Methane - Mitigation Technologies, Options, and Policies

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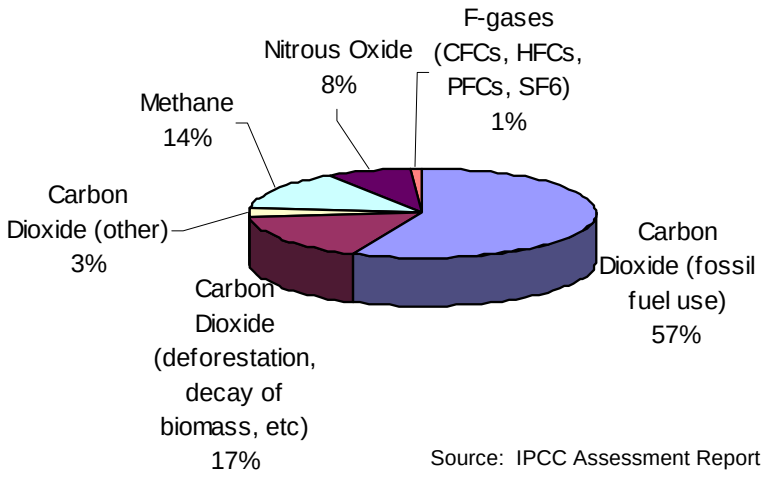
Overview

- Importance of Methane
- Technology and Mitigation Options
- Mitigation Analysis - Economic Potential
- Efforts to Reduce Methane
  - Policy Measures
  - International – Kyoto – Methane to Markets
- Next Steps & Concluding Thoughts

Methane as a Greenhouse Gas

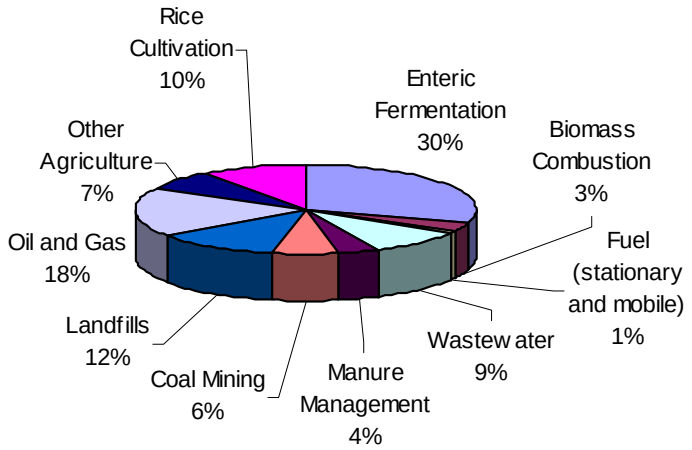
- A potent greenhouse gas (GHG) with 100-year global warming potential (GWP) of 23 and atmospheric lifetime of ~12 years
- The 2nd most important GHG, accounting for ~18% of total radiative (climate) forcing, or about one-third of that of CO_2. (IPCC)

Global Anthropogenic GHG Emissions by Gas (2004)



Source: IPCC Assessment Report 4 (2007)

Estimated Global Anthropogenic Methane Emissions by Source (2005)

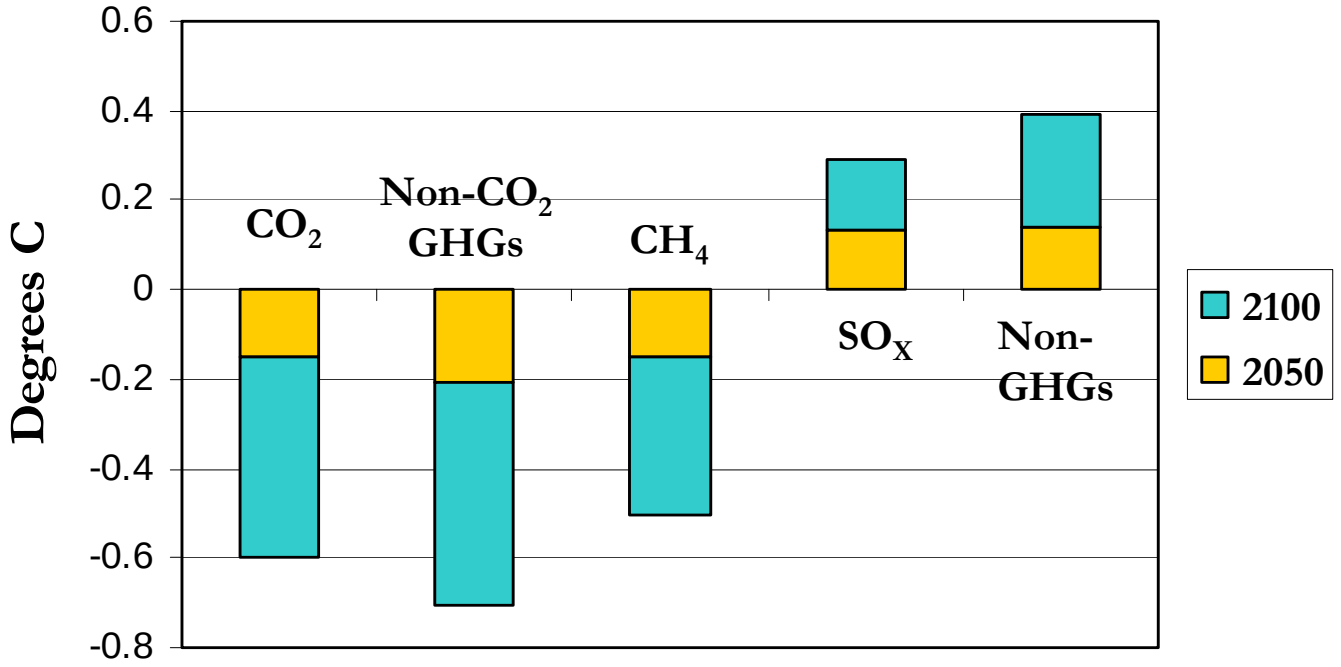


Source: U.S. EPA Report (2006)

Why Target Methane?

Global mean temperature effect of a 50% reduction in greenhouse emissions from reference between 2000 – 2050, maintained through 2100.

★ *Reducing CH_4 emissions offers significant near term climate benefits.*



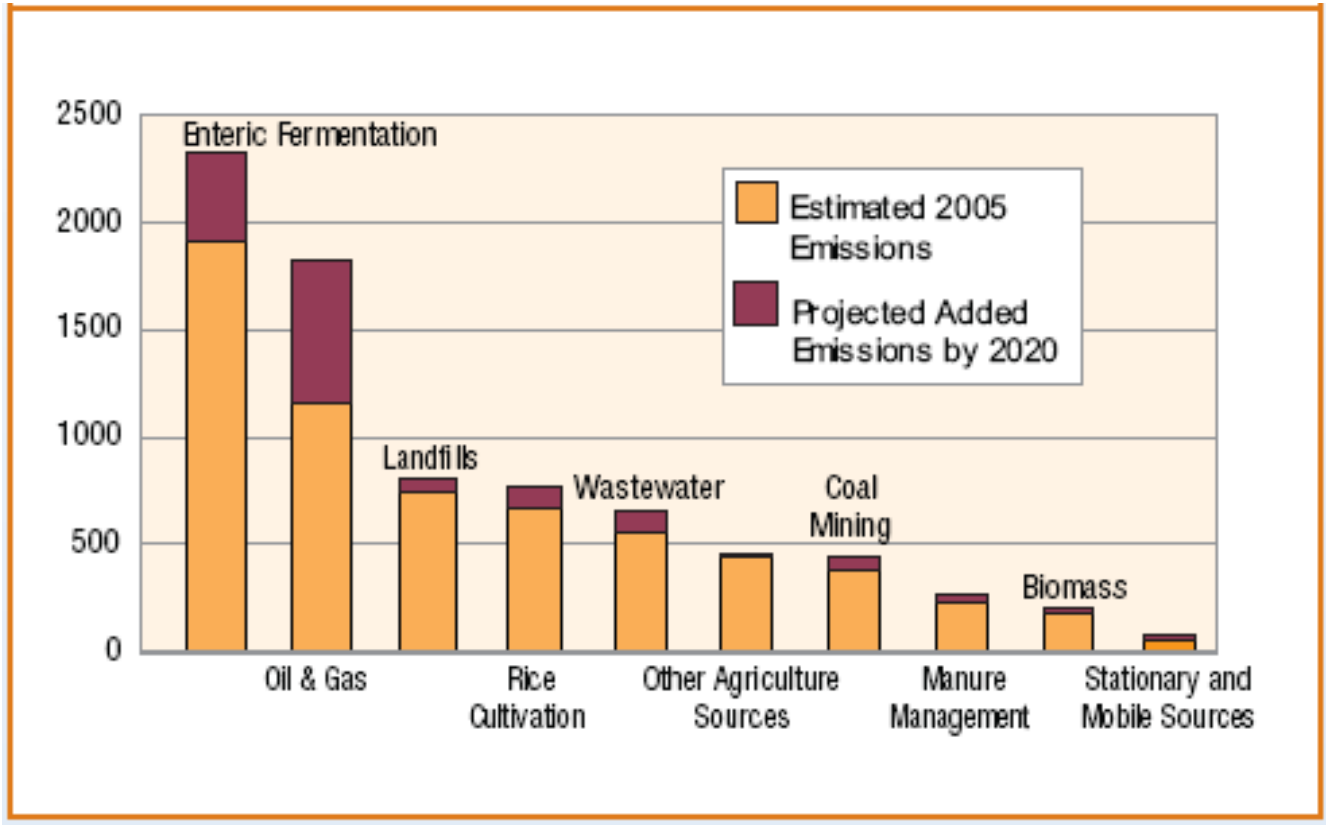
Source: MIT, 2003

Methane Mitigation Delivers Significant Co-Benefits

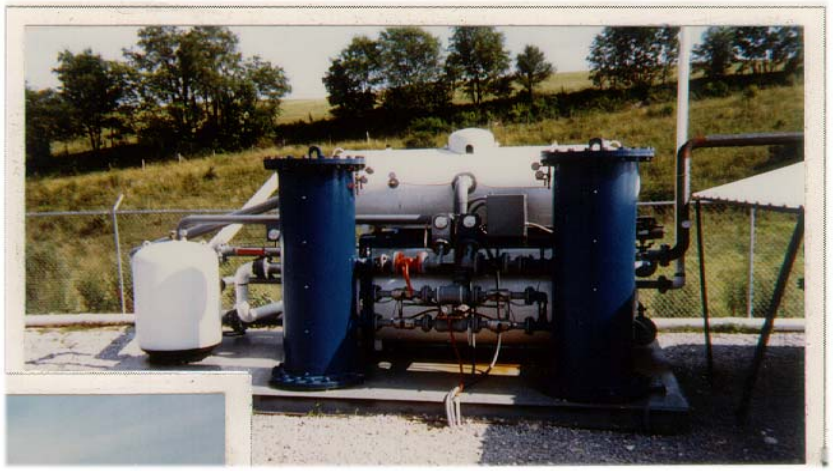
- **New Energy Sources**
  - Mitigation makes methane available for local energy purposes, thereby strengthening energy security, enhancing local economies and fostering sustainability
- **Environmental Quality and Public Health**
  - Local water quality improvements due to improved management of agricultural wastes
  - Reduction of local emissions of VOCs from landfills, agriculture, and oil and gas systems
- **Industrial Safety**
  - Methane is explosive - improved worker safety in the coal and oil & gas sectors
- **Odor reduction** (landfills, agriculture)

Future Emissions Growth

Global anthropogenic methane emissions are projected to increase by 23 percent to 7,904MMTCO$_2$E by 2020



Reducing CH_4 from Energy



- Coal Mines
  - Drill wells to recover CH_4 released by mining
  - Use in pipelines, electricity, at the mine
  - Improve mine safety
- Oil and Gas Systems
  - Reduce leaks and improve practices at all stages of system
  - Eliminate venting
  - More product to sell

Reduce CH_4 from Waste

- Landfills
  - Collect CH_4 generated by waste decomposition
  - Use for electricity, industry, communities, vehicles, flare
  - Improve safety and odors

- Livestock Manure
  - Collect CH_4 generated in large dairy/swine lagoons
  - Use on-farm, generate electricity, flare
  - Reduce odors, improve water quality

Reduce CH_4 from Agriculture

- Ruminant Livestock
  - Improve diet and nutrition
  - Improve overall animal health
  - Increased product (milk, meat, work) from animals
  - Lower emissions per unit product

- Rice Cultivation
  - Use different cultivars
  - Modify water management, fertilization practices
  - More research needed to ensure productivity maintained and no unintended effects (i.e., N_2O)

Technology Potential

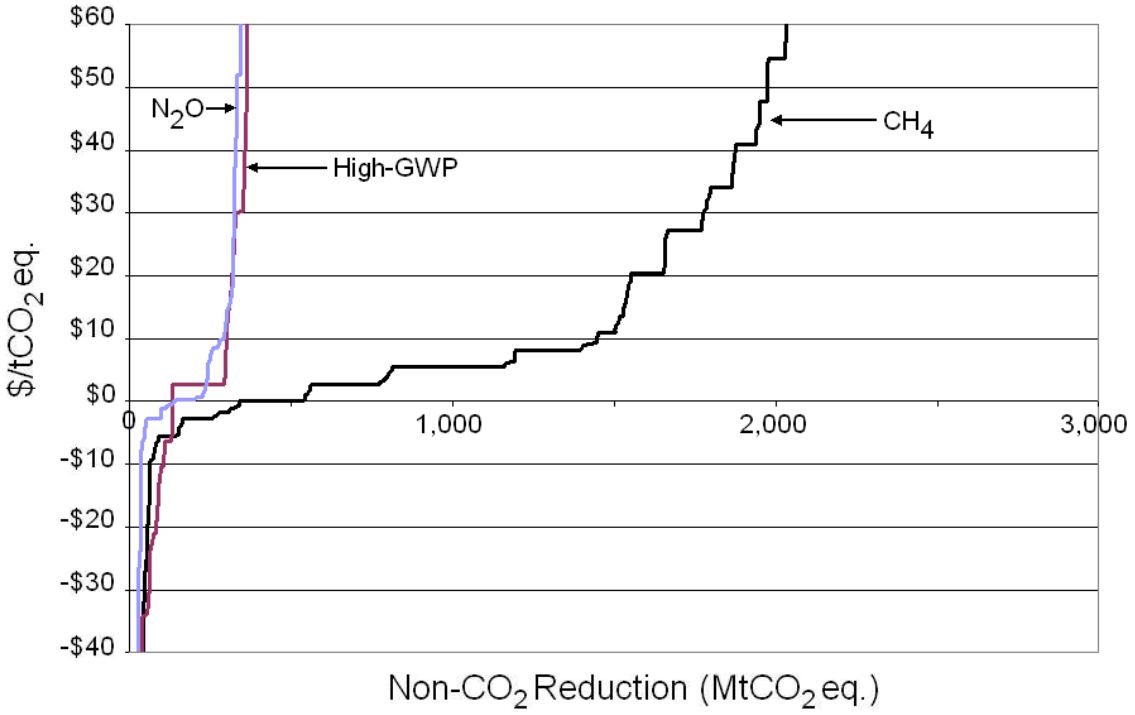
Source	Near-Term Potential	Expanded Longer-Term Potential?
Coal Mining	Strong	Yes (mine ventilation air)
Oil & Gas Systems	Strong	Yes (better leak detection)
Landfills	Strong	Yes (recycling, advanced land filling practices)
Livestock Manure	Good, but *	Yes
Ruminant Livestock	Limited	Yes, but*
Rice Cultivation	Limited	Yes, but*

* Significant deployment challenges (i.e., number of actors, markets)

Cost Effective Opportunities

Methane mitigation has the largest potential across all the non-CO_2 greenhouse gases

- At a cost-effective level, the potential for methane mitigation is greater than 500 $MtCO_2eq$.
- The potential for reducing methane emissions grows three-fold as the breakeven price rises from \$0 to \$20/tCO_2eq.
- At a breakeven price of \$30/tCO2eq, reduction potential reaches nearly 1,800 MtCO2eq
- While less than that of methane, nitrous oxide and high-GWP gases exhibit significant cost-effective mitigation potential.



Policy Instruments for Methane

- Partnership programs aimed at overcoming market barriers
  - Successful strategy in US with coal, landfill & oil/gas
  - Focuses on cost-effective reduction opportunities
- Regulatory programs
  - US Landfill Rule (Clean Air Act-NSPS)
- Financial Incentives
  - Tax credits (i.e., coalbed methane, landfill gas, renewable energy)
  - Can encourage energy recovery
- Market Mechanisms
  - Emissions trading or offsets (CDM/JI)

Methane in the Kyoto Protocol

- Methane included in “basket of gases”
- Domestic methane reductions targeted by many Annex I countries
  - However, CH_4 not currently included in the EU emission Trading System
- Strong international interest in methane through the Clean Development Mechanism (CDM)
  - Primarily landfills, coal mines, and livestock manure

Methane to Markets (M2M) Partnership

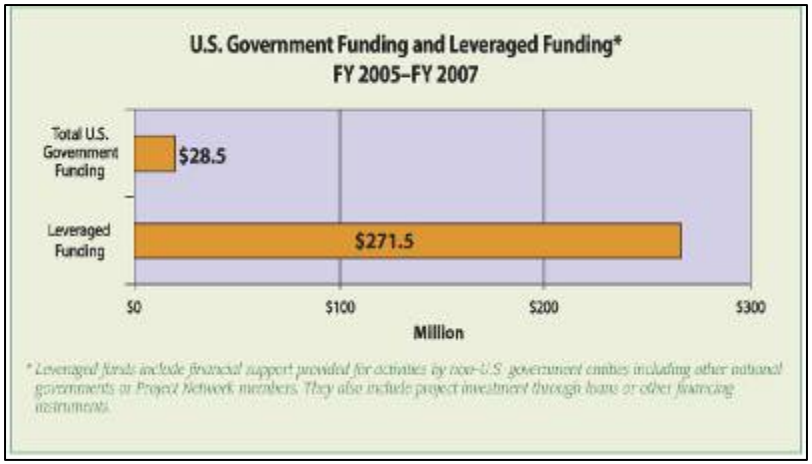
- Encourages development of ***cost-effective*** methane recovery and use opportunities in
  - coal mines
  - landfills
  - oil and gas systems and
  - agriculture (manure waste management)
- Private companies, multilateral development banks and other relevant organizations participate by joining the ***Project Network – over 850 organizations now participating***
- 29 Partner Governments

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

US M2M Commitment

- EPA is USG-lead for M2M
- USG Provided $38 million over four years since Partnership launch in 2004. To date:
  - Supporting a wide range of projects and activities
  - Leveraged over $270 million in public and private sector contributions

- Providing significant support to the Partnership through the ASG and technical support in all 4 sectors
  - Supporting projects in Argentina, Brazil, China, Colombia, Ecuador, India, Korea, Mexico, Mongolia, Nigeria, Poland, Philippines, Russia, Thailand, Ukraine and Vietnam.



Key M2M Successes

- Brought high-level focus on methane
  - Raising awareness within governments of the multiple benefits of methane recovery
  - Demonstrate importance of near-term climate benefits at low cost
- Directly involving the private sector and financing organizations
- Provides technical assistance and capacity building to ensure long-term project success of projects both under and outside of the Kyoto Protocol

- Successful engagement of key developing countries
  - China, India, Brazil, Mexico
- 30 country action plans across the four target sectors –140 projects and activities in countries across the globe
- Achieving real reductions – Ongoing projects and activities are expect to achieve annual emission reductions of 24 MMTCO$_2$E

Next Steps for M2M

- Terms of Reference up for renewal in 2009/2010
- Growing interest in accelerating global methane efforts due to impacts in the Arctic and near-term benefits (economic-energy-climate) of methane
- Opportunities to expand scope and commitments
  - New emission sources (wastewater, livestock, rice cultivation)
  - New and increased commitments (financial, policies and measures)
  - Enhanced monitoring and reporting
- Possible linkages to a post-2012 agreement
- M2M Steering Committee has process for moving forward
  - ASG seeking input on potential futures from M2M countries
  - ASG developing white paper assessing different options for moving the Partnership forward
  - Steering Committee will meet September 10-11, 2009 in Washington, DC to discuss future directions

Take Home Messages for CH_4 . . .

- Methane is essentially “natural gas”
  - Technologies for methane recovery and use are available
  - Favorable economics due to the market value of natural gas
- Many methane projects can be readily “added on” or integrated into ongoing operations
- The non-climate reasons for reducing methane are frequently more important to the involved parties
  - Energy
  - Safety issues
  - Productivity
  - Quality of life – odors, clean fuel supplies

U.S. EPA Contacts and Additional Materials

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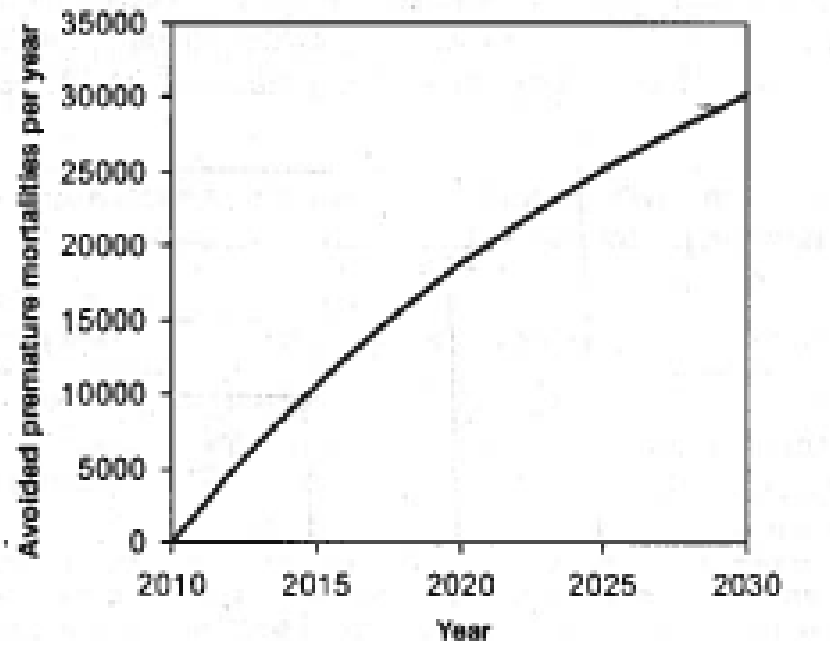
Methane and Ozone – GHG and Air Quality Benefits

- Methane contributes to background tropospheric ozone levels by increasing summer afternoon temperatures
- Methane emission reductions can result in avoided mortalities
- Capturing methane can also reduce VOC emissions and control noxious odors



Avoided global mortalities based on a 65 Mt/yr reduction in methane emissions starting in 2010 (West et al, 2006)

Reduction Potential for Key Sectors

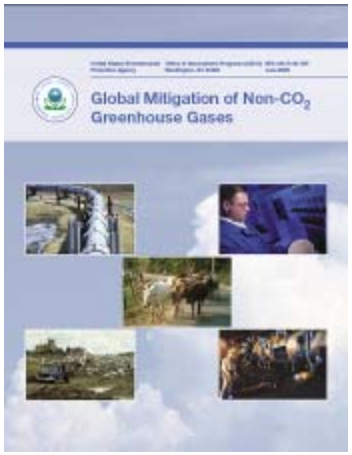
Cost per $MTCO_2E$	$0	$15	$30	$45	$60	Baseline ($MMTCO_2E$)
Agriculture	13%	21%	30%	34%	36%	269.3
Coal Mines	15%	80%	80%	80%	80%	449.5
Landfills	12%	41%	50%	57%	88%	816.9
Oil & Gas	10%	25%	33%	38%	54%	1,695.8

Source: *Global Mitigation of Non-CO_2 Greenhouse Gases: 1990–2020* (EPA Report 430-R-06-005)

Mitigation Potential

- Recent focus on multi-gas strategies calls for
  - improved understanding of mitigation potential
  - incorporation of non-CO2 greenhouse gas mitigation estimates in climate economic analyses, including “offsets” analyses and integrated assessment climate scenarios modeling
- USEPA has developed a comprehensive global mitigation analysis for non-CO_2 GHGs, covering:
  - all non-CO2 greenhouse gases (methane, nitrous oxide, high GWP gases)
  - all emitting sectors (energy, waste, agriculture, and industrial processes)
  - all regions of the world
- Bottom-up analysis of mitigation option breakeven prices
- Determines at what carbon price a mitigation option becomes economically viable

http:/www.epa.gov/nonco2/econ-inv/international.html



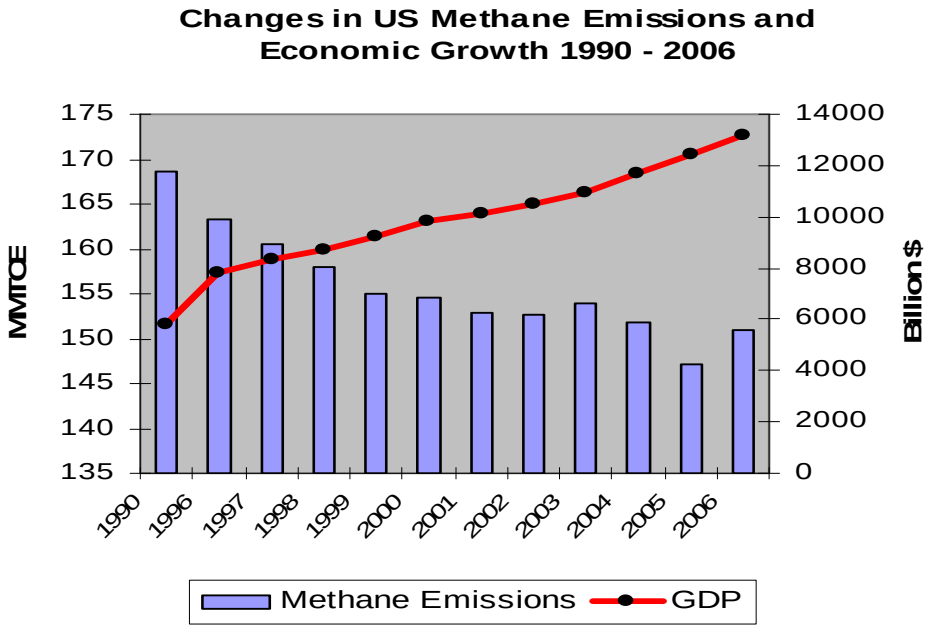
***Global Mitigation of Non-CO_2 Greenhouse Gases* (USEPA, 2006)**

Barriers beyond Economics

- Lack of awareness of emission levels, reduction opportunities and value of lost fuel
- Lack of information on and training in new technologies and practices
- Traditional industry practices
- Regulatory and legal issues
- Limited methane markets and infrastructure
- Lack of institutional capacity

Methane Partnerships

- Natural Gas STAR
  - over 100 companies (57% of industry) in program
  - Since 1993, companies have reported reductions of 63 MMTCE, valued at over $4.2 billion USD.
- Coalbed Methane Outreach Program
  - 80% of mine degasification CH4 is used (up from 25% in 1993)
  - industry effort to demonstrate use for ventilation air methane
- Landfill Methane Outreach Program
  - Over 425 US projects -- tripled since 1994
  - Strong corporate interest in use of landfill gas
- AgSTAR
  - Since 1994, the number of biogas recovery systems has doubled; over 180 projects - generating about 300 million kWh per year.



So, is there potential for a "success story" here?

- It depends…
  - Technically: significant, near-term reduction potential
  - Economically: many profitable opportunities and more at comparatively low-cost (in climate terms)
- But what level of CH_4 reduction is "success"?
  - Methane to Markets & the Kyoto Protocol will result in emission reductions
  - Are these approaches "enough" and can they be enhanced?
- In 2002, EPA examined the feasibility of the methane component of the "Hansen scenario"
  - Could we stabilize methane emissions over the period 2000 to 2050?
  - The analysis has not been updated but main findings hold true

Conclusion

- *Stabilization could nearly be achieved in 2025 based on the emission reduction potential associated with four major methane sources: landfills, coal mines, natural gas & oil systems, and manure management systems*

- *Maintaining stabilization through 2050 would necessitate emission reductions across a wider array of sources, particularly ruminant livestock and rice production.*