GMI IN MONGOLIA

GLOBAL METHANE INITIATIVE (GMI)

2013

CONTENTS

FOREWORD

Since entering the 21st century the issues of climate change has caused increasing extensive concern of the international society. Climate change brings about severe challenges to sustainable development and to the future of world. It has already become an urgent topic facing the entire mankind.

The Millennium Development Goals-based Comprehensive National Development Strategy (MDG-based CNDS) of Mongolia approved in 2008 identifies the needs “to exploit the mineral deposits of strategic importance based on advanced technologies, intensify economic development, improve the structure of economic sectors, build financial capacity and the capital accumulation in order to establish a knowledge-based economy”.

The Millennium Development Goals-based Comprehensive National Development Strategy (MDG-based CNDS) of Mongolia also identifies the need “to create a sustainable environment for development by promoting capacities and measures on adaptation to climate change, halting imbalances in the country’s ecosystems and protecting them”. In addition, the MDG-based CNDS includes a Strategic Objective to promote capacity to adapt to climate change and desertification, and to reduce their adverse impacts. In order to address challenges relevant to climate change, Mongolia has developed its National Action Programme on Climate Change and the programme was approved by the State Great Khural (Parliament) in 2000 and updated in 2011.

Mongolia is a developing country and is well recognized internationally for her efforts to reduce green gas emissions and Mongolia has consistently demonstrated its strong support of international initiatives in protection of the global climate. In order to comply with her international obligations and commitments Mongolia developed and implemented several environmental protection policy documents such as Mongolian Sustainable development strategy and national Agenda 21, National climate change action Plan, energy policy strategy, the renewable energy aimed at reducing green house gases emissions in Mongolia.

In recent years, Mongolian Government is attaching great impor¬tance on the Coal methane mine(CMM) and coalbed methane(CBM) development and utilization

Therefore, the Government of Mongolia becomes 24th member of the Methane to Markets Partnership program operated by US Environmental Protection Agency’s Climate Change Division on 27th March 2008.

The Government of Mongolia supports Global Methane initiatives. It will provide more financing channels and technical support , and accelerate development of methane recovery and utilization. In the framework of the Global methane initiative program, Mongolian Nature and Environment Consortium is implementing E PA’s grant award on coal Mine Methane (CMM) Resources Assessment and emission Inventory Development in Mongolia. The grant award has two interrelated objectives:

- to estimate CMM resources at coal basins throughout Mongolia in order to identify prospective CMM project sites,

- to develop an accurate, high-quality CMM emissions inventory within Mongolia to both identify potential project areas as well as to track progress of future CMM projects.

The team of Mongolian Nature and Environment Consortium and Ravin Ridged Resources Co ltd, USA took samples that conducted near or within Nariin Sukhait, Baganuu, Tavan Tolgoi mining areas in order to estimate coal mine methane resources for these basins. Analysis of obtained data in progress.

The Mongolian Nature and environment consortium organized workshop on coal Mine Methane (CMM) Resources Assessment and emission Inventory Development in Mongolia which was held in June, 2012 in Ulaanbaatar. The objectives of the Workshop were to a better understanding of the methane recovery and utilization development issues. During the workshop more than 25 coal experts and scientists of Mongolia, interna¬tional coal mine methane experts, Government officials, and representatives of provide sector discussed the opportunities of use of methane for sustainable development.

The workshop particularly benefitted from the presence and contributions of Dr. Ray President, Raven Ridge Resources and Ms. Charlee Boger, environment expert of Raven Ridge Resources. They read comprehensive lectures on concepts of CMM assessment and methods of CMM emission inventory.

Mongolian Nature and environment consortium prepared a brochure on Mongolian participation in Global Methane Initiatives (GMI) and distribute to the public in order to promote of public awareness on CMM and CBM development.

We welcome any comments and inquires related to the brochure. Please feel free to send to the Mongolian Nature and Environment Consortium, Mongolia. I would like to take this opportunity to express my graduate to scientists and experts who have been actively involved in the elaboration of this brochure and to the Environment Protection Agency, USA for financial support and technical assistance.

Dr. BADARCH Mendbayar

Director of Mongolian Nature and Environment Consortium

MINING, ENERGY AND FUEL POLICY IN DOCUMENT OF THE

MILLENNIUM DEVELOPMENT GOALS-BASED COMPREHENSIVE NATIONAL DEVELOPMENT STRATEGY OF MONGOLIA

5.2.1. INDUSTRIAL DEVELOPMENT POLICY

5.2.1.1. Development policies for geology, mining and minerals, and heavy industry

Exploit the mineral deposits of strategic importance based on advanced technologies, intensify economic development, improve the structure of economic sectors, build financial capacity and the capital accumulation in order to establish a knowledge-based economy.

PHASE ONE (2007-2015):

STRATEGIC OBJECTIVE 1. ***Exploit mineral deposits of strategic importance. Undertake government-funded geological surveys, pursue a policy that enables the State to own over 51% of the share of the mineral deposits upon completion of resource evaluation:***

- Start to exploit mineral deposits: Copper and gold of Oyu Tolgoi, copper of Tsagaan Suvarga, coal of Tavan Tolgoi, silver of Asgat, nonferrous metals of Tsav, iron ore of Tumurtei, coal and bitumen of Choir-Nyalga, brown coal of Tsaidam, uranium of Mardai and Gurvanbulag, and other major deposits of strategic importance
- Increase the capacity of Erdenet Ore-dressing Corporation, and enhance the product processing.
- Significantly increase the production of cathode copper and steel.
- Start processing of coking coal.
- Adopt technologies for extracting fuel and petroleum from coal. Increase the volume of oil extraction.
- Improve the level of mineral raw material processing, and increase the output of final products.
- Expand geological exploration and mineral survey.

STRATEGIC OBJECTIVE 2. ***Protect the natural environment in mining sector and maintain the ecological balance:***

- Improve the rehabilitation of mined areas.
- Introduce unified standards for exploitation technology.
- Make an ecological and economic assessment of deposits and improve standards for evaluating, imposing and making payable penalties for ecological damage, compensation and fees.
- Improve the safety and health conditions of mining. Encourage and expand exploitation of underground minerals and processing of minerals deep underground.
- Put in place incentives for mining that produce minimum waste and for the introduction of advanced machinery and technology.

PHASE TWO (2016 -2021):

STRATEGIC OBJECTIVE 1. ***Exploitation of strategic deposits will be intensified. Advanced machinery and technology will be introduced in mining and natural resources sector, processing and sale of end products will be expanded:***

- Widely introduce advanced, sophisticated technology that has minimum waste and environmentally friendly to maximize the utilization of mineral resources.
- Maintain at an appropriate level volume of extraction of mineral resources, enhance the level of processing and significantly increase the development of end products.
- Build large plants of extraction and processing of oil that will fully meet domestic needs and export oil products on international markets.
- Develop small and medium size enterprises and services affiliated to mining and heavy industry complete

5.2.1.2. Policy of developing processing industry

Develop competitive processing industry and improve considerably economic diversification.

PHASE ONE (2007-2015):

STRATEGIC OBJECTIVE 1. ***Expand production of end products capable of competing at international markets, in particular:***

- Develop production of export-oriented, knowledge intensive, small-size competitive products.
- Produce ecologically clean products competitive on international markets.

STRATEGIC OBJECTIVE 2. ***Create and develop industrial and technology parks with available domestic and external resources for the regional development:***

PHASE TWO (2016 -2021):

STRATEGIC OBJECTIVE 1. ***Strengthen and increase the volume of a knowledge - intensive, advanced technology-based production:***

- Increase extraction and processing of oil and its products and fully satisfy domestic needs.

5.3.2. ENERGY SECTOR DEVELOPMENT POLICY

PHASE ONE (2007-2015):

STRATEGIC OBJECTIVE 1. ***Establish an "Integrated Energy System of Mongolia," increase the profitability of energy sector and create the most favourable conditions for its development. Build capacity to export energy abroad.***

STRATEGIC OBJECTIVE 2. ***Improve electric power supply to soums, settlements and herder households:***

- Apart from connecting soums and settlements, which are not linked to the integrated energy system to electricity transmission air lines, ensure steady supply of electricity to soums and settlements through using renewable and other energy sources.

PHASE TWO (2016 -2021):

STRATEGIC OBJECTIVE 1. ***Increase the efficiency of Mongolia's integrated energy system and create favourable conditions for its development:***

- Increase the efficiency of regional energy systems
- Create a modern system to regulate energy flows

5.3.3 FUEL SECTOR DEVELOPMENT POLICY

STRATEGIC OBJECTIVE 1. ***Gasify coal and supply small-size power plants with fuel:***

- Build small-size plants, which use coal to produce smoke-free fuel.

CLIMATE CHANGE POLICY IN MONGOLIA

Damdin DAGVADORJ, Ph.D,
Ministry of Environment and Green Development

The Government of Mongolia has prioritized the establishment of a safe and healthy environment for its people while sustaining a long term, comprehensive policy on socio- economic development, with an emphasis on implementing green development strategy and protecting the environment and natural resources inherited from our ancestors, as a result of their attention, over thousands of years, to maintaining the ecological balance.

Climate change is already a real fact in Mongolia. According to the instrumental observations at meteorological stations in Mongolia show that the country's annual mean temperatures have risen by 2.16°C between 1940 and 2011 that is much higher than global average. Scientists are warning that climate in Mongolia will continue to change dramatically during the 21st Century. Because of its specific geographical and climatic conditions, Mongolia is likely to be more heavily influenced by global climate change. The impact of climate change on the ecological systems and the natural resources would have a direct and serious affect on almost all sectors of the national economy and all spheres of social life, i.e. it touches all aspects of the life support system. Climate change response measures will help to address the inevitable need to adapt to climate change and to mitigate greenhouse gas emissions, in order to meet the requirements of Mongolia's sustainable development strategies. As a result of climate change countermeasures, climate resilient and low carbon societies would be established in the country.

INTEGRATING CLIMATE CHANGE POLICY INTO NATIONAL AND SECTORAL DEVELOPMENT PROGRAMMES

The Parliament of Mongolia has passed several laws directed toward environmental protection including the State Policy on the Environment (1997), which forms the legal basis for the protection of the environment and natural resources. The Mongolian Environmental Action Plan of 1995 outlines the country's priorities for environment and resource management. The Mongolian Action Programme for the 21st Century (MAP 21), the National Action Plan to Combat Desertification, the National Biodiversity Action Plan, National Water Programme, the Action Programme to Protect Air, and the National Action Programme to Protect the Ozone Layer were developed. In particular, the MAP 21 includes concrete considerations and recommendations on adaptation to climate change and the mitigation of GHGs emissions. The Law on Air (2012) and the Law on Environmental Protection (2012) are the main legal instruments for the protection of air and environment.

The Millennium Development Goals-based Comprehensive National Development Strategy (MDG-based CNDS) of Mongolia approved in 2008 identifies the need "to create a sustainable environment for development by promoting capacities and measures on adaptation to climate change, halting imbalances in the country's ecosystems and protecting them". In addition, the MDG-based CNDS includes a Strategic Objective to promote capacity to adapt to climate change and desertification, and to reduce their adverse impacts.

In order to address challenges relevant to climate change, Mongolia has developed its National Action Programme on Climate Change and the programme was approved by the State Great Khural (Parliament) in 2000 and updated in 2011. The action programme includes the national policy and strategy to tackle the adverse impacts of climate change and to mitigate greenhouse gas emissions. The Mongolia National Action Programme on Climate Change (NAPCC) is aimed not only at meeting the UNFCCC obligations, but also at setting priorities for action and to integrate climate change concerns into other national and sectoral development plans and programmes. The NAPCC is based on the pre-feasibility studies on climate change impact and adaptation assessment, GHG inventories, and GHG mitigation analysis. This Action Programme includes a set of measures, actions and strategies that enable vulnerable sectors to adapt to potential climate change and to mitigate GHGs emissions. The starting point was that these measures should not adversely affect sustainable socio-economic development. The Government has been developed the NAPCC's implementation plan and its implementation is underway.

The Government has established an inter-disciplinary and inter-sectoral National Climate Committee (NCC) led by the Minister for Environment and Green Development, to guide national activities and measures aimed at adapting to climate change and mitigating GHG emissions. The Climate Change Coordination Office (CCCO), under the supervision of the Chairman of the NCC, has been established by the Government, in order to carry out day to day activities related to the implementation of commitments and duties under the UNFCCC and Kyoto Protocol, to manage the nationwide activities, and to bring into action the integration of climate change related problems in various sectors.

In order to integrate the climate change concerns and actions into sectoral development programmes, a measures and actions that have an inter-sectoral and inter-disciplinary nature are included in recently approved sectoral development programmes such as National Programme on Water, National programme to combat desertification, Third Arable farming programme, Livestock programme, "Livestock health Programme", "Programme on Improvement of livestock quality", "Programme to support the development of intensive livestock", "Milk Programme", "Livestock fodder Programme", "Food Security Programme" as well as Energy efficiency Improvement, Renewable Energy Programme and others.

At the international level, Mongolia has joined many environment-related UN Conventions and Treaties, such as the UN Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD) and the Convention to Combat Desertification (CCD), The Vienna Convention for the Protection of the Ozone. The UN implementing and specialized agencies like UNDP, World Bank and UNEP support capacity strengthening of concerned national and local institutions to fulfill their commitments and provisions received under these conventions, to implement and monitor related policies, and to enhance coordination among them. The international organizations and partner countries also cooperate with local governments, civil society organizations, research organizations and the media for a wider outreach of environmental awareness campaigns.

POLICIES AND MEASURES ON ADAPTATION TO CLIMATE CHANGE

In the new Millennium and in the era of globalization and climate change, the new technology needs to be introduced into the most vulnerable environmental components and economic sectors to make them independent of the environment and the weather hazards, through renovation and improvement of conventional methods and approaches. Today, all states acknowledge that it is impossible to provide sustainable development without providing a correlation of economic acceleration, human growth and natural resource utility. Mongolia has formulated and implemented a sustainable development policy as the milestone of the state development strategies. Clearly, for a country which is vulnerable to climate change, the formulation and implementation of a policy on adaptation to climate change is vital for the sustainable development of the country. The measures to reduce the adverse affects caused by climate change are based on impact and vulnerability assessment of climate change on the environmental and economic sectors. Also, new developments and amendments of policies and legal documents are required in order align them with recent climate change and the latest socio-economic development updates.

The current priority issue is not whether it is necessary to adapt to climate change, but how to adapt to it. The major part of adaptation is targeted on studies and assessments of climate change impact, including evaluation of the impact of climate change, its dangers and risks and the formulation of methods and measures to mitigate it. Efficient methods and strategies are needed in the first place in order to implement an adaptation policy on climate change. Implementation strategies must include factors related to legislation, structure, finance, human resources, science and media, and coherence with other policies and strategies. Also, it is vital to assess the subjective and objective impediments to the implementation of strategy and to take into the consideration how it is correlated with other socio-economic demands, while formulating a methodology to overcome or facilitate the removal of these impediments.

The sustainable development of Mongolia is largely dependent on the beneficent cooperation of the environment and the economy, while the economy is closely related with natural resources such as pastureland, animal husbandry, agriculture and natural resource utility. Adaptation technology usually requires a considerable amount of investment at the outset. On the other hand, the efficiency of adaptation measurements is not easily recognized in the short term and it takes a tremendous amount of effort and time. Apart from funding, the major factors in the successful implementation of adaptation procedures are ability, willingness and the concern of the people involved with the realization process. A successful completion is guaranteed only when there is provision for public participation in the action. The herders, farmers and local communities are the first sectors to benefit from a policy of adaptation. Also, it is crucial to have the participation and assistance of experts and specialists in training, fertilization, selection and invention of new breeds and irrigation construction. Currently the importance of taking action to increase public awareness of climate change is obvious, as well as the need to increase government willingness to cooperate with NGO-s and the public, to be supported by them and provide them with adequate information.

Land Degradation and Desertification. Due to climate change associated with human activities in the country, desertification and land degradation have become real challenges in Mongolia. Theoretically, land degradation is defined as a decline in soil fertility and land desertification as increasing vegetation scarcity, biomass and sand of grassland. A survey has identified the fact that desertification has become a disastrous problem for Mongolia. Action taken to adapt to climate change can be carried out through improving the management of land utility. Strategies and measures to combat land and pasture degradation and desertification are identified in the National Programme to Combat desertification and the National Action Plan on Climate Change. The good management and coordination of activities included in these programmes are essential to reduce the desertification.

Natural disasters and communicable diseases. Mongolia is one of Asia's counties most prone to natural disasters. Due to climate change, the frequency and magnitude of natural disasters in Mongolia is tending to increase. For instance, the occurrence of forest and steppe fires and their recurrence have increased tremendously because of the decline in spring precipitation by 17 percent in the last 60 years. The damage from fires is estimated to be billions of Tugrugs, excluding the environmental and human losses. There is a likelihood that the occurrence of steppe fires is dependent on the intensification of El Nino or Southern oscillation. So, it is vital to improve the management capacity of the Government, its institutions and the public towards hazards and early warning systems of natural disasters such as drought, zud (severe winter), snow storms and floods. Also, scientific approaches and models need to be used in developing weather forecasting methods and appropriate computing capacities to predict and estimate future climate change in Mongolia.

Animal Husbandry. Pastoral animal husbandry has adapted to climate and its risks for centuries in Mongolia. However, current climate change has been accelerating, so actions to adapt to climate change are necessary in livestock sector management. Climate change adaptation strategy in animal husbandry stimulates the implementation of the above directions of the programme. The adaptation measures will decrease the adverse impact of climate change on animal weight and production and pasture production. This approach should be consistent with the government policy that promotes community and herders' ownership. The basis of state policy on pasture land management is to establish a network of pasture land management.

Arable farming. The impact of climate change causes a noticeable reduction in the crop yield of the central region. So, adaptation to climate change and prevention measures must be taken at the level of the agricultural sector as well as at the national level, with an immediate start. Training and educating the general public and the people in the agricultural sector on climate change adaptation measures is essential. Research on agriculture should focus on the development of new varieties of crops resistant to climate change and introducing advanced irrigation systems. Possible counter actions to overcome the negative impacts of climate change should be the priority adaptation methods. Agricultural adaptation methods are mainly addressed to state and private farming entities.

Water Resources. Water is not only a component of nature, but also plays a leading role in the restoration, protection and upgrading of the ecosystem. Land utility and other human activities are all regulated by water management. So, the most appropriate method to adapt to climate change in the water sector is the formulation and stabilization of a water resource management policy.As suggested in various researches, land surface water resources tend to be enhanced during the first stage of climate change. However, there is no sign whatsoever of enhancement as yet during these years. This means that people still face the problems of water scarcity. Building structures which regulate the flow of rivers and lakes are not only the means of adaptation to climate change but also the solution to the problems pertaining to water shortage, overcoming water scarcity, prevention of floods and so on.

Considering the current water situation and the anticipated impacts of climate change on water, it is necessary to implement the following activities:

- Protection of water resources and its source areas,
- Improvement of urban water supplies,

- Increasing pasture water supplies,
- Introduction of modernized water saving technologies and irrigation systems,
- Improving water quality and water sanitation,
- Educating public on proper water usage.

POLICIES AND MEASURES TO MITIGATE GHG EMISSIONS

Although total greenhouse gases emissions of Mongolia is almost negligible if compare with other countries, NAPCC includes certain measures for reducing GHG emissions by sources and enhancing GHG removals by sinks. GHG mitigation measures and actions should be integrated with strategies and goals for improving energy and heat efficiency, increasing renewable energy shares in energy generation and introducing environmentally sound technologies in energy, transport, industry, agriculture and waste management sectors. The reduction of GHG emissions in the energy sector is being promoted by implementing measures and projects in energy supply and demand sectors. The strategies for sustainable development and reduction of greenhouse gases in the energy sector are focused on renewable and other clean energy use, energy supply efficiency improvement, clean coal technologies, and energy efficiency improvement in buildings and industry. In the transportation sector, greenhouse gas reducing strategies are to improve traffic conditions, to use more fuel efficient vehicles and to implement shifts from individual road vehicles to rail and public transport systems.

Greenhouse gas reduction strategies in agriculture are to improve animal husbandry management and technology to increase the productivity of each type of animals. The livestock sector development strategy aims to build risk management capabilities to ensure reliable protection for the wealth and income of herders and to increase production to optimal levels, taking into consideration regional advantages in increasing productivity. Low efficiency leads to an increased number of livestock being vulnerable to natural disasters. The number of livestock has exceeded the estimated carrying capacity of Mongolia's pasture, causing land degradation and desertification. As for the waste sector, policies and measures to establish a foundation to minimize waste, increase recycling and expand waste management processes should be implemented. Policies to increase removals and decrease emissions are also being implemented in the forestry sector through efficient management and maintenance of forests and afforestation.

Nationally appropriate mitigation actions. Mongolia has become a signatory of the Copenhagen Accord and submitted list of nationally appropriate mitigation actions (NAMA) to the UNFCCC Secretariat in January 2010. The NAMA include a general outline of the above mentioned GHG mitigation measures, which will be implemented with support from the international mechanisms to strengthen national capacities, to transfer advanced technologies; and to provide financial resources to developing countries and parties.

CONCLUSION

The Government of Mongolia, the academia, the general public and the private sector have made very significant progress in climate change research, awareness and planning since joining the UNFCCC and Kyoto Protocol in 1990s. In achieving goals, identification of possible barriers that would hamper success should be assessed at this point of preparation for the Second National Communication under the UNFCCC, as a course of mainstreaming, integrating and pushing forward climate change in the planning and implementation process.

Planning options of climate change policy making and response measures include the following key issues:

- Reduce vulnerability of livestock and other sensitive sectors to the impacts of climate change through the suggested adaptation measures which require actions in a coordinated way and incorporation in long-term planning.

- Continue research, training, strengthening, and building upon existing capacity might be the most important measure for strengthening the adaptive capacity and vulnerability and strategic adaptation planning and disseminating results in easily understandable terms to aid in legislation, planning and general applications.

- Assess and, when needed, improve forecasting and warning systems for disaster preparedness such as for drought, zud, etc. to help meet potential threats.

- Refine existing impact and vulnerability analyses discussed herein to the greatest extent possible, reducing the uncertainties and fine-tuning the assumptions towards more meaningful policy recommendations. Translating these findings and recommendations into easily understandable and not-so technical terms will be most useful.

- Continue to improve and refine the existing vulnerability and adaptation research in other areas such as energy, biodiversity and forestry, crops and the direct and indirect health effects of climate change

- Implement greenhouse gas reduction projects through the recommended mitigation measures in energy, industry, transport, forestry and waste management sectors.

- Pursue national and international collaboration such as research, resources sharing and climate/weather forecasting at the North-East Asia sub-regional level, for Mongolia to take an active.

TERMS OF REFERENCE FOR THE GLOBAL METHANE INITIATIVE

The undersigned national government entities (collectively referred to as “the Partners”) set forth the following Terms of Reference for the Global Methane Initiative (referred to as “the Initiative”). The Initiative serves as a framework with the goal of achieving global reductions of anthropogenic methane emissions through partnerships among developed countries, developing countries, and countries with economies in transition in coordination with the private sector, researchers, development banks, and other relevant governmental and non-governmental organizations.

1. PURPOSE

To create a voluntary, non-binding framework for international cooperation to reduce methane emissions and to advance the recovery and use of methane as a valuable clean energy source to increase energy security, enhance economic growth, improve air quality, and improve industrial safety. The Initiative will focus on the development of strategies and markets for the abatement, recovery, and use of methane through technology development, demonstration, deployment and diffusion, implementation of effective policy frameworks, identification of ways and means to support investment, and removal of barriers to collaborative project development and implementation. The Initiative will serve to complement and support Partners’ efforts implemented under the United Nations’ Framework Convention on Climate Change.

2. FUNCTIONS

The Partners will seek to:

2.1 Identify and promote areas of bilateral, multilateral, and private sector collaboration on methane abatement, recovery, and use in the areas of agriculture, coal mining, landfills, oil and natural gas systems, and wastewater treatment, and in other areas as agreed to by the Partners.

2.2 Develop improved emissions estimates and identify the largest relevant emission sources to facilitate project development.

2.3 Identify cost-effective opportunities to recover methane emissions for energy production and potential financing mechanisms to encourage investment.

2.4 Identify and address barriers to project development and improve the legal, regulatory, financial, institutional, technological and other conditions necessary to attract investment in methane abatement, recovery and utilization projects.

2.5 Identify and implement collaborative projects aimed at addressing specific challenges to methane abatement and recovery, such as raising awareness in key industries, removing barriers to project development and implementation, identifying project opportunities, and demonstrating and deploying technologies.

Partners will also work together to share lessons learned from these cooperative activities.

2.6 Foster cooperation with the private sector, research organizations, development banks, and other relevant governmental and non-governmental organizations.

2.7 Integrate and coordinate Initiative activities with related activities and initiatives.

2.8 Support the identification and deployment of best management practices in the abatement, recovery, and use of methane.

2.9 Work to improve scientific understanding in relation to the abatement, recovery, and use of methane.

2.10 Develop and implement action plans that outline a series of concrete activities and actions that directly support the core goals and functions of the Initiative. Action plans can be useful tools in advancing project implementation, facilitating investment, and creating appropriate policy frameworks that support methane abatement, recovery, and use.

2.11 Communicate their progress and accomplishments in implementing action plans and undertaking other activities to support the Initiative's goal.

2.12 Periodically assess the effectiveness of the Initiative's efforts to achieve its goal.

3. ORGANIZATION

3.1 A Steering Committee, Administrative Support Group, and Subcommittees are to be formed. The Subcommittees will focus on the following focal areas: Agriculture, Coal Mining, Landfills, Oil and Gas Systems, and Wastewater Treatment. The Steering Committee may establish additional Subcommittees, working groups, or enlarge the scope of existing Subcommittees in other focal areas as agreed. Each Subcommittee will create and support a Project Network.

3.2 The Steering Committee will govern the overall framework, policies and procedures of the Initiative; annually review progress of the Initiative; and provide guidance to the Administrative Support Group and Subcommittees. The Steering Committee should meet at least once per year, at times and locations to be determined by its appointed representatives. The Steering Committee will make decisions by consensus.

3.3 Appendix A lists those Partners that may appoint up to two representatives to the Steering Committee. Appendix A may be amended by consensus of the Steering Committee.

3.4 The Subcommittees will be responsible for guidance and assessment of area-specific activities and engaging representatives of the private sector, development banks, researchers and other relevant governmental and non-governmental organizations. Each Subcommittee will work to implement its program of action, offer assistance to Partners in the development and implementation of their action plans, provide guidance on project identification, identify and address key barriers and issues for project development, address market assessment and reform issues, facilitate investment and financing opportunities, and report on progress. Subcommittees will report to the Steering Committee. Subcommittees will meet as often as necessary to fulfill their responsibilities, making use of electronic media (including email, teleconference and videoconference) as appropriate in order to minimize travel. Each Subcommittee will make decisions by consensus.

3.5 The Subcommittees will be comprised of representatives from interested Partners. Each Partner may appoint up to three members to each Subcommittee. Each Subcommittee will select two Partners as co-chairs, ideally one from a developed and the other from a developing country or country with an economy in transition. At their discretion, Subcommittees may select one additional co-chair. Every three years, Subcommittees should review their leadership to provide other Partners the opportunity to act as co-chair.

3.6 A Project Network will be created under each Subcommittee to serve as an informal mechanism to facilitate communication, project development and implementation, and private sector involvement. The Project Network will be key to reaching out to and organizing the efforts of the private sector, governmental and non-governmental organizations. The Project Network will be comprised of representatives from local governments, the private sector, the research community, development banks, and other governmental and non-governmental organizations. Those interested in becoming partners in the Project Network will sign and submit a Project Network Membership Agreement.

3.7 The Administrative Support Group will serve as the principal coordinator of the Initiative's communications and activities. The focus of the Group will be administrative. The Group will not act on matters of substance except as specifically instructed by the Steering Committee. Specifically, the Group will:

3.7.1 Organize the meetings of the Initiative,

3.7.2 Arrange special activities such as teleconferences and workshops,

3.7.3 Receive and forward new membership requests to the Steering Committee,

3.7.4 Coordinate communications of Initiative activities, progress, andaccomplishments,

3.7.5 Act as a clearinghouse for information for the Initiative,

3.7.6 Provide support for activities related to the Project Network, and

3.7.7 Perform such other tasks as the Steering Committee directs.

3.8 The Administrative Support Group will be supported and hosted by the United States, at the Environmental Protection Agency in Washington D.C. Another Partner's offer to support and host the Group will be accepted by the consensus of the Steering Committee.3.9 Each Partner will designate an Administrative Liaison to serve as its principal point of contact to the Administrative Support Group. The Group will work with the Liaisons to ensure an adequate flow of information between the Initiative and individual Partners.

3.10 The Administrative Support Group may, if appropriate, involve personnel employed by the Partners to assist in specific activities undertaken by the Group. Such personnel will be remunerated by their respective employers and will remain subject to their employers' conditions of employment.

4. MEMBERSHIP

4.1 These Terms of Reference establish a framework for voluntary cooperation and do not create any legally binding obligations between or among the Partners. Each Partner is expected to conduct the activities contemplated by these Terms of Reference in accordance with the laws under which it operates and the international instruments to which it is a party.

4.2 The Steering Committee may invite other national governmental entities to join the Initiative through endorsement of the Terms of Reference.

5. FUNDING

5.1 Participation in the Initiative is on a voluntary basis. Each Partner may, at its discretion, contribute funds, personnel and other resources to the Initiative subject to the laws, regulations and policies of the Partner. Any costs arising from the activities contemplated in these Terms of Reference are to be borne by the Partner that incurs them, unless other arrangements have been made.

5.2 These Terms of Reference do not create any right or benefit, substantive or procedural, enforceable by law or equity against the Partner, their officers or employees, or any other person. No Partner should submit a claim for compensation to another Partner for activities it carries out under these Terms of Reference. These Terms of Reference do not direct or apply to any person outside of the governments of the Partners.

6. COMMENCEMENT, MODIFICATION, TERMINATION, EXTENSION, AND WITHDRAWAL

6.1 Commencement, Modification and Termination Terms of Reference of the Global Methane Initiative

6.1.1 These Terms of Reference commence on 1 October 2010 and will continue in effect for 5 years unless extended or terminated by the Steering Committee.[1]

6.1.2 These Terms of Reference may be modified at any time by consensus of the Steering Committee.

6.2 Extension and Withdrawal

6.2.1 By consensus, the Steering Committee may extend these Terms of Reference for additional periods.

6.2.2 A Partner may withdraw from the Initiative by giving written notice to the other Partners and the Administrative Support Group 90 days prior to its anticipated withdrawal.

1 The Initiative was originally known as the Methane to Markets Partnership, whose Terms of Reference commenced on 16 November 2004. Terms of Reference of the Global Methane Initiative

APPENDIX A: STEERING COMMITTEE MEMBERS

ARGENTINA
AUSTRALIA
BRAZIL
CANADA
CHINA
COLOMBIA
ECUADOR
ETHIOPIA
EUROPEAN COMMISSION
FINLAND
GERMANY
GHANA
INDIA
ITALY JAPAN
MEXICO
NIGERIA
POLAND
REPUBLIC OF KOREA
RUSSIA
UKRAINE
UNITED KINGDOM
UNITED STATES

Global Methane Initiative

GLOBAL METHANE INITIATIVE (GMI) PARTNER ACTION PLAN GUIDANCE DOCUMENT

This guidance document is intended to assist Partners in the development of their GMI Partner Action Plans. As stated in the GMI Terms of Reference, "*Action plans can be useful tools in advancing project implementation, facilitating investment, and creating appropriate policy frameworks that support methane abatement, recovery, and use.*" The goal of the GMI Partner Action Plan is to articulate the overall vision for a Partner's participation in GMI, outline key country activities and priorities, and provide a mechanism to advance cooperation among Partners by identifying needs and opportunities.

The GMI Partner Action Plans are an important way to help drive current and future project development activity, either internally or externally in coordination with other Partners. The GMI Partner Action Plans are ***not*** intended to replace the sector action plans that Partners have developed or are developing through the Subcommittees. The sector action plans serve a critical function. They provide detailed, sector-specific technical and policy information that provides the context for setting priorities as well as identify and communicate what additional assistance may be needed and where opportunities for collaboration exist. The appendix to this document provides additional details and guidance on the sector action plans.

The Steering Committee recognized the importance of broader action plans at the national level, and it tasked the GMI Administrative Support Group (ASG) with drafting guidance for their development. This document provides a brief outline and description of key elements that could be included in a GMI Partner Action Plan.

The GMI Partner Action Plans are intended to be concise, flexible, living documents. Ideally, the Partner Action Plan can be limited to only a few pages while referencing the specific data and articulating needs in the more detailed sector action plans. Secondly, the plans are flexible. While Partner countries are encouraged to include the elements described here, they are welcome to tailor their plans as appropriate. Finally, the Partner Action Plan should be a dynamic document that is easily updated as needed.

GUIDING QUESTIONS FOR SUGGESTED GMI PARTNER ACTION PLAN ELEMENTS:

1. ***What are your country's objectives and priorities for participating in the Global Methane Initiative (GMI)?***

a. **APPENDIX – Elements for Sector Specific Action Plans**

PARTNER SECTOR ACTION PLANS - SUGGESTED ELEMENTS

This guide is intended to assist GMI Partners or other stakeholders in the development of GMI Sector Action Plans, which ultimately should provide data and information that guides the development of an overarching GMI Partner Action Plan. The following list of suggested topic areas includes common elements across all the GMI sectors and is recommended for analysis and inclusion as you develop and/or refine existing sector-specific methane action plans. This outline should be considered as a guide to help you think of what elements to include with your plans – Partner countries can include more or less elements and are free to format their plans in a way that best fits their information. As you know, sector action plans have been an important ongoing component of the Subcommittee work under the GMI and many countries have completed these for different sectors. If you have already developed sector plans, consider updating or modifying them as your program evolves.

1. Country Background and Overview of Methane Emissions

Provide an introduction and overview of your country. Specifically look to provide developers, decision-makers, investors and others with a background on the sector-specific methane reduction opportunities, as well as background regarding the scale and the sources of methane emissions within your country. The introduction can include general information on the country, the climate, geography and other interesting information that may be relevant to better understand methane sources within the country. If methane emission information is not immediately available, some general estimates may be possible using international studies such as EPA's study titled: *Global Anthropogenic Emissions of Non-*CO_2 *Greenhouse Gases: 1990–2020* (EPA Report 430-R-06-003) – available at: www.epa.gov/climatechange/economics/international.html

Some Resources and Items to consider:

a. Existing national greenhouse gas (GHG) inventory and/or climate change program documents.
b. Specific sector databases in Government Ministries.

2. Characterization of Public and Private Sector Involvement

Provide an overview of key actors in the methane arena within your country – both internal and external. This could focus on how methane emissions are managed in your country (e.g., owned and operated by the public or private sectors) or could focus on specific sources.

Some groups to consider include:

- Owners/Operators
- Sector-Related Organizations (e.g., trade associations)
- Utilities
- Local Governments
- State or Provincial Agencies
- Regional/Geographic Collaborations (e.g., Latin America)
- Non-Governmental Organizations (NGOs)
- Equipment Providers/Suppliers
- Other Private Sector Representatives
- Financiers (e.g., multi-national development banks)
- Project Developers
- Consultants
- Technical Experts
- Researchers
- Universities

c. Consider how the sources of methane emissions are managed in each sector and consider which ministries have authority over each sector; also think about which funding institutions are active in the methane sector.

3. **Challenges to Mitigation or Abatement of Methane Emissions**
Consider whether any project development barriers currently exist within you country and provide an overview of the challenges.

Some broad areas to consider include:
- Awareness
- Financial/economical
- Legal/regulatory
- Policy enforcement
- National capacity
- Project identification and development
- Resource/gas ownership issues
- Markets (e.g., end users)
- Low power prices
- Lack of transportation infrastructure
- Proven, cost-effective technologies (i.e., cost-benefit analysis)
- Inadequate/consistent (i.e., year-round) inputs
- Project scale (e.g., volume of gas)

4. **Activities to Promote Methane Mitigation and Abatement (internally and externally)**

Provide an overview of initiatives or activities that exist now in your country that promote methane abatement, recovery, and use (e.g., GMI activities). Also consider an overview of international climate work you are currently engaged in with an emphasis on methane with neighboring countries and others.

Some activities you may have already completed or considered may include:
- Data collection (e.g., inventories, research) and information products (e.g., reports)
- Information sharing
- Capacity building (e.g., workshops, clearinghouse)
- Targeted information exchange (e.g., list serves)
- Technical training (e.g., study tours)
- Prefeasibility studies
- Feasibility assessments
- Project identification
- Technology demonstrations
- Pilot projects
- Technology deployment
- Adoption of new policies/changes to regulatory framework
- Development of financial incentives

d. Consider including a section on additional types of assistance that could be useful to get projects moving and listings of successful projects developed.

5. **Policy, Market and Legal Drivers to Advance Methane Project Development**
Include a discussion of any market issues related to project development within your country. Some key issues could include: uses for methane, prices and tariffs, competition, import duties, market access (e.g. access to electric utility grid, gas pipeline), renewable or green energy standards, and regulatory issues. Also discuss how project financing, legal issues and policies addressed both internally and externally.

Some items to consider here (note these may also apply to number 3 above) include:

- Prices and tariffs
- Competition
- Access (e.g., electric utility grid, natural gas pipeline)
- Renewable or green energy standards (e.g., portfolios)
- Carbon credits
- Regulatory
- Legal framework (e.g., decrees, licensing/permitting)
- Climate change position (e.g., Kyoto Protocol signatory, CDM/JI opportunities)
- Policies and/or other mandates that might affect methane mitigation (e.g., mine safety, organic waste diversion)

6. Country Priorities

Based on the information gathered in covering the topics above, list some key near and long-term goals for your country on methane reduction, domestically and internationally.

7. Additional Information - Emission Sources, Mitigation Potential and Successful or Potential Projects

Additional information can be included to help others to better understand the full suite of activities within your country. Examples of information that could be included here include sector-specific emissions inventories, lists of active projects or projects in development, and any additional information listed above such as specific policies or laws, relevant ministries or organizations and any other contacts deemed useful to include.

- **Build and operate medium and large-size industrial complexes, which produce liquid fuel from coal.**

STRATEGIC OBJECTIVE 2. ***Build and operate coke-chemistry and coal, energy and chemical industrial complexes:***

- On the basis of Tavan Tolgoi coking coal deposit, process coal, and set up and operate a centre and a coal chemistry research laboratory.
- Produce petroleum products from coal.

PHASE TWO (2016-2021):

STRATEGIC OBJECTIVE 1. Build a large capacity power plant using clean coal technologies and acquire full industrial capacity to produce petroleum products from coal:

- Build a fuel, energy and coal chemistry complex at Choir-Nyalga coal deposit.
- Obtain hydrogen, methanol, DME and other new kinds of fuel from coal.
- Acquire full coke-chemistry production capacity and export no less than 5 million tones of coke annually.

POWER UP!

T. MATRAJT, Caterpillar Electric Power, US,

Discusses a sustainable solution that reduces emissions and provides an efficient source of energy

Coal seam methane (CSM) is a significant contributor to global warming. A byproduct of coal formation in subterranean coal seams, CSM is released before or during active coal mining. There are two basic types of coal seam methane (CSM): coalbed methane (CBM) and coal gas methane (CGM). CGM is also split into two major categories: coal mine methane (CMM) and ventilation air methane (VAM). Globally, coal mines emit approximately 400 million tCO_2e/year of methane, equivalent to the consumption of 818 million bbl of oil or the CO_2 emissions of 64 million passenger cars. By 2020, the world's coal mines are expected to produce emissions of 450 million tCO_2e/year.

Methane contributes to global warming because it does not dissipate quickly. In fact, when released through coal mining or other processes, methane remains in the atmosphere for as long as 15 years. Aside from the US and China, leading emitters include Ukraine, Australia, Russia and India. Methane is also considered more harmful than some other prevalent greenhouse gases (GHGs) as it has a global warming potential 21 times more than that of CO_2.

Stakeholders responsible for coal and power production are looking for ways to safely and economically mitigate the release of CSM. One way CSM emissions can be significantly decreased is through the recovery and use of drained gas. Through this process, the CSM is sequestered and used for fuel in reciprocating gas engine generator sets. This mature and proven technology is highly effective for gas mitigation and power generation. It also provides many benefits. In addition to improving air quality and enhancing overall mine safety, the power generated can then be used at the minesite to provide power to developing or remote areas or sold to the grid.

SELECTING THE RIGHT COAL METHANE POWER PLANT

When considering the installation of a CSM power plant, there are a number of factors that must be evaluated, including the length of time it will need to be fully operational, the composition of the gas to be sequestered and the availability of appropriate equipment and support.

Typically, a permanently-installed CSM power plant development requires 12 – 18 months from start to completion. Duration depends significantly on site accessibility and the preparation and complexity of the power plant. For mobility and ease of installation, some generator set manufacturers offer pre-configured containerised sets for lease or rental, which can be delivered, installed and commissioned, in as little as one month.

Before selecting the right CSM-fired power system, the methane gas composition and condition must be evaluated. It is important to understand the heating value, methane number, contamination levels and water content of the fuel. This analysis is necessary not only to understand the extent of fuel conditioning equipment needed, but also to match the fuel to the optimal power system. Some coal gas, particularly CBM, can consist of nearly pure methane and may not require specialised fuel train, fuel treatment or dewatering equipment. On the other hand, some CMM or VAM may be high in CO_2 and other impurities that require special fuel systems.

The level of fluctuation in gas composition over time should also be understood and communicated to the power system provider. Some manufacturers offer control systems that automatically adjust to changing compositions of CSG, correcting the air/fuel mix and spark timing to accommodate these fluctuations. Designing a system with a gas storage buffer to mix the gas before it is fed to a reciprocating engine or turbine can also shield the generator from these fluctuations. Ideally, the project should be developed using an integrated systems approach that incorporates a fuel system designed to accept very low-pressure gas, typical of a coal mine ventilation system, and a fuel and control system customised to match the site requirements.

Table 1. Methane emissions (tCO_2e) from coal mining activities

Regions	1990	1995	2000	2005	2010	2015	2020
Africa	9.7	10.7	9.3	8.4	8.2	8.2	8.7
China/CPA[1]	152.1	177.3	145.5	162.5	179.5	196.6	213.9
Latin America	5.4	5.3	6.9	7.6	8.4	9.5	10.7
MIddle East	0.3	0.3	0.4	0.4	0.4	0.4	0.5
Non-EU eastern Europe	1.0	1.0	1.9	2.3	3.0	3.9	5.3
Non-EU FSU[2]	142.0	84.4	67.6	59.5	58.6	57.0	55.6
OECD90[3] & EU	188.0	154.3	124.6	123.2	121.5	116.7	119.3
Southeast Asia	18.1	18.3	20.8	24.3	27.9	33.1	38.5
World Total	**516.7**	**451.5**	**376.9**	**388.1**	**407.6**	**425.6**	**449.5**

1. CPA: centrally planned Asia.
2. FSU: former Soviet Union.
3. OECD90: Organisation for Economic Cooperation and Developments (Member states at 1990).

Table 2. Global warming potentials (GWP) and atmospheric lifetime (years)

Gas	Atmospheric lifetime	100 year GWP[1]	20 year GWP	500 year GWP
Carbon dioxide (CO_2)	50 – 200	1	1	1
Methane (CH_4)[2]	12	21	56	6.5
Nitrous oxide (N_2O)	120	310	280	170

Source: IPCC (1996)
1. GWPs used here are calculated over a 100 year time horizon.
2. The methane GWP includes the direct effects and those indirect effects due to the production of tropospheric oxone and stratospheric water vapour. The indirect effect due to the production of CO_2 is not included.

Choosing the right generator set manufacturer is another important consideration. The manufacturer and dealership staff must be highly qualified and understand the unique needs of a CSM project. In addition, the local dealer should be able to provide design, preventive maintenance, parts and repair services, logistical and technical support, financing and payment options, as well as an understanding of local customs and economics.

HOW A CSM POWER PLANT WORKS

CSM power systems vary depending on the type of gas that is available. For example, with VAM the concentration of methane in the recovered air is very low, typically in the 0.3 – 1.5% range. Because of the low methane concentration, it is difficult to reuse it for power generation purposes.

In CBM, however, degasification systems (commonly referred to as gas drainage systems) are used. Vertical or horizontal wells are drilled into the coalbed and a vacuum is applied to the well to extract the methane. Compared to VAM, the quality of the methane in this type of extraction is often very high, with methane content above 85% being common. This is especially true from vertical wells drilled into the coal seam well ahead of the actual mining.

Gas produced when horizontal wells are drilled into the face of the coal seam as it is being mined (CMM) typically has more air mixed with the methane as it is gathered. This gas is generally composed of 25 – 60% methane with the rest being other, resident inert gases such as oxygen and nitrogen. The percent of methane can vary depending on the proximity to, and the amount of, mining activity in the coal seam at the time of extraction.

When CMM is removed from the ground, it is held in large tanks until it is pretreated for use in reciprocating gas engines. At large operations, such as those being conducted in China, tanks hold approximately 30,000 m^3 of CMM. Pretreatment includes filtering the CMM for dust and particles through 10 µm filters and then 1 µm filters, drying the gas to below 80% relative humidity, and then sending it through a fuel train, where the pressure is regulated to between five and 35 kPa.

After this pretreatment process, the CMM is sent to generator sets built close to the minesite and managed with switchgear to provide synchronisation, voltage checks, loading and unloading of the engines and overall system protection. Figure 1 illustrates a typical layout of a CMM-fueled generator set system.

PROVEN SUCCESS AT THE WORLD'S LARGEST CSM POWERED PLANT

Caterpillar has a proven track record of providing generator sets specifically designed for CSM. The company begins with CSM composition and stability analyses, which are used to determine the best engine selection for a specific site. Caterpillar's experience in this type of power generation has been proven successful at several sites around the world including China, where the growing economy demands environmentally-conscious solutions to meet power generation needs.

In 2006, with assistance from the US Environmental Protection Agency and other federal partners, Caterpillar received a contract from China to supply the power generation equipment for the Sihe mine, the world's largest CSM power plant. This project, which was completed in 2009, is the result of collaborative efforts between the public and private sectors through the Global Methane Initiative, a US-led initiative that now includes 37 partner countries, including China and the European Commission.

At the Sihe mine, 60 Cat® G3520C low-energy fuel generator sets are producing 108 MW of electricity from CBM and CMM. In addition, exhaust gas heat is being recovered and used to drive steam turbines, which produce another 12 MWe. Finally, a jacket water heat recovery process has been implemented and is being used as source of hot water for the mining operations.

The Cat G3520C generator sets run at 1500 rpm with a continuous rating of 1966 kWe under standard operating conditions. An open combustion chamber design allows the gensets to operate using low-pressure gas supplies of just 5 – 35 kPa (0.7 psi – 5 psi). The low-boost pressure requirement reduces the installation cost of fuel treatment systems often found in low-energy fuel environments.

Through this process of sequestering the Sihe mine coal methane and converting it to useable energy, an estimated 40 million tCO_2e emissions will be avoided over a 20 year period. This emissions reduction is equivalent to removing one million cars from the roads annually.

A GLOBAL ENERGY SOURCE

The Sihe mine project is just one successful example where CSM is used as a viable sustainable energy source. In Australia, the Appin and Tower coal mines in New South Wales constitute what is arguably the largest CSM energy project in the world, and one of the world's largest reciprocating engine-generator installations of any kind.

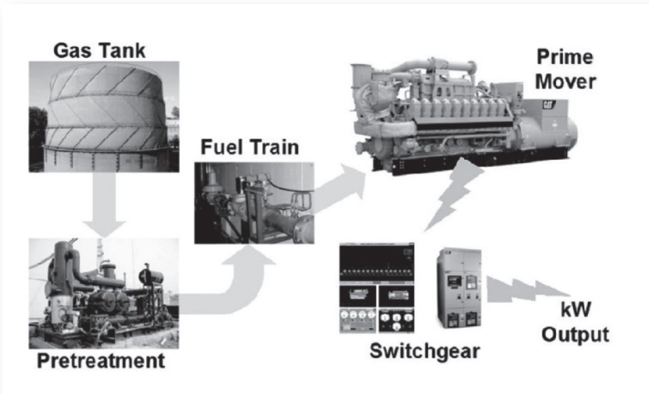

Figure 1. Typical plant layout.

Consuming 600,000 m^3/day of CSM (supplemented when necessary by natural gas from Moomba, Australia), 94 Cat G3516 reciprocating engines coupled to SR4 brushless generators deliver a combined 94 MW of continuous capacity to the local utility grid.

According to the Global Methane Initiative, additional ongoing CSM projects can be found in 16 countries, including Australia, China, Czech Republic, Germany, Poland, the UK and the US, where projects are being hosted in active mines. Germany, Ukraine, the UK and the US also host many projects at abandoned mines. Countries that are in early development stages include New Zealand, India and South Africa. These three countries have conducted methane drainage in addition to ventilation at active coal mines. Italy is currently assessing the feasibility of drainage at an abandoned mine. All of these countries have strong potential to recover and use drained gas in the future, and in turn reduce the emission of harmful greenhouse gases into the atmosphere.

As emissions regulations continue to tighten globally and local governments implement new policies to drive a cleaner and more sustainable environment, mitigating CSM through generator sets offers mine owners an opportunity to benefit from the investment while reducing their environmental impact. This form of distributed generation is a mature and proven technology that can yield significant, positive results, including reduced coal mine emissions and improved safety and quality of life in mining communities around the world.

What next for VAM?

Jayne SOMERS, US Environmental Protection Agency,

US, and Clint Burklin, Eastern Research Group, US, provide a brief update on the world VAM destruction technology market.

Methane, a powerful greenhouse gas (GHG), is often found in coal seams and significant quantities of methane gas can be released into underground mine workings as part of coal mining operations. Because concentrations above 5% are explosive in air, mines must ensure that methane does not build to dangerous levels within the mine. This is accomplished in part through the use of large-volume ventilation air systems that dilute and remove methane from the mine. Although the concentration of exhausted methane in ventilation air is quite low (typically <1%), the volume of mine air that ventilation systems move is so great that they actually constitute the largest global source of methane emissions from underground coal mines. Five countries make up over 75% of ventilation air methane (VAM) emissions:

- China (40%).
- US (15%).
- Ukraine (15%).
- Australia (5%).
- Russia (5%).

Having a global warming potential of 21 times greater than an equivalent weight of CO_2, the annual VAM emissions from these five countries is equivalent to over 225 million t of CO_2,or approximately 38% of global coal mine methane (CMM) emissions. In 2010, global methane emissions from coal mines were estimated to be approximately 584 million t of CO_2 equivalent, accounting for 8% of total global methane emissions.

Several manufacturers began pilot-scale demonstrations of technologies for the destruction of VAM in the 1990s. These VAM destruction technologies are based on the same technologies used for many years for the destruction of volatile organic carbon (VOC) emissions. The demonstrations were successful and led to three manufacturers/project developers now operating five commercial-scale projects (Figure 1). These commercial projects have operated since 2007 in Australia, China, the UK and the US. As a result of these projects, the technical and economic performance of the technologies is relatively well documented and the technical risk is considered relatively low.

All three companies are offering technologies based on regenerative thermal oxidation (RTO) and are demonstrating >95% destruction of methane with a >90% availability. Although RTO technology will destroy methane at levels as low as 0.2%, the most ideal sites for these technologies are ones that have VAM concentrations ranging from 0.5 – 1.9% methane in ventilation flows of 100,000^{3}ft/minute, or more. Ideally, the ventilation shafts should have a life of more than six years and access to stable electrical supply at reasonable cost. The companies offering VAM destruction technologies also offer a wide range of financial agreements, ranging from sale of a turnkey facility to various lease agreements, profit sharing arrangements or simple royalty payments.

The key factor limiting more widespread application of VAM destruction technology is the lack of economic market or regulatory drivers for VAM destruction. The primary drivers for the current VAM projects have been the carbon markets for the reduction of GHG emissions under the UN Framework Convention on Climate Change (UNFCCC) and other voluntary initiatives.

The Kyoto Protocol, created and adopted under the UNFCCC, is an international regulatory framework that defines clear emission reduction commitments using flexible mechanisms, such as the clean development mechanism (CDM) and joint implementation (JI), that have laid the foundation for the development of the international carbon market. The voluntary carbon market was established primarily by companies, individuals and events that buy emission reductions to reduce their carbon footprint. Currently, both the CDM and JI carbon markets are driven by commitments under the Kyoto Protocol that are undefined after expiration of the protocol at the end of 2012. Such uncertainty in the compliance carbon market creates financial hurdles that reduce investment opportunities. In addition, as a result of the global economic recession, the current monetary value and interest in purchasing voluntary carbon reductions is very low, which also limits investment in VAM destruction. Table 1 summarises the world market for VAM destruction technologies.

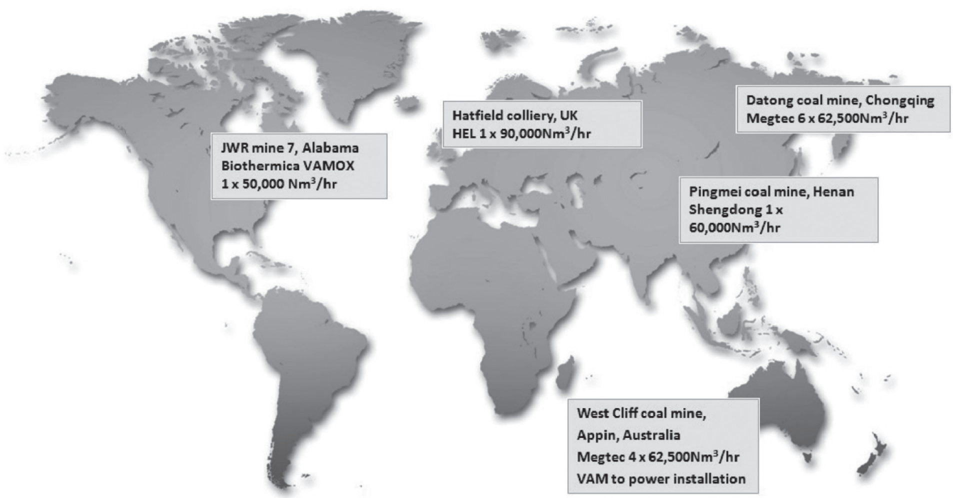

Figure 1. Current worldwide VAM projects.

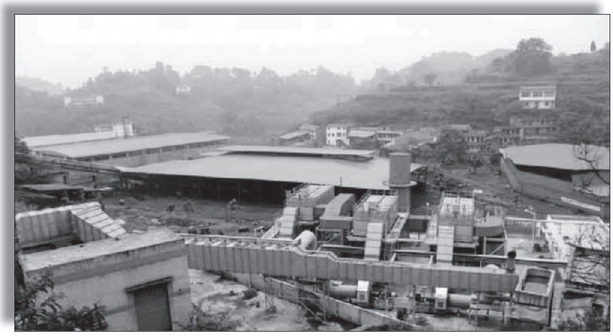

Figure 2. RTO Installation at the DaTong coal mine in Chongqing municipality, China.

Image courtesy of MEGTEC.

Although the current market for VAM destruction is soft, before 2008 – when carbon prices were as high as US$ 20/t – the 300 million tpa of CO_2 equivalent of VAM emissions potentially represented a US$ 6 billion/year market. But in recent years, carbon prices have declined and become subject to increased volatility. Several factors could reduce the economic risk of investing in VAM technologies and improve the VAM destruction market. An extension of the Kyoto Protocol beyond 2012, or some other form of regulatory mechanism, would send a clear market signal and revive the price of carbon reductions for signatory countries. As an alternative, countries can take unilateral measures like China, which has extended the value of carbon reductions implemented in China by offering letters of approval (LOA) under the CDM that honour the sale of carbon reductions through 2020. Australia has recently adopted a carbon tax on significant GHG sources that could create a market for VAM destruction at gassier mines. Currently, the EU does not include methane or methane reductions in countries within its mandatory GHG reduction program. Broadening the EU GHG trading programme (EU ETS) to include methane would greatly expand the VAM market to European mines. Countries and organisations can also provide incentives for VAM destruction. Grants such as those provided by Australia, the province of Quebec, Canada, and the US greatly facilitated the BHP West VAMP, J.R. Walters Black Warrior and Consol Windsor projects.

Table 1. The world market for VAM destruction technologies.

China	China is the world's largest underground coal producer, with an output of 2.66 billion t in 2009. VAM emissions are estimated at 18.3 billion m3 2009. A CDM mechanism is in place, with carbon value extended until 2020 to enable a return on investment.
Australia	The country produced 117 million t of coal from underground mining in 2009, with VAM calculated at 1.3 billion m3 for that year. The recent adoption of a carbon tax could provide a mechanism for return on investment.
Mexico	Mexico only produced 11.5 million t of coal, but the majority of its coal mines use modern longwall mining techniques and exhibit favorable VAM abatement characteristics such as large volumes and high VAM concentrations. CDM and VCM mechanisms are in place with carbon value until 2020 to enable a return on investment.
Russia, Ukraine and Kazakhstan	These three countries collectively produced 300 million t of coal in 2009, with VAM emissions calculated at 6.2 billion m3. A wide range of mining techniques, mining conditions and levels of mechanisation are found in these countries. There is significant potential for VAM abatement projects.
India	India produced 529 million t of coal in 2009, the majority from open-cast mining. Most underground mines are small scale and not gassy, currently offering poor conditions for VAM abatement. However, Coal India Ltd plans to dramatically increase coal production by 2020.
US	The US produced 378 million t of coal from underground mines in 2009, with calculated VAM emissions of 2.8 billion m3. Large gassy coal mines give favourable conditions for VAM abatement projects, but a weakened global voluntary carbon market (VCM) presents high financial risk hurdles. The State of California's market-based GHG emission reduction may provide opportunities in the future.
South Africa	Some 250 million t of coal were produced in 2009, but South Africa's coal mines tend to be shallow, thus not gassy. However, the country has good future potential as coal mines access deeper reserves.
Western Europe	The EU Emission Trading Scheme (ETS) does not recognise methane as a GHG, thus no commercial mechanism exists to enable return on investment.

In summary, coal mine ventilation air is a significant global source of methane emissions from mining activities, and the destruction of this methane offers a significant GHG mitigation opportunity. Oxidation technology for the destruction of VAM has matured through the success of multiple long-term full-scale demonstration and commercial projects implemented across several continents. Based on the estimated quantity of VAM emissions, the world market for VAM destruction technologies has a potential value of several billion dollars. However, as the world's focus temporarily slips away from climate change to international financial stability, the lack of medium-term clarity for the carbon market means that these technologies are not being implemented as quickly as the opportunity deserves. In response, there are also several measures that Governments and organisations can take to boost the VAM destruction market including financial incentives, and regulatory and market based programmes.

REFERENCES

1 *US EPA, "Assessment of the Worldwide Market Potential for Oxidizing Coal Mine Ventilation Air Methane" (EPA 430-R-03-002; 2003).*

2 *US EPA, DRAFT: Global Anthropogenic Emissions of Non-CO_2 Greenhouse Gases: 1990–2030 (EPA 430-D-11-003; 2011). Available at: www.epa.gov/climatechange/economics/international.html.*

NOTES

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NEEDS TO DETERMINE METHANE SOURCES IN MONGOLIAN COAL MINES

Prof. B.NAMKHAINYAM Mongolian University of Science and Technology
Mr. B.OCHIRSUKH Mongolian Nature and Environment consortium

Mongolia also has substantial proven reserves of coal, and annual coal production is presently about 30 million metric tons, almost all of the sources are used for steam and electricity generation. Coal is the main energy source in the country. The Mineral Resources Authority has revealed that around 50 organizations currently exploit coal in 36 mines. Two of these are state-owned, three are owned by province administrations, and the remaining 45 are private companies.

An efficient use of coal and introduction of respective advanced technologies into energy sector is one of vital areas of the national development. In general, Mongolian energy sector is almost fully dependant on brown coal. About 98 percent of electrical power generation and whole heating energy of Mongolia is produced by coal.

COAL DEPOSITS AND ITS RESERVE IN MONGOLIA

Mongolia is one of ten countries with the most coal reserves, and further exploration could increase its reserves. Mongolia has geological coal reserves of 150 billion tons in 300 deposits and occurrences in 15 coal basins, falling into 3 major regions.

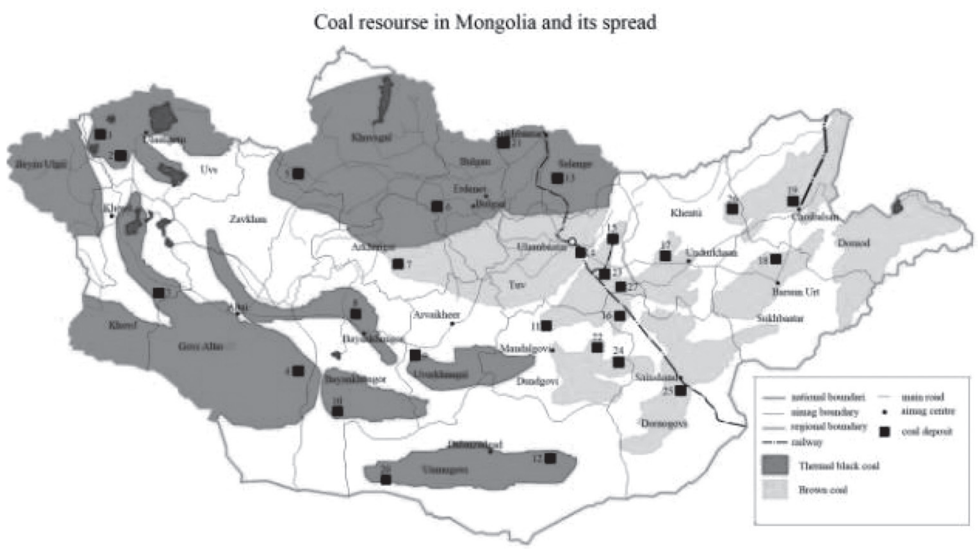


Figure 1. Coal resource in Mongolia and its spread

1-Nuurst khotgor, 2-Khartarvagatai, 3-Khushuut, 4-Zeegt, 5-Mogoingol, 6-Saikhan ovoo, 7-Bayantsagaan, 8-Uvurchuluut, 9-Bayanteeg, 10-Shinejinst, 11-Tevshyngovi, 12-Tavantolgoi, 13-Sharyngol, 14-Nalaikh, 15-Baganuur, 16-Shivee ovoo, 17-Chandgan tal, 18-Talbulag, 19-Aduunchuluun, 20-Nariin sukhait, 21-Ulaan ovoo, 22-Khuut, 23-Tsaidam nuur, 24-Uvdug khudag, 25-Sainshand, 26-Khulst nuur, 27-Tugrug nuur [3]

Coal deposits and occurrences are widespread the country, but most of the coal resources are concentrated in the east, central and south areas. For example, most of coal reserves are in the Tavan Tolgoi, Nariin sukhait, Khushuut, Nuurstkhotgor, Baganuur, Shivee-Ovoo, Shariin gol, Uvdug khudag, Tevshiin govi, Tsaidam nuur, Ulaan-Ovoo and Tugrug nuur deposits. [3]

With growing demand of coal worldwide, especially from China, coal mining in Mongolia has been developing rapidly in recent years. In near future, it is planned to construct thermal power plants at Aduunchuluu, Tavantolgoi, Shivee Ovoo and Baganuur coal deposits with total capacity of 2800 MW.

Annual electricity generation of the plants is estimated to be 14-16 billion kW from combustion of approximately 12.0 million tons of coal every year. In addition to that, domestic demand of coal will increase as well.

Growth dynamics is shown in below which shows that coal exploration is to increase 2.5 folds during 2010 to 2020.

Table.1 Forecast of Coal production and consumption by country, mil. tons

№		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	**Consumption**	7,06	7.3	8.0	9.2	10.3	10.7	11.1	11.7	12.3	12.7	13.0
2	**Export**	13,2	9.7	10.0	10.8	14.7	19.3	23.9	28.3	30.7	34.3	37.0
3	**Production**	20,26	17.0	18.0	20.0	25.0	30.0	35.0	40.0	43.0	47.0	50.0

There are two major reasons for determining coal mining methane in Mongolia.

- The more coal exploration, the higher methane emission from coal mining methane. Efficient utilization of this methane will help not to lose the methane and reduce GHG emission;
- Defining methane sources from coal mining to be included in the GHG national inventory is crucial.

NEEDS TO USE METHANE AS A FUEL

Methane is a traditional fuel. Its confirmed reserves on the Earth reache 240 trillion cubic meters and it usually extracted from depths 800 meter or more.United States, Russia and China are the countries with the biggest reserves of methane. In 2011, China emitted 25 thousand million cubic meters of methane from coal mining annuallly. This resource is not explored yet.

Methane in the Earth's atmosphere is one of important greenhouse gases with global warming potential that is 21 times higher than carbon dioxide. Its emission has been intensified through industrialization and total emissions have doubled during the last 100 years. About 18 per cent of the Earth's atmosphere consists of methane. Scientists report that the annual average emission of methane is expected to increase by 0.6 per cent. Methane persists in the atmosphere for approximately 11 years. The world's estimated liquid fuel reserve is 30-50 years. Conversion of vehicles to utilize methane fuel is one solution which can contribute to a reduction in fuel availability.

Mongolia also emits a significant amount of methane during mining of coal. Like China, this resource is no currently captured and used. Further, utilizing methane instaed of liquid fuel can result in a reduction of GHG emissions by 13 per cent.

Bigger cities and aimag centers use substantial amounts of raw coal for heating buildings and households in various types of combustion stoves. The air pollution bigger cities and aimag centers has reached a crisis level. Recent studies estimate that the cities pollution during the winter season exceeds average allowable air quality levels by 5-6 times.

Methane replacement can coal consumption and its associated toxic emissions.

- Air and environmental pollution of the city is reduced;
- Fuel cost savings for businesses and households located in the city's remote or ger district; and
- Atmospheric methane emissions from coal mining reduced.

The following benefits are expected from methane utilization:

1. Methane burns more efficiency than coal. Efficiency rates for stoves and boilers using gas fuel is more than 90 percent. This means less GHG emissions and financial savings through lower fuel-related expenses;
2. Total consumption amount of methane will be lower, considering that its heating value is higher than coal by 2.5 times and higher than gasoline by 1.2 times,. It allows savings through mining and distribution costs.
3. Methane is cheaper than other fuels; its heating economic unit value is lower due to its relatively cheaper price.

METHANE EMISSION FROM COAL MINES IN MONGOLIA

Mongolia ratified the United Nations Framework on Climate Change (UNFCC) on 30 September 1993. Since ratification of the Kyoto Protocol on December 15, 1999, Mongolia has submitted two national communications so called the national inventory of greenhouse gas (GHG) emissions on 1 November 2001 and 10 December 2010, respectively.

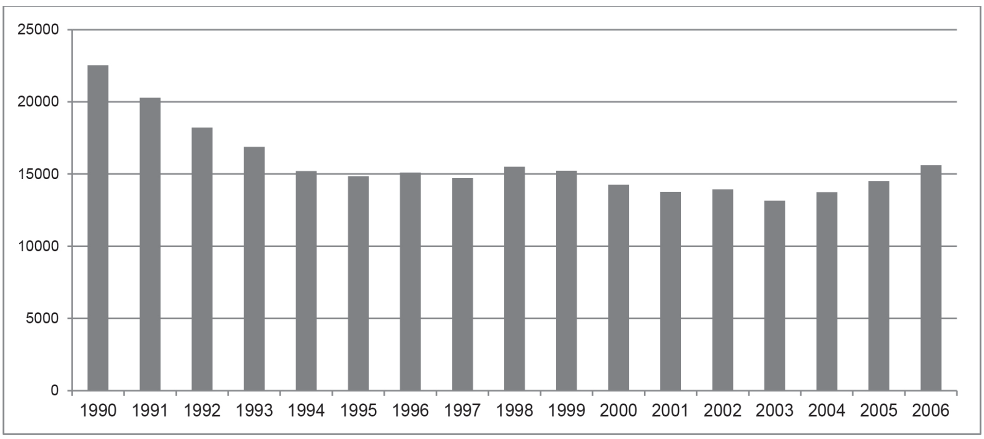


Figure 2.Total GHG Emissions in CO_2-eq for the period 1990-2006 [1]

1 2nd National Communication, GHG National Inventory 2010

The energy sector (including stationary energy, transport and fugitive emissions) was the largest source of greenhouse gas emissions comprising 65.4% (10,213.09 Gg) of emissions (Figure 3). The second largest source of GHG emissions was agriculture sector (41.4%).

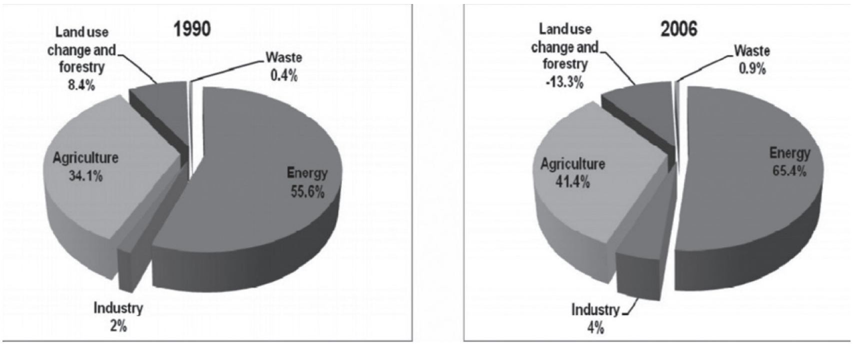


Figure 3. Contribution to total CO_2-eq emissions by sector for 1990 and 2006

For Land use change and forestry sector, the total CO_2 removals were 13.3% due to increase of the area of abandoned lands and reduce of newly cultivated land. Other relatively minor sources currently include emissions from industrial process and waste sector.

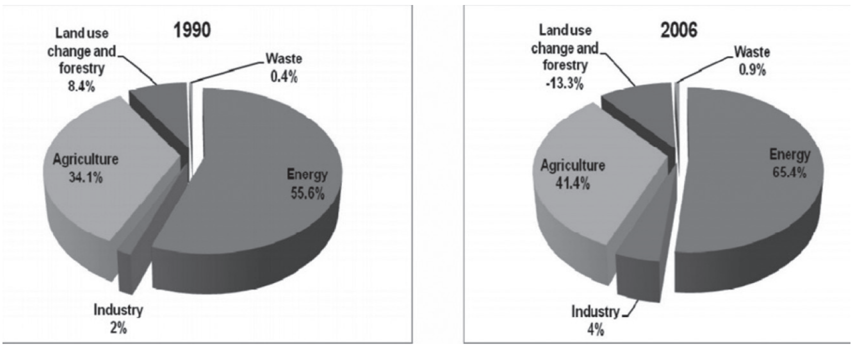


Figure 4. GHG emission of Mongolia, 1990 and 2006

Carbon dioxide is the most important greenhouse gas in Mongolia's inventory with a share of 50.4 % of the total CO2-eq emissions in 2006 followed by methane which comprises 41.8%.

Methane CH_4. The sources of methane emissions in the energy sector arise from fuel combustion activities and fugitive emissions from coal mining. The values of CH_4 emissions from the energy sector are relatively low. In 1990, CH_4 emissions from the energy sector were 18.38 Gg and decreased to 11.64 Gg in 1995. CH_4 emissions have been increasing since 1996 and reached 15.39 Gg in 2006. Fugitive emissions from coal mining accounted for 50% of CH_4 emissions from the energy sector in 1990, 42% of CH_4 emissions from the energy section in 2000, and 46% of CH_4 emissions from the energy sector in 2006.
The main contributor to the total methane emissions is the agriculture sector with about 92- 93% (290.0 CH_4 Gg or 6463.0 Gg CO_2-eq) of the total methane emissions. The second biggest contribution comes from the energy sector (from coal mining and handling activities) with about 5-6%, while all other sectors are contributing with less then 2% in total.

METHANE EMISSIONS FROM COAL MINING AND HANDLING ACTIVITIES

Coal mining and post-mining activities contribute to methane emissions as methane contained in the coal is released during coal mining activities. However, these emissions are not significant compared to methane emissions from agriculture, comprising only 1.6-3.5 per cent of all methane emissions.

Activity data: In Mongolia, working approximately about 20 coal mining from where produced 30.0 million tones of coal per year. Most of the coal produces from surface and only 5% of total coal is mined as a underground. The mines are located 50-250 km far from main consumers and therefore, coal stored before delivery to consumers by train and car. Activity data are available from Statistical Year Book of Mongolia. However, separate data of underground and surface mining data were supplied from Energy Authority of Mongolia.

Methodology: The structure of the CH_4 emissions from coal mining (underground and surface mining) and post-mining activities (underground and surface mining) is (Greenhouse Gas Inventory Guidelines, Workbook, Vol. 3, 1996):

CH_4 emissions (Gg) = Coal production (10^6 t) x CH_4 Emission Factor (m^3 CH_4/ton coal) x Conversion Factor (Gg/10^6 m^3)

Emission factors: The emission factors (m^3 CH_4/t) used for coal mining and handling are selected as an average value given in IPCC guidelines. In Mongolian case, the emission factors (m^3 CH_4/t) are unclear and default parameters of IPCC guidelines are applied for the calculations.

Table 2. Emission factor in coal mining

Category	Emission factor used for National inventory	Emission factor given in IPCC guidelines
Underground Coal:		
Mining:	**17.5**	10.0-25.0
Post-mining:	**2.5**	0.9-4.0
Surface coal:		
Mining	**1.2**	0.3-2.0
Post-mining:	**0.1**	0.0-0.2

REFERENCE

[1] B.Namkhainyam "The Environmental issues of thermal supply sceince and technology", Mongolian Technical University ofScience and Technology, Ulaanbaatar, Mongolia, vol. 41, 2009, pp. 67-73, 75-101, 161-169. (in Mongolian)

[2] J.Byambaa, Mongolian geology and minerals, vol 5., "Combustible minerals", Ulaanbaatar, 2009, p.p. 99-108 (in Mongolian)

[3] Statistics of Mongolian energy sector, Ulaanbaatar, 2011, pp. 53-72. (in Mongolian)

OVERALL POLICY FOR THE COAL INDUSTRY IN MONGOLIA

B.Altsukh Senior Officer, Fuel Policy Department,
Ministry of Mineral Resources and Energy, Mongolia

22 July 2011

CONTENT:

- ENSURING VALUE FOR MONGOLIAN COAL
- GOVERNMENT SUPPORT FOR COAL INDUSTRY:
- STRENGTHENING TIES WITH COAL CONSUMERS

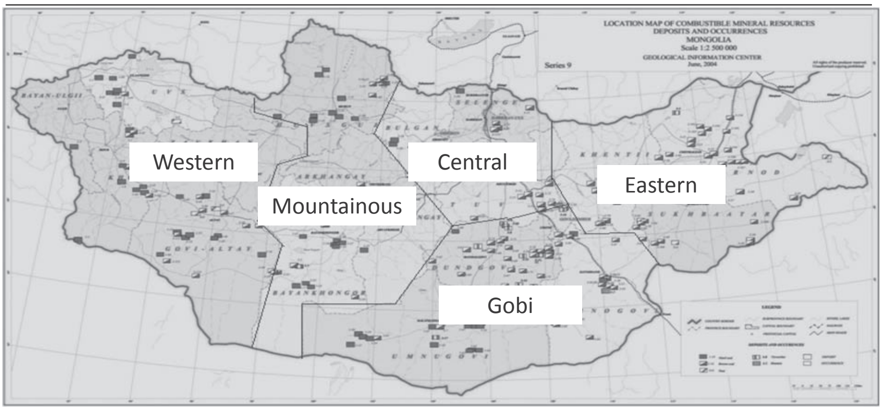
21 JUNE 2011

OTHER POTENTIAL COAL DEPOSITS:

21 JUNE 2011

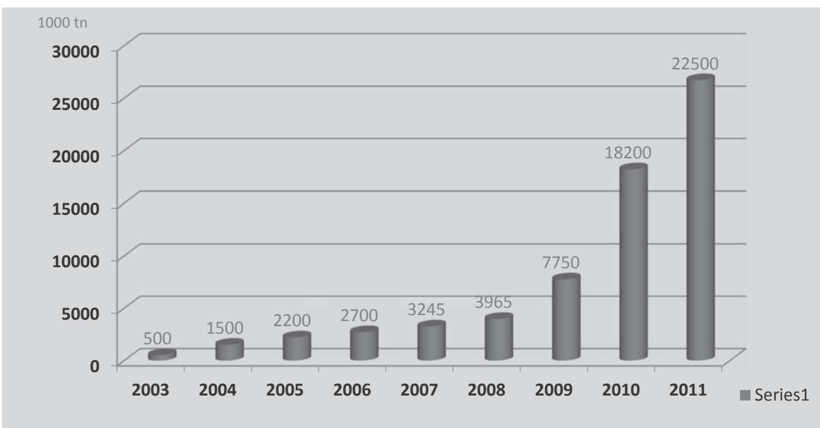
№	Coal basins and area	Geological resources, million tons		
		Proven	Geological	Total
1	Kharkhiraa	172.5	4592.7	4765.2
2	Mongol Altai	49.0	10040.6	10089.6
3	Altain Chanad	3.1	12300.0	12303.1
4	Uvurkhangai	4.2	1221.9	1226.1
5	Ikh Bogd	5.2	3450.0	3455.2
6	Ongyin Gol	42.6	1471.1	1513.7
7	Orkhon-Selenge	408.8	7295.3	7704.1
8	South-Govi	2960.0	10070.0	13030.0
9	Nyalga-Choir	5932.0	14401.1	20333.1
10	Dundgovi	104.1	13117.2	13221.3
11	Sukhbaatar	68.0	4190.2	4258.2
12	Choibalsan	213.2	14700.7	14913.9
13	Tamsag	190.0	31803.0	31993.0
14	Dornogovi		23534.0	23534.0
Total		10152.7	152187.8	162340.5

21 JUNE 2011



№	Index	Central region	Mountainous region	Gobi region	Western region	Eastern region	Total
1.	Number of deposits	13	13	20	23	16	85
2.	Reserves /million ton/	26528.1	7704.1	49785.3	27157.9	51165.1	162340.5
3.	Share in the total	16.5%	4.7%	30.6%	16.7%	31.5%	100%

MONGOLIAN COAL EXPORT



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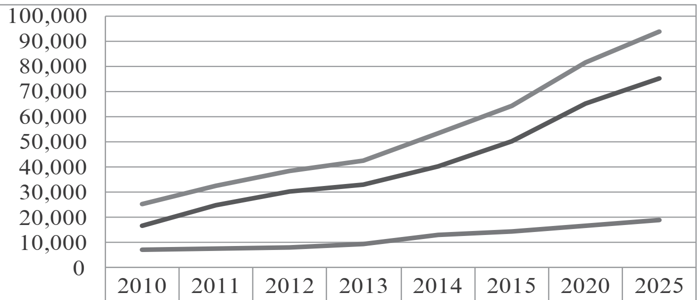
COAL PRODUCTION AND EXPORT PROJECTION

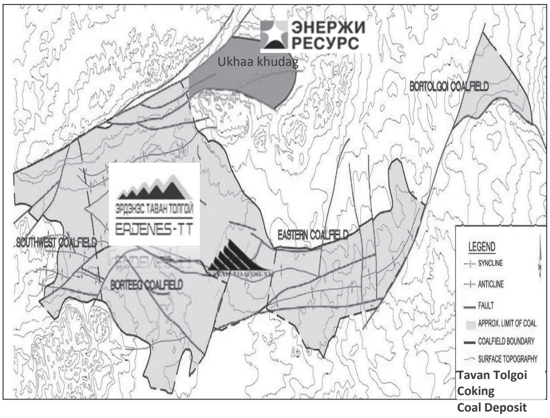


	2010	2011	2012	2013	2014	2015	2020	2025
Total production	25,344	32,634	38,340	42,635	53,355	64,580	81,587	94,010
Export	16,635	25,000	30,000	33,000	40,000	50,000	65,000	75,000
Internal consumption	7,344	7,634	8,340	9,635	13,355	14,580	16,587	19,010

Current major Coal exporters are located in the Southern part of Mongolia, close to China = 50 - 270 km

	Coking coal	Thermal coal
Calorific value:	6500-8500 kcal	4500-6500 kcal
Sulfur	0.6%	0.8%
Ash	10%	20-33%
Moisture	8.5%	8.5%

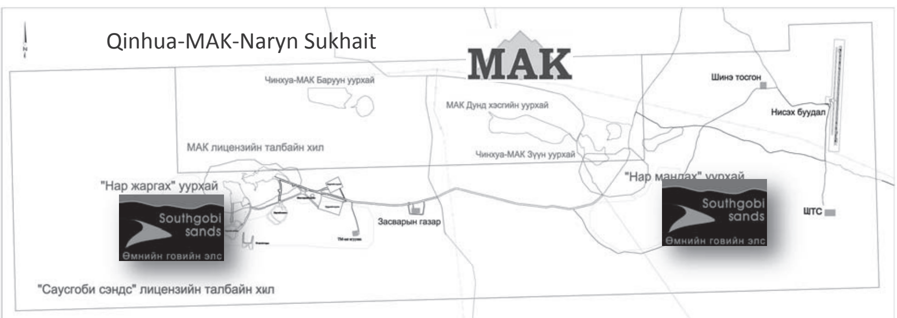
COAL EXPORT MAINLY TO CHINA



1. Tavan Tolgoi Co: 6.1 mln
2. ER Co: 4.7 mln
3. Erdenes TT: 0.7 mln

In 2011 total of 11.5 mln tons

COAL EXPORT MAINLY TO CHINA



1. MAK Co: 5.2 mln
2. Qinhua –MAK: 1.7 mln
3. South Gobi Sands: 3.8 mln

In 2011 total of 10.7 mln tons

PROBLEMS FACED

- Infrastructure: electricity, water, transportation
- Finance: high interests, short term
- Lack of qualified personnel and equipment
- Inappropriate coal pricing and trading
- Border station capacity

GOVERNMENT POLICY ON COAL SECTOR

- Improve legal environment:
  - Amendment into Minerals Law
  - Regulations: environmental issues, licensing, taxation
- Increase of exploration budget and intensify geological survey
- Increase of production and export:
  - Target Markets: China, Japan, Korea, Taiwan
- Introduction of value added production:
  - Preparation, Washing plants
  - Lignite upgrading: semi-coke
  - Gasification and Liquefaction
- Responsible mining principles

COAL SECTOR: MARKET / CUSTOMER ORIENTED APPROACH:

- Effective Integration of:
  - Coal resources
  - Coal Mines
  - Logistics
  - Marketing: Target markets : China, Japan, Korea, Taiwan
- Supports needed from:
  - Government and non government organizations: MMRE, MRAM, Coal Association and new bodies establishment when necessary
  - Information technology
  - Financial institutions

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ENSURING MARKET VALUE FOR MONGOLIAN COAL

First Coal washing plant opened 11 June 2011 :
- Energy Resources – National Company
- Total Capacity: 10 mtpa
- Over 150 job creating

Tavan Tolgoi West and East Tsankhi:
- 2 x 15 – 30 mtpa capacity washing plant
- About 200 job creating

21 JUNE 2011

GLOBAL METHANE INITIATIVE

STRENTHENING TIES WITH COAL CONSUMERS:

- Coal pricing, trading, marketing
- Coal quality: classification, side expertise
- Coal processing
- Public private partnership
- Negotiation contracts
- Mutual exchange of experiences
- Regular sector meetings
- etc

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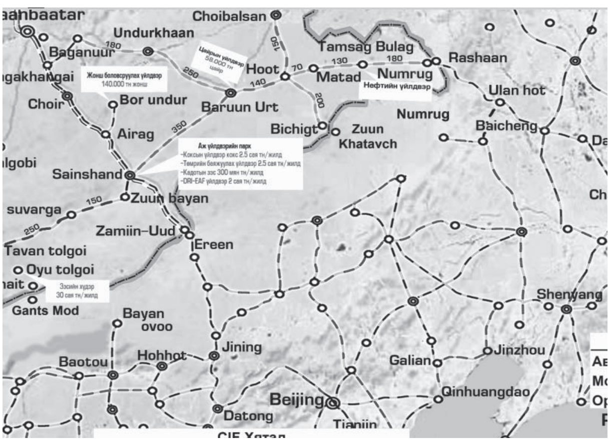

Possible 3 routes:

1. Zamin Uud – Erlian – Tianjin
2. Bichigt – Zuun hatavch – Qinhuangdao
3. Numrug – Rashaan - Jinzhou

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STRENTHENING TIES WITH COAL CONSUMERS:

- Other major ports:
  - Qinhuangdao port is close to east Inner Mongolia. Also, it is close to Easter part of Mongolia – Huut – Bichigt and Huut Rashaant railway line planned
  - Huanghua port - one of main ports for coal transportation

21 JUNE 2011

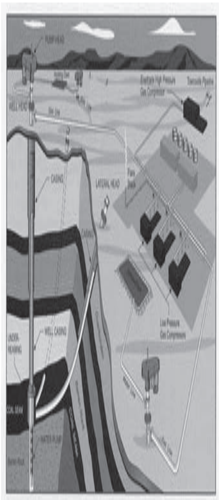
Coal bed methane

Нүүрснээс гаралтай байгалийн хий буюу нүүрсний давхаргын метан хийн таамаг нөөц 5-10 триллион метр куб байна.

Prognosticate resources of CBM 5-10 trillion м³

Mongolia was enter to the member of:
“Methane partnership”, 2008
“International gas union” 2011

Some research on CBM recources



- 2004-2005, “Storm cat” company, on the Nariin Sukhait coal field, resource is ***34 billion $м^3$*** ;
- 2007, “NorWest mine services“ company, on the “ Tavantolgoi” coal mine, ***20-30 billion $м^3$*** ;
- 2010, Australian company, on the Nalaikh coal mine, coal mine methane emission was ***40 million м3*** ;
- 2009-2010, Found of Science and technology:
  - -Kharkhiraa coal field ***60-90 billion м3***
  - -Ongi gol coal field ***40-60 billion м3***
- 2011, Korea gas corporation, Nalaikh, Tugrugnuur, Tcaidamhuur coal field, **analysis for methane content of coal**

Coal to Liquid

The Mongolian government goals for CTL project:
-National Million development goals program
-National industrialization program
-New development program

The Cooperation Treaty within the CTL , industrial and technology sectors entered between the Government of the Federal Republic of Germany and the Government of the Republic of Mongolia on October 13, 2011

The Global Methane Initiative

Building on the Success of the Methane to Markets Partnership

Cancun COP-16 Side-Event

Henry Ferland, Director
Global Methane Initiative Secretariat

1

Global Methane Initiative

Overview

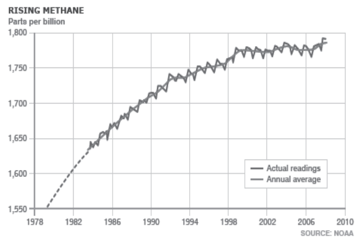
- Why Methane
- Five Years of Success: Methane to Markets
- Looking Forward to a New Global Methane Initiative
- Next Steps

2

Global Methane Initiative

Methane (CH_4)

- Potent greenhouse gas
  - 100-year GWP = 25
  - Lifetime = 12 years
  - Most important short-lived forcer—based on emissions, accounts for >1/3 of current anthropogenic forcing
- Ozone precursor
  - Effects background ozone levels
- Clean energy source - primary component of natural gas
- Many emission sources
  - energy, agriculture & waste sectors
  - 50 - 70% of are anthropogenic
- Concentration of methane in the atmosphere has increased by 150% in the last 260 years
- After about a decade of slow growth—as of 2007 global average methane concentrations have started to increase



Global Methane Initiative

3

Methane Projects Deliver Significant Co-Benefits

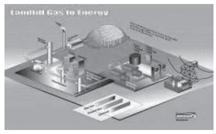
- New Sources of Clean Energy
  - Mitigation makes methane available for local energy purposes
- Air Quality Improvement
  - Decrease in background ground-level ozone – a 20% reduction in global methane emissions could avoid large Northern Hemisphere mortality (140,000 – 400,000 lives in 2030)
  - Reduction of local emissions of VOCs and HAPs from landfills, agriculture, and oil and gas systems
  - Odor reductions in the landfill and agriculture sectors
- Water Quality Benefits
  - Local water quality improvements due to improved management of agricultural wastes and leachate in landfills
- Industrial Safety
  - Methane is explosive - improved worker safety in the coal mining and oil & gas sectors

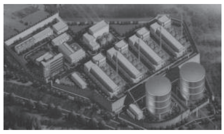
Global Methane Initiative

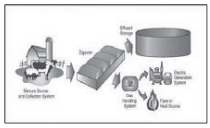
4

Partnership Approach to Project Development

- **Strategic Focus**
  - Conduct capacity building and outreach efforts with all Partner countries in relevant sectors
  - Develop sector and country specific strategies to identify and overcome barriers to projects
  - Leverage relationship with PN to advance projects







- **Key Activities**
  - Technical Assistance and Project Identification
    - Data collection, assessment reports, pre-feasibility studies
  - Tool Development and Technology Transfer
    - LFG generation model, CMM and Landfill database
  - Training and Capacity Building
    - Clearing houses, training workshops, study tours, peer matching

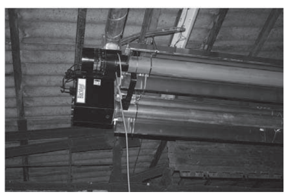
Global Methane Initiative

5

Farms and Landfills— Providing Renewable Energy

Animal Waste to Cooking Fuel in Vietnam

Landfill Gas to an Infrared Heater in Ukraine



Global Methane Initiative

6

Oil, Natural Gas and Coal Mining—Environment and Energy Solutions

Reducing Leaks and Losses from Natural Gas and Oil Operations—
More Energy to Markets and less VOCs and HAPs

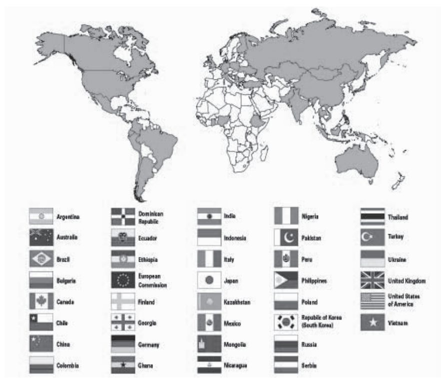
Capturing Methane from Gassy Mines—Clean Energy and Mine Safety

Global Methane Initiative

7

Global Partners

- Global effort to reduce methane emissions through deployment of cost-effective recovery and use projects
  - Landfills, coal mines, agricultural, and oil and gas systems
- Since 2004 the Partnership has grown from 14 to 38 governments and over 1000 public and private organizations— covers nearly 70% global methane emissions



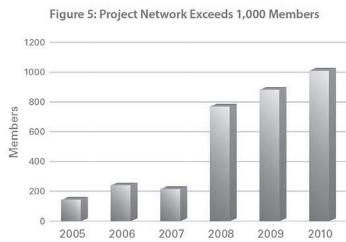
Global Methane Initiative

8

GLOBAL METHANE INITIATIVE

The Project Network

- Brings necessary actors together to implement reduction projects
- Over 1,000 organizations
- Project Network members can:
  - Expand business and increase profits
  - Distinguish themselves in the marketplace
  - Identify financial and technical support for potential projects
  - Build capacity
  - Mitigate climate change
- The Partnership has leveraged more than $480 million USD of private financing since 2004.

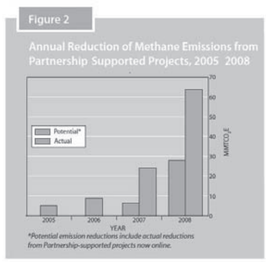


Global Methane Initiative

9

Delivering Results

- Delivering Results Today
  - Supporting 300 projects
  - Actual annual reductions of nearly 30 MMTCO$_2$e, and pipeline of projects that should deliver 61 MMTCO$_2$e/year when fully implemented
  - Delivering environmental and energy co-benefits
- Strong support from key developing countries
- Creating Pathway for Future Success
  - 80 technology transfer events in 23 countries
  - Showcased 225 project opportunities at the 2007 and 2010 Project Expos
  - Complements UNFCCC



Global Methane Initiative

10

GLOBAL METHANE INITIATIVE

Ministerial—Launch of the Global Methane Initiative—October 1, 2010—Mexico City, Mexico

- SEMARNAT Minister Juan Elvira and U.S. EPA's Assistant Administrator Gina McCarthy led Mexican & US delegations in launching an expanded effort to accelerate global methane reductions.
- The United States pledged at least $50 million over five years to GMI.
- Twenty Partner governments participated in the launch along with the Asian Development Bank and the Inter-American Development bank.
  - All provided statements of support for a Ministerial Declaration that focuses international attention on the critical role the new Global Methane Initiative can play in the collective fight against climate change.

Global Methane Initiative

11

Global Methane Initiative (GMI)

The GMI builds on the existing structure of M2M and is supported by revised Terms of Reference. Key elements include:

- Methane Action Plans
  - Ensure that all partner countries commit to develop national methane action plans to coordinate methane reduction efforts at home and abroad.
  - Developed countries provide coordinated assistance to developing countries.
- New Resource Commitments
  - From developed country Partners and others in a position to do so.
- Expanded Scope
  - Abatement and avoidance from wastewater treatment, landfills, agriculture.

Potential Results

- Over 1.5 billion tons of CO_2-eq reductions per year possible by 2020 at low cost.
- With sustained, high level commitment, GMI could deliver substantial reductions .

Global Methane Initiative

12

GMI Continued

- All existing Partners and activities under M2M will become part of GMI.
- The Methane to Markets Partnership program materials will be modified over the coming months to reflect the enhancements and expansions of GMI.
- Additional information on the GMI can be found at: <www.globalmethane.org/gmi>.

13

Global Methane Initiative

Conclusions

- We believe there are tremendous opportunities for near term methane mitigation in developing countries using existing technologies and practices.
- The launch of the Global Methane Initiative offers an excellent opportunity to build on the success of Methane to Markets, to achieve real progress towards reducing climate change in the near term while improving the lives of people around the world.

14

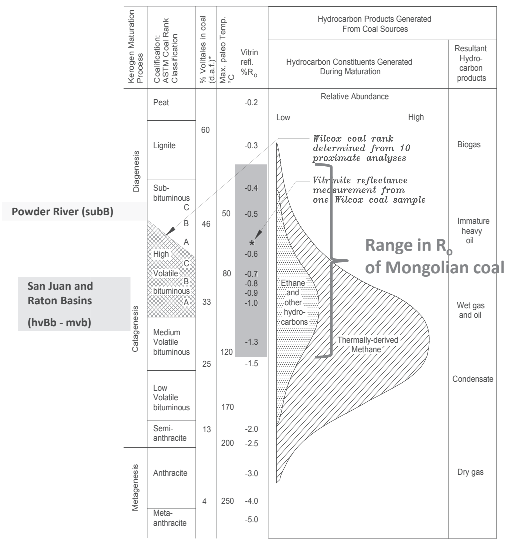
Global Methane Initiative

Concepts Used for Conducting CBM and CMM Resource Assessment in Frontier Areas

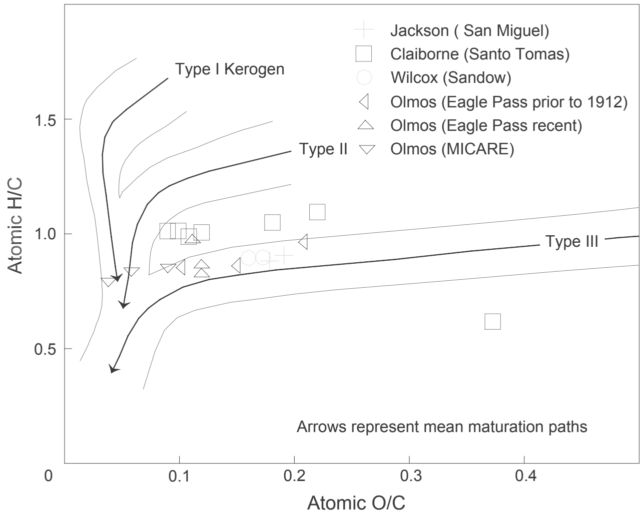
25 June 2012

Ulaanbaatar, Mongolia

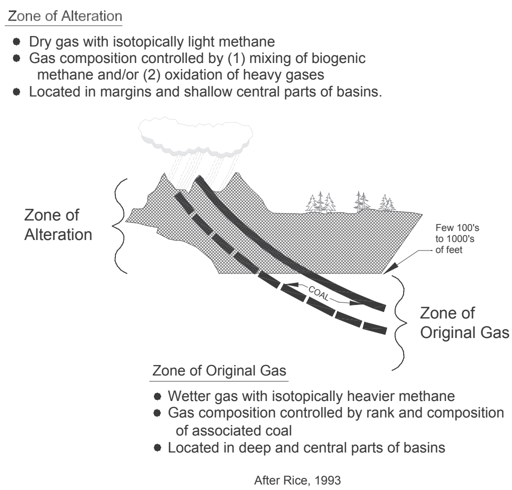
Coal Rank and Hydrocarbon Generation



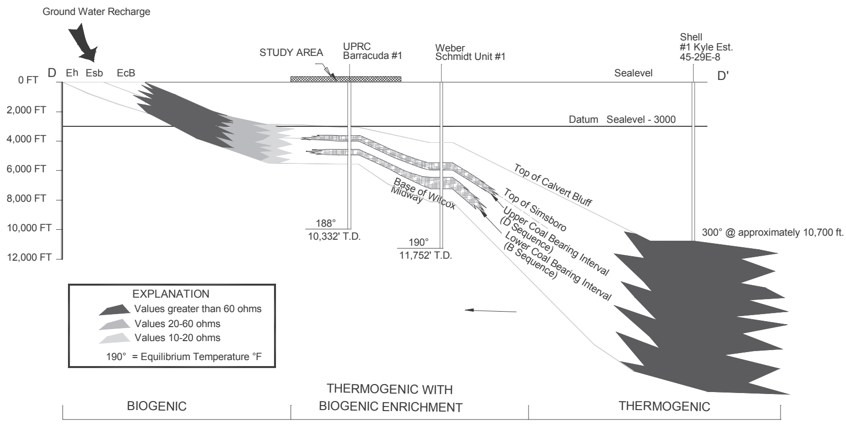
Van Krevelen-type Diagram for Coal Deposits Occurring in South Texas and Northern Mexico



Model of Methane Occurrence and Enrichment in Coal



Model for Methane Generation in Upper Texas Gulf Coast



Comparison of CBM Producing Basins in USA to Coal Basins in Mongolia

	San Juan	*Raton*	*Powder River*	*Tavan-tolgoi*	*Nariin-sukhait*	*Nuurstk-hotgor*
Coal Rank	***hvBb-mvb***	***hvBb-mvb***	***subB***	***hvBb-mvB***	***hvBb***	***hvBb-c***
Gas Content m³/tonne	***3-14***	***6-14***	***<3***	***?***	***?***	***?***
Max. Coal Thk.	***8-14m***	***<3.5m***	***30-50m***	***1-73m***	***1-54m***	***1-38m***
Cum. Coal Thk.	***13-20m***	***13-22m***	***75-105m***	***?***	***?***	***?***
Sorption Time	***>52 days***	***>8 days***	***>7 days***	***?***	***?***	***?***
Depth of Completion	***~800m***	***~650m***	***~150m***	***?***	***?***	***?***

Data Required for CBM/CMM Resource Evaluation:

Coal Mine Provides:

- Coal resource data:
  - Depth, thickness, lateral extent- tonnes of coal by depth
  - Coal quality data (proximate analysis)-from samples tested

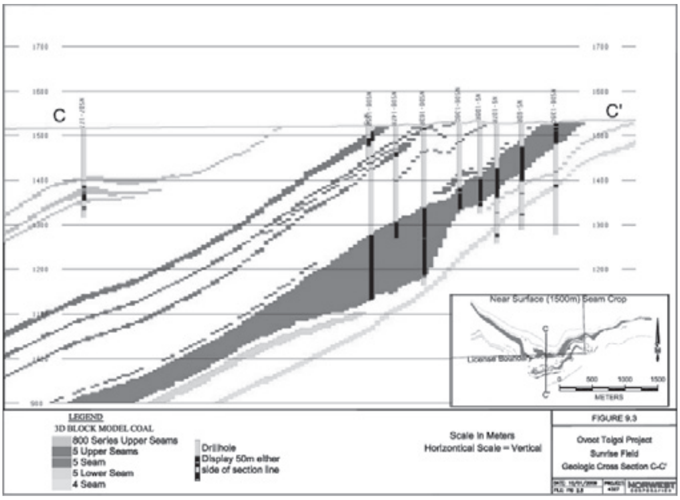
MNEC team provides:

- Desorption test:
  - Gas content of coal sample (m^3/tonne of coal)
  - Field test- takes several days to a few weeks
- Adsorption test
  - Measures Gas Capacity of coal sample
  - Laboratory test- takes a few weeks
- Gas Chromatography
- Determines the gases composition: i.e., CH_4, CO_2, N_2, H_2S

CBM/CMM Resource Assessment Approaches

- Usually a volumetric calculation:
  - multiply mass of coal (tonnes) by gas content (cubic meters of methane per ton of coal) = volume of gas in place
  - Volume of gas is most accurate when based on desorption testing
  - Can use adsorption testing to get estimate by using predicted volume of gas for coal resource at given depth
- Two accepted approaches to calculate estimate:
  - Use low, high, and mid range single values for all parameters; result is a resource estimate ranging from low to high forecasts
  - Stochastic estimate using probability functions developed for each parameter yielding a probabilistic forecast of resources

Cross-section through Ovoot Tolgoi hvB-hvA Coal Deposit



Thickness of Seams Occurring in Ovoot Tolgoi Deposit

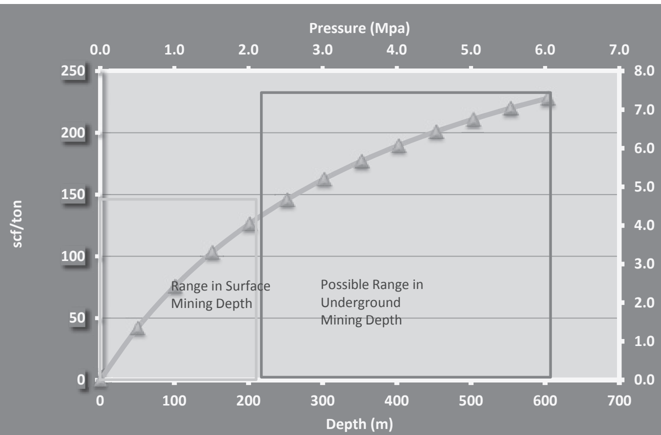
Property	Series	No Seams	Minimum Thickness* (m)	Maximum Thickness* (m)	Mean Thickness* (m)
Sunrise Field	Upper Seams	11	0.6	74	10
	5 Main	1	0.9	157	53
	5 Lower	1	0.6	100	16
	4 Main	1	1.0	30	8
Sunset Field	Upper Seams	60	0.6	31	7
	5 Main & Lower	2	0.6	142	39

In- Place Coal Resources Delineated by 430 Boreholes Drilled from 2006 through 2009

Area	Type	Resource Limits Depth (m)	ASTM Group	In-Place Resources (Million Tonnes)		
				Measured	Indicated	Inferred
Sunrise Field	Surface	Surface to 250m	hvB to hvA	53.8	15.7	4.9
Sunset Field	Surface	Surface to 250m	hvB to hvA	82.1	19.4	8.1
Sub-Total				**135.9**	**35.1**	**13.0**
Sunrise Field	Underground	250m to 600m	hvB to hvA	11.2	5.2	11.2
Sunset Field	Underground	250m to 600m	mhB to hvA	34.6	27.8	9.3
Sub-Total				**45.8**	**33.0**	**20.5**
Total				**181.7**	**68.1**	**33.5**

Resources estimated using cross-section method

Hypothetical Isotherm for hvB-hvA Coal Rank



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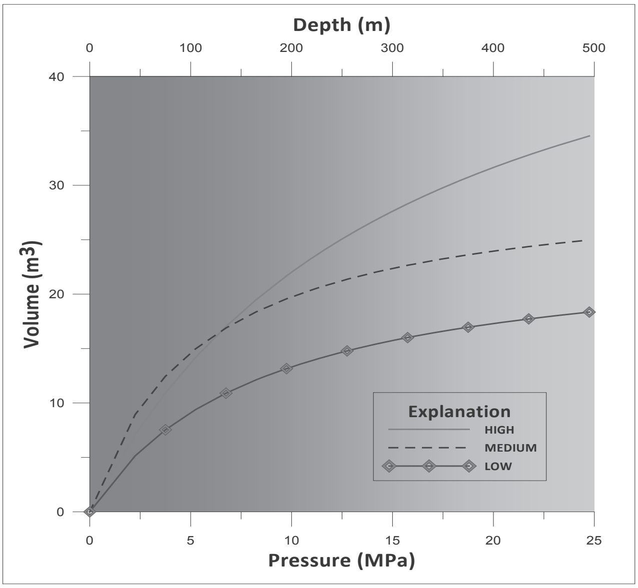
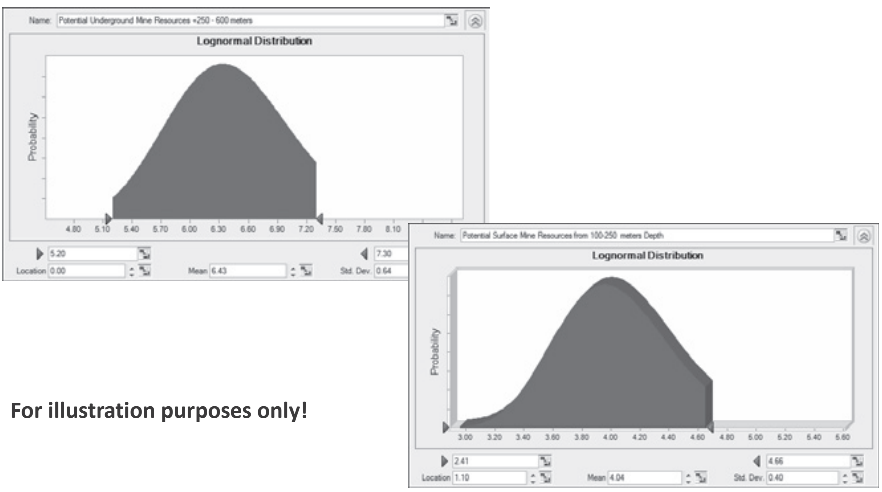
13

Adsorption Isotherm

High Volatile Bituminous Coal

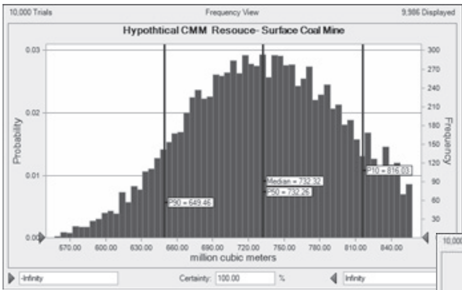


Hypothetical Gas Content Probability Distributions for Ovoot Tolgoi Coal Resources



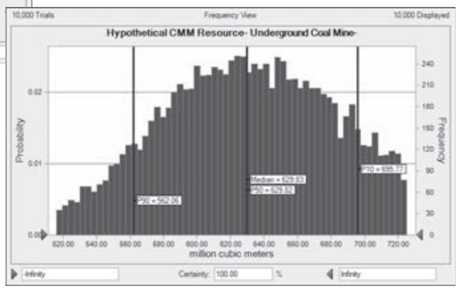
For illustration purposes only!

Hypothetical CMM Resources of Ovoot Tolgoi Coal Deposit



Potential Surface Coal Mine CMM Resource Estimate (million cubic meters)		
P_{90}	P_{50}	P_{10}
649	732	816

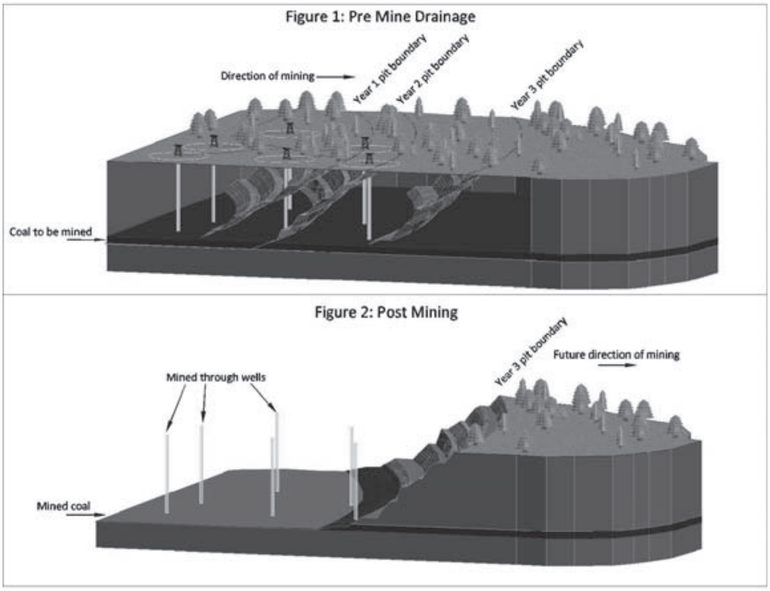
Potential Underground Coal Mine CMM Resource Estimate (million cubic meters)		
P_{90}	P_{50}	P_{10}
562	630	696



For illustration purposes only!

Vertical in Advance of Mining

- Boreholes are shut-in as mining approaches/evidence of air in produced gas
- Surface equipment and casing is removed prior to mine-through
- Timing – producing as far in advance of mining as possible
- Applicable to strip mines

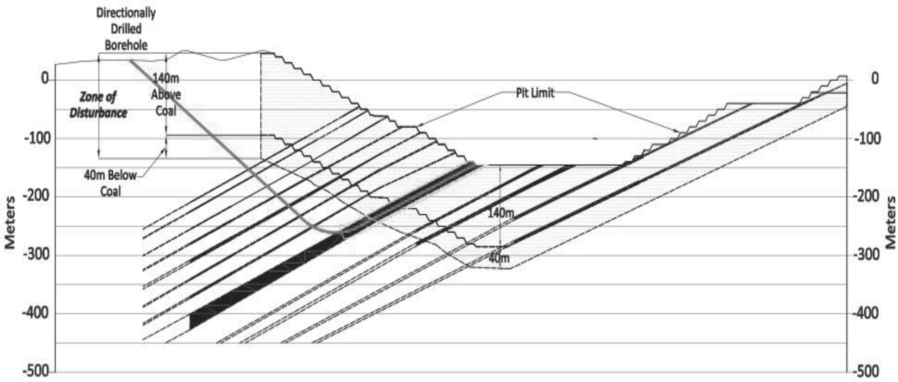


Lateral in Advance of Mining

– Depending on placement, boreholes may continue to produce during mining and post mining
– Applicable to some single seam strip mines and to open pit mines
– May access more coal if sidetracks are employed

19

Laterally-drilled Borehole



Surface Mine Drainage Considerations

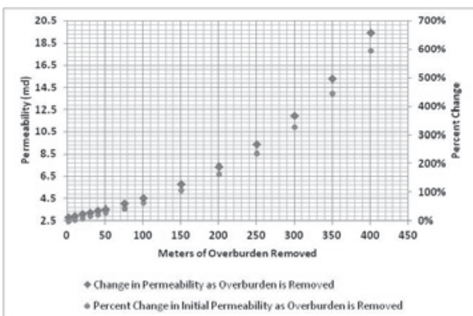
- Coordination of gas drainage project development with mining operations is essential
- Surface logistics
  - Waste piles, storage, space issues
  - Gas transportation
    - Permanent vs. temporary gathering lines

Overburden Removal Increases Permeability

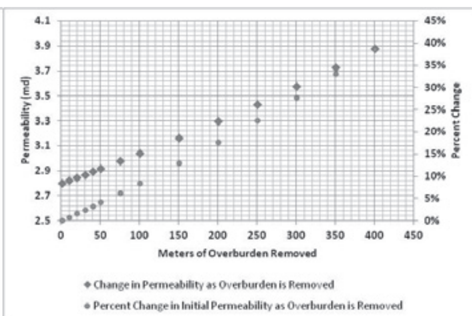
- Permeability increases exponentially with decreasing effective stress
- Effective stress is diminished as overburden is removed during mining
- Permeable pathways occurring in geologic structures such as breached folds or faults are enhanced as overburden is removed.
- Matrix and fracture permeability is enhanced as a function of the stiffness of the rock mass, density of fracturing and thickness of overburden removed.

Impact of Rock Stiffness on Increases in Permeability as Overburden is Removed

Medium-Volatile Bituminous Coal



Sub-bituminous Coal



Fracture compressibility for bituminous coal from *A New Coal-Permeability Model: Internal Swelling Stress and Fracture-Matrix Interaction* by Hui-Hai Liu and Jonny Rutqvist, Transp Porous Med (2020) 82: 157-171.
Fracture compressibility for sub-bitumious coal , high volatile bituminous and equation for relationship between overburden removal and permeability increase from *Improvements in Measuring Sorption-Induced Strain and Permeability in Coal* by E.P. Robertson, SPE 116259, 2008 SPE Eastern Regional/AAPG Eastern Section Joint Meeting held in Pittsburgh, Pennsylvania.

Raton Basin Stats

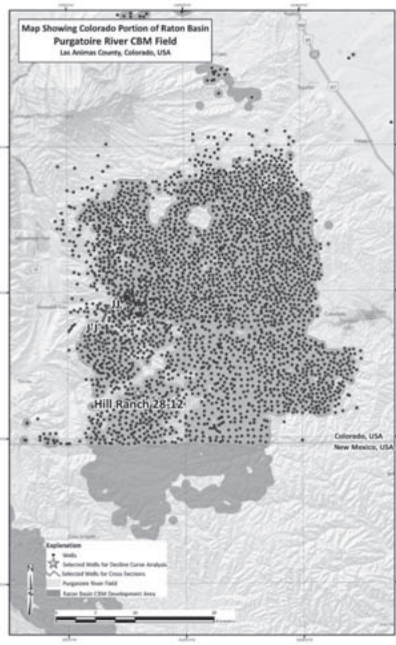
The adjacent map is of wells within the Purgatoire River Basin and includes both conventional gas and CBM wells. The data for New Mexico was not available online.

According to the COGCC production, which is digitally available beginning 1999:

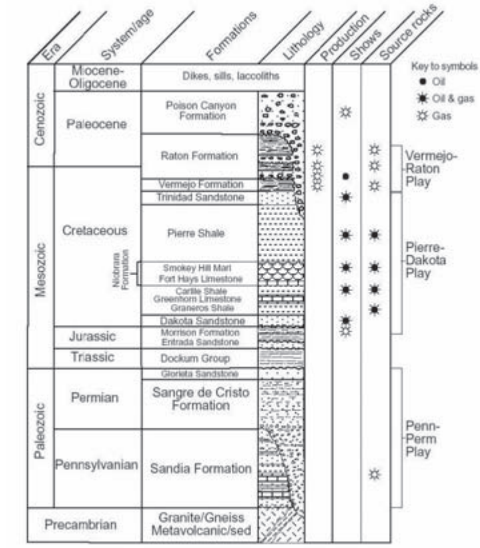
- 1,084,690,019 mcf / 30,714,665,566 m^3 of gas has been produced from both conventional and CBM wells.
- 1,267,849,786 bbls / 151,176,829 m^3 / 151,179,022,629 L

The basin is approximately 50 miles (80 km) east-west, and 90 miles (140 km) north-south.

- 11,200 km^2
- 4,500 mile^2



Generalized stratigraphic column for Raton Basin



Source: Dolly, E. D., and Meissner, F. F., 1977, Geology and gas exploration potential, upper Cretaceous and lower Tertiary strata, northern Raton Basin, Colorado, *in* Veal, H. K., ed., Exploration Frontiers of the Central and Southern Rockies: Rocky Mountain Association of Geologists, Field Trip and Conference Guidebook, p. 247-270.

Structural Cross Section

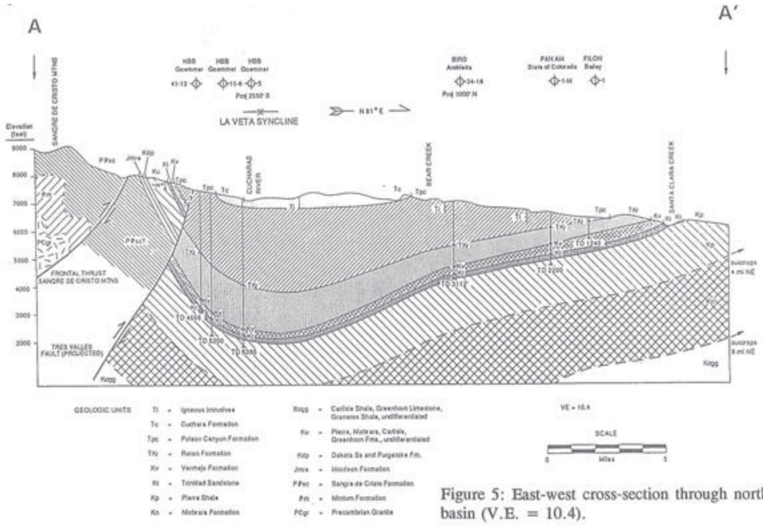
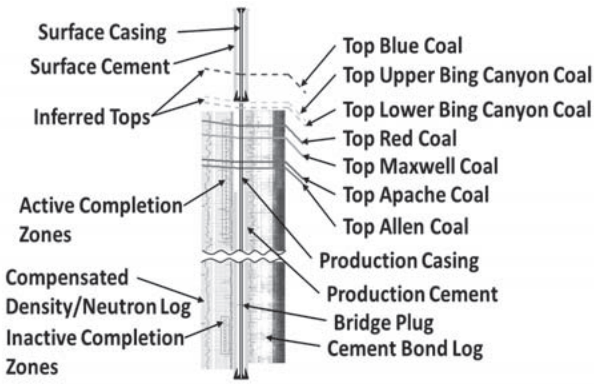
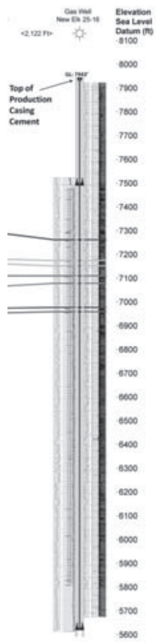


Figure 5: East-west cross-section through northern Raton basin (V.E. = 10.4).

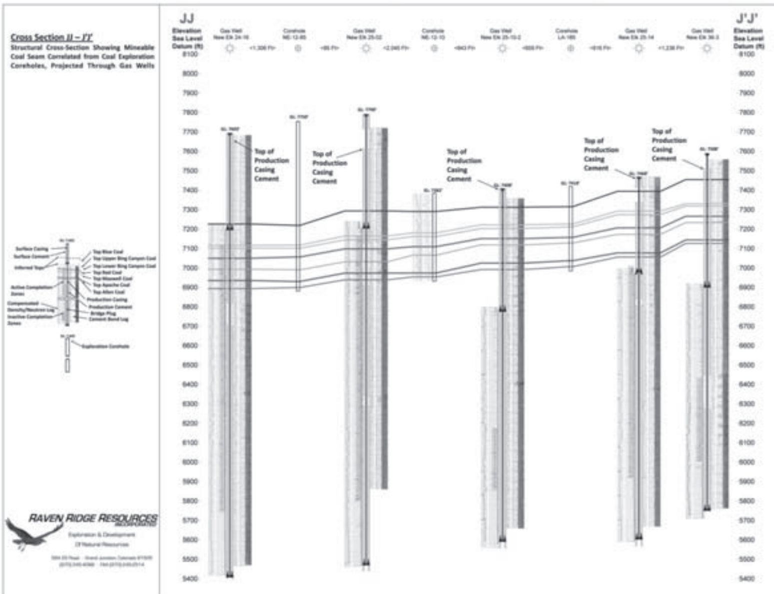
Source: Stevens, S.H., Lombardi, T.E., Kelso, B.S., McBane, R.A., and Oldaker, P.; "Geologic and Hydrologic Controls on Coalbed Methane Resources in the Raton Basin", Proceedings of the 1993 International Coalbed Methane Symposium, Birmingham, Alabama, May 17-21, 1993.

Example Wellbore

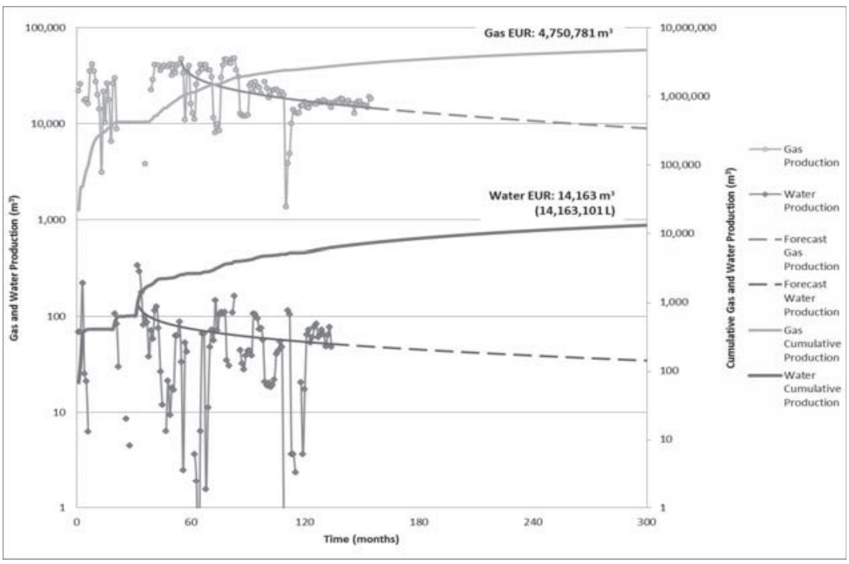




Cross Section Through Mining Property



Hill Ranch 28-12 Gas and Water Production Decline Curves



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Thanks!

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Approach for a Surface Mine Methane Emissions Inventory in Mongolia

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Ulaanbaatar, Mongolia
June 25, 2012

MNEC   Global Methane Initiative   U.S. EPA Coalbed Methane Outreach Program   RAVEN RIDGE RESOURCES INCORPORATED

Surface Mine Methane Emissions

- Methane emitted by the **coal excavated** and processed during mining activities
- Methane emitted by the **coal and other gas bearing strata in the overburden and/or underburden** exposed by mining activities
- Methane emitted from the **floor and/or highwall** of the mine
- Methane emitted by the **overburden coal excavated and stored on site in waste piles**

Surface Mine Methane Emissions cont'd

- Methane emissions from excavated coal
  - Gas content
  - Quantity of material excavated
- Methane emissions from over/underburden
  - Gas content and thickness of the adjacent coal seams
  - Permeability of the coals and other strata found in the overburden, interburden and underburden
  - Overburden thickness
  - Amount of disturbance to the mine floor and highwall as a result of mining

Surface Mine Methane Emissions cont'd

- Methane emissions from floor
  - Gas content of the unmined coal beneath the mine floor
  - Proximity of the coal seams to the mine floor
  - Extent of disturbance of the coal and the effect this has on its permeability
  - Amount of coal left in the floor
  - Presence of water

Surface Mine Methane Emissions cont'd

- Methane emissions from highwall
  - Gas content of the unmined coal remaining in the highwall
  - Extent of disturbance of the coal near the highwall and the impact this has on the permeability
  - Presence of water

Project Background

- Mongolia's First National Communication to the UNFCCC (2001)
  - Limited data – coal gas investigations had not yet been conducted.
  - Only data for the Nailakh deposit were available.
- Second National Communication (2010)
  - 2006 inventory data
  - IPCC Tier 1 methodology

IPCC Guidelines

- The Intergovernmental Panel on Climate Change (IPCC) is the leading international body for the assessment of climate change.
- Developed *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*
- Volume 2> Chapter 4: Fugitive Emissions>Fugitive Emissions from Mining, Processing, Storage, and Transportation of Coal>Coal Mining and Handling

IPCC Guidelines cont'd

- Tier 1: countries choose from a global average range of emission factors and use country-specific activity data (coal production) to calculate total emissions > Highest Uncertainty
- Tier 2: country- or basin-specific emission factors that represent the average values for the coals being mined
- Tier 3: uses direct measurements on a mine-specific basis > Lowest Uncertainty

Inventory Approach for Mongolia

- Not yet feasible to collect mine-specific Tier 3 measurement data for surface mines
- Alternative – collect data on surface mine coal production and use emission factors
- **For countries with significant coal production and multiple coal basins, disaggregation of data and emission factors to the coal basin level will improve accuracy**

Inventory Approach for Mongolia cont'd

- Tier 2 approach is desirable in Mongolia to reduce uncertainty
- With widespread coal deposits of varying rank, it is important to develop *basin-specific emission factors*

Inventory Approach for Mongolia cont'd

- Geologic data collection via questionnaire and consultation
  - Coal characteristics: Rank, quality, permeability
  - Coalbed characteristics: Depth of occurrence, lateral extent of the coalbed, coalbed thickness
  - Other information: Presence of water, extent of disturbance of the coal near the highwall and the impact this has on the permeability, gas content of the unmined coal beneath the mine floor, etc.

Sample Data from U.S. Mines Compared with Mongolia

	San Juan	*Raton*	*Powder River*	*Tavan-tolgoi*	*Nariin-sukhait*	*Nuurstk-hotgor*
Coal Rank	***hvBb-mvb***	***hvBb-mvb***	***subB***	***hvBb-mvB***	***hvBb***	***hvBb-c***
Gas Content m^3/tonne	***3-14***	***6-14***	***<3***	***?***	***?***	***?***
Max. Coal Thk.	***8-14m***	***<3.5m***	***30-50m***	***1-73m***	***1-54m***	***1-38m***
Cum. Coal Thk.	***13-20m***	***13-22m***	***75-105m***	***?***	***?***	***?***
Sorption Time	***>52 days***	***>8 days***	***>7 days***	***?***	***?***	***?***
Depth of Completion	***~800m***	***~650m***	***~150m***	***?***	***?***	***?***

Inventory Approach for Mongolia cont'd

- Equip Mongolia with gas desorption equipment for gas content analysis
  - Can used in combination with geologic data to calculate gas resources contained within coal strata for methane resource assessment
  - Calculate basin-specific gas content based on coal analysis from select mines

Inventory Approach for Mongolia cont'd

- Adsorption isotherm testing samples
  - Taken from the desorbed coal sample at the end of the desorption test (sent to another laboratory)
  - Results are used to determine gas capacity of coal sample, or how much gas the coal can hold at reservoir temperature and pressure
  - Critical information can be interpreted from this test: pressure at which the gas will begin to desorb from the coal, maximum volume of recoverable gas; this data can be used to characterize the coal and estimate the amount of gas that may be present a different pressure (depth).

Inventory Approach for Mongolia cont'd

- Construct a basin-wide gas content map using isotherm and gas content data
- Measured gas content and isotherm data will be used to estimate the gas content of the coals contained in nearby basins

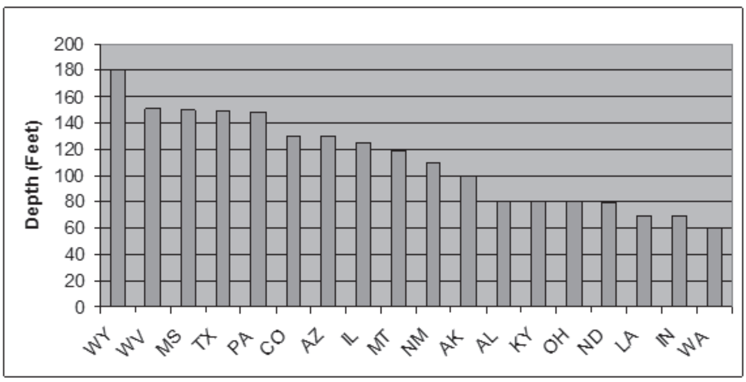
Example U.S. Coal Basin Gas Content Data

Coal Basin	Inventory Code	Major Coal Rank Mined	2003 Revised Gas Content (cf/t)	Recommended New Gas Contents (cf/t)	Comments
Northern App	NAB	Bituminous	59.5	59.5	Data compiled from USBM report
Central App	CAB	Bituminous	24.9	24.9	Data compiled from USBM and MRCP reports
Warrior	WRB	Bituminous	30.7	30.7	Data compiled from USBM report
Illinois	ILB	Bituminous	34.3	34.3	Data compiled from USBM and MRCP reports
S.West/Rockies	WTB	Bituminous			
S.West (NM, AZ, CA)		Bituminous	7.3	7.3	Data compiled from USBM and MRCP reports
Rockies (CO)		Bituminous	33.1	33.1	Data compiled from USBM and MRCP reports
Rockies (UT)		Bituminous	16.0	16.0	Data compiled from USBM and MRCP reports
N.Great Plains	NGP	Lignite	5.6	5.6	North Dakota mines lignite coal
Northern Rockies (MT,WY)	WYM	Sub-bituminous	5.6	20.0	Data compiled from USGS, and private sector
West Interior	WIN				
Forest City, Cherokee		Bituminous	34.3	34.3	Arkansas, Missouri, Kansas, Iowa coals similar to Illinois Basin
Arkoma (OK)		Bituminous	74.5	74.5	Data compiled from USBM and MRCP reports
TX, LA		Sub-bituminous	33.1	11.0	Texas & Louisiana mine borderline sub-bituminous coal
Northwest	NWB	Sub-bituminous	5.6	16.0	Washington, Alaska coals similar to Powder River Basin

Inventory Approach for Mongolia cont'd

- Geologic data will be used to develop country or basin-specific (depending on data) emission factors for active surface mining and post-mining emissions

Example Data: Average Overburden Depth of U.S. Surface Coal Mines



Basin-specific Emission Factors

- In order to develop accurate emission factors for some basins in Mongolia, analysis will be conducted on:
  - Thickness of the adjacent coal seams
  - Permeability of the coals and other strata found in the overburden, interburden and underburden
  - Overburden thickness
  - The amount of disturbance to the mine floor and highwall as a result of mining coal
- In U.S., current emission factor is 200% to account for gas in over- and underburden, adjacent seams, etc.

SMM Emissions Estimation

- Emissions from surface mines (and post-mining activities) will be calculated by multiplying basin-specific coal production by a basin-specific gas content and then by the basin/country-specific emission factor to determine methane emissions

Annual emissions (m^3) = basin specific gas content (m^3/tonne) x emission factor (%) x coal production (tonnes)

Products

- Once this analysis is complete, and gas contents and emission factors are determined, a set of spreadsheets will be developed that will facilitate completion of an annual inventory.
- Utilizing the latest coal production data available, the MNEC and other interested institutions staff will be trained on use of the spreadsheets to complete inventories in following years.

Future Considerations

- Some surface mines have indicated plans to eventually move mining to underground operations to reach deeper seams
- Emissions calculations for underground mines may be done directly – Tier 3 data
- Ventilation air volume, methane concentration
- Drainage data from any CMM wells