



US Department of State Foreign Service Officers

Coalbed & Coal Mine Methane

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Presentation Outline

- **What is coalbed/coal mine methane?**
- **Why do we care about it?**
- **How is it produced/captured/emitted?**
- **How much is produced and what can you do with it?**
- **What is the international problem/potential?**

Coalbed Methane in the News Daily !!!!

- **May 12, 2013 (CNN) -- *A coal mine explosion in China's southwestern Sichuan province killed 28 miners***
- **February 11, 2013 (Reuters) -- *Methane blast kills 18 at Russia coal mine***
- **November 19, 2010 (CNN) -- *29 miners confirmed dead after New Zealand mine explosion***
- **April 5, 2010 (New York Times) -- *No Survivors Found After West Virginia Mine Disaster...29 Dead***

AND THEN THIS HAPPENED

Raspadskaya Mine

DANGER: Rapsadskaya Mine

91 people died in May 2010



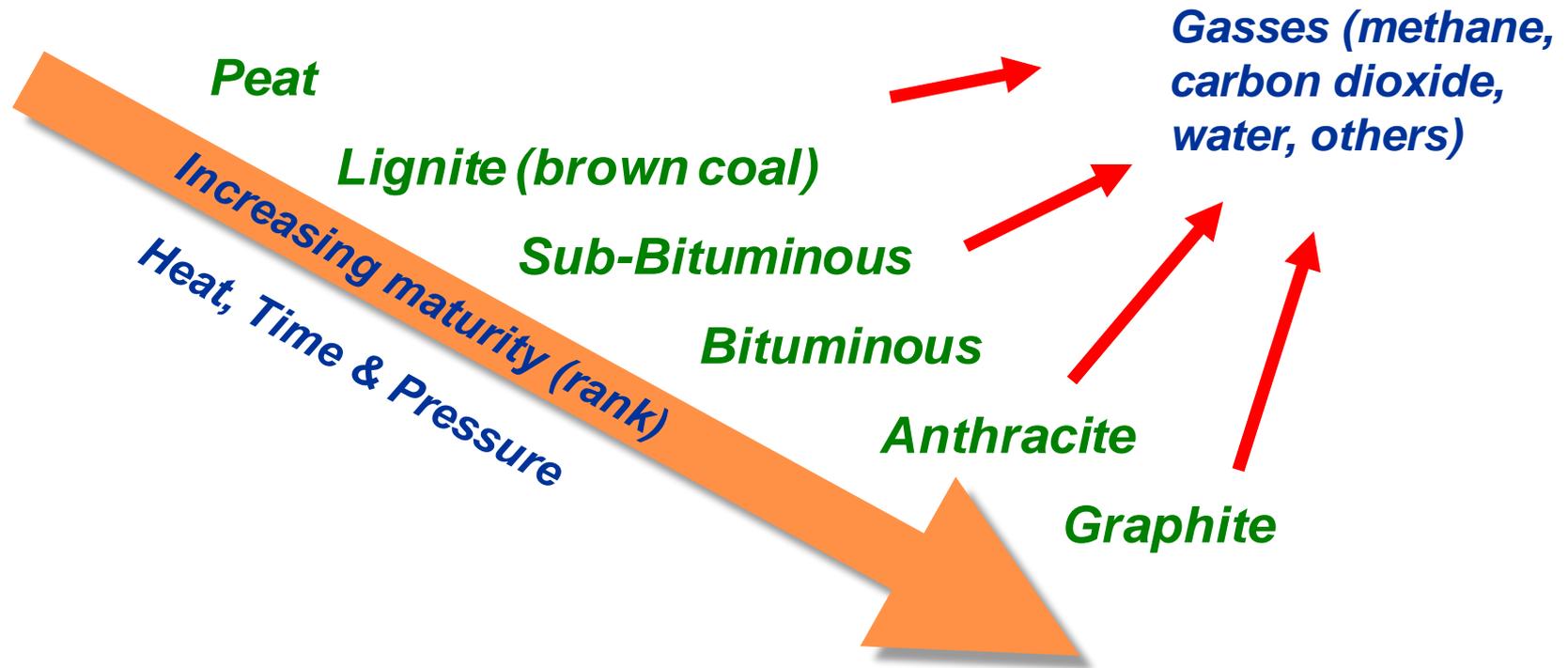
What Is Coalbed/Coal Mine Methane?



What Is Coalbed Methane?

Coalbed Methane is:

Natural gas that is formed during the normal, geologic process of changing plant material into coal

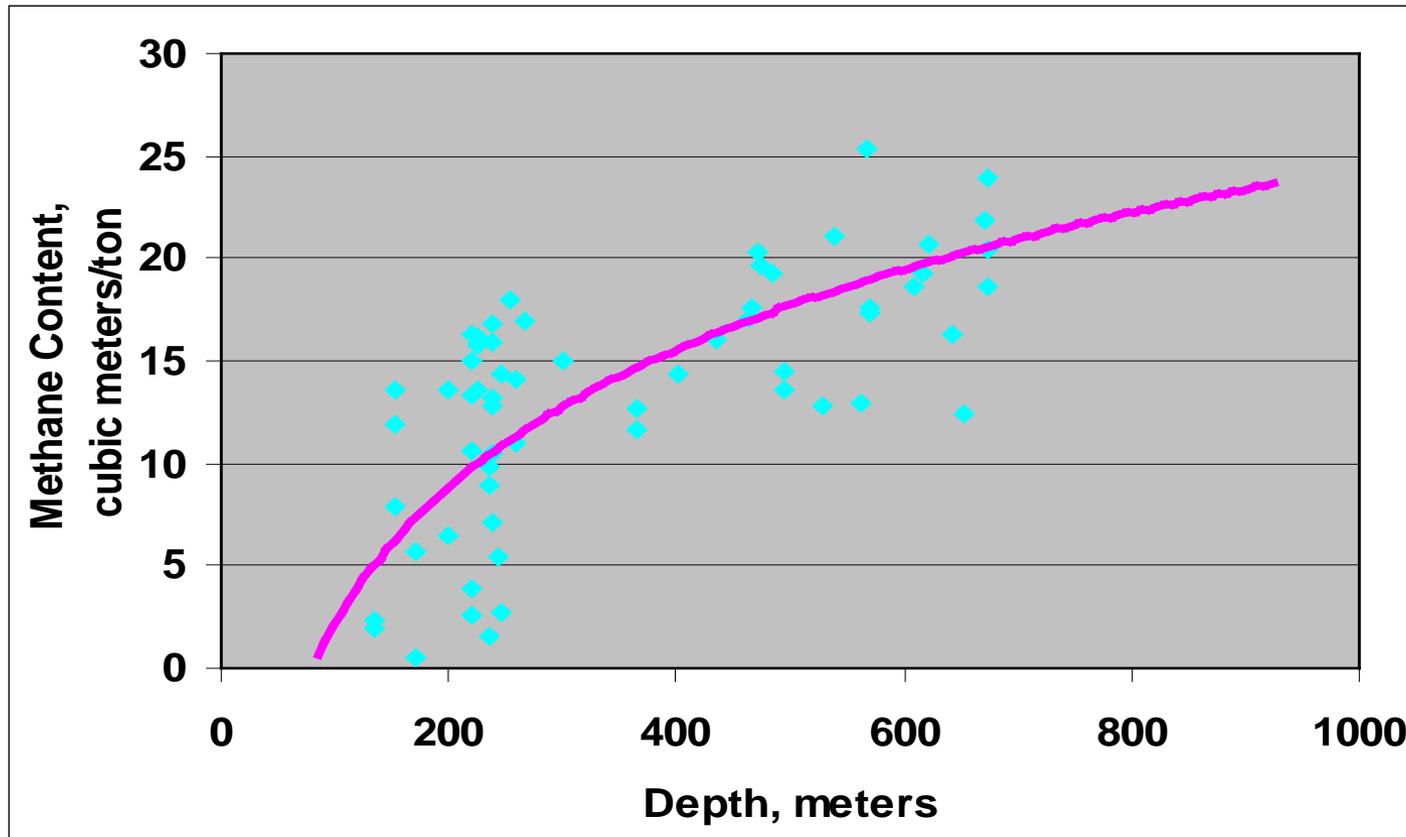


Coalbed Methane comes from?

- **Large volumes of gas are formed during decay of plant and animal material**
- **Some of the generated gas remains in the coal**
 - The gas remaining in the coal is generally termed “*coalbed methane*”
- **The amount of gas remaining in the coal today is highly variable**
 - Generally, the deeper the coal seam, the more gas it contains

Methane Content vs. Depth for Low Volatile Bituminous Coal

Central Appalachian Basin, USA



What is Coalbed Methane (cont.)?

- **Coalbed methane is a mixture of gasses**
 - Methane (80% to 98%)
 - Carbon Dioxide (<1% to ~15%)
 - Nitrogen (<1 to ~5%)
 - Higher hydrocarbons (<1 to ~5%)
- **Conventional natural gas is primarily methane**
 - Coalbed methane = natural gas

Why Do We Care About Coalbed Methane?

DANGER DURING MINING

- **Coalbed methane is released into underground coal mines during the extraction process**
 - Dangerous gas must be removed from the mine
 - Generally, coalbed methane mixes with the mine atmosphere (<1% to over 90% cbm)
 - Explosive range 5-15%
 - Various methods employed to remove the methane
 - Often vented to the atmosphere as a waste product

Why Do We Care About It?

BUT IT HAS VALUE

- **Coalbed methane is a valuable, clean, abundant energy source**
 - About 10 percent of the current US natural gas production is coalbed methane (vs. 0 % 20 years ago)

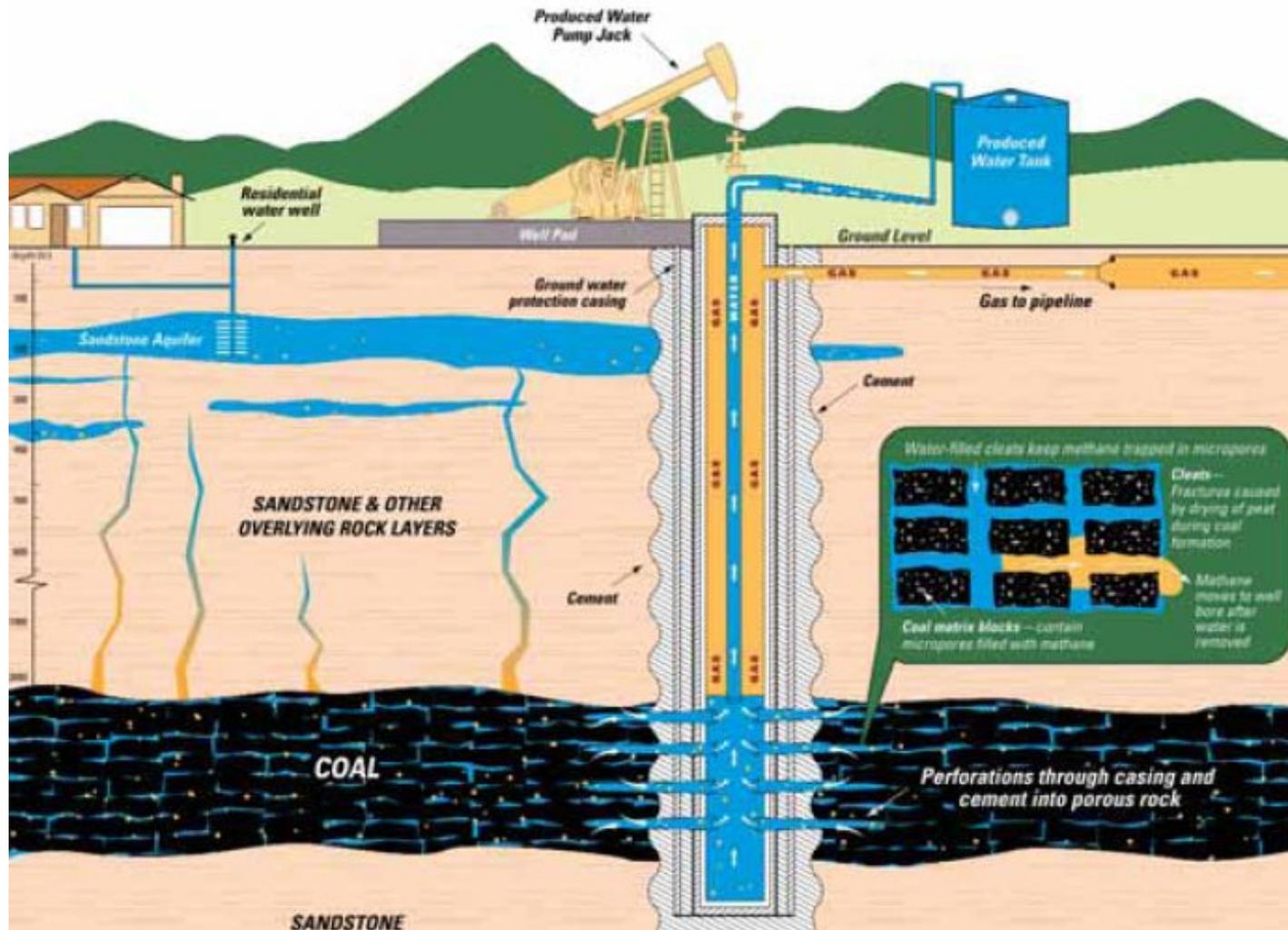
AND IT ADDS TO GHG EMISSIONS WHEN RELEASED

- **Methane is a potent greenhouse gas**
 - About 25 times more effective than carbon dioxide
 - Worldwide mine emissions are significant (8% of total anthropogenic methane – 103 million metric tons of carbon equivalent)

How is It Produced-Captured-Emitted?

- **CH₄ released during mining process**
- **Coalbed methane (natural gas)**
 - Vertical production wells
 - Horizontal production wells
- **Coal mine methane**
 - Ventilation air
 - Vertical gob (goaf) wells
 - Horizontal/cross-measure wells

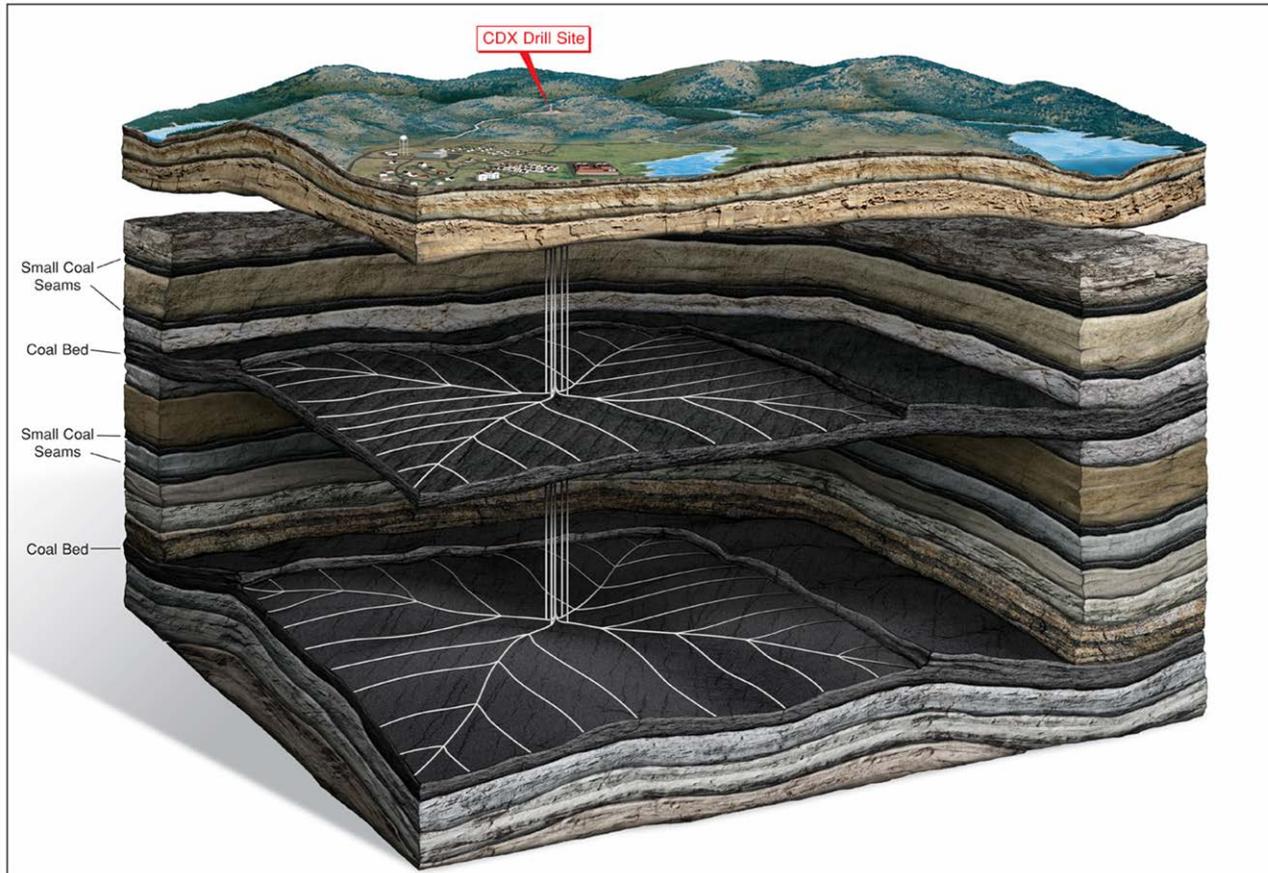
How is It Produced-Captured-Emitted?



Drilling a Coalbed Methane Vertical Production Well – USA



Coalbed Methane Horizontal Production Well – USA



Coal Mine Methane – Mine Ventilation

- **Control of methane through dilution by the circulation of fresh air through the mine openings**
 - Large fans used to pull fresh air through the mine
 - Flow from a typical fan is 1-2 million ft³/min
- **Universal to all underground coal mines**
- **Largest source of coal mine methane**
 - Up to 30 million ft³/day emitted from large, gassy mines in the US

Coal Mine Methane – In-mine Well

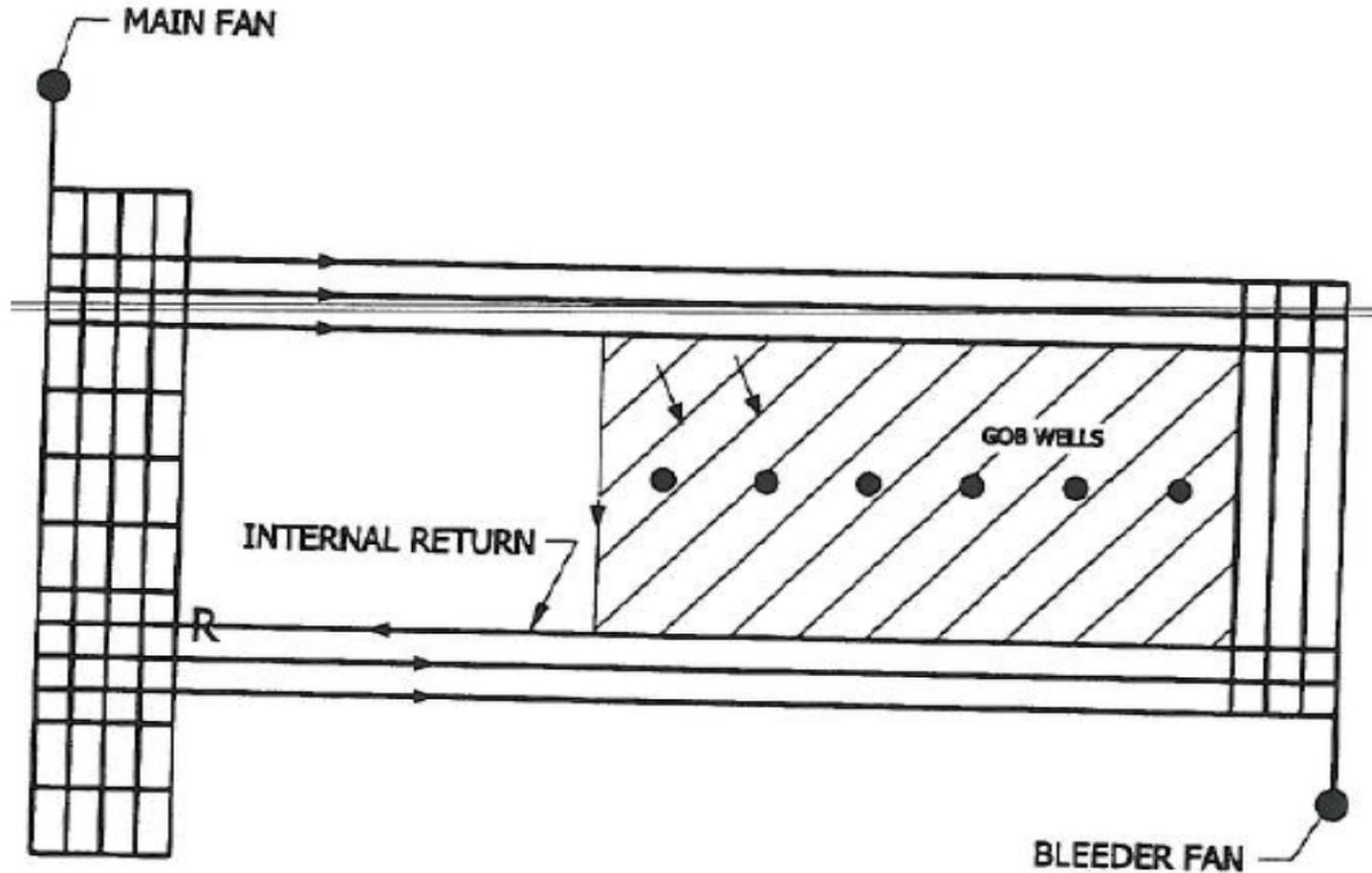
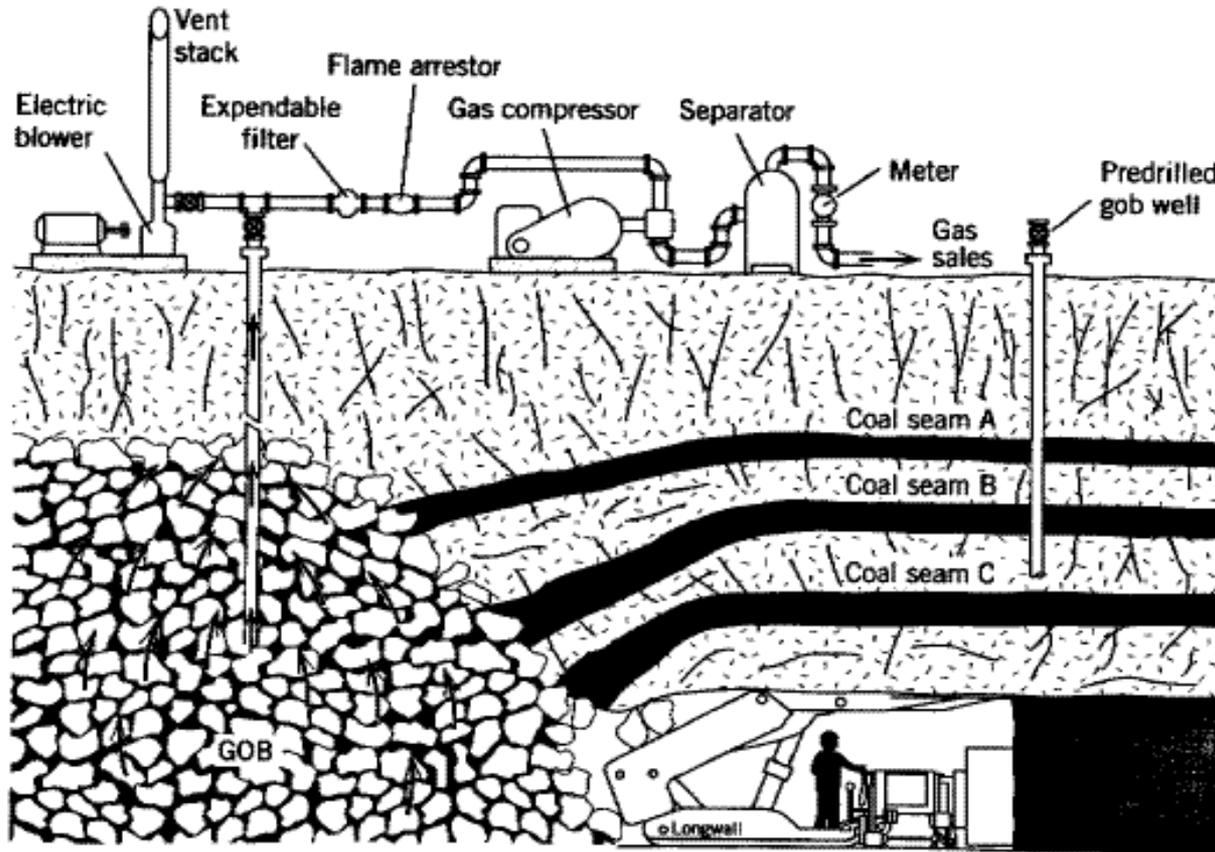


Figure 8
Ventilation Layout for a Longwall Panel in Very Gassy Coal Seams

Coal Mine Methane – In-mine Well



Coal Mine Methane – Gob (Goaf) Well



Coal Mine Methane – Mine Ventilation



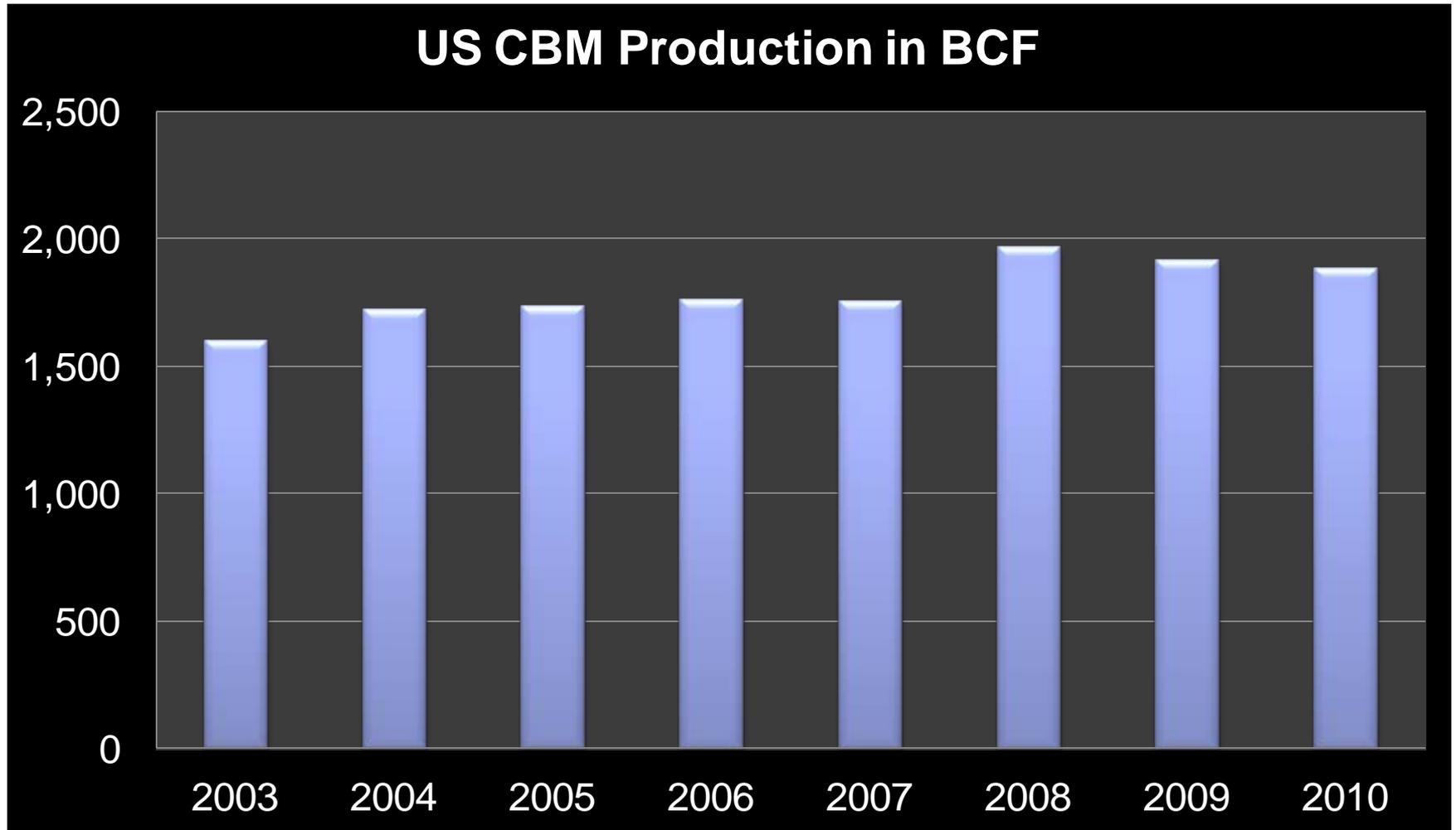
Quality of Produced Coalbed/Coal Mine Methane

- **High quality gas (>90% methane)**
 - Primarily vertical or horizontal coalbed methane wells
 - May be gob and horizontal wells
- **Medium quality gas (30% to 90% methane)**
 - Primarily gob and in-mine wells
- **Low quality gas (0.1% to 2% methane)**
 - Primarily ventilation air

How Much is Produced and What Can You Do With It?



Current CBM Production 1.9 Tcf Annually



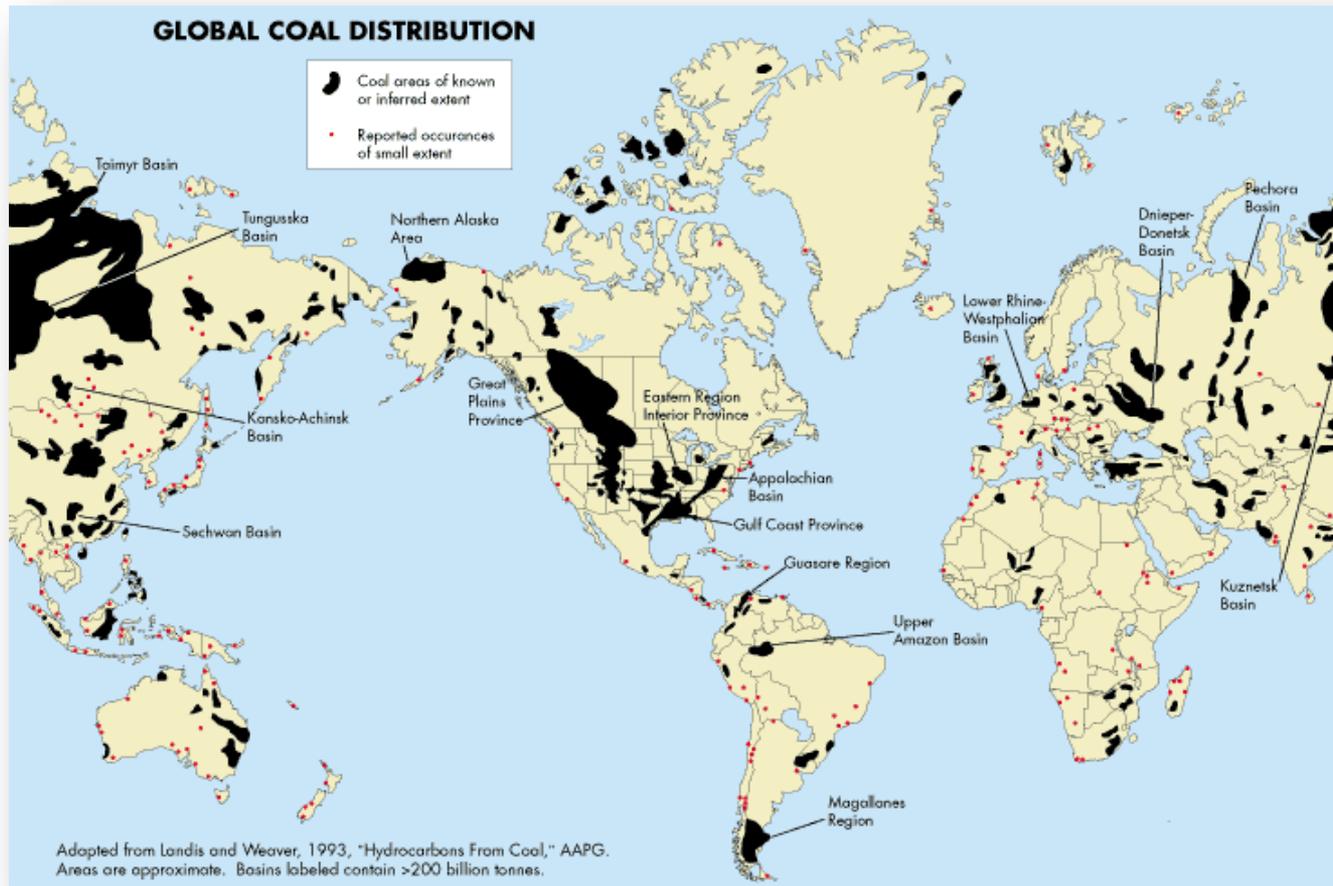
Uses of Coalbed/Coal Mine Methane – High Quality Gas

- **High quality methane is generally suitable for insertion in natural gas pipelines**
- **Can be used anywhere conventional natural gas is used**
 - Electric power generation
 - Thermal use
 - Chemical conversion
- **Highest value product**

What is the International Potential?



Coalbed/Coal Mine Methane is Worldwide



World Coalbed Methane Resources

(Note: Resources are NOT the same as Reserves!)

<u>COUNTRY</u>	<u>METHANE RESOURCE (trillion ft³)</u>
China	1,060 - 1,240
Russia	600 - 4,000
Canada	200 - 2,700
Ukraine	60
United States	700
Australia	300 - 500
Germany	100
Poland	100
United Kingdom	60
Kazakhstan	40
Southern Africa	30
India	30
TOTAL	3,280 – 9,560

Commercial Coalbed Methane Development – Currently Geographically Limited

- **Commercial production of coalbed methane**
 - United States, Canada, and Australia
 - USA – 51×10^9 m³ annually
 - Canada – 3.4×10^9 m³ annually
 - Australia – 1.7×10^9 m³ annually
 - Ongoing exploration projects in India, China, Russia, Mexico, Ukraine, and a limited/varying number of other countries
 - Attempted to some degree in over 30 countries
 - Technology is U.S. developed and exportable
 - Canada and Australia are penetrating market

Benefits for Coalbed Methane/Coal Mine Methane Development

- **Abundant, clean energy source**
 - Often found in countries with little or no conventional oil and gas
- **Improved mine safety, remove explosion hazard**
 - Sago Mine Explosion
 - Upper Big Branch
 - China, Columbia, Mexico, Russia, Turkey
- **Improved mine economics, revenue stream**
- **Greenhouse gas emission reduction and Carbon Credits**

Coalbed Methane/Coal Mine Methane – Environmental Considerations

- **Water production**
- **Development of formerly undeveloped lands**
- **Greenhouse gas emission (methane) reduction**
- **Carbon sequestration, Enhanced Gas Recovery**

Environmental Considerations – Greenhouse Gas Emission Reductions

- As a GHG, methane is **25X more potent than CO₂**
 - Mine emission reductions highly desirable
 - Fuel substitution
 - Capture and use of coal mine methane may offset use of “dirtier” fuels



*VAM oxidizer at Consol Energy's mine –
West Virginia*

Coalbed/Coal Mine Methane Contacts

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- **US EPA Coalbed Methane Outreach Program**
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- **US DOE – National Energy Technology Laboratory**
<http://www.netl.doe.gov>
- **Coalbed Methane Association of Alabama**
<http://www.coalbed.com>
- **Methane to Markets Partnership**
<http://www.methanetomarkets.org/index.htm>



Questions?