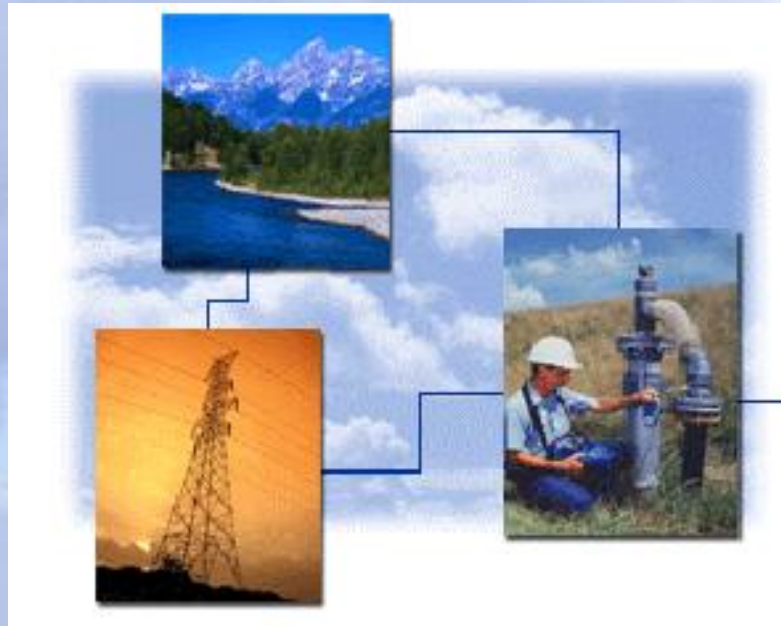


US EPA LMOP Introduction and Overview



***Pacific Island Energy Conference
Tom Frankiewicz
U.S. Environmental Protection Agency
Landfill Methane Outreach Program (LMOP)
June 22, 2009***



Presentation Outline

- LMOP/LFG 101
- LFG Project Costs & Revenues
- State of LFGE
- Case Studies
- Partnering with LMOP
- Other Energy Partnerships and Services from EPA



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.



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)
- If uncontrolled, LFG contributes to smog and global warming, and may cause health and safety concerns



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 CO₂
- 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 largest human-made source of methane in the United States in 2005, accounting for 24% generated

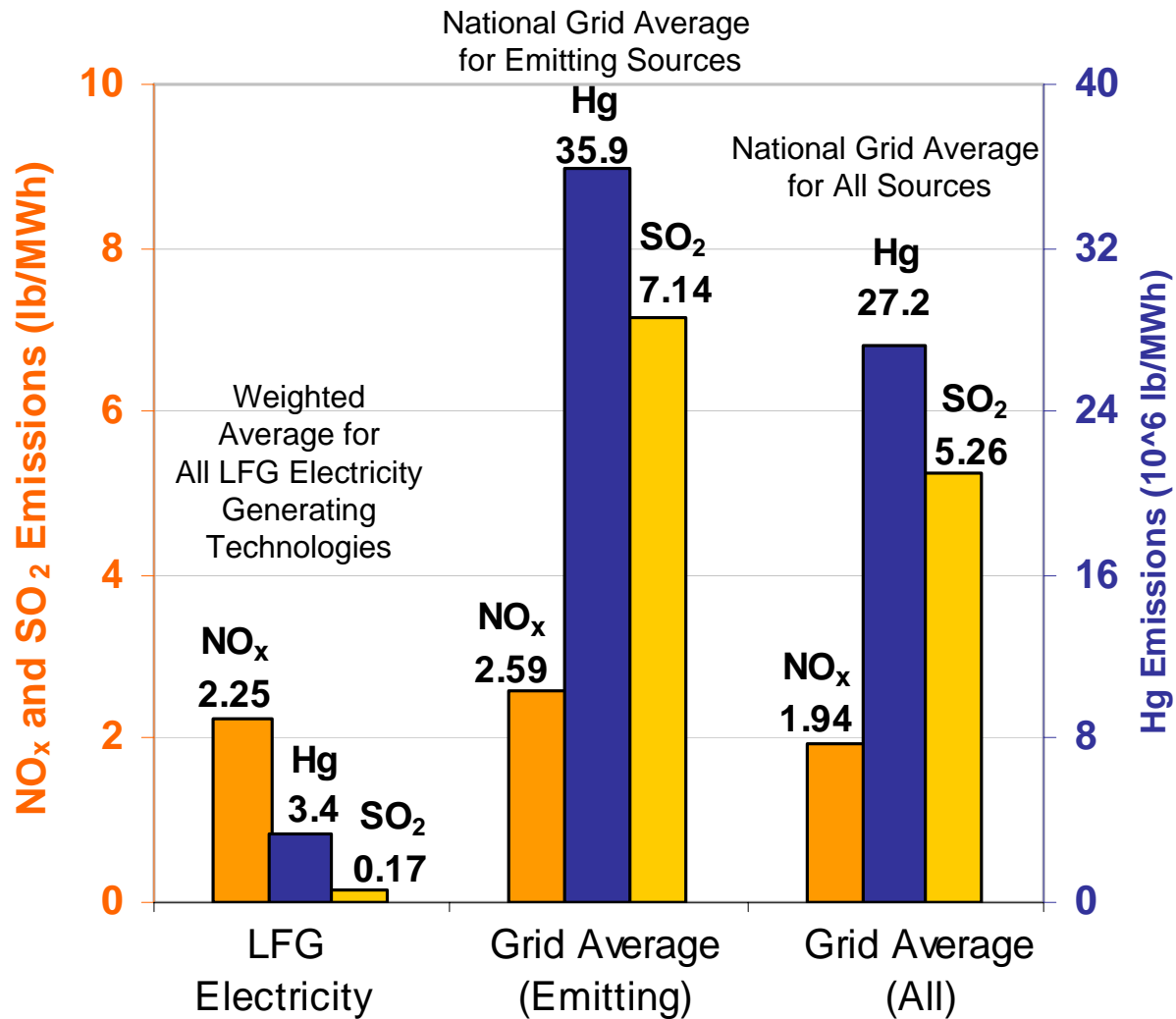


Landfill Gas and Green Power A Winning Combination

- Dual benefit → destroys methane and other organic compounds in LFG
- Offsets use of nonrenewable resources (coal, oil, gas) reducing emissions of
 - SO₂, NO_x, PM, CO₂
- LFG is a recognized renewable energy resource
 - Green-e, EPA Green Power Partnership, 28 states, Sierra Club, 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



LFG Electricity Emission Reduction Benefits



Sources: LFG from AP-42 (1998); Grid averages from eGRID2007 V1.1

File Last Updated: February 2009



Jobs and Revenue Creation

- A typical 3 MW LFG electricity project is estimated to have the following benefits (direct, indirect, and induced) during the construction year:
 - Increase the output of the national economy by ~\$14 million (\$3 million of which is a local benefit and mostly employee earnings)
 - Employ nearly 70 people nationally (expressed in full-time equivalents [FTE] per year)



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 |
|--|-----------------|------------------|
| Increase output of national economy | \$6 million | \$12 million |
| Portion of national benefit at local level | \$2 million | \$4 million |
| People employed nationally (FTE) | 43 | 80 |



Typical Electric Project Components & Costs

- 3 MW engine project for 15 years:
 - Installed engine and gas treatment skids
 - Installed capital cost = ~\$5,100,000
 - Interconnect
 - ~\$250,000 (approximate – many variables at play)
 - Annual operation & maintenance
 - Cost = ~\$570,000/year
- Total capital cost = ~\$5.35 million
- Total annual cost = ~\$570,000



Typical Direct Use Components & Cost

- 800 scfm project for 15 years:
 - Gas compression & treatment
 - Installed capital cost = ~\$1,040,000
 - Pipeline
 - Installed capital cost = ~\$330,000/mile
 - Annual operation & maintenance
 - Cost = ~\$50,000/year
 - End-of-pipe combustion equipment retrofits, if needed
- Total capital cost (5-mile) = ~\$2.69 million
- Total O&M cost = ~\$750,000



Potential LFG Revenue

- Electric projects
 - Sale of electricity (4 - 6 cents/kWh)
 - Sale of Renewable Energy Credits (RECs)
 - Premium pricing for renewables through RPS/RPG or voluntary green power markets
 - Tax credits & incentives
 - Clean Renewable Energy Bonds (CREBs)
- Direct-use projects
 - Sale of LFG (\$/MMBtu)
- Both
 - Greenhouse gas emissions trading
 - Energy cost savings
 - Other federal incentives (EECBG)



State of the LFG Industry

February 2009

- At least 470 operational projects in 44 states supplying:
 - 12 billion kilowatt hours of electricity and 82 billion cubic feet of LFG to direct-use applications annually
- Estimated **Annual Environmental Benefits**
 - Carbon sequestered annually by **~19,000,000 acres of pine or fir forests**, or
 - CO₂ emissions from **~195,000,000 barrels of oil consumed**, or
 - Annual greenhouse gas emissions from **~15,400,000 passenger vehicles**
- Estimated **Annual Energy Benefit**
 - Powering more than **936,000 homes** and heating more than **567,000 homes**

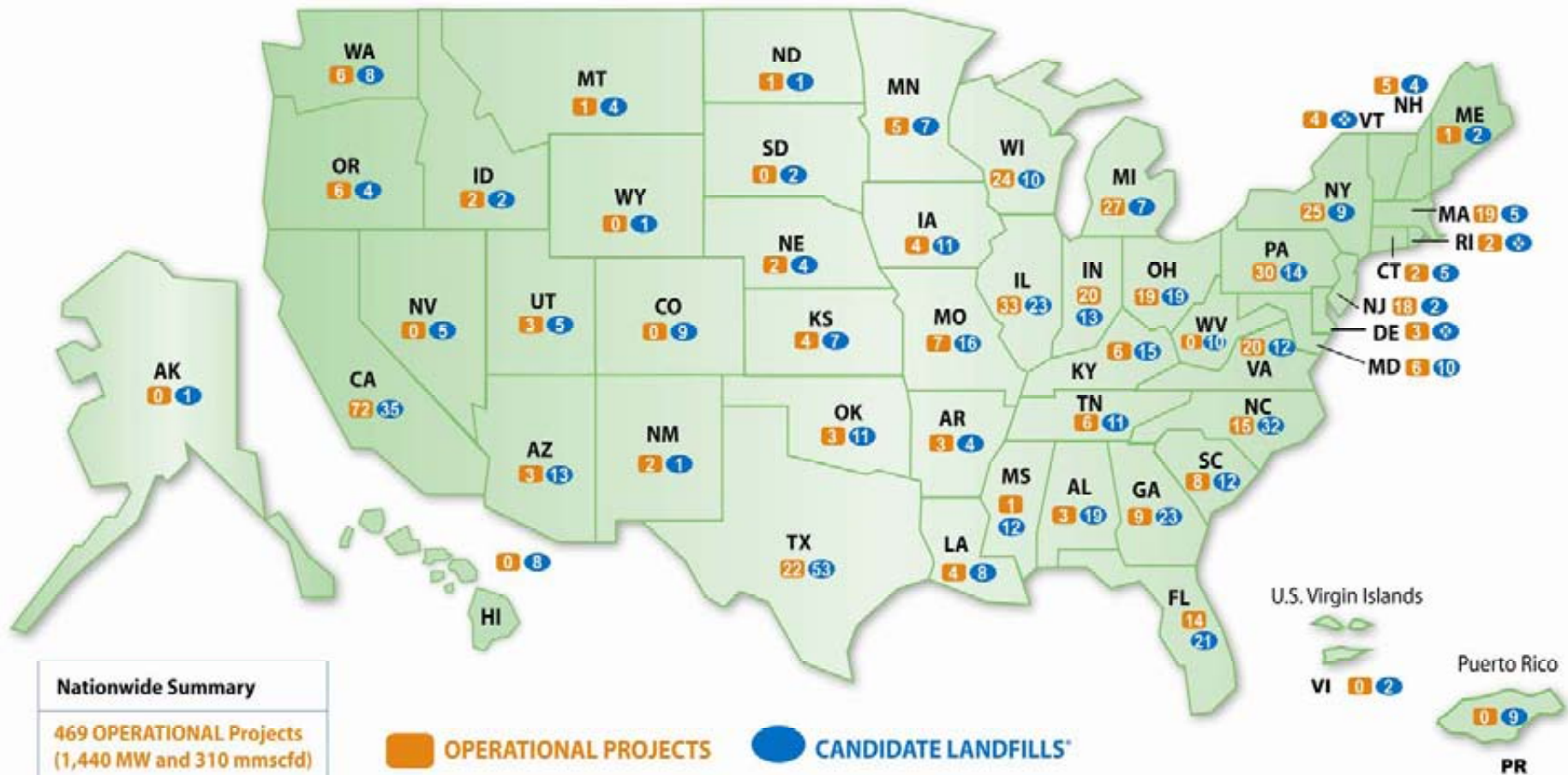


Many Untapped LFG Resources

- Currently 520 candidate landfills with a total gas generation potential of 610 million standard cubic feet per day OR electric potential of 1,200 MW
- If projects were developed at all these landfills, estimated
 - **Annual Environmental Benefit =**
Planting 1.70 million acres of forest
OR removing the emissions from
1.2 million vehicles on the road, and
 - **Annual Energy Benefit =**
Powering 763,000 homes per year



LFG Energy Projects and Candidate Landfills



* Landfill is accepting waste or has been closed for 5 years or less and has at least 1 mmtons of waste and does not have an operational/under construction LFGCE project; or is designated based on actual interest/planning.

These data are from LMOP's database as of December 22, 2008.
 ◊LMOP does not have any information on candidate landfills in this state.

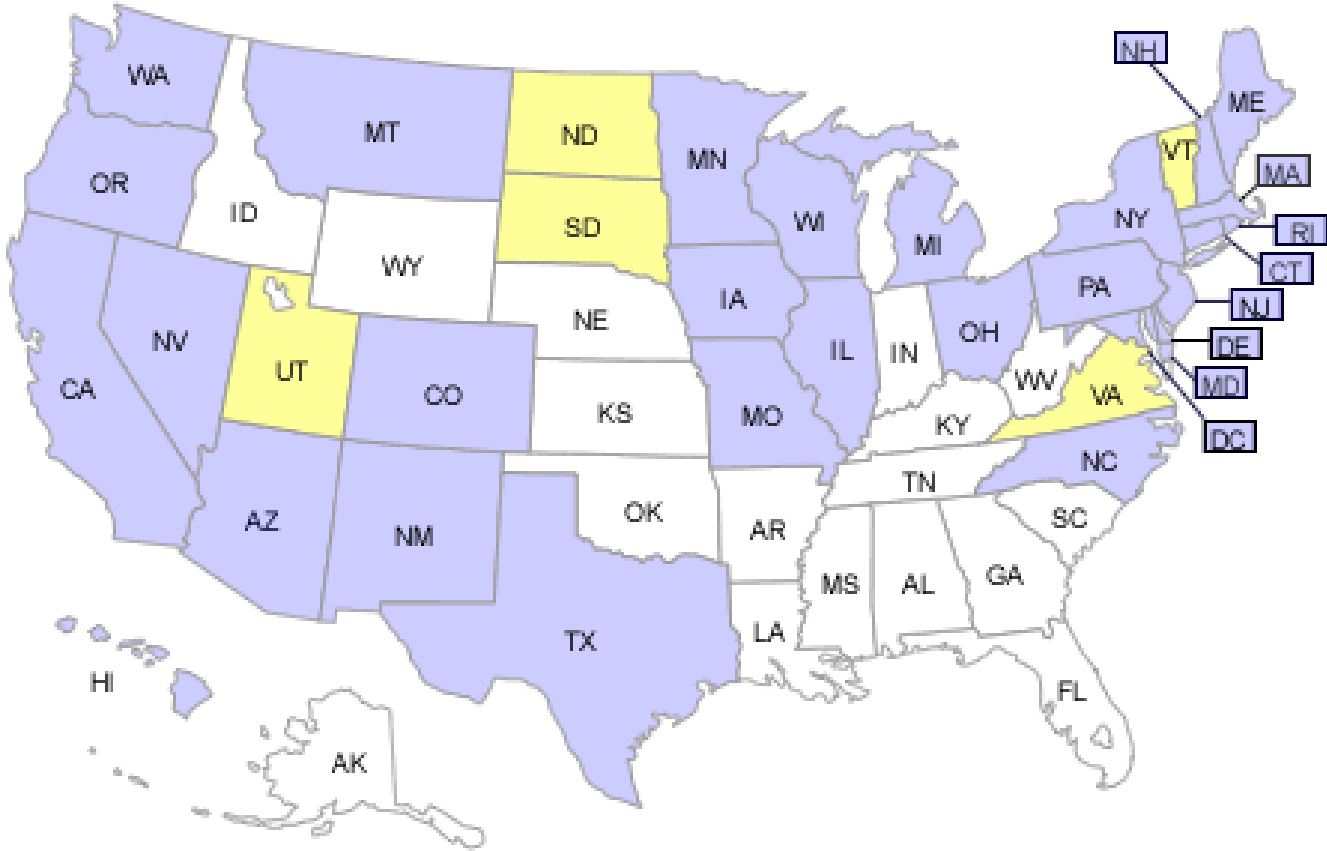


Federal Financial Incentives

- Section 45 Tax Credit
 - Electricity generation – 1.0 cent/kWh
 - Placed in service by 12/31/13
 - 10-year payout period
- U.S. Treasury Grant Program
- EECBG Program
 - National allocation of \$3.2 billion in FY'09



States with RPS or Goal



- States with RPS
- States with RPS Goals





Public and Private Entities Moving to Reduce GHG Emissions

- Voluntary Markets
 - Currently where most GHG activity occurs
 - Examples – CCX, VCS
- Compliance Markets
 - Rapidly evolving, will become the dominant market
 - Led by RGGI and CCAR (note Nov. deadline registering your project!)





Tracking Trends

- GHG trading markets continually evolve and mature..... new entries into the market- GE-AES, VCS, etc.
- State/regional initiatives taking the lead- RGGI did first auction September 08, went into effect January 2009; second auction planned
- Impacts of Congressional legislation and potential landfill CH₄ regulation – particularly cap and trade
- Three year tax credit extension and new CREBs allocation as part of American Recovery & Reinvestment Act
- New state RPSs include LFG
- Corporate sector interest in LFG continues to grow
- Consolidation in the waste sector





Diversity of Project Generation Types



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



Microturbine
(range from 30 kW to 250 kW)



Gas Turbine
(range from 800 kW
to 10.5 MW)

Direct Use

- 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



LFG-fired Boiler Ft. Wayne, IN





Emerging Technologies: LFG for Vehicle Fuel

- Los Angeles, CA converts LFG into CNG to fuel landfill equipment (Puente Hills LF)
- Franklin Co, OH converts LFG to CNG to fuel 2 sedans and 4 pick-ups with plans to build commercial CNG facility in coming years
- Central LF, CA plans to convert LFG to CNG to fuel Sonoma County school buses
- Waste Management in CA plans to produce 10-20K gal LNG per day for garbage trucks



Honeywell

NUCOR

HILL
AIR FORCE BASE, Utah
OGDEN AIR LOGISTICS CENTER

DART

CYTEC

Rolls-Royce



SENECA Foods.com
"A World Leader In Agribusiness"

Owens Corning

Cargill



The Ultimate Driving Machine

The Solae Company



GM



LAFARGE

Jenkins Brick Company

LOOK WHO'S USING LANDFILL GAS!

AJINOMOTO

CONE corporate denim finishing jacquards

Nestlé
Makes the Very Best

INTERNATIONAL PAPER
From innovation to results.

INTERFACE

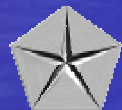
MALLINCKRODT

DUPONT
The miracles of science

Lucent Technologies
Bell Labs Innovations



SC Johnson



CHRYSLER



Look Who's Talking about LFG!

Charlotte.com
The Charlotte Observer

npr

GreenBiz.com

USA TODAY

CNBC

The Economist

boston.com
The Boston Globe

NATIONALGEOGRAPHIC.COM

Greenwire

THE LEADER IN ENERGY & ENVIRONMENTAL POLICY NEWS

The Philadelphia Inquirer

The New York Times

VOA

THE OAKLAND PRESS

The Journal Press

WSJ.com THE WALL STREET JOURNAL ONLINE

THE OKLAHOMAN

WIRED NEWS

CNN.com

How Smart People Work

FAST COMPANY

Gazette.Net
FORTUNE

The Nation.

PRENSA LIBRE.com
UN PERIODISMO INDEPENDIENTE, HONRADO Y DIGNO

The Telegraph

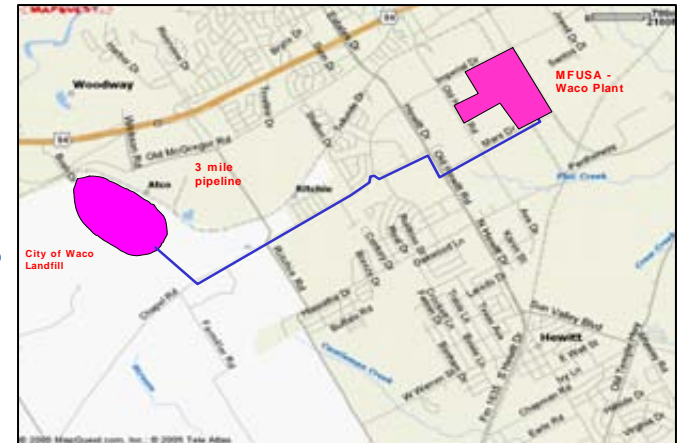
vegetarian times
GREAT FOOD, GOOD HEALTH, SMART LIVING



Direct-Use Case Study **MARS Snackfood USA and City of Waco Landfill**

LFG from city landfill is piped to MARS for use in boiler

- Replaces natural gas
- LFG replaced 60% of plant's boiler fuel – 600 mmBTU/day
- Saves plant over \$600,000/year
- Project lifetime of at least 25 years
- Reduced CO2 emissions by 10,000 tonnes
- Equivalent to 3% of MARS total energy use for U.S. factories



**2008 LMOP
Award Winner**

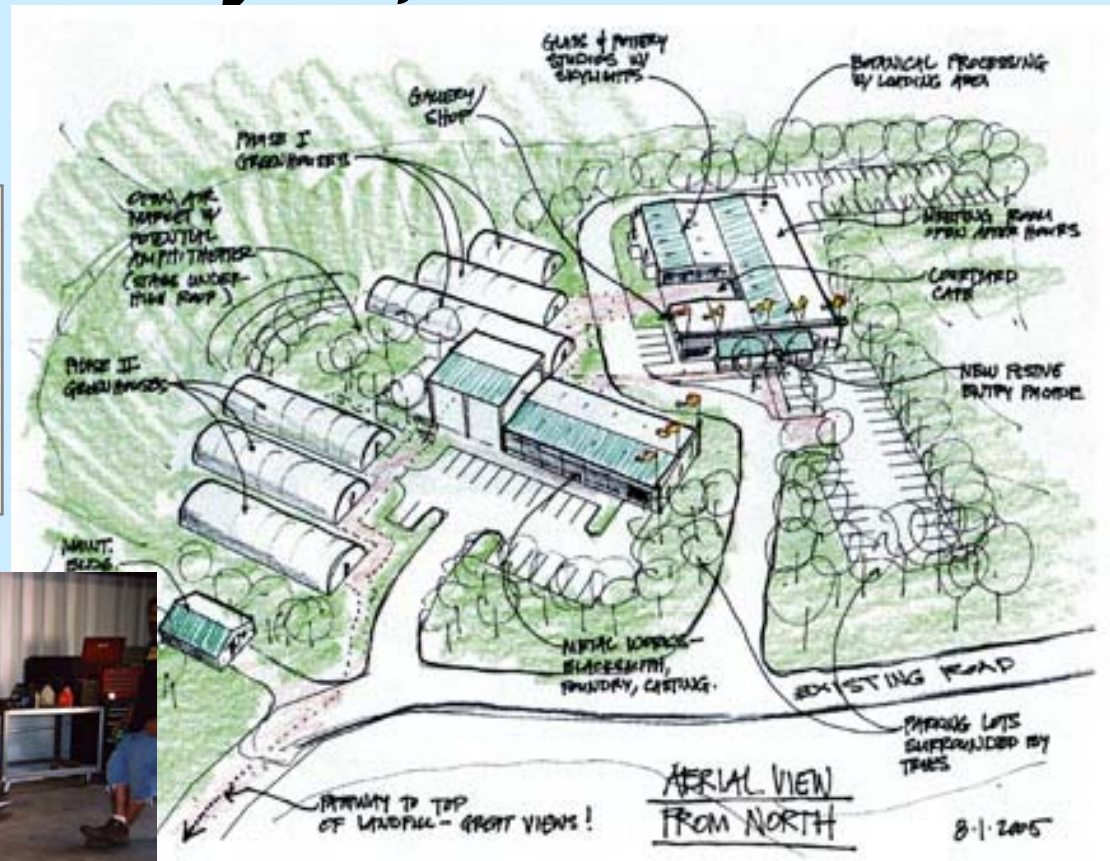




Direct-Use Case Study Jackson County Green Energy Park Sylva, NC



*LMOP
2006
Project of
the 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
- Support for ribbon cuttings and other public relations
- Presentations at conferences
- State training workshops
- LMOP Annual Conference & Project Expo



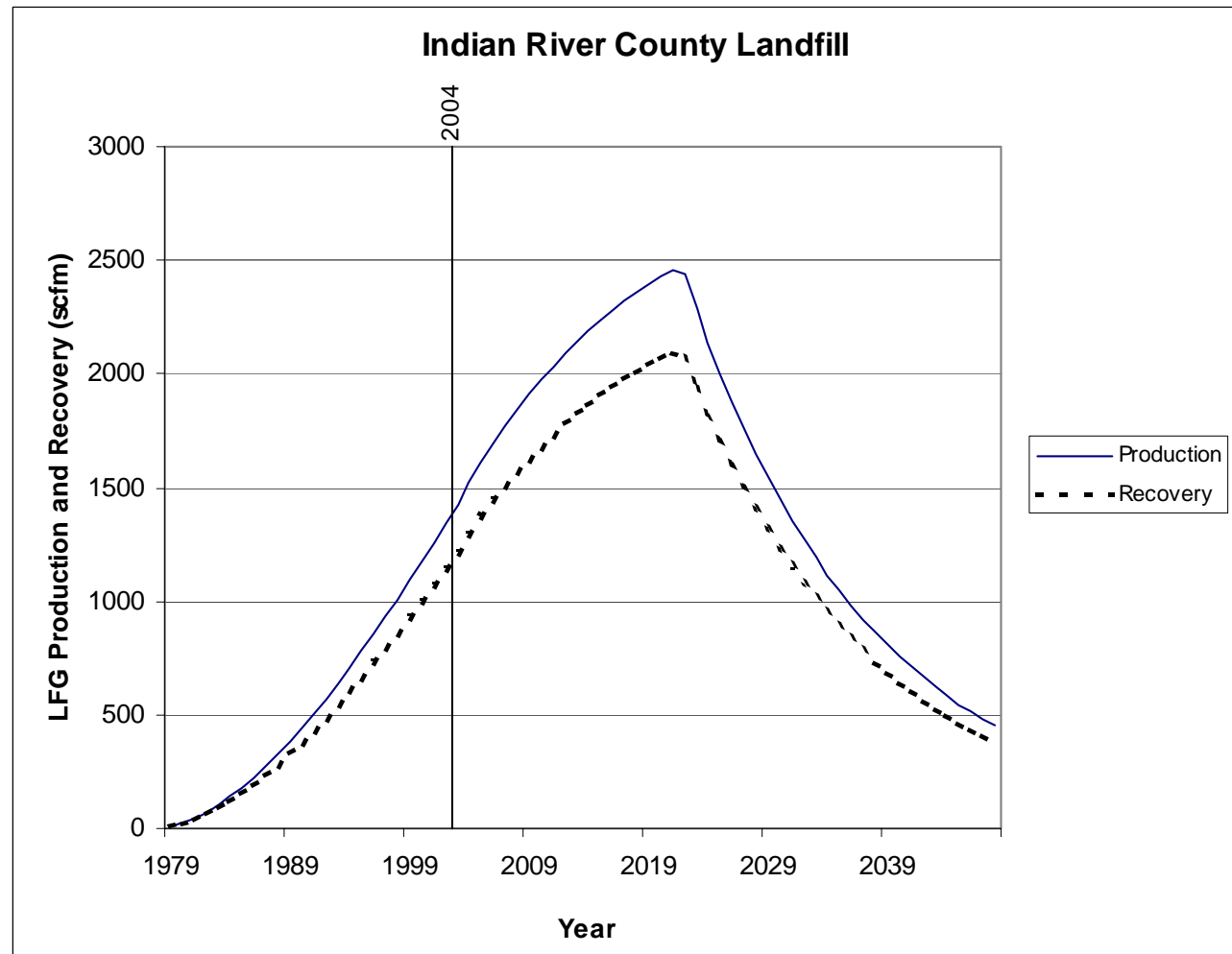
How Can We Work Together?

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*

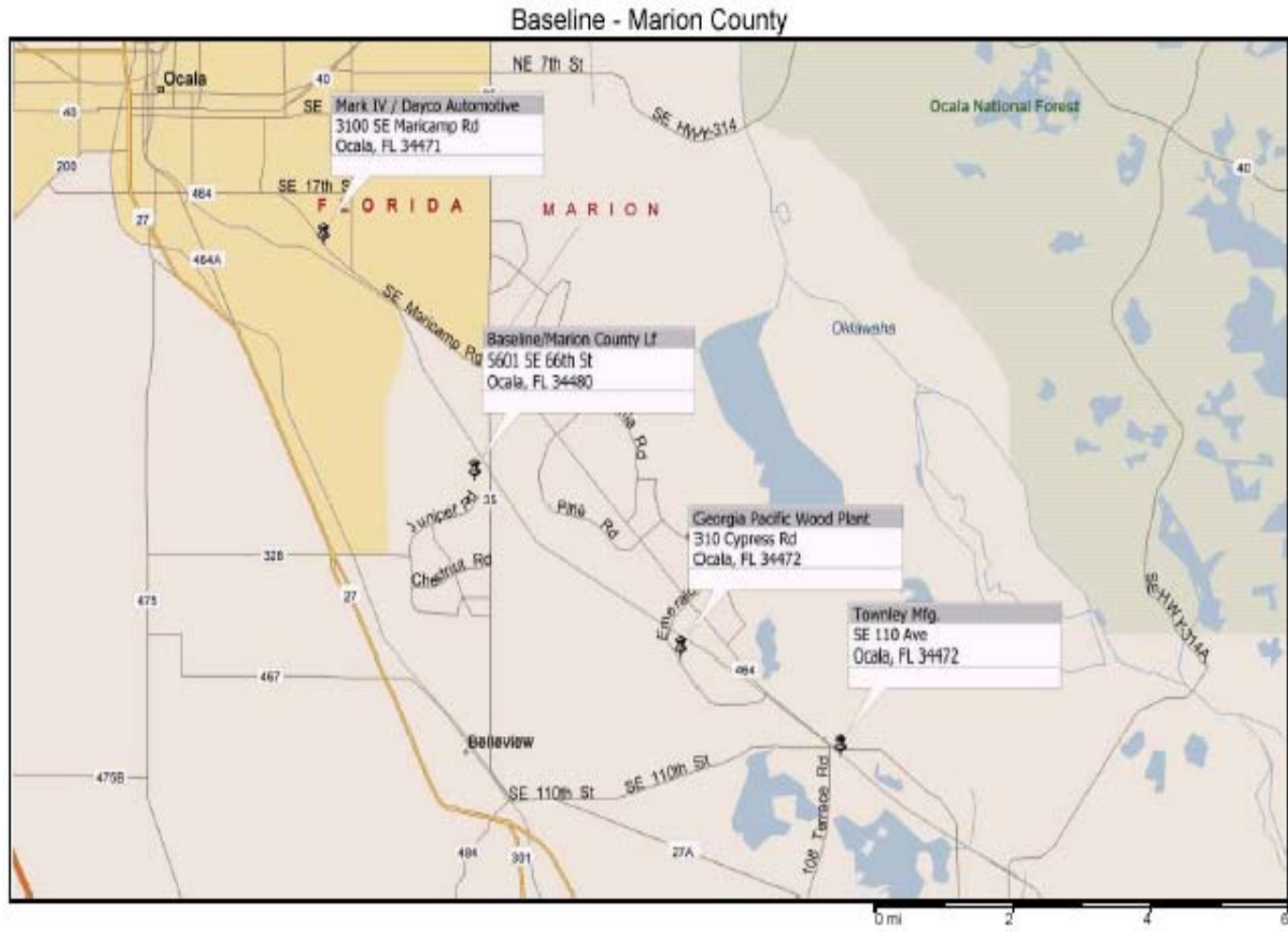


Analyze Energy Potential from Landfill





Identify Potential Matches





EPA Project Expo

- Interested in an LFGE Project?
- EPA features a select number of landfills at the Annual LMOP Conference in January.
- LMOP will develop a “resume” for your landfill to feature at the conference.
- Contact me if interested!



Methane to Markets Partnership

- Encourages development of **cost-effective** methane recovery and use opportunities in
 - coal mines
 - landfills
 - oil and gas systems and
 - agriculture (manure waste management)
- Private companies, multilateral development banks and other relevant organizations participate by joining the **Project Network – over 790 organizations now participating**
- **29 Partner Governments**

| | |
|----------------|----------------|
| Argentina | Kazakhstan |
| Australia | Korea |
| Brazil | Mexico |
| Bulgaria | Mongolia |
| Canada | Nigeria |
| Chile | Pakistan |
| Colombia | Philippines |
| China | Poland |
| European Comm. | Russia |
| Ecuador | Thailand |
| Finland | Ukraine |
| Germany | United Kingdom |
| India | United States |
| Italy | Vietnam |
| Japan | |





Tools and Services Offered to M2M Partners

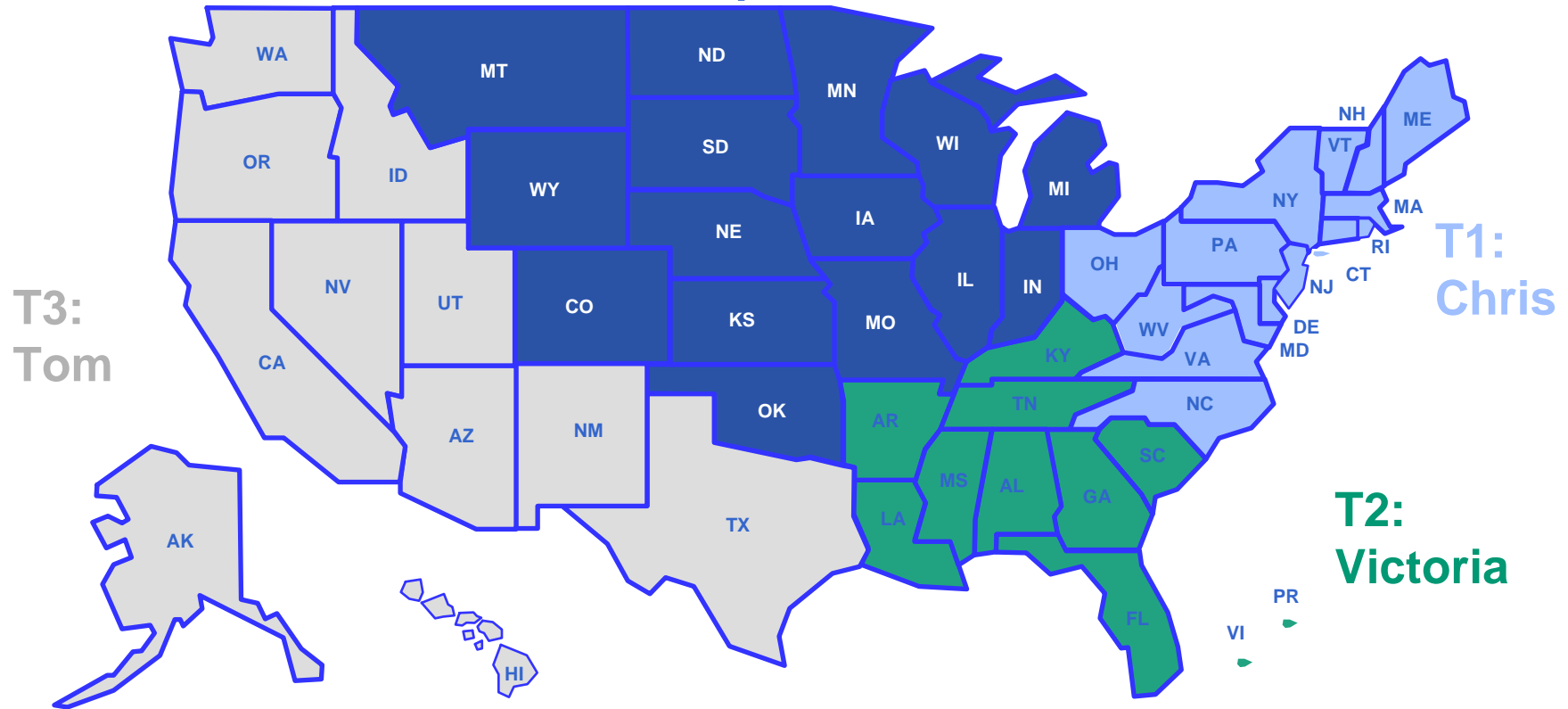
- ◆ **Hands-on Technical Assistance** – assisting partners to identify and assess potential landfill energy projects
- ◆ **Training and Outreach** – reaching out to and training government officials, landfill owners and operators, and project developers
- ◆ **Developing Tools and Resources** – to identify, assess, and develop projects in partner countries



For More Information

www.epa.gov/lmop

T4: Swarupa



Tom Frankiewicz

frankiewicz.thomas@epa.gov, (202) 343-9232

Chris Godlove

godlove.chris@epa.gov, (202) 343-9391

Rachel Goldstein

*goldstein.rachel@epa.gov
(202) 343-9391*

Victoria Ludwig

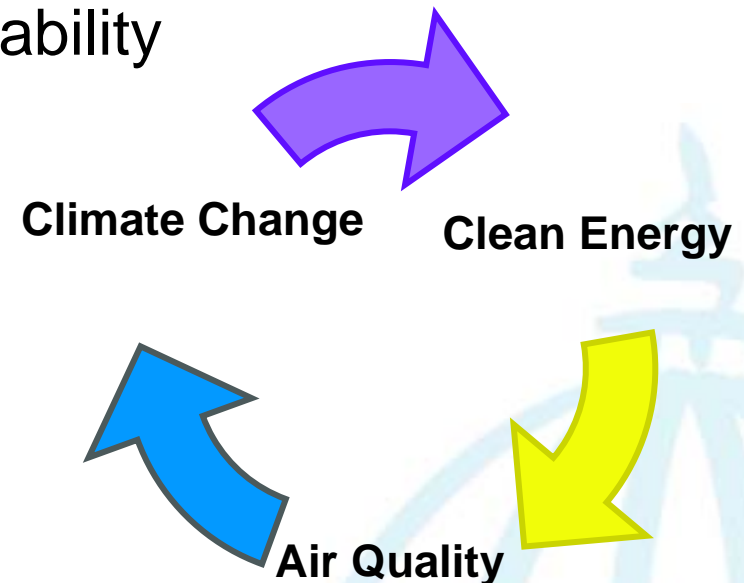
ludwig.victoria@epa.gov, (202) 343-9291

Swarupa Ganguli

ganguli.swarupa@epa.gov, (202) 343-9732

Climate – Clean Energy Framework: Multiple Benefits

- **Territorial Governments are looking for:**
 - Air quality improvements
 - Greenhouse gas emission reductions
 - Energy security and reliability
 - Economic development
 - Public health
 - Quality of life

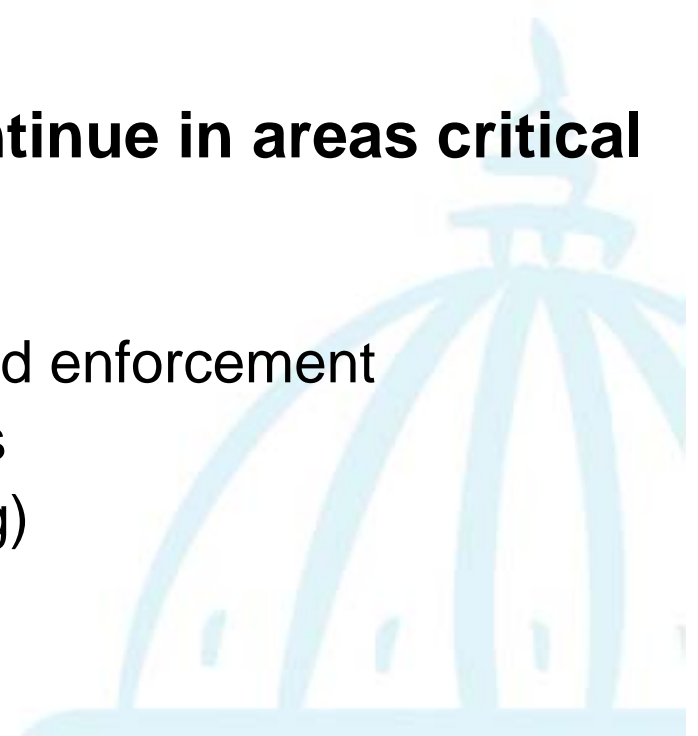


Clean Energy: Energy Efficiency, Renewable Energy, Combined Heat and Power

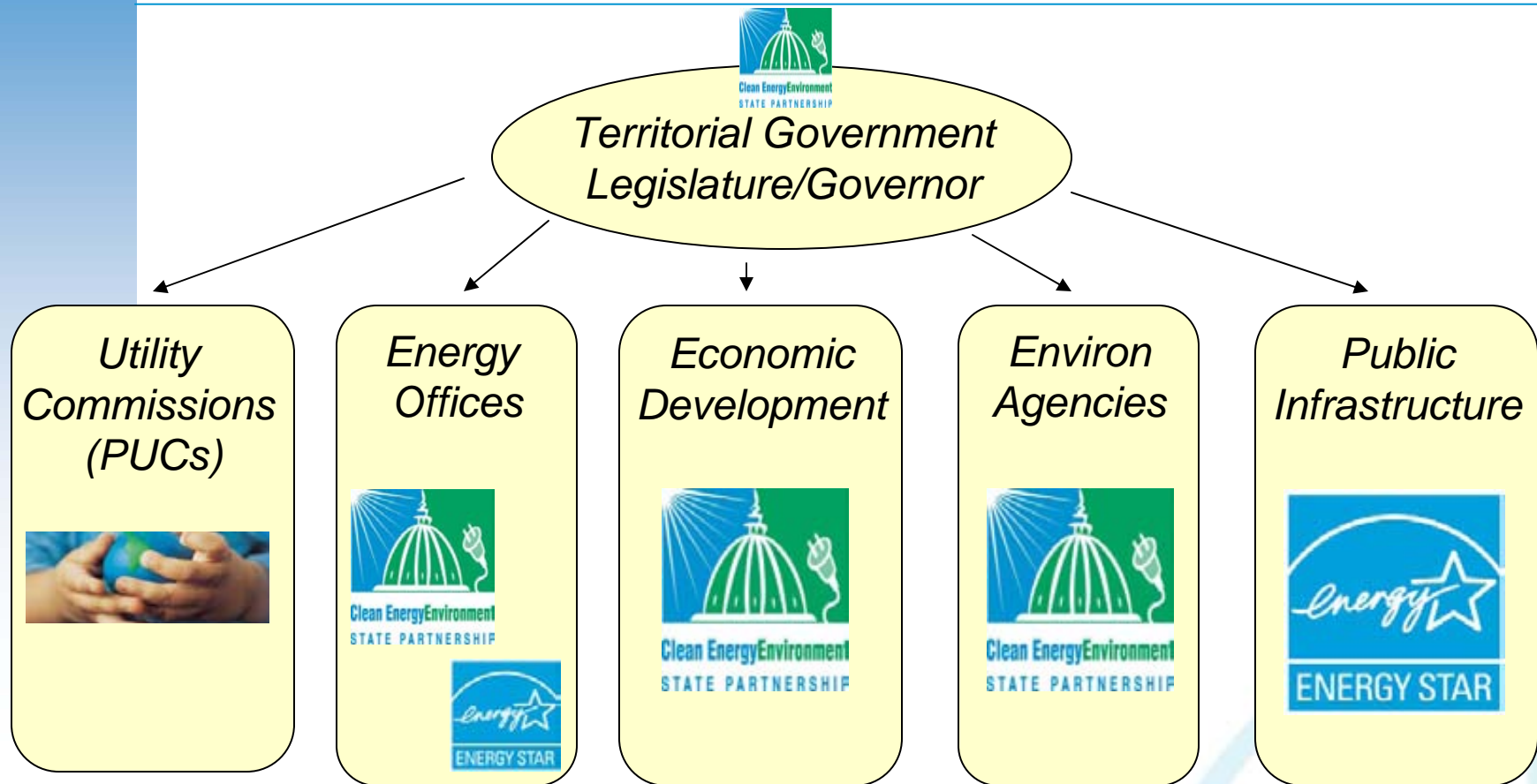


Roles for State / Local Governments in Addressing Climate Change

- **State / Local experience to date includes:**
 - Clean Energy/Climate Action Plans (32 states)
 - Regional cap-and-trade (RGGI, WCI, MWA)
 - Energy efficiency programs
 - Renewable Portfolio Standards (RPS) / RE promotion
 - Transportation
- **Regulatory authority will continue in areas critical for climate:**
 - Utility regulation
 - Building code development and enforcement
 - Appliance efficiency standards
 - Land use decisions (incl. siting)
 - Transportation



State Government Work is Dispersed; Local Gov'ts Range from Complex to All-in-One



Leverage EPA's Climate / Clean Energy Programs

CPPD



Clean Energy Environment
STATE PARTNERSHIP



Clean Energy Environment
MUNICIPAL NETWORK



ENERGY STAR



CHP
COMBINED HEAT AND
POWER PARTNERSHIP



EPA
GREEN
POWER
PARTNERSHIP



HEAT ISLAND REDUCTION
INITIATIVE



U.S. Environmental Protection Agency

CCD



EPA POLLUTION PREVENTER



COALBED
METHANE
OUTREACH
PROGRAM



LANDFILL METHANE
OUTREACH PROGRAM



AGSTAR
LIVELAND AND POLLUTION PREVENTION

OW



EPA
WASTE
WISE

OTAQ



Tomorrow's Buses for Today's Children
CLEAN SCHOOL BUS USA

Help State and Local Governments:

- Learn from Best Practices
- Emphasize Co-Benefits
- Integrate Planning
- Prioritize EE as a Resource

Offer:

- Direct Technical Support
- Peer Exchange
- Tools and Guidance



Clean Energy Environment
STATE AND LOCAL PROGRAM



SmartWay
Transport Partnership
U.S. ENVIRONMENTAL PROTECTION AGENCY

Contact Us

State Climate - Clean Energy Programs

www.epa.gov/cleanenergy/energy-programs/state-and-local/state

Local Climate - Clean Energy Programs

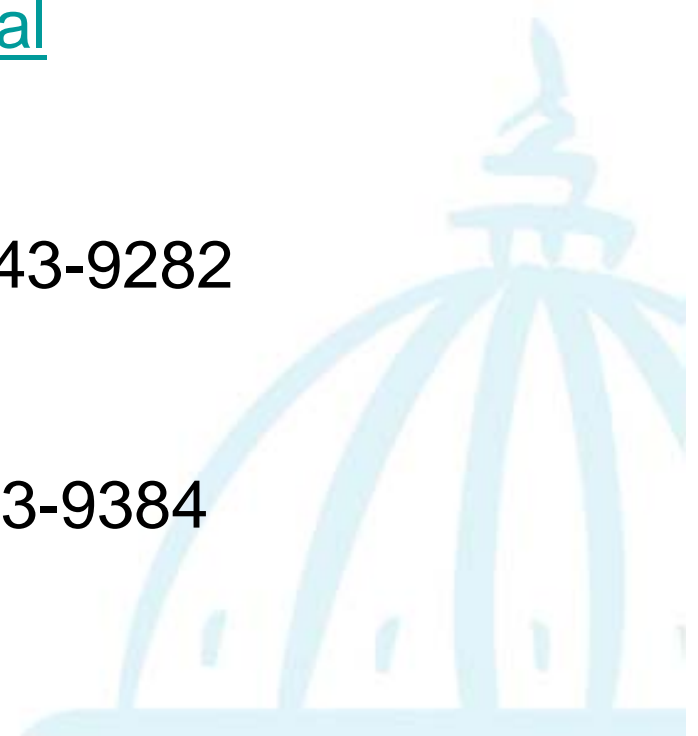
www.epa.gov/cleanenergy/energy-programs/state-and-local/local

Danielle Sass Byrnett

byrnett.danielle@epa.gov, 202-343-9282

Neelam Patel

patel.neelam-r@epa.gov, 202-343-9384





LMOP

Contact Information

Tom Frankiewicz
Program Manager
U.S. EPA LMOP
(202) 343-9232

Frankiewicz.thomas@epa.gov



Useful Links for More Info.

U.S. EPA LMOP

www.epa.gov/lmop

LMOP Funding Guide

<http://www.epa.gov/landfill/res/guide/>

LMOP Database of Projects

<http://www.epa.gov/lmop/proj/index.htm>

Database of State Incentives for Renewable Energy (DSIRE)

www.dsireusa.org

DOE – Energy Efficiency & Conservation Block Grants Program

http://apps1.eere.energy.gov/wip/block_grants.cfm