

Montana's Energy – Groundwater – Agriculture Nexus

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COAL

SPRING

STOCK WATER

Montana Bureau of Mines and Geology

A non-regulatory research Bureau for the State of Montana
A department within Montana Tech of the University of Montana



Serving the
citizens of Montana
through geologic
and hydrologic
research and
information

Butte



The MBMG mandate is to *conduct research and assist in the orderly development of the State's energy, mineral and water resources.*

Since **1919**, the MBMG has been the principal source of earth science information for the state of Montana

Billings

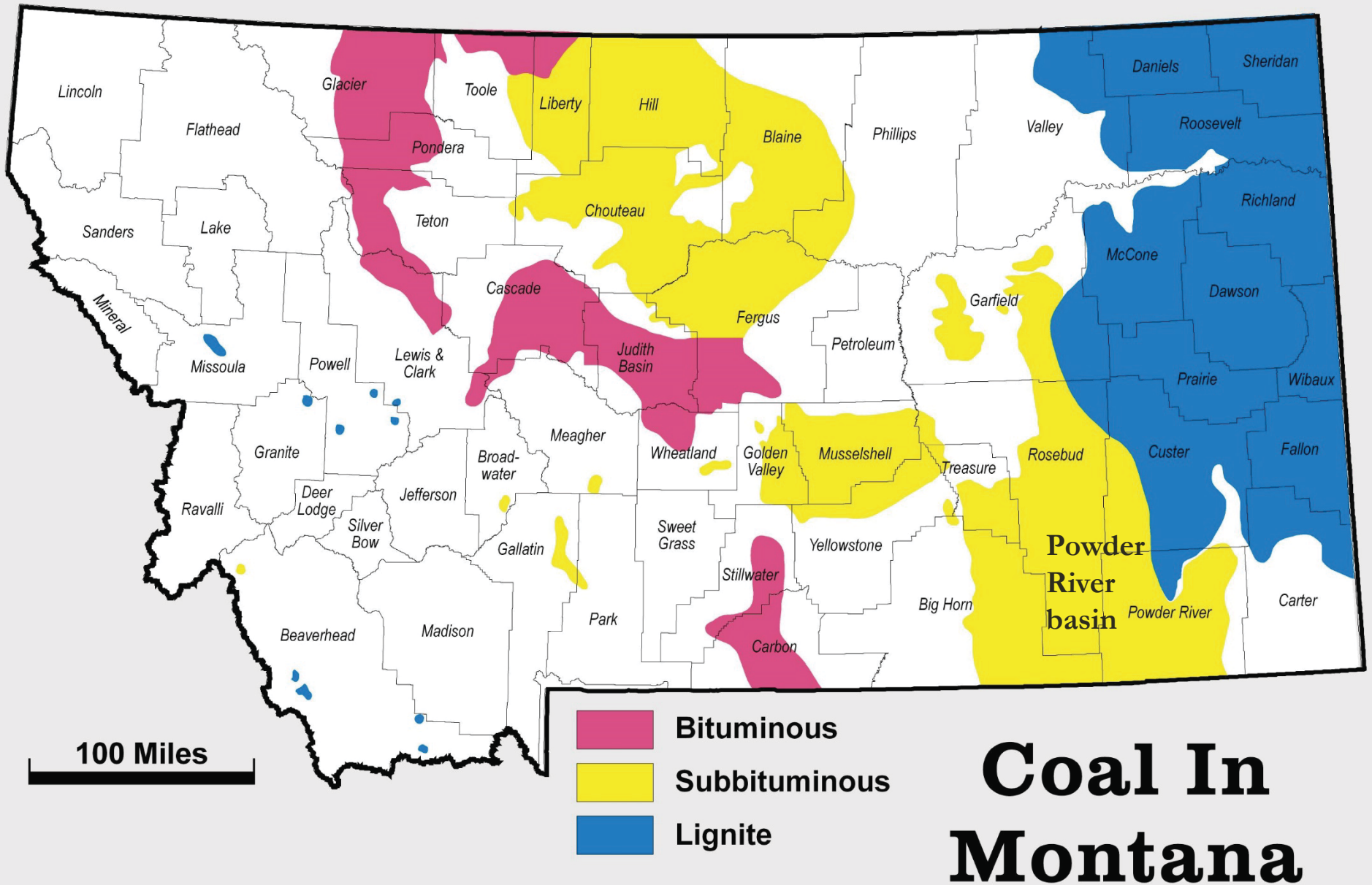


Energy in Montana

- Montana is a net supplier of energy to the nation.
- The Williston Basin of Montana and North Dakota holds one of the largest accumulations of crude oil in the United States; its Bakken and Three Forks formations are currently estimated to be capable of producing 7.4 billion barrels of oil.
- Montana's four refineries are able to process heavy Canadian crude oil for regional markets.
- Wind electric power generation in Montana grew by almost 32% in 2013 and supplied 6% of the state's net electricity generation.
- Montana has created a Renewable Energy Resource Standard requiring that public utilities and competitive electricity suppliers obtain 15% of electricity sales from renewable energy resources by 2015.
 - *From U.S. Energy Information Administration (www.eia.gov)*

Coal



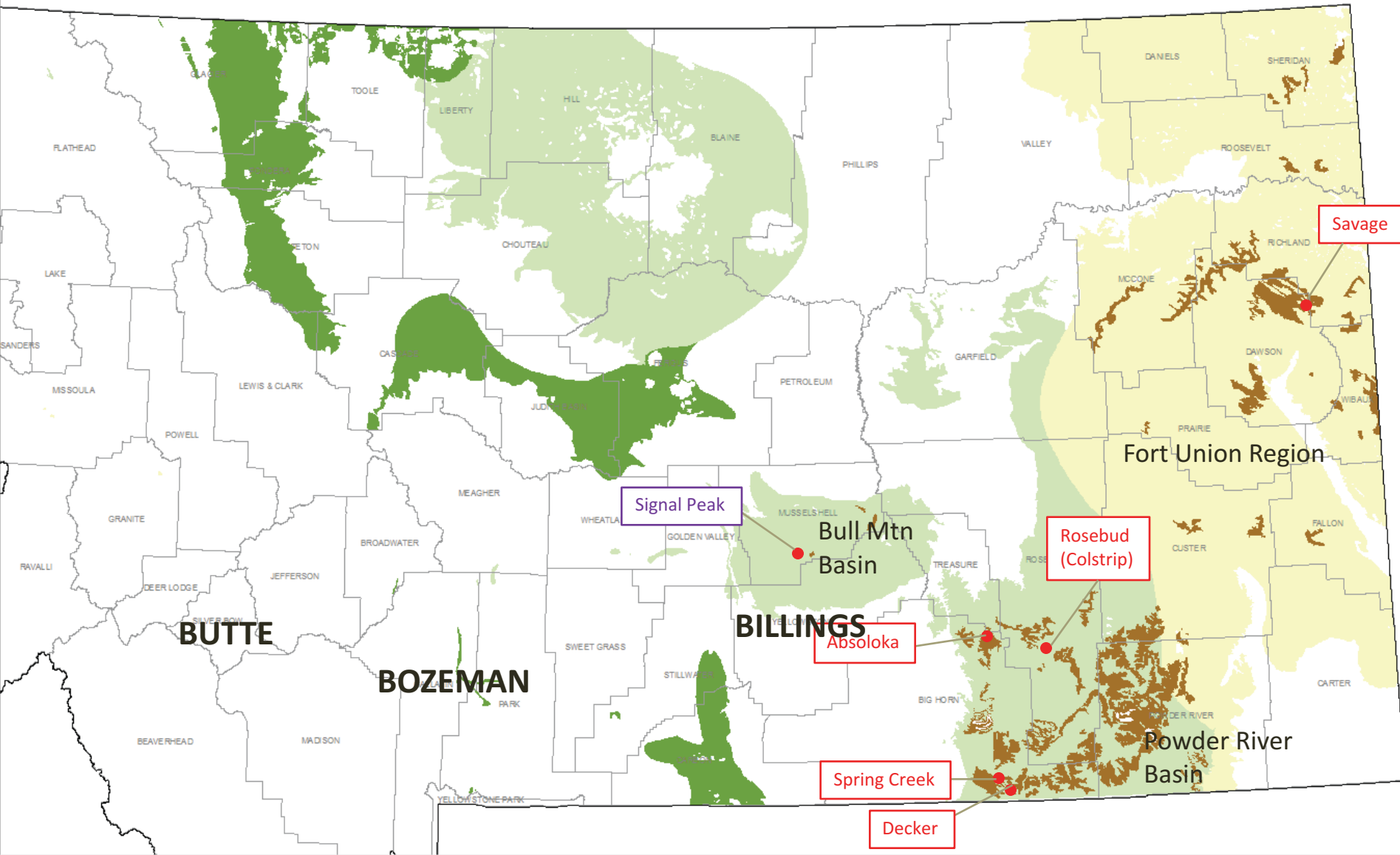


**~90% of reserves and
production come from PRB**

Demonstrated Reserve Base of 120 billion tons
(28% of Nation; 8% of the world)
70 underground
50 surface (strippable)

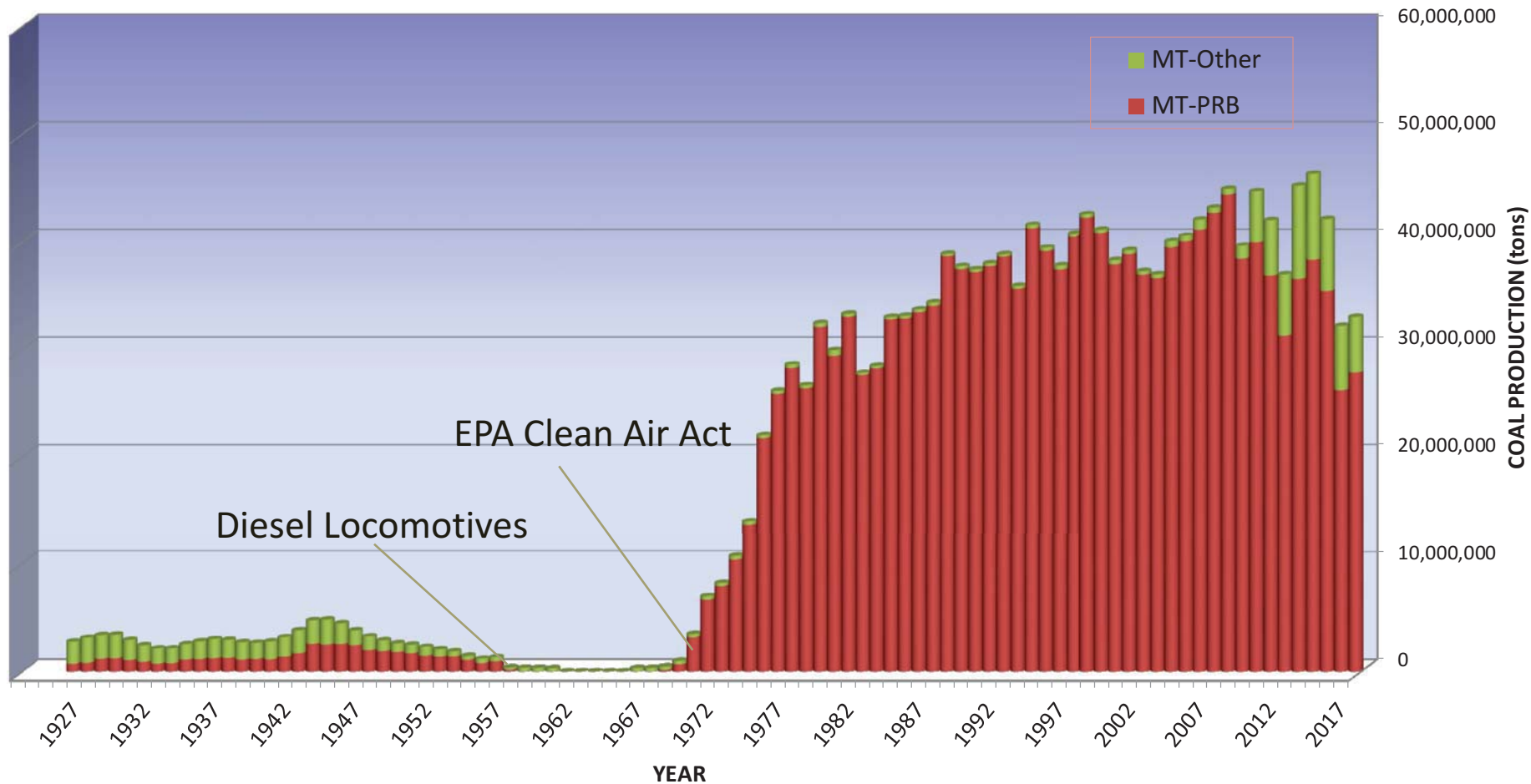
Coal Mines

- 5 surface mines, 1 underground
- MT production is about 40 million tons per year

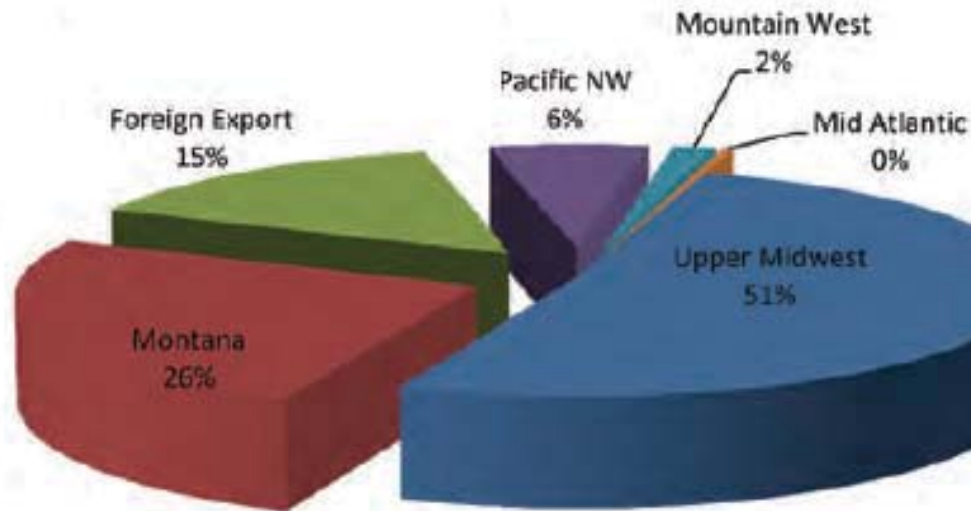


Montana Coal Production

MONTANA COAL PRODUCTION



2010 Montana Coal Destination by Region

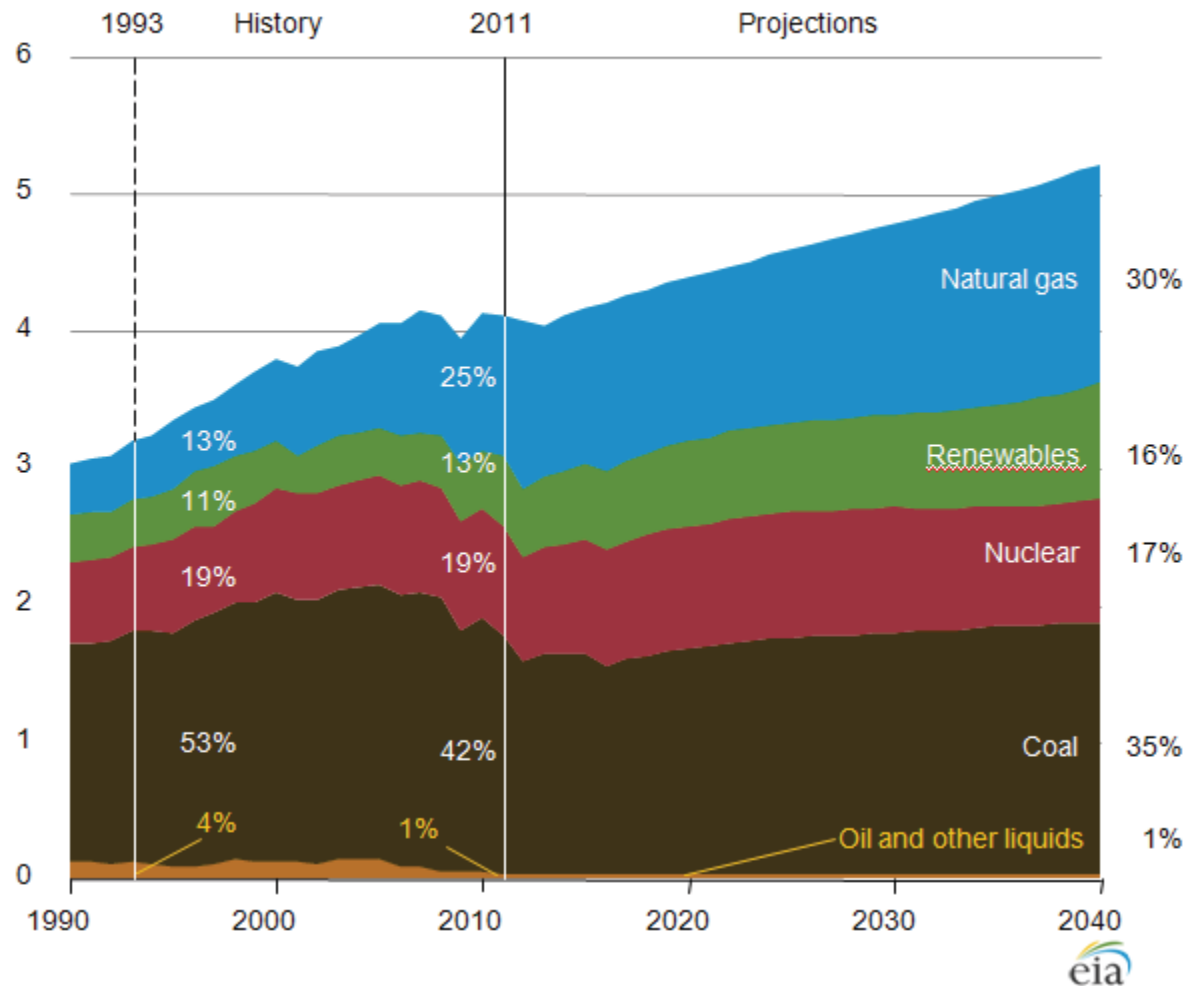


26% used locally, 51% sent to the Midwest,
15% shipped overseas (primarily to Asia).

Historically, 50% of U.S. electrical power has come from coal. Projected to decrease.

Figure 12. Electricity generation by fuel, 1990-2040

trillion kilowatthours per year



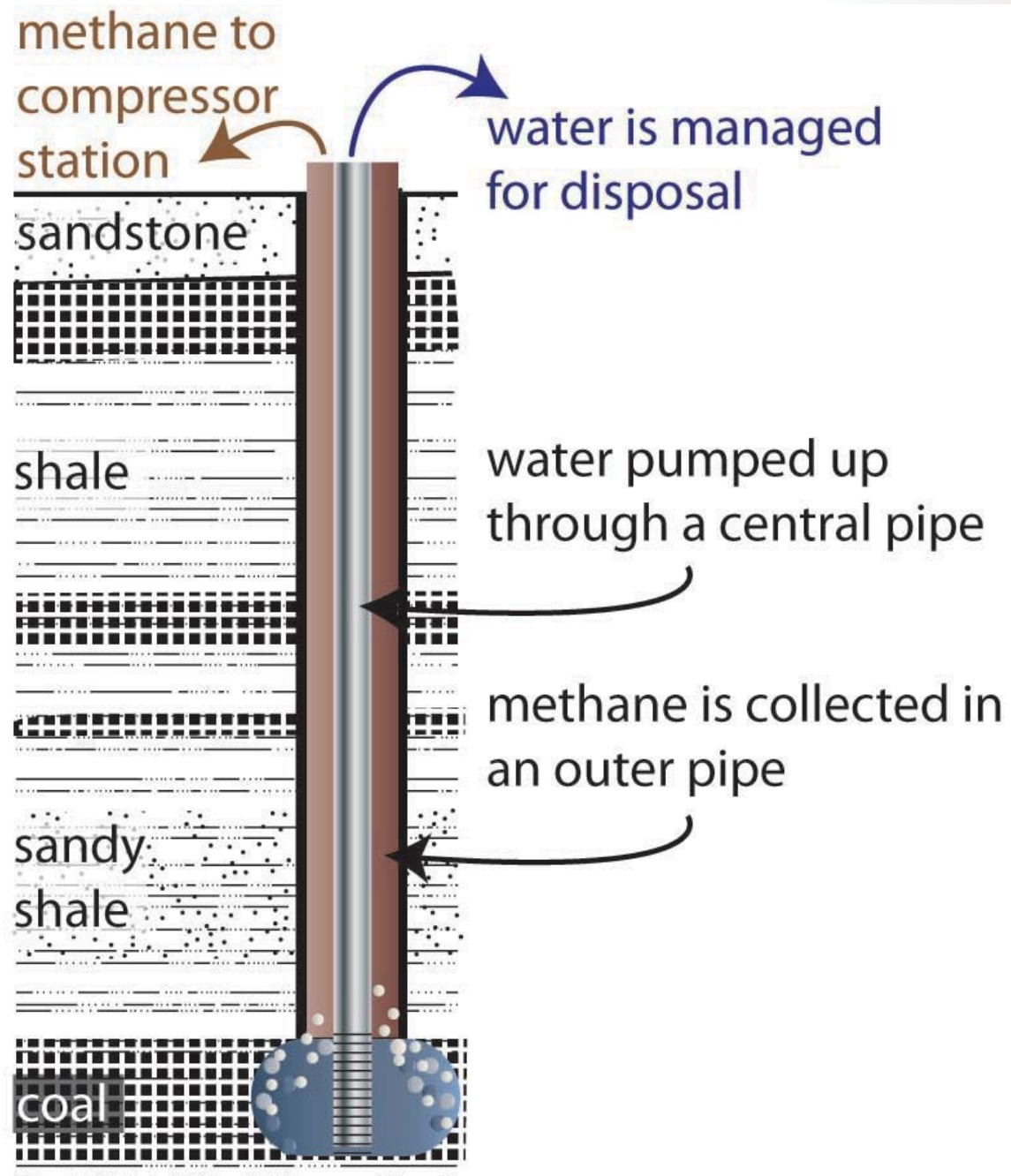
EIA (Energy Information Administration)
projections through 2040

Coalbed Methane

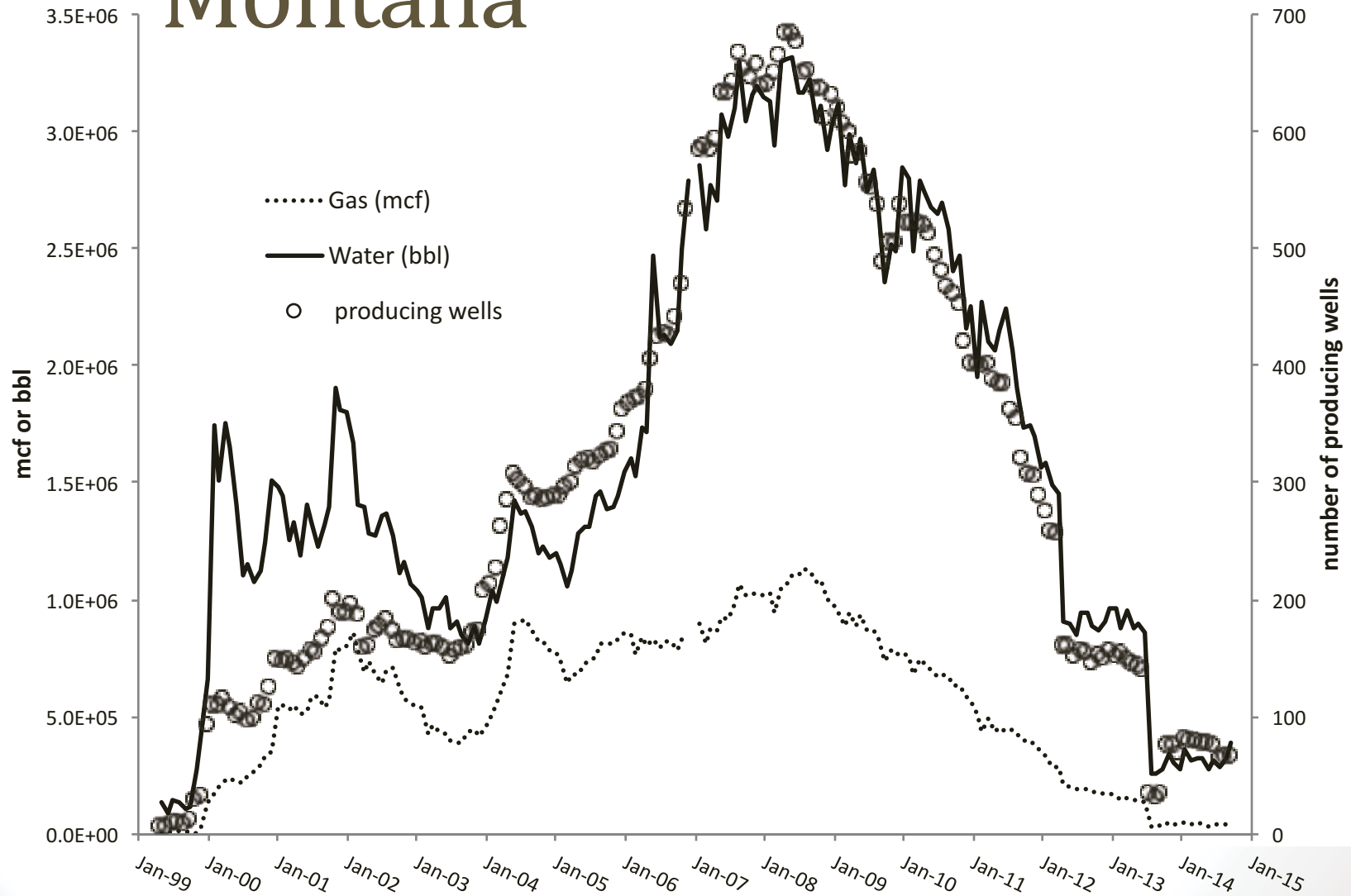
Site SL-6 Canyon Coal
Site SL-7 Canyon Coal

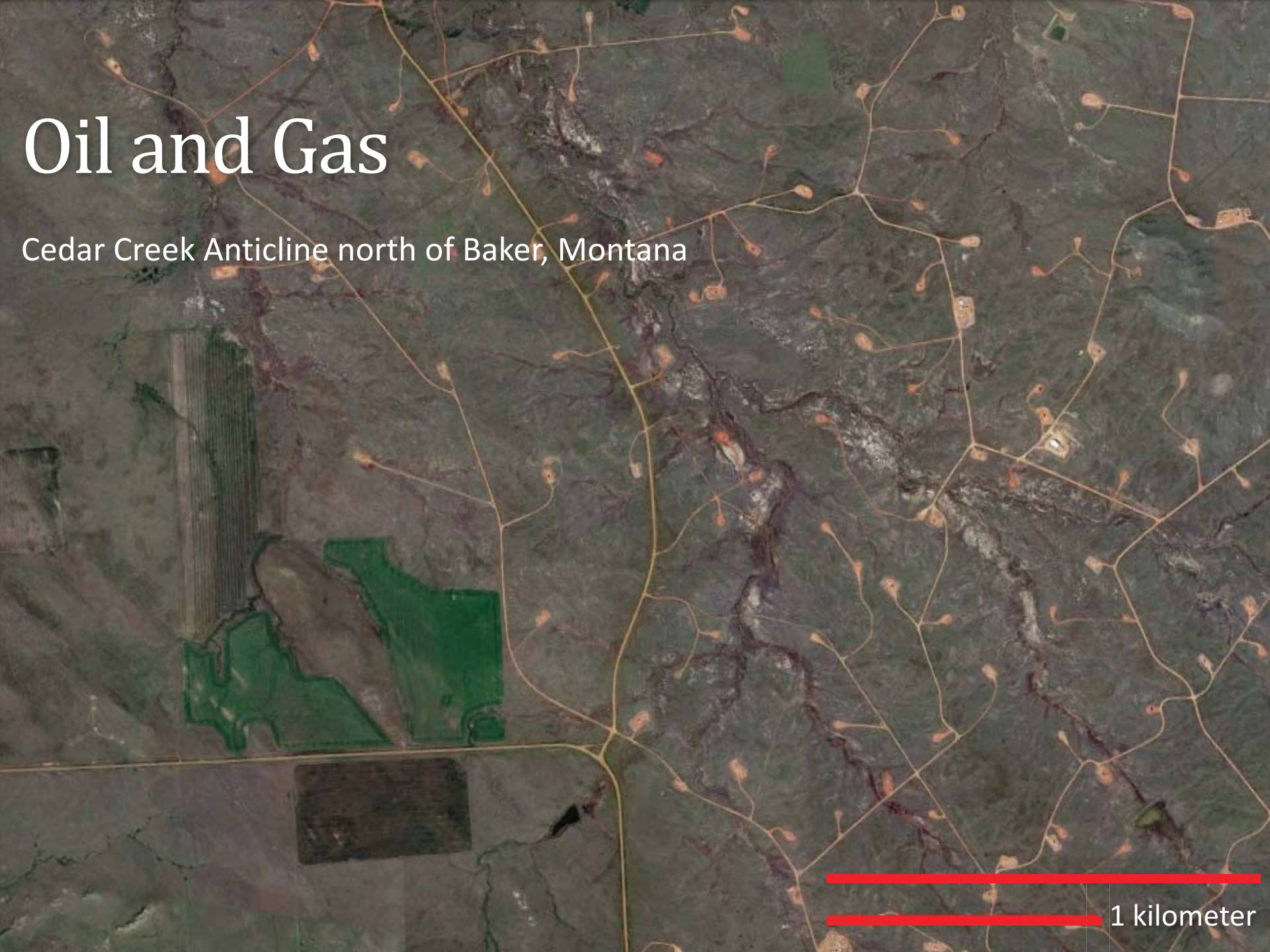
Produce free blowing methane gas





CBM Production in Montana



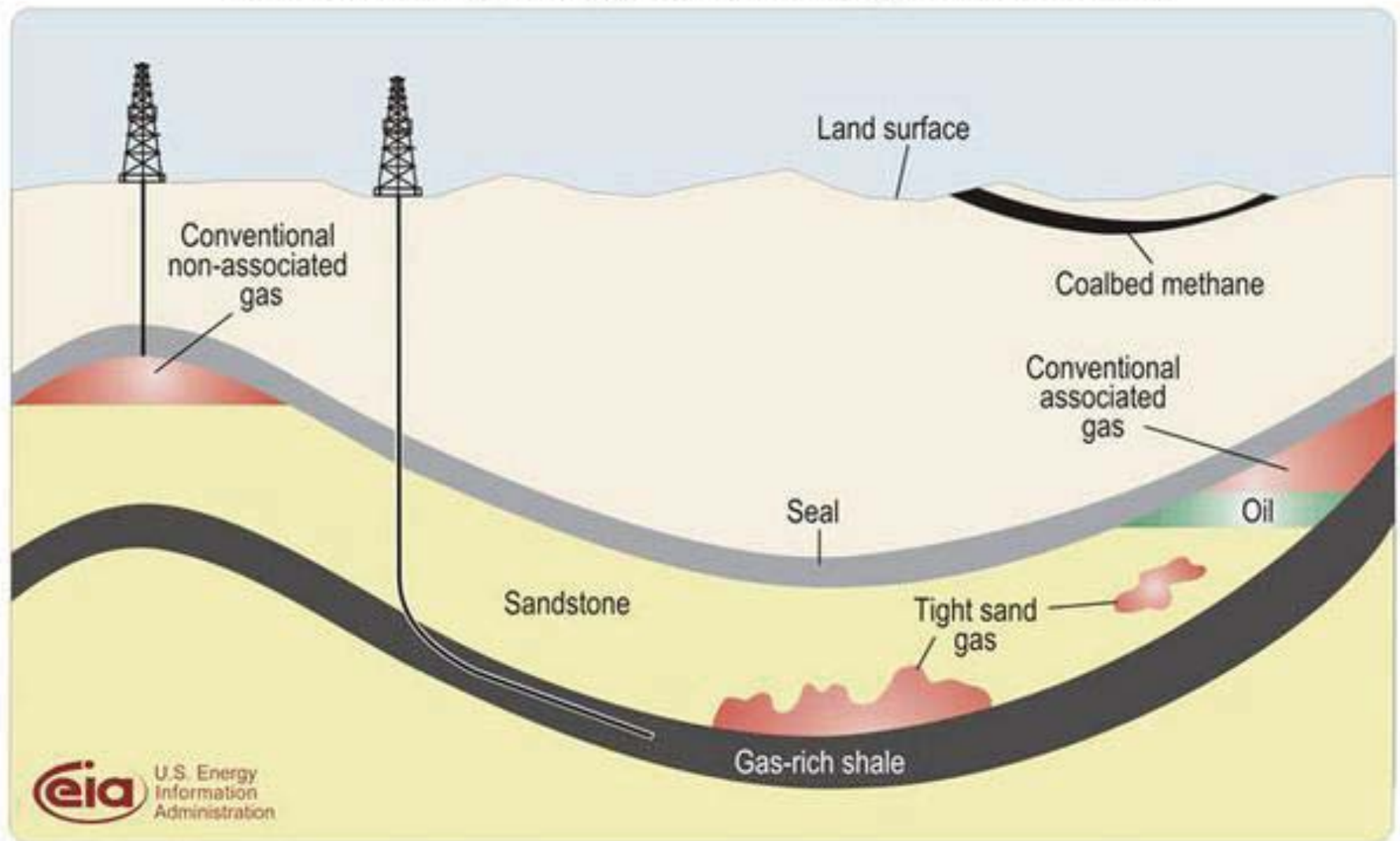


Oil and Gas

Cedar Creek Anticline north of Baker, Montana

1 kilometer

Schematic geology of natural gas resources



ERA	PERIOD	EPOCH	FORMATION				
CENOZOIC	QUATERNARY	HOLOCENE	ALLUVIUM, COLLUVIUM, EOLIAN DEPOSITS				
			GLACIAL DRIFT (TILL, OUTWASH, ICE-CONTACT DEPOSITS)				
			PRE-GLACIAL ALLUVIUM AND TERRACE DEPOSITS				
	TERTIARY	PLIOCENE	FLAXVILLE FORMATION				
		MIOCENE	WOOD MTN FM.				
		OLIGOCENE					
		Eocene					
		PALEOCENE	FORT UNION FORMATION	SENTINEL BUTTE MBR.			
				TONGUE RIVER MEMBER	LEBO MBR.	LUDLOW MBR.	
MESOZOIC	CRETACEOUS	UPPER	HELLCREEK FORMATION			PIERRE SHALE	
			FOX HILLS SANDSTONE				
			BEARPAW SHALE				
			JUDITH RIVER FORMATION				
			CLAGGET SHALE				
		LOWER	EAGLE			COLORADO GROUP	
			GAMMON SHALE				
			NIOBARA SHALE				
			CARLE SHALE				
			GREENHORN FORMATION				
			BELL FOURCHE SHALE				
			MOWEY SHALE				
			MUDDY-NEWCASTLE SANDSTONE				
			SKULL CREEK SHALE				
			BASAL COLORADO SS, FALL RIVER SS, "DAKOTA"				
	JURASSIC	UPPER	KOOTENAI FORMATION			FUSON SHALE	
			MORRISON FORMATION				
			SWIFT FORMATION				
		MIDDLE	RIVERDON FORMATION				
			PIPER FORMATION				
	TRIASSIC	LOWER	NESSON FORMATION			LAKOTA SS.	
PALEOZOIC	PERMIAN	UPPER	SPEARFISH FORMATION			PINE SALT	
		LOWER					MINNEKAHTA LS
	PENNSYLVANIAN	UPPER				OPECHE FM.	
		LOWER					MINNELUSA FORMATION
	MISSISSIPPIAN	UPPER	HEATH FM.			BIG SNOWY GROUP	
			OTTER FORMATION				
			KIBBEY FORMATION				
			CHARLES FORMATION				
		LOWER	MISSION CANYON LIMESTONE				MADISON GROUP
			LODGEPOLE LIMESTONE				
	DEVONIAN	UPPER	THREE FORKS FM.			BAKKEN FORMATION	
			BIRD BEAR-NISKU FORMATION				
			DUPELOU FORMATION				
			SOURIS RIVER FORMATION				
		MIDDLE	DAWSON BAY FORMATION				WINNIPEG-ELK POINT GROUPS
	SILURIAN	UPPER				INTERLAKE FORMATION	
		LOWER					
ORDOVICIAN	UPPER	STONY MTN FM.			BIG HORN GROUP		
		RED RIVER FM.					
	LOWER	WINNIPEG FORMATION					
CAMBRIAN	UPPER	DEADWOOD FORMATION					
	LOWER						
PRECAMBRIAN		Z					
		Y					
		X					
		W	GRANITIC "BASEMENT" ROCKS- 1.7 BILLION YEARS OLD				

sampled aquifers

5,000 - 8,000 feet

major
Williston Basin
petroleum targets

Groundwater monitoring around energy development

- The impetus:

3rd Party Monitoring

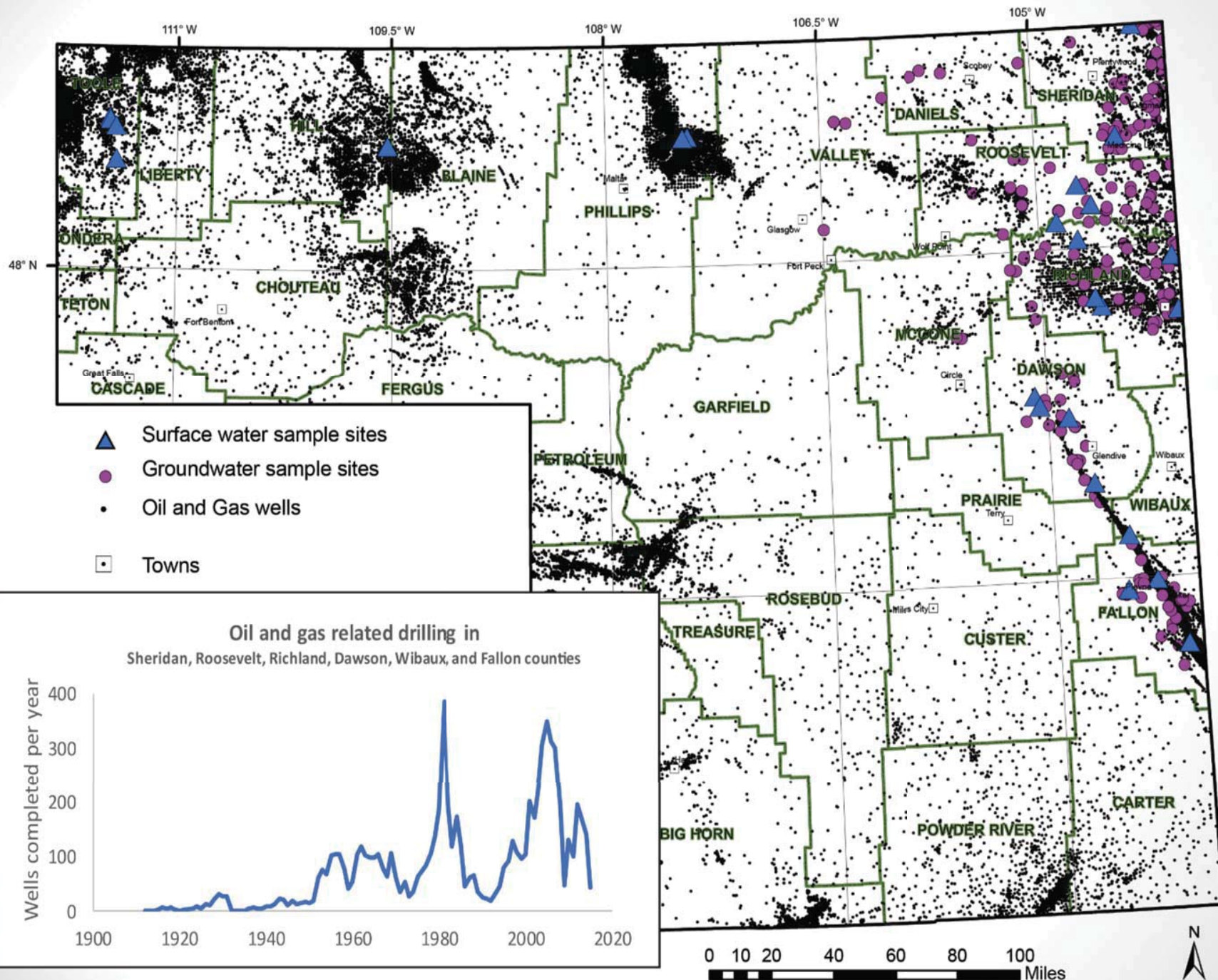
- Establish ambient conditions and natural variability
- Long-term and region-wide to determine causal relationships
 - Climatic
 - Land use changes
 - Human induced
- Non-regulatory data provided for use by all parties
- Helps facilitate responsible development of resources
 - Identify the resource; quantity and quality
 - Provides scientific information to developers, regulators, and residents

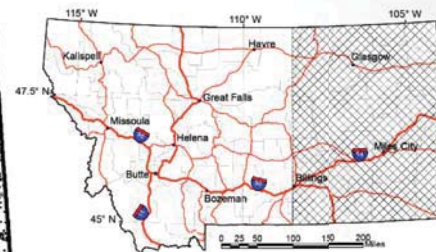
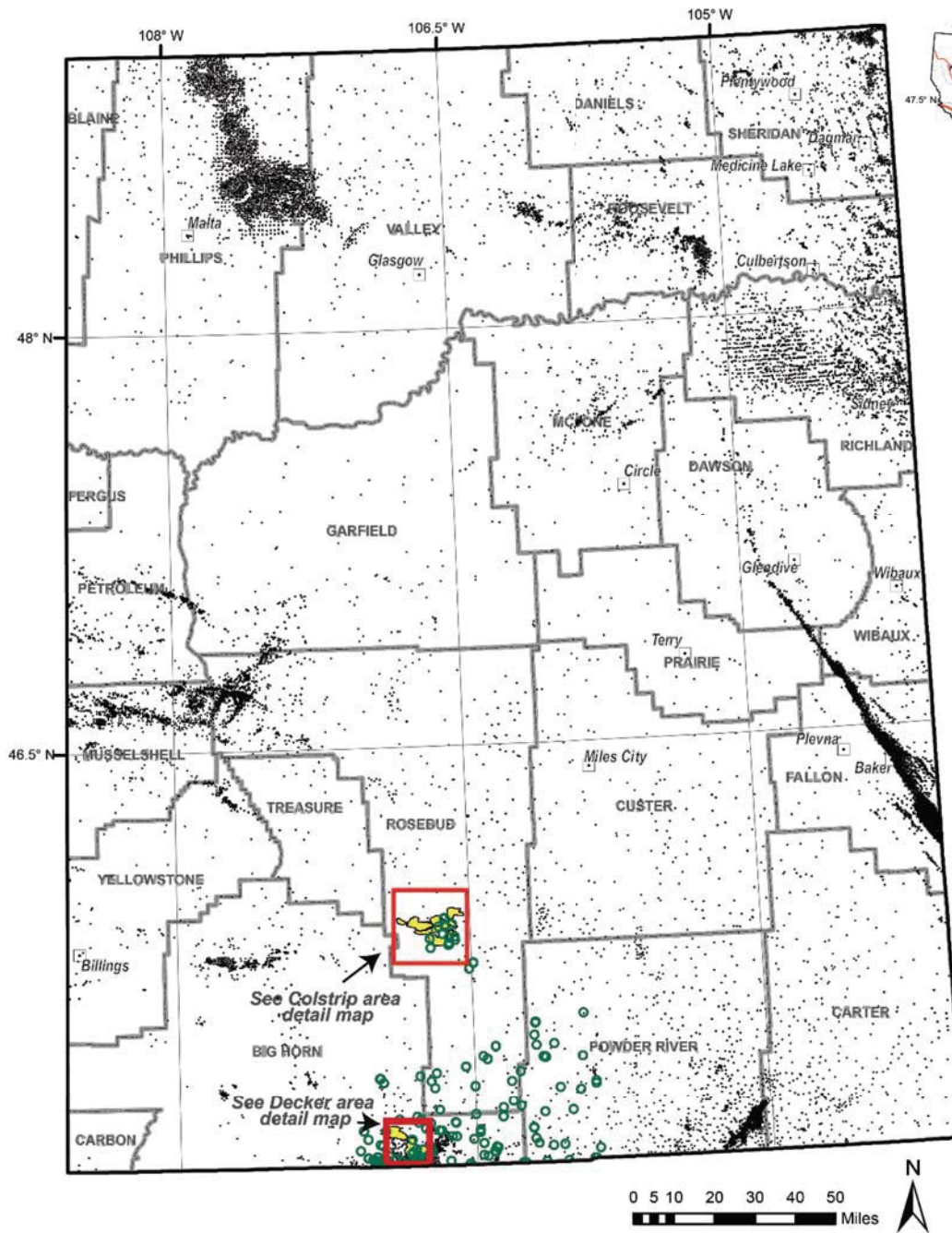
Groundwater monitoring around energy development

- The impetus:

- Local Concern

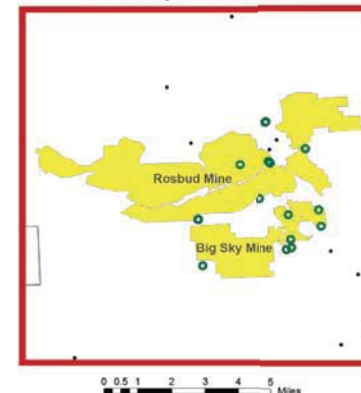
- Water drawdown from coal mines
 - Wyoming's experience with CBM development
 - Fracking in the news





Hatched area indicates area of main map extent

Colstrip area detail

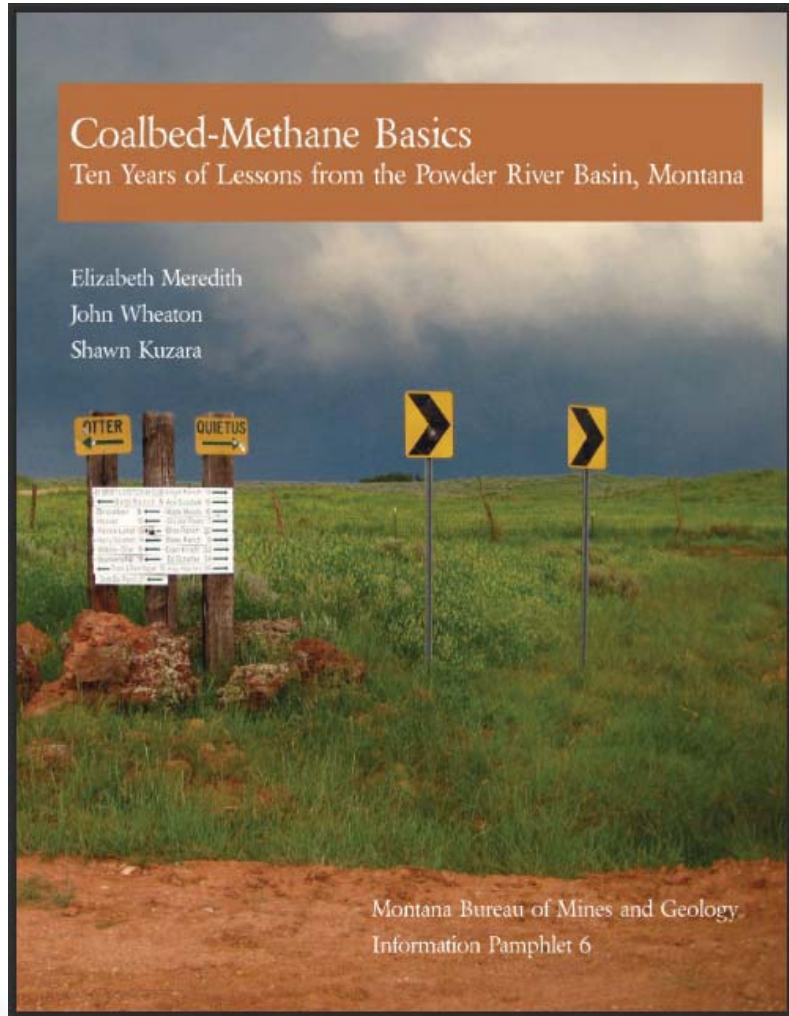


Decker area detail

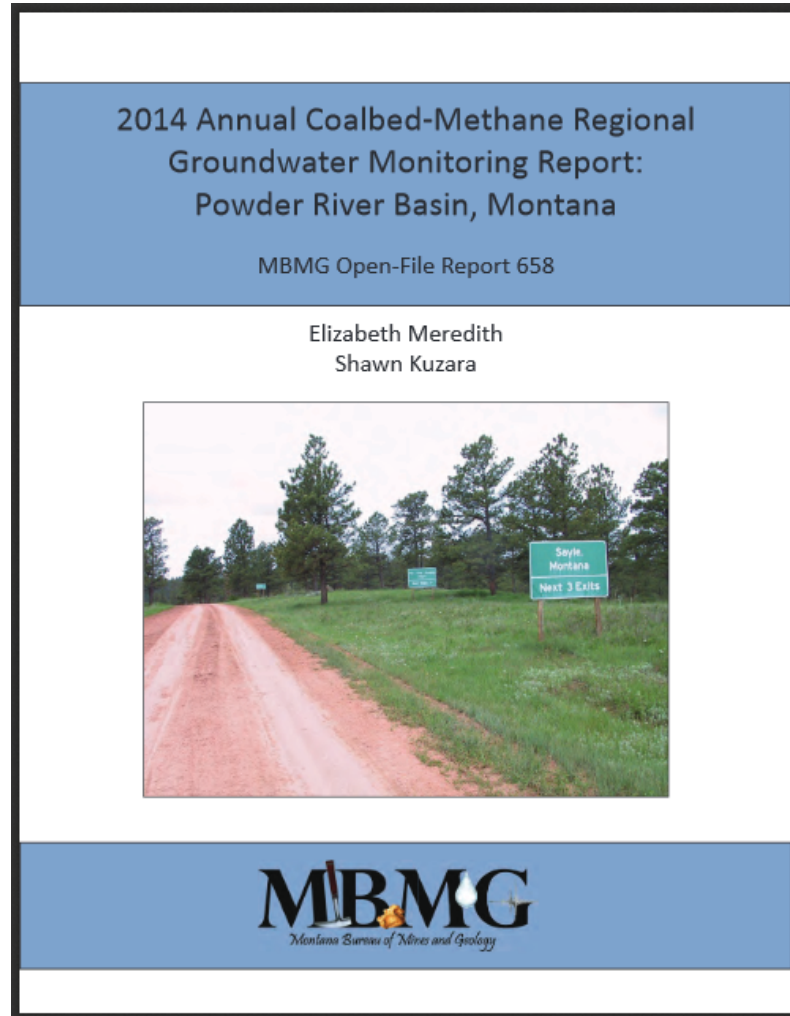


- CBM/Coal Monitoring Wells
- Oil and gas wells
- Extent of Decker and Colstrip area coal mines

Reports for a variety of audiences



For the general public (IP-6; 2012)



For scientific audiences (OFR 658; 2015)



Thank You.

**Thank you.
Questions?**

