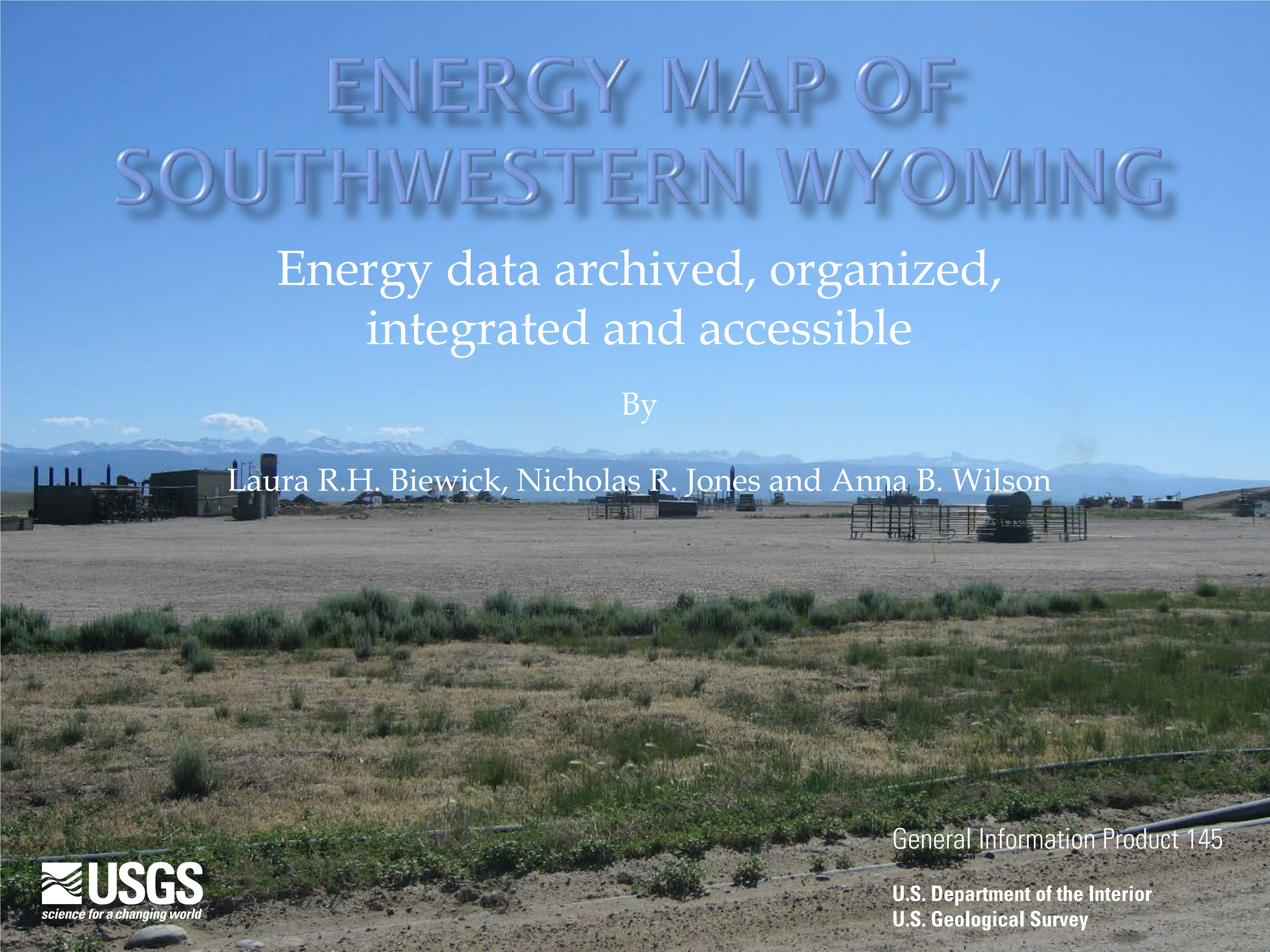

ENERGY MAP OF SOUTHWESTERN WYOMING

Energy data archived, organized, integrated and accessible

By

Laura R.H. Biewick, Nicholas R. Jones and Anna B. Wilson

General Information Product 145

U.S. Department of the Interior
U.S. Geological Survey

Outline of Presentation

- Purpose
- Downloadable Data and the Interactive Map
- Electrical Energy Sources: Coal and Wind
- Oil and Gas
- Oil Shale
- Energy Corridor
- Solar

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Purpose

The Wyoming Landscape Conservation Initiative (WLCI) focuses on conserving world-class wildlife resources while facilitating responsible energy development.

Much of the information in the energy map product is based on published data that can be found elsewhere, but is not assembled together in one place in a way that clarifies what the energy potential looks like.

For the WLCI long-term, science-based effort, a comprehensive inventory of geologic energy data needs to be available as an online resource so that the information is easily accessible in Geographic Information Systems (GIS) and other research-related software, as well as by a variety of disciplines.

Downloadable Data and the Interactive Map

- The energy map is built using GIS techniques and expertise.
- The energy data are provided in a geodatabase and interactive maps; pertinent layers are displayed on a PDF map.
- The work completed to date focuses primarily on the electrical power sources of coal (including coalbed methane), and wind energy (Biewick and Jones, 2012), published as Part A.
- Planned for Part B is oil and gas, oil shale, uranium, and solar data; as well as infrastructure associated with exploration, production and development; and the extent and nature of restrictions or impediments to energy-resources development.

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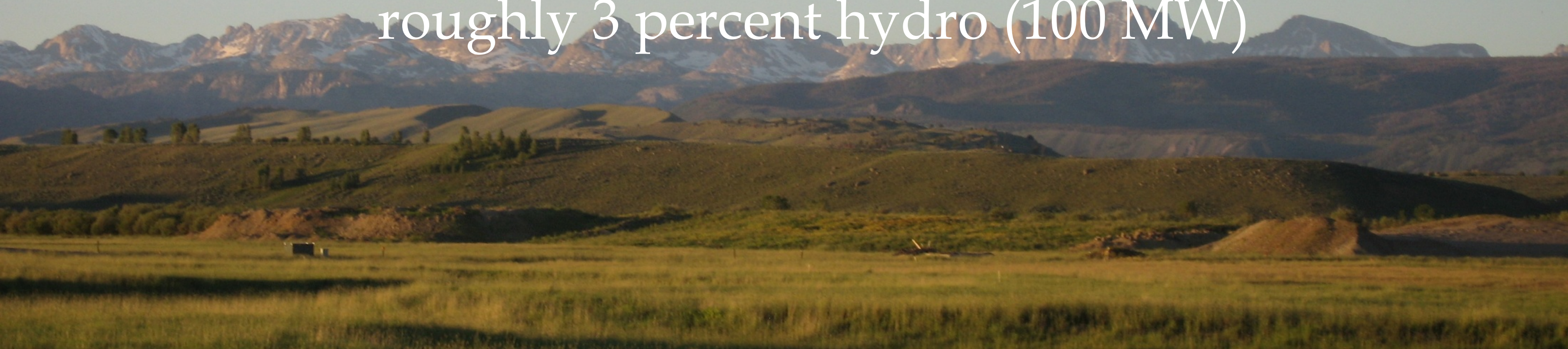
Electrical Energy Sources: Coal and Wind

as of November, 2010 (Biewick and Jones, 2012)

roughly 79 percent coal (3,024 MW)

roughly 18 percent wind (674 MW)

roughly 3 percent hydro (100 MW)



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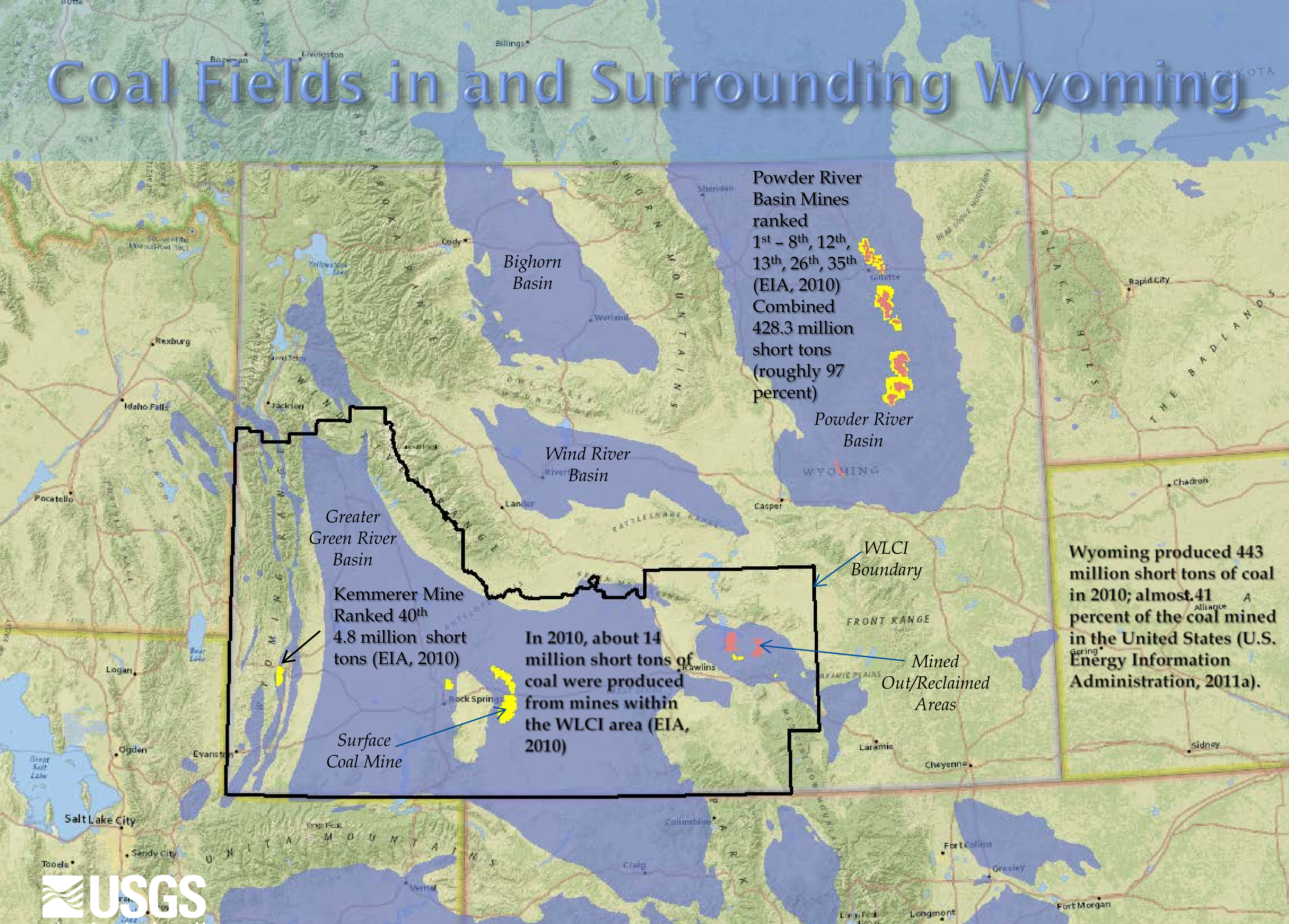
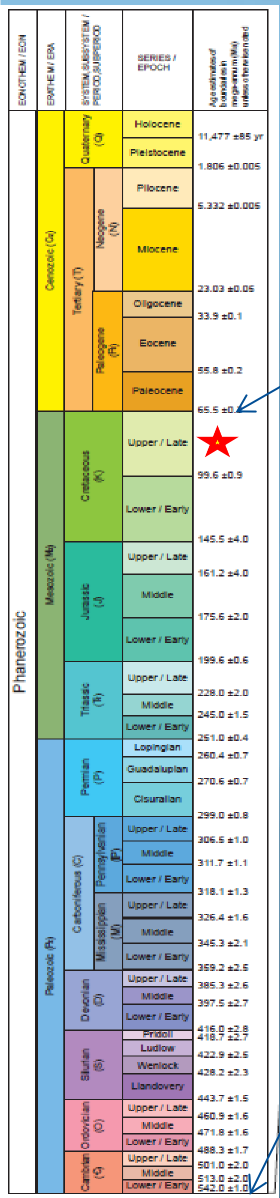
Megawatt (MW)

Coal Fields in and Surrounding Wyoming



From U.S. Energy Information Administration (EIA), 2010

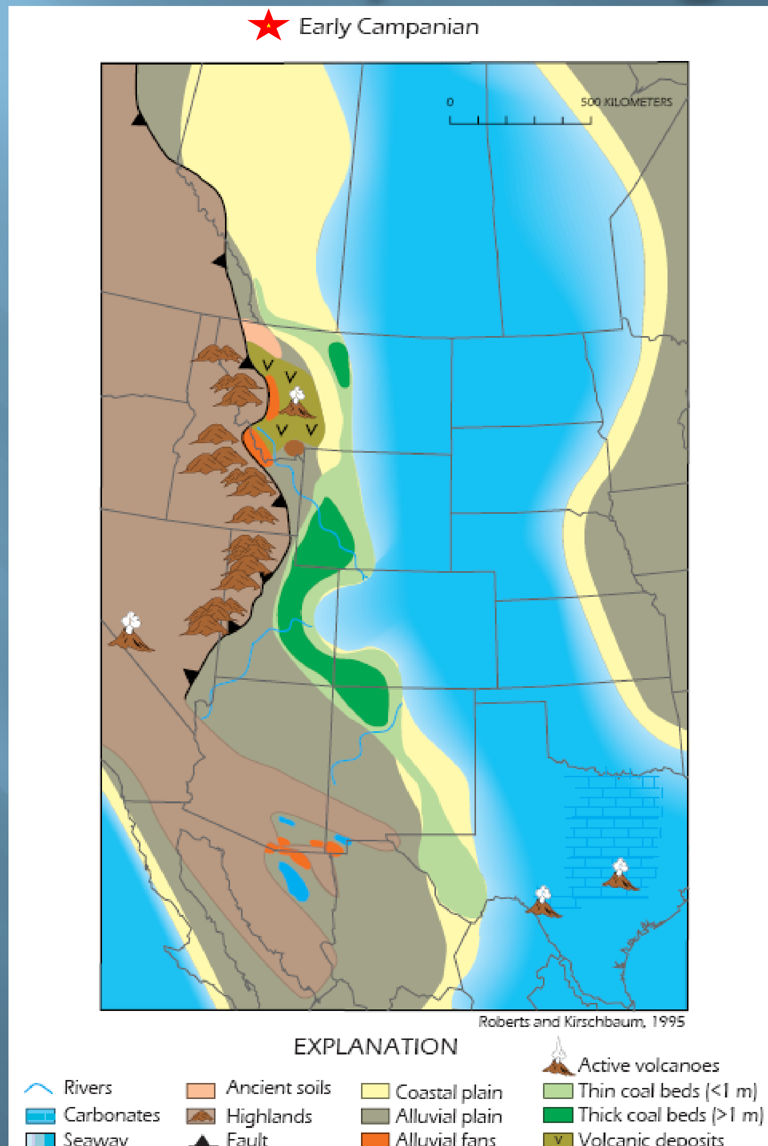
Why is there so much coal in Wyoming?



Dinosaurs became extinct at the end of the Cretaceous Period

Earliest evidence of complex forms of animal life

From U.S. Geological Survey (USGS) Geologic Names Committee (2007)



Throughout much of the Cretaceous Period, a good portion of the area that is today Wyoming was at or near sea level. The climate was tropical to subtropical and a vast seaway occupied the Western Interior of North America. The body of water is known most commonly as the Western Interior Cretaceous Seaway. Vegetation grew in coastal wetlands bordering the seaway, and extensive deposits of organic material accumulated in lower coastal plain depositional settings (Roberts and others, 1995).

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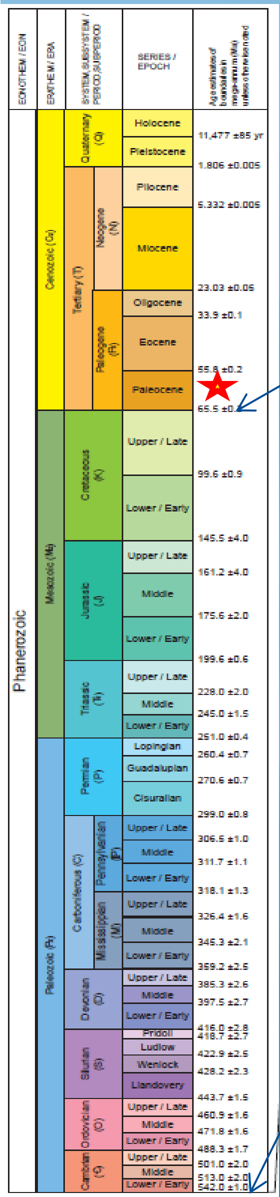
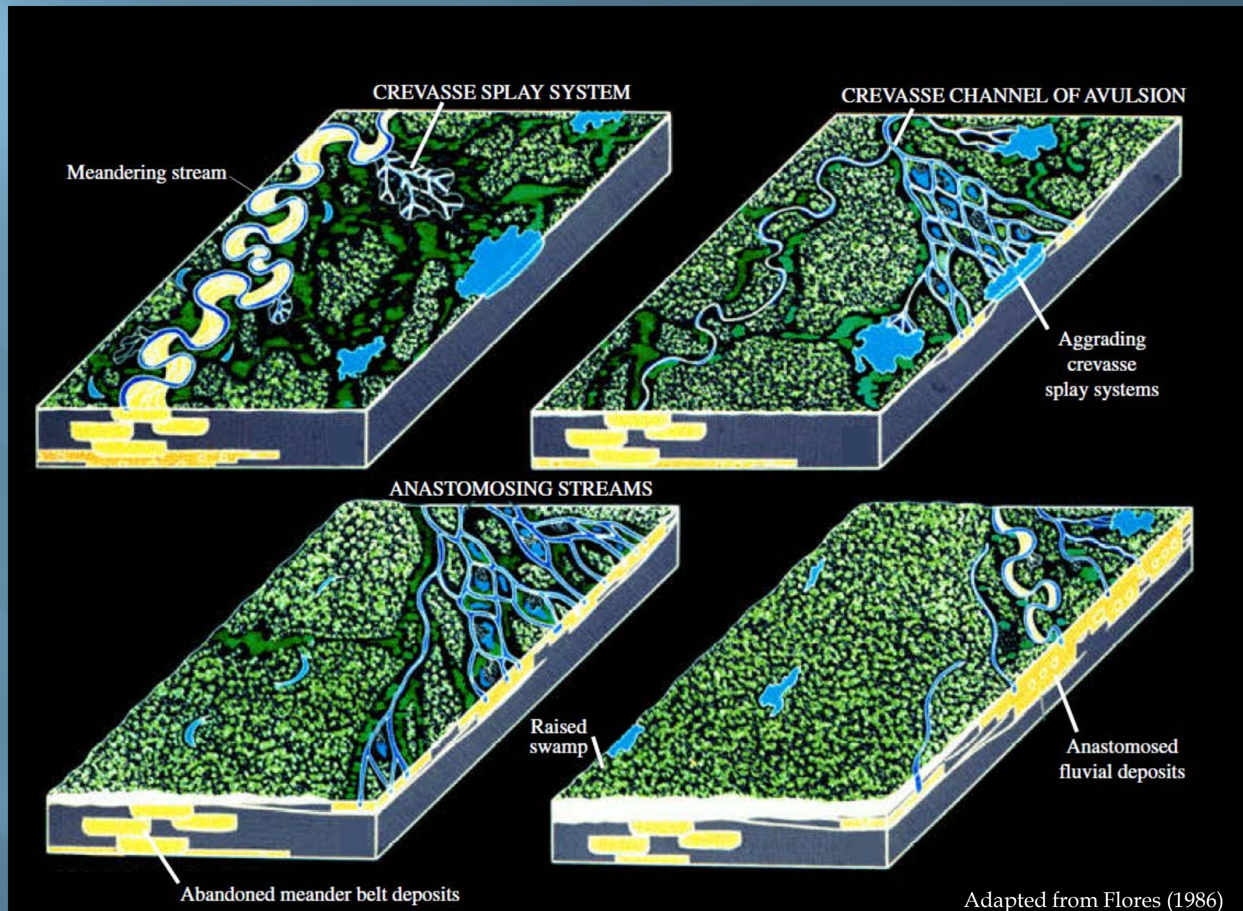
Why is there so much coal in Wyoming (cont.)?



Dinosaurs became extinct at the end of the Cretaceous Period

Earliest evidence of complex forms of animal life

From U.S. Geological Survey (USGS) Geologic Names Committee (2007)



Adapted from Flores (1986)

Over time, the seaway retreated, and marine and coastal-plain environments became restricted to areas north and east of Wyoming, in what is now North and South Dakota. During the Paleocene Epoch ★ (about 65 to 56 million years ago), wetlands in Wyoming developed in low lying floodplains and along fluvial corridors.

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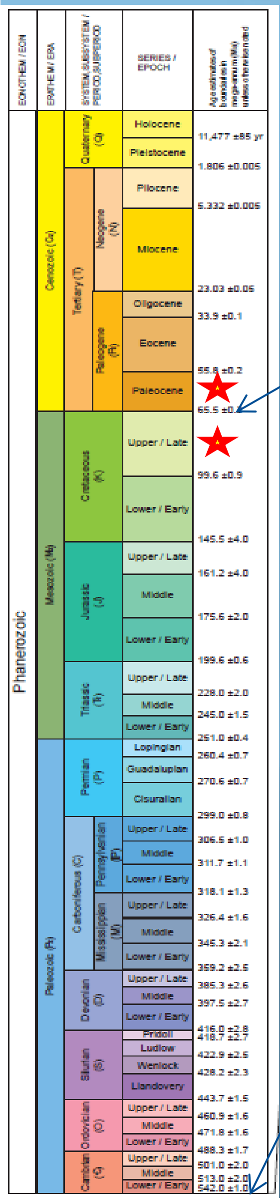
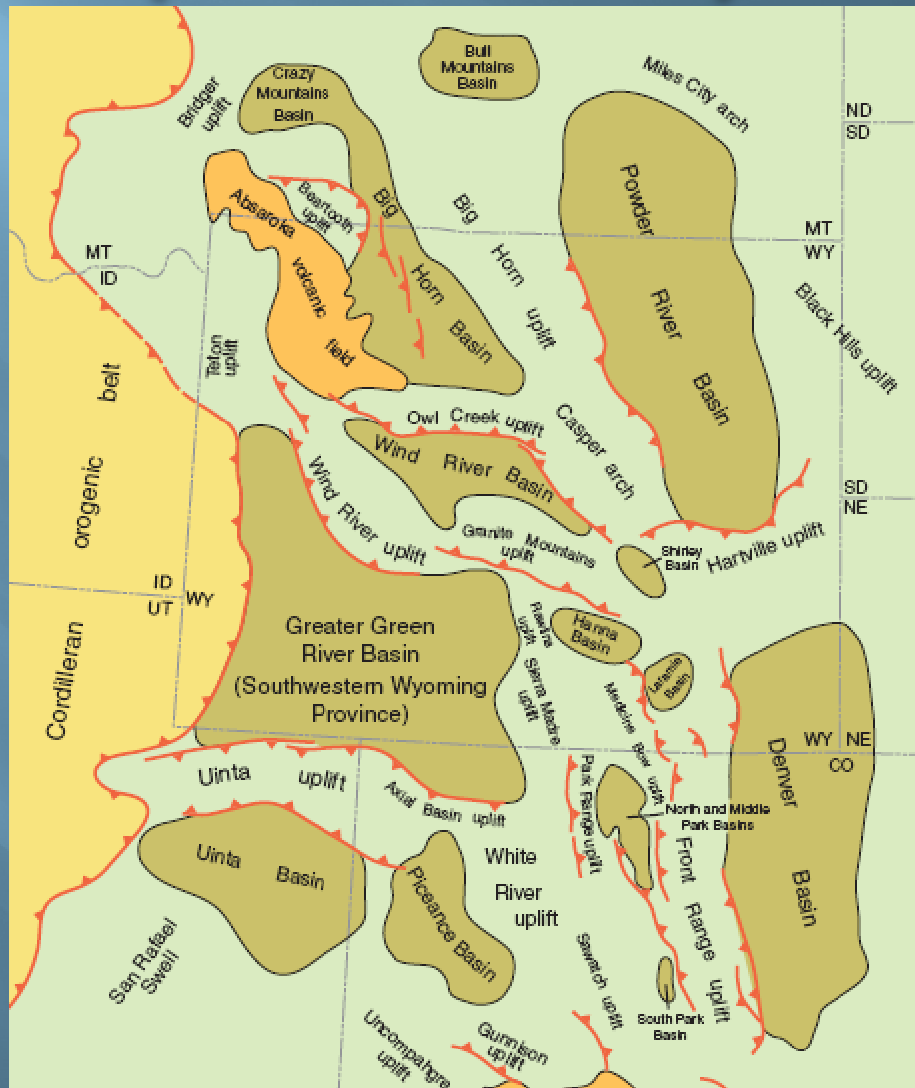
Why are there so many fossil fuel deposits in Wyoming?



Dinosaurs became extinct at the end of the Cretaceous Period

Earliest evidence of complex forms of animal life

From U.S. Geological Survey (USGS) Geologic Names Committee (2007)



Modified from Dickinson and others (1988) in Finn and Johnson (2005)

The sedimentary basins in Wyoming contain some of the largest fossil fuel deposits in the United States (U.S. Energy Information Administration, 2010). These basins developed throughout the Late ★ Cretaceous-early Tertiary during the Laramide orogeny. Uplift during the Laramide orogeny divided the area into structural basins and intervening highlands.

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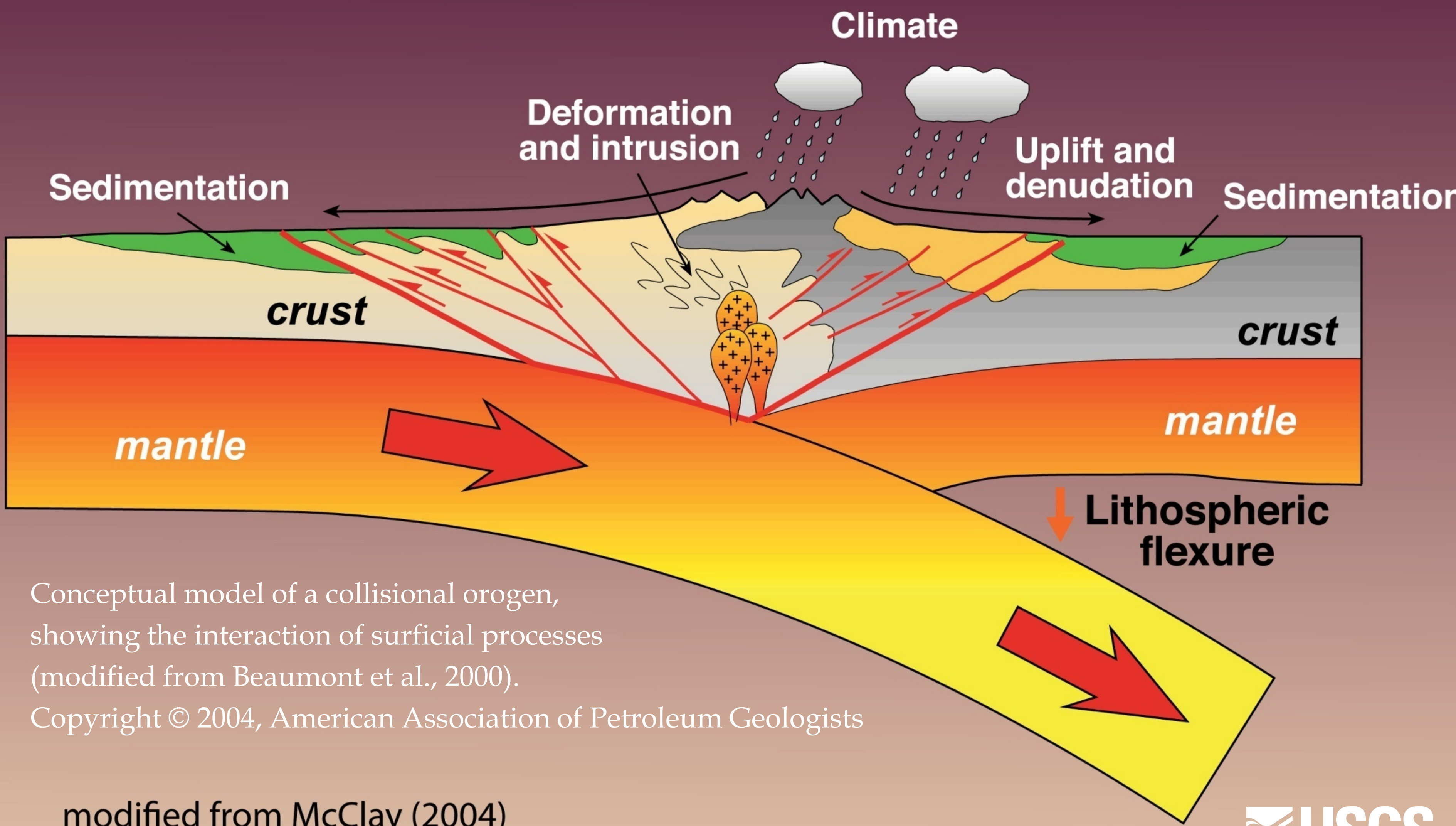
Great volumes of erosional debris were carried from the uplands by rivers and streams and deposited in the subsiding basins. These sediments buried and preserved the organic material, where it eventually was transformed into oil, gas, and coal.



Conceptual model of a collisional orogen, showing the interaction of surficial processes (modified from Beaumont et al., 2000).

modified from McClay (2004)

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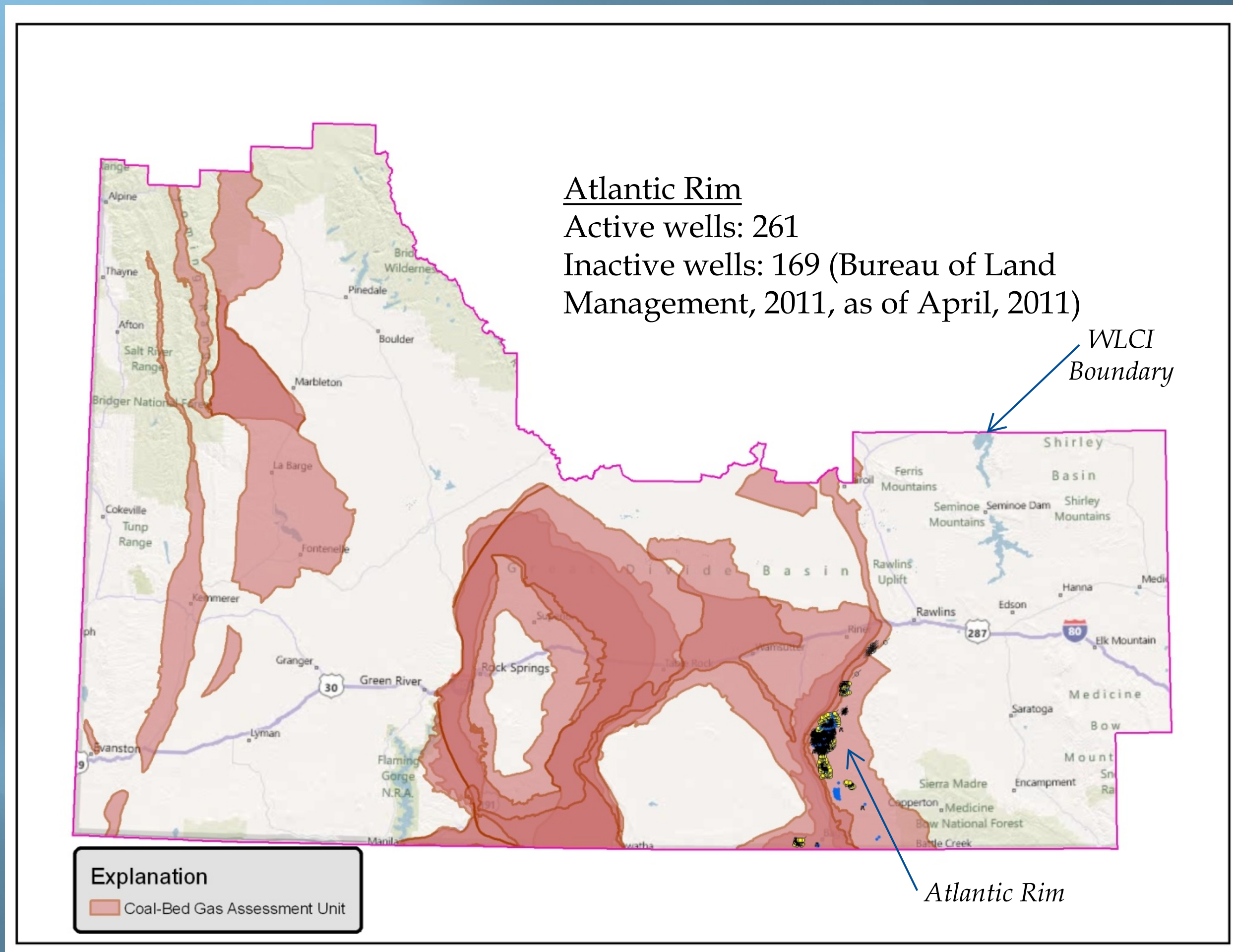
Coalbed Gas



Some coals contain enough gas to be potentially economic. In 2002 and 2003, the USGS assessed coalbed gas resources in the Southwestern Wyoming and the Wyoming Thrust Belt Provinces, and estimated a mean of 1.89 trillion cubic feet (TCF) of undiscovered coalbed gas in seven coalbed gas assessment units (Kirschbaum and others, 2002; 2004). Although these Assessment Units (AUs) extend beyond the boundary of the WLCI, 74 percent of the area covered by these AUs is within the WLCI.

According to the U.S. Bureau of Land Management, 2011, no new wells had been drilled since 2008 at the Atlantic Rim. The departure from the predicted drilling rate is generally attributed to the decline in natural gas prices, and wells that are not economical to operate at current natural gas prices have been shut-in or temporarily abandoned.

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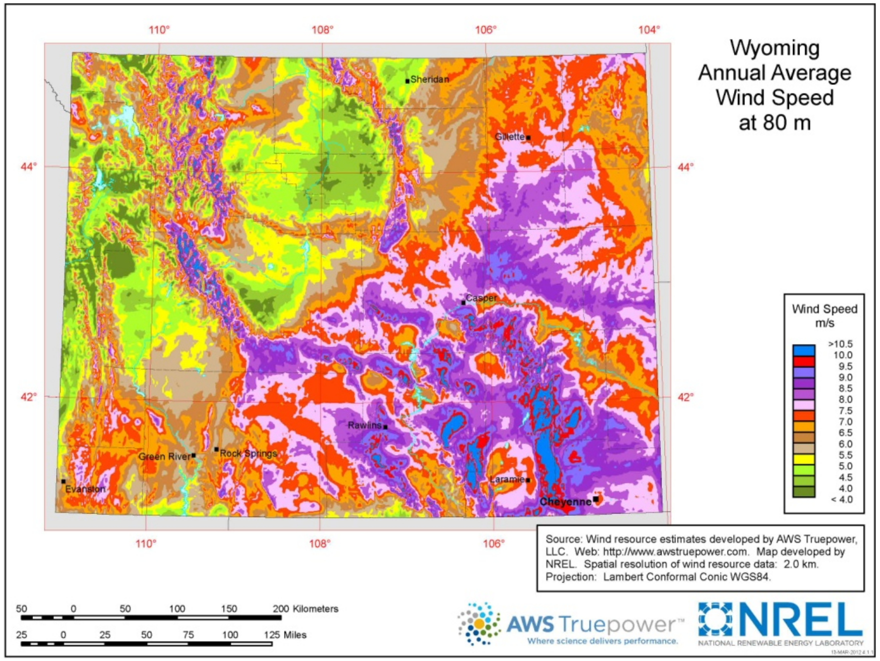
Wind Energy



U.S. Department of Energy (2010a)

One of the most favorable locations for wind-power development in the Nation is located in southern Wyoming. Across southern Wyoming from the Utah border on the west to the Nebraska border on the east, a gap in the Rocky Mountains channels strong winds generated from across the plains, making this area ideally suited for wind-power development (U.S. Energy Information Administration, 2011b).

The wind-resource map shows the predicted mean annual wind speeds at an 80-meter (m) height. Utility-scale, land-based wind turbines are typically installed between 80-100 m. Areas with annual average wind speeds around 6.5 m/second (s) and greater at an 80-m height are generally considered to have a resource suitable for wind development.

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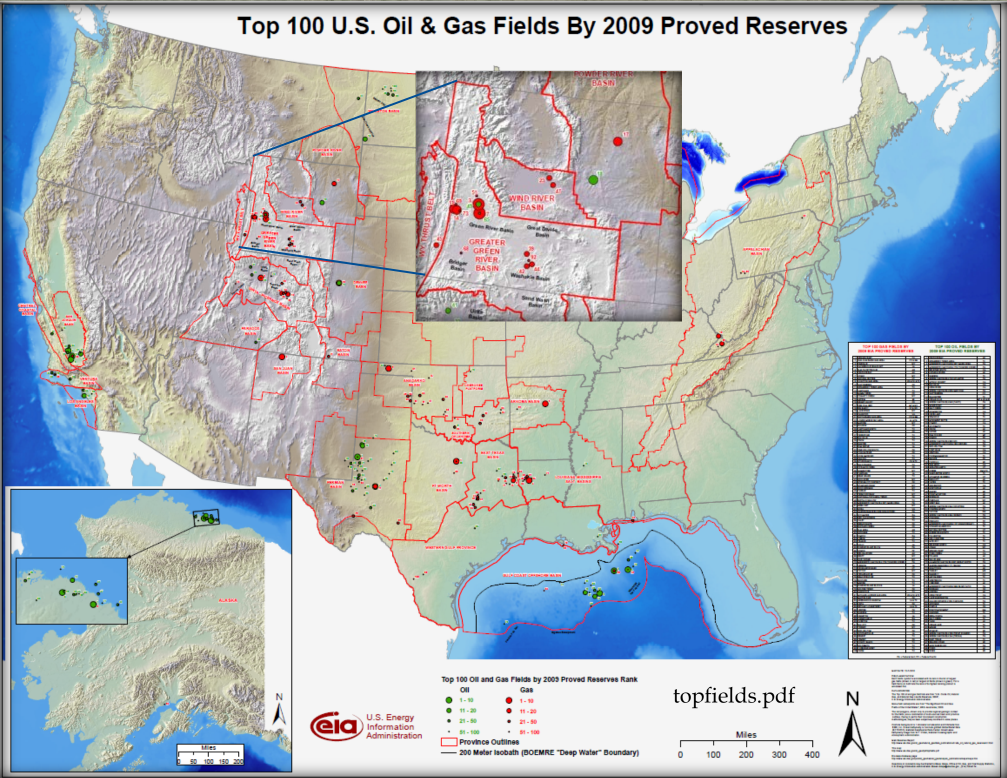
Oil and Gas



In 2010, Wyoming ranked second (only to Texas) in natural gas marketed production of 2.3 TCF (U.S. Energy Information Administration, 2011b). Southwestern Wyoming has 15 of the Nation's largest oil and gas fields, including the Pinedale (third largest) and Jonah (seventh largest) natural gas fields (U.S. Energy Information Administration, 2009).

Fogarty Creek – 14th largest

Powder River Basin – 17th largest

Lake Ridge – 19th largest

Pinedale – 49th largest (oil)

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Oil and Gas Drilling Activity

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Data Series 625

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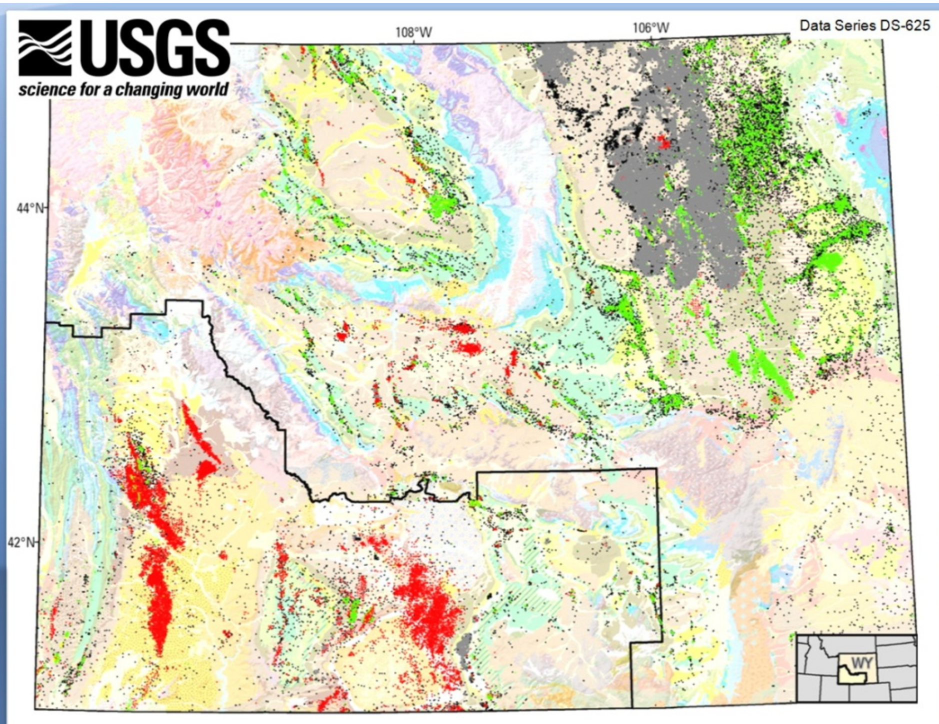
Geodatabase of Wyoming statewide oil and gas drilling activity to 2010

By Laura R.H. Biewick

Click on this map graphic to open the historical drilling activity slideshow. Press Esc key to return.



First posted August 8, 2011

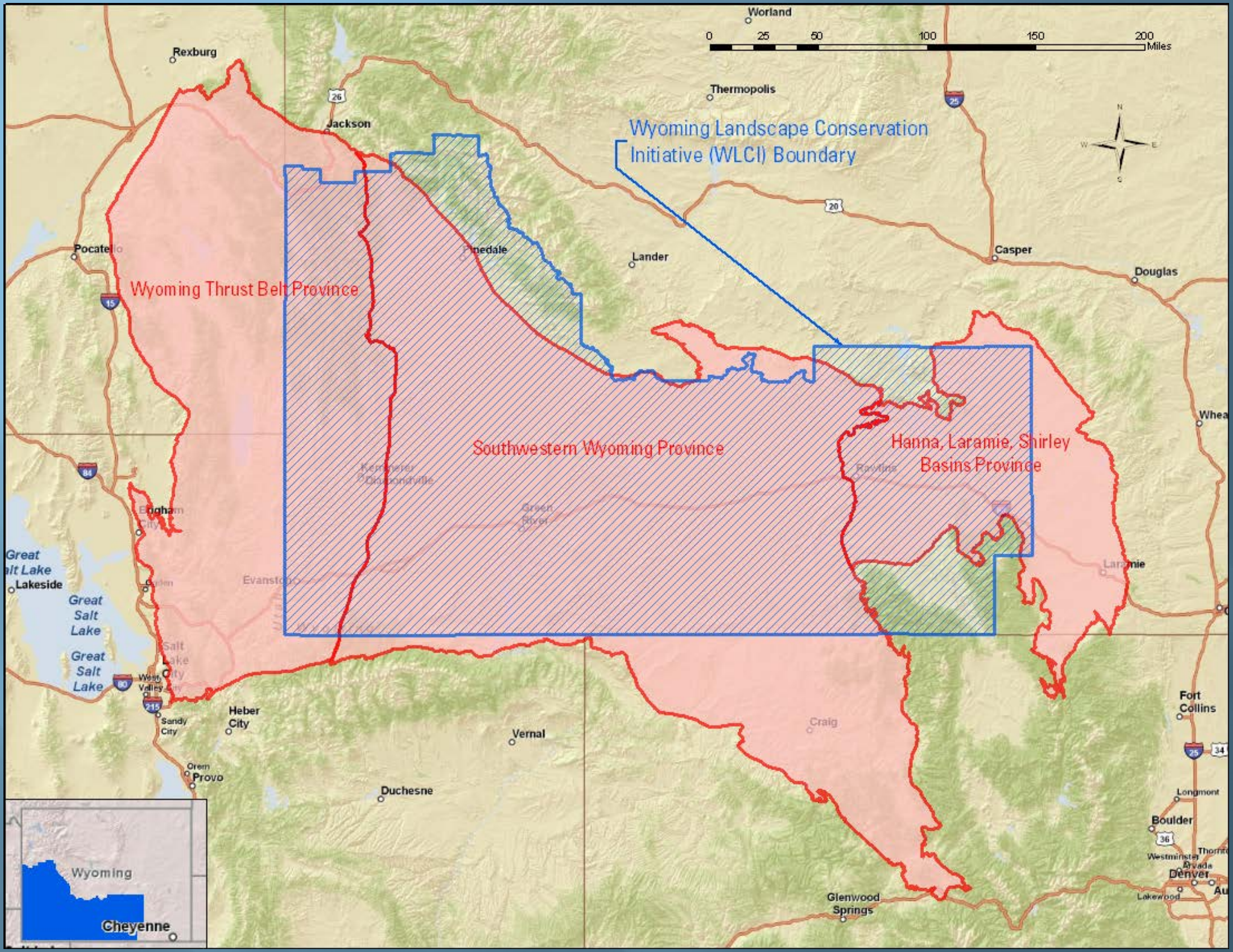
- **Open Slideshow of Historical Perspective of Drilling Activity** (Requires Microsoft Office PowerPoint)
- **Download Oil and Gas Well Data** (GIS)
- **Download Published Map File Package** (Interactive Map)
- **Data Documentation**
  Refer to the Readme and Metadata files for more information.
- **Table 1 - Logic**

For additional information contact:
Center Director, U.S. Geological Survey
Central Energy Resources Science Center
Box 25046, MS-939
Denver Federal Center
Denver, CO 80225-0046

http://energy.cr.usgs.gov/

From Biewick (2011), using data from WOGCC (2010)

USGS Oil and Gas Provinces in and Around the WLCI



The most recent USGS assessments of the potential for undiscovered oil and gas estimate combined resources of a mean of 85.8 TCF of undiscovered natural gas, a mean of 264 million barrels of undiscovered oil, and a mean of 2.7 billion barrels of undiscovered natural gas liquids, most of which are in the Southwestern Wyoming Province (Kirschbaum and others, 2002; 2004; Dyman and others, 2006).

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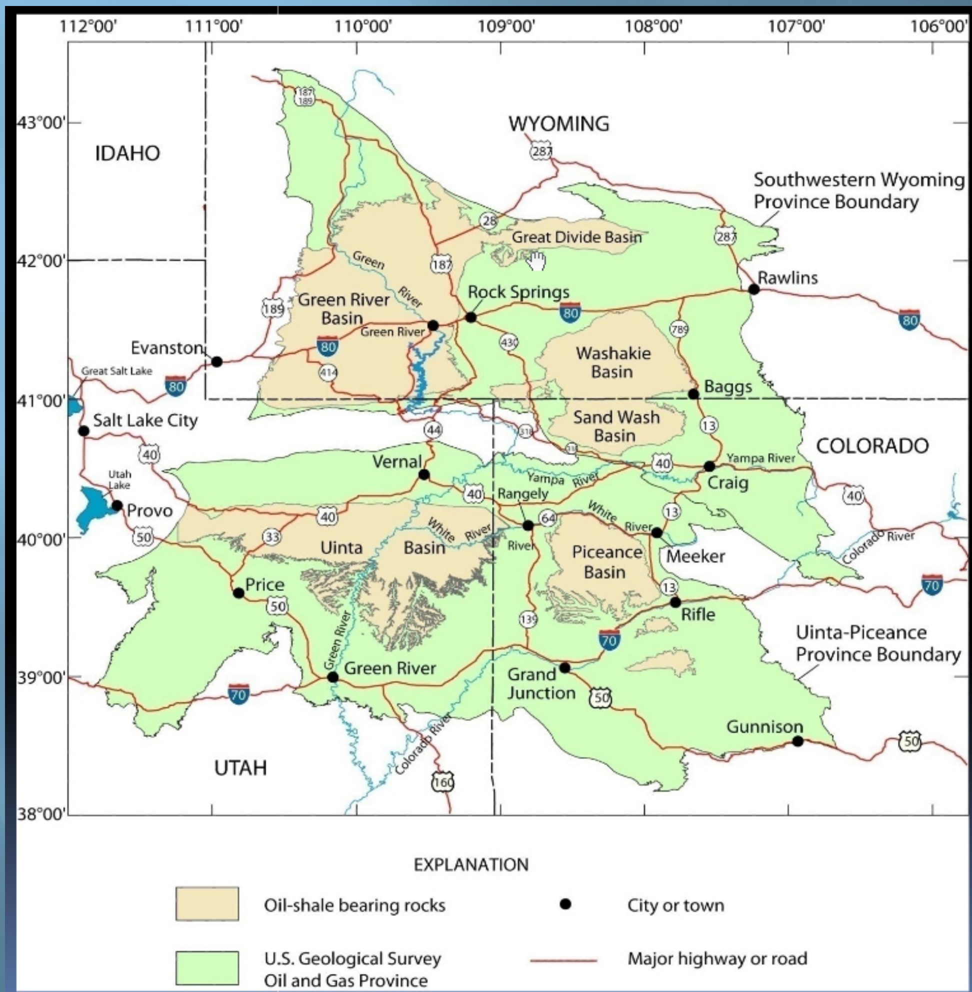
Oil Shale



The Eocene Green River Formation contains the largest known oil shale deposits in the world. Wyoming's oil shale deposits are generally lower grade and less favorable for commercial extraction than those in Utah and Colorado.

Total in-place resources are estimated at 1.44 trillion barrels of oil (Johnson and others, 2011).

There is, at present, no economic method to extract oil from the Green River Formation oil shale. A ton of oil shale may produce about one third of the energy as a ton of coal, it requires temperatures ranging from 280–400 degrees C to extract the oil from the shale, and there are additional environmental problems as well (Johnson and others, 2009).

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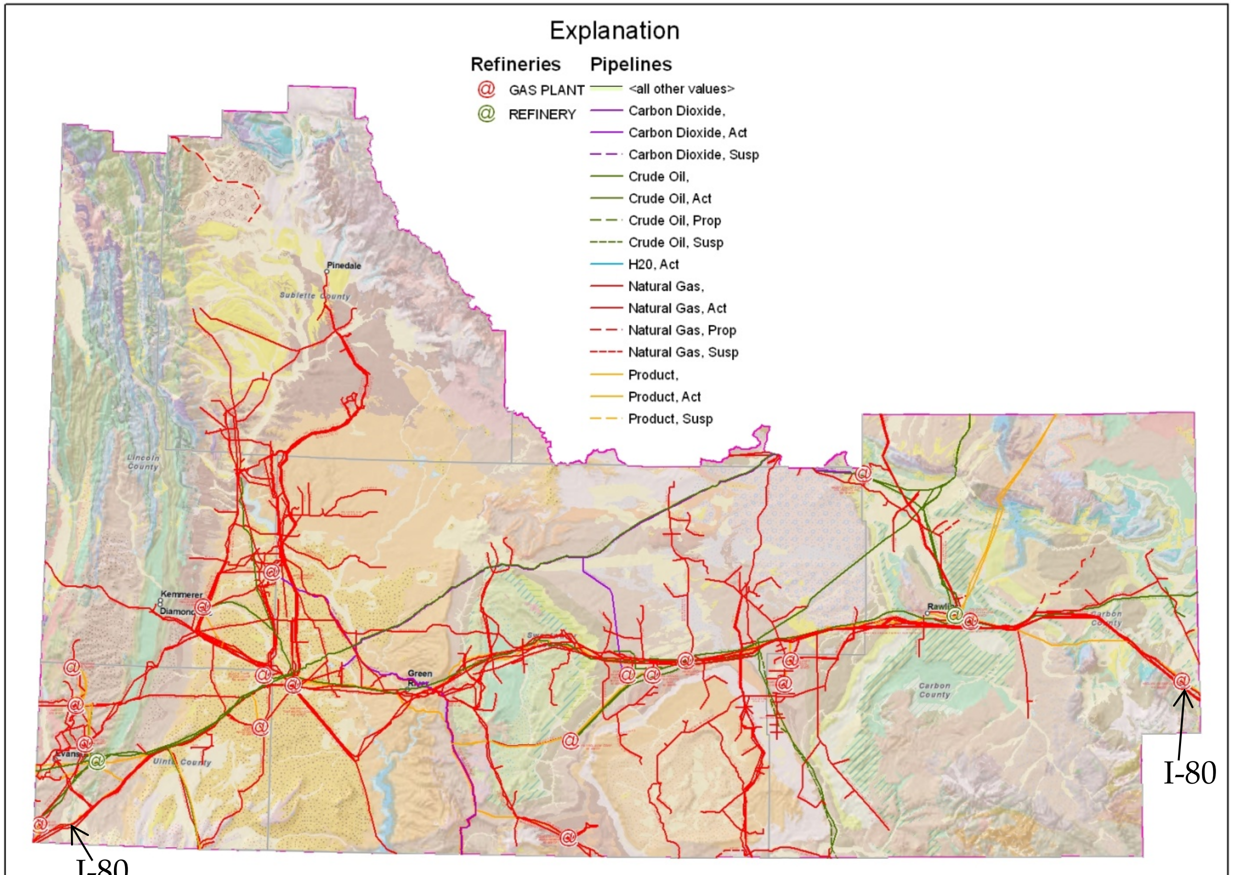
Infrastructure – Energy Corridor



Pipelines from the Wyoming State Geological Survey (WSGS) – DeBruin (2007)

The State of Wyoming is a transportation crossroads for Canadian crude oil imports and local Rocky Mountain production flowing to Midwest and Mountain markets in the United States (U.S. EIA, 2011b). A major pipeline corridor that extends across the WLCI area and is roughly parallel to U.S. Interstate 80 transports the majority of Wyoming's gas supply from large fields to the north and the south, to in-state and out-of-state markets in the Midwest and California. Mapped pipelines, oil refineries, and natural gas processing plants are from the oil and gas fields map of Wyoming (DeBruin, 2007). Oil produced in the area is processed both out of state and at the refinery in Sinclair, Wyoming (DeBruin, 2007).

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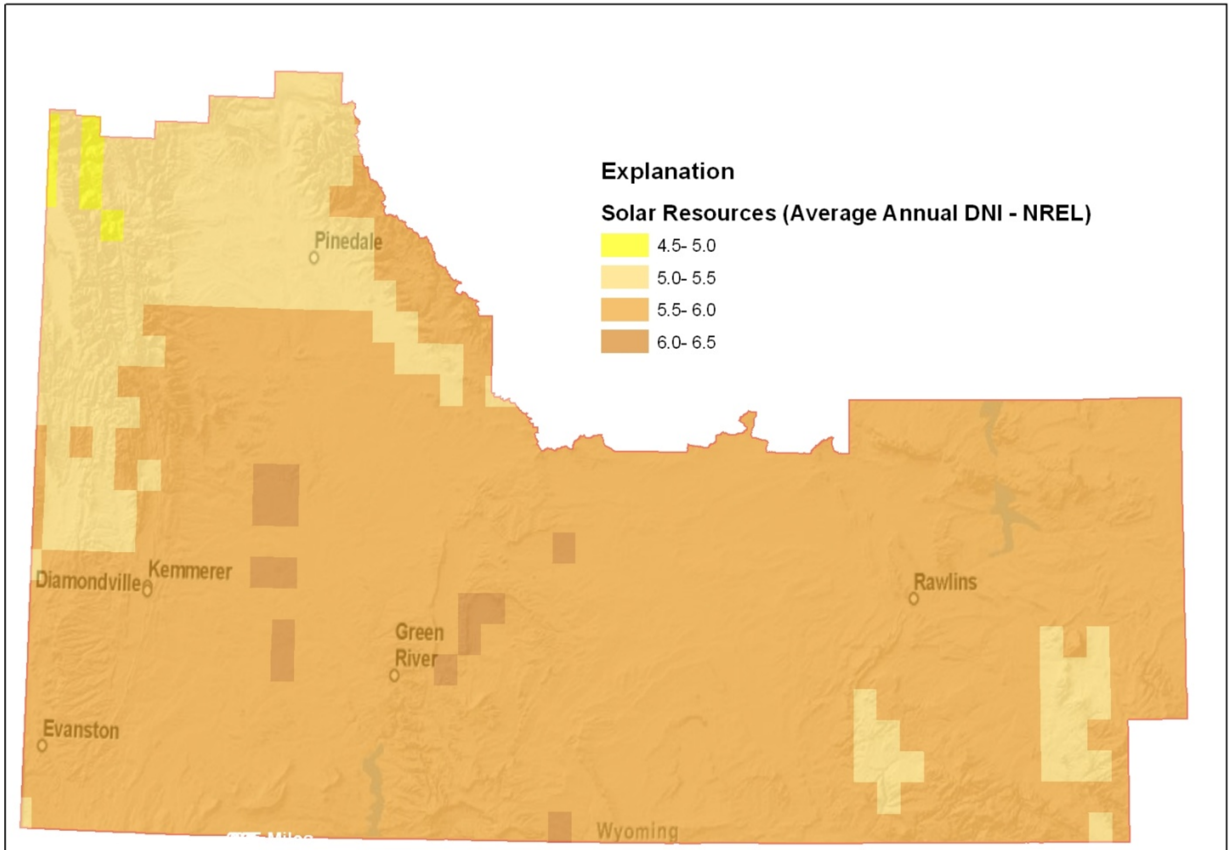
Solar



From U.S. Department of Energy, National Renewable Energy Laboratory (NREL), 2007 Direct Normal Irradiance (DNI)

Solar-resource map products provide visual presentations of the solar resource and can be used to identify areas rich in solar resources within the WLCI. The solar-data layer included in the interactive map provides monthly average and annual average daily total solar resource averaged over surface cells of 0.1 degrees in both latitude and longitude, or about 10 kilometers (km) in size (U.S. Department of Energy, National Renewable Energy Laboratory, 2010b).

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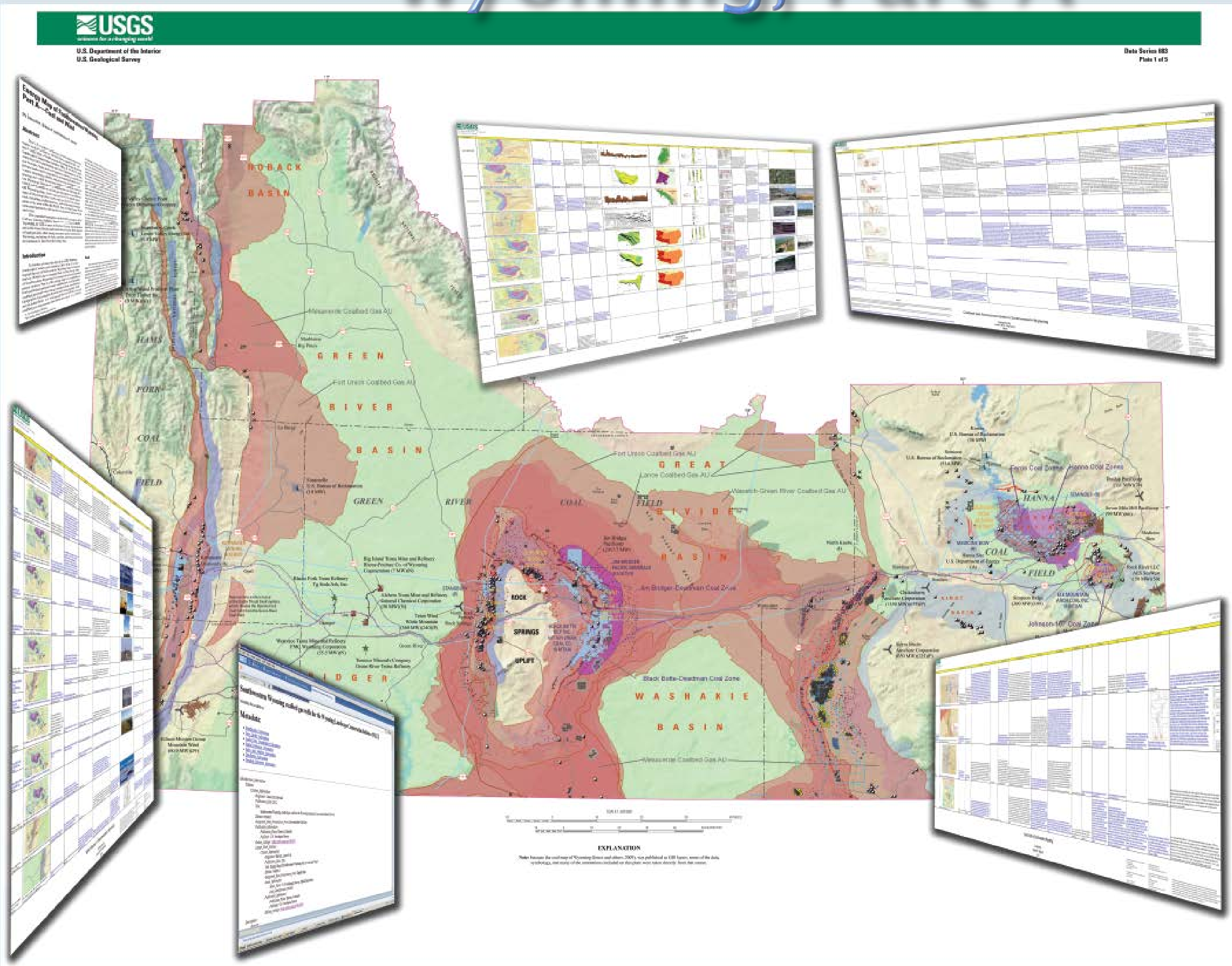
Energy Map of Southwestern Wyoming, Part A



Biewick and Jones (2012)

(USGS DS 683)

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