resources identified significant potential for federal LFG-to-energy projects, based on the proximity of landfills to large federal facilities (over 100,000 ft^2).

- More than 1200 large federal facilities are within 15 miles of at least one candidate landfill.



Federal facilities within 15 miles of a candidate landfill.

- Nearly 500 of these facilities are within 5 miles of a candidate landfill—well within the limits for economic feasibility.

Benefits of LFG for Federal Facilities

- Energy cost savings
- Security from power grid interruptions
- Lowest cost system for both accommodating a steady base load and providing backup generation capacity
- Progress toward federal goals for use of renewable energy
- Hedge against fluctuations in fuel and power costs
- Significant environmental benefit from reduced greenhouse gas emissions

Project Examples — LFG-to-Energy

NASA Goddard Space Flight Center

LFG is fueling boilers at the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (GSFC) in Maryland. In fact, NASA is making history as the first federal agency to burn LFG on federal property. The gas is piped about 5 miles to GSFC from the Prince George's County Sandy Hill Landfill. Two of the five boilers at GSFC were modified to burn LFG and use natural gas and fuel oil as backup.

NASA expects to save taxpayers an estimated \$3.5 million in fuel costs over the next 10 years while increasing energy security by relying on a locally available renewable fuel source. In addition, this LFG project will reduce greenhouse gas emissions by more than 1.6 million metric tons of CO_2 equivalents over 10 years. These greenhouse gas benefits are roughly equivalent to preventing the emissions of more than 35,000 cars during every year of the project's lifetime.

Lucent Technologies

Lucent Technologies estimates it saves \$100,000 per year on fuel bills by using LFG instead of fossil fuel to fire the boiler system at its Columbus, Ohio, facility. Lucent entered into a 20-year agreement in 1992 with SBM Energy to purchase LFG produced by the Bedford Landfill about 3 miles from its site. The landfill contains about 2.5 million tons of waste.

Lucent uses LFG to fuel boilers that generate steam for space heating and hot water. A backup system allows the boilers to supplement the LFG with natural gas if necessary. SBM agreed to sell LFG to Lucent for at least 10 percent less than the market price of natural gas. Sometimes the savings reach as much as 20 percent. SBM bears all the capital costs

Pipes collect methane from inside the Sandy Hill Landfill to be piped to the Goddard Space Flight Center.

of the project, including installation and operation of the wells, construction of the pipeline from the landfill to the Lucent site, gas filtering and conditioning, and modifications to Lucent's boiler system.

After 13 years, the amount of gas the landfill is producing is beginning to decline slightly. It is expected to produce enough gas to recover profitably for about 5 more years. The project reduces greenhouse gas emissions by the equivalent of about 162,000 tons of carbon per year—roughly the amount that would be absorbed by 49,000 acres of trees or produced by 23,000 automobiles. In 1994, EPA presented Lucent with an award to recognize it as being the first industrial site to use LFG as a fuel.

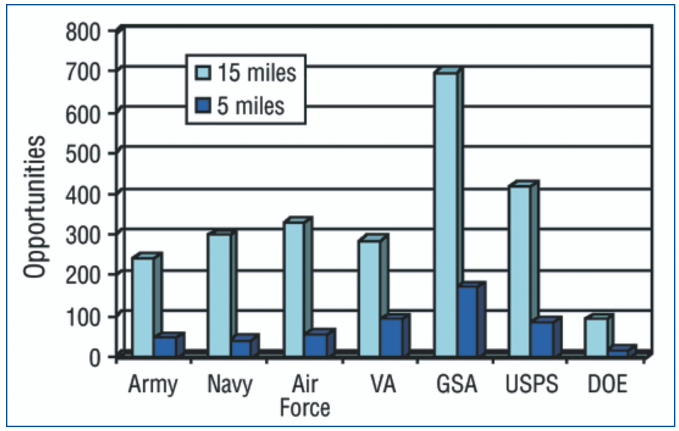
General Motors

General Motors is using LFG to displace coal and natural gas at three of its assembly plants and has made a commitment to buy at least 8 million kWh per year of electricity generated using LFG.

This powerhouse boiler burns landfill gas.

At GM's truck assembly plant in Fort Wayne, Indiana, one of three powerhouse boilers that supplies the plant was converted to use LFG delivered by pipeline from a landfill 8 miles away. The LFG supplies 16 percent of the energy used by the plant. GM estimates that using LFG will save as much as $500,000 annually compared with using natural gas. Since the LFG price is fixed, using it avoids fluctuations in market prices for fossil fuels.

The Orion plant near Detroit has used LFG from two nearby landfills since 1998 to displace more than half of



Federal agencies with the greatest potential LFG project opportunities.

the coal once burned in its powerhouse. The 4-million-ft^2 plant is located between the Eagle Valley Landfill, operated by Waste Management, Inc., and the Oakland Heights Landfill, operated by Allied Waste Systems. Methane from the landfills is used to fire the boilers that generate steam and provide utility service to the main assembly plant.

Before the switch to LFG, the powerhouse burned almost 60,000 tons of coal annually.

The switch to LFG has cut the amount of sulfur dioxide released into the air by 40 percent and nitrogen oxides by 46 percent. Some coal still is used during the winter months, but the boiler system runs exclusively on LFG during the rest of the year.

In January 2000, the implementation of LFG at the Orion assembly facility was named 1999 Project of the Year by the EPA Landfill Methane Outreach Program.

Rules of Thumb

- Landfills begin producing methane as soon as 6 months after they begin operation.
- The typical lifetime of an LFG-to-energy project is 10–20 years.
- One million tons of municipal solid waste can yield about 300 standard cubic feet per minute (scfm) of recoverable LFG—enough to deliver about 800 kW.
- An LFG project that uses 300 scfm yields the same reduction in greenhouse gases as removing an estimated 6100 cars from the road or planting about 8300 acres of forest.

For More Information

To find out more about using the BAMF Super ESPC to implement an LFG-to-energy project at your facility, please contact one of the following BAMF Super ESPC Program team members:

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