



The Solutions Network

Rochester, New York

# Opportunities for LFG Energy



Chris Voell

Environmental Protection Agency

Landfill Methane Outreach

Program



## Why does EPA care?

---

- ❖ Methane is a potent heat-trapping gas.
- ❖ Landfills are the largest human-made source of methane in the US.
- ❖ There are many cost effective options for reducing methane emissions while generating energy.
- ❖ Projects reduce local air pollution.
- ❖ Projects create jobs, revenues, and cost savings.



## EPA LMOP

- ❖ 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.*



# Landfill Gas 101

---

- ❖ Landfill gas (LFG) is a by-product of the decomposition of municipal solid waste (MSW).
- ❖ LFG:
  - ~ 50% methane ( $\text{CH}_4$ ).
  - ~ 50% carbon dioxide ( $\text{CO}_2$ ).
  - <1% non-methane organic compounds (NMOCs).
- ❖ For every 1 million tons of MSW:
  - ~ 1.0 MW of electricity
  - ~ 550,000 cubic feet per day of landfill gas.
- ❖ If uncontrolled, LFG contributes to smog and global warming, and may cause health and safety concerns.



# LFG Energy Emission Reduction Benefits (lbs/MWh)

<b>Emission Type (LFG from AP-42; others from eGRID)</b>	<b>NO<sub>x</sub></b>	<b>SO<sub>2</sub></b>	<b>Mercury</b>
Weighted Average for all LFG Electricity Generating Technologies	2.05	0.17	3.4 x 10 <sup>-6</sup>
National Grid Average – Emitting Sources Only	4.09	8.48	37.0 x 10 <sup>-6</sup>
National Grid Average – All Sources	2.96	6.04	27.2 x 10 <sup>-6</sup>



# LFGE Project Benefits

---

- ❖ Destroys methane and other organic compounds in LFG
  - Each 1 MW of generation = planting ~12,000 acres of trees per year, removing the emissions of ~8,800 cars per year, or preventing the use of ~93,000 barrels of oil per year
- ❖ Offsets use of nonrenewable resources (coal, oil, gas) reducing emissions of:
  - SO<sub>2</sub> contributes to acid rain
  - NO<sub>x</sub> contributes to ozone formation and smog
  - PM is a respiratory health concern
  - CO<sub>2</sub> is a global warming gas



## Jobs and Revenue

---

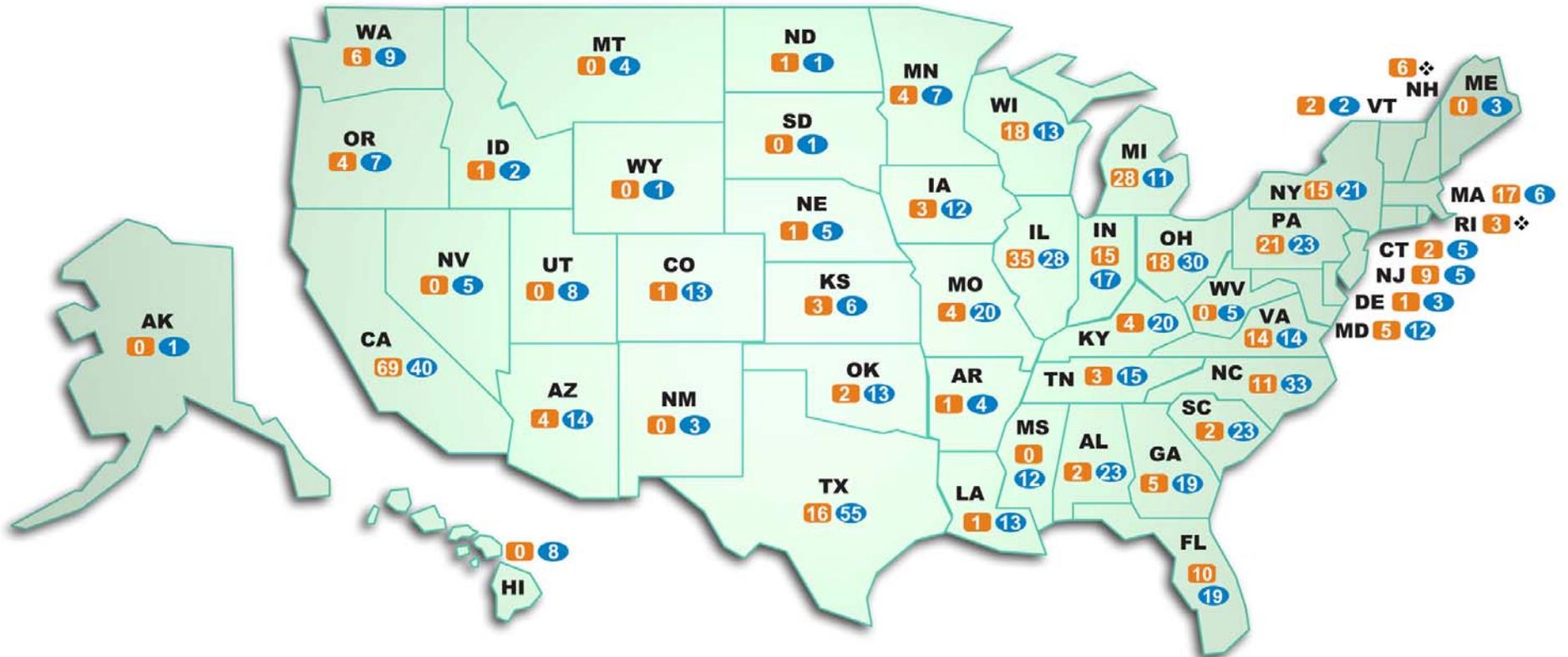
- ❖ A typical 3 MW LFG electricity project is estimated to have the following national benefits (direct, indirect, and induced) during the construction year:
  - Increase the output of the US economy by \$14 million
  - Increase US employee earnings by \$3.5 million (wages, salaries, etc.)
  - Employ 90 people (expressed in full-time equivalents per year)



## Industry Status

---

- More than 365 projects in 39 states supplying:
  - 8,000,000,000 kilowatt hours of electricity per year
  - 75,000,000,000 cubic feet per year of landfill gas to direct use applications



**Nationwide Summary**  
 367 OPERATIONAL Projects  
 >600 CANDIDATE Landfills  
 have 18 MMTCE Potential

 OPERATIONAL PROJECTS  
 CANDIDATE LANDFILLS

These data are from LMOP's database as of April 22, 2004.  
 ❖LMOP does not have any information on candidate landfills in this state.

U.S. Virgin Islands  
 VI 0 2

Puerto Rico  
 PR 0 6



# Environmental Benefits

---

## ❖ Estimated Annual Benefits:

- Planting 18,000,000 acres of forest,
- Preventing the use of 140,000,000 barrels of oil,
- Removing emissions equivalent to 13,000,000 cars, or
- Offsetting the use of 295,000 railcars of coal.



# LFGE and Green Power

---

- ❖ LFGE is a recognized renewable energy resource (*Green-e*, EPA Green Power Partnership).
- ❖ LFGE Serves as the “baseload renewable” for many green power programs.
- ❖ LFG is generated 24/7 and available over 90% of the time.
- ❖ LFG can act as a long-term price and volatility hedge against fossil fuels.
- ❖ Utilities are already using LFGE.

**Internal  
Combustion  
Engine**



**Gas  
Turbine**

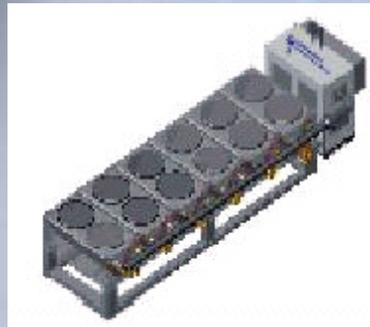


## Emerging Technologies



**Microturbine**

August 8-11, 2004

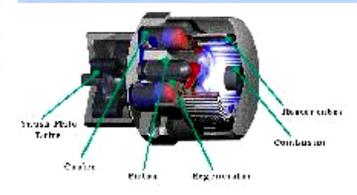


**Organic Rankine  
Cycle Engine**

[www.energy2004.ee.doe.gov](http://www.energy2004.ee.doe.gov)



**Stirling "External  
Combustion" Engine**





## Antioch Community H.S.

---

- ❖ First school co-generation (CHP) project on LFG
- ❖ Landfill former Superfund site
- ❖ 12 microturbines with 360 kW capacity
- ❖ Exhaust energy produces 290,000 BTUs/hour at 550°
- ❖ School expects to save \$100,000/year

## ❖ Direct-use projects are growing

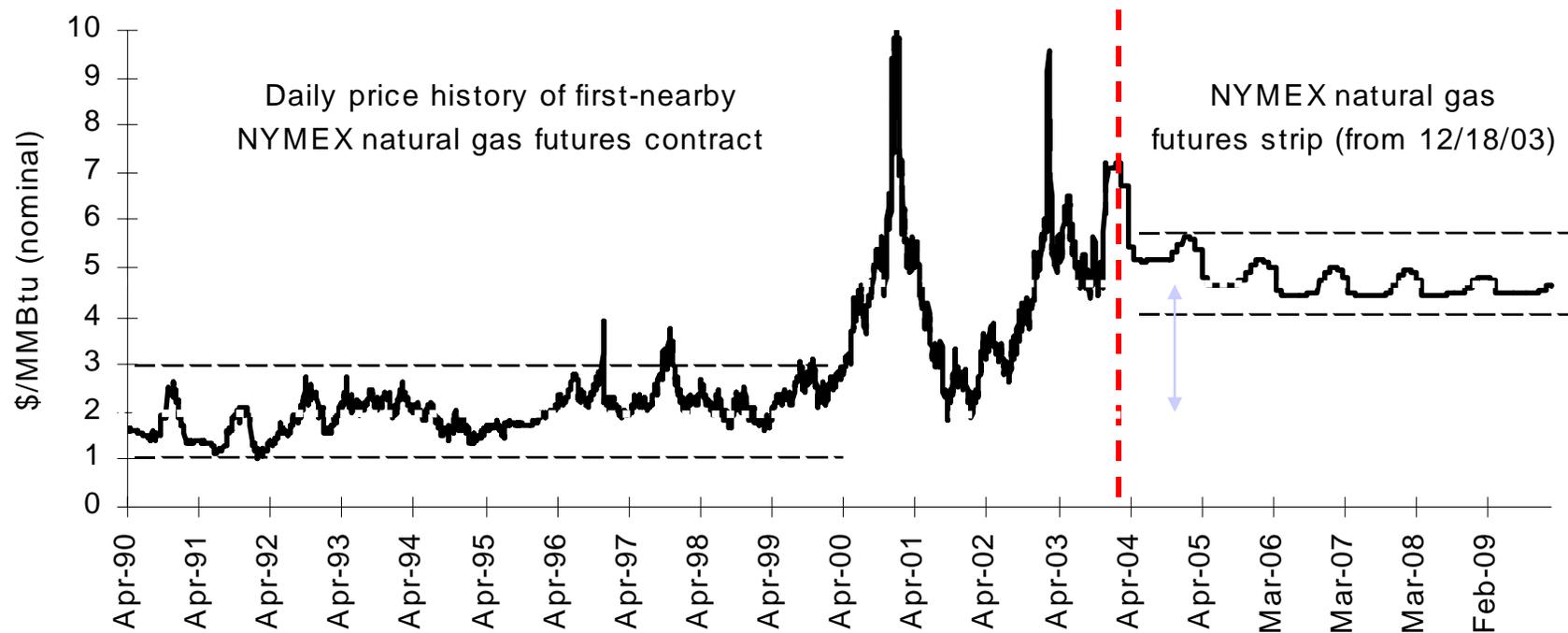
- Boiler applications - replace natural gas, coal, fuel oil
- Combined heat & power (CHP)
- Direct thermal (dryers, kilns)
- Natural gas pipeline injection (medium and high-Btu)
- Greenhouse
- Leachate evaporation
- Vehicle fuel (LNG)
- Artist studios
- Hydroponics and Aquaculture



**Pottery Studio Sugar Grove, NC**



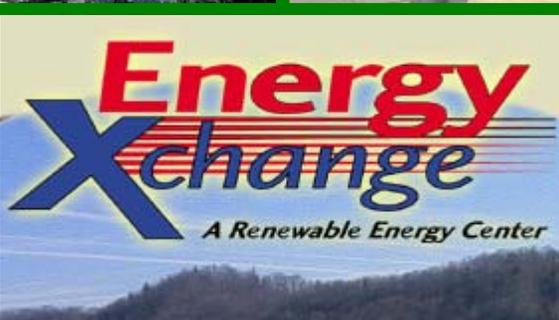
# Natural Gas Prices



Source: NYMEX

**2004**  
**Energy**

# EnergyXchange, NC





# LFG Users



The Ultimate Driving Machine

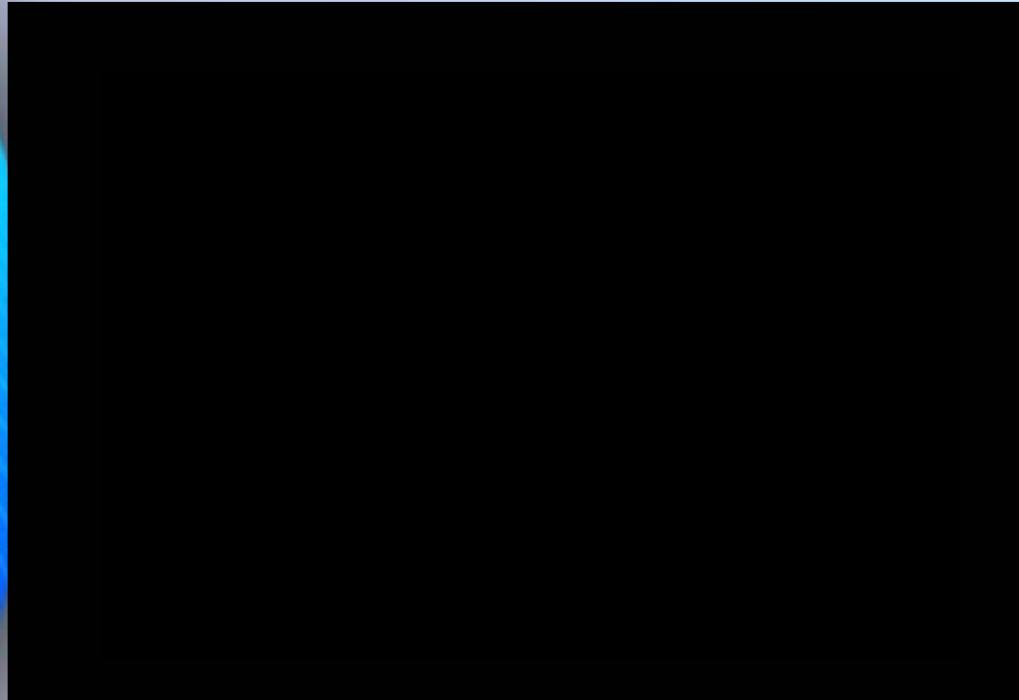


From innovation to results.





The Ultimate  
Driving Machine

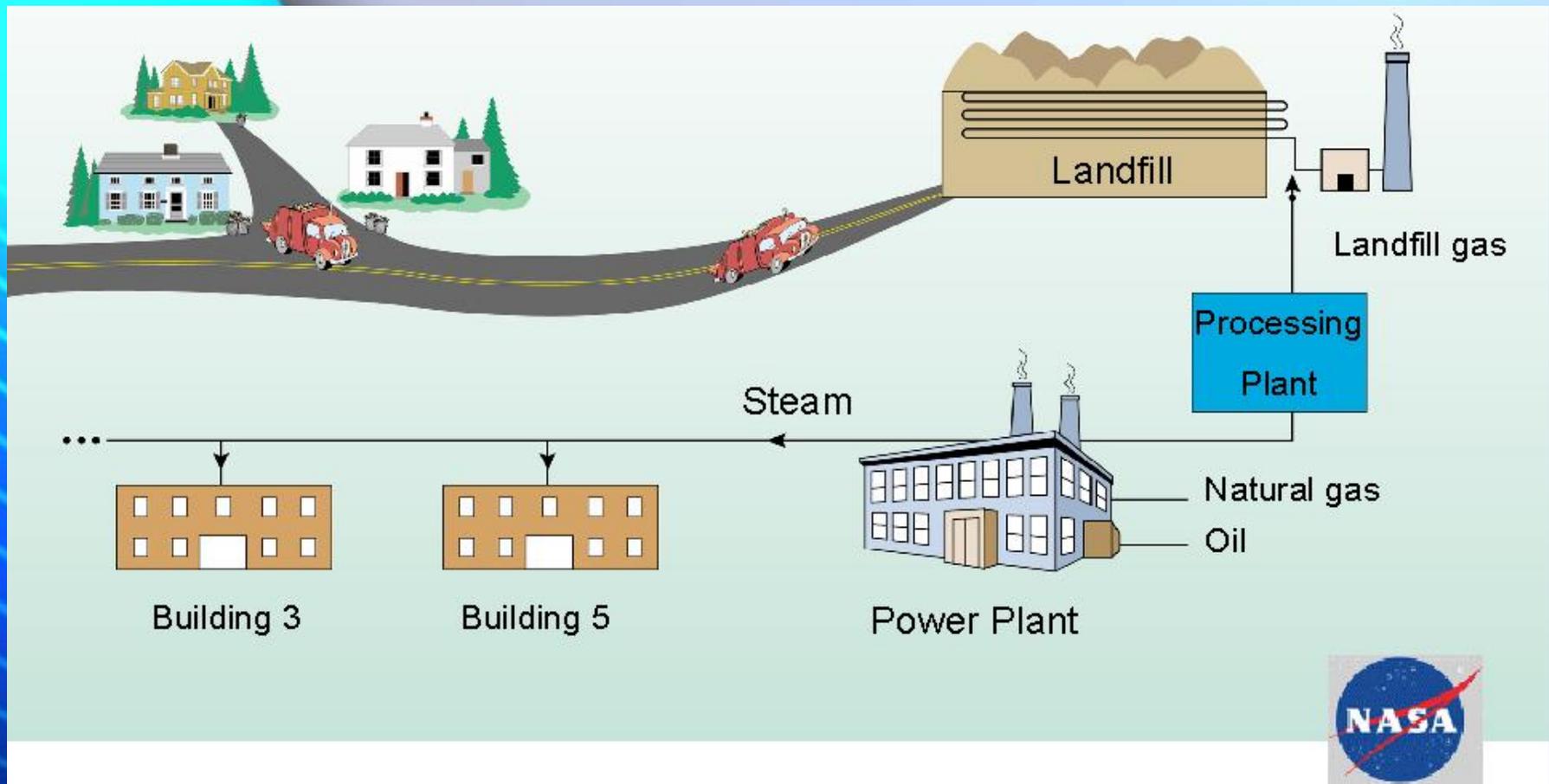


***“This LFG energy project allows BMW to take a wasted source of energy and use it to generate electricity, which benefits the environment and area residents through lower emissions.”***

Dr. Helmut Leube, President, BMW Manufacturing Corp.

August 8-11, 2004

[www.energy2004.ee.doe.gov](http://www.energy2004.ee.doe.gov)





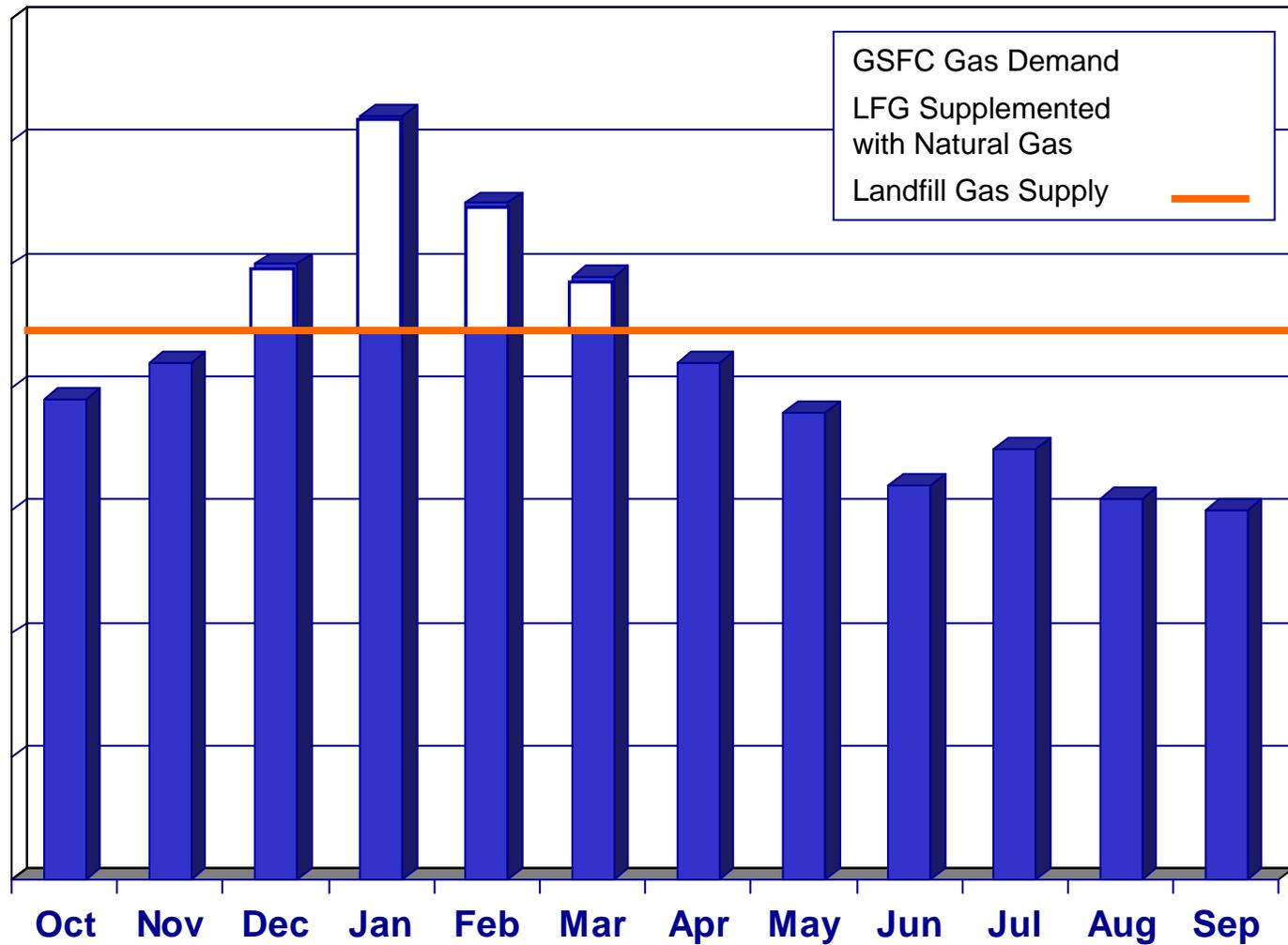
## Hill AFB, Utah

---

- ❖ Using the FEMP ESPC BAMF contract
  - Exelon Federal Services (Ameresco)
- ❖ Hill AFB < 1 mile from Davis County LF
- ❖ LFG will be piped to Hill AFB, where engine generators will be located (1 MW)
- ❖ Selling electricity to Utah Power
  - Results in \$300,000-\$400,000 credit per year on utility bill
- ❖ Expected on-line in fall 2004



# Supply/Demand at GSFC





## GSFC Project Benefits

---

- ✓ NASA wins by saving \$350K/year on fuel cost, and no cost to the government
- ✓ NASA increases energy reliability
- ✓ Public and Private Partnerships
  - ✓ Developers win by making a profit
  - ✓ County wins by sharing the LFG fee
- ✓ Reduced local emissions
- ✓ Sustainability goals - 80% of NASA's renewable energy source goal met through this project
- ✓ Offset fossil fuel usage



# Untapped Potential

---

- ❖ Currently over 600 candidate landfills and a total potential of over 1,700 MW.
- ❖ Total expected annual environmental benefits if all projects were developed:
  - Planting over 20 million acres of forest, or
  - Removing the emissions from over 14.6 million cars on the road, or
  - Powering over 1 million homes per year.



# LMOP Services

- ❖ Partnerships and networking (over 365)
- ❖ Newsletter and listserv
- ❖ Direct Project Assistance
  - Feasibility studies, end user searches
- ❖ Technical Assistance Resource
- ❖ LFG Advocate
- ❖ PR/Ribbon Cuttings



August 8-11, 2004

[www.energy2004.ee.doe.gov](http://www.energy2004.ee.doe.gov)



## LMOP Services

---

- ❖ Project and Candidate Database
- ❖ Green Pricing Accreditation
- ❖ State Workshops/Conferences
- ❖ Peer Matching
- ❖ Web Site (e.g., publications, database)

*❖ Annual LMOP Conference, Project Expo, and Partner Awards - January 10-11 2005 in Baltimore!*



## For more information

[www.epa.gov/lmop](http://www.epa.gov/lmop) - LMOP Hotline: 888-782-7937

- ❖ Brian Guzzone, [guzzone.brian@epa.gov](mailto:guzzone.brian@epa.gov), 202-343-9248
- ❖ Rachel Goldstein, [goldstein.rachel@epa.gov](mailto:goldstein.rachel@epa.gov), 202-343-9391
- ❖ Chris Voell, [voell.christopher@epa.gov](mailto:voell.christopher@epa.gov), 202-343-9406



August 8-11, 2004

[www.energy2004.ee.doe.gov](http://www.energy2004.ee.doe.gov)