Methane to Markets Partnership
Coal Mine Methane Subcommittee
Country Profile: United States of America

I. Introduction Or Summary Of Coal Industry And CMM Recovery/Use

A. Coal Industry

(sources: US Energy Information Administration, National Mining Association)

- The US is the world second largest coal producer after China, and coal is the leading domestic source of energy production in the US.
- The gassy coal seams of the US are found in four geographic regions: the Appalachian Basins of the eastern US (medium to high volatile bituminous and anthracite); the Illinois Basin in the Midwest (medium to high volatile bituminous), the Rocky Mountain Basins in the western US (lignite, subbituminous to medium/high volatile bituminous), and the Gulf Coast and Anadarko Basins of the South/Southwest (lignite, subbituminous – medium/high volatile bituminous).
- Total US coal production in 2003 was 1.07 billion short tonnes (971 million metric tonnes). Almost all coal produced in the US is consumed in domestic markets. The US exports only 4% of its coal production, and its imports equal 2.5% of total domestic production.
- Coal production and use have risen steadily since 1960 are expected to continue this trend through at least 2025.
- Recoverable reserves are currently estimated at 268 billion short tons providing a 250-year supply.
- In 2003, underground coal production was 33% of total US coal production or 353 million short tons. Of the 58 "Major Mines" in the US (EIA classification - minimum 4 million tons per year of coal production), 20 are underground mines.
- Underground mines in the US are either longwall or room and pillar operations. Room and pillar operations are either conventional or continuous mining operations.
- Longwall mines produced 184 tons or 52% of underground production, and 36 of the 50 gassiest underground mines are longwall operations with the remaining 14 using continuous miners.
- Electric power generation is the predominant market for coal in the US accounting for 92% of all coal consumption, and 53% of all electricity produced in the US in 2003 was from coal-fired plants.

B. Coal Mine Methane

(Sources: U.S. Environmental Protection Agency; Mine Safety & Health Administration/US Department of Labor)

- The US has significant coalbed methane resources. Various sources estimate the CBM resource base at between 4 and 11 trillion cubic meters (Tm^3) ranking the US behind Canada, Russia, China, and Australia.
- Active methane drainage has been employed at US mines for many years, and pre-mine drainage began in the 1970's.
- The US ranks behind China as the second largest emitter of coal mine methane.
- Major sources of CMM emissions
    - Active mines
        - Ventilation systems generate 58% of active underground emissions
        - Methane drainage systems generate 42% of active underground mine emissions
    - Active Surface (i.e., open cast) mines
    - Abandoned underground mines.

  - Post-mining activities such as processing, storage and transportation (minimal effort on recovery and use of post-mining emissions).
- The US includes active mine emissions and abandoned mine emissions in its annual *Inventory of Greenhouse Gas Emissions and Sinks*.
  - The methodology used to calculate active underground emissions uses mine specific data and meets IPCC Tier 3 guidelines.
  - The methodology for surface mine emissions and post-mining emissions use basin- or sub-basin specific emission factors and coal production is consistent with IPCC Tier 2 guidelines.
- CMM emissions at active mines: 1990 and 2003
  - Total annual emissions declined by 28.4 million metric tonnes of carbon dioxide equivalent (MMTCO2E) or 35% from 82.17 MMT to 53.77 MMT between 1990 and 2003 (see Tables 1 and 2).
  - 10.5 MMT or 37% of the reduction in total annual emissions (74% reduction in underground emissions) is due to additional recovery and use of CMM. The remainder is due to industry restructuring and closure of gassy mines.
- Methane drainage efficiency increased from 32% in 1990 to 42% in 2003. The US defines "drainage efficiency" as the quantity of methane drained from active underground mines as a percentage of the total methane liberated through drainage and ventilation systems.
- Through 2004, all CMM and AMM used in the US have been recovered through methane drainage systems. To date, there has been no attempt at recovering and using ventilation air methane (VAM) or methane from post-mining activities. There is some interest in draining methane from the high wall at open caste mines.
- Almost all CMM captured in the US is injected into the natural gas pipeline network due to mature infrastructure and low cost. In the Eastern US, it is even economically viable to upgrade the gas quality through processing (e.g.,pressure swing adsorption, cryogenic processes).
- Other uses in the US include coal drying, mine heating, and power generation. Demonstration projects include use of CMM in fuel cells (completed in 2004) and conversion to LNG for use in fleet vehicles (still under development).

Table 1: US Coal Mine Methane Emissions (Million Cubic Meters)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
UG Liberated	4,758	4,645	4,588	4,022	4,078	4,446	4,220	3,908	4,135	3,823	3,795	3,823	3,738	3,761
Post UG	538	510	510	453	481	481	510	510	510	481	481	481	453	447
Surface	736	680	680	651	623	651	651	651	651	623	623	651	623	592
Post Surface	119	110	110	105	108	102	105	108	108	102	99	105	102	96
Total Liberated	**6,151**	**5,944**	**5,888**	**5,231**	**5,290**	**5,681**	**5,486**	**5,177**	**5,404**	**5,030**	**4,999**	**5,061**	**4,916**	**4,897**
UG Used	391	396	459	649	756	847	1,022	801	997	898	1,028	1,127	1,246	1,127
Total Emitted	**5,760**	**5,548**	**5,429**	**4,582**	**4,534**	**4,834**	**4,463**	**4,376**	**4,407**	**4,132**	**3,971**	**3,934**	**3,670**	**3,769**
UG Drainage	1,529	1,529	1,529	1,274	1,303	1,303	1,416	1,189	1,388	1,161	1,274	1,359	1,473	1,586

*UG – Underground mines; Post UG – Post-mining emissions from underground mines; *Post Surface – Post-mining emissions from surface mines

Table 2: US Coal Mine Methane Emissions (Million Metric Tonnes CO2 Equivalent)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
UG Liberated	67.87	66.26	65.45	57.37	58.18	63.43	60.20	55.75	58.98	54.54	54.14	54.54	53.33	53.65
Post UG	7.68	7.27	7.27	6.46	6.87	6.87	7.27	7.27	7.27	6.87	6.87	6.87	6.46	6.38
Surface	10.50	9.70	9.70	9.29	8.89	9.29	9.29	9.29	9.29	8.89	8.89	9.29	8.89	8.44
Post Surface	1.70	1.58	1.58	1.49	1.54	1.45	1.49	1.54	1.54	1.45	1.41	1.49	1.45	1.37
Total Liberated	87.75	84.80	83.99	74.62	75.47	81.04	78.25	73.85	77.08	71.75	71.31	72.19	70.13	69.85
UG Used	5.58	5.66	6.54	9.25	10.79	12.08	14.58	11.43	14.22	12.81	14.67	16.08	17.78	16.08
Total Emitted	82.17	79.14	77.45	65.37	64.68	68.96	63.67	62.42	62.86	58.94	56.64	56.12	52.36	53.77
UG Drainage	21.82	21.82	21.82	18.18	18.58	18.58	20.20	16.97	19.80	16.56	18.18	19.39	21.01	22.62

Sources for Tables 1&2:
US EPA. Draft *Inventory of US Greenhouse Gas Emissions & Sinks: 1990-2003*
US EPA. Draft *Inventory of US Greenhouse Gas Emissions & Sinks: 1990-2003*

- Abandoned mine emissions were included for the first time in the 1990-2002 annual *Inventory of Greenhouse Gas Emissions and Sinks*.
- The methodology for abandoned mine emissions is consistent with IPCC Tier 2 guidelines.
- Abandoned mine emissions in the US are estimated to total between 10-15% of active mine emissions (12% in 2002).
- The US Government has refined the original methodology used to estimate the emissions from 1990-2002 emissions. In addition, new data has been incorporated into the analysis. The revised methodology and new data result in an increase in the emissions estimates for each year. The new emission estimates will appear in the *1990-2003 Inventory*. Tables 3 and 4 include the original AMM estimates and the revised estimates.
- There are about 20 AMM projects in the US using methane from 30 abandoned mines. The primary uses of AMM are injection into the natural gas pipeline system and power generation

Table 3: US Abandoned Mine Methane Emissions (MM m3)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1990-2002 Inventory	239	242	270	303	319	357	419	392	337	312	312	296	290
1990-2003 Inventory	425	436	466	492	583	591	606	568	502	514	544	488	448

Table 4: US Abandoned Mine Methane Emissions (MMTCO2E)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1990-2002 Inventory	3.41	3.45	3.85	4.33	4.55	5.10	5.97	5.60	4.80	4.44	4.44	4.22	4.13
1990-2003 Inventory	6.07	6.22	6.64	7.01	8.31	8.43	8.65	8.10	7.17	7.34	7.76	6.96	6.38

Sources for Tables 3&4: US EPA. *Inventory of US Greenhouse Gas Emissions & Sinks: 1990-2002*
Memorandum dated 2 December 2004 from Raven Ridge Resources, US EPA Contractor

II. Overview Of CMM Potential (I.E., Projected Volume), List Of Existing Or Planned Projects, And Upstream/Downstream Technologies

A. Overview of CMM Potential

- Active coal mines account for approximately 10% of all man-made methane emissions in the US.
- Mines are quite variable in terms of the amount of methane they liberate, their gassiness or "specific emissions" (methane liberated per ton of coal mined), and their annual coal production. The volume of methane liberated from each mine ranges from less than 0.3 mmcf/d to over 70 mmcf/d. Specific emissions range from approximately 25 cf/ton to over 11,000 cf/ton. Annual coal production ranges from approximately 300,000 tons at some mines to over 10 million tons per year.
- Among active mines in 2003, 18 mines had methane drainage systems in place producing 1.6 million cubic meters of methane (22.62 MMTCO2E).
- There were methane recovery projects in Alabama, Colorado, New Mexico, Pennsylvania, Virginia, and West Virginia.
- The recovery efficiency in the US (i.e., methane drained versus all methane released from liberated from underground mines) has steadily increased from 32% in 1990 to 42% in 2003. The remainder of CMM from underground mines is released through mine ventilation systems. Table 5 shows the types of drainage used and the number of US mines employing those technologies.
- As of 2003, 11 mines used the methane produced through their drainage systems. Table 6 lists those mines, the operator, the quantity used, and the end-uses.
- In addition to the mines listed, new projects became operational in 2004 at the Cumberland and Emerald mines in Pennsylvania. Methane is produced through in-mine horizontal boreholes and surface gob wells for natural gas pipeline sales.

Table 5: Methane Degasification (Drainage) Systems Employed in the US

Method	Current Use in U.S. Coal Mines[b]
Vertical Pre-Mine Wells	Used by eight mines.
Gob Wells	Used by 18 mines.
Horizontal Boreholes	Used by 12 mines.
Longhole Horizontal Boreholes	Used by at least two mines.
Cross-measure Boreholes	Formerly used at one mine; has never been widely used in the U.S.,

Table 6: Methane Use at Active Mines in the US in 2003
(Million Cubic Meters (MM m3) and Million Metric Tonnes CO2 (MMTCO2)

Mine Name	Mine Location (State)	Total Emissions Avoided 2003	Methane Use Option
Blue Creek No. 4, 5, 7	Alabama	232 MM m3 (3.31 MMTCO2)	Pipeline Sales
Oak Grove	Alabama	42.7 MM m3 (0.61 MMTCO2)	Pipeline Sales
Shoal Creek	Alabama	10.3 MM m3 (0.15 MMTCO2)	Pipeline Sales
Mine "X"	Colorado	0.40 MM m3 (0.01 MMTCO2)	Mine heating
San Juan	New Mexico	0.40 MM m3 (0.01 MMTCO2)	Pipeline Sales
Blacksville No. 1	Pennsylvania	34.0 MM m3 (0.48 MMTCO2)	Pipeline Sales
Buchanan No. 1 VP #8	Virginia	785 MM m3 (11.2 MMTCO2)	Pipeline Sales On-Site Use Power Generation
Federal No. 2	West Virginia	8.5 MM m3 (0.12 MMTCO2)	Pipeline Sales, Power Generation (planned)
US Steel No. 50	West Virginia	15.7 MM m3 (0.22 MMTCO2)	Pipeline Sales

*Mine X has requested that they remain anonymous at this time.

III. Challenges And/Or Priorities To Greater CMM Recovery And Use:

A. Gas ownership

Disputes over ownership of methane produced from coals seams presents one of the most significant barriers to further development of the coal mine methane industry in the US. Ownership of carbon-based mineral rights is often divided between oil/natural gas and coal. Whether on public or private land, the coal lessee has had the right to capture and discharge methane without paying royalties to maintain safe working conditions. Although some states have attempted to clarify the ownership issue through legislation, the US Government has not done so. Therefore, these disputes are settled on a case-by-case basis, and there have been no precedent-setting cases and decision to date.

B. Legal framework (e.g., licensing, royalties, PSAs, environmental standards, safety issues)

- **Licensing**: For in-mine boreholes and gob wells, mine operators receive approval directly from the Mine Safety & Health Administration (MSHA). For exploration and production licenses for pre-mine drainage on property outside the jurisdiction of MSHA and for production of methane from abandoned mines that are no longer under MSHA's jurisdiction, licenses are granted by the state in which the wells are drilled.
- **Royalties**: Mineral leases are either federally-owned by the US Government, as is the case in many parts of the West, or privately-owned as is the case in the other areas of the country and in parts of the West. For private leases, laws in each individual state govern ownership of the resource. Federal law governs US Government leases, and the Bureau of Land Management in the Department of Interior manages the mineral rights on those properties. Although royalty fees are negotiable for private leases, a standard royalty of 12.5% of revenues on sales is usually paid

by the operator/lessee to the owner of the mineral estate.

- **Taxes**: Severance taxes are paid to state governments on revenues from natural gas sales. Power sales and other uses generating revenues are also taxed.
- **Production Sharing Agreements**: The US does not have a PSA regime.
- **Environmental Standards**: Methane recovery projects must comply with stringent environmental standards, especially in environmentally sensitive areas and near urban centers. Environmental protection measures generally can be categorized as pollution control measures and habitat/land use protection. Pollution control requirements include (1) air quality standards for production of Nitrous Oxides, Sulfur Oxides, and particulate matter; (2) water quality standards limiting storm-water and waste-water discharge from facilities; and (3) noise abatement. Habitat/land-use restrictions include compliance with the Endangered Species Act and protection of forests and habitat such as limiting access in roadless areas. In some instances, especially on federal lands, it may be necessary to prepare a formal environmental impact assessment.
- **Safety**: The regulatory agencies that govern safety relating to operating a coal mine methane recovery project
    - MSHA has jurisdiction over mining-related matters including operation of any in-mine drilling and gas gathering equipment. MSHA also retains jurisdiction over most surface equipment.
    - Occupational Safety & Health Administration (OSHA) has jurisdiction over worker health and safety for equipment unrelated to the mining operation (e.g., gas engines away from mine facilities).
    - The National Institute for Occupational Safety & Health conducts mine safety research.

C. Climate change position (i.e., signatory to Kyoto Protocol)

- The US is a party to the UN Framework Convention on Climate Change, but has not ratified the Kyoto Protocol.
- Carbon emissions are not regulated or taxed on a national basis; however, several states have begun establishing emissions limits (discussed later in the profile).

D. Technical difficulties (e.g., aging or available equipment)

- Developing accurate emissions baselines on a project-specific basis
- Improving degasification in the tight seams of the Northern Appalachian Basin
- Improving resource and reserve assessments at both active and abandoned mines.
- Successfully demonstrating the recovery and use of mine ventilation air methane.
- Measuring emissions at surface mines.

E. R&D resources

The R&D associated with methane capture and use is funded by two US Government agencies, the U.S. Department of Energy which focuses on gas production and utilization and the National Institute of Occupational Safety & Health which focuses on mine safety research. Some examples of R&D research include:

- Carbonate fuel cell demonstration using CMM. - Completed
- Surface to in-seam drilling methods to recover CMM in advance of mining, and enhance recovery of CBM and sequester CO2 in unmineable coal seams - Ongoing
- Application of slant-hole to horizontal directional drilling for degasification of coal seams in advance of mining among other uses - Ongoing
- Conversion of coal mine methane into liquefied natural gas (LNG) to fuel heavy trucks - Ongoing

- Demonstration of a combination gas- processing/power generation system at a West Virginia coal mine to produce 500 thousand cubic feet per day of pipeline-quality gas and 1.2 megawatts of electricity - Completed
- Capture and use of VAM - Ongoing

F. Institutional issues

The US mining industry recognizes that methane emitted to the atmosphere is a lost resource. With high natural gas prices, the natural gas sales for some mines are significant revenue generators and several coal companies have changed their position to "Energy" companies to reflect the broader suite of energy production. As such, the institutional barriers that once inhibited CMM development are not considered to be major barriers to development. Rather, market, legal (especially ownership), and, to a lesser degree, technical barriers are the primary hurdles faced by developers of CMM projects.

IV. Market Assessment & Reform Issues

A. Transportation of methane (onsite vs. offsite use)

- **Offsite:** The great majority of US CMM usage to date has been offsite (sales to pipeline). The existing gas pipeline infrastructure in the U.S. plays an important role in determining if and where pipeline sales are feasible. In the Eastern United States, the natural gas pipeline system is more extensive and is located closer to gassy coal mines than in the Western United States. In some instances, mines may need to construct a feeder pipeline to transport the CMM to the pipeline from the wellhead or from the gas upgrading/processing facility. Mines in the Western US often have little or no access to pipelines and thus the option for pipeline sales is limited there, since building feeder pipelines would be cost prohibitive. Unlike in Europe or China, typically in the U.S. large population centers are not located in close proximity to coal mines. Thus, in the absence of reasonably accessible long-distance pipelines, there are not readily accessible methane markets near most mines.
- **Onsite:** There have been a limited number of onsite uses for CMM in the United States, including power generation, thermal coal drying, and mine heating, as listed in Table 6 and described below. The low rate of onsite usage is primarily due to the fact that natural gas prices have been relatively high and electricity prices have been relatively low. As a result, many mines find it more profitable to sell their gas to pipelines and buy the electricity they require.

B. End uses (power vs. sale to pipeline)

- **Sales to pipeline**: The majority of CMM recovery projects in the United States involve selling the methane directly to natural gas pipelines. To meet the high quality gas required by pipelines (usually 95% or greater methane with minimal contaminants), generally only gas from wells drilled into virgin seams in advance of mining is suitable. If necessary, lower quality CMM (e.g., gob well gas) can be processed to remove contaminants. Both cryogenic gas processing and pressure swing adsorption are used to upgrade gas quality. Another technique used in the US is blending gob gas with virgin coalbed methane.
- **Current power projects:** There are a limited number of power projects currently in existence or planned at US mines (see Table 6).
  - *Combined power project*: 88 MW power generation station (CONSOL Energy and Allegheny Energy) at VP#8 and Buchanan mines (Virginia) fueled by both CBM and CMM. This is currently the second-largest CMM power plant in the world, although it is used only for power peaking and operates very infrequently. This project is the only CMM project in the world to utilize large turbines (two 44 MW turbines).
  - *Power project*: 1.2 MW (using internal combustion engines) at Federal No. 2 mine, West

Virginia

- *Thermal coal dryer*: CONSOL recovers approximately 1.5 mmcfd (42,500 m^3/d) from the VP#8 and Buchanan mines (Virginia) for use in drying coal.
- *Mine heating*: Two US mines have used drained CMM to heat their mines in the winter months.
- *Abandoned mines*: Currently, there are approximately 20 projects using gas from 30 abandoned U.S. coal mines in applications ranging from power generation to pipeline injection.

- **Potential power or utilization projects**
  - *Ventilation air methane (VAM) oxidation*: There are currently no VAM oxidation projects in operation in the United States, but US EPA and the US Department of Energy are co-funding a demonstration project using ventilation air from a sealed portion of an active CONSOL mine.
  - *Flaring:* In the U.S., flaring has been used at a closed mine but has not been implemented at active mines. The coal industry has expressed concerns about the safety of flaring due to the potential for the flame to propagate back down to the mine and cause an underground explosion. For flaring to be implemented at active mines would require its acceptance by miners, union parties, mine owners, and the Mine Safety & Health Administration (MSHA).

C. Prices and tariffs

- **Prices:**
  - *U.S. natural gas prices*. *Reference: US Energy Information Administration (EIA)*
    National weighted average wellhead price (nominal):
    $4.98 per thousand cubic feet (2003)
    $2.95 per thousand cubic feet (2002)
    $4.00 per thousand cubic feet (2001)
    Henry Hub spot price: $6.15 / MMBTU (November 2004)
    US NYMEX Futures Prices (February 2005): $6.095 / MMBTU
  - *US electricity prices: Reference: US Energy Information Administration (EIA)*
    Retail price in industry sector (2002 average) ~ $0.045 per kW-hr.
    All sectors (2002 average): ~$0.065 per kW-hr
    Utilities in 34 states offer their customers "green pricing," in which customers opt to pay a premium on their electric bills to have a portion or all of their power provided from renewable sources. However, none of these states define coal mine methane as "renewable" (Pennsylvania is the only state to do so but does not have a green pricing program in place at this time).
  - *US coal prices, 2003: Reference: US Energy Information Administration (EIA)*
    $25.29 per ton, coal delivered to US steam-electric utility plants
    $50.63 per ton, coal delivered to coke plants (metallurgical)
- **Tariffs:** Within the U.S., royalties for the use of coal mine methane are to be paid to the owner of the gas estate (see above discussion on ownership issues). Generally, royalties of 12.5% are owed to the federal government for all mineral leases (including coal mine methane) from federal lands. Royalties for privately owned gas estates are negotiated on a case by case basis. Through the North American Free Trade Agreement (NAFTA), enacted in 1994, the U.S. has removed all gas tariffs for gas exports / imports to or from Mexico and Canada.

D. Competition: The markets for coal, gas, and electricity have been largely deregulated. Power generation is deregulated, and there is free and open access in the wholesale market. Power transmission rates are regulated, but there is open access to transmission lines. Power distribution (retail) continues to be regulated and the prices of electricity are regulated closely by regional public utility commissions (PUCs). For natural gas, generation is deregulated, and there is free and open access in the wholesale market. Transportation of coal and natural gas is regulated by the federal government for interstate transport and by states for intrastate transport. Distribution is deregulated and there is free and open access to these commodities in the wholesale market, and there is free and open competition in these wholesale markets.

E. Market access

There is free and open market access for retail of methane (natural gas), electricity, and coal.

F. Product support mechanisms

The U.S. government provides limited research and development related to coalbed methane and coal mine methane development and exploration (through NIOSH, as described above).
Prior to 2004, there were tax credits for production of coalbed methane and coal mine methane. These production credits have since lapsed and it is unclear if there will be new legislation to reauthorize them.

G. Carbon credits

- **Kyoto Protocol**. The United States is not a signatory to the Kyoto Protocol, and there are no national emission restrictions or regulations limiting carbon dioxide emissions in the U.S. There are no taxes on carbon emissions, no national cap and trade programs for carbon or carbon dioxide emissions, and no national markets for carbon credits.

- **Private carbon exchanges outside of the Kyoto regime**. There is some potential for carbon or greenhouse gas emissions credits that may be generated outside the Kyoto compliance regime. For instance, the Chicago Carbon Exchange is a private, voluntary market for emission allowance trading between firms. Some firms are voluntarily engaging in the carbon market, through self-imposed carbon emissions reductions or financial investments in greenhouse gas emission reductions. In the absence of national or international regulatory incentives, these firms may be motivated by strategic goals including strategic market positioning, potential to influence policy, beneficial public relations, or corporate social responsibility obligations (F. Lecocq, State and Trends of the Carbon Market, 2004).

- **State government carbon emission limits and incentives.** Although there are no national emission caps, there may be increasing incentives for firms to obtain carbon credits as several state governments have or are considering establishing limited carbon emission caps. To date, however, no states have included methane in their greenhouse gas emission reduction strategy. A few states have established emission caps on existing powerplants (New Hampshire and Massachusetts). Some states have offset requirements for new power plants (Massachusetts, Washington, and Oregon. Under Oregon's scheme, companies have the option of paying $0.85 per tonne of excess emissions. The Oregon Climate Trust pools these funds to purchase offsets from projects in the U.S. and abroad. A consortium of Northeastern states is considering regional carbon emission caps. Several states have established mandatory or voluntary greenhouse gas emissions reporting, including New Jersey, California, Wisconsin, and New Hampshire.

H. Definition of "methane" for regulations and contracts (natural vs. renewable resource)

- **Federal**. There is currently no federal standard or portfolio standard (e.g., minimum requirement) for renewable energy.

- **States' definition of methane vis-à-vis renewable standards.** Currently, 18 states have renewable energy portfolios or standards. Only one state, Pennsylvania, defines renewable energy to include coal mine methane. In 2004, Pennsylvania's Clean Energy Portfolio Standard became law. Qualified power sources must provide 20% of the state's electricity by 2020. "Tier 1" sources, which must make up 8% of the portfolio, includes coal mine methane, as well as wind, solar, small hydropower, geothermal, and biomass.

V. Key Stakeholders In The CMM Industry

The following companies have invested in and / or operate CMM utilization at US mines, supply and/or operate related equipment, or provide services:

A. Mining/Energy Companies & Related

Allegheny Energy (Electric Power); Arch Coal, BHP Billiton; Black Warrior Methane (natural gas production); CONSOL Energy; Drummond Coal; Eastern Associated Coal / Peabody; Jim Walter Resources; Oxbow Minerals, USX Corp.; National Mining Association; Cumberland & Emerald Mines (formerly owned by RAG America but now independent)

B. Equipment Manufacturers/Vendors

BCCK, BOC Gases, Caterpillar, Cummins Engine, Engelhard, Ingersoll-Rand, MEGTEC Systems, Northwest Fuels Development, Solar Turbines, Waukesha Engines

C. Services

See website of US EPA Coalbed Methane Outreach Program at http://www.epa.gov/coalbed/partner.html

D. Federal Government

Department of Energy; Department of Labor – Mine Safety & Health Administration; US Geological Survey; Environmental Protection Agency; National Institute of Occupational Safety & Health

VI. Finance

Capital investment costs for CMM projects vary greatly depending on the project scope and site-specific requirements. Similarly, operating costs vary greatly depending on the site characteristics.

A. Internal (Domestic) Mechanisms

Several U.S. government agencies provide funding resources for CMM recovery and utilization projects located in the United States.

- *U.S. Department of Energy (DOE)* grants have provided funding for a number of demonstration projects
- *The Small Business Administration (SBA)* operates a loan fund that assists small businesses engaged in energy technology and energy efficiency by guaranteeing loans if key conditions are met.
- *EPA's Environmental Finance Program* assists communities in funding environmental projects by helping to lower costs, increase investment, and build partnerships.

B. External (foreign) mechanisms.

The US does not receive foreign assistance. However, there are three key export financing agencies within the US Government to provide financing for projects based outside the US that result in significant exports: the US Trade & Development Agency, the US Export Import Bank, and the Overseas Private Investment Corporation.

C. Private sector investment

In the United States, the vast majority of direct project funding has come from the private sector, especially mining companies or private investment firms that have provided the capital investment for gas processing, blending, and transport for pipeline sales.

D. Multilateral agreements

The US does not receive assistance under any multilateral governments.

E. Incentives (subsidies, taxes)

Tax credits were used to encourage the production of so-called "unconventional" sources of natural gas, including virgin coal seam coalbed methane and coal mine methane. Known as "Section 29" tax credits (referring to the chapter of the Internal Revenue Service tax code), they allowed for tax credits beginning at nominally $3 per barrel oil equivalent, gradually reduced. The credits were enacted in 1980 and expired on December 31, 2002. The Section 29 tax credit is widely believed to have spurred coalbed methane (CBM) production throughout the US. Omnibus energy legislation was introduced, but did not pass, in the 108th Congress. Early versions of the bill reauthorized the Section 29 tax credits, although these provisions were later deleted from the bill. It is unclear if these tax credits will be reinstated in another version of the Energy bill to be taken up in the 109th Congress.

VII. Current Cooperation Among Countries (Existing Bilateral Agreements Or Grants)

Australia: CMM cooperation is not included in any US – Australia bilateral agreements. EPA has maintained an informal dialogue with the Commonwealth Scientific and Industrial Research Organization (CSIRO).

China: US-China Climate Bilateral, US – China Air Quality Bilateral. US EPA has provided grant funding to support the China Coalbed Methane Clearinghouse since 1994, and the current agreement extends through 2005. In late 2004, US TDA announced a $500K technical assistance grant to support the development of a 120 MW CMM power project in the Shanxi province.

India: Coalbed methane is included in the India – US Economic Dialogue. No formal CMM cooperation to date. EPA provided technical support in the late 1990s that led to the award of a CMM Global Environment Facility (GEF) project in India. EPA is currently negotiating the establishment of a Coalbed Methane Clearinghouse in India. TDA has funded coalbed methane development project feasibility study in India and has funded several study tours.

Japan: CMM cooperation is not included in any US – Japan bilateral agreements. EPA has maintained an informal dialogue with the Japan Coal Energy Center (JCOAL).

Mexico: CMM cooperation is not included in any US – Mexico bilateral agreements. EPA has maintained an informal dialogue with Mexican mines since 2000 and with the Ministry of Economy in 2004.

Russia: CMM cooperation is included in the US – Russia Climate Bilateral Agreement and in the US – Russia Energy Dialogue. US EPA began working in Russia in the mid – 1990s and has provided

technical, policy, and financial support that continues today. In cooperation with the Russian Academy of Sciences, EPA created a coalbed methane clearinghouse (Uglemetan – the International Coal & Research Center) in Kemerovo. US EPA is providing technical support for the GEF project awarded to Russia in 2003, and is providing organizational support to Uglemetan through 2005.

UK: CMM is not included in any US – United Kingdom bilateral agreements. EPA maintains an informal dialogue with the UK Department of Trade & Industry (DTI).

Ukraine: CMM cooperation is not included in any US – Ukraine bilateral agreements. EPA began working in Ukraine in the mid-1990s and co-funded CBM/CMM with US AID. EPA funded an existing CMM clearinghouse in 1998 and initiated funding of a new organization, Partnership for Energy & Environmental Reform (PEER) in 2000. Total EPA funding through 2004 equals $500,000, including most recent award (September 2004) of $89,000 to support US Department of Labor multi-million dollar mine safety methane drainage and utilization program. US TDA funded a feasibility study in the late 1990s that was never completed.

United Nations Economic Commission for Europe (UNECE): The US EPA has funded a three-year grant to the UNECE for a project to develop Coal Mine Methane Projects in Central and Eastern Europe and the Commonwealth of Independent States. The United Nations Foundation has contributed matching funds. The program is directed at encouraging investment in coal mine methane utilization projects. The first year of the program will focus on coal mine methane in Russia.

Other (non-Methane to Markets): CMM is included in climate bilateral agreements between the US and South Africa and the US and Canada.

VIII. Wish List

- More active collaboration and cooperation with developing Methane to Markets Partners to promote coal mine methane recovery and utilization.
- Increase the number of Western U.S. mines recovering and utilizing CMM
- Obtain endorsement from US Mine Safety & Health Administration (MSHA) to proceed with Ventilation Air Methane (VAM) projects
- Achieve resolution of outstanding legal issues concerning ownership of the coalbed methane resource

What the U.S. can provide to other countries

- Funding and technical support to promote CMM project development:
- Conducting feasibility (and pre-feasibility) studies and technical assessments for CMM utilization projects
- Identifying and working to overcome institutional, regulatory, and financial barriers to CMM project implementation
- Establishing in-country clearinghouses to serve as central information sources for CBM and CMM development activities, data, and resources
- Information sharing and technology transfer including conducting workshops, conferences and symposia, preparing and disseminating analytical reports, training, and publications

IX. Outreach

The US EPA's Coalbed Methane Outreach Program is a voluntary program whose goal is to reduce methane emissions from coal mining activities. CMOP's mission is to promote the profitable recovery and utilization of coal mine methane, a potent greenhouse gas that contributes to climate change if emitted to the atmosphere but is a valuable fuel source when collected and used for energy. The program's goals are (1) to reduce greenhouse gas emissions, (2) to achieve the profitable recovery and use of coal mine methane, and (3) to promote the use of a clean energy source. Specific outreach activities for our international Partners would include:

- Identifying, evaluating, and promoting methane reduction options, including technological innovations and market mechanisms to encourage project implementation
- Conducting workshops to educate the mining industry on the environmental, mine safety, and economic benefits of methane recovery
- Preparing and disseminating reports and other materials that address topics ranging from technical and economic analyses to overviews of legal issues
- Conducting feasibility and pre-feasibility studies.
- Providing global access to information regarding latest developments through the CMOP website and regular email updates and newsletters.

X. Summary & Conclusions

The US coal industry is one of the world's leaders in the capture and use of mine methane. Recovery at active mines has been ongoing for many years, although abandoned mine methane recovery is relatively new with the first projects starting in the early 1990's. Primarily through the Department of Energy and the National Institute for Occupational Safety & Health, the US Government has put considerable effort toward assisting the industry develop and implement new technologies for improved methane drainage. In addition, EPA's Coalbed Methane Outreach Program has focused on promoting the environmental and socio-economic benefits of CMM and AMM utilization in the US and other countries. EPA and other US agencies such as USAID have a long history of international cooperation, and expect to broaden this cooperation under Methane to Markets.