Methane to Markets

An International Framework to Advance the Recovery and Use of Methane as a Clean Energy Source

CSD Partnership Fair

Erin Birgfeld

Director, Methane to Markets Secretariat
Hosted by the US Environmental Protection Agency

2 May 2007

Methane to Markets

Overview

- M2M Snapshot
- Benefits of methane capture and use projects
- M2M Structure and Activities
  - Partnership Expo, Oct 2007
- Sector Opportunities and Case Studies
  - Oil and Gas
  - Agriculture
  - Coal Mining
  - Landfills
- Conclusions

Methane to Markets Partnership Overview

- Advances recovery and use of methane as a valuable clean energy source and encourages development of ***cost-effective*** methane recovery and use projects

- 20 Partner Countries

Argentina	**Japan**
Australia	**Korea**
Brazil	**Mexico**
Canada	**Nigeria**
Colombia	**Poland**
China	**Russia**
Ecuador	**Ukraine**
Germany	**United Kingdom**
India	**United States**
Italy	**Vietnam**

- Private companies, multilateral development banks and other relevant organizations participate by joining the ***Project Network***
  - *over 500 organizations now participating*

Cost-Effective Projects Recover and Use Methane

Coal Mines

Oil and Gas Systems

Landfills

Livestock Waste

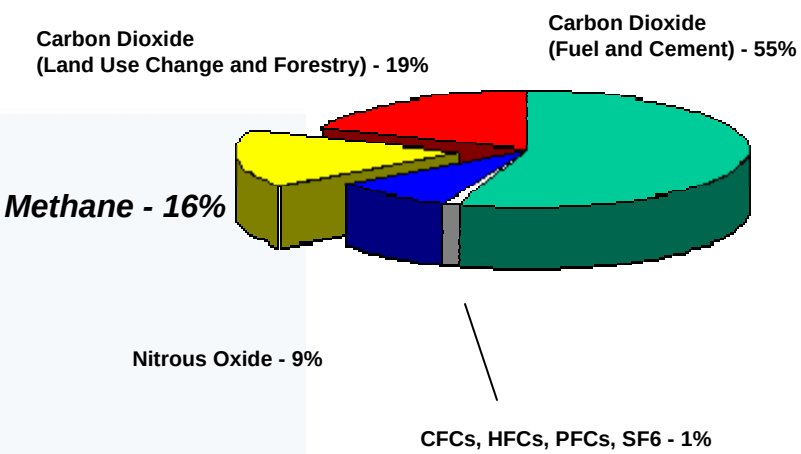
Methane to Markets

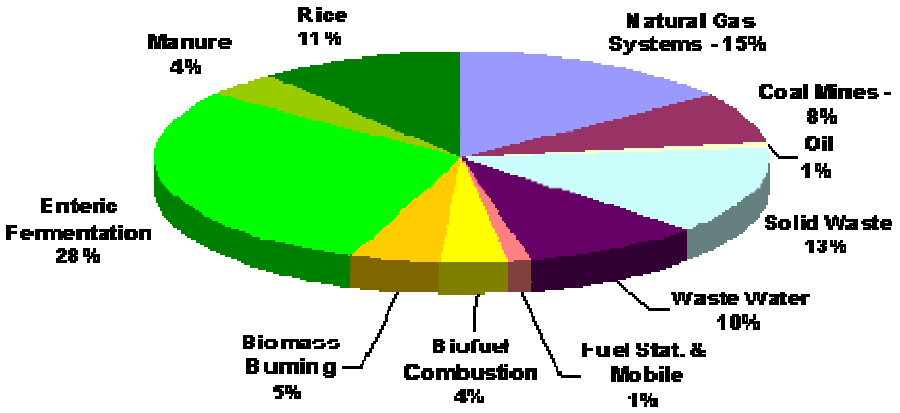
Why focus on Methane?

- A potent greenhouse gas (GHG) with 100-year global warming potential of 23; atmospheric lifetime of ~12 years
- The 2nd most important GHG accounting for ~18% of total climate forcing
- A primary constituent of natural gas and a valuable, clean-burning energy source

Global GHG Emissions in 2000

40,702 million tonnes carbon dioxide equivalent ($MtCO_2e$)





Significant Benefits of Methane Recovery and Use Projects

BENEFITS OF METHANE PROJECTS

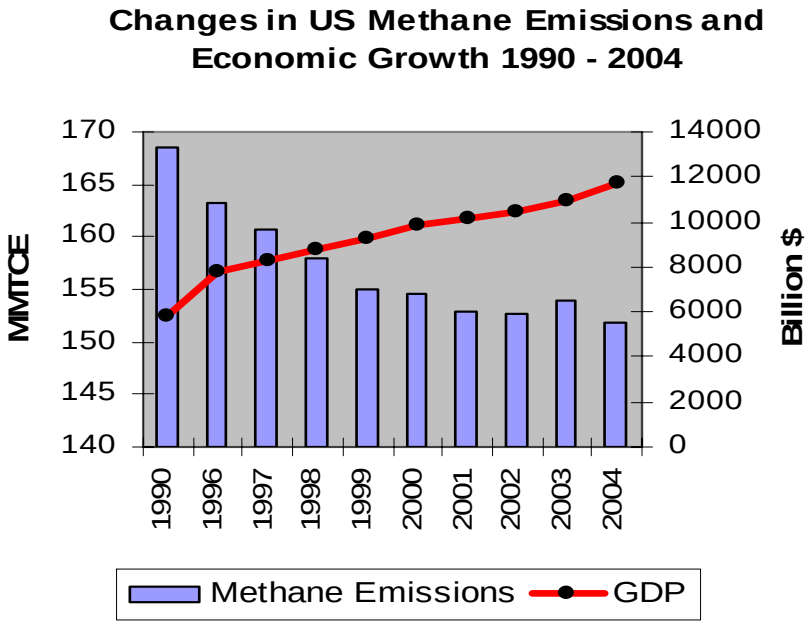
- Reduced greenhouse gas emissions
- Increases energy efficiency at oil and gas facilities
- Reduced waste of a valuable fuel and important local energy source and
- Improved industrial safety and productivity
- Improved air quality, water quality and reduced odors
- Economic growth and energy security

BUT BARRIERS EXIST…

- Lack of awareness of emission levels and value of lost fuel
- Lack of information on and training in available technologies and management practices
- Traditional industry practices
- Regulatory and legal issues
- Limited methane markets and infrastructure
- Uncertain investment climate

EPA's Voluntary Programs Have Produced Measurable Results

- Natural Gas STAR
  - over 100 companies (57% of industry) in program
  - Since 1993, companies have reported reductions of 470 Bcf, valued at over $3.5 billion.
- Coalbed Methane Outreach Program
  - 90% of mine degasification CH_4 is used (up from 25% in 1993)
  - industry effort to demonstrate use for ventilation air methane



- Landfill Methane Outreach Program
  - Over 400 US landfill projects -- tripled since 1994
  - Strong corporate interest in use of landfill gas
- AgSTAR
  - Since 1994, the number of operational biogas recovery systems has doubled; growing to over 180 projects that are generating about 400 million kWh of energy per year.

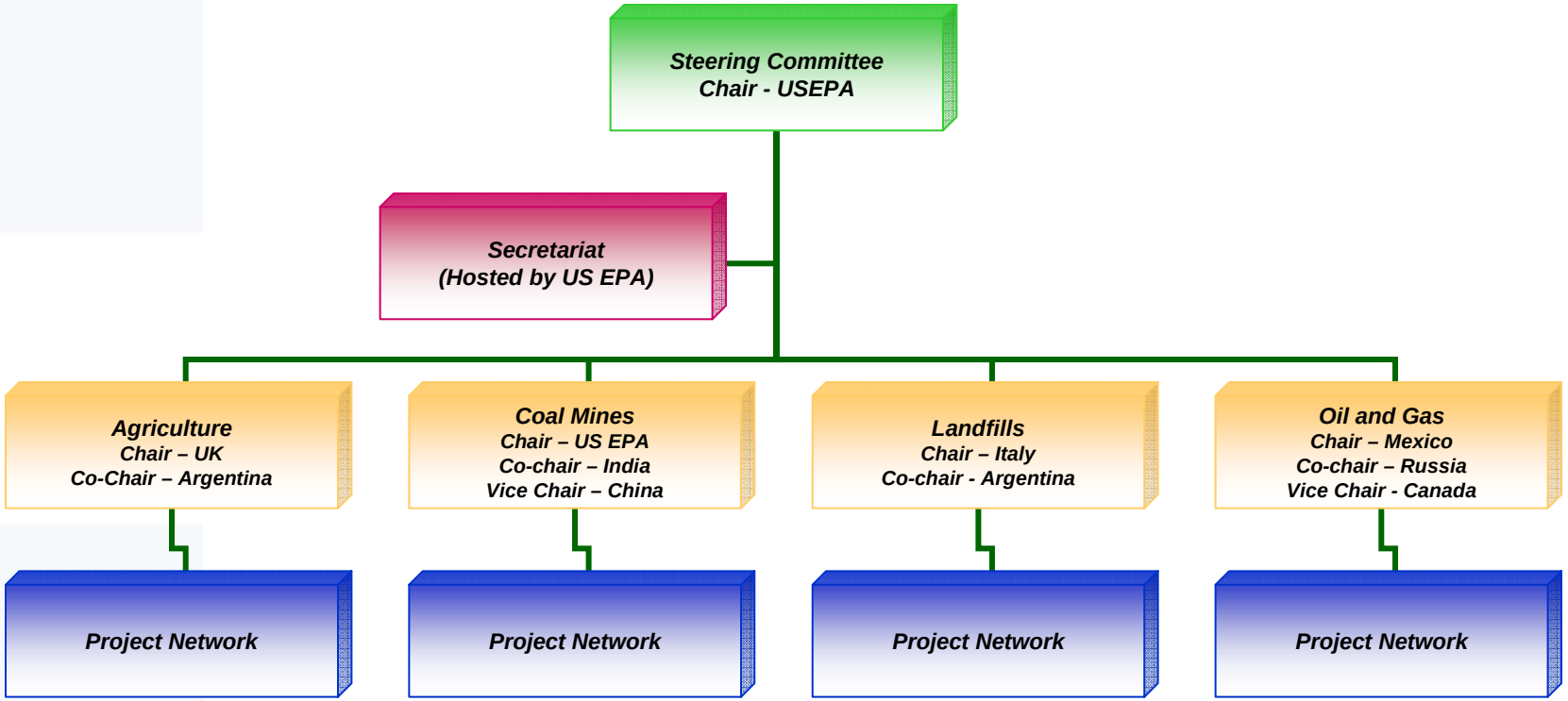
Methane to Markets

U.S. Involvement in M2M

- Broad involvement and coordination

- U.S. pledged $53 million over five years at M2M launch in 2004
- Recent activities
  - Technical experts participate on all subcommittees and promote projects and activities that support sector action plans on a bilateral basis
  - $2.5 million grant solicitation on projects that promote M2M
  - Released USG Accomplishments report in October 2006
    - Ongoing projects and activities supported by U.S. are expect to achieve annual emission reductions of 5 MMTCO2E

M2M Organization and Structure



Methane to Markets

Activities and Workplan

- Subcommittees develop and implement “Action Plans” focusing on concrete activities to overcome barriers to projects
  - Country profiles in each sector
  - Address policy, training, capacity building, tech transfer issues
  - *Identify and promote near-term project opportunities*
- Build Partnerships by expanding the Project Network
  - Critical organizations include private sector and the investment community among others
  - Provide value to PN members who are actively promoting projects
- Track and Communicate Accomplishments
  - 2008 Progress Report Planned
  - USG Accomplishment Report available now
- M2M Partnership EXPO, October 2007
  - Partners to support development of project pipelines

M2M Partnership Expo – 30 Oct 2007

Hosted by China's National Development and Reform Commission and U.S. EPA, the Expo will:

- Highlight methane capture and use technologies and services in a trade show format
- Showcase project opportunities to potential investors
- Parallel sector tracks covering technical, policy, financing, and regulatory issues related to project development.

Beijing, China

30 October – 1 November 2007

For more information go to: www.methanetomarkets.org/expo

Methane Emissions from the Oil and Gas Industry

- M2M countries contribute 56% of global methane emissions from oil and gas systems

Emissions from Natural Gas and Oil Systems in 2005 ($MtCO_2e$)

Russia	172.7
US	127.6
Ukraine	90.8
Mexico	77.2
Nigeria	51.3
Canada	38.3
India	**26.0**
Argentina	15.1
UK	8.0
Germany	7.7

Australia	7.6
China	6.3
Poland	5.8
Italy	5.4
South Korea	4.1
Brazil	3.7
Colombia	1.9
Ecuador	0.7
Japan	0.4

M2M Countries: 650.6
Global: 1,165.0

Global Anthropogenic Emissions of Non-CO_2 Greenhouse Gases 1990-2020, U.S. EPA, June, 2006

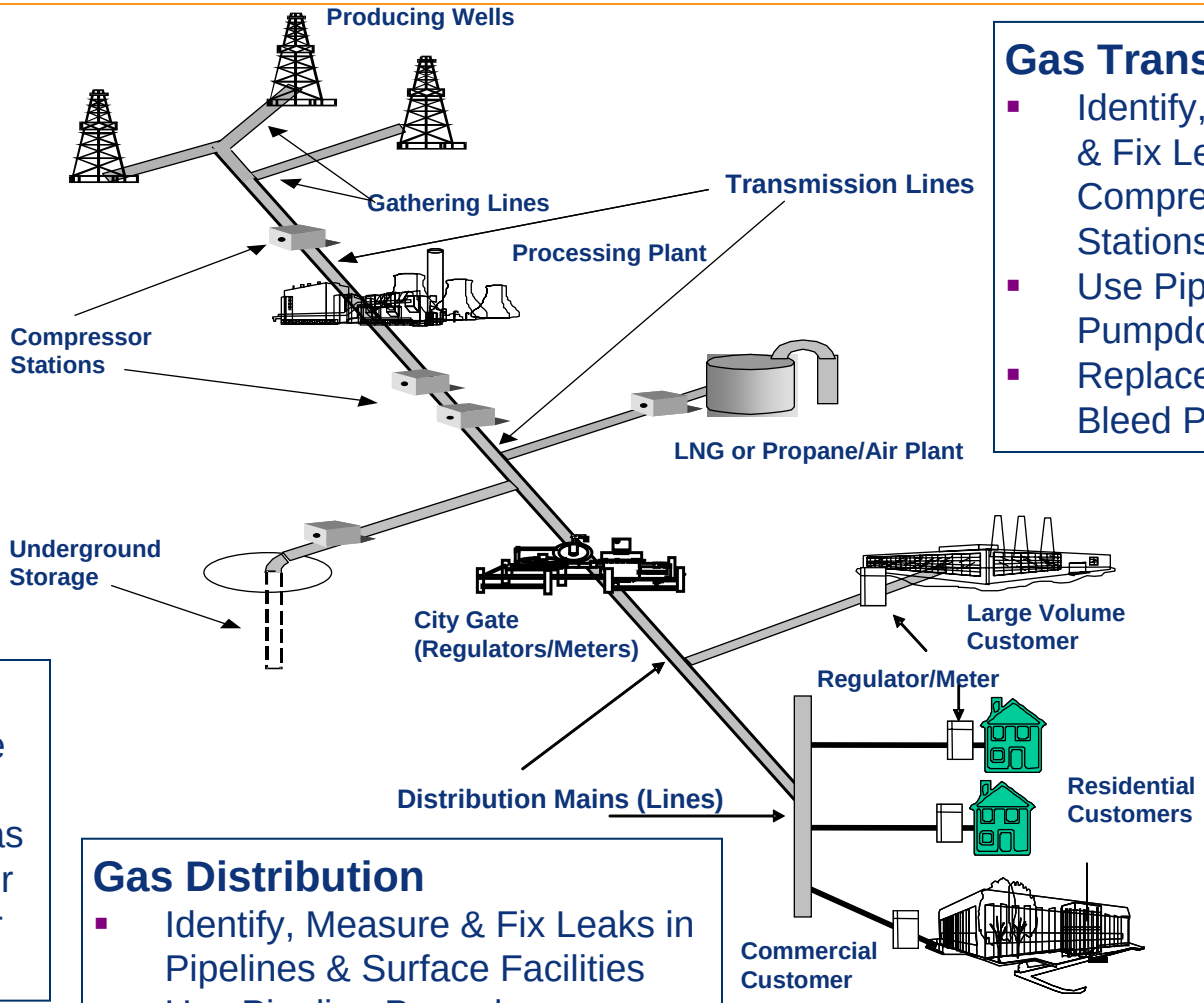
Oil & Gas Methane Emission Reduction Opportunities

Gas Production & Processing

- Reduced Emission Well Completions
- Install Plunger Lifts on Gas Wells
- Identify, Measure & Fix Leaks in Processing Plants
- Install Flash Tank Separators on Dehydrators

Oil Production

- Install VRUs on Crude Oil Storage Tanks
- Route Casinghead Gas to VRU or Compressor for Recovery & Use or Sale



Gas Distribution

- Identify, Measure & Fix Leaks in Pipelines & Surface Facilities
- Use Pipeline Pumpdown Techniques to Minimize Venting

Gas Transmission

- Identify, Measure & Fix Leaks in Compressor Stations, Pipelines
- Use Pipeline Pumpdown
- Replace High-Bleed Pneumatics

Picture courtesy of American Gas Association

Methane to Markets Activities

- Reducing methane emissions is profitable in a variety of ways:
  - Sales value of recovered methane and other hydrocarbons
  - Lower costs by installing state-of-the-art equipment
    - Operating
    - Maintenance
    - Fuel
    - Capital / replacement
  - Potential carbon market value
- Methane to Markets can help Partner organizations benefit from these revenue sources with assistance in:
  - Project feasibility studies
  - Technical training or assistance
  - Demonstrations
- International GasStar Launched in 2006

Reducing Emissions: Leak inspection and repair

Reducing Emissions: Change compressor maintenance and shutdown practices

Methane to Markets

Case Study: Colombia

- One partner company has oil production facilities in Colombia that are currently flaring and venting methane
- EPA proposed the process diagrammed below to turn methane emissions and gas waste into electrical energy
  - Install VRU to capture vented emissions off water knockout tank
  - Install Reciprocating Engine/Generator to burn previously flared gas for electricity

Key Savings

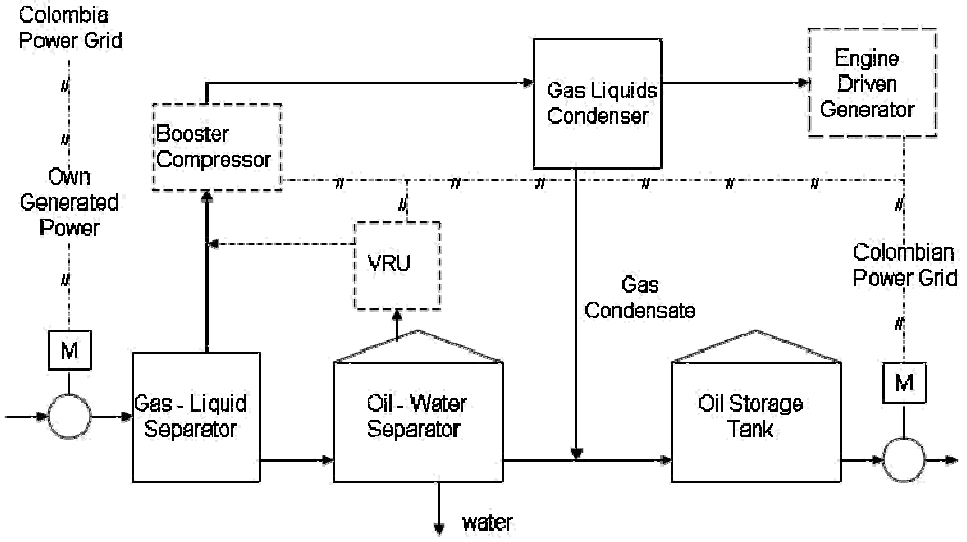
- 3,100,000 m^3 per year not flared/vented
- Power Generated - 8 Mega Watts (MW)

Economics

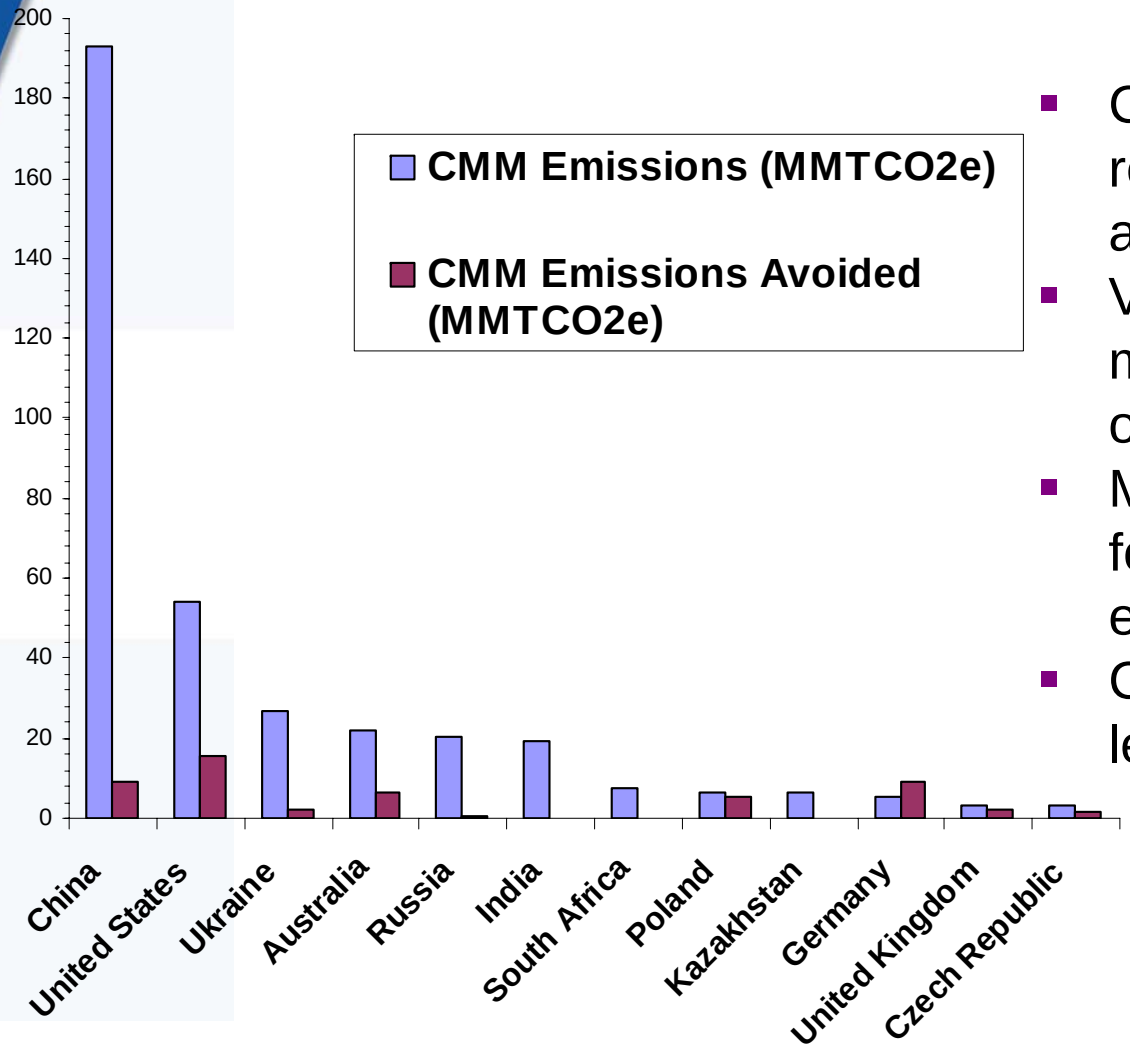
- 14 months simple payback
- 87% internal rate of return

Carbon reductions

- 283,000 m^3 per year methane
- 80,000 TCO_2e per year



Global Emissions of Coal Mine Methane (CMM)



- CMM emissions represent ~8% of global anthropogenic methane
- Ventilation systems are most significant source of CMM emissions
- M2M Partners account for about 85% of all VAM emissions
- China and US are leading emitters

Mitigation of CMM

Recovery of CMM from diverse sources

- Ventilation Air Methane
- Pre-Mine Drainage
- Gob/Goaf Gas
- In-Mine
- Abandoned (closed) Mine Methane

Ventilation shafts produce large volumes of very dilute methane (~ 1% or less) that is challenging to recover

"Drainage" of CMM from active or closed mines yield gas streams quality ranging from low to high concentrations of methane

CMM End-Use Opportunities

High-Quality Gas

- Natural gas pipelines
- Local distribution
- Vehicle fuel (LNG)

Medium-Quality Gas

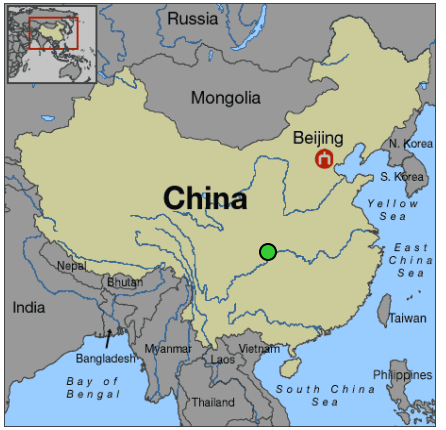
- Power generation
- Combined heat & power
- District heating
- Coal drying
- Boiler fuel
- Industrial applications
- Fuel cells

Low-Quality Gas & Ventilation Air Methane

- Oxidation
- Combustion air
- Lean burn turbines

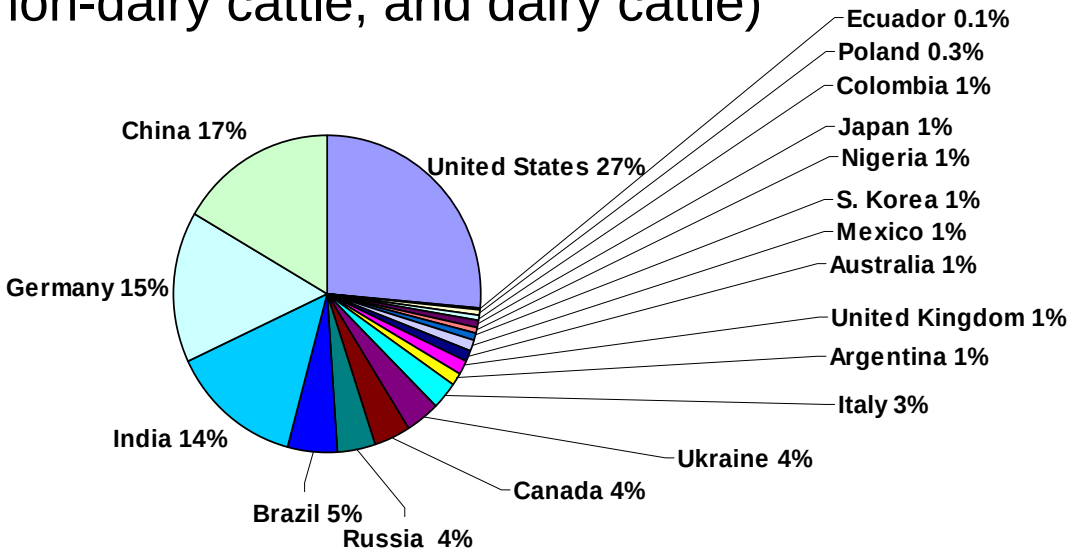
Key CMM project example: Sihe Mine, Jincheng

- Hosted by Jincheng Mining Group, Shanxi Province, China
- World's largest CMM power generation project (120 MW)
  - Will utilize IC engines (Caterpillar)
- Project financing: $237 million project funding
  - $117 million ADB loan for project development
  - $500,000 USTDA technical assistance grant to support project design, engineering, and procurement decisions
  - Other equity and debt sources include JBIC, local entities
  - World Bank Carbon Finance Unit deal to buy carbon credits (CERs)



Global Emissions from Agriculture (Animal Waste)

- Methane is produced and emitted during the anaerobic decomposition of organic material in livestock manure
- Globally, livestock manure contributes ~70 MMTCE of methane emissions
- Three groups of animals account for >80% of total emissions (swine, non-dairy cattle, and dairy cattle)
- M2M Countries represent 62.4% of global emissions from the Manure Management sector



Overview: Potential Methane Reduction Options

- **Aeration** – energy is used to provide oxygen to meet oxygen demand of waste (1 lbs. BOD requires 1 HP)
  - energy intensive and very expensive
  - used as tertiary treatment in sewage to meet discharge requirement
  - residual solids become problematic
  - Can produce nitrous oxide - much higher GWP
- **Shifting liquid/slurry handling to solid manure handling**
  - very limited because of scale
  - more economical to flush manure from confined production systems (pigs and dairy)
- **Anaerobic digesters**
  - consistent with farm waste handling objectives
  - oxygen demand satisfied anaerobically
  - produces biogas providing farm energy opportunities

Aeration

Anaerobic Digester

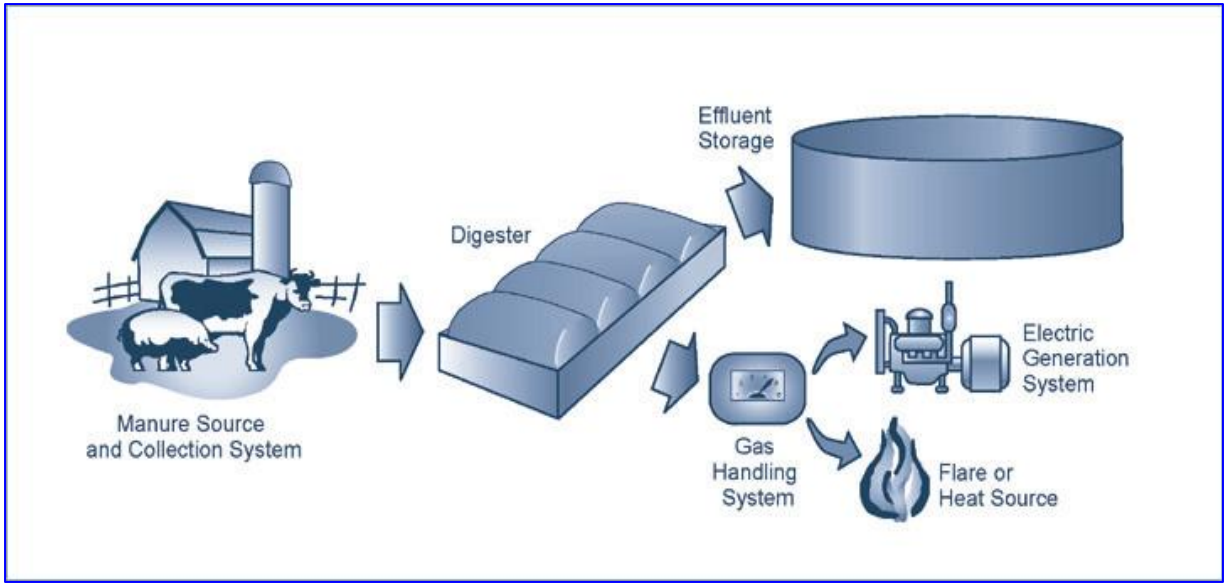
What are Anaerobic Digesters?

- Anaerobic digestion is a biological process. It occurs in an oxygen free environment.
- Biological treatment/stabilization systems that collect and combust off-gases.
- Digesters separate manure treatment from storage functions which can result in lower initial installation costs for new or expanding farms

✓**Air Quality benefits** (odor, GHGs, H.S., ammonia)

✓**Water Quality benefits** (BOD, pathogens, nutrient management)

✓**Return on Investment…Energy revenues**



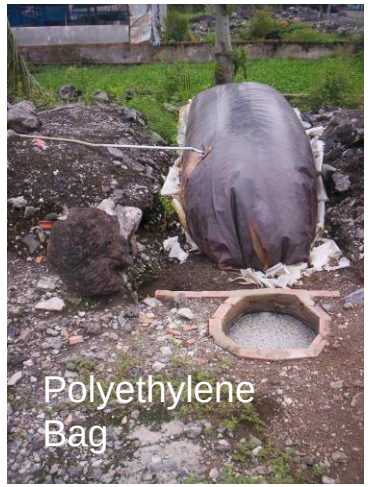
Examples of GHG Reduction and Gas Use Options/Needs

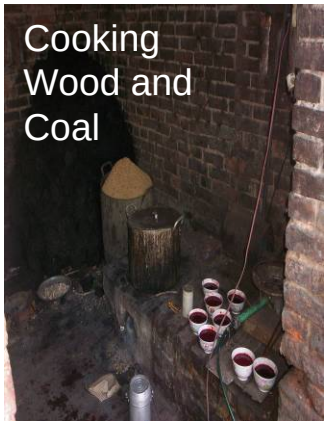
GHG Reduction

- Anaerobic blankets
- Covered lagoons
- Fixed dome
- Polyethylene and PolyPro bags

End Uses/Needs

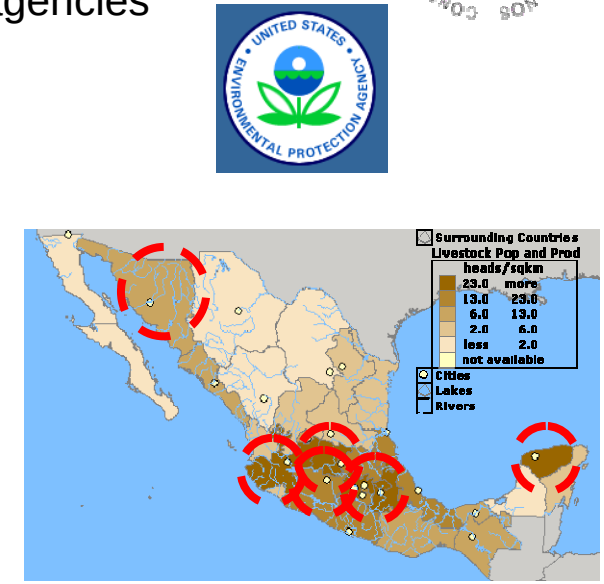
- Pumps
- Cooking
- Shaft Power
- Heat lamps and Light
- Electricity/Cogen
- Propane Offset
- Flares





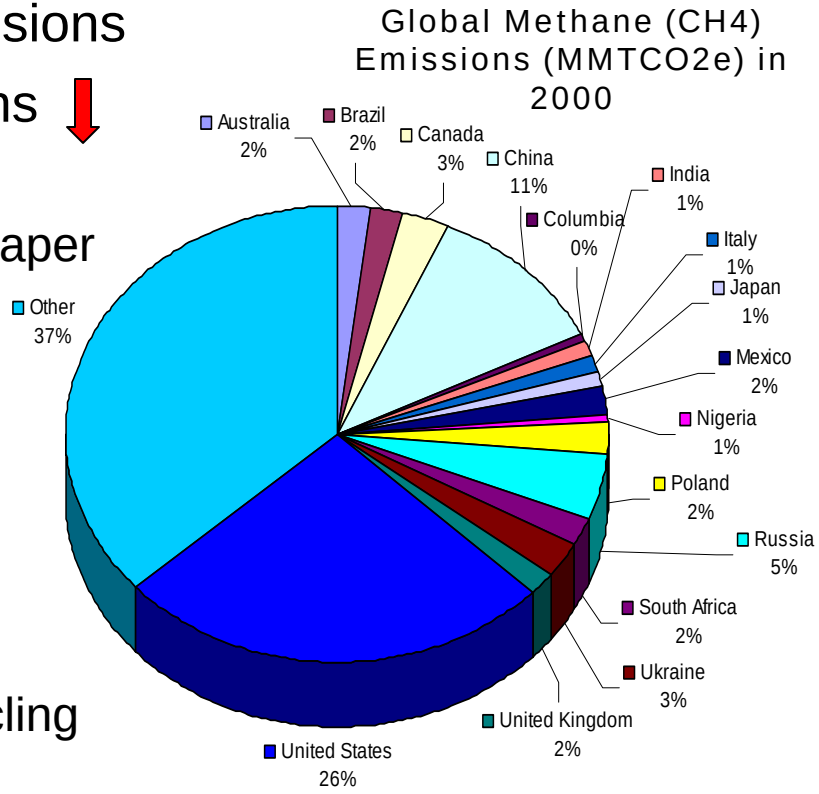
Mexico: Case Study

- 2nd largest swine population in Latin America (>18 million pigs)
- Program Approach
  - Identify M.R. opportunities and implement demonstration projects
  - Follow-on workshop/extension component
  - Add-on capacity building and policy component
  - Program coordinated with USAID and national agencies
- M2M focusing on Two Regions
  - Lerma Chapala watershed
  - Veracruz
- Methane reductions small/medium farms (CE)
  - Ranges 1 – 1,000 MT/year/farm
- Methane Reduction corporate farms (CE)
  - Sow 6,000 MT/year/farm
  - Finishing 2,500 MT/year/farm
  - 80,000 MT/year/pyramid



Landfill Methane Capture and Use

- Methane is produced and emitted during the anaerobic decomposition of organic material in landfills
- Globally, landfills are the 3rd largest anthropogenic source, accounting for 13 percent of emissions
- Emissions in Industrialized Nations ↓
  - Increased LFG regulation
  - Increased recycling of organics/paper
  - Increased utilization (>1000)
- Developing Nations Sharply ↑
  - Shift from open dumps to sanitary/engineered landfills
  - Increased MSW generation and disposal
  - Lack of LFG regulation and recycling



Project Examples: World Bank Collaboration

- 2005 Latin American LFG Project Expo in Uruguay
  - *Objective:* present the result of 10 pre-feasibility studies to encourage landfill representatives to engage the private sector to seek investment opportunities.
  - *Results:* at least 5 of the 10 sites are proceeding to full-scale project implementation.
- Pre-feasibility Studies
  - 2-5 studies planned in Latin America and China.
  - World Bank identifies the municipalities and EPA conducts the technical studies.
- Training and Workshops
  - Participated in capacity building events in India and China.
- Evaluated landfill methane project opportunities and improved solid waste disposal practices in 56 provincial capitals in Thailand

Case Study: USEPA and Mexico Landfill Gas Collaboration

- Beginning in 2005, USEPA, SEMARNAT, SEDESOL, NADBank, BECC, and USAID partnered to evaluate landfill gas uses at landfills along the US/Mexico border
- EPA adapted LFG modeling tools to suit conditions in Mexico
- Several sites were reviewed and two landfills were selected for further study:
  - **Pre-feasibility assessments performed at Ensenada and Nuevo Laredo**
- Both studies are in draft and under review by SEMERNAT and the municipalities. Once final the studies will be used to attract investors to develop landfill gas capture and control projects.
- Upcoming activities:
  - Work with SEMARNAT to identify other candidate sites for assessment
  - Hold a workshop to assist municipalities with selecting a developer

Methane to Markets

Conclusions

- M2M is a unique international partnership
  - Near-term
  - Voluntary
  - Public-private
  - Multiple benefits (energy, economic, environmental, safety)
- M2M focuses on offering valuable collaborative opportunities for methane project development

Contact Information

- M2M Secretariat
  - asg@methanetomarkets.org
  - www.methanetomarkets.org
- Erin Birgfeld
  - Tel: +1.202.343.9079
  - Fax: +1.202.343.2202
  - birgfeld.erin@epa.gov