

# MIT – Future of Coal

- The risks of global warming are real and the United States and other governments should and will take action to restrict the emission of CO<sub>2</sub> and other greenhouse gases.
- Coal will continue to play a large and indispensable role in a greenhouse gas constrained world.



# World Energy Profile

- Today fossil sources account for 80% of energy demand:
  - Coal (25%),
  - natural gas (21%),
  - petroleum (34%),
  - nuclear(6.5%),
  - hydro (2.2%),
  - biomass and waste (11%).
  - Only 0.4% of global energy demand is met by geothermal, solar and wind.
- 50% of the electricity generated in the U.S. is from coal
- China is currently constructing the equivalent of two, 500 megawatt, coal-fired power plants per week and a capacity comparable to the entire UK power grid each year.



# MIT

- “As stressed in an earlier MIT study of the nuclear option, if additional CO2 policies are adopted, it is not likely that any one path to emissions reduction will emerge. All will play a role in proportions that are impossible to predict today”.



# MIT

“Carbon-free technologies, chiefly nuclear and renewable energy for electricity, will also play an important role in a carbon-constrained world, but absent a technological breakthrough that we do not foresee, coal, in significant quantities, will remain indispensable”.



# CHALLENGE OF SCALE FOR CARBON CAPTURE

- The United States produces about 1.5 billion tons per year of CO<sub>2</sub> from coal-burning power plants.
- If all of this CO<sub>2</sub> is transported for sequestration, the quantity is equivalent to three times the weight and, under typical operating conditions, one-third of the annual volume of natural gas transported by the U.S. gas pipeline system.
- At present the largest sequestration project is injecting one million tons/year of carbon dioxide (CO<sub>2</sub>) from the Sleipner gas field into a saline aquifer under the North Sea.



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- Coal is certain to play a major role in the world's energy future for two reasons:
  - It is the lowest-cost fossil source for base-load electricity generation
  - In contrast to oil and natural gas, coal resources are widely distributed around the world.



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- Coal can provide usable energy at a cost of between \$1 and \$2 per MMBtu compared to \$6 to \$12 per MMBtu for oil and natural gas
- Economics and security of supply are significant incentives for the continuing use of coal



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**“We conclude that CO2 capture and sequestration (CCS) is the critical enabling technology that would reduce CO2 emissions significantly while also allowing coal to meet the world’s pressing energy needs”.**



**“The priority objective should be the successful large-scale demonstration of the technical, economic, and environmental performance of the technologies that make up all of the major components of a large-scale integrated CCS system — capture, transportation and storage”.**



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- **Successful implementation of CCS will inevitably add cost for coal combustion and conversion.**
  - \$25/ton for capture and compression
  - \$5/ton for storage



- Even with carbon emission restrictions in place and limited nuclear power expansion the MIT report estimates a 60% increase in US coal usage with CCS for power production by 2050.
- Governor Schweitzer projects that CTL / hybrid plug-in vehicle deployment could displace as much as 2 billion bbl of imported oil / year



- Advanced coal technology can overcome the adverse impacts of conventional coal energy generation.
- Addressing some of these challenges is what this ETIC meeting is about.



- **2004 PRODUCTION – MM Short Tons**

–US 1,110

–Australia 391

–Russia 309

–South Africa 268

–India 444

–China 2,156

- *Source: DOE/EIA IEA (2006), Tables 2.5 and C.6*



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“U.S. leadership in emissions reduction is a likely prerequisite to substantial action by emerging economies”.



# Schweitzer Energy Policy

Addresses Energy Issues at 3 levels:

- International - Climate Change
- National - Energy Security
- Montana - Economic Development



# Montana Department of Commerce EPID

Marty Tuttle – Division Administrator

Tom Kaiserski – Program Manager

Chantel McCormick – Energy Dev Officer

Sarah Trueaux - Desmond – Adm. Assistant

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