ENERGY RESOURCES IN UTAH

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The unique geologic history, geography, and climate of Utah have resulted in an abundance of nonrenewable and renewable energy resources. Nonrenewable energy resources include fossil fuels, such as oil, coal, and natural gas, as well as naturally occurring elements, such as uranium. Renewable energy resources are those that are replenished by natural processes and include geothermal, solar, and wind energy. Additionally, water, when passed through hydroelectric power plants, and biomass, such as animal waste and landfill gas (methane), provide alternative renewable energy resources.

FOSSIL FUEL RESOURCES

Petroleum – Petroleum, also known as crude oil, is a flammable liquid comprised of hydrocarbons and other organic compounds that are naturally occurring and found in rock formations. Petroleum is refined in order to produce fuel for heating, power generation, and motor fuel.

In 1850, Captain Howard Stansbury noted signs of oil from a seep near Rozel Point on the northern shore of Great Salt Lake. By 1904, oil was being produced from the oil seep near Rozel Point, and oil had been found near Mexican Hat in southeastern Utah and near the town of Virgin in southwestern Utah. However, large-scale, commercial development did not begin until the 1940s and 1950s when oil wells were drilled in Vernal and in the Paradox Basin. Since the early 1960s, Utah has consistently ranked high among oil-producing states (UGS, 2009a; BEBR, 2007). Presently, the major oil and gas producing area in Utah is the Uinta Basin in the northeastern part of the state. However, other areas of fossil fuel production include Carbon and Emery counties, the Paradox Basin in San Juan County, the Uncompahgre Uplift in Grand County, the Thrust Belt in Summit County, and the recently discovered Covenant Field in the Central Utah Overthrust (Figure 8.6.1).

Utah contains three of the 100 largest oil fields in the United States and five petroleum refineries. Currently, there are 355 million barrels of proven oil reserves in the state. Crude oil production in Utah has seen a substantial resurgence over the past 5 years with the discovery of the Covenant Field in central Utah and increased exploration and drilling in the Uinta Basin. Crude oil production increased to 21.3 million barrels in 2008, up 9.1 percent from 2007 and up 63 percent from 2003 (Figure 8.6.2). The value of extracted crude oil in Utah for 2007 was more than $1.2 billion (UGS, 2009a).

While Utah currently has access to enough petroleum to meet its needs, prices are increasing and supplies are diminishing. Increases in population and wealth in Utah will probably result in increased demand for petroleum products, especially motor fuel. The increases in demand for gas and other petroleum products in Utah will be competing with increased demand from other rapidly-growing areas in the United States, as well as with other nations across the globe (UGS, 2009a).

Natural Gas Production – Natural gas is comprised of methane and other gases of organic origin. It is found in coal beds, natural gas fields, and oil fields. Before natural gas can be used as fuel, it must undergo extensive processing to remove all material other than methane.

In 1891, a water well in Farmington Bay near the Great Salt Lake was being drilled. At the depth of 1,000 feet, a pocket of natural gas was discovered. Gas from this area was piped to Salt Lake City in 1895 and 1896 through wooden pipelines until shifting sand in the lakebed plugged the wells (UGS, 2009a). Presently, Utah contains two of the 100 largest natural gas fields in the United States. More than 80 percent of Utah households use natural gas for heating; however, Utah only consumes about one-half of the production in the state. Natural gas is abundant in the Rocky Mountain region and continues to provide some of the least-expensive natural gas in the nation. Currently, the rate of natural gas consumption in Utah is increasing. Electric utilities have increased the use of natural gas power plants in the past few years. Natural gas is a rapidly growing industry and is an increasingly important natural resource for the state (Newell et al., 2008).

Natural gas production in Utah has seen a substantial increase in the past few years with the significant increase in drilling in the Uinta Basin. Utah produced a record high 418 billion cubic feet of natural gas in 2008, 8.5 percent more than in 2007 and 46 percent more than in 2003 (Figure 8.6.3). Marketed production and actual natural gas sales also reached record highs at 405 and 372 billion cubic feet, respectively. Approximately 19 percent of natural gas production was from coalbed methane wells, but this is decreasing as numerous new conventional wells are being drilled in the Uinta Basin and as existing coalbed methane wells are declining in production. The value of natural gas produced in Utah for 2007 was more than $1.5 billion (UGS, 2009a).

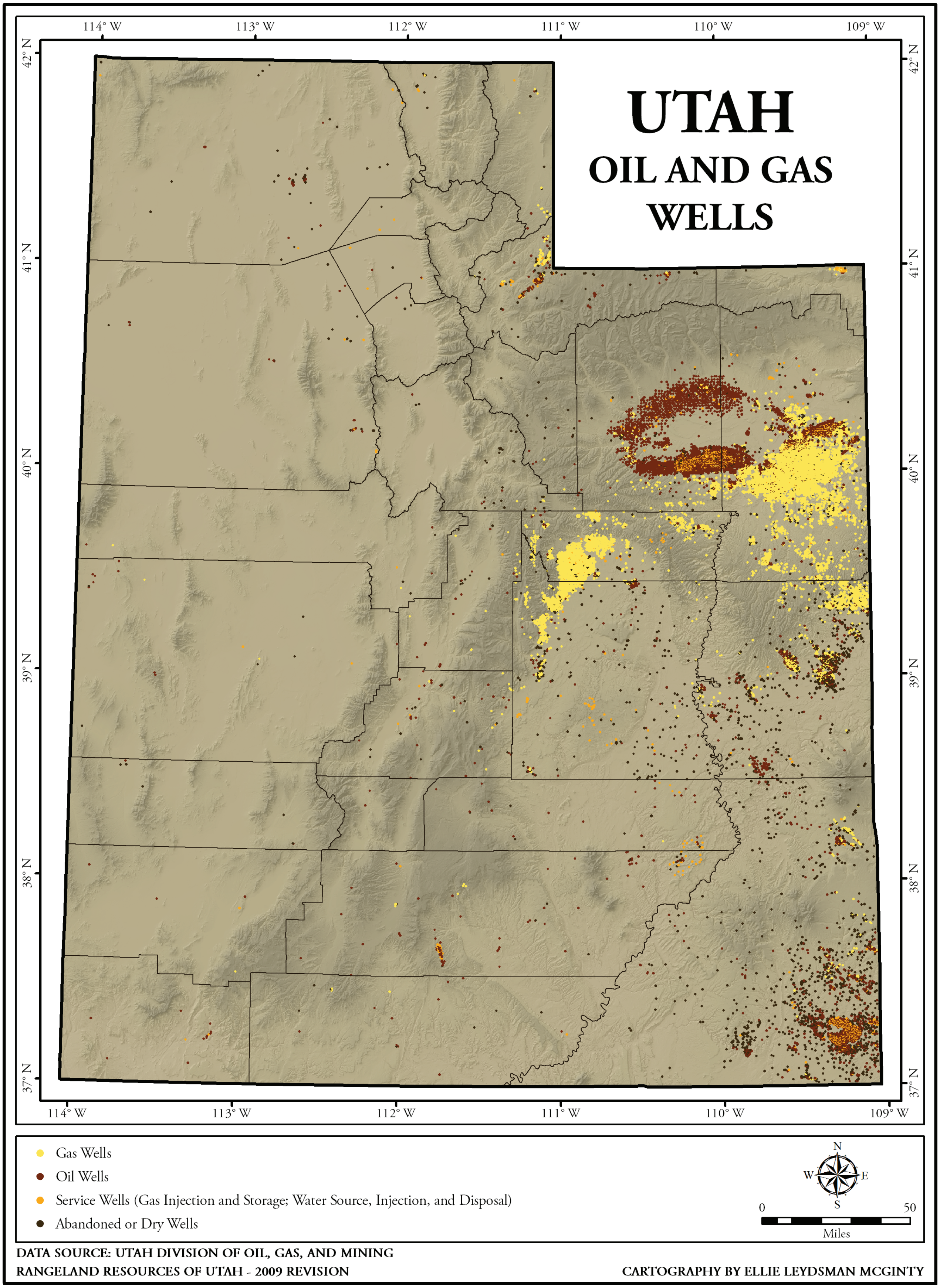

Figure 8.6.1. Oil and gas wells in Utah.

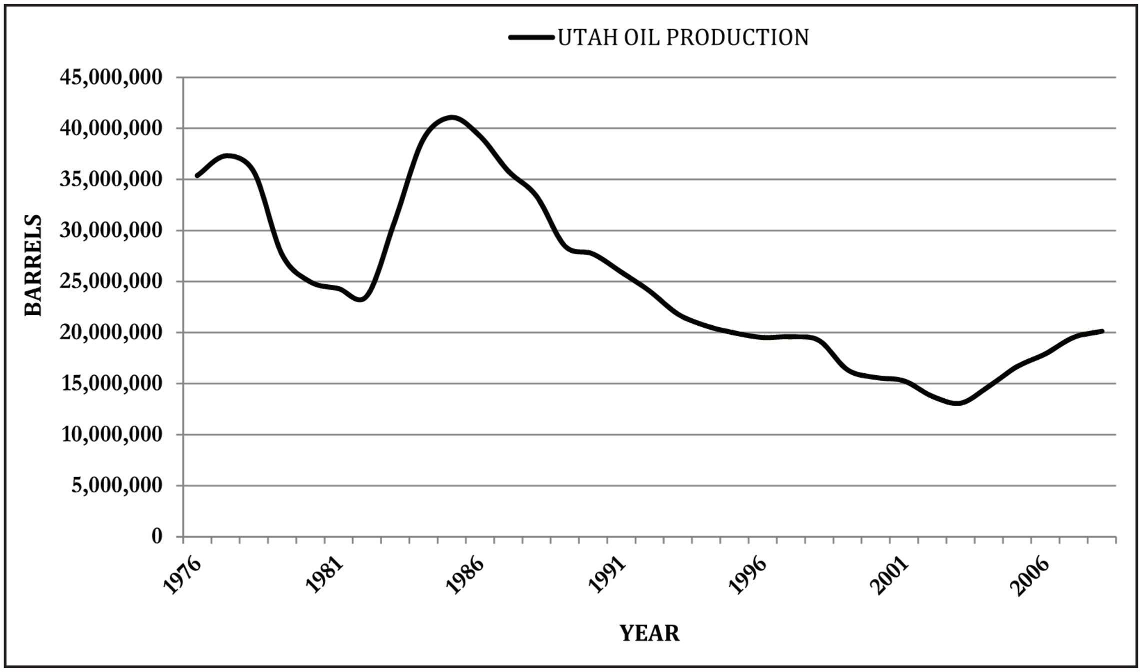

Figure 8.6.2. Oil production in Utah from 1976 to 2008.
Source: Utah Geological Survey (UGS).

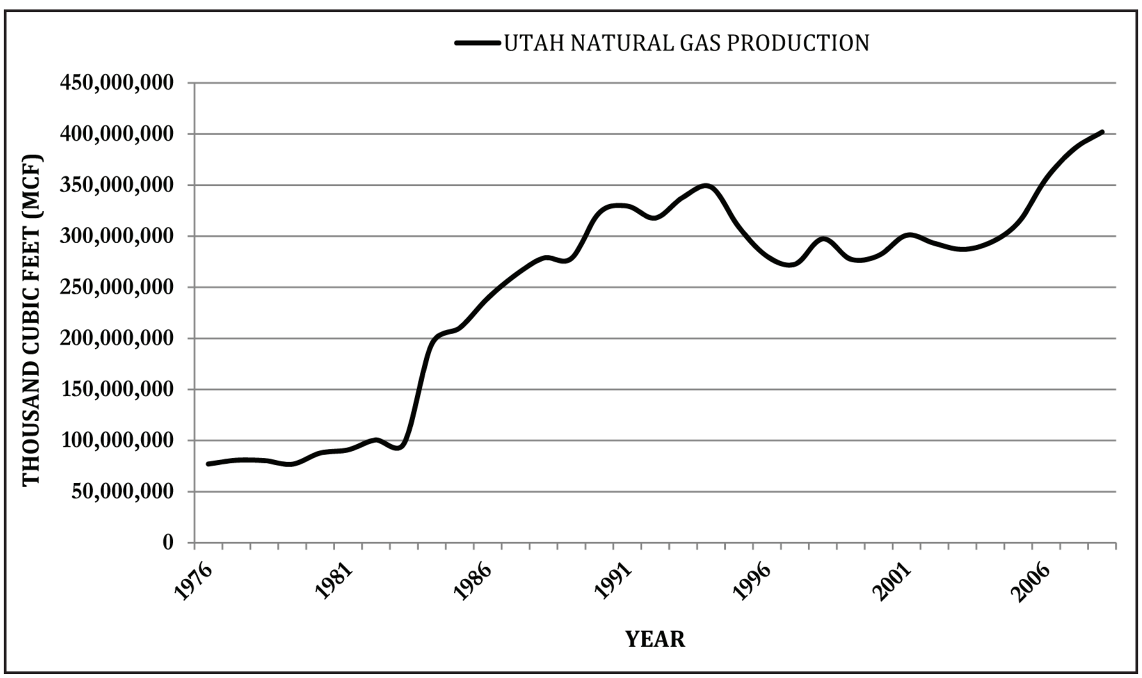

Figure 8.6.3. Natural gas production in Utah from 1976 to 2008.
Source: Utah Geological Survey (UGS).

Natural gas is more of a regional commodity than crude oil, with more dependence on local supply and demand factors. The necessity of transporting natural gas by pipeline is affected by availability of transportation infrastructure, which has a large influence on natural gas prices. Currently, there is a shortage of pipeline capacity in the Rocky Mountains, and wellhead natural gas prices in the area are depressed compared to the rest of the country (UGOPB, 2009).

Coal Production – Coal is a combustible, sedimentary rock that was formed approximately 3 million years ago. Organic remains, specifically plants, were protected by water and soil against oxidation and biodegration; therefore, carbon was trapped in the ground. Through time, the chemical and physical properties of carbon were changed by thermal and geological processes to create a solid material (UMA, 2009).

Coal prospecting and mining began in the 1850s and has been an important part of the Utah economy since the 1890s. By the 1950s, oil and natural gas largely replaced coal as the chief home-heating fuel and for industrial purposes. However, between 1970 and 1983, Utah coal production doubled as oil prices increased. Many electrical power plants were converted from oil to coal at this time (UGS, 2009a). Ninety-two percent of all coal produced is used to generate electricity, which provides approximately half of all the electricity used in the United States. In Utah, coal generates about 82 percent of all electricity; generating this electricity consumes 60 percent of the total coal produced in Utah. Utah coal is desirable because of its high-BTU (British thermal unit), low-sulfur, and low-ash content. The demand for coal is expected to rise, given population growth and increasing demand for electricity (Newell et al., 2008).

Coal production in Utah increased through the 1980s and 1990s, reaching an all-time high of 27 million short tons in 1996. Utah coal production was 24.3 million short tons in 2008 (Figure 8.6.4). Currently, all coal in Utah is mined from the Wasatch Plateau, Book Cliffs, and Emery coal fields in central Utah (Figure 8.6.5). The greatest revenue from coal was realized in 1982, at more than $1 billion (inflation adjusted). Today, approximately 64 percent of coal produced in Utah is distributed within the state, with the majority of it going to electric utilities. The average price for electricity in Utah is the fifth lowest in the nation, largely because of the abundant supply of coal (UGS, 2009a).

Oil Shale and Tar Sands – Oil shale and tar sands are two natural resources that can be converted into petroleum products. Utah contains some of the largest deposits in the world of both of these materials. It is estimated that the United States reserves of oil shale are 1.6 tril-

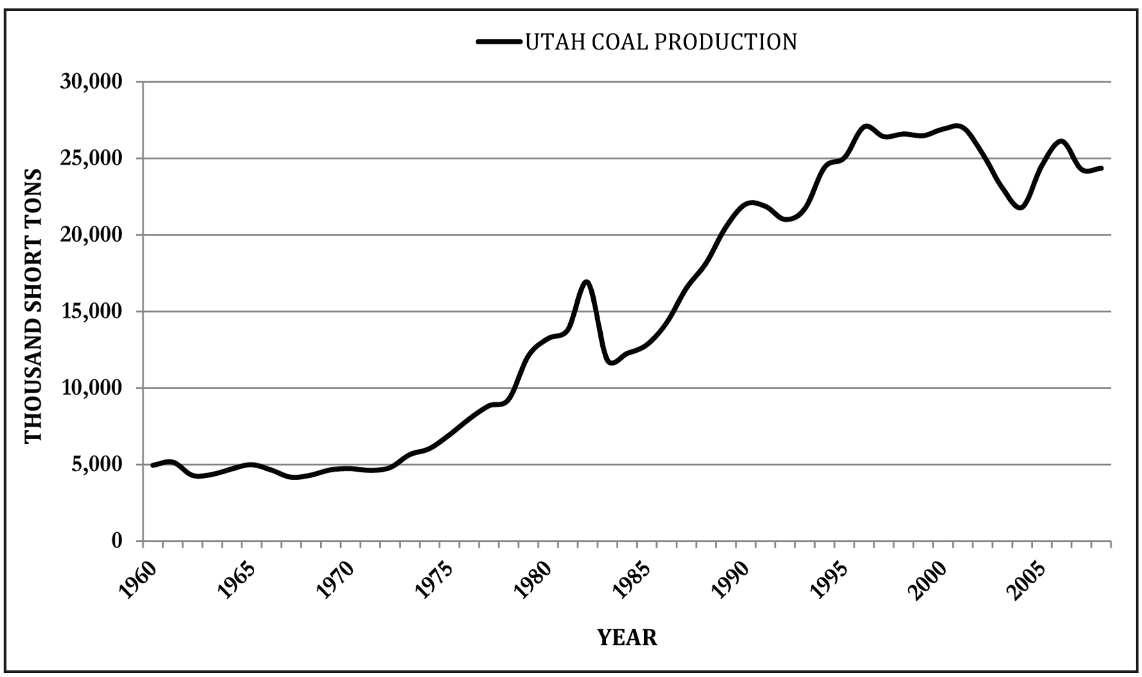

Figure 8.6.4. Coal production in Utah from 1960 to 2008.
Source: Utah Geological Survey (UGS).

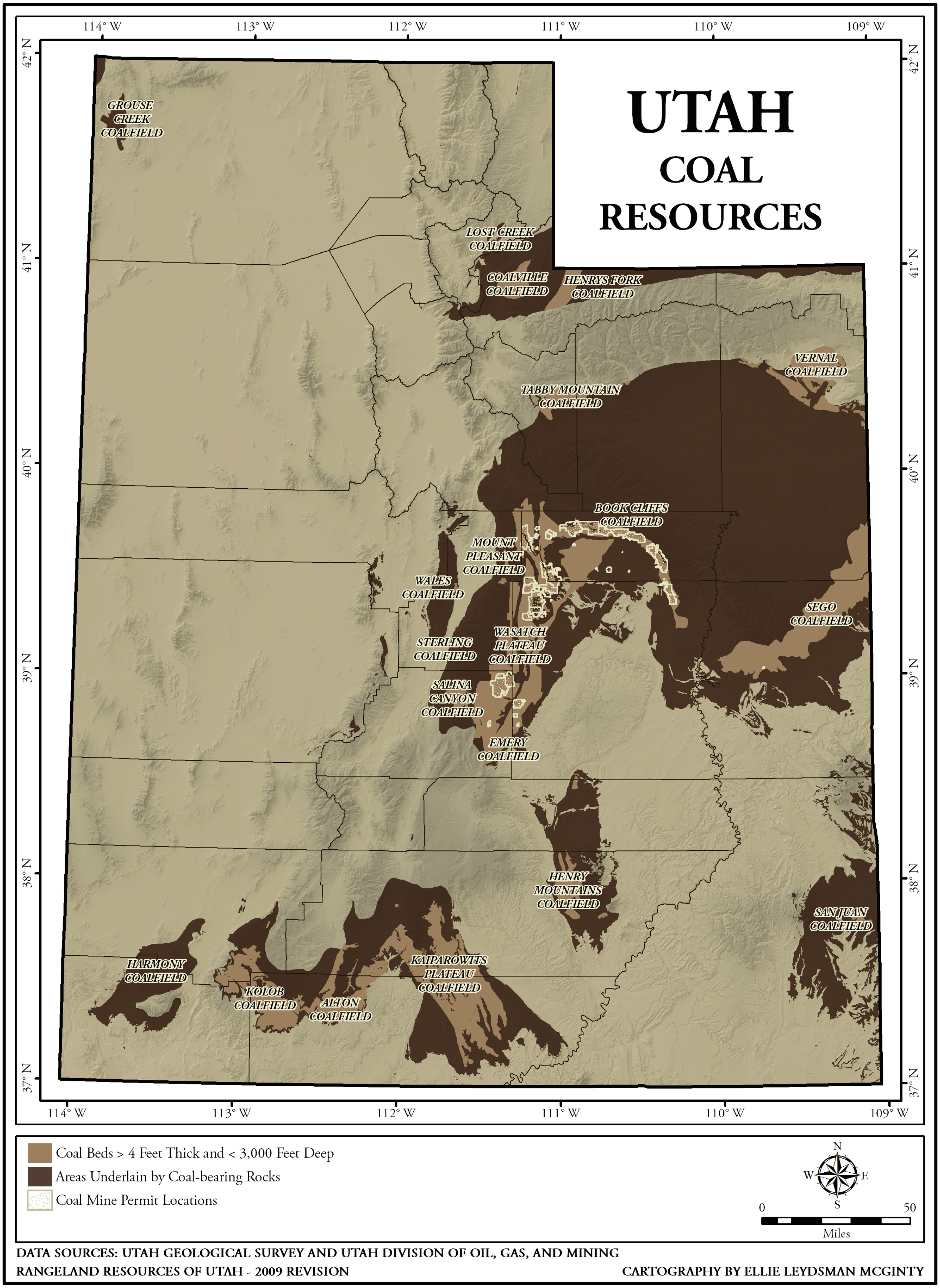

Figure 8.6.5. Coal resources and coal mine permit locations in Utah.

lion barrels, with Utah reserves at approximately 499 billion barrels (Tabet, 2006). The United States estimate for measured reserves of tar sands is 22.6 billion barrels, with 14 to 15 billion barrels of measured reserves in Utah (Gwynn, 2007). The problems facing the development of these resources include environmental damage from the extraction, production, and use of the material, as well as financial, technological, and ownership issues. These oil substitutes become more financially-viable resources as the price of traditional oil goes up (Newell et al., 2008).

The Utah Governor's Office is working with local stakeholders and policymakers, as well as the federal government, in preparing for the eventual development of oil shale and/or tar sands in Utah. Recently, the environmental assessment for a 60-acre research, development, and demonstration (RD&D) lease of the White River oil shale mine on federal lands in eastern Utah has been completed by the Bureau of Land Management. The Governor's Office is monitoring the data as it becomes available from research and development projects, and the state will work with stakeholders to formulate responsible development policies (UEO, 2009).

RENEWABLE ENERGY RESOURCES

Geothermal Power Generation – Exploitable geothermal resources come from the transport of heat to the surface through several geological and hydrological processes. Geothermal resources commonly have three components: 1) a heat source, 2) relatively high permeability reservoir rock, and 3) water to transfer the heat. Numerous high-temperature resources occur in the Basin and Range Province of the western United States as the result of deep circulation along major faults in a region of high heat flow (Figure 8.6.6). Utah has high-temperature resources that are suitable for electricity generation, as well as direct use and heat pump applications, and is one of only four states with geothermal electric power plants (UGS, 2009c).

More than 15 years ago, Phillips Petroleum and Utah Power teamed to build the Blundell Plant, the first geothermal electric plant outside of California. The hydrothermal reservoir at Blundell lies 3,000 feet below the Earth's surface and contains water at more than 500 degrees Fahrenheit and a pressure of 500 pounds per square inch. There are currently three geothermal power plants in operation in Beaver County, Utah: Blundell Units 1 and 2 and Thermo Hot Springs. Unit 1 of the Blundell Plant has a gross capacity of 25 megawatts, Unit 2 has a capacity of 11 megawatts, and Thermo Hot Springs has a net capacity of 10 megawatts. Electric power has been generated at the Cove Fort-Sulphurdale Known Geothermal Resource Area (KGRA), also in Beaver County. In 2003 and 2004, the Cove Fort-Sulphurdale units were shut down for modernization. Utah currently has five projects in various stages of development that would supply 234 megawatts of electricity (US DOE, 2008; Slack, 2008; UGS, 2009b; UGS, 2009c; Nielson et al., 2006).

Solar Power Generation – The Renewable Energy Atlas of the West (Nielsen et al., 2006) estimated the annual solar electricity generation potential in Utah to be 69 billion kWh (kilowatt-hours), based on the following assumptions: 1) rooftop and open space installed systems represent 0.5 percent of the total area of the state, 2) solar panels occupy 30 percent of the area set aside for solar equipment, and 3) the average system efficiency is 10 percent.

Different collector types use the sun in different ways. Concentrating collectors, collectors that focus the sun (like a magnifying glass), can reach high temperatures and efficiencies and only use direct rays from the sun. Flat panel collectors are mounted on rooftops or on the ground and are stationary. These collectors can use both the direct rays and reflected light. They use all available sunlight and are the best choice for many northern states. For flat-plate collectors, Utah has very good solar resources. For concentrating collectors, Utah has good resources throughout the state with the best resources falling in the southern region of the state (US DOE, 2008) (Figure 8.6.7).

Wind Power Generation – The United States Department of Energy (2008) reports that Utah has wind resources that will support utility-scale production. Large contiguous areas of high-quality wind energy resources are located in western Utah, especially near the Raft River Mountains in Box Elder County near the Idaho border, and in the area near Milford in Beaver and Millard counties. Other good wind resource areas are located on the higher ridge crests throughout the state (Figure 8.6.8). In addition, small wind turbines may have applications in some areas. As a renewable resource, wind is classified according to wind power classes, which are based on typical wind speeds. These classes range from Class 1 (the lowest) to Class 7 (the highest). In general, Class 4 or higher (greater than 15.7 miles per hour) can be useful for generating wind power with large turbines.

The Renewable Energy Atlas of the West (Nielson et al., 2006) estimated the annual wind electricity generation potential in Utah to be 23 billion kilowatt hours. The es-

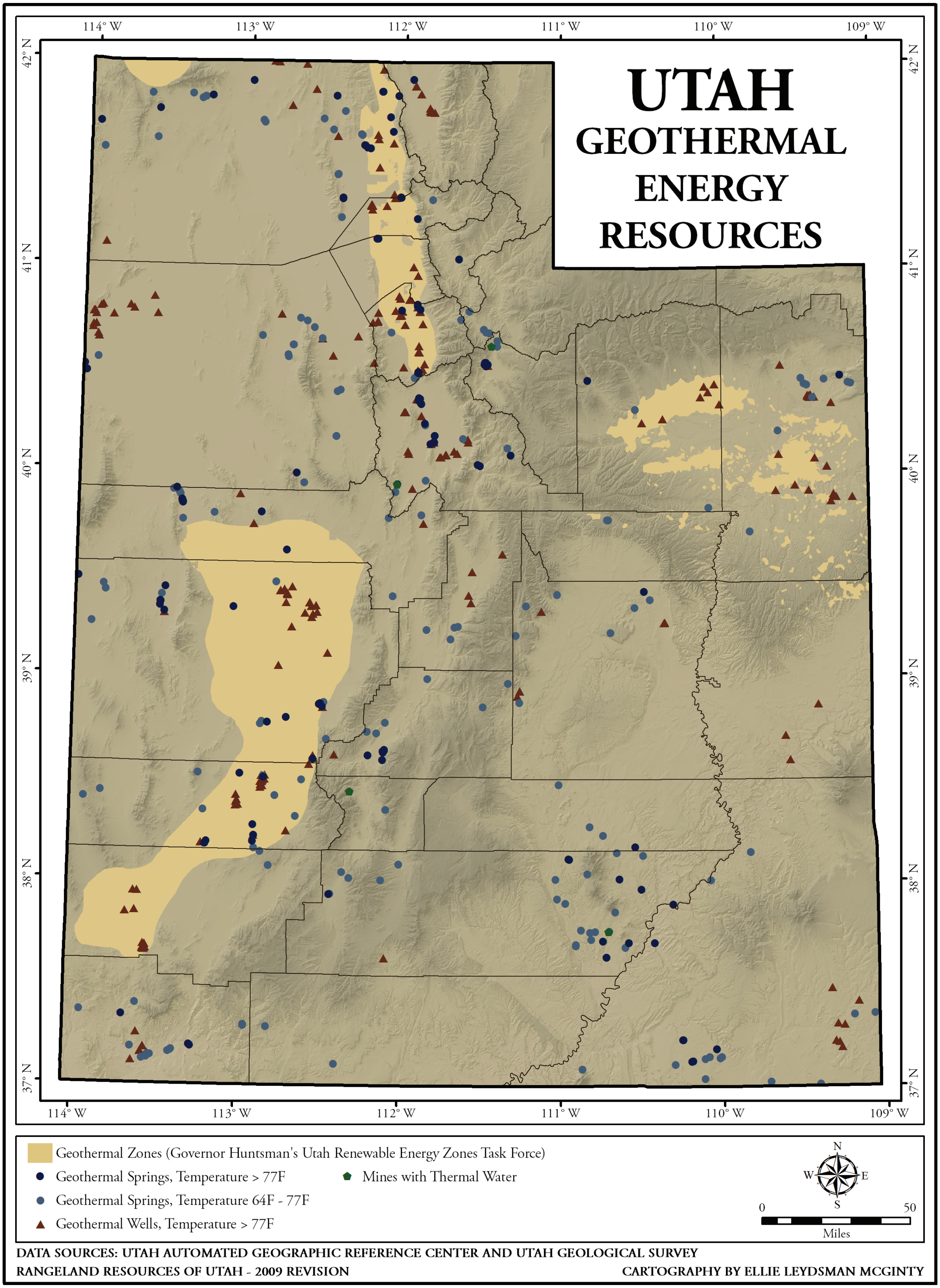

Figure 8.6.6. Geothermal zones, springs, and wells in Utah.

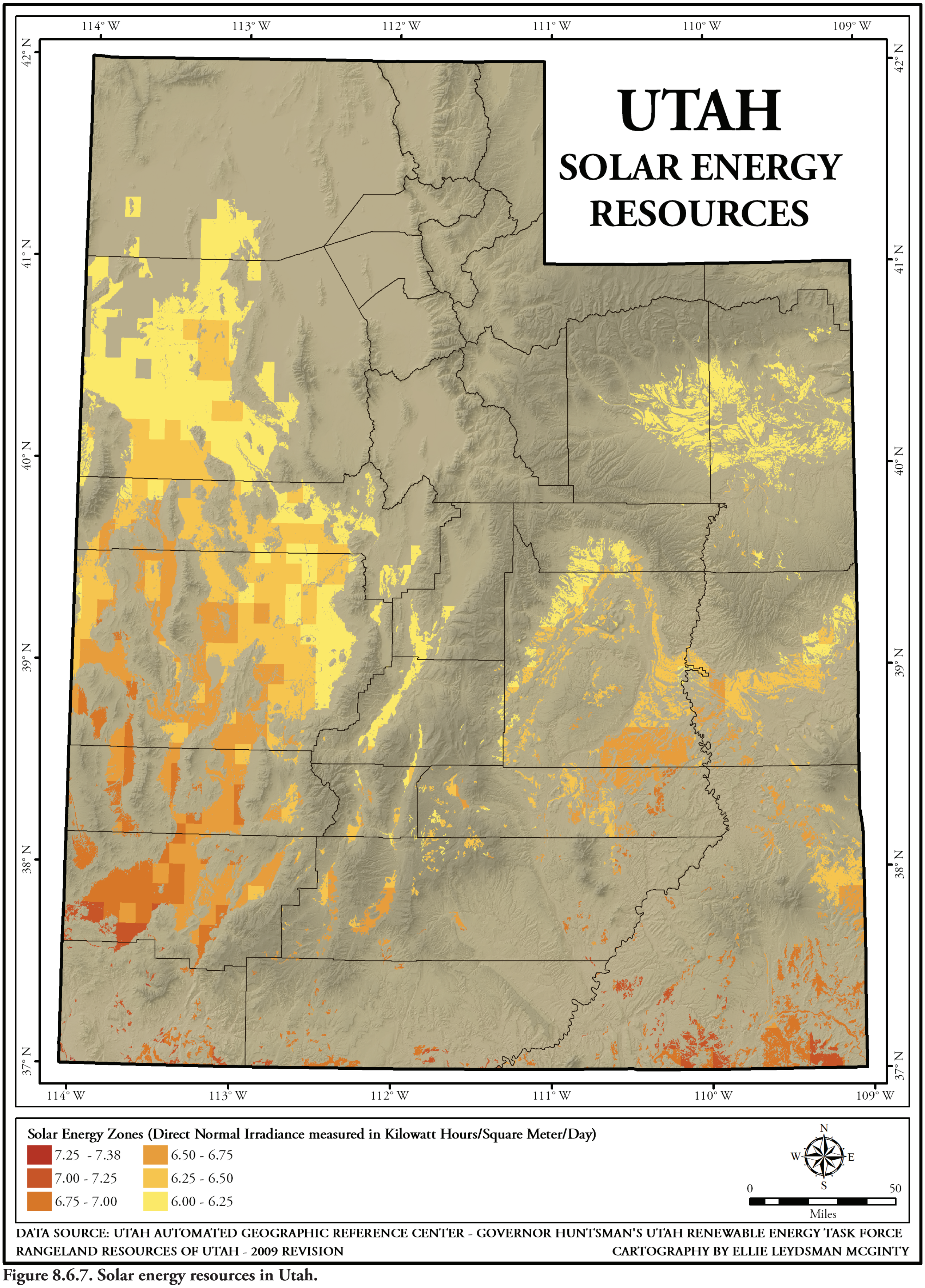

Figure 8.6.7. Solar energy resources in Utah.

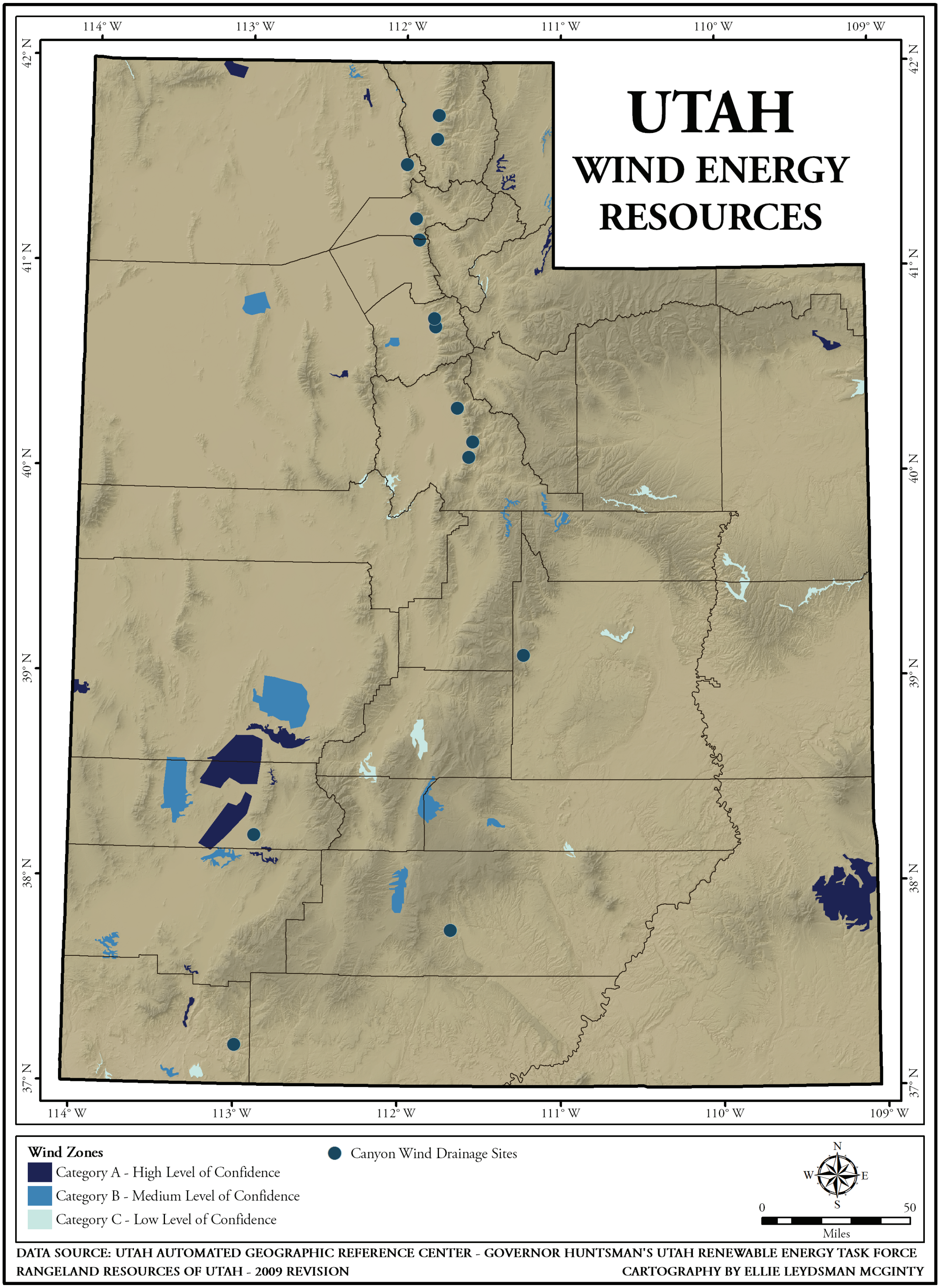

Figure 8.6.8. Wind energy resources in Utah.

timate excludes the following areas, which are assumed to be infeasible for wind development: 1) federally classified sensitive land – 100 percent excluded, 2) forest – 50 percent excluded, 3) agriculture – 30 percent excluded, 4) range – 10 percent excluded, and 5) mixed agriculture and range – 20 percent excluded. The feasibility of developing wind for electricity is contingent on a number of issues, including sufficient wind resource, transmission access, location approval, avian issues, aesthetics, and local community support (Mongha et al., 2006).

Commercial-scale wind energy is now included in the electric generation portfolio of Utah. The first commercial wind farm at the mouth of Spanish Fork Canyon began generating electricity in late 2008 (UGOPB, 2009). This farm consists of nine 2.1-megawatt turbines, providing a total capacity of 18.9 megawatts. In addition, construction is underway just north of Milford, Utah, for a 200-megawatt wind farm that will contain 97 2.1-megawatt turbines. In January 2009, the Utah School and Institutional Trust Lands Administration (SITLA) issued its first lease for the development of wind energy resources on state trust lands. The 1,560-acre lease was issued to a subsidiary of the developer of the 200-megawatt Milford Wind Project in Beaver and Millard counties. SITLA anticipates the lessee will locate approximately 11 wind turbine generators of up to 2.5 megawatts each on trust lands, depending on final engineering and turbine availability. The lessee will pay land rentals, plus additional payments based on the capacity of turbines located on state trust lands (Hebertson and McMichael, 2009).

Hydroelectric Power Generation – There are 92 hydroelectric power plants with a combined total electricity generation capacity of 276.5 megawatts in Utah. Hydroelectric power plants capture the kinetic energy of water to generate electricity. A turbine and a generator convert the kinetic energy to electrical energy. These hydroelectric plants vary by ownership (municipal, commercial, cooperative, and federal) and size and are located on various streams and rivers around the state (UGS, 2009d).

Biomass Power Generation – The Renewable Energy Atlas of the West (Nielsen et al., 2006) estimated the electricity-generating potential from landfill gas and animal waste to be 1 million megawatt hours per year. Currently, there are five power plants in Salt Lake and Davis counties utilizing municipal waste or landfill gas as the power source for generating electricity. The combined capacity of these five plants is 4.4 megawatts (UGS, 2009e).

NUCLEAR ENERGY RESOURCES

Nuclear power is a source of energy derived from the fission (splitting) of atoms. It accounts for approximately 19 percent of total electricity generated in the United States. Utah neither generates nor imports power from nuclear power plants. By-products of nuclear energy are cleaner than those produced by burning fossil fuels for power (near-zero emissions of carbon dioxide, sulfur oxides, nitrogen oxides, and ash), but it does produce solid waste by-products that must be stored. While these waste products are small compared to the electricity produced, they require specific safety measures. There has been discussion of building a plant in Utah. An operator is expected to submit an application to the United States Nuclear Regulatory Commission in 2010 for a new nuclear power plant. The estimated construction costs of building such a plant in Utah are as high as $2 to 3 billion (Newell et al., 2008).

More than 300,000 pounds of U_3O_8 (uranium/yellow cake), valued at approximately $26 million, were produced from three Utah mines in 2008. The first year that uranium production values have been reported since 1997 was in 2008. The reactivation of the uranium mines is largely the result of a three-fold increase in yellow cake prices that peaked in 2007. Spot uranium prices declined by about 50 percent in 2008, resulting in one mine closure. This price drop may delay or preclude the planned opening of several mines and the reopening of the Ticaboo Uranium Mill (UGOPB, 2009; Bon and Krahulec, 2008).

ISSUES AFFECTING THE UTAH MINING INDUSTRY

Significant short-term issues expected to impact the mineral industry in Utah include the availability of capital to fund exploration and development of new mineral resources, conflicts in commodity leasing (for example, oil and gas versus potash), permitting delays, and the decreased incentive to explore for metal and mineral commodities in a declining price environment. Long-term issues include the change in rural Utah from a resource-based to a tourism-based economy that will continue to have a significant long-range impact on the availability of lands open for exploration, and the willingness of the public to accept mineral development in areas they consider environmentally sensitive (UGOPB, 2009).