



E understanding **ENERGY** in **MONTANA** **2018**

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Introduction

Montana energy issues continue on a dynamic course of change, garnering significant public scrutiny in the state. In the more than 20 years since the decision to deregulate Montana's electricity supply, consumers have witnessed the bankruptcy and reemergence of NorthWestern Energy (NWE), the Baaken Shale boom, growth in renewable energy resources, a changing coal industry, changing electric generation portfolios, and heightened discussion of climate change's effect on the environment. The Environmental Quality Council first prepared this guide in 2002. It was revised in 2004, 2010, and 2014. The Energy and Telecommunications Interim Committee (ETIC) in 2017 agreed to again revise the guide to provide the most up-to-date background information available to the policymakers and citizens of Montana. The 2017-2018 guide includes a restructured electricity section to better reflect the current nature of electricity generation in the state. Special thanks should be extended to the DEQ, particularly Jeff Blend, Dan Lloyd, and the section authors listed at the front of this guide. Their work in preparing information and compiling statistics was integral to the publishing of this document.

The guide focuses on recent and historical trends in energy supply and demand. It is divided into five sections. The first is an overview of electricity supply and demand in Montana. The section is further divided into chapters concerning each of the generating resources in the state. The second section details the electric transmission grid, how it works and the future of transmission capacity in the state. A third section addresses natural gas supply and demand. The fourth section covers the coal industry in Montana, detailing the mining history of the state and the future of coal in Montana. The final section of the book addresses the state's petroleum production and refining industry in the state.

The revised guide provides readers both historical and current perspective on the energy sector in Montana. Emerging resources like distributed generation and energy efficiency programs are discussed along with conventional generation in an effort to provide a holistic look at the changing industry.

Comments on the Data

Data for this guide comes from several sources, which don't always agree. This is due to slightly different data definitions and methods of data collection. The reader should always consider the source and context of specific data.

Glossary

General

British Thermal Unit (Btu): A standard unit of energy equal to the quantity of heat required to raise the temperature of 1 pound of water by 1 degree Fahrenheit (f).

Cogeneration or Cogenerators: A process that sequentially produces useful energy (thermal or mechanical) and electricity from the same energy sources.

Customer Class: A group of customers with similar characteristics (e.g., residential, commercial, industrial, sales for resale) identified for the purpose of setting a utility rate structure.

Demand-Side Management: Utility activities designed to reduce customer use of natural gas or electricity or change the time pattern of use in ways that will produce desired changes in the utility load.

Commercial Sector: Energy consumed by service-providing facilities and business equipment. It includes federal, state, and local governments; other private and public organizations, such as religious, social, or fraternal groups; and institutional living quarters.

Industrial Sector: Energy consumed by facilities and equipment used for producing, processing, or assembling goods. It encompasses manufacturing, agriculture, forestry, fishing and hunting, mining, including oil and gas extraction, and construction.

Residential Sector: Energy consumed by private household establishments primarily for space heating, water heating, air conditioning, cooking, lighting, and clothes drying.

Transportation Sector: Energy consumed to move people and commodities in the public and private sectors, including military, railroad, vessel bunkering, and marine uses, as well as the pipeline transmission of natural gas.

Fossil Fuel: Any naturally occurring fuel of an organic nature, such as coal, crude oil, and natural gas. Fuel: Any substance that, for the purpose of producing energy, can be burned, otherwise chemically combined, or split or fused in a nuclear reaction.

Renewable Energy: Energy obtained from sources that are essentially sustainable (unlike, for example, the fossil fuels, of which there is a finite

supply). Sources of renewable energy include wood, waste, solar radiation, falling water, wind, and geothermal heat.

Short Ton: A unit of weight equal to 2,000 pounds. All tonnages used in this guide are in short tons.

Electricity Supply and Demand

Average Megawatt (aMW): A unit of energy output over a specified time period. For a year, it is equivalent to the total energy in megawatt-hours divided by 8,760 (the number of hours in a year).

Capacity: The amount of electric power that a generator, turbine, transformer, transmission circuit, station, or system is capable of producing or delivering.

Demand: The rate at which electric energy is delivered to a system, part of a system, or piece of equipment at a given instant or during a designated period of time (see Load). vii

Generation (Electric): The production of electric energy from other forms of energy; also, the amount of electric energy produced, expressed in kilowatt-hours.

Gross Generation: The total amount of electric energy produced by the generating units in a generating station or stations, measured at the generator terminals.

Net Electric Generation: Gross generation less the electric energy consumed at the generating station for station use. (Energy required for pumping at pumped-storage plants is regarded as plant use and is subtracted from the gross generation and from hydroelectric generation.)

Hydroelectric Power Station: A plant in which the turbine generators are driven by falling water.

Kilowatt (kW): One thousand watts. The kW is the basic unit of measurement of electric power.

Kilowatt-hour (kWh): One thousand watt-hours. The kWh is the basic unit of measurement of electric energy and is equivalent to 3,412 Btu.

Load (Electric): The amount of electric power required by equipment in use at a given time at any specific point or points on a system.

Megawatt (MW): One million watts.

Megawatt-hour (MWh): One million watt-hours.

Nameplate Capacity: The full-load continuous rating of a generator, prime mover, or other electrical equipment under specified conditions as designated by the manufacturer. Installed station capacity does not include auxiliary or house units. Nameplate capacity is usually shown on the manufacturer's identification plate

attached mechanically to the equipment. Because manufacturers have differing standards, there may be no fixed relationship between nameplate capacity and maximum sustainable capacity.

PURPA: Public Utility Regulatory Policies Act of 1978—the first federal legislation requiring utilities to buy power from qualifying independent power producers.

Qualifying Facilities: Small power producers or cogenerators that meet the Federal Energy Regulatory Commission's or the Montana Public Service Commission's size, fuel source, and operational criteria as authorized by PURPA.

Watt: The electrical unit of power or rate of doing work. A watt is the rate of energy transfer equivalent to 1 ampere flowing under pressure of 1 volt at unity power factor (volt and ampere in phase). It is analogous to horsepower or foot-pound-per-minute of mechanical power. One horsepower is equivalent to approximately 746 watts.

Montana's Electric Transmission and Distribution Grid

ATC: (Available Transmission Capacity) is calculated by subtracting committed uses and existing contracts from rated total transfer capacity. Contract Path: A path across portions of the interconnected grid, owned by different owners, for which a

transaction has gained contractual permission from the owners or other rights holders with transferable rights.

Distribution: The process of using relatively small, low-voltage wires for delivering power from the transmission system to local electric substations and to electric consumers. ERCOT: The Electric Reliability Council of Texas, a separate synchronous grid connected by AC/DC/AC converter stations to the Western Interconnection and the Eastern Interconnection.

FERC: Federal Energy Regulatory Commission (formerly the Federal Power Commission). The federal agency that regulates interstate and wholesale power transactions, including power sales and transmission services, as well as licensing of dams on rivers under federal jurisdiction.

High voltage: Voltage levels generally at or above 69 kilovolts (kV). Transmission lines in Montana are built at voltage levels of 100 kV, 115 kV, 161 kV, 230 kV, and 500 kV. In other states lines have also been built at 345 kV and 765 kV. Canadian utilities build at still other voltage levels. Direct current transmission lines have been built at +/-400 kV, which may sometimes be described as 800 kV.

Inadvertent Flows: Portions of power transactions that flow over portions

of the interconnected grid that are not on the contract path for the transaction.

Reliability: The characteristic of a transmission system (or other complex system) of being able to provide full, uninterrupted service despite the failure of one or more component parts.

Synchronous: Operating at the same frequency and on the same instantaneous power cycle. The Western Interconnection is a synchronous grid, which means all generators in the Western Grid are producing power in phase with each other. Other synchronous grids in North America include ERCOT, Quebec, and the Eastern Interconnection (the entire continental U.S. except for ERCOT and the Western Interconnection). Total

Transfer Capacity: The rated ability of a transmission line or group of related transmission lines to carry power while meeting the regionally accepted reliability criteria.

Transmission: The process of using high-voltage electric wires for bulk movement of large volumes of power across relatively long distances.

West of Hatwai Path: A transmission path consisting of ten related transmission lines that are generally located in the area west and south of Spokane, WA. The West of Hatwai

path is a bottleneck for power flowing from Montana to the West Coast and California, and it is relatively heavily used.

Western Interconnection: The interconnected, synchronous transmission grid extending from British Columbia and Alberta in the North to the U.S.-Mexican border in the South and from the Pacific Coast to a line extending from the Alberta-Manitoba border through eastern Montana, eastern Wyoming, western Nebraska, and the extreme western part of Texas.

Coal Production

Coal: A black or brownish-black solid combustible substance formed by the partial decomposition of vegetable matter without free access to air and under the influence of moisture and, often, increased pressure and temperature. The coal rank (anthracite, bituminous, subbituminous, and lignite) is determined by its heating value.

Anthracite: Hard and jet black with a high luster; it is the highest coal rank and is mined in northeastern Pennsylvania. Anthracite contains approximately 22 to 28 million Btu per ton as received.

Bituminous: The most common coal; it is soft, dense, and black with well-defined bands of bright and dull material. Bituminous is ranked between anthracite and

subbituminous and is mined chiefly in Kentucky, Pennsylvania, and West Virginia. The heating value ranges from 19 to 30 million Btu per ton as received.

Lignite: A brownish-black coal of the lowest rank; it is mined in North Dakota, Montana, and Texas. The heat content of lignite ranges from 9 to 17 million Btu per ton as received.

Subbituminous: A dull black coal ranking between lignite and bituminous. It is mined chiefly in Montana and Wyoming. The heat content of subbituminous coal ranges from 16 to 24 million Btu per ton as received.

Coal Rank: A classification of coal based on fixed carbon, volatile matter, and heating value. F.O.B. Mine Price: The "free on board" mine price. This is the price paid for coal measured in dollars per short ton at the mining operation site and, therefore, does not include freight/shipping and insurance costs.

Surface Mine: A mine producing coal that is usually within a few hundred feet of the earth's surface. Overburden (earth above or around the coal) is removed to expose the coal bed. The bed is then mined using surface excavation equipment such as draglines, power shovels, bulldozers, loaders, and augers.

Underground Mine: A mine tunneling into the earth to the coal bed. Underground mines are classified

according to the type of opening used to reach the coal i.e., drift (level tunnel), slope (inclined tunnel), or shaft (vertical tunnel).

Natural Gas

Bcf: One billion cubic feet.

Tcf: One trillion cubic feet.

Dekatherm (dkt): One million Btu of natural gas. One dekatherm of gas is roughly equivalent in volume to 1 Mcf.

Gas Well: A well that is completed for the production of gas from either nonassociated gas reservoirs or associated gas and oil reservoirs. Lease

Condensate: A natural gas liquid recovered from gas well gas (associated and nonassociated) in lease separators or natural gas field facilities. Lease condensate consists primarily of pentanes and heavier hydrocarbons. Liquefied Petroleum

Gases (LPG): Propane, propylene, butanes, butylene, butane propane mixtures, ethane-propane mixtures, and isobutane produced at refineries or natural gas processing plants, including plants that fractionate raw natural gas plant liquids. Marketed Production: Gross withdrawals less gas used for repressuring, quantities vented and flared, and nonhydrocarbon gases removed in treating or processing operations.

Mcf: One thousand cubic feet. One Mcf of natural gas is roughly equivalent in heat content to one dekatherm.

MMcf: One million cubic feet.

Natural Gas: A mixture of hydrocarbon compounds and small quantities of various nonhydrocarbons existing in the gaseous phase or in solution with crude oil in natural underground reservoirs at reservoir conditions. The principal hydrocarbons usually contained in the mixture are methane, ethane, propane, butane, and pentanes. Typical nonhydrocarbon gases that may be present in reservoir natural gas are carbon dioxide, helium, hydrogen sulfide, and nitrogen. Under reservoir conditions, natural gas and the liquefiable portions occur either in a single gaseous phase in the reservoir or in solution with crude oil and are not distinguishable at the time as separate substances.

Petroleum

Barrel: A volumetric unit of measure for crude oil and petroleum products equivalent to 42 U.S. gallons.

Crude Oil (Including Lease Condensate): A mixture of hydrocarbons that exists in liquid phase in underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities. Included are lease condensate and

liquid hydrocarbons produced from tar sands and oil shale.

Petroleum: A generic term applied to oil and oil products in all forms, such as crude oil, lease condensate, unfinished oil, refined petroleum products, natural gas plant liquids, and nonhydrocarbon compounds blended into finished petroleum products.

Petroleum Products: Petroleum products are obtained from the processing of crude oil (including lease condensate), natural gas, and other hydrocarbon compounds. Petroleum products include unfinished oils, natural gasoline and isopentane, plant condensate, unfractionated stream, liquefied petroleum gases, aviation gasoline, motor gasoline, naphtha-type jet fuel, kerosene, distillate fuel oil, residual fuel oil, naphtha less than 400 degrees F end-point, other oils over 400 degrees F end-point, special naphthas, lubricants, waxes, petroleum coke, asphalt, road oil, still gas, and miscellaneous products.

Executive Summaries

Summary Points:

These points summarize by topic the *Understanding Energy in Montana* guide. They cover each of the chapters concerning electricity supply and demand, transmission and distribution, coal production, natural gas, and petroleum products. Readers should consult the guide itself for detailed information, technical explanations, and more data about the topics in these summaries.

Summary Points:

Electricity Supply and Demand in Montana

- As of 2017, Montana generating plants have the capacity to produce about 6,200 MW of electricity. This number is constantly changing as new plants are added every year and older ones are occasionally shut down.
- Montana generators produced 3,325 aMW from 2011 to 2015. Montana usage accounts for about half of total in-state production, or about 1,600 aMW. In 2015, Montana consumed an estimated 1,600 aMW and produced 3,322 aMW. The other half of Montana electricity production is exported west to Washington and Oregon via the Colstrip transmission lines.
- Montana's largest generating facility includes the four privately owned coal-fired generating units at Colstrip. The combined capacity of the units totals 2,094 MW or about 30 percent of Montana's total current generation capacity.
- The largest hydroelectric plant in Montana is Avista's Noxon Rapids Dam, recently upgraded to 562 MW in capacity. The largest wind facilities are the 189 MW Rimrock and 210 MW Glacier Wind projects, both owned by Naturener.
- Montana generation is powered primarily by coal (55 percent of total for 2015) and hydropower (34 percent of total from 2015), a small amount of natural gas (2 percent of total generation in 2015), and increasing amounts of wind (7 percent of total generation in 2015).
- Montana electric consumers are served by 31 distribution utilities: 2 investor-owned utilities, 25 rural electric cooperatives, 3 federal agencies, and 1 municipality. Two additional investor-owned utilities and four cooperatives based in other states serve a small number of Montana consumers. In 2015, investor-owned utilities were responsible for 48 percent of the electricity sales in Montana, cooperatives 29 percent, federal agencies 3 percent, and power marketers 19 percent.
- Electricity in Montana costs less than the national average. In 2015, the Montana electricity price averaged 8.90 cents/kWh compared to 10.41 cents/kWh nationally. In 1997 before electricity deregulation, Montana's average price of 5.2 cents/kWh was 1.7 cents below the national average of 6.85 cents/ kWh.

Summary Points:

Utility Deregulation in Montana

- In January 1997, the Montana Power Company and a number of Montana's large energy customers brought forward a legislative proposal (Senate Bill No. 390) to deregulate retail electricity supply in Montana. Montana's electricity laws and policies have received significant public attention and scrutiny since that time, when Montana decided to deregulate electricity supply and opted to allow some Montana consumers to choose, given a competitive market, their own electricity supplier.
- The fundamental premise of Montana's restructuring law was that competition would provide greater benefits to consumers than they would otherwise have received under a historically regulated environment. One of the driving forces behind restructuring was a 1996 decision by the Federal Energy Regulatory Commission to deregulate electricity supply markets at the wholesale level.
- In January 1997, the Montana Power Company and a number of Montana's large customers brought forward a legislative proposal, Senate Bill No. 390, to deregulate retail electricity supply. The legislation passed 36-14 in the Senate and 78-21 in the House of Representatives. Montana joined several other states that had already enacted legislation or adopted policies to implement customer choice.
- Restructuring and customer choice applied primarily to the Montana Power Company service territory, but it also applied to PacifiCorp's territory in Northwest Montana. PacifiCorp, which served about 36,000 Montana customers primarily in Flathead and Lincoln counties, put its Montana distribution facilities up for sale and announced that Flathead Electric was the successful bidder.
- Ultimately, competitive choice did not develop for small residential and commercial customers in the state, and with the approval of the "Electric Utility Industry Generation Reintegration Act" by the 2007 Legislature, the transition to customer choice ended for NorthWestern customers. The act also put NorthWestern on track to transition into a vertically integrated utility, owning both generation assets and transmission and distribution assets.

Summary Points:

Hydropower in Montana

- Hydropower accounted for more than one third of Montana's net electric generation in 2015. There are currently 32 operating hydroelectric facilities in Montana and six of the state's largest generating plants are water powered.
- At more than 562 megawatts of nameplate capacity, Noxon Rapids, located along the Clark Fork River in Sanders County, is the largest hydroelectric facility in Montana with a nameplate capacity of 562 megawatts. The facility ships nearly all of its generation out of state.
- Montana ranked seventh among states for power generated by hydroelectric dams, falling from fifth largest due to drought conditions experienced in the second half of 2015. Most hydroelectric facilities in the state are owned by utilities. The Bureau of Reclamation or the Army Corps of Engineers own others. One of these large facilities, the Seli's Ksanka Qlispe' dam (formerly the Kerr Dam) was purchased by the Confederated Salish and Kootenai Tribes in 2015.
- Most of Montana's large hydroelectric dams are run of the river dams located along the Missouri River. These dams were built between the late 1800's and the 1950's to meet the electricity demand of the state's increasing population and high-energy consuming industries such as copper mining and production.

Coal-Fired Electric Generation in Montana

- Coal-fired generation has provided the majority of the electricity produced in the state since construction of Colstrip Unit 4 was completed in 1986. Montana's vast reserves of sub-bituminous coal are used to power most of the in-state coal generation. As of June 2017, there was 2,289 MW of coal-fired generating capacity in Montana, representing 37 percent of the state's nameplate generating capacity. In 2015, coal generated 16,013 GWh, representing 55 percent of all in-state electric generation.
- In 2010, a significant number of coal-fired power plants across the nation announced plans for retirement. Since that time, 101 GW of coal generation in the U.S. have either retired or announced plans to retire in the coming years. Nationally, 65 GW of coal-fired capacity was retired by June 2017.

Summary Points:

- A lawsuit was brought in 2013 under the Clean Air Act by the Sierra Club and the Montana Environmental Information Center against Puget Sound Energy and Talen Energy, the owners of Colstrip Units 1 & 2. The suit, settled in 2016, resulted in an agreement to shutter the two units no later than July 1, 2022.
- The four-unit facility in Colstrip leads all coal-fired electric generation in terms of capacity in Montana and is the second largest coal-fired facility west of the Mississippi River. Colstrip has the largest nameplate capacity of any generator with 2,094 MW; Units 1 and 2 are rated at 307 MW and Units 3 and 4 at 740 MW. It also contributes the most electric production of any facility in the averaging more than 14,000 GWh annually over the past decade. The four units at Colstrip are jointly owned by six entities.

Wind Energy in Montana:

- The National Renewable Energy Laboratory (NREL) estimates 679,000 MW of wind generation potential at 80 meters above ground in the state, ranking Montana second in total wind energy production potential.
- Despite this potential, Montana's distance from large, population centers (energy loads) and its transmission constraints have resulted in the state developing a small fraction of its utility scale wind potential. Montana developed 695MW of installed wind energy capacity by 2016, ranking Montana 22nd in installed wind capacity among states. Wind energy accounted for nearly 7 percent of Montana's net electricity generation in 2015.
- Montana's first utility scale wind project, the 135 MW Judith Gap wind facility near Harlowton, began operating in 2005. After the construction of Judith Gap and the passage of RPS requirements in 2005, Montana saw several additional wind energy projects become operational between 2005 and 2012. In 2007, the Diamond Willow wind farm near Baker began operating. This 30MW facility is owned by Montana Dakota Utilities and meets their obligations under the state RPS. In 2009, both phases of the 210 MW Glacier Wind farm were completed. The facility is currently the largest wind energy facility in the state located near Shelby in northcentral Montana.

Summary Points:

- Since 2016, several new utility scale wind projects have been proposed in Montana and are at various stages of permitting and development. The 300 MW Clearwater wind farm is one proposed project that if developed, would be the state's largest wind energy facility. Most of these projects depend on their ability to export electricity.

Utility-Scale Solar Power in Montana:

- Utility-scale solar photovoltaic (PV) generating systems are an emerging energy supply in Montana, but still represent a small slice of Montana's generating mix. The installation of Distributed utility customer-sited PV systems has gradually increased in Montana in the past decade. Utility-scale solar farms developed to sell power directly into the grid came online in the last year. The combined output from solar PV systems in Montana represents about .04 percent of statewide electricity sales.
- Being a northern state, Montana does not have the solar energy resources found in the desert Southwest states of California, Nevada, Arizona, and New Mexico, which have seen dramatic increases in solar energy in recent years, including the installation of large, utility-scale solar energy facilities. Nevertheless, Montana has respectable solar energy potential as compared against other U.S. cities.
- The combination of a high number of sunny or partly sunny days and a temperate summer climate, which reduces efficiency losses that occur with PV systems as temperatures increase, help to make up for the northern latitude of the state. The strongest solar potential within Montana can be found in areas across the southern tier of the state, with the weakest in the northwest.
- Currently there are six operational, utility-scale solar projects in Montana, each with a generating capacity of 2 to 3 MW-AC. The projects are located on private land and are approximately 30 to 40 acres in size. The projects consist of many rows of solar modules (panels) mounted on single-axis trackers (mechanical equipment that rotates the modules from east to west over the course of the day to follow the sun).

Summary Points:

Biomass, Methane, and Landfill Generation in Montana:

- Montana has millions of acres of forested and agricultural land with potential to provide biomass resources for electric generation, thermal energy production, and alternative transportation fuels. The state also shows potential for electric generation fueled by the methane and carbon dioxide produced from decomposing and fermenting municipal and agricultural waste. However, development of biomass energy resources in Montana is limited, primarily because there are lower-cost renewable and conventional fuel resources available.
- The only developed biomass combined heat and power (CHP) facility in Montana is located at the F.H. Stoltze Land and Lumber Company in Columbia Falls. This 2.5-megawatt cogeneration facility generates heat and steam from burning on-site wood waste. The steam output powers a turbine to generate electricity that is sold to Flathead Electric Cooperative.
- Municipal waste facilities (landfills) are required to prevent methane produced by decaying garbage from leaking into the air and groundwater. These facilities provide an ideal location for generating electricity from biogas.
- Methane produced from decaying garbage at the Flathead County Landfill near Kalispell is captured with a network of buried pipes and burned in an on-site generator to produce 1.6 megawatts of electricity. The generator provides enough electricity to power approximately 1,600 customers of Flathead Electric Cooperative. Additionally, Montana Dakota Utilities installed equipment to capture, clean, and process methane at the Billings Regional Landfill beginning in late 2010. The resulting natural gas is fed into MDU's pipeline system and delivered to homes and businesses in the area.

Distributed Generation in Montana:

- In 1999, with the passage of Montana net metering legislation (SB 409; Chapter 323, Laws of 1999) by the Montana Legislature, NorthWestern Energy customers were given the opportunity to interconnect a grid-compatible solar, wind, or hydropower generator with a generating capacity of 50 kilowatts or less on their property.

Summary Points:

- A net metering system provides energy to the customer generator's premises; any excess energy is exported back to the utility and credited on the customer's bill. That credit may be carried forward over a twelve-month billing cycle. The utility does not pay customer generators for excess energy provided to the utility. NorthWestern net metering customers are credited for excess generation at the retail rate.
- Of the net-metered generating capacity reported, solar PV systems account for 90 percent of total capacity. Wind turbines represent the second largest type of generation, followed by micro-hydro generators.
- Technology and production advances in the solar PV industry have helped drive down the cost of distributed solar PV installations relative to other distributed generation technology. Historical NorthWestern Energy net metering data show a trend in which installations of distributed wind energy systems have largely decreased since 2011, while installations of solar PV systems have accelerated in recent years.
- Montana's first community solar installations were built in 2016 and 2017 by five separate electricity service providers. There are four "virtually net metered" or "shared solar" projects operated by rural electric co-ops in which co-op members have purchased one or more panels of a solar PV array sited on co-op property, or in one case on a public school.

Montana's Electric Transmission and Distribution Grid:

- The transmission network in Montana, as in most places, initially developed because of local decisions in response to a growing demand for power. The earliest power plants in Montana were small hydroelectric generators and coal-fired steam plants built at the end of the nineteenth century to serve local needs for lighting, power, and streetcars. The earliest long-distance transmission lines were built from the Madison hydroelectric plant, near Ennis, to Butte and from Great Falls to Anaconda.
- Montana is an electricity export state. Currently, the state's net electricity exports are almost equal to the amount of electricity consumed in the state each year. For example, in 2015 Montana generated 29,104 GWh and consumed just 14,207

GWh. There are four primary electric transmission paths that connect Montana to the rest of the Western Interconnect and larger markets in the West.

- Most of Montana is integrally tied into the U.S. Western Grid. The easternmost part of the state, with less than 10 percent of total Montana load, is part of the U.S. Eastern Grid and receives its power from generators located in that grid, including generators as far away as the east coast.
- A considerable amount of existing capacity on transmission lines is not available for use because it is held off the table for reliability reasons when paths are rated. Uncertainty affects the transmission needs of utilities because they don't know in advance what hourly loads will be or which generating units may be unavailable.
- The Montana Alberta Tie Ltd (MATL) came online in September 2013. It is the first direct interconnection between the Alberta and Montana balancing areas and is capable of carrying 300 MW in either direction.
- In the past decade, several stakeholders have voiced interest in developing additional transmission capacity to export Montana's generation potential to other markets. Montana's large energy resources and small in-state electricity demand make it a hot spot for proposed transmission projects to export power out of state.

Coal Production in Montana:

- The Montana coal industry exists to support the generation of electricity. Coal-fired power plants account for a majority of Montana's electric generation portfolio, but recently coal usage has declined. Coal fueled nearly two-thirds of the state's total electric generation in the 2000's, and remained between 50 percent and 55 percent since 2010. Nearly three-quarters of the coal mined in Montana is exported, primarily to Midwestern utilities and to coal brokers. The coal that remains in Montana fuels electric generating plants, with most used at the Colstrip generating facility.

Summary Points:

- Montana was the sixth largest coal producer in the U.S. in 2015, with 42 million tons mined. The majority of in-state mining occurs in the Powder River Basin southeast of Billings. With the exception of the small lignite mine at Savage and the bituminous Signal Peak, mine north of Billings, Mont., the state produces low-sulfur subbituminous coal, with up to 18 million Btu per ton. Like most coal in the West, Montana coal's lower sulfur content produces less sulfur emissions, but is also lower in heat content when compared to coal mined in the East.
- The price of Montana coal averaged \$17.44 per ton at the mine in 2015, up from the previous 20 years when it was near \$10.00 per ton. The average price of coal peaked at \$14.22 per ton in the early 1980s and began a downward trend that lasted to the turn of the century. By 2002, the price fell nearly 60 percent. The price of Montana and Wyoming coal is far below the U.S. average of \$31.83. The two main reasons for the difference are transportation costs and the lower heat content of the coal.
- There are currently six major coal mines in Montana operating in Big Horn, Musselshell, Richland, and Rosebud Counties. Westmoreland Mining, LLC, controls three of these mines, accounting for more than 13 million tons of coal in 2016. In 2007, Westmoreland gained 100 percent ownership of the Absaloka Mine in Big Horn County. During the 1990s, the last Montana mine producing less than 100,000 tons annually closed. A new mine at that site, the Signal Peak Mine, near Roundup, opened in 2003.
- Production has recently decreased in Montana, from about 45 million tons in 2008 to 32 million tons in 2016. The trend mirrors the national totals, with production decreasing from about 1.2 billion tons mined in 2008 to just under 0.9 billion tons in 2015. Most of this decline can be credited to weak economic markets for coal both domestic and internationally. Coal generation for domestic electric generation plants is down as older coal plants close and existing plants run less of the time. Low natural gas prices and cheaper renewables mean that natural gas, wind and solar are fueling more electricity production.

Summary Points:

Natural Gas in Montana:

- Montana currently consumes more natural gas than it produces. In 2015, Montana produced 51.4 billion cubic feet (Bcf) and consumed 75.0 Bcf. A significant portion of in-state production is exported, and at least half of Montana's consumption is imported from Canada and other states. This is especially true in the eastern portion of the state where most natural gas produced leaves the state in pipelines, and much of what is consumed is imported from other states.
- From 2012-2016, Montana produced an annual average of about 57.9 Bcf of gas, which is down from the decade before that when the average was around 99 Bcf per year and annual production totals reached as high as 115 Bcf. Reasons for this recent decline in Montana gas production include less associated natural gas from the Bakken oil field, the collapse of coal-bed methane due to economics, a lack of fracking in state, traditional shallow reserves from conventional wells declining, and very few (almost zero) new conventional wells being drilled.
- Domestic, in-state gas wells are located primarily in the north-central portion of the state, although other portions of the state also have wells. In 2015, the northern portion of Montana accounted for 71 percent of total in-state production, the northeastern portion 24 percent, and the south-central portion 3 percent as defined by Montana DNRC.
- Recent Montana natural gas consumption averages 65 to 80 Bcf per year. Both residential and commercial gas consumption are currently growing slowly, and remain roughly level with 1970s consumption figures. Usage by industry is expected to stay fairly level in the near term unless a large new gas consuming company enters or leaves the state. Traditionally, industrial usage has varied more than other sectors.

Summary Points:

- The 53 MW capacity Basin Creek electric generation plant near Butte began operations in late 2005. Natural gas usage at the Basin Creek plant constitutes a small percentage of Montana's total usage. It is typically used as a peaking resource and when electricity prices are high. The 150 MW capacity Dave Gates Generating Station (DGGs) near Anaconda began operations in 2011 and uses a small percentage of Montana's total. Neither plant functions as a base load resource, and neither plant required extensive upgrades to NWE's pipeline system.
- NWE's gas transmission system is regulated by the Montana PSC. The NWE system consists of more than 2,000 miles of transmission pipelines, 5,000 miles of distribution pipelines, and three major in-state storage facilities.

Petroleum and Petroleum Products in Montana:

- During the 2016 fiscal year, Montana produced about 25.8 million barrels of crude oil, worth more than \$888 million in gross value. This oil production accounted for the majority of the \$85 million in oil and gas production tax revenue collected by Montana. Approximately ninety-five percent of Montana's crude oil production is exported to other states, primarily North Dakota and Wyoming, while 88 percent of the crude oil refined in Montana is imported from Canada with another 9 percent coming from Wyoming.
- The state is home to four refineries, three in the Billings area and another in Great Falls. In total, Montana's refineries have the capacity to refine 205,100 barrels/day (bbl/day) of crude oil. In 2016, Montana's four petroleum refineries exported 37 percent of their refined liquid products to Washington, North Dakota, Wyoming, and additional points east and south. This is slightly below the five-year average of exporting 39 percent of the refined output. Crude oil receipts at Montana's four refineries totaled 66.5 million barrels in 2016.

Summary Points:

- Three crude oil pipeline networks serve Montana's petroleum production regions. One network owned by True Companies bridges the Williston and Powder River Basins in the eastern part of the state. The Front Range and Glacier Pipelines in Central Montana primarily move crude oil from Canada to Montana refineries in Billings and to points further on in Wyoming. Enbridge's Express pipeline in the same general area transports western Canadian crude through central Montana to Casper, Wyo., with very little of that crude offloaded in state.
- The majority of oil production in Montana occurs in the Williston Basin of eastern Montana, which is not connected by crude pipelines to Montana's four refineries. As a result, in 2016, more than 95 percent of Montana oil production was exported from the state, mostly to Wyoming and the Dakotas, through the eastern Montana pipeline system or through unit train shipments originating out of western North Dakota.
- Four petroleum refineries currently operate in Montana with a combined refining capacity of 205,100 bbl/day: ExxonMobil (61,500 bbl/day) and Phillips 66 (60,000 bbl/day) in Billings, CHS (59,600 bbl/day) in Laurel and Calumet Montana Refining (24,000 bbl/day) in Great Falls. Montana refineries typically refine 63-68 million barrels of crude oil a year.

Electricity Supply and Demand in Montana

As Montana's electricity sector continues to evolve, in-state electricity supply and demand is increasingly influenced by complex national trends. The deregulation of wholesale electricity markets through the federal Energy Policy Act of 1992 and the legislatively driven deregulation of Montana's retail market in 1997 have largely been turned back in recent years. Montana's electricity supply continues to change. New generation is coming online and some large coal generators are slated to close. New generation is fueled by wind, natural gas, and solar assets. In-state Electricity demand has remained flat in recent years due to a higher penetration of energy efficiency and the exit of several large industrial customers.

NorthWestern Energy (NWE), Montana's dominant electric utility, emerged from bankruptcy in late 2004, and is financially stronger today than when it first started in Montana. In 2015, NWE bought back 11 in-state dams owned by PPL Montana, and formerly owned by the Montana Power Company (MPC). NWE continues to transition toward vertical integration, owning more of its own generation to meet its customers' needs.

Montana Electricity Facts 2017

Generation capability -- 6,200 MW
Average generation -- 3,300 aMW
Average load (demand) -- 1,600 aMW

Montana in Perspective¹

Montana generates more electricity than it consumes. Even so, it is a relatively small player in the western electricity market. As of 2017, Montana generating plants have the capacity to produce about 6,200 MW of electricity. This number is constantly changing as new plants are added every year and older ones are occasionally shut down. Plants do not run constantly, nor do they produce exactly the same amount of electricity from year to year. For example, the output from hydroelectric generators

¹ In this chapter, electricity is measured in kilowatt-hours (kWh) or megawatt-hours (MWh) to describe supply and demand. One MWh is produced when a one MW generator runs at full capacity for 1 hour. A one MW generator running for 8,760 hours in a year produces one average megawatt (aMW). Residential customers who do not use electricity for heating typically use 10 to 30 kWh per day. Helena and the Helena valley in 2012 consumed approximately 80 aMW with peak usage near 128 MW. (David Fine, NWE, Dec 10, 2013).

depends on the rise and fall of river flows, and if any type of plant requires downtime for refurbishing and repairs. Montana generators produced 2,977 aMW from 2001 to 2005, 3,278 aMW from 2006 to 2010, and 3,325 aMW from 2011 to 2015. Montana usage accounts for about half of total in-state production, or about 1,600 aMW.² In 2015, Montana consumed an estimated 1,600 aMW or about 1,700 aMW, assuming 8 percent transmission line losses, and produced 3,322 aMW.³ The other half of Montana electricity production is exported west to Washington and Oregon via the Colstrip transmission lines. The Colstrip coal generation plant, the Glacier and Rimrock wind farms, and a few of the larger dams in northwestern Montana account for the vast majority of contracted Montana electricity exports.

Montana straddles the two major electric interconnections in the country. Most of Montana is in the Western Interconnection, which covers all or most of 11 states and two Canadian provinces; it also includes small portions of one Mexican state and three other U.S. states. Less than 10 percent of Montana's load and about 4 percent of the electricity generated in Montana occurs in the Eastern Interconnection. The 2015 Montana average load (sales plus transmission losses) was equivalent to less than 2 percent of about 100,000-aMW load in the entire Western Interconnection.⁴

Generation

There are more than 50 major generating facilities in Montana. Montana's 10 largest electric generation plants are listed below by capacity and output (**Charts E1 and E2**). The oldest operating generating facility in Montana is Madison Dam near Ennis, built in 1906. The newest are several wind generation and solar generation facilities that have come online since 2014. Montana's largest generating facility includes the four privately owned coal-fired generating units at Colstrip. The combined capacity of the units totals 2,094 MW or about 30 percent of Montana's total current generation capacity. The largest hydroelectric plant in Montana is Avista's Noxon Rapids Dam, recently upgraded to 562 MW in capacity. The largest wind facilities are the 189 MW Rimrock and 210 MW Glacier Wind projects, both owned by Naturener.

² U.S. EIA, 2017

³ Ibid.

⁴ Byron Wortz, Western Electricity Coordinating Council, 2017.

Table 1. Ten Largest Plants by Generation Output, 2015			
Plant	Primary Energy Source or Technology	Operating Company	2015 Output (MWh)
1. Colstrip	Coal	Talen Energy	14,844,275
2. Libby Dam	Hydroelectric	U.S. Corps of Engineers-North Pacific Division	1,757,669
3. Noxon Rapids Dam	Hydroelectric	Avista Corp	1,635,111
4. SKQ Dam	Hydroelectric	Salish-Kootenai Tribe	1,073,292
5. Hungry Horse Dam	Hydroelectric	U S Bureau of Reclamation	1,000,298
6. Fort Peck	Hydroelectric	USCE-Missouri River District	753,359
7. Yellowtail	Hydroelectric	U S Bureau of Reclamation	744,118
8. Rim Rock	Wind	NaturEner	603,536
9. Billings Generation Inc.	Pet Coke	Yellowstone Energy Partnership Ltd.	500,087
10. Thompson Falls	Coal	NorthWestern Energy	522,509

Source: U.S. EIA data.

Table 2. Ten Largest Plants by Generation Capacity, 2017			
Plant	Primary Energy Source or Technology	Operating Company	Net Summer Capacity (MW)
1. Colstrip*	Coal	Talen Energy	2,094
2. Noxon Rapids	Hydroelectric	Avista Corp	562
3. Libby	Hydroelectric	USCE-North Pacific Division	525

4. Hungry Horse	Hydroelectric	U S Bureau of Reclamation	428
5. Yellowtail	Hydroelectric	U S Bureau of Reclamation	287
6. Glacier	Wind	Naturener	210
7. Séliš Ksanka Qlispè Project (SKQ)	Hydroelectric	Confederated Salish and Kootenai Tribe	206
8. Rimrock	Wind	Naturener	189
9. Fort Peck	Hydroelectric	USCE-Missouri River District	180
10. Dave Gates	Natural Gas	NorthWestern Energy	150

*Colstrip is operated by Talen Energy; actual ownership is shared by six utilities.

Source: U.S. EIA data

NorthWestern Energy and Puget Sound Energy owned facilities produce the largest percentage of electricity generated in Montana. Both NWE's and Puget Sound's facilities accounted for about 15 percent of the total generation in Montana in 2015. Talen Energy was close behind at about 14 percent. NWE's generation is derived mostly from the company's hydroelectric dams it recently purchased and an 11 percent share in Colstrip. PPL and Puget Sound's generation comes from the companies' shares in the Colstrip generating facility.

Avista, with a 15 percent interest in Colstrip Units 3 and 4 and full ownership of the Noxon Rapids hydroelectric plant on the Clark Fork River, is also a major producer of electricity in Montana. The company accounts for more than 10 percent of the state's total generation. .

Bonneville Power Administration (BPA) and the Western Area Power Administration (WAPA) are owned by the federal government. Two of Montana's largest energy generation facilities, Libby Dam on the Kootenai River (U.S. Army Corp of Engineers) and Hungry Horse dam on the South Fork of the Flathead (U.S. Bureau of Reclamation), provide power for the BPA. Headquartered in Portland, Oregon, the BPA transmits and sells wholesale electricity in Washington, Oregon, Idaho, and western Montana. BPA is the marketing agent for power from all of the federally owned hydroelectric projects in the Pacific Northwest and is one of four federal marketing agencies. BPA is a large player in northwestern Montana for both electric supply and transmission line operations. WAPA, like BPA, is a power marketing agency. It markets power for federal hydroelectric facilities in the region east of the Continental Divide in Montana. WAPA operates three hydroelectric facilities in Montana: Yellowtail on the Bighorn River (U.S. Bureau of Reclamation), Canyon Ferry near Helena, and Fort Peck (U.S. Army Corp

of Engineers) on the Missouri River. The Fort Peck Dam is configured to deliver electricity to both the Western and Eastern Interconnections.

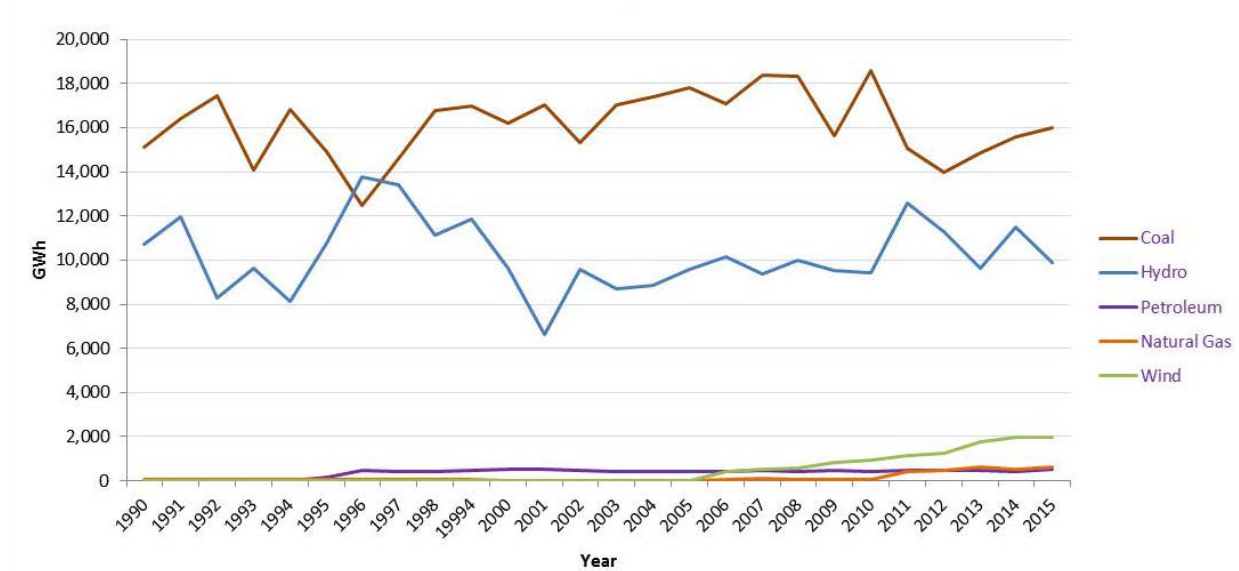
NWE is the largest utility in Montana and is regulated by the Montana Public Service Commission (PSC). NWE's Montana operations are headquartered in Butte. The company's corporate headquarters are located in Sioux Falls, S.D. It provides generation and transmission to a majority of customers in the western two-thirds of Montana, although a number of large industrial companies and some co-ops purchase electricity supply elsewhere.

NWE owned very little generation in Montana in 2002, but slowly acquired facilities since that time. NWE owns a 30 percent interest in Colstrip Unit 4 (about 6 percent of the state's total generation capacity) and purchases electricity from a number of small qualifying power production facilities (QFs) that include waste coal, pet coke, small hydroelectric, solar, and wind generation. In 2011, NWE commissioned the Dave Gates natural gas turbine generating facility near Anaconda (150 MW) to provide regulation services for NWE's balancing area (the transmission lines that are operated by NWE). NWE also retained Montana Power Company's QF contracts and has expanded those contracts. NWE also has contracts for the output from the Basin Creek natural gas plant, Judith Gap Wind Farm, and Tiber Dam.

Montana generation is powered primarily by coal (55 percent of total for 2015) and hydropower (34 percent of total from 2015). Until 1986, when Colstrip 4 was completed, hydropower was the dominant source of net electric generation in Montana. Most of the small amount of petroleum used for electric generation (2 percent of total generation in 2015) is actually petroleum coke from the refineries in Billings. A small amount of natural gas (2 percent of total generation in 2015) and increasing amounts of wind (7 percent of total generation in 2015) round out the in-state generation picture. It is likely that wind will make up a larger percentage of Montana's total generation in the future as more wind farms are built and as Montana's generation portfolio continues to diversify. Coal could make up between 50 and 60 percent of the state's total generation until Units 1 and 2 at Colstrip shut down no later than 2022. Hydroelectric dams generally produce about 30 to 40 percent of total generation and this is expected to remain the same in the future.

During spring runoff, utilities operate their systems to take advantage of cheap hydroelectric power, both on their own systems and on the wholesale market around the region. Routine maintenance on thermal plants is scheduled during this period. Thermal plants generally must run more in the fall when hydroelectric power availability is low.

Figure 1. Montana Electric Generation from Primary Fuels: Total Generation (GWh 1990-2015)



Consumption

Montana electric consumers are served by 31 distribution utilities: 2 investor-owned utilities, 25 rural electric cooperatives, 3 federal agencies, and 1 municipality. Two additional investor-owned utilities and four cooperatives based in other states serve a small number of Montana consumers. In 2015, investor-owned utilities were responsible for 48 percent of the electricity sales in Montana, cooperatives 29 percent, federal agencies 3 percent, and power marketers 19 percent.

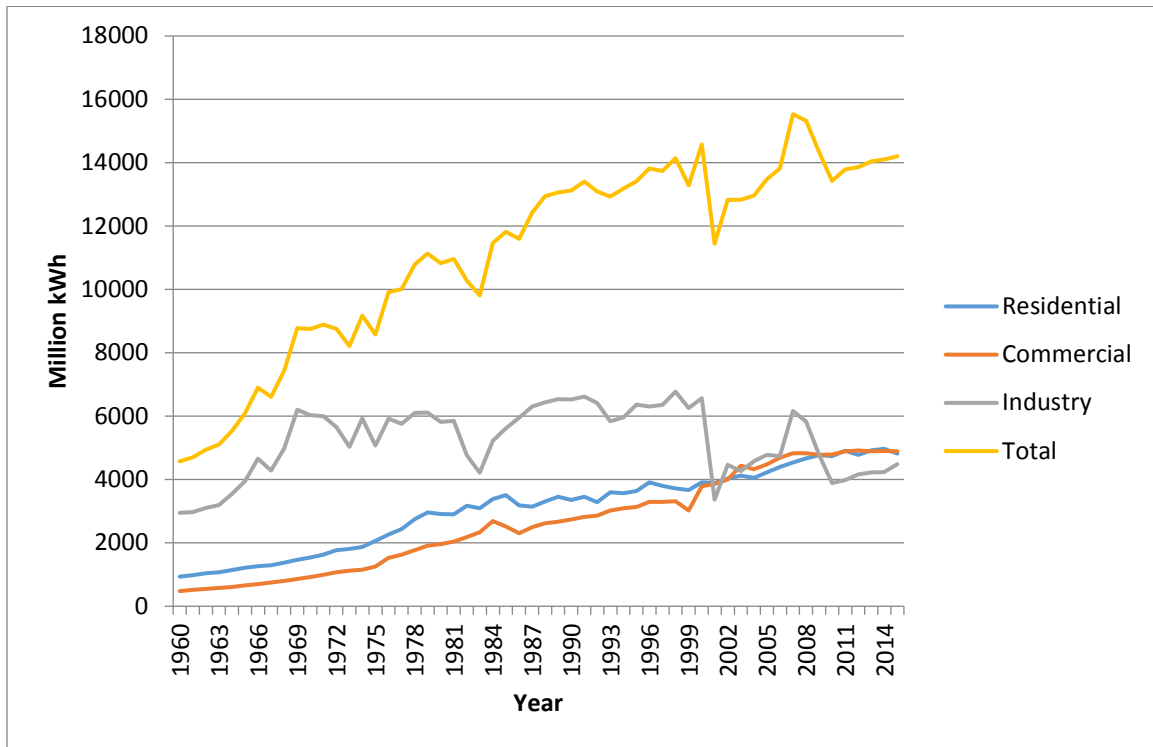
Reported sales of electricity in Montana in 2015 were 14.0 billion kWh (14,000 GWh), down from 15.5 billion kWh in 2007. Decreased industrial use, the scaling back or closing of some large companies and the economic recession of 2008 lowered slightly electricity consumption. Total Montana electricity sales tripled between 1960 and 2000, then dropped by more than 15 percent as industrial loads tumbled following the electricity crisis of 2000-2001. Sales have risen since then (**Figure 1**).

Since 1990, sales to the commercial sector have grown the most, followed by sales to the residential sector. In the same period, industrial sales were inconsistent. Residential growth tends to track population growth, while commercial growth tends to track economic activity. Growth in both sectors may slow if electricity prices rise or energy efficiency technology continues to permeate the market. There are no statewide forecasts for future electricity consumption.

Consumption patterns continually shift as existing electricity-consuming equipment and appliances become more efficient, while conversely, new electricity-consuming inventions gain market share in U.S. homes and jobs. Looking to the future, the potential for electric vehicles to

achieve a nontrivial percentage of new vehicle sales in Montana has the potential to significantly change consumption patterns in the state and nation.

Figure 2. Annual Electricity Sales in Montana, 1960-2015



Electricity in Montana costs less than the national average. In 2015, the Montana electricity price averaged 8.90 cents/kWh compared to 10.41 cents/kWh nationally.⁵ In 1997 before electricity deregulation, Montana's average price of 5.2 cents/kWh was 1.7 cents below the national average of 6.85 cents/kWh. For both Montana and the U.S., electricity prices rose moderately faster than inflation since 1997.

Montana's largest electricity consumers are large industrial customers, including metal mines, the four in-state oil refineries, large petroleum pipelines, forestry products companies, a silicon manufacturer, and a cement plants. These customers generally use NWE, MDU, or WAPA as their electricity transmission provider, but most buy their power from non-utility suppliers, such as power marketers. These are generally privately negotiated contracts.

There is ample interest in developing new electricity generation in Montana, largely centered on construction of wind and solar projects. Three factors currently challenge the construction of new generation in Montana. The first is obtaining a firm power purchase agreement for that electricity. The second hurdle is the lack of available firm transmission to send that generation

⁵ U.S. EIA, 2017.

to off-takers located out of state. The third issue involves the challenges of siting a new transmission line.

There are several reasons project developers are considering Montana for generation projects. The first is regional demand for generation---especially for renewable generation. While electricity demand is relatively flat in the U.S. West, a large number of existing power plants have retired or are slated for near-term retirement. Some power plants are retiring near the end of the facilities' useful life when it is no longer economic for them to meet new environmental standards by installing pollution controls and other upgrades. Coal plants are also retiring due to a potential future with a price on carbon and some states' goals to divest of coal generation citing climate change concerns. According to M.J. Bradley and Associates, "As of June 2017, nearly 63 GW of coal capacity has retired from the U.S. generating fleet. The peak retirement years occurred in 2015 and 2016, when 19.5 GW and 13.5 GW retired, respectively... A good number of closures (21.1 GW) are planned between now and 2020 and more than 19.3 GW have announced plans to close after 2020."⁶

Some power plants, particularly nuclear plants, are being priced out of the market by cheap natural gas, flat electricity demand, and low electricity spot prices overall (sometime occurring from excess renewable generation in the middle of the day). New generation will be needed to replace power plants going off-line. This generation will likely consist of natural gas and renewables due to their lower costs and an increasing number of electric consumers demanding a lower carbon footprint.

The price for developing wind and solar generation assets has dropped enough to compete with traditional fossil fuel plants. However, many argue that the value of renewables is less than that of base load and peaker plants (that typically run during the highest demand periods) due to the lack of control utilities have over electricity generation from renewable sources.

Remote renewable resources in places such as Montana have several advantages over building those resources closer to large cities (e.g. Seattle, Portland). For one, the wind resources in Montana and Wyoming are higher capacity than those found on the West Coast. Second, Montana wind is more complementary to peak electricity demand in western cities than wind from the Columbia Gorge, despite the latter being closer to the region's electric loads.

⁶ M.J. Bradley and Associates, LLC, August 28, 2017, MJB&A Issue Brief, <http://www.mjbradley.com/sites/default/files/MJBAcoalretirementissuebrief.pdf>

Utility Deregulation in Montana

In January 1997, the Montana Power Company and a number of Montana's large energy customers brought forward a legislative proposal (Senate Bill No. 390) to deregulate retail electricity supply in Montana. Montana's electricity laws and policies have received significant public attention and scrutiny since that time, when Montana decided to deregulate electricity supply and opted to allow some Montana consumers to choose, given a competitive market, their own electricity supplier. At the time, it was a fundamental policy shift for the state from regulating the price of electricity supply to allowing competitive markets to set the price of electricity supply. It was also a shift that would dominate the energy policy discussion in Montana for the next 20 years.

The fundamental premise of Montana's restructuring law was that competition would provide greater benefits to consumers than they would otherwise have received under a historically regulated environment. One of the driving forces behind restructuring was a 1996 decision by the Federal Energy Regulatory Commission to deregulate electricity supply markets at the wholesale level. Wholesale transactions involve the sale of electricity from large suppliers (i.e., power producers) to large electricity buyers and sellers (utilities, power marketers, etc.).

Therefore, in January 1997, the Montana Power Company and a number of Montana's large customers brought forward a legislative proposal to deregulate retail electricity supply. The reasons stated in the testimony before the Montana Legislature to pass Senate Bill No. 390 were:

- Competitive markets would provide Montana electricity consumers with cheaper prices over the long term.
- Congress was seriously contemplating national deregulation legislation, and Montana should take a leadership position so that the federal government would grandfather in our policy choices.
- Montana's large industrial customers were looking at an electricity supply market that was cheaper than the traditional regulated utility supply. If they could get better prices, it would enhance plant profitability and promote economic development in Montana.
- The Montana Power Company needed to be proactive in a competitive environment that was emerging, as opposed to reactive.
- Competition is here, wholesale power supply markets are competitive, and large customers are demanding retail access.

The legislation passed 36-14 in the Senate and 78-21 in the House of Representatives. Montana joined several other states that had already enacted legislation or adopted policies to implement

customer choice. In passing Senate Bill No. 390 (Chapter 505, Laws of 1997), the 1997 Legislature noted that competitive markets exist, that Montana customers should have the freedom to choose their electricity supplier, that Montana consumers should be protected, and that the financial integrity of Montana utilities should be maintained.⁷

Restructuring and customer choice applied primarily to the Montana Power Company service territory, but it also applied to PacifiCorp's territory in Northwest Montana. PacifiCorp, which served about 36,000 Montana customers primarily in Flathead and Lincoln counties, put its Montana distribution facilities up for sale and announced that Flathead Electric was the successful bidder. At the time, the Public Service Commission (PSC) processed transition plans for both Montana Power Company and PacifiCorp. Rural electric cooperatives were allowed to determine whether their customers would be offered a choice of electricity supplier. Because North Dakota is the primary service territory of Montana-Dakota Utilities, that utility originally was allowed to defer customer choice until July 1, 2006.

Deregulation was a highly controversial decision, and one the Legislature did not take lightly. "In the legislative debate over SB 390, one thing that proponents and opponents managed to agree upon was the importance of the issue. 'I don't know that I'll ever carry legislation that is more significant,' reflected Senator Fred Thomas (R-Stevensville), the lead sponsor. And the lead opponent, Rep. David Ewer (D-Helena), commented quite plainly, 'This bill is the most economically significant bill of the session and one of the most economically significant of our history'."⁸

By the end of 1999, the Montana Power Company ultimately sold most of its generating units to Pennsylvania Power and Light Montana (PPL Montana/Talen Energy/Riverstone Holdings). The company sold its generation assets to PPL for \$757 million. The sales price was a little over \$150 million higher than the estimated book value of the generation assets. As a result, Montana Power Company proposed a 4% rate reduction in energy supply through the remainder of the then-transition period through June 2002. The remainder of Montana Power Company's contracts and leases, including qualifying facility (QF) contracts and the entire distribution utility, was sold to NorthWestern Energy in February 2002. NorthWestern paid \$1.1 billion to buy the electric transmission and distribution assets and natural gas properties in Montana. That acquisition was largely financed with debt and helped drive NorthWestern into bankruptcy – addressed later in this chapter. By June 2003, Touch America, the telecommunications company spun off Montana Power, also filed for bankruptcy.

⁷ For text of testimony in support and in opposition, see the committee minutes of Senate Bill No. 390 during the 1997 legislative session.

⁸ *Montana's power trip: Electric deregulation consumers and the environment*, Patrick Judge, University of Montana, Graduate School These, 2000, page 13.

Flathead Electric, which serves every major city in northwestern Montana and the surrounding rural areas, entered into the deregulated electricity markets after passage of the 1997 restructuring law. The Montana PSC approved the sale of PacifiCorp's electric distribution facilities in Montana to Flathead Electric Cooperative, which was to include allocation of \$4 million in net proceeds from the sale to benefit PacifiCorp's Montana customers. Flathead bought about \$112 million worth of new equipment and service territory and arranged supply contracts tied to market rates. By 2001, rates for Flathead customers had increased by as much as 31 percent.⁹

Under the provisions of SB 390, the governance of restructuring was shared by the PSC and a multifaceted Transition Advisory Committee (TAC) that combined legislators, executive branch appointees, representatives from industry, labor, and consumer groups, and was funded entirely by contributions from the private sector. The TAC's job was to monitor the transition to competition as set forth in state law, and the PSC's job was to craft and enforce rules.

In 2001, the California energy crisis began to unfold, with wholesale energy prices in California increasing by 270% from the previous year.¹⁰ Suspicion that Enron and other power marketers and suppliers were gaming the California system to maintain high electricity prices also began to surface. The power crisis spilled over into other states as California scrambled to secure out-of-state power. Wholesale energy prices in the Pacific Northwest rose to unprecedented levels.¹¹ "Although the new legislation had little immediate effect on small customers, large industrial customers were able in 1998 to obtain electrical energy from cheaper suppliers than the Montana Power Company. Otherwise, regulators, MPC, public interest groups, the TAC, and others muddled through the arcana of transition plans, stranded costs, rules for the licensure of 'can't wait to market in Montana' power suppliers, and the inevitable litigation. Except for noticing that our electricity bills detailed the separate costs of energy generation, transmission, and distribution, most of us were blithely unaware of the awesome choice awaiting us," according to an early TAC report.

However, some industrial customers were hit hard by the increased market prices attributed to the California energy crisis. In addition, when cost based rates expired at the end of the transition period, Montana Power Company, later NorthWestern, utility customers did see significant rate increases associated with the transition to market-based rates. Between May 2001 and July 2003, the average residential bill increased by 20 percent.

⁹ <http://www.dailyinterlake.com/archive/article-38d776c9-3fea-52e4-9e82-a93213e428a0.html>

¹⁰ The Congress of the United States, Congressional Budget Office, Causes and Lessons of the California Electricity Crisis, (Washington, DC, September 2001), p. viii.

¹¹ "The Electrical Utility Industry Restructuring Transition Advisory Committee," a report to the Governor and 58th Legislature, Jeff Martin and Todd Everts, December 2002.

The 2001 Legislature was faced with the energy crisis and questions about Montana's decision to deregulate in 1997. In response, the Legislature enacted House Bill No. 474. It extended the transition period to competition to July 1, 2007. The bill also designated the default supplier as the customers' distribution supplier and required that the distribution services provider have an ongoing regulated default supply obligation beyond the end of the transition period. Customers who chose an alternative electrical energy supplier (primarily large industrial customers) also were given an opportunity to receive electrical energy from the default supplier.

House Bill No. 474 also authorized a Montana Power Authority to purchase, construct, and operate electrical generation facilities or electrical energy transmission or distribution systems and to enter into joint ventures for these purposes. The Board of Examiners was authorized to issue revenue bonds (not to exceed \$500 million) for the Montana Power Authority to acquire electrical generation facilities and build electrical energy transmission or distribution systems.¹²

The 2001 Legislature also passed House Bill No. 645 creating a power pool designed to free up energy being supplied to Montana Power Company by PPL at cost-based rates. The change allowed power to be used to bail out industrial customers that were shutting down and laying off workers due to high market prices. In March 2001, Montana Power Company also was evaluating bids from wholesale suppliers to provide energy once its buy-back contract with PPL expired on July 1, 2002. At the time, those bids were in the range of \$80-\$100 per MWh. The tumultuous times were just beginning.

Shortly after passage of House Bill No. 474, the PSC determined that the legislation not only protected ratepayers but also attempted to foster the financial integrity of the Montana Power Company as a public utility and as a distribution services provider – a serious conflict.¹³ PPL Montana and the Montana Power Company filed complaints against the PSC in federal district court and state district court, respectively, challenging the PSC's assertion of authority.

About the same time, Representatives Michelle Lee of Livingston and Christopher Harris of Bozeman initiated a petition to refer House Bill No. 474 to the voters at a November 5, 2002, general election. They argued that the legislative process that led to the enactment of the legislation was flawed and was closed to public scrutiny. In addition, Montana taxpayers would be on the hook for a default on any energy loans provided by the Montana Board of Investments.¹⁴ After a few legal stops, the referendum qualified for the ballot as Initiative

¹² http://leg.mt.gov/content/publications/committees/interim/2001_2002/trans_adv_com/1158jfea.pdf

¹³ For an analysis of the Public Service Commission's assertion of regulatory authority over the default supplier's electricity supply obligation under House Bill No. 474 and contrary view of the apparent conflict in legislative intent under House Bill No. 474, see Greg Petesch, letter to Senator Fred Thomas, June 7, 2001, in Transition Advisory Committee, Minutes, June 19, 2001.

¹⁴ "The Electrical Utility Industry Restructuring Transition Advisory Committee," a report to the Governor and 58th Legislature, Jeff Martin and Todd Everts, December 2002.

Referendum No. 117.¹⁵ On November 5, 2002, the voters rejected House Bill No. 474 by a 60% to 40% margin. The decision, however, did not overturn deregulation. Another bill, for example, Senate Bill No. 19, also had passed in 2001 – extending customer transition to June 30, 2007. Senate Bill No. 269 also had passed in 2001, indefinitely delaying transition to competition for Montana Dakota Utilities.¹⁶

The November 2002 voters also were presented with Initiative 145 to “buy back” the dams in Montana. The initiative created an elected public power commission to determine whether purchasing hydroelectric dams in Montana was in the public interest and repealed the Montana Power Authority created by the 2001 legislature.¹⁷ It was defeated 68% to 32%.

The 2003 Legislature continued to address the evolution of deregulation in Montana. The 2003 Legislature passed House Bill No. 509 addressing default supply planning, establishing an Energy and Telecommunications Interim Committee of the Legislature, and requiring a cost recovery mechanism. In addition, Senate Bill No. 247 was passed in the 2003 session allowing for preapproval of default supply resources. The Legislature also further extended the date for full customer choice until July 1, 2027. The PSC also continued to exert its regulatory authority. By August 2003, Montana customers, however, were paying some of the highest electricity rates in the region.¹⁸

In August 2003, the Montana Consumer Counsel petitioned the PSC to open a financial investigation into NorthWestern Energy. In September 2003, NorthWestern Energy filed for chapter 11 bankruptcy. In a written statement, then-Gov. Judy Martz called the bankruptcy filing another “unfortunate chapter” in the state’s business history. NorthWestern Energy said the financial decision would not lead to interruption of services to its 300,000 gas and electric customers.

While there was much finger-pointing about what role Montana regulators and legislators could have played to prevent the financial troubles, about a year later, NorthWestern announced it had officially emerged from bankruptcy and started trading its newly issued stock. In connection with the bankruptcy stipulations, the PSC approved a consent order in July 2004 between NorthWestern, the PSC, and the Consumer Counsel. The agreement remains in place today and stipulates aspects for rate review, certain regulatory controls, and some financial requirements.¹⁹

¹⁵ 2002 Voter Information Pamphlet, Montana Secretary of State.
http://sos.mt.gov/Portals/142/Elections/archives/2000s/2002/2002_VIP.pdf

¹⁶ http://leg.mt.gov/content/publications/committees/interim/2001_2002/trans_adv_com/1158jfea.pdf

¹⁷ http://sos.mt.gov/Portals/142/Elections/archives/2000s/2002/2002_VIP.pdf

¹⁸ “Under Deregulation, Montana Power Price Soars,” *New York Times*, Jonathan Glater, August 21, 2003.

¹⁹ PSC Docket D2003.8.019, Order No. 6505e.

Montana's energy supply journey, however, continued, and in June 2006, NorthWestern Energy and Babcock and Brown Infrastructure (BBI) filed a joint application with the PSC seeking the commission's approval of BBI's acquisition of NorthWestern. In 2007, the PSC unanimously denied the application, finding that the proposed \$2.2 billion merger would present a risk to NorthWestern's financial integrity and to Montana customers of NorthWestern.²⁰

Ultimately, competitive choice did not develop for small residential and commercial customers in the state, and with the approval of the "Electric Utility Industry Generation Reintegration Act" by the 2007 Legislature, the transition to customer choice ended for NorthWestern customers. The act also put NorthWestern on track to transition into a vertically integrate utility, owning both generation assets and transmission and distribution assets.

The 2007 Electric Utility Industry Restructuring and Customer Choice Act, or the "reregulation" bill as it was often called, allowed NorthWestern Energy to own electric power plants again and to dedicate the power it produces to Montana customers. It significantly tailored customer choice, limiting the ability of retail customers with a monthly demand of less than 5,000 kilowatts to migrate to other electricity suppliers if those customers were receiving electricity from a public utility prior to October 2007.

Prior to the 2007 law, as previously discussed, a NorthWestern Energy customer could choose an electricity supplier. If a customer was a member of a cooperative that did not open up to competition or a customer of Montana-Dakota Utilities Co., the price of retail electricity supply remained set by either the cooperative board or the PSC, respectively. For the most part, competitive markets did develop to serve large industrial electricity customers, and most of those customers selected alternative electricity suppliers.

The TAC, in its November 2000 annual report, described some positive results of the transition to competition. It found that most large industrial customers in Montana obtained electricity from suppliers other than Montana Power Company at cost savings of 5% to 10%. Both Glacier Electric Cooperative and Flathead Electric also opened their systems to competition. Flathead Electric purchased the distribution system of PacifiCorp and began serving PacifiCorp's former customers.²¹ But the positive aspects also came with some caveats. As mentioned previously, some industrial customers were hard hit. The PSC also ended up filing an injunction in state district court to prevent PacifiCorp from selling the utility and fleeing the state to avoid what the PSC determined to be stranded benefits due to PacifiCorp's customers as a result of the transition to competition.

Market volatility and the lack of significant small-customer retail competition, however, forced the 2007 Legislature to effectively put an end to full customer choice.

²⁰ PSC Docket D2006.6.82, Final Order 6754e.

²¹ http://leg.mt.gov/content/publications/committees/interim/1999_2000/tac/final1999report.pdf

In January 2007, the Energy and Telecommunications Interim Committee requested that a bill be brought forward (House Bill No. 25) to move toward reregulation of Montana's retail electricity supply. The bill was amended several times and was the subject of much debate. The reasons stated in the testimony before the Legislature to pass House Bill No. 25 were:

- Competitive markets had not developed for small customers in Montana and electricity consumers were being exposed to higher market prices.
- NorthWestern Energy, with no generation assets of its own, lacked power at the bargaining table when securing the supply it needed to meet customer demand.
- Continuing to have small customer choice in law while a competitive market didn't actually exist created electric load uncertainty that impeded NorthWestern Energy's ability to plan for and procure electricity supply at optimal terms and prices.
- NorthWestern Energy needed the ability to build new plants and dedicate that power to Montana customers at regulated, stable rates.²²

In signing House Bill No. 25 (Chapter 491, Laws of 2007) in May 2007, former Governor Brian Schweitzer noted: "Potential benefits from HB 25 will only accrue down the road."

After passage of House Bill No. 25, if someone in Montana is a small customer of NorthWestern who did not choose an alternative electricity supplier prior to October 2007, that person is now part of the electricity supply load that is regulated by the PSC. Small NorthWestern Energy customers still have the opportunity to purchase a separately marketed product composed of electricity from renewable resources – subject to a tariff and other limitations.

With changes made by the 2007 Legislature, NorthWestern Energy also began pursuing its own generation assets, using the guidelines put into place in House Bill No. 25 and directing the PSC on the steps to be followed in reviewing and potentially approving NorthWestern Energy's electricity supply resources. To ease concerns about financing new power plants, Montana law allows utilities to obtain preapproval for certain, significant generating projects they hope to build or acquire. Preapproval provides some level of cost recovery assurance prior to constructing or acquiring generation assets.

By 2015, owned generation resources supplied about 75% of NorthWestern's retail load requirements. NorthWestern Energy owns about 854 megawatts, including 222 megawatts or a 30% share in Colstrip Unit 4, 150 megawatts of generation from the Dave Gates Generation

²² For the text of testimony in support and in opposition, see the committee minutes of House Bill No. 25 during the 2007 legislative session.

Station, which is used as a regulating reserve plant, 40 megawatts from Spion Kop Wind, and 442 megawatts from the 2014 purchase of hydroelectric generating facilities in Montana.²³

In 2014, NorthWestern Energy acquired the 11 hydroelectric facilities previously owned by Talen Energy Corp. (PPL Montana) representing 633 megawatts of capacity and one storage reservoir. The \$900 million purchase of the hydroelectric generating facilities includes Thompson Falls Dam on the Clark Fork River; Kerr Dam on the Flathead River; Madison Dam on the Madison River; Mystic Lake Dam on West Rosebud Creek; and Hauser, Holter, Black Eagle, Rainbow, Cochrane, Ryan and Morony dams along the Missouri River. In 2015, Kerr Dam was transferred to Energy Keepers, Inc., a wholly owned corporation of the Confederated Salish and Kootenai Tribes.

The sale signaled the return of the dams to utility ownership -- about 15 years after they were sold by Montana Power Company during Montana's experiment with deregulation. To pay for the acquisition, NorthWestern Energy customers are paying a rate increase amounting to about 5% or \$4.20 per month for a typical residential customer.²⁴

"The dams that are so much a part of Montana's environment and heritage are now dedicated to serve our Montana customers, at prices based on the cost of providing service, not on the western power market. Fifty years from now, as these assets are paid down, our children and grandchildren will appreciate the farsighted leadership of Montana PSC Chairman Gallagher and his colleagues, who made this possible," said Bob Rowe, NorthWestern Energy's CEO.

The 2009 Legislature also continued to take steps to allow for utility integration. In approving House Bill No. 294 (Chapter 127, Laws of 2009), the Legislature allowed a natural gas utility that had restructured to acquire natural gas production and gathering resources and include them in the rate base. The revisions to the law also establish procedures for a utility to apply to the PSC for approval to include them in the rate base prior to the acquisition.

Beginning in 2010, NorthWestern started acquiring gas production and gathering assets. As of December 2015, the company-owned reserves totaled 65.9 Bcf and were estimated to provide about 27% of the company's expected annual retail natural gas load in Montana. The company also owns and operates three natural gas storage fields with aggregate working gas capacity at about 17.75 Bcf and maximum aggregate daily deliverability of about 195,000 dekatherms.²⁵

²³ <https://www.northwesternenergy.com/docs/default-source/documents/ataglance/ataglancemt>

²⁴ http://billingsgazette.com/business/features/northwestern-purchase-of-montana-dams-complete/article_86bfb948-d78d-5098-98df-b579743b8436.html

²⁵ <http://www.northwesternenergy.com/docs/default-source/documents/MTFiling/GeneralRateCase/VolumeII/StatementN>

During the 2017 Legislature, questions were raised about NorthWestern Energy’s treatment in the current law, and whether all aspects of House Bill 25 should remain in place or whether NorthWestern has successfully transitioned into a vertically integrated utility.

The 2017 Legislature passed and approved House Bill No. 193, revising how NorthWestern Energy’s electricity cost recovery is conducted. It standardizes the treatment of all public utilities, including NorthWestern, for the approval of cost-tracking adjustments. It eliminated an exemption allowing the utility to recover the full cost of power it purchases from other sources. The Montana Consumer Counsel supported the legislation and asked that a “relic of deregulation” be removed. NorthWestern Energy opposed the bill and argued that it eliminated prudence in regulatory decisions. “NorthWestern has struggled mightily to put humpty-dumpty together again,” John Alke, representing NorthWestern Energy, told the 2017 House Energy, Technology and Federal Relations Committee. The company argued that the company still operates under a bankruptcy agreement and consent order entered into by the PSC, Montana Consumer Counsel, and company in July 2004 and therefore standardized treatment was inappropriate.²⁶

With passage of the bill, the PSC in May 2017 initiated a process to develop a replacement electricity tracker for NorthWestern. The action became intertwined with other 2017 PSC decisions regarding qualifying facilities and contract lengths. The issue continues to simmer, with the PSC finding, “the commission remains interested in potential adjustment base rates.”²⁷ NorthWestern Energy also intends to file a general rate case in September 2018. It can be anticipated that with the filing of a general rate case – the first since 2009, the ongoing issues concerning qualifying facilities and contract lengths, and implementation of House Bill No. 193 by the PSC will all lead to a number of energy policy issues being brought before the 2019 Legislature.

Hydropower in Montana

Hydropower is an important part of Montana’s energy generation mix and accounted for more than one third of the state’s net electric generation in 2015. There are currently 32 operating hydroelectric facilities in Montana and six of the state’s largest generating plants are water powered. At over 562 megawatts of nameplate capacity, Noxon Rapids, located along the Clark Fort River in Sanders County, is the largest hydroelectric facility in Montana with a nameplate capacity of 562 megawatts. The facility ships nearly all of its generation out of state. In 2015, Montana ranked seventh among states for power generated by hydroelectric dams, falling from

²⁶ For the text of testimony in support and in opposition, see the committee minutes of House Bill No. 193 during the 2017 legislative session.

²⁷ PSC Docket D2017.5.39, Order 7563.

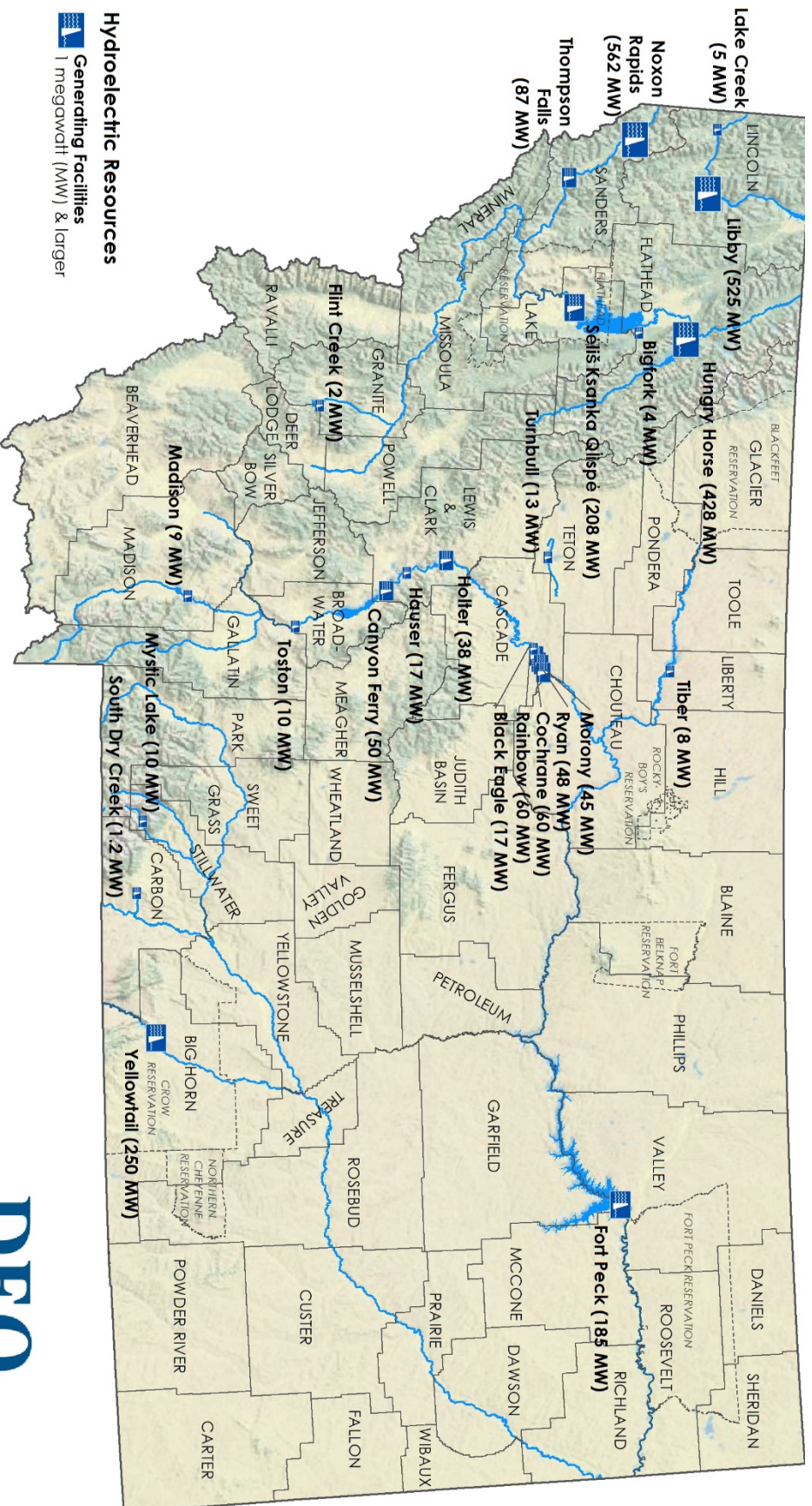
fifth largest due to drought conditions experienced in the second half of 2015. Most hydroelectric facilities in the state are owned by utilities. Others are owned by the Bureau of Reclamation or the Army Corps of Engineers. One of these large facilities, the Seli’s Ksanka Qlispe’ dam (formerly the Kerr Dam) was purchased by the Confederated Salish and Kootenai Tribes in 2015. This is the first tribally owned hydroelectric dam in the United States.

Most of Montana’s large hydroelectric dams are run of the river dams located along the Missouri River. These dams were built between the late 1800’s and the 1950’s to meet the electricity demand of the state’s increasing population and high-energy consuming industries such as copper mining and production. Other large hydroelectric dams in Montana are part of the Federal Columbia River Power System, which includes a series of hydropower projects on the Columbia River and its tributaries in Idaho, Oregon, Washington, Montana and Wyoming. The Hungry Horse, Libby, and Noxon dams are storage dams that generate electricity but also serve as flood control and irrigation systems on the Columbia River Power System. The Bonneville Power Administration (BPA), a federal power marketing agency, markets power from these dams and sells it to rural electric cooperatives in Montana and other utilities across the Northwest.

Table 3. Montana Hydroelectric Facilities

Facility Name	Company Name	County	Initial Operation Date	Generator Nameplate (MW)
Noxon Rapids	Avista	Sanders	1959	562.4
Libby Dam	U.S. Corps of Engineers	Lincoln	1975	525.0
Hungry Horse Dam	U.S. Bureau of Reclamation	Flathead	1952	428.0
Yellowtail Dam	U.S. Bureau of Reclamation	Big Horn	1966	250.0

Montana Hydroelectric Resources



Hydroelectric Resources
Generating Facilities
 1 megawatt (MW) & larger

Last updated January 2018



Facility Name	Company Name	County	Initial Operation Date	Generator Nameplate (MW)
Seli'š Ksanka Qlispe' Dam	Confederated Salish and Kootenai Tribes (CSKT)	Lake	1938	207.6
Fort Peck Dam	U.S. Corps of Engineers	McCone	1943	185.3
Thompson Falls	NorthWestern Energy	Sanders	1915	87.1
Cochrane Dam	NorthWestern Energy	Cascade	1958	60.4
Rainbow Dam	NorthWestern Energy	Cascade	1910	60.0
Canyon Ferry Dam	U.S. Bureau of Reclamation	Lewis and Clark	1953	49.8
Ryan Dam	NorthWestern Energy	Cascade	1915	48.0
Morony Dam	NorthWestern Energy	Cascade	1930	45.0
Holter Dam	NorthWestern Energy	Lewis and Clark	1918	38.4
Hauser Dam	NorthWestern Energy	Lewis and Clark	1911	17.0
Black Eagle Dam	NorthWestern Energy	Cascade	1927	16.8
Turnbull Hydro	Turnbull Hydro, LLC	Teton	2011	13.0
Mystic Dam	NorthWestern Energy	Stillwater	1925	10.0
Broadwater Dam	Montana DNRC	Broadwater	1989	9.6
Madison Dam	NorthWestern Energy	Madison	1906	8.8
Tiber Dam	Tiber Dam, LLC	Liberty	2004	7.5
Lake Creek	CSKT	Lincoln	1917	4.5
Bigfork	Pacificorp	Flathead	1910	4.2
Flint Creek Dam	Granite County	Granite	1901	2.0
South Dry Creek Dam	Hydrodynamic	Carbon	1985	2.0
Boulder Creek	Boulder Creek Hydro, LLC	Lake	1984	0.51
Ross Creek	Ross Creek Hydro, LLC	Gallatin	1990	0.45
Wisconsin Noble	Wisconsin Creek, LLC	Madison	1989	0.4
Hellroaring	Mission Valley Power Co.	Lake	1916	0.4

Boulder Creek	CSKT	Lake	1984	0.4
Pony Generating Station	Gerald and Glenda Ohs	Madison	1985	0.3
Pine Creek	Howard and Mildred Carter	Park	1986	0.3
Strawberry Creek	Hydrodynamics, Inc.	Park	1987	0.19

The ownership history of the dams currently owned by NorthWestern Energy reflects Montana’s history with electricity deregulation and re-regulation. The 11 hydroelectric facilities currently owned by NorthWestern Energy were built between the late 1800’s and the late 1950’s. NorthWestern Energy’s predecessor, The Montana Power Company, was formed in 1912 and acquired the existing dams. The company built additional large dams over several decades to serve their customers. After the Montana Legislature passed Senate Bill No. 390 to implement electricity deregulation in 1997, the Montana Power Company sold its coal and hydroelectric generating facilities to Pennsylvania Power and Light (PPL), a private, unregulated power marketing company. In 2007, the Montana Legislature passed a bill that re-regulated the electricity sector and allowed NorthWestern Energy to own electric generating assets to serve their Montana customers. In 2014, the Public Service Commission approved NorthWestern Energy’s purchase of the 11 hydroelectric facilities from PPL for \$870 million.

Future Hydroelectric Generation Opportunities

The potential for new, large, run of the river hydroelectric dams is limited but opportunities to increase hydroelectric generation in Montana are being explored through retrofits of existing dams and pumped storage hydro projects. The Montana Department of Natural Resources and Conservation (DNRC) evaluates the potential for small hydropower project potential at the 22 state-owned dams in Montana. Water from these dams is marketed to local water users, primarily for irrigation. A 2012 study assessed the feasibility of hydropower on three state-owned dams in Montana.²⁸ These dams included Tongue River Dam in Big Horn County, the Painted Rocks Dam on the West Fork of the Bitterroot River in Ravalli County and the Cooney Dam on Red Lodge Creek in Carbon County. Based on power generation potential, transmission line requirements and other financial considerations, the Tongue River Dam was deemed marginally feasible for power generation. The DNRC made an application to the Federal Energy Regulatory Commission (FERC) for a preliminary permit for the Tongue River Power Project and FERC granted the Montana DNRC the permit on July 30, 2014.

²⁸ DNRC. *Report on Survey of Power Generation Capacity to Montana Legislature Energy and Telecommunications Interim Committee*. June 2016. <http://leg.mt.gov/content/Committees/Interim/2015-2016/Energy-and-Telecommunications/Meetings/July-2016/hydrocover.pdf>

Pumped storage

Hydroelectric pumped storage moves water between two reservoirs located at different elevations to store energy and generate electricity. These facilities operate like large batteries on the grid. During times of low electricity demand (most often at night), excess electricity generation is used to pump water from the lower reservoir to the upper reservoir. When demand for electricity is high, the stored water in the upper reservoir is released through a turbine to the lower reservoir to generate electricity. In addition to electricity storage, pumped storage projects can help stabilize the grid and help integrate and balance renewable energy and other variable energy resources on the grid.²⁹ One potential pumped storage project, the Gordon Butte Pumped Storage Project, has received a construction and operating license from FERC. This 400 MW project would be located on private land in Meagher County. The upper reservoir would be built on Gordon Butte and the lower reservoir would be located below Gordon Butte. The water cycled between the reservoirs could allow for an estimated 8.5 hours of energy generation at maximum discharge. Another project, the Coffin Butte Pumped Storage Hydro Project has received a preliminary permit from FERC to begin a multi-year licensing process. Both Gordon Butte and Coffin Butte projects are being developed by Absaroka Energy, a company based in Bozeman, Montana.

Coal-fired electric generation In Montana

Coal-fired generation has provided the majority of the electricity produced in the state since construction of Colstrip Unit 4 was completed in 1986. Montana's vast reserves of sub-bituminous coal are used to power most of the in-state coal generation, with one facility, the Lewis and Clark Station in Richland County, burning lignite coal from the nearby Savage Mine.

As of June 2017, there was 2,289 MW of coal-fired generating capacity in Montana, representing 37 percent of the state's nameplate generating capacity. In 2015, coal generated 16,013 GWh, representing 55 percent of all in-state electric generation.³⁰

In 2010, a significant number of coal-fired power plants across the nation announced plans for retirement. Since that time, 101 GW of coal generation in the U.S. have either retired or

²⁹ Federal Energy Regulatory Commission. "Pumped Storage Projects" <https://www.ferc.gov/industries/hydropower/gen-info/licensing/pump-storage.asp>. Accessed on October 20, 2017.

³⁰ U.S. Department of Energy, Energy Information Administration, Form EIA-923.

announced plans to retire in the coming years.³¹ Nationally, 65 GW of coal-fired capacity was retired by June 2017. In April of 2015, the J.E. Corette plant in Billings ceased operations. The plant was dismantled later that year. Additionally, a lawsuit was brought in 2013 under the Clean Air Act by the Sierra Club and the Montana Environmental Information Center against Puget Sound Energy and Talen Energy, the owners of Colstrip Units 1 & 2. The suit, settled in 2016, resulted in an agreement to shutter the two units no later than July 1, 2022.

While the majority of Montana’s coal-fired facilities are owned by regulated utilities, independent power producers own a portion of the state’s existing fleet. The Hardin Generating Station, a merchant coal-fired power plant, has not fully paid their taxes over the past few years and the owners of the facility have indicated they may shutter the facility as soon as the first quarter of 2018.

Table 4. Montana Coal-Fired Generation Facilities

Facility Name	Company Name	County	Initial Operation Date	Generator Nameplate (MW)
J.E. Corette (RETIRED)	Talen Energy	Yellowstone	1968-Retired 2015	153
Colstrip Unit 1	Talen Energy (50%), Puget Sound Energy (50%)	Rosebud	1975	307
Colstrip Unit 2	Talen Energy (50%), Puget Sound Energy (50%)	Rosebud	1976	307
Colstrip Unit 3	Talen Energy (30%), Puget Sound Energy (25%), Portland General Electric (20%), Avista (15%), PacifiCorp (10%)	Rosebud	1984	740
Colstrip Unit 4	NorthWestern Energy (30%), Puget Sound Energy (25%), Portland General Electric (20%), Avista (15%), PacifiCorp (10%)	Rosebud	1986	740

³¹ Source: ACCCE. *Retirement of Coal-Fired Electric Generating Units*. June 11, 2017. Retrieved from: <http://www.americaspower.org/wp-content/uploads/2017/06/Coal-Retirements-Paper-June-2017.pdf>

Lewis & Clark	Montana-Dakota Utilities	Richland	1958	53.1
Rosebud	Colstrip Energy LP (CELP)	Rosebud	1990	35
Hardin Generating Station	Heorot Power Management	Big Horn County	2006	107

The four-unit facility in Colstrip leads all coal-fired electric generation in terms of capacity in Montana and is the second largest coal-fired facility west of the Mississippi River. Colstrip has the largest nameplate capacity of any generator with 2,094 MW; Units 1 and 2 are rated at 307 MW and Units 3 and 4 at 740 MW. It also contributes the most electric production of any facility in the averaging more than 14,000 GWh annually over the past decade. The four units at Colstrip are jointly owned by six entities.

Table 5. Colstrip Ownership Breakdown

	Units 1 & 2	Unit 3	Unit 4	Total (%)	Total (MW)
Puget Sound Energy	50%	25%	25%	32%	677 MW
Talen Energy	50%	30%	--	25%	529 MW
Portland General Electric	--	20%	20%	14%	296 MW
NorthWestern Energy	--	--	30%	11%	222 MW
Avista Corp.	--	15%	15%	11%	222 MW
PacifiCorp	--	10%	10%	7%	148 MW

Wind Energy in Montana

Montana's large geographic area and high plains with interspersed mountains and river valleys make it one of the highest ranked states for utility-scale wind generation potential in the U.S. The National Renewable Energy Laboratory (NREL) estimates 679,000 MW of wind generation potential at 80 meters above ground in the state, ranking Montana second in total wind energy production potential. As depicted in the map below, most of the state's best wind energy resource lies in the central and eastern areas of the state. Despite this potential, Montana's distance from large, population centers (energy loads) and its transmission constraints have resulted in the state developing a small fraction of its utility scale wind potential. Montana developed 695MW of installed wind energy capacity by 2016, ranking Montana 22nd in installed wind capacity among states. Wind energy accounted for nearly 7 percent of Montana's net electricity generation in 2015.

Current Projects

Montana's first utility scale wind project, the 135 MW Judith Gap wind facility near Harlowton, began operating in 2005. The Judith Gap facility is owned by Invenergy. NorthWestern Energy purchases power from Judith Gap to help meet their Renewable Portfolio Standard (RPS) requirements under state law. After the construction of Judith Gap and the passage of RPS requirements in 2005, Montana saw several additional wind energy projects become operational between 2005 and 2012. In 2007, the Diamond Willow wind farm near Baker began operating. This 30MW facility is owned by Montana Dakota Utilities and meets their obligations under the state RPS. In 2009, both phases of the 210 MW Glacier Wind farm were completed. The facility is currently the largest wind energy facility in the state located near Shelby in northcentral Montana. The 189MW Rim Rock wind farm located north of Cut Bank and the 40MW Spion Kop wind farm northwest of Geysers were completed in 2012. In addition to the larger wind energy developments, a number of smaller wind energy developments successfully obtained power purchase contracts to sell renewable electricity to NWE. These developments include the nine MW Horseshoe Bend wind farm completed in 2006 near Great Falls, the 10MW Gordon Butte wind farm completed in 2012 near Martinsdale, and the 20MW Musselshell I & II wind farms completed in 2012 near Shawmut. Montana's newest wind facilities began operation between 2014 and 2016. Two Dot wind owned by NJR Clean Energy Ventures is a 9.7 MW facility that sells its power to NorthWestern Energy. The 10 MW Greenfield Wind project, operational since 2014, and the 20MW Fairfield Wind project, operational since 2016, are located in Teton County and are owned by Greenbacker Renewable Energy. Several smaller wind projects under one MW have contracts to sell power to NorthWestern Energy.

Montana Wind Resources

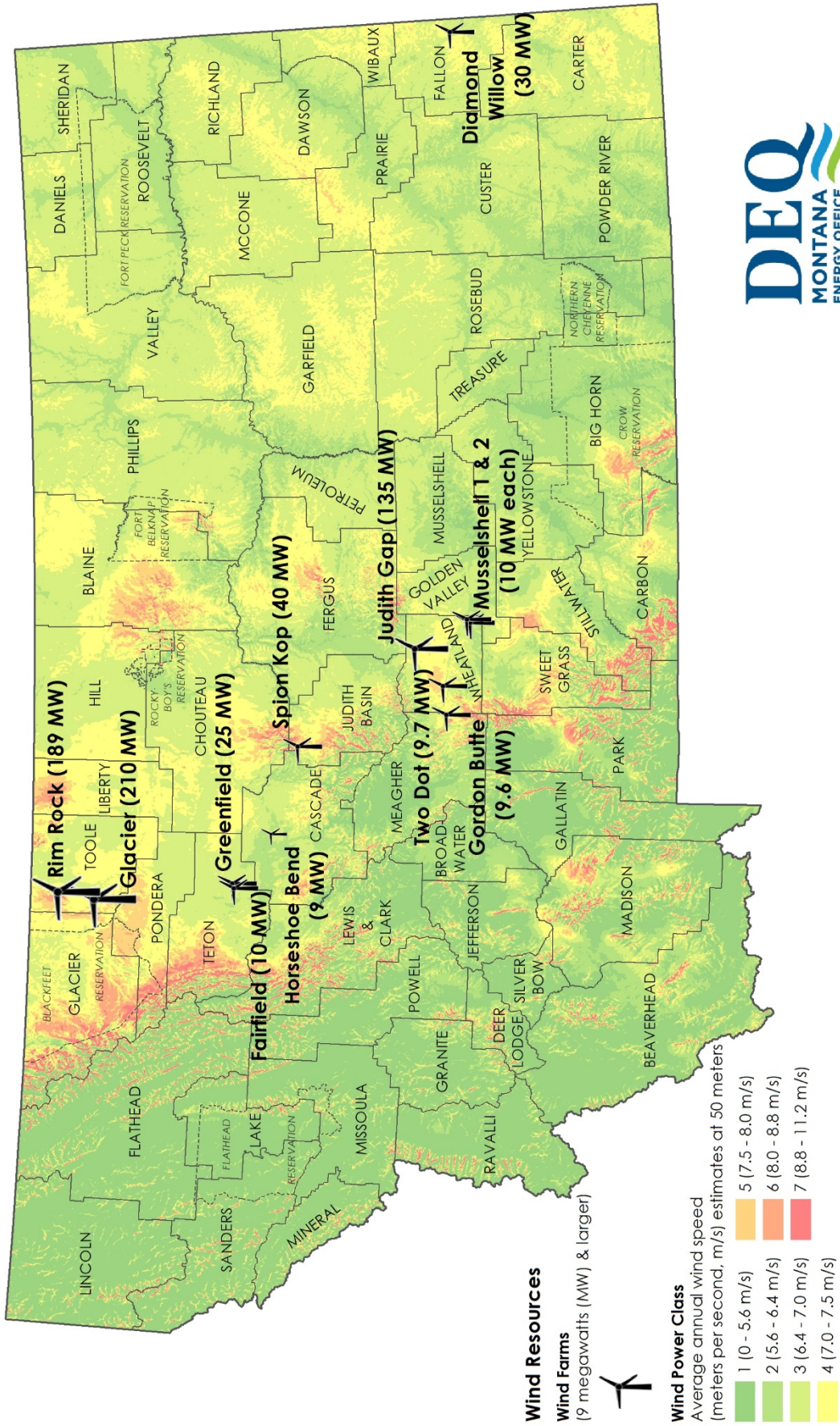


Table 6. Montana Wind Facilities

Facility Name	Owner	County	Operation Date	Generator Nameplate (MW)
Glacier Wind 1&2	NaturEner	Toole	2008, 2009	210 MW
Rimrock Wind	NaturEner	Toole	2012	189 MW
Judith Gap Wind	Invenergy	Wheatland	2005	135 MW
Spion Kop Wind	NorthWestern Energy	Judith Basin	2012	40 MW
Diamond Willow 1&2	Montana Dakota Utilities	Fallon	2007, 2010	30 MW
Musselshell 1 &2	Goldwind USA	Wheatland	2012	20 MW
Fairfield Wind	Greenbacker Renewable Energy	Teton	2014	20 MW
Greenfield Wind	Greenbacker Renewable Energy	Teton	2016	10 MW
Two Dot wind	NJR Clean Energy Ventures	Wheatland	2014	9.7 MW
Gordon Butte Wind	Gordon Butte Wind, LLC	Meagher	2012	9.6 MW
Horseshoe Bend Wind	United Materials of Great Falls, Inc.	Cascade	2006	9 MW
Martinsdale Colony South	Two Dot Wind, LLC	Wheatland	2007	2MW
Martinsdale Colony	Two Dot Wind, LLC	Wheatland	2004	0.75 MW
Sheep Valley Ranch	Two Dot Wind, LLC	Wheatland	2004	0.455 MW

Since 2016, several new utility scale wind projects have been proposed in Montana and are at various stages of permitting and development. The 300 MW Clearwater wind farm is one proposed project that if developed, would be the state’s largest wind energy facility. Most of these projects depend on their ability to export and sell electricity to out-of-state utilities and electricity suppliers to meet energy demand in states with larger populations than Montana. Currently, more than half of the electricity generated in Montana is exported. Most of this electricity is generated at the Colstrip Generating Station and sold to utilities in Washington and Oregon. Since the announcement that Colstrip Units 1 and 2 would be retiring no later than 2022, these utilities are considering what resources will replace their share of the Colstrip units. Montana’s wind resource may be a viable option for these utilities because it is most productive during the winter, when energy loads in Washington and Oregon are at their peak.³² The Colstrip transmission lines will also have open capacity with the closure of the two Colstrip

³² Northwest Power Planning and Conservation Council. *System Capacity Contribution of Montana Wind Resources*. August 2, 2016. Accessed online <https://www.nwccouncil.org/media/7150484/3.pdf>.

units. Future wind projects may also be developed as “qualifying facilities” under the federal Public Utility Regulatory Policy Act (PURPA). The proposed 80-megawatt Vivaldi Springtime wind project is one of these qualifying facilities and could begin operating in 2018.

Solar Power in Montana

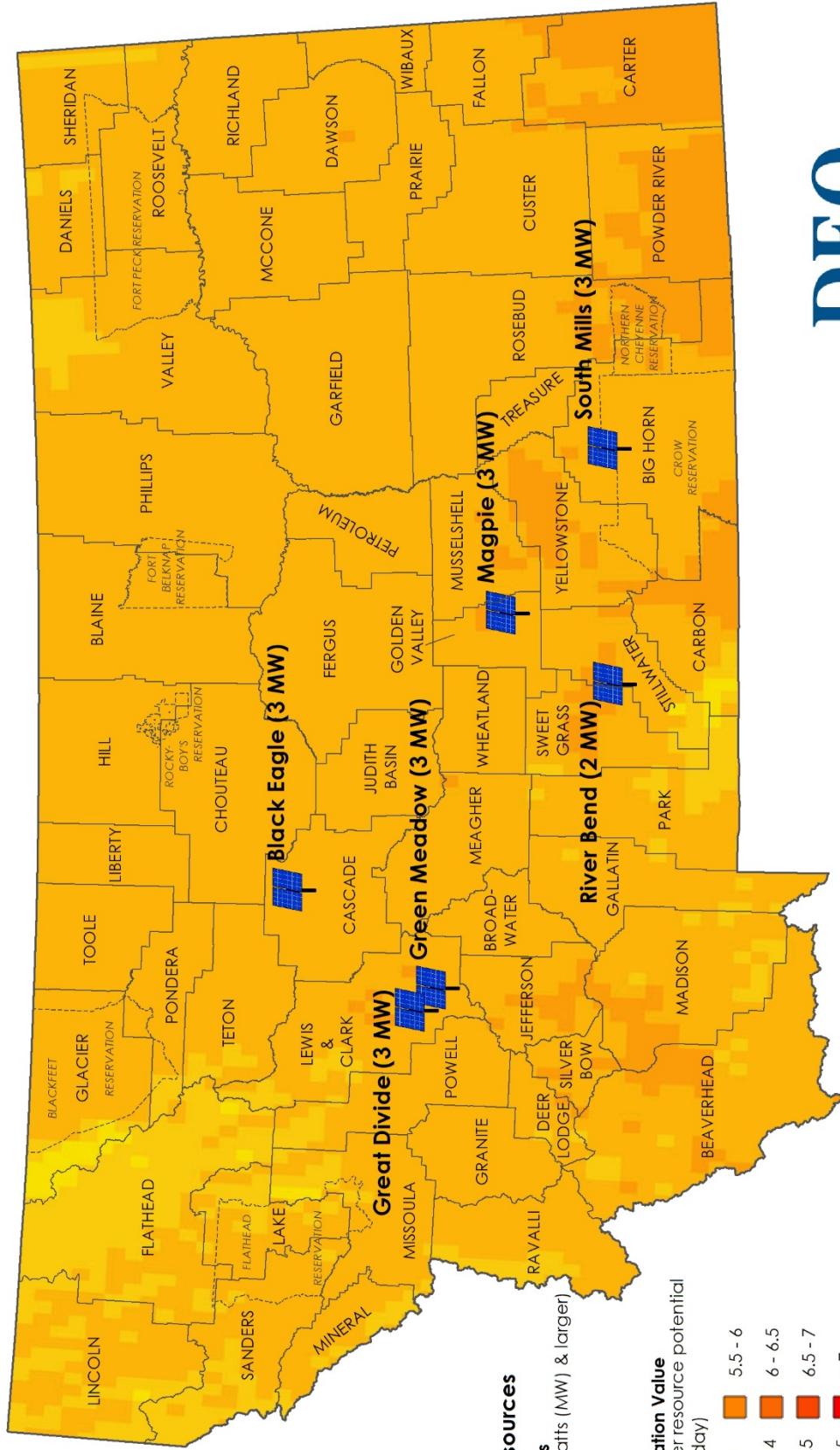
Utility-scale solar photovoltaic (PV) generating systems are an emerging energy supply in Montana, but still represent a small slice of Montana’s generating mix. The installation of Distributed utility customer-sited PV systems has gradually increased in Montana in the past decade. Utility-scale solar farms developed to sell power directly into the grid came online in the last year. The combined output from solar PV systems in Montana represents about .04 percent of statewide electricity sales. That puts Montana ahead of neighboring Wyoming, North Dakota and South Dakota based on energy supplied from solar, but behind Idaho. By comparison, states with the highest levels of solar energy development in the country are currently supplying 3 to 13 percent of their electricity from solar PV installations (Table 1).

Table 7. Solar market penetration summary³³

	Montana	Idaho	Wyoming	North Dakota	South Dakota	California	Arizona	Hawaii
Number of Customers (2015)	605,057	835,429	336,471	450,869	461,994	14,832,166	3,011,728	489,694
2016 Peak Demand (MW)	4,348	3,935	1,256	8,032	3,558	66,775	19,560	1,659
Solar Capacity (MW)	28	359.3	3	0.3	0.4	18,920	3,151	748
Solar Capacity as % of Peak Demand	0.64%	9.13%	0.24%	0.00%	0.01%	28.33%	16.11%	45.12%
2015 Retail Electric Sales (MWh)	11,485,015	23,058,814	16,924,762	18,128,948	12,101,979	181,586,115	77,295,498	9,503,226
% Electricity from Solar	0.04%	0.61%	0.01%	0.00%	0.00%	13.39%	5.11%	7.01%

³³ Montana Department of Environmental Quality. (2017). *Montana Solar Market Assessment*. <http://deq.mt.gov/Portals/112/Energy/Documents/Montana%20Solar%20Market%20Assessment%20-%20Final.pdf?ver=2017-09-15-114156-387>

Montana Solar Resources



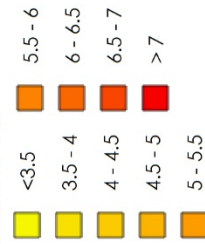
Solar Resources

Solar Farms
(2 megawatts (MW) & larger)



Solar Insolation Value

Solar power resource potential
(kWh/m2/day)



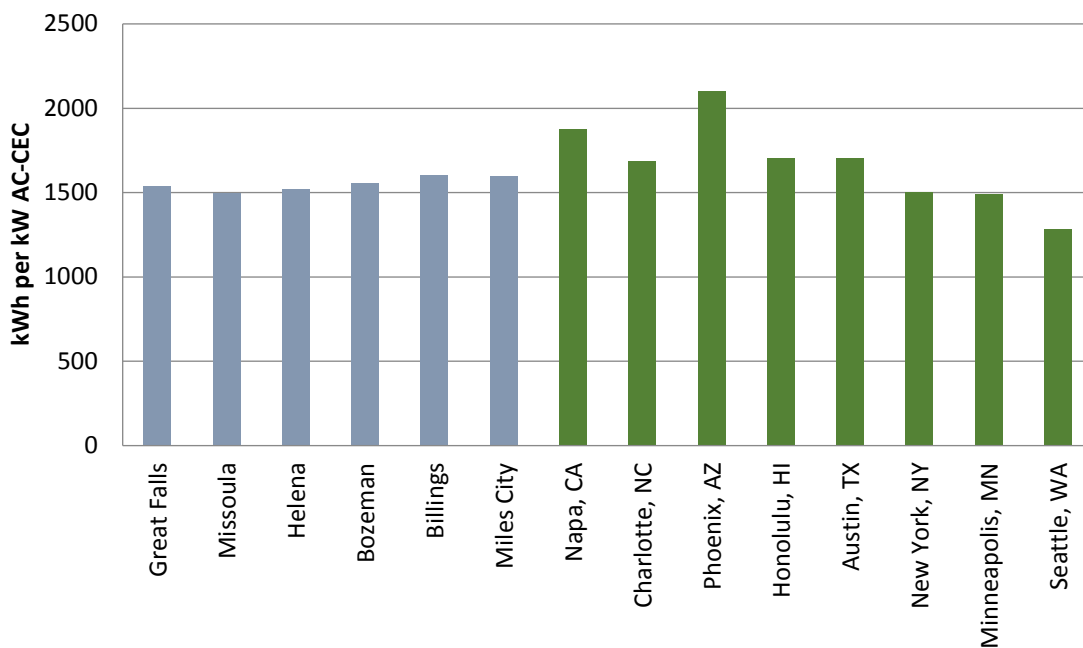
Last updated January 2018



Montana's solar resource

Being a northern state, Montana does not have the solar energy resources found in the desert Southwest states of California, Nevada, Arizona, and New Mexico, which have seen dramatic increases in solar energy in recent years, including the installation of large, utility-scale solar energy facilities. Nevertheless, Montana has respectable solar energy potential as compared against other U.S. cities (Figure 1).

Figure 3. Ten-year average solar production in selected U.S. cities³⁴



The combination of a high number of sunny or partly sunny days and a temperate summer climate, which reduces efficiency losses that occur with PV systems as temperatures increase, help to make up for the northern latitude of the state. The strongest solar potential within Montana can be found in areas across the southern tier of the state, with the weakest in the northwest (Figure 2).

Operational utility-scale solar projects

Currently there are six operational, utility-scale solar projects in Montana (Figure 2 and Table 2), each with a generating capacity of 2 to 3 MW-AC. The projects are located on private land and are approximately 30 to 40 acres in size. The projects consist of many rows of solar modules (panels) mounted on single-axis trackers (mechanical equipment that rotates the modules from east to west over the course of the day to follow the sun).

³⁴ Ibid, pg. 6.

Table 8. Utility-scale solar PV facilities³⁵

Facility Name	Company Name	County	Initial Operation Date	Generator Nameplate (MW-AC)
Green Meadow Solar, LLC	Enerparc Inc.	Lewis & Clark	2017	3
River Bend Solar, LLC	Enerparc Inc.	Sweet Grass	2017	2
South Mills Solar, LLC	Enerparc Inc.	Big Horn	2017	3
Great Divide Solar, LLC	Enerparc Inc.	Lewis & Clark	2017	3
Magpie Solar, LLC	Enerparc Inc.	Golden Valley	2017	3
Black Eagle Solar, LLC	Enerparc Inc.	Cascade	2017	3
			TOTAL	17

The six solar farms operating statewide were developed by Cypress Creek Renewables, FLS Energy, and Enerparc to sell energy to NorthWestern Energy under the requirements of the federal Public Utility Regulatory Policies Act (PURPA). The projects were developed as PURPA qualifying facilities (QFs) and were granted 25-year standard rate power purchase agreements by NorthWestern Energy, at a rate of approximately \$66/MWh. While QFs up to 80 MW may negotiate a rate with NorthWestern Energy or appeal to the PSC to set an appropriate rate, standard rates are limited to facilities with a generating capacity of three MW or less and are based on the utility’s avoided cost (the marginal cost the utility would pay to procure power from another source). The standard rate under which each of the six original Enerparc projects were developed was suspended by the PSC in June of 2016. The commission approved revised standard offer terms in October of 2017 with a 15-year contract length and a rate of \$37.26/MWh during high demand hours, and \$28.14/MWh during low demand hours³⁶.

³⁵ Source: Cypress Creek Renewables.

³⁶ Montana Public Service Commission, Docket D2016.5.39

Biomass, Methane and Landfill Generation in Montana

Montana has millions of acres of forested and agricultural land with potential to provide biomass resources for electric generation, thermal energy production, and alternative transportation fuels. The state also shows potential for electric generation fueled by the methane and carbon dioxide produced from decomposing and fermenting municipal and agricultural waste. However, development of biomass energy resources in Montana is limited, primarily because there are lower-cost renewable and conventional fuel resources available.

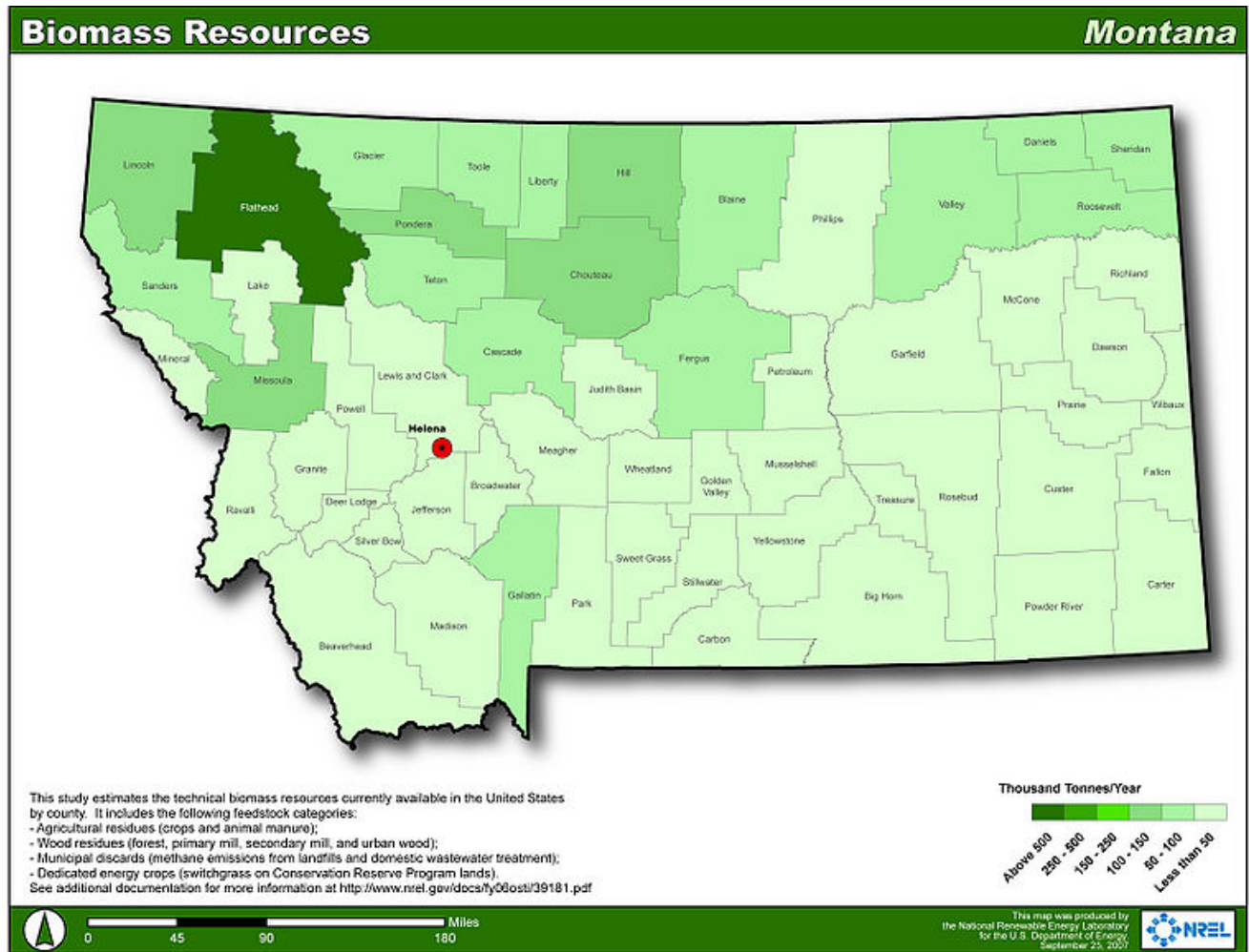
Woody Biomass

Woody biomass, in the form of pellets, chips and cordwood, is used in a variety of power production and thermal heating applications. The most economical source of woody biomass fuel is associated with saw log harvest and saw mill operations. This type of electric generation in Montana remains limited because it is not currently cost-competitive with other electric generation resources. High harvest and transportation costs for woody biomass limit its economic viability as a standalone electricity supply resource. Combined heat and power (CHP), is the most economical option for generating electricity from woody biomass. CHP is also known as cogeneration and it allows for electricity generation and production of useful thermal energy in a single, integrated system. This allows for greater efficiencies and cost savings in facilities that have large demands for thermal energy such as heating, steam, hot water and even cooling. Biomass CHP facilities often achieve between 60 and 80 percent energy conversion efficiencies. Existing sawmills in Montana provide an opportunity for CHP because they can use the electricity generation to power the operation and produce heat and steam for drying lumber using on-site woody biomass.

The only developed biomass CHP facility in Montana is located at the F.H. Stoltze Land and Lumber Company in Columbia Falls. This 2.5-megawatt cogeneration facility generates heat and steam from burning on-site wood waste. The steam output powers a turbine to generate electricity that is sold to Flathead Electric Cooperative through a power purchase agreement. Excess heat captured from the plant is used in the lumber mill's kilns for wood drying.

Woody biomass is also used as fuel in boilers to heat schools, hospitals and other community buildings. There are currently 14 woody biomass heating projects at facilities in western Montana.

Figure 4. Montana's Biomass Energy Resources. Source: NREL



Biogas and Methane

Organic matter such as agricultural waste, manure, municipal waste, and plant material in an anaerobic environment can all produce gases such as carbon dioxide and methane, which make up biogas. Biogas can be burned in an engine to run an electrical generator. Municipal waste facilities (landfills) are required to prevent methane produced by decaying garbage from leaking into the air and groundwater. These facilities provide an ideal location for generating electricity from biogas. Methane produced from decaying garbage at the Flathead County Landfill near Kalispell is captured with a network of buried pipes and burned in an on-site generator to produce 1.6 megawatts of electricity. The generator provides enough electricity to power approximately 1,600 customers of Flathead Electric Cooperative. Additionally, Montana Dakota Utilities installed equipment to capture, clean, and process methane at the Billings Regional Landfill beginning in late 2010. The resulting natural gas is fed into MDU's pipeline system and delivered to homes and businesses in the area.

Distributed Generation in Montana

“Distributed generation” refers to geographically dispersed, utility customer-owned renewable energy systems, usually interconnected on the customer side of a utility meter. In 1999, with the passage of Montana net metering legislation (SB 409; Chapter 323, Laws of 1999) by the Montana Legislature, NorthWestern Energy customers were given the opportunity to interconnect a grid-compatible solar, wind, or hydropower generator with a generating capacity of 50 kilowatts³⁷ or less on their property. A net metering system provides energy to the customer generator’s premises; any excess energy is exported back to the utility and credited on the customer’s bill. That credit may be carried forward over a twelve-month billing cycle. The utility does not pay customer generators for excess energy provided to the utility. NorthWestern net metering customers are credited for excess generation at the retail rate, however legislation that passed in 2017 (HB 219; Chapter X, Laws of 2017) initiated a utility-led review of the costs and benefits of net metering systems and allows for the Montana Public Service Commission (PSC) to establish separate rate classes and different rates for new customer generators.

The (PSC) approved a net metering tariff for Montana-Dakota Utilities in 2008, modeled closely after the state’s statute. Most of the state’s electric cooperatives have established their own net metering policies with varying terms and requirements.

The number of reported net metering systems and generating capacity is listed below by electricity provider (Table 8). Of the net metered generating capacity reported, solar PV systems account for 90 percent of total capacity. Wind turbines represent the second largest type of generation, followed by micro-hydro generators.

³⁷ For reference, a 50-kilowatt (kW) solar PV array in Helena would generate approximately 69,000-kilowatt hours annually, more than 7 times the amount of energy consumed by an average NorthWestern Energy residential customer.

Table 9. Net metering facilities interconnected to selected Montana utilities³⁸

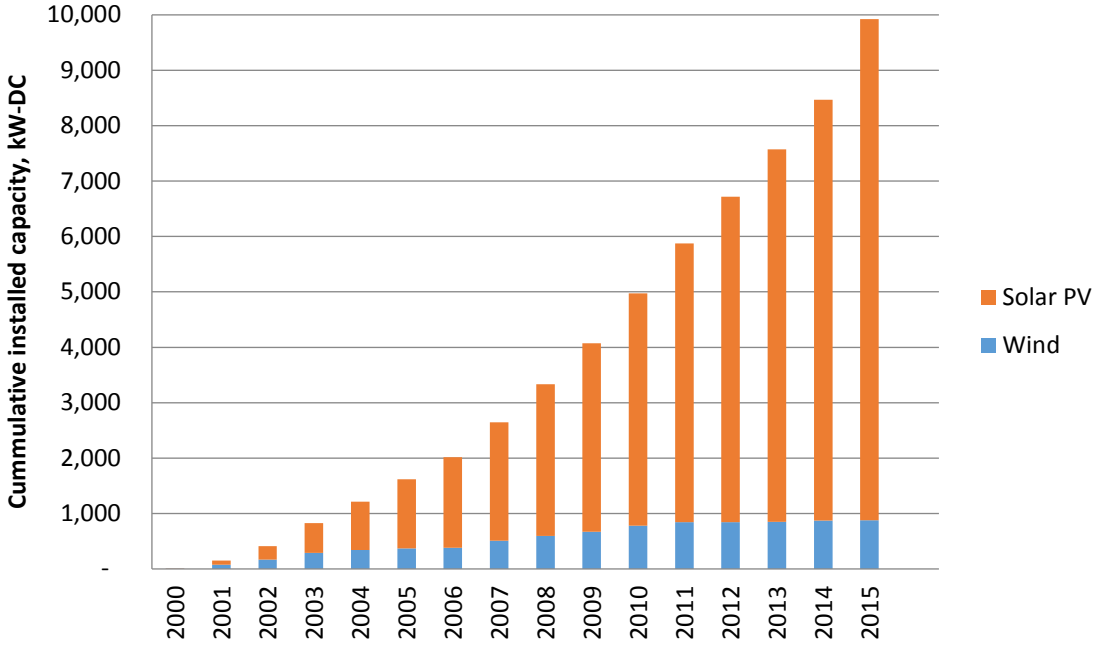
	Number of net metering systems	Generating capacity of net metering systems (kW-DC ³⁹)
Beartooth Electric Co-op	41	354
Big Flat Electric Co-op	0	0
Big Horn Electric Co-op	2	4
Fall River Electric Co-op	0	0
Fergus Electric Co-op	20	212
Flathead Electric Co-op	52	501
Glacier Electric Co-op	6	75
Goldenwest Electric Co-op	0	0
Hill County Electric Co-op	9	38
Lincoln Electric Co-op	10	35
Lower Yellowstone Electric Co-op	2	10
Marias River Electric Co-op	0	0
McCone Electric Co-op	0	0
Mid-Yellowstone Electric Co-op	2	N/A
Mission Valley Power	23	103
Missoula Electric Co-op	41	227
Montana Dakota Utilities	6	17
Northern Lights Electric Co-op	8	35
NorthWestern Energy	2,143	11,726
Park Electric Co-op	29	196

Technology and production advances in the solar PV industry have helped drive down the cost of distributed solar PV installations relative to other distributed generation technology. Historical NorthWestern Energy net metering data show a trend in which installations of distributed wind energy systems have largely decreased since 2011, while installations of solar PV systems have accelerated in recent years (Figure 1).

³⁸ Energy Information Administration, U.S. Department of Energy. (2017). *Form EIA-861M, Net metering, through August 2017*. Retrieved from: <https://www.eia.gov/electricity/data/eia861m/>.

³⁹ The nameplate generating capacity of distributed PV systems is typically reported in kilowatts of direct current (DC) voltage. PV modules produce DC voltage, which is converted by inverters to AC voltage in order for the output to be compatible with the transmission and distribution grid. While residential and small-commercial PV systems are described by their DC rating, utility scale solar farms and power plants are typically rated by their AC output.

Figure 5. Cumulative installed generating capacity, net metering systems, NorthWestern Energy⁴⁰



The adoption rate of distributed generation hinges on multiple factors, including the installed cost of the equipment, eligibility of the owner for federal and state tax credits and other incentives, and the kilowatt-hour rate at which excess generation is credited to the owner. National data reported for the first quarter of 2017 showed installed cost for residential PV (2.5-10 kW) hovering around \$4.00/watt, with the installed cost for small commercial systems (10-100 kW) closer to \$3.80/watt⁴¹. That cost is down from \$4.50/watt and \$4.00 for residential and small commercial systems respectively in 2014. Data from Montana’s Alternative Energy Revolving Loan Program (AERLP) suggest installed costs for distributed solar PV installations are lower than national averages. The average pre-incentive installed cost per watt for grid-tied systems funded by the AERLP in July 2016 through June 2017 was \$2.78/watt⁴². The average is based on cost data from thirty-eight systems ranging in size from two to 50 kW-DC.

After accounting for local costs, available tax incentives, and Montana-specific utility rates, the payback for a residential solar PV array installed in Montana ranges from approximately 13 years for a NorthWestern Energy customer to approximately 23 years for a member of Flathead Electric Co-op, which has significantly lower retail electricity rates and higher fixed monthly

⁴⁰ NorthWestern Energy, Montana Renewable Energy Association
⁴¹ National Renewable Energy Laboratory, U.S. Department of Energy. (2017). *Q4 2016/Q1 2017 Solar Industry Update*. Retrieved from: <https://www.nrel.gov/docs/fy17osti/68425.pdf>.
⁴² Montana Department of Environmental Quality.

charges than NorthWestern⁴³. The useful life of a solar PV array is typically considered to be 25 years or longer.

Community Solar

Montana’s first community solar installations were built in 2016 and 2017 by five separate electricity service providers. There are four “virtually net metered” or “shared solar” projects operated by rural electric co-ops in which co-op members have purchased one or more panels of a solar PV array sited on co-op property, or in one case on a public school. The participating members are given a credit on their monthly electric bill equal to the output of their proportional ownership in the array. The projects were built using a variety of different funding sources including, in some cases, grants from the U.S. Department of Agriculture Rural Energy for America Program, and the Bonneville Environmental Foundation. NorthWestern Energy, which is currently restricted in state law from operating a similar virtual net metering project has built a 385 kW solar PV array on land owned by the City of Bozeman. The project is being used to evaluate the output of the solar array compared to a variety of Bozeman-area residential and commercial utility customers. Montana State University is also a partner in the pilot project.

Table 10. Community solar installations in Montana⁴⁴

	Year installed	Total installed community solar capacity (kW-DC)	Number of Panels	Cost per Panel	Outside grant funding	Approximate payback per panel (inclusive of federal investment tax credit)
Ravalli Electric co-op	2016	50 kW	176	\$750	Yes	20 years
Missoula Electric Co-op	2016	100 kW (two 50 kW phases)	358	\$700	Yes for phase one, no for phase two	23 years
Flathead Electric Co-op	2016	101 kW	356	\$900	Yes	21 years
Fergus Electric Co-op	2017	100 kW	324	\$595	No	9.4 years
NorthWestern Energy	2016	385 kW	1,152	N/A—Panels or shares in pilot project were not sold	No	N/A—Pilot project not structured with subscription model

⁴³ Norris, Benjamin, P. Gruenhagen, M. Chang, and S. Fields. (2017). *Montana Solar Market Assessment*. Clean Power Research and Synapse Energy Economics. Prepared for Montana Department of Environmental Quality. Retrieved from: <http://deq.mt.gov/Portals/112/Energy/Documents/Montana%20Solar%20Market%20Assessment%20-%20Final.pdf?ver=2017-09-15-114156-387>, pg. 21.

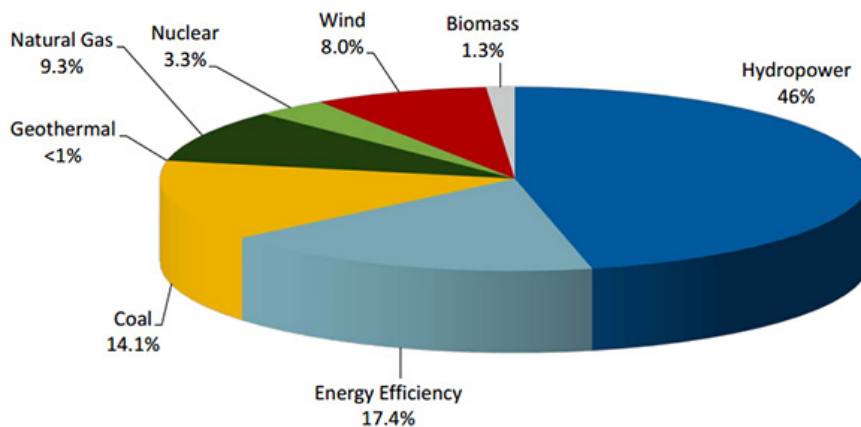
⁴⁴ Ibid.

Energy Efficiency in Montana

Energy efficiency and conservation are often used interchangeably, but the terms describe differing methods to reduce energy consumption. Energy efficiency reduces the energy consumed in performing a task. Energy conservation is often behavioral and aims to reduce overall energy use. For example, installing an LED light bulb instead of an incandescent light bulb is considered an energy efficiency measure. Turning the same light off when it is not in use is energy conservation. Energy efficiency is often measured in terms of “average megawatts” (aMW) savings that utilities can achieve through customer energy savings.

Energy efficiency can help utilities meet growing customer demand by yielding energy savings that reduce the need for new generation resources. Energy efficiency also reduces the need to build new powerlines and upgrade or replace transmission and distribution system equipment. The avoided cost provided by energy efficiency has led many utilities to categorize energy efficiency as a resource, on par with any other generating resources. In the Northwest, energy efficiency was the second largest electricity resource after hydropower in 2014 (Figure X).

Figure 6: Percentage of Load Growth Met by Electricity Resources in Northwest States (OR, WA, ID, MT)



Source: Northwest Power Planning and Conservation Council

Demand-side management (DSM) is one energy efficiency program that encourages consumers to modify their level and pattern of energy usage. Demand side management programs are often utility- administered and include financial incentives for customers to reduce or defer their energy use. These programs are designed to save consumers money and allow utilities to avoid spending ratepayer dollars to build new resources and upgrade existing infrastructure.

Some DSM programs can be targeted at reducing energy use during the highest use (peak) periods. Utilities often make infrastructure investment decisions based on consumer demand during peak periods. Demand response is a type of demand side management that can cause certain consumers to reduce their energy use during peak periods. These consumers could be large such as a refinery or as small as an individual home. Montana’s current energy policy (Title 90, chapter 4, part 10, MCA) promotes demand-side management.

Energy Efficiency Savings

In 2016, United States utilities invested approximately \$7.6 billion in energy efficiency and saved approximately 25.4 million megawatt-hours (MWh), or 2,899 average megawatts of electricity.⁴⁵ This savings is the equivalent of nearly 1.5 times Montana’s total annual electricity use. Most energy savings can be attributed to federal, state, and local policies and utility-initiated programs that encourage energy efficiency in the industrial, commercial, and residential sectors. Most of Montana’s current energy efficiency savings are driven by utility programs, state-led initiatives, and energy efficiency incentives. Montana’s largest utility, NorthWestern Energy set a goal in their last biennial resource plan to achieve six average megawatts of energy savings per year between 2010 and 2024 for 84 average megawatts by 2025. Since 2010, the utility has achieved greater annual energy savings than 6.0 average megawatts and spent less to achieve these energy savings than budgeted.⁴⁶ Between 2011 and 2014, NorthWestern Energy achieved about 9.5 aMW of energy savings per year on average.

The electric cooperatives in western Montana receive their electricity supply from the Bonneville Power Administration (BPA) and participate in BPA energy efficiency programs to varying degrees. Overall, the BPA energy efficiency programs in Montana have averaged about 2.3 aMW of savings in the last several years. In total, Montana utilities average about 11.5aMW per year in energy efficiency savings.

Energy Efficiency Programs and Policies

One common energy efficiency policy is an Energy Efficiency Resource Standard (EERS). These policies establish goals for utilities to achieve energy efficiency savings over several years. Energy efficiency standard targets are based on a percentage of retail sales, achieved incrementally over time. Montana has not adopted an EERS for utilities. Some utilities in Montana offer rebates and other incentives for customers who purchase energy-efficient appliances and light bulbs, receive energy audits, and participate in other energy conservation and efficiency programs. Most of the funding for electric and gas utility efficiency programs in

⁴⁵ American Council for an Energy-Efficient Economy. *The 2017 State Energy Efficiency Scorecard*. September 2017.

⁴⁶ NorthWestern Energy. *2015 Electricity Supply Resource Procurement Plan. Chapter 3: Demand Side Management. Table 3-1 DSM Acquisition Plan and Budget*.

Montana comes from the Universal Systems Benefits (USB) fund passed by the legislature in 1997 as part of the electricity deregulation legislation. USB programs were established to ensure continued utility funding to support low-income energy assistance, energy conservation, and renewable resource projects. Investor-owned utilities and electric cooperatives are required to establish and fund USB programs that meet these three public purposes. There is a USB surcharge on each electric and gas utility customer's bill that funds the utility USB programs. On average, this charge adds about one dollar to customers' natural gas and electric bills each month. Since 2007, more than \$60 million of funding has been contributed by utilities toward USB programs in the state.

Other policies such as energy codes reduce energy consumption in the building sector. Buildings consume 74 percent of electric consumption and 41 percent of the total energy used in the United States. Montana's residential energy code requires state standards for factors such as insulation levels, thermal ratings for windows, and heating appliance performance. Montana's current statewide energy code for new residential buildings is based on the 2012 International Energy Conservation Code (IECC). Every three years, the Montana Department of Labor must review the energy code and consider whether to adopt all or parts of the latest versions of national and international building standards for energy efficiency.

Energy Efficiency Savings Potential

The Northwest Power Planning and Conservation Council develops a regional power plan every five years for Idaho, Montana, Oregon, and Washington. The Northwest Power Act of 1980 established the Council and the purposes of the regional power plan. One of the primary purposes is to encourage conservation and efficiency in the use of electric power within the Pacific Northwest. Since 1980, more than half of the northwest region's growth in demand for electricity has been met with energy efficiency and the region has exceeded annual efficiency targets set by the Council every year since 2005. The Council published and adopted the seventh iteration of the regional power plan in February 2016. The Seventh Power Plan estimates that across the four states there are 4,300 average megawatts of electricity sector conservation that can be economically developed between 2015 and 2035. This energy efficiency potential is enough to meet all expected load growth during that 20-year planning horizon. This is a potential savings equivalent of 2.5 times Montana's total electricity consumption in 2016. A 2016 energy efficiency market study conducted for NorthWestern Energy determined that the economic energy efficiency potential for the utility between 2015 and 2034 is approximately 94 aMW, or 11.5 percent of forecasted baseline sales.⁴⁷

⁴⁷ Nexant, Inc. *Electricity Energy Efficiency Market Potential Study for NorthWestern Energy*. November 2016

Demand Response

Demand response is a specific type of demand side management that represents a voluntary and temporary change in consumer electricity use when the power system is stressed. Demand response programs often create price signals for consumers to reduce electricity use at the times of the day and during certain periods of the month when electricity use is the highest (peak load). Reduced electricity during peak periods can help significantly reduce costs associated with transmission and other electricity system upgrades because systems are frequently built, upgraded and expanded to accommodate peak electricity use. The Northwest Power Planning and Conservation Council's regional power plan identifies cost-effective demand response resources as the least cost-solution for meeting the region's new peaking capacity needs by 2021. The plan estimates that a minimum of 600 MW of cost-effective demand response is available to meet regional peak capacity needs. Residential and commercial voluntary demand response programs available in Montana have so far been limited to NorthWestern Energy's demand response pilot program for select customers in Helena and a demand response program for Flathead Electric Cooperative's residential customers. Both voluntary programs have focused on offering incentives to participating customers to install smart thermostats and smart appliances to control their energy use during peak times.

Montana's Electric Transmission and Distribution Grid

The electric transmission and distribution grid serves the vital function of moving power from generating plants to customers and their electric loads (demand).⁴⁸The grid reliably provides this service even when individual elements of the transmission grid are out of service.

Ownership and the rights to use the transmission system are complex matters. The use is further complicated by line congestion on in-state and interstate lines. The methods by which electricity flows on the lines is changing over time. Electric transmission also faces increasing regulation at the national level, new markets at the regional level, and increasing amounts of variable generation on the system. The construction of new in state and out-of-state transmission lines to expand the capacity of the current grid and make new Montana power generation possible also provides a challenge, raising questions about property rights, economic development, and whether new lines are actually needed.

Basics of the Grid

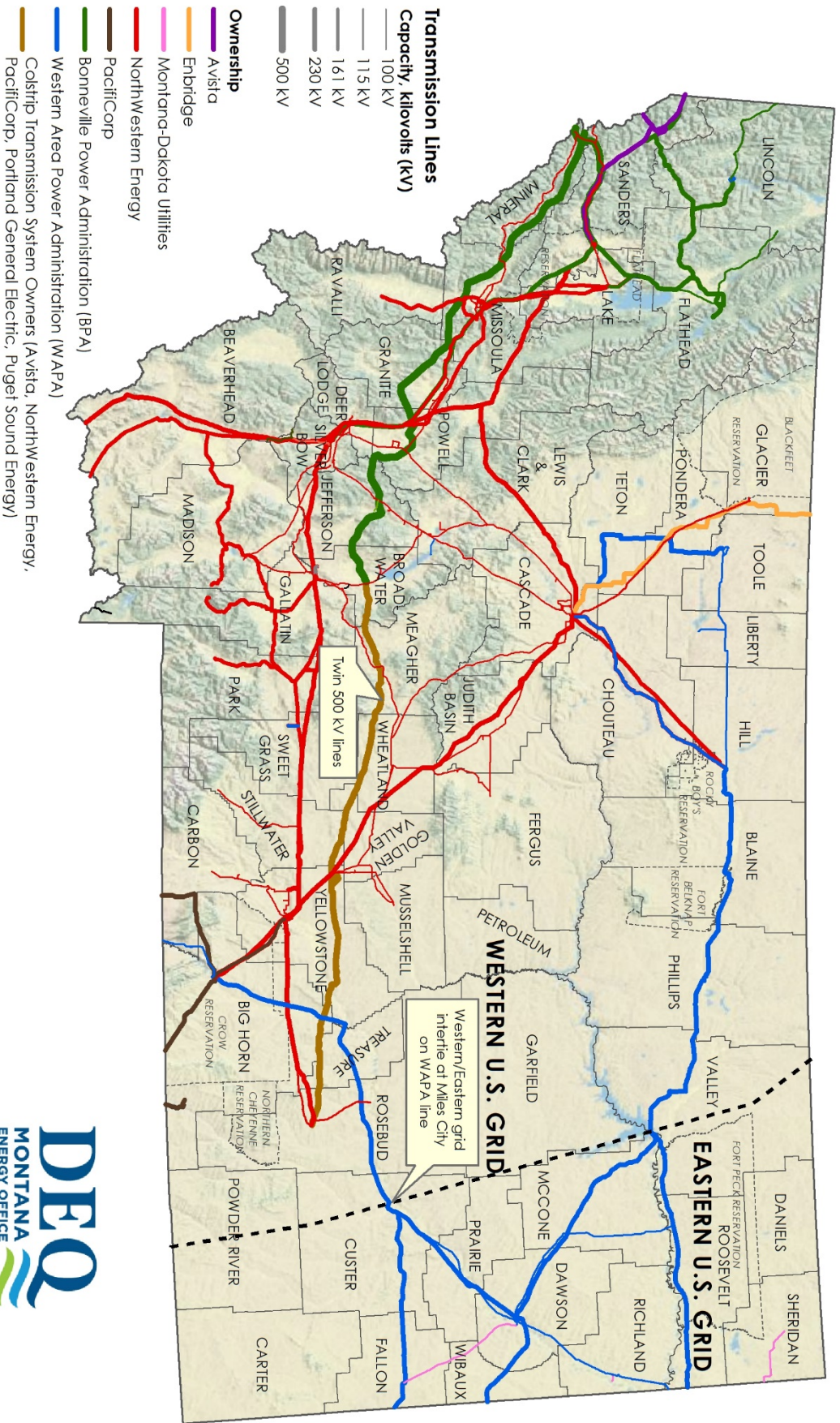
- Transmission lines are high voltage lines, usually 69 kV and above, that deliver electricity over long distances. The power on these lines is usually stepped down to a lower voltage to serve demand. Distribution lines are those lines that are smaller than 69 kV and deliver power directly to cities, homes, and businesses. Transmission lines are typically seen on large metal or wooden structures high above the ground. Distribution lines are typically found in neighborhoods and along highways on much smaller wooden poles.
- NorthWestern Energy runs the largest transmission balancing area in Montana. The Bonneville Power Administration operates a large system in the northwest part of the state. The Western Area Power Administration runs part of that system in the northeast and eastern region of the state. Most distribution in Montana is ran by NorthWestern Energy, one of 25 coops, or Montana Dakota Utilities. Montana spans parts of both the Eastern Grid and Western Grid.

Transmission in Montana

The transmission network in Montana, as in most places, initially developed because of local decisions in response to a growing demand for power. The earliest power plants in Montana were small hydroelectric generators

⁴⁸ Electric loads are referred to as electricity demand.

Montana Transmission Lines



Last updated January 2018



and coal-fired steam plants built at the end of the nineteenth century to serve local needs for lighting, power, and streetcars. The earliest long-distance transmission lines were built from the Madison hydroelectric plant, near Ennis, to Butte and from Great Falls to Anaconda. The latter was, at the time of construction, the longest high-voltage (100 kilovolt or kV) transmission line in the country, and is still operational today. These first lines were built to service the mining and smelting operations in the Butte-Anaconda area.

The Montana Power Company (MPC) presided over Montana's first integrated transmission system. As the transmission system grew, the MPC expanded its network to include 161 kV lines and ultimately a 230 kV backbone of lines. The federally owned Western Area Power Administration (WAPA) electric transmission system in Montana began to transport electricity to Fort Peck in the 1930s during construction of the dam there and then to move power to markets following construction of the generators at the dam. WAPA's system continued to grow in northern and eastern Montana as its needs to serve rural electric cooperatives expanded.

Long-distance interconnections between Montana and other states did not develop until World War II. During the war, the 161 kV Grace Line was built from Anaconda south to Idaho. Later, BPA extended its high-voltage system into the Flathead Valley to interconnect with Hungry Horse Dam and to serve the now-defunct aluminum plant at Columbia Falls. In the mid-1980s, a double-circuit 500 kV line was built from the Colstrip generating plant in eastern Montana to the Idaho state line near Thompson Falls where it connects into two separate 500 kV lines that head into Washington State. The double circuit 500 kV lines are Montana's largest. By 2002, the MPC sold its generation, transmission, and energy holdings, becoming Touch America. Its transmission assets were purchased by NorthWestern Energy (NWE) and most of its generation was sold to PPL Montana.⁴⁹

Most intrastate electric transmission in Montana is currently owned by NWE and WAPA. BPA has major interstate lines in northwest Montana and PacifiCorp owns a few smaller interstate lines as does Avista. WAPA lines in eastern Montana cross into North Dakota and serve local Montana loads in the eastern portion of the state. In most cases, MDU's distribution service uses WAPA transmission lines and in a few cases co-owns the line. The electric distribution cooperatives in Montana not served by a major utility use the NWE, MDU, BPA, and WAPA lines for transmission.

⁴⁹ In 2015, PPL Montana sold its hydroelectric generation assets to NorthWestern Energy.

Montana is an electricity export state. Currently, the state's net electricity exports are almost equal to the amount of electricity consumed in the state each year. For example, in 2015, Montana generated 29,104 GWh and consumed just 14,207 GWh.⁵⁰ There are four primary electric transmission paths that connect Montana to the rest of the Western Interconnect and larger markets in the West.⁵¹ These paths are:

- Montana to the Northwest – Path 8
- Montana to Idaho – Path 18
- Montana Southeast – Path 80⁵²
- Montana to Alberta – Path 83

Typically, power flows from east to west over Path 8, north to south over Paths 18 and 80, and varies on Path 83. Directionally, energy on these transmission lines typically flows from Montana to out-of-state loads, although on occasion electricity flows into Montana on these same lines. There is no official “path” leaving the most eastern portion of the state. It is important to note that Path 8 is very large, rated at 2200 MW east-to-west, whereas Path 18 is rated at 383 MW north-to-south. The Montana Alberta Tie Line path is rated at approximately 300 MW in both directions at this time and the transfer between Western and Eastern grids at Miles City are rated at 200 MW. It is also important to note that these path ratings change over time.

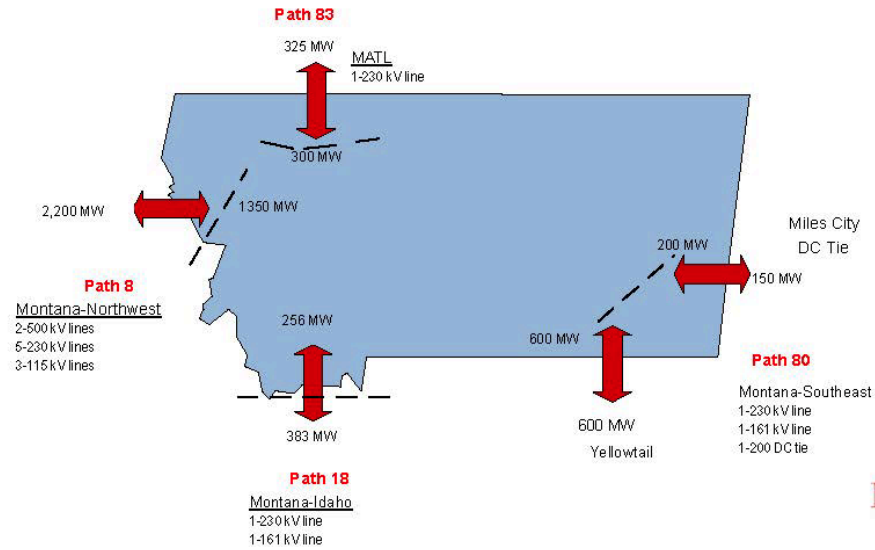
As U.S. and Canadian utilities grow increasingly dependent on each other for support and reliability, the North American transmission network has developed into two major interconnected grids, divided roughly along a line that runs through eastern Montana south to Texas. The western United States is a single, interconnected, and synchronous electric system that will be referred to in this chapter as the U.S. Western Grid (**Figure 5**). Most of the eastern United States is a single, interconnected, and synchronous electric system as well (U.S. Eastern Grid). Texas and parts of Quebec are exceptions. Texas is considered a separate interconnection with its own reliability council and is referred to as ERCOT.

⁵⁰ U.S. EIA; “consumed” referred to electricity sales. It is possible that slightly more was actually consumed in-state

⁵¹ Transmission “paths” are groups of parallel transmission lines that carry power within the same general areas.

⁵² WECC 2013 Path Rating Catalog, <http://www.wecc.biz/library/Pages/Path%20Rating%20Catalog%202013.pdf>.

Figure 7. WECC-Rated Paths



80



Source: NorthWestern Energy. Note the MW capacity numbers could change over time

The Eastern and Western grids are not synchronous with each other. The two grids are only weakly tied to each other with converter stations. One of these stations is located at Miles City. The station is capable of transferring up to 200 MW of electricity in either direction from one grid to another.⁵³ Depending on transmission constraints, a limited amount of additional power can be moved from one grid to the other by shifting hydroelectric generation units at Fort Peck Dam.

Figure 8. U.S. Western Interconnection-Major Lines



Most of Montana is integrally tied into the U.S. Western Grid. The easternmost part of the state, with less than 10 percent of total Montana load, is part of the U.S. Eastern Grid and receives its power from generators located in that grid, including generators as far away as the east coast.

Certain transmission lines in Montana are regulated under the Montana Major Facility Siting Act (MFSA) administered by the Montana Department of Environmental Quality (DEQ). MFSA works to ensure the protection of the state's environmental resources, ensure the

⁵³ Donald G. Davies, Chief Senior Engineer, Western Electricity Coordinating Council.

consideration of socioeconomic impacts from regulated facilities, provide citizens with an opportunity to participate in facility siting decisions, and establish a coordinated and efficient method for the processing of all authorizations required for regulated facilities. In general, electrical transmission lines greater than 69 kV and longer than ten miles in length are covered under MFSA if they meet certain criteria. Historically, the Montana PSC has jurisdiction over cost recovery for new transmission projects that serve Montana retail customers, but not over siting decisions.

How the Transmission System Works

There are big differences between the physical properties and economics of a typical alternating current (AC) electrical transmission system, as well as between its commercial operation and management. The flow of power on a transmission network (the charge of electrons) obeys the laws of physics. The commercial transactions that ship power across the grid follow a different, and not fully compatible, set of rules from the actual flow of power.

Transmission “paths” are generally groups of more or less parallel transmission lines that carry power within the same general areas. A given transmission path can consist of one or more transmission lines that transport electricity from one major electricity “node” to another. Nodes may consist of large generators, large loads, or a major substation. For example, the two transmission lines that run from the Dillon, MT area into Idaho, the Grace line and the AMPS line, form what is called “Path 18”.

The transmission grid is sometimes described as an interstate highway system for electricity, but the flow of power on an AC grid differs in very significant ways from the flow of most physical commodities. When power is sent from one point to another on the transmission grid, the power will flow over all connected paths on the entire network (e.g. The Western Grid), rather than a single path (the scheduled path) or even the shortest distance path. A power transmission from one point to another will distribute itself so that the greatest portions of that power flow over the paths (transmission lines) of lowest resistance. The resistance or impedance of a given transmission line depends on its voltage and current. Power flows generally cannot be constrained to any particular physical or contract path, but instead follow the laws of physics. It should be noted, however, that there are tools available to redirect some flows of power under certain economic or extreme circumstances.

Electric power flows in opposite directions also net against each other. If traffic is congested in both directions on an interstate highway, it will come to a halt in all lanes and not a single additional vehicle will be able to enter the flow. By contrast, if 100 MW is shipped westbound on a given transmission line from point A to point B and 25 MW is sent simultaneously eastbound on that same line from point B to point A, the actual measured flow on the line is 75 MW in a westbound direction. If 100 MW is sent in each direction on the same line at the same

time, the net measured flow is zero. In this situation, additional power could still physically flow in either direction up to the full capacity of the line in that particular direction.

Electric power also travels near the speed of light and is generally consumed at the same moment it is generated. Almost all generated power distributed over the grid must be consumed instantaneously off of the grid.⁵⁴ Unlike gas, oil, coal, and other energy sources, electricity currently cannot yet be stored economically as inventory in large quantities. As a result, transmission operators constantly balance electricity supply (generation) and demand (consumption) in every moment. This is a complicated process that involves significant labor and technology, complicated balancing routines, numerous transmission jurisdictions, and federal and state oversight.⁵⁵ The fact that almost all power generated on the grid must be consumed instantaneously is the reason why steady generation sources fueled by coal or flexible resources such as natural gas (that can ramp up and down) are often easier to manage than some renewable sources such as wind and solar, whose generation levels vary with the weather and are not under the control of grid operators. It is, in part, because of the constant need to balance supply and demand that the electric transmission system has been called the most complicated machine on the planet. As battery technology quickly progress, higher levels of electricity storage are becoming a reality, but still remain a small fraction of total power being delivered.

The actual physical flows on a grid are the net result of all generators and all loads (electricity demands) on the network at a given instant in time. In any real transmission network, there are many generators located at hundreds of different points on the network and many loads of varying sizes located at thousands of different locations. Because of netting flows, actual path loadings at any given moment depend on the amounts and locations of electric generation and load as opposed to the contracted schedules in place at a given time. Actual path capacity loads are also impacted by congestion of certain lines or paths on the grid and outages on the grid. For example, Path 8 has a 2,220 MW path rating east to west under ideal conditions, but often has a lower rating under various grid and weather conditions.

In contrast with the physical reality of the transmission network, management of transmission flows has historically been by “contract path”. A transaction involving the shipment of power between two points, referred to as the contract path, is allowed to occur if space has been purchased on any path connecting the two points. Purchasers include the utilities or companies

⁵⁴ With current technology, a small fraction of generated power can be stored in flywheels, in salt caverns (usually associated with wind power), in melted salts (solar farms), in large batteries, and in pumped storage.

⁵⁵ There are several high-tech and human mechanisms for balancing supplies and demand on the entire Western Grid and within individual operating areas, like NWE’s balancing authority in Montana. There are also new technologies being developed to economically allow the storage of large quantities of electricity on the grid, but they are not available yet.

owning the lines or the entities holding rights to use those wires along that path at any given hour of the year (firm rights). Purchasers may also include entities that do not own firm rights, but want to use the grid on a short-term basis when available.

In a perfect world, such transactions flow on the contract path agreed to by the interested parties. Due to the laws of physics that ultimately govern the grid and grid conditions at any given time, however, portions of any contracted transaction flow along other paths aside from the contracted path. These are “unscheduled flows”. An unscheduled flow is the result of the difference between the physics of the transmission system and the scheduling paradigm (contract rights). Inadvertent flows are also flows that are not scheduled but can be caused by a variety of events, including but not limited to unplanned loss of generators or load, data errors, and scheduling errors.⁵⁶

On the Western Grid, major unscheduled flows occur around the entire interconnection at any given moment. For example, power sent from hydroelectric dams in Washington to California loads flows directly south over the contracted pathways, but also flows clockwise through Idaho, Utah and Colorado into New Mexico and Arizona and then west to California. Power sent from Colstrip in eastern Montana to Los Angeles flows mostly west on Path 8 to Oregon and Washington, via the double-circuit 500 kV line that runs through Garrison and Taft, and then south to California. This westerly path is its contracted path. However, a small amount of Colstrip power also flows over other paths on its way to California including south through Wyoming on Path 80.

Unscheduled flows may interfere with the ability of transmission path owners to make full use of their contractual rights. The Western Electricity Coordinating Council (WECC) addresses unscheduled flows with an unscheduled flow mitigation plan. Utilities (or other transmission owners) whose wires are affected accommodate a certain amount of this unscheduled flow by reducing their available transmission capacity. If further reductions are necessary, the path owners can request an adjustment of flows throughout the interconnection. Path owners can also call for curtailment of schedules across other paths that affect their ability to use their own path.⁵⁷

If scheduled flows do not exhaust a path rating (fill up the line), the unused capacity may be released as “non-firm” transmission capacity. Non-firm capacity is available during only some hours of the year, not during all hours as with firm capacity. Non-firm capacity is generally not purchased far in advance. Owners of transmission capacity who do not plan to use extra room on their lines can in some instances release it early. Owners, however, are often reluctant to do so because of needs for flexibility or a desire to withhold access to markets from competitors.

⁵⁶ Byron Woertz, WECC, Manager, System Adequacy Planning

⁵⁷ Ibid.

At least some of Naturener's wind farm power in north-central Montana has used non-firm transmission line room in the past to move power to the coast.

Transmission adds monthly charges to electricity bills and can result in different electricity costs across regions. Electricity prices are impacted by the cost of transmission service to move power from one area to another. For example, a generator in Montana who wishes to sell to the Mid-Columbia (Mid-C) market, the major electricity trading hub closest to Montana and located in Washington, pays transmission charges on the NWE system and then on either the BPA or Avista system. These charges are necessary to transmit, or "wheel", the power from the NWE system area to Mid-C.⁵⁸ These additional costs mean that the wholesale-priced power from generation in NWE's territory for local Montana consumption is generally sold in Montana at a discount relative to the Mid-C market price for electricity because of the avoided transmission charges of sending that power into the Mid-C hub. In this manner, transmission pricing is integrally linked to electricity pricing throughout the region and the country. If transmission in a certain area tends to be congested, this can lead to higher electricity prices in areas that import that electricity (such as Southern California).

Jurisdiction over transmission rates resides both with state utility regulators and with the Federal Energy Regulatory Commission (FERC), depending on circumstances. In the case of NWE, transmission rates for bundled retail customers are determined by the Montana PSC. Wholesale transactions that use NWE's transmission facilities pay the FERC-regulated transmission price. A standard feature of FERC-regulated transmission service is the Open Access Transmission Tariff (OATT). Each FERC-regulated transmission provider, including NWE and BPA, posts the terms and conditions of its transmission service in its FERC-approved OATT. The OATT identifies various transmission product offerings, including network integration service, point to point (PTP) transmission service, and ancillary services.

PTP transmission service allows a transmission customer to wheel power to and from distinct locations. Ancillary services are services needed to support transmission service and maintain reliable operation of the transmission system. Each transmission provider's OATT includes terms and pricing for ancillary services that are required to support transmission service and maintain system balance. In general, FERC's treatment of these services is standardized across the country.

⁵⁸ In electric power transmission, **wheeling** is the transportation of electric energy (megawatt-hours) from within an electrical grid to an electrical load outside the grid boundaries. The two types of wheeling are a wheel-through, where the electrical power generation and the load are both outside the boundaries of the transmission system and a wheel-out, where the generation resource is inside the boundaries of the transmission system but the load is outside. Wheeling often refers to the scheduling of the energy transfer from one Balancing Authority to another. [https://en.wikipedia.org/wiki/Wheeling_\(electric_power_transmission\)](https://en.wikipedia.org/wiki/Wheeling_(electric_power_transmission))

Grid Capacity and Reliability

The amount of power that a transmission line can carry is limited by several factors, including its thermal limit. When electricity flows get high enough on a particular line, the wire heats up and stretches, eventually sagging too close to the ground or to other objects. Arcing -- electricity traveling to the ground -- may result. When that happens, the transmission line can fail, instantly stopping electricity flow and affecting the rest of the grid. Inductive characteristics on a line are associated with magnetic fields that constantly expand and contract in AC circuits wherever there are coils of wire, including transformers. This is not an issue for DC transmission lines.

The most important reason for determining the total amount of power that a line can carry is reliability. Reliability is the ability of the transmission system to provide full, uninterrupted service to its customers despite the failure of one or more component parts of that system. The transmission network is composed of thousands of elements that are subject to failure. Causes include lightning, ice, pole collapse, animals shorting out transmission lines, falling trees, vandalism, and increasingly terrorism (including cyber-attacks). Reliability of the grid is ensured by building redundancy into it. The grid is designed to withstand the loss of key elements and still provide uninterrupted service to customers.

Reliability concerns limit the amount of power that can be carried over a line or path to the amount of load that can be served with key elements out of service on the grid. Within NWE's service area in Montana the reliability of the transmission system is evaluated by computer simulation through long-term transmission planning. The network is simulated at future load and generation levels while taking key individual elements out of service. The simulation determines whether all loads can be served with voltage levels and frequencies within acceptable ranges. If acceptable limits are violated, the network must be expanded and strengthened. Typically, this entails adding transmission lines to the system, replacing components of the system, or rebuilding existing lines to higher capacities.

Most major paths are rated in terms of the amount of power they can carry based on their strongest element being unavailable. In some cases, the reliability criteria require the ability to withstand having two or more elements out of service. The Colstrip 500 kV lines west of Townsend are a double-circuit line, but they cannot reliably carry power up to their thermal limit because one circuit may be out of service and because both circuits are on the same towers (increasing the chance of a wildfire or other catastrophic event taking out both paths). As a result, they carry significantly less power than their thermal limit in either direction.

The actual rating on a path can change hourly and depends on several factors, including ambient air temperature, other lines service status, and various load and supply conditions on the larger grid. The Montana transmission lines heading west toward the Idaho panhandle and Washington are called the Montana-Northwest path (Path 8). The Montana-Northwest path is

generally limited to 2,200 MW east to west and 1,350 MW west to east. These are the maximum ratings under ideal conditions, and the ratings on these paths are often lower. The Montana-Northwest path leads to the West of Hatwai path, which is larger and is composed of a number of related lines west of the Spokane area.

Ownership and Rights to Use the Transmission System

Rights to use the transmission system are held by the transmission line owners or by holders of long-term contract rights. Rights to use rated paths have been allocated among the owners of the transmission lines that compose the paths. In addition, the line owners have committed to a variety of contractual arrangements to ship power for other parties. Scheduled power flows by rights holders are not allowed to exceed the path ratings.

The FERC issued Order 888 in April 1996, which requires that transmission owners functionally separate their transmission operations and their power marketing operations. This means that all generators have the right to access utilities' transmission systems. If the transmission system in place does not have sufficient capacity to accommodate a bona fide request for transmission service, the utility must begin the process to build the needed upgrades, if the transmission customer pays for the incremental cost of the upgrades.

Power marketing occurs when transmission owners that own generation market it off-system to make money or to reduce costs for their native loads. These transmission line owners must allow other parties to use their systems under the same terms and conditions as their own marketing arms. Each transmission owner must maintain a public website called the Open Access Same-Time Information System (OASIS) on which available capacity is posted.

Available transmission capacity (ATC) is the available room on existing transmission lines to move power during every hour of the year. ATC is calculated by subtracting committed uses and existing contracts from total rated transfer capacity on existing transmission lines. ATC may change on an hourly basis depending on grid conditions. These existing rights and ATC are rights to transfer power on a firm basis every hour of the year. The owners of transmission rights on rated paths may or may not actually schedule power during every hour. When they don't, the unused space may be available on a non-firm basis. As of 2018, a small amount of ATC is available on most major rated paths on the U.S. Western Grid, including those paths leading west from Montana to the West Coast. The rights to use the existing capacity on these lines are for the most part fully allocated and tightly held.

In terms of ATC, incremental export capacity out of Montana is extremely limited. There is no incremental firm export capacity out of Montana to the Southwest (Path 18) and limited incremental export capacity out of Montana to the Northwest (Path 8). The retirement of Colstrip units 1 and 2 could change this situation and open up room on the Colstrip transmission lines and beyond. The retirement of Montana coal-fired power plants, particularly Colstrip units 1 and 2, would potentially allow new generation to use transmission capacity

previously used for the state's coal generation. High level studies by the Northern Tier Transmission Group have suggested that wind power using the 600 MW of freed up transmission capacity from Colstrip to the west would not cause major problems on the grid. However, more rigorous studies would need to be conducted to make definitive statements.

ATC is also constrained in state on NWE's system--especially in the area south of Great Falls. Where ATC is available in-state, it is typically to move power within Montana or wheel power through Montana to interstate lines.

Despite little ATC availability, most transmission paths on the Western Grid are fully scheduled for only a small portion of the year, and non-firm space is often available. However, non-firm access cannot be scheduled far in advance, and its access cannot be guaranteed. Non-firm access is a workable way to market excess power for existing generators. Non-firm availability may be a reasonable way to develop new firm power transactions if backup arrangements can be made to cover the contracts in the event that the non-firm space becomes unavailable. Financing new generation may be difficult, however, unless the power can be shown to move to market via firm transmission space.

Congestion

Transmission constraints are often referred to as transmission 'congestion'. Transmission congestion raises the price of delivered power. It often prevents low-cost power from reaching the areas where it is needed. Low-cost power has little value if it cannot be transmitted to a location where energy is needed. For example, because most existing Montana transmission is fully contracted, future generators in Montana may be prevented from selling their power into a number of wholesale markets except by using non-firm rights or paying for new lines to be built. When transmission congestion exists, generators may be forced to sell into other locations where buyers pay less for power.

In general terms, additional transmission capacity allows more generators to access the grid, promoting competition and lowering prices. Conversely, limited capacity necessitates either transaction curtailment or re-dispatch from a generator that bypasses the bottleneck in the system. Areas with consistently the highest electricity prices, like southern California, experience the greatest degrees of transmission congestion year round due to a variety of factors including huge demands, huge peaking demands during hot weather, and the necessity of large imports from other states.

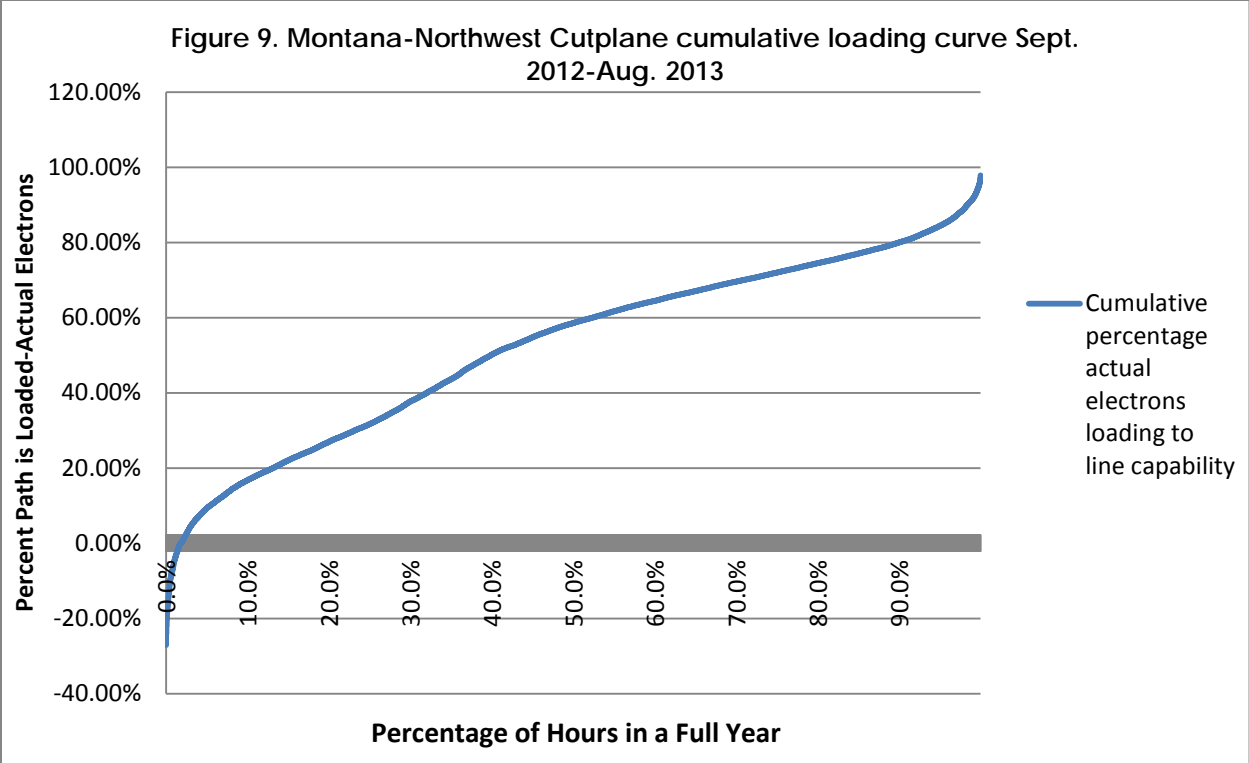
Transmission congestion can be defined in several ways. A transmission path may be described as congested if no rights to use it are for sale. Congestion may mean that a path is fully scheduled and no firm space is available, or it could mean that the path is fully loaded in the physical sense.

By the first definition, the paths through which generators in Montana send their power west are mostly congested and few firm rights are currently available for those paths. By the second definition, the paths west of Montana are congested during a few hours of the year. Contract holders fully use their scheduling rights only a small fraction of the time; the rest of the time they use only portions of their rights.

By the third definition, the lines are almost never physically congested. Even when the lines are fully scheduled, the net flows are almost always below path ratings. The third definition is based on actual loadings. Actual loadings are different from scheduled flows because of the difference between the physics and the management of the grid.

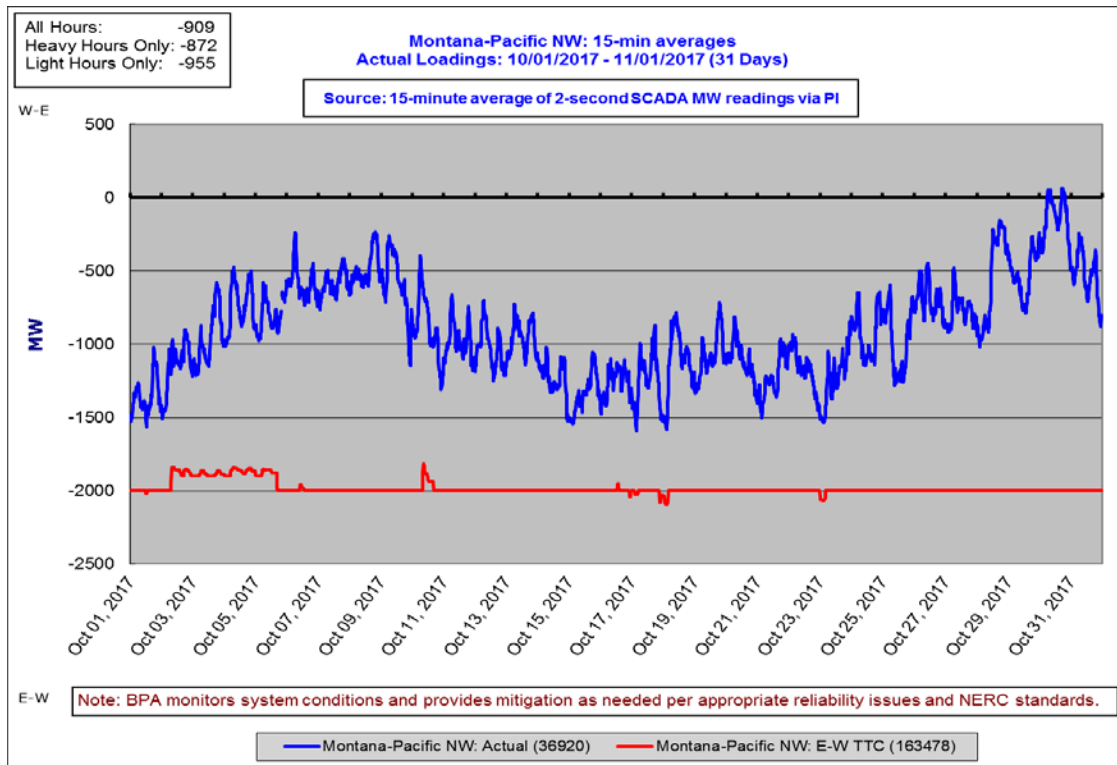
As mentioned above, schedules are contract-path-based. In contrast, actual loadings follow the laws of physics, are net-flow-based and include inadvertent flows. Actual flows on the paths west of Montana are almost always below scheduled flows because of the inadvertent flows and loop flows in that part of the grid. **Figure 6** shows that from September 2012 to August 2013 the highest actual physical loadings on the Montana-Northwest path (Path 8) were loaded at or above 90 percent of the path capacity for only a few hours. For most hours, the path was not heavily loaded.⁵⁹ On the other hand, the path was 60 percent loaded or more about 50 percent of all hours in that time period, indicating that Path 8 is actually one of the most heavily used in the Western Interconnect. Even a well-used line, however, usually has physical space available for more electrons.

⁵⁹ <https://transmission.bpa.gov/Business/Operations/Paths/> .



The most recent month of data from the NorthWest-Montana cutplane also shows actual flows (in blue) well below Total Transmission Capacity (Path 8). This figure should be read upside-down in the sense that the red line is the capacity level and anything above it is electricity loading below capacity.

Figure 10. Montana-Pacific Northwest 15-minute averages



Source: BPA, <https://transmission.bpa.gov/Business/Operations/Paths/>

Path 18 from Montana to Idaho consists of two transmission lines. According to WECC, Path 18 is not historically congested based on actual electricity flows over the line.⁶⁰ Although Path 18 is not congested based on actual flows on the lines, it is heavily utilized from a scheduling standpoint. Actual flows are not high relative to the path rating due to the path being scheduled in both directions.

A considerable amount of existing capacity on transmission lines is not available for use because it is held off the table for reliability reasons when paths are rated. Uncertainty affects the transmission needs of utilities because they don't know in advance what hourly loads will be or which generating units may be unavailable. The need for flexibility affects transmission needs because utilities want the right to purchase power to serve their loads from the cheapest source at any given time.

⁶⁰ 10-Year Regional Transmission Plan: WECC Path Reports, WECC, approved by the Board of Directors September 22, 2011.

Grid Management by a Regional Transmission Organization

A large portion of the electric load in the U.S. is procured through market transactions overseen by various Regional Transmission Organizations (RTO) and Independent System Operators (ISO). These organizations are independent entities that emerged as a result of guidelines prescribed in FERC Orders 888 and 889 with which FERC sought to introduce competition and efficiency into electricity markets. RTOs and ISOs are charged under these orders with promoting nondiscriminatory access to transmission lines and fostering a competitive environment in restructured electricity markets. These organizations are responsible for developing a platform for the oversight of transmission capacity, transmission access scheduling, and congestion management.⁶¹

While most of Montana's service area is not part of an RTO, the Midwest Independent Transmission System Operator (MISO), which covers much of the Midwest, controls the region of eastern Montana that lies in the U.S. Eastern Grid. In the U.S. Western Grid, the Alberta Electric System Operator (AESO) operates in Alberta and CAISO operates in California.

In Montana, discussions surrounding an independent body operating and controlling access to the transmission system have been underway since the mid-1990s among transmission owners and other stakeholders in the Pacific Northwest. The stakeholders include NWE and the BPA, among others. An RTO would allow all parties to signal their willingness to pay for transmission access and theoretically make efficient use of the grid. In addition, RTO management would result in congestion price signals that would encourage economy-based decisions on the location of new generation and on the expansion of capacity on congested transmission paths.

Several western stakeholders are involved in ongoing discussions of expanding CAISO, and developing aspects of ISOs such as Energy Imbalance Markets. PacifiCorp, which operates as a retail electric utility in pockets across the Western Interconnect, including parts of Wyoming that neighbor Montana, has been working with CAISO to evaluate the steps needed to integrate CAISO and the balancing authorities operated by PacifiCorp. The Mountain West Transmission Group, a group of electricity service providers, covers Colorado and parts of four other western states, is exploring joining the Southwest Power Pool's regional transmission organization.

Recent History of Transmission Lines in Montana

In the past decade, several stakeholders have voiced interest in developing additional transmission capacity to export Montana's generation potential to other markets. Montana's large energy resources and small in-state electricity demand make it a hot spot for proposed transmission projects to export power out of state. The largest electricity market in the Western Interconnect is California. In addition, substantial electricity load exists in Arizona, Colorado,

⁶¹ *Markets for Power in the United States*, Paul L. Joskow, *The Energy Journal*, Vol. 27, No. 1, 2006, page 17.

Oregon, Utah, and Washington. Although electricity growth in most areas is flat, these markets will need substantial new resources in order to replace retiring generation and meet environmental goals. Renewable resource mandates also suggest that a significant portion of newly built resources will be renewable.

The Montana Alberta Tie Ltd (MATL) came online in September 2013. It is the first direct interconnection between the Alberta and Montana balancing areas and is capable of carrying 300 MW in either direction.

In the last decade, few rebuilds of existing lines have taken place in Montana, including a WAPA 115 kV line between Great Falls and Havre built to 230 kV specifications and a rebuild of BPA's 115 kV line from Libby to Troy. NWE replaced a 50 kV line between Three Forks and the Four Corners area with a new 161 kV line. NWE also upgraded to a 161 kV line between Four Corners and Big Sky. At this time, MDU has indicated it has no major plans for electric transmission upgrades in Montana.

The BPA has prepared preliminary engineering and partially completed an Environmental Impact Statement on relatively low-cost improvements that would expand capacity on the Montana-Northwest path (Path 8) by 500-700 MW, specifically the double circuit 500 kV line. This upgrade is called the Montana to Washington project (M2W) and could be used by new generators to access West Coast markets. Similar upgrades on the Colstrip lines have been discussed for central Montana. The project would not require a new right of way, and would utilize existing poles. Additional developers looking at projects in Montana have expressed interest in utilizing the potential upgraded BPA capacity that would be created by the project but the project only removes one transmission bottleneck in the region. Additional transmission constraints exist to the west of this segment in Washington state. These bottlenecks would need to be dealt with separately to move power to the specific load centers that Montana developers are interested in reaching.⁶²

New lines connecting Montana to the rest of the Western Grid could increase competition among Montana energy suppliers. Increasing supplier competition in Montana's market could lower or stabilize electricity prices to Montana ratepayers in the near and distant future, although the extent and significance of such savings are unknown.

New high-voltage transmission lines can be difficult and contentious to site. Siting the Colstrip double-circuit 500 kV lines in western Montana, particularly in the areas of Boulder, Rock Creek, and Missoula, required much work with a variety of entities.⁶³ As a result, the route was sited away from the interstate highway corridor, opening new corridors through forested areas.

⁶² Mark Reller, BPA

Recent experience with the MATL and proposed MSTI lines show Montana citizens and landowners are concerned about interference with farming practices, visual impacts, reductions in property values, potential human health effects, and the use of private land rather than public land for electric transmission purposes.

Rural growth and residential construction in western Montana since the Colstrip lines were sited in the early 1980s may compound siting challenges for additional new lines sited through the western portion of the state. Siting opportunities are limited by actual and contemplated wilderness areas and Glacier National Park in the western region. Siting and routing a new line out of the state in a westerly direction would likely prove extremely challenging due to geographical, wilderness, and political issues. Due to these difficulties, the most likely routes for new transmission in and out of Montana are north toward Canada, south toward Wyoming and Idaho, and possibly alongside existing transmission lines to the west.

Regional Transmission Planning in the Western Interconnection

NTTG

The Northern Tier Transmission Group (NTTG) is a group of transmission providers and customers formed under FERC Order 890. They are involved in the sale and purchase of transmission capacity on the power grid that delivers electricity to customers in the Northwest and Mountain states. The NTTG coordinates individual transmission systems operations, products, business practices, and planning of their high-voltage transmission network to meet and improve transmission services that deliver power to customers. Their work establishes a plan for general transmission improvements needed for feasible system operation at times of transmission stress years in the future.

FERC Order 1000

In July 2011, FERC issued Order 1000, titled Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities. The order reforms the current transmission planning processes for new transmission lines and outlines new cost allocation principles for transmission lines approved for purposes of cost allocation. Order 1000 requires regional planning groups to consider transmission that is necessary for reliability, economics, and achievement of federal or state laws and regulations when developing regional plans. Order 1000 also requires interregional coordination on transmission planning. It requires that each region have coordinated procedures for the evaluation of transmission projects that span multiple regions. Order 1000 addresses cost allocation for new transmission facilities.

Committee on Regional Electric Power Cooperation (CREPC)

CREPC is a joint committee of the Western Interstate Energy Board and the Western Conference of Public Service Commissioners. CREPC is composed of the public utility commissions, energy agencies, and facility siting agencies in the western states and Canadian provinces in the western electricity grid. It works to improve the efficiency of the western electric power system.⁶⁴ CREPC's main issues are integrating more renewable energy into the system, the energy imbalance market, future transmission plans, and current changes in the structure of WECC.

Current Transmission Issues

There are a number of issues affecting the changing uses of the transmission system and the need for and ability to complete new transmission projects. These include the way reliability criteria are set, the limited number of hours the system is congested, the increasing costs of building new lines, ways to meet growing power needs without building new lines, problems involved in siting high-voltage transmission lines, the energy imbalance market, increasing renewable penetration, and cyber security.

Western Electricity Coordinating Council Bifurcation

Reliability criteria for the Western Interconnection are set by the WECC. In the wake of large power outages on Sept. 8, 2011, many industry stakeholders voiced concerns with what they saw as lax criteria at WECC. The Arizona and Southern California system disturbance left 2.7 million customers without power and the NERC and the FERC issued a joint report identifying deficiencies in WECC's management of its reliability responsibilities and concluded that those deficiencies contributed to the blackout. WECC's current responsibilities include serving as the regional entity for Western Interconnection development and enforcing reliability standards for the bulk electric system in the Western Interconnection. Concern arose that housing both the regional entity and reliability coordinator roles within WECC affects the group's ability to fulfill both responsibilities. In 2013, the WECC approved a resolution to bifurcate WECC. Under this new structure the reliability coordinator and interchange authority functions in the Western Interconnection became a separate entity from WECC.⁶⁵ WECC is now the Regional Entity responsible for compliance monitoring and enforcement.

Peak Reliability (Peak) was formed in 2014 as a result of the bifurcation of the Western Electricity Coordinating Council (WECC) into a Regional Entity (WECC) and a Reliability Coordinator (Peak). The bifurcation of WECC received final approval from the Federal Energy Regulatory Commission (FERC) on February 12, 2014. Peak, a company wholly independent of

⁶⁴ <http://www.westgov.org/wieb/site/crepcpage/>.

⁶⁵ Northwest Power and Conservation Council, July 2, 2013, <http://www.nwcouncil.org/media/6868113/p2.pdf>.

WECC performs the Reliability Coordinator function in the Western Interconnection.⁶⁶ Peak, as the reliability coordinator, works closely with each of the balancing authorities in the western grid to maintain real-time, situational awareness of the operation of the Western Grid.

Merchant lines

Efforts by FERC to open electricity markets through approval of merchant transmission projects are meant to stimulate independent investment in transmission facilities, allowing for greater competition among power producers. Starting in 2000, FERC began approving applications by parties proposing market-based transmission rates known as merchant transmission projects. Merchant transmission is a model under which transmission costs are recovered through market-based or negotiated rates as opposed to traditional cost-based rates. Merchant transmission projects are a means to bring forward new capital investment to reduce transmission congestion and to link regional markets in situations in which the prospect of cost-based rate recovery proves to be insufficient to spur transmission development.

As a matter of basic economics, transmission congestion leads to disparate power prices. While these disparities may produce an incentive to construct new generation, it is plausible that new transmission priced at market rates would be a less expensive solution. Such projects may not necessarily be proposed under the traditional model of cost-based ratemaking. The issues confronting proposed merchant generation plants are different from those faced by traditional utilities. Utilities plan, finance, and build transmission and generation together and recover costs from ratepayers. Private generation developers, under the merchant model, must absorb the risk or convince another party to absorb that risk. The development of state renewable energy standards has given added impetus to merchant transmission, as parties seek to bring remote renewable energy to populated load centers.

Transmission Construction Cost

High-voltage transmission lines are expensive to build. A typical single-circuit 500 kV line may cost \$2 million per mile or more. A double-circuit 500 kV line may cost \$3.1 million or more per mile. A 500 kV substation costs \$50 million to \$75 million, depending on its location on the network. If series compensation is required, 500 kV substations may cost up to \$100 million. However, 230 kV lines are somewhat cheaper, about half the cost per mile of 500 kV lines, and substation costs run nearly \$25 to \$30 million each.⁶⁷

DC lines are cheaper still, but the equipment required to convert AC to DC is extremely expensive. Consequently, DC technology is generally used only for very long-distance transmission with no intermediate interconnections. At present there are only two major DC

⁶⁶ Text taken from <https://www.peakrc.com/aboutus/Pages/History.aspx>

⁶⁷ Craig Williams, WECC, Market Interface Manager.

lines in the Western Interconnection – the Pacific DC Intertie from Celilo in northern Oregon to Sylmar near Los Angeles and the IPP line from the Intermountain Power Project generating station in Utah to the Adelanto substation near Los Angeles. Neither line has any intermediate connections.

Alternatives for Meeting Increasing Electricity Demand

Increasing costs and siting difficulties for new transmission lines, are leading to the development of alternative methods to strengthen the grid. Some existing lines can be upgraded with new equipment to increase capacity without building a new corridor through a new right of way such as the M2W project. Lines can be rebuilt on existing rights-of-way and one new line built on the grid could allow higher ratings on other lines in the grid. Energy conservation at the consumer level can also forestall the need for new lines. Many utilities implement demand-side management programs, energy efficiency programs, and interruptible rates to lower peak demands on the system. Generation plants can be located near their loads, eliminating some need for long-distance transmissions of electricity.

Storage projects utilizing pumped hydro technology also assist in balancing the system.

Montana based, Absaroka Energy, LLC, is developing the Gordon Butte Pumped Storage Hydro Project located on private land in Meagher County. The 400 megawatt, 3,400 megawatt-hour plant is designed to take advantage of the unique geological features of Gordon Butte to create a new closed-loop pumped storage hydro facility. This facility would provide ancillary and balancing capabilities to utilities and generation owners, as well as, provide multiple services to facilitate stability, reliability, growth and longevity to existing energy infrastructure and resources in the state and region.⁶⁸

Transmission Capacity to Accommodate New Generation in Montana

There is a “chicken and egg” problem in developing new transmission projects. If no transmission capacity is available to reach markets, generation developers may have a difficult time financing projects. Yet without financing, potential generators probably can’t make firm commitments to encourage utilities to invest on their own in new transmission capacity projects.

New generation plants need firm power purchase agreements (PPA) to build in order to obtain financing. Occasionally, generation plants are built to market their energy into wholesale markets, but such facilities more common in deregulated electricity markets. With low spot prices across the West and tightened lending requirements, the majority of projects slated for construction in the western U.S. in the next decade will have firm power purchase agreements

⁶⁸ Gordon Butte Pumped Storage

before ground is broken. Because Montana is already a net exporter of electricity and because NorthWestern Energy's Renewable Portfolio Standard is already largely met, demand for new generation built in Montana would mostly likely come from out of state. The challenge that Montana projects—like all projects—face is contracting to produce power for customers at a price that is both profitable to the project developer and competitive with other energy sources, including sources potentially closer to the end-consumer. Transmission charges could be high enough between Montana resources and West Coast load centers to challenge the competitiveness of Montana-based projects. Low electricity prices and the ISOs and RTOs add uncertainty to the process.

Numerous proposed transmission lines in the Western U.S. are not constructed due in part to this problem.

The regulatory structure in Montana requires proving a need for new transmission projects that are 230kV or larger and longer than ten miles. Such projects must meet the standards outlined under MFS (75-20-104(8)(a)(i), MCA).

California Renewable Portfolio Standard

While California is not the only renewable market in the West, California's RPS will require more renewable energy than the rest of the western states combined. It is likely that many wind developments proposed in Montana and other western states intend to sell into the California market. California has a statutory 50 percent RPS requirement by 2030 for all large utilities in the state. While other states are mostly meeting RPS standards and California utilities are on track to meet their 2020 RPS targets, by 2030 California utilities will require twice as much renewable energy as the other Western states combined. Corporate buyers and community choice aggregators are growing sources of demand for renewable energy as well, but their market impacts could prove to be less regional in nature if they look to procure near the communities they serve.⁶⁹ Recent changes to California's RPS rules place some additional burdens on out-of-state wind resources. These changes could negatively impact developers' interest in pursuing wind resources in Montana and could decrease interest in new transmission.

Western Electricity Coordinating Council Energy Imbalance Market

An Energy Imbalance Market (EIM), as proposed by WECC aggregates the variability of generation and load over balancing authorities and reduces the total amount of required reserves for a balancing area. An EIM more easily allows participants to use the lowest-cost

⁶⁹ RETI 2.0 Western States Outreach Project Report, Prepared by Energy Strategies, LLC for submission under Agreement with the Western Interstate Energy Board October 12, 2016

generation in the market to balance loads and generation. In some ways, an EIM serves some of the functions an ISO or RTO might serve.

The EIM initiative is a comprehensive market-based proposal to address generator imbalances in the West. It is a regional economic dispatch tool that supplies imbalance energy within transmission and reliability constraints. The EIM would be a 5-minute, security-constrained economic dispatch model using locational marginal pricing for energy imbalances. The EIM could utilize physically available transmission space and would reduce the costs of integrating variable energy resources. The EIM would allow the deviations from electricity schedules to be resolved using the most cost-effective, physically deliverable resource. A variety of groups are currently exploring the possibility of implementing this market, but it is not yet being used in Montana.

EIM is a real-time energy market that operates what is called a "security constrained economic dispatch" (SCED). The model is similar to an auction. Utilities submit a schedule of the resources they anticipate serving their consumer demand as they move into the operating hour to the independent operator of the market. At the same time, those utilities and other owners of power plants submit incremental bids of their plants' capacity -- essentially, an offer to move up or down as certain plants go up and down, and as the same type of volatility happens to consumer demand.⁷⁰

The EIM operator then allows the least-cost resources to meet any given utility's demand, so long as there is space available on the transmission system. In addition to this, the automation present in a SCED allows the grid to more flexibly absorb or replace unanticipated over- or under-production of weather-dependent renewables. These two things -- least-cost dispatch and renewable integration -- make up the value proposition of EIM. Basically, without it, the system functions on bilateral trading that lacks the visibility of multiple players coming together to form a multi-party "bid stack." The system also lacks the automation that allows for bids to happen in real time. This is opposed to the current situation of the hourly schedules that dominate the western interconnection outside the EIM.

Smart Grid

A smart grid is a modernized electrical grid that uses information and communications technology to gather and act on information in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity.⁷¹ "Smart grid" generally refers to a class of technology people are using to bring utility electricity delivery systems into the 21st century, using computer-based remote control and automation. These systems are made possible by two-way communication technology and computer processing that has been used for decades in other industries. Smart Grid technologies are

⁷⁰ This paragraph and the next one are taken from an email response from Commissioner Travis Kavulla, Montana Public Service Commission.

⁷¹ Department of Energy

beginning to be used on electricity networks, from power plants and wind farms to the consumers of electricity in homes and businesses. A smart grid can alert customers to real time prices in order to promote conservation and allow for tiered electricity pricing. This technology can also help grid management from many places and sensors rather than one central location, and potentially lead to lower restoration times after a blackout. Concerns about the smart grid include cost, cybersecurity, and personal privacy.

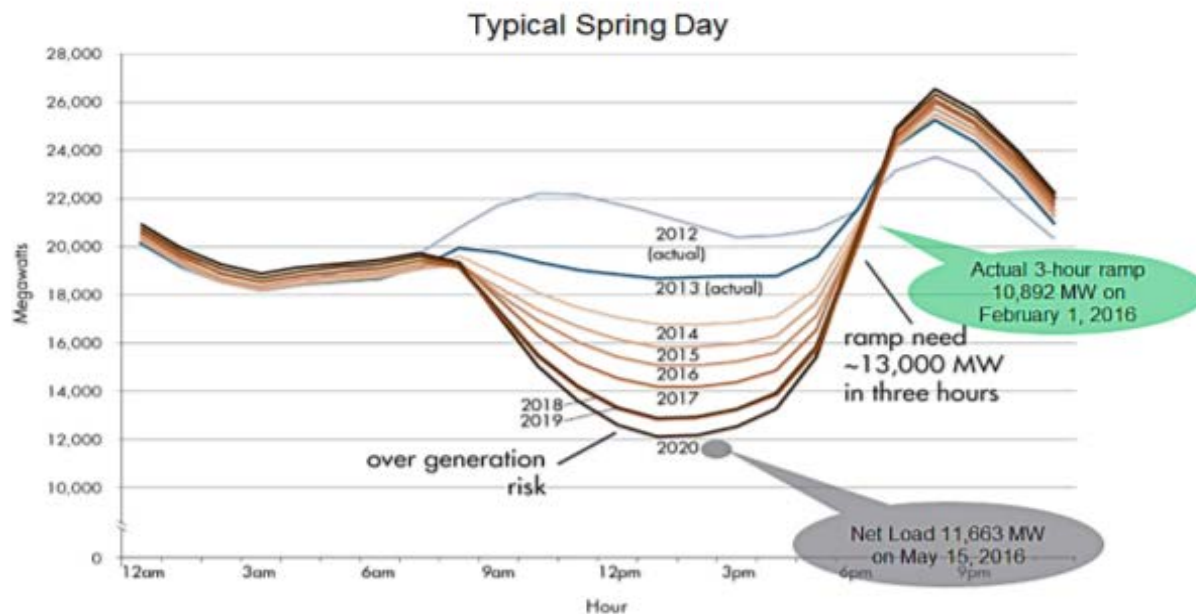
Increasing Renewables: Duck Curve and Inertia⁷²

Historically, the California ISO (CAISO) directs conventional, controllable power plant units to move up or down with instantaneous or variable demand. With the growing penetration of renewables on the grid, there are higher levels of non-controllable, variable generation resources. Because of that, the ISO must direct controllable generation resources to match both variable demand and variable supply. Variability must also be managed intra-hour and from day-to-day. The ISO needs a resource mix that can react quickly to adjust electricity production to meet the sharp changes in electricity net demand. These resources feature ramping flexibility and the ability to start and stop multiple times per day. To ensure supply and demand match at all times, controllable resources need the flexibility to change output levels and start and stop as dictated by real-time grid conditions.

CAISO created curves for every day of the year from 2012 to 2020 to illustrate how the net load following need varies with changing grid conditions. The net load curve or duck chart in Figure 2 illustrates the steepening ramps expected during the spring. The duck curve is so-named due to the shape of net load during the day in California. The chart shows the system requirement to supply an additional 13,000 MW, within approximately three hours, to replace the electricity lost by solar power as the sun sets. Oversupply occurs when all anticipated generation, including renewables, exceeds the real-time demand. During oversupply times, wholesale prices can trend low and even negative in which generators have to pay utilities to take the energy. In almost all cases, oversupply is a manageable condition but it is not a sustainable condition over time. The duck curve in Figure 2 shows that oversupply is expected to occur during the middle of the day as well. Because the ISO must continuously balance supply and demand, steps must be taken to mitigate oversupply risk.

⁷² California ISO-What the Duck Curve Tells us About Managing a Clean Grid, https://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf

Figure 11. The Duck Curve



Source: CAISO

The following actions avoid oversupply conditions:

- 1.) increasing demand by expanding the ISO control area beyond California to other states so low-cost surplus energy can serve consumers over a large geographical area;
- 2.) increasing participation in the western Energy Imbalance Market in which real-time energy is made available in western states;
- 3.) transitioning our vehicles to electricity;
- 4.) offering consumers time-of-use rates that promote using electricity during the day when there is plentiful solar energy and the potential for oversupply is higher;
- 5.) increasing energy storage; and
- 6.) increasing the flexibility of power plants to more quickly follow ISO instructions to change its generation output levels.

Cybersecurity

An adversary with the capability to exploit vulnerabilities within the U.S. power grid might be motivated to carry out a cyber-attack under a variety of circumstances. An attack on the power grid could be part of a coordinated military action, intended as a signaling mechanism during a crisis, or as a punitive measure in response to U.S. actions in some other arena. A cyberattack

could cause power losses in large portions of the United States that last days in most places and several weeks in others.

Attacks on power grids are no longer a theoretical concern. In 2015, an attacker took down parts of a power grid in Ukraine. Although attribution was not definitive, geopolitical circumstances and forensic evidence suggest Russian involvement. A year later, Russian hackers targeted a transmission level substation, blacking out part of Kiev. In 2014, Admiral Michael Rogers, director of the National Security Agency, testified before Congress saying China and other countries likely had the capability to shut down the U.S. power grid. Attacks could inflict damage on the many health and safety systems that depend on electricity. Given the fragility of many industrial control systems, even reconnaissance activity risks accidentally causing harm.⁷³

Today, the electric power industry is forging ahead with a series of initiatives to safeguard the electric grid from threat and is partnering with federal agencies to improve sector-wide resilience to cyber and physical threats. The industry also collaborates with the National Institute of Standards and Technology, the North American Electric Reliability Corporation, and federal intelligence and law enforcement agencies to strengthen its cybersecurity protocols.

⁷³ Council on Foreign Relations, “A Cyberattack on the U.S. Power Grid”, <https://www.cfr.org/report/cyberattack-us-power-grid>

Coal Production in Montana

The Montana coal industry exists to support the generation of electricity. Coal-fired power plants account for a majority of Montana's electric generation portfolio, but recently coal usage has declined. Coal fueled nearly two-thirds of the state's total electric generation in the 2000's, and remained between 50 percent and 55 percent since 2010. Nearly three-quarters of the coal mined in Montana is exported, primarily to Midwestern utilities and to coal brokers. The coal that remains in Montana fuels electric generating plants, with most used at the Colstrip generating facility.

Early Observations

The earliest white explorers of the region documented coal in present-day Montana. Captain William Clark, on the return trip through what is now Montana, led half of the Lewis and Clark Expedition down the Yellowstone River, passing within perhaps 50 miles of the coal beds of what is now known as the Rosebud field, part of the larger Fort Union Formation in the Powder River Basin.

The following excerpt is from Clark's Yellowstone River journal from the summer of 1806:

*In the evening I pass Starters of Coal in the banks on either side ... bluffs about 30 feet above the water and in two vanes [veins] from four to 8 feet thick, in a horizontal position. This coal or carbonated wood is like that of the Missouri [River] of an inferior quality.*⁷⁴

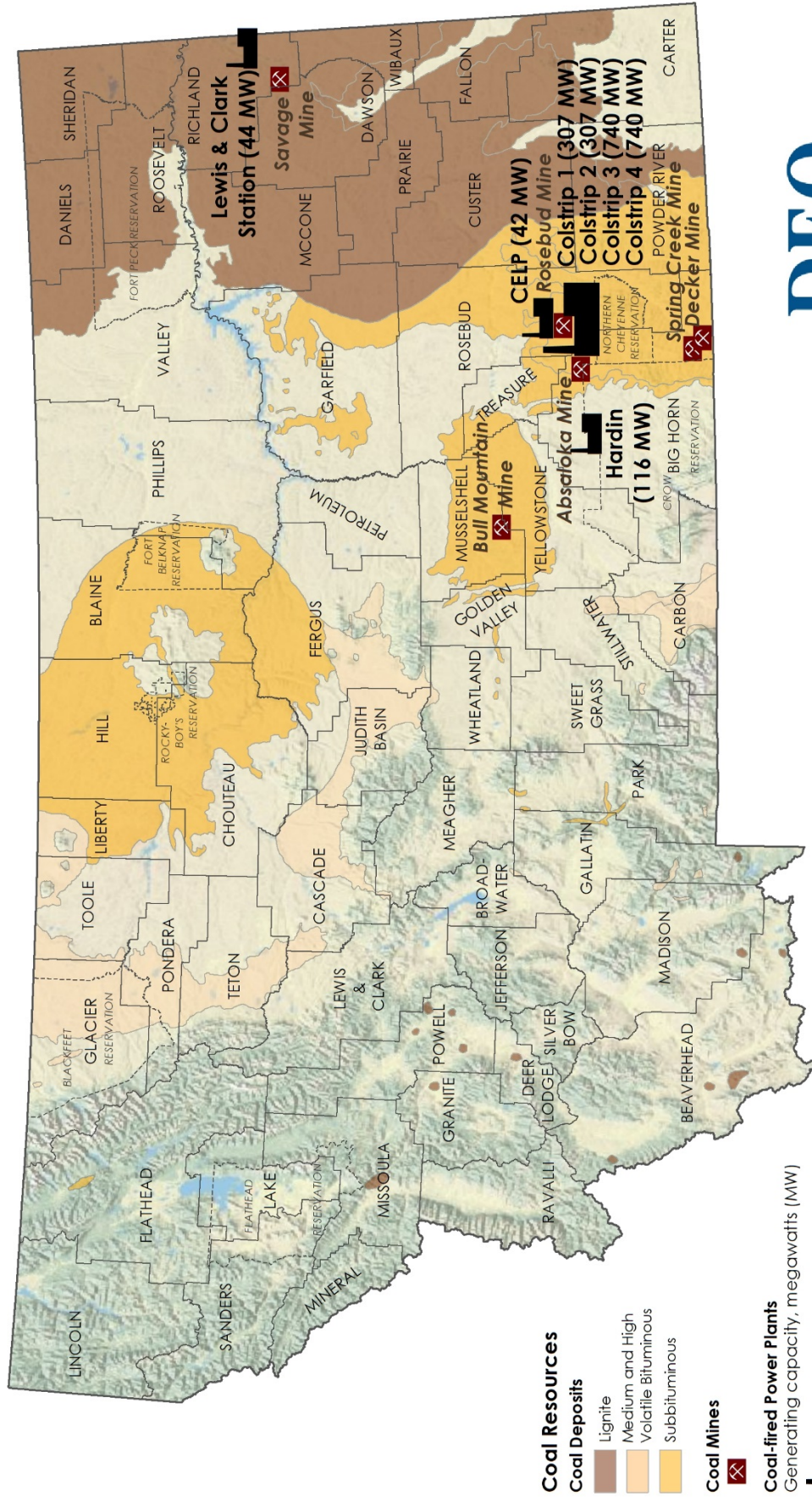
The annual federal Statistics of Mines and Mining compiled for the western states and territories for 1873 and 1875 indicated limited seasonal coal extraction in the Big Hole Valley, at Mullan Pass west of Helena, at Fort Benton, and at Belt along the Missouri River. During this time, the coal was probably used principally to forge iron for blacksmithing in nearby towns.

Railroad planners became interested in local coal to build steam for locomotive power, and early surveys in Montana Territory often included geologists on the lookout for available deposits. In 1882, the geologists of the Northern Transcontinental Survey visited the region in the course of a general reconnaissance of the Northwest, a chief object of the exploration being to secure information concerning coal resources. The existence of valuable coal deposits in the Great Falls region was clearly recognized by the survey, as were lesser-quality deposits near present-day Lewistown and in the Bull Mountains.⁷⁵

⁷⁴ *Journals of the Lewis & Clark Expedition*, R. Gold Thwaites, editor, 1905.

⁷⁵ *Geology of the Lewistown Coal Field, Montana*, U.S.G.S., 1909, Calvert, W.R.

Montana Coal Resources



Last updated January 2018

The narrow-gauge Utah & Northern (later Union Pacific) reached Montana from the South in 1880, connecting to Butte the following year.⁷⁶ Northern Pacific and to a lesser extent Union Pacific formed coal mining companies to exploit the deposits at Timberline on Bozeman Pass, and by 1885 more than 83,000 tons per year was mined there, mostly for rail transportation.⁷⁷ Great Northern launched a coal subsidiary in 1888 at Sand Coulee outside of Great Falls to provide for its Montana operations.⁷⁸

By 1880, use of coal in Montana was growing to include more industrial uses—principally ore processing—in addition to commercial and domestic home heating. Non-transportation industrial use would grow significantly over the next quarter century with the rise of copper smelting and refining in the Butte-Anaconda district and at Great Falls. The use of coal for mineral reduction declined early in the twentieth century, at least partially as hydroelectric dams came online along the Missouri River.

Production

Montana was the sixth largest coal producer in the U.S. in 2015, with 42 million tons mined. The majority of in-state mining occurs in the Powder River Basin southeast of Billings. With the exception of the small lignite mine at Savage and the bituminous Signal Peak, mine north of Billings, Mont., the state produces low-sulfur subbituminous coal, with up to 18 million Btu per ton. Like most coal in the West, Montana coal's lower sulfur content produces less sulfur emissions, but is also lower in heat content when compared to coal mined in the East. According to the EIA, the total tonnage of coal produced west of the Mississippi surpassed coal produced east of the Mississippi in recent decades.⁷⁹ (**Figure 13**). In 2015, 548 million tons were mined west of the Mississippi compared to 348 million tons east of the Mississippi.

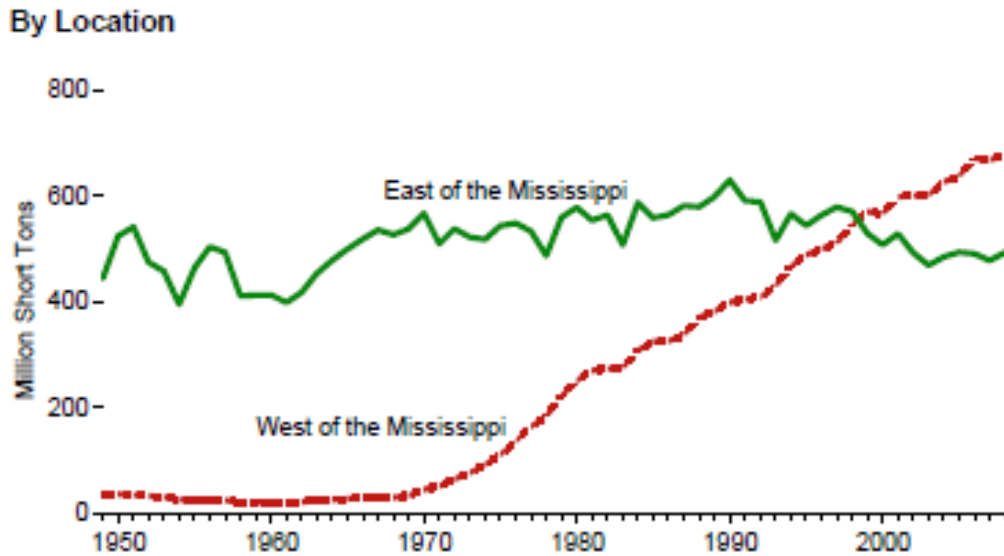
⁷⁶ *Montana: A History of Two Centuries*, Malone, M., et al, 1976.

⁷⁷ Op cit, McDonald and Burlingame.

⁷⁸ *The Cascade County Album: Our History in Images*, Cascade County Historical Society, 1999.

⁷⁹ <https://www.eia.gov/totalenergy/data/annual/showtext.php?t=ptb0702>

Figure 12. Historical coal production in the U.S.



Coal mining has occurred in Montana since territorial days. Early production primarily filled the need for heating fuel with some coal converted to coke for smelting, and some production used for industrial steam power and to power locomotives. Production initially peaked in the 1940s at around 5 million tons per year. As diesel replaced steam locomotives, production declined, reaching its lowest point in 1958. That year, only 305,000 tons were mined, an amount equivalent to less than 1 percent of current output. Output remained stagnant for a decade, maintained by production for a small electric generating plant near Sidney. Production began to increase in 1968, when Western Energy Company began shipping coal mined from the Colstrip area to a generating plant in Billings owned by its parent company, the Montana Power Company.

As Montana mines began supplying electric generating plants in Montana and the Midwest, coal production jumped. Production in 1969 totaled 1 million tons; 10 years later, production increased to 32.7 million tons as Colstrip Units 1 and 2 become operational and export markets continued to develop. Production increased gradually to almost 43 million tons in 1998. In the past two decades, production remained near 40 million tons, reaching 42 million tons in 2015. Nearly 25 percent of that amount fuels the Colstrip electric generation plant. In the past decade, Montana has accounted for 4 to 5 percent of the coal mined each year in the U.S., maintaining its share of the U.S. market. Western states other than Wyoming followed a path similar to Montana. Wyoming's market share grew over that time in the rich and productive fields located in the Powder River Basin.

While significant, Montana's coal output is dwarfed by that of Wyoming, which produced 42 percent of the nation's coal in 2015. The gap between the two states is due in part to a

combination of physical factors that make Montana coal less attractive than coal from Wyoming. Montana coal generally is more costly to mine. Coal seams tend to be thinner, though still thick in comparison to eastern coal, and buried under more overburden than seams in Wyoming. Wyoming coal tends to have slightly lower average ash and sulfur content than Montana coal. Coal from the Decker area boasts the highest Btu in the Powder River Basin, with about the same sulfur content as Wyoming coal, but its high sodium content can cause problems in combustion. The difference in production between the two states is further affected by the superior development of the rail transportation network in the southern end of the Powder River Basin in Wyoming.

The price of Montana coal averaged \$17.44 per ton at the mine in 2015, up from the previous 20 years when it was near \$10.00 per ton.⁸⁰ The average price of coal peaked at \$14.22 per ton in the early 1980s and began a downward trend that lasted to the turn of the century. By 2002, the price fell nearly 60 percent. The price of Montana and Wyoming coal is far below the U.S. average of \$31.83. The two main reasons for the difference are transportation costs and the lower heat content of the coal. Average transportation costs for Powder River coal are currently more than the mine mouth cost of the coal itself, which is mostly shipped to out-of-state generating plants.⁸¹

There are currently six major coal mines in Montana operating in Big Horn, Musselshell, Richland, and Rosebud Counties. Westmoreland Mining, LLC, controls three of these mines, accounting for more than 13 million tons of coal in 2016. In 2007, Westmoreland gained 100 percent ownership of the Absaloka Mine in Big Horn County. During the 1990s, the last Montana mine producing less than 100,000 tons annually closed. A new mine at that site, the Signal Peak Mine, near Roundup, opened in 2003.

Expansions at the Signal Peak mine were expected to bring a significant increase in Montana's total current coal output. A 35-mile rail spur was added to the BNSF line near Broadview to deliver coal from Signal Peak to various markets. With the expansion, the mine was expected to ramp up production to about 15 million tons per year. However, production has leveled out at around 6 million tons in the past few years.

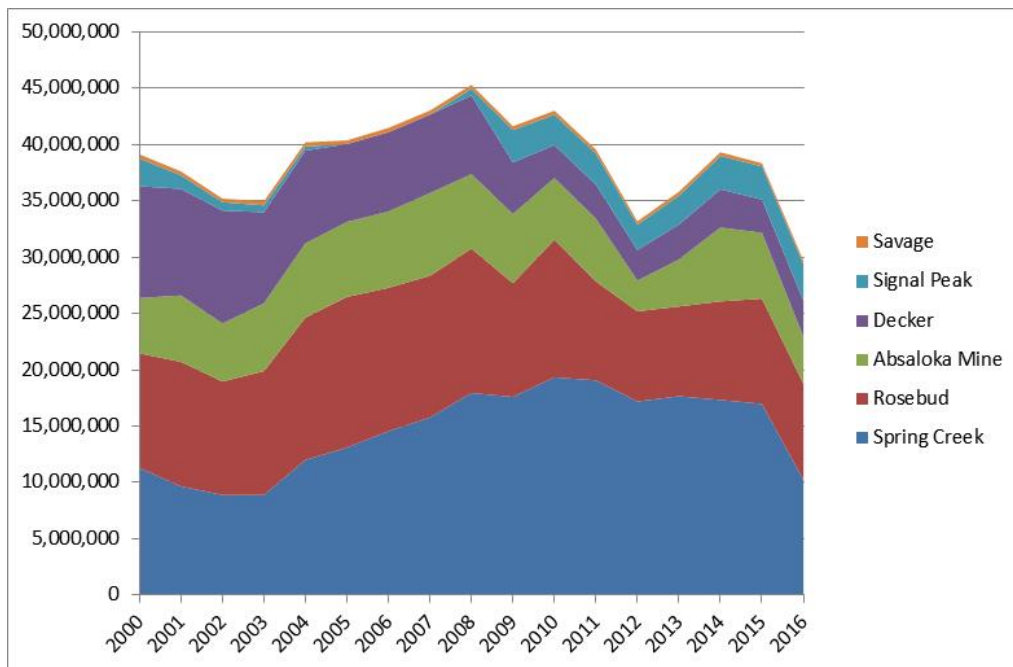
The West Decker Mine expanded significantly until 2008, when production from the West Decker mine sharply decreased in volume. The East Decker mine picked up a portion of that production in 2009. The Spring Creek mine, owned by Cloud Peak, was the largest producing mine in Montana in 2016, accounting for nearly 32 percent of production, or about 10 million tons. This is sharply down from previous years where the total production was consistently more than 15 million tons. Western Energy Company (a subsidiary of Westmoreland) operates

⁸⁰ 2012 EIA, <http://www.eia.gov/coal/annual/pdf/table31.pdf>.

⁸¹ U.S. EIA, 2017

the Rosebud Mine and is the second largest in-state producer at 8.5 million tons, accounting for 26 percent of Montana coal production in 2016.

Figure 13. Production of Coal Mines in Montana (2000-2016)



Production has recently decreased in Montana, from about 45 million tons in 2008 to 32 million tons in 2016. The trend mirrors the national totals, with production decreasing from about 1.2 billion tons mined in 2008 to just under 0.9 billion tons in 2015. Most of this decline can be credited to weak economic markets for coal both domestic and internationally. Coal generation for domestic electric generation plants is down as older coal plants close and existing plants run less of the time. Low natural gas prices and cheaper renewables mean that natural gas, wind and solar are fueling more electricity production. Foreign demand also appears to have declined. Air quality regulations have accelerated the recent trend of coal plant closures. Natural gas is also substituted for coal in other industrial applications. The future of Montana coal economics depends in large part on greenhouse gas regulations for electric generation, the amount of U.S. coal-fired generation in operation, natural gas prices, and coal export markets.

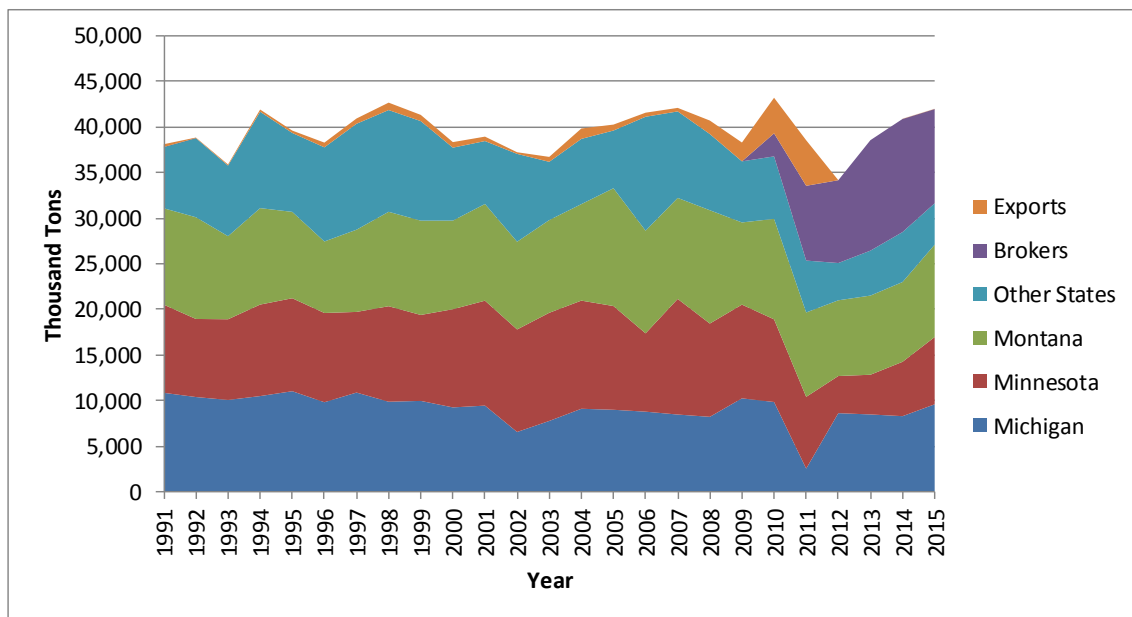
Almost all coal produced in Montana generates electricity. In recent years, about three-quarters of production has been shipped by rail to out-of-state utilities and, increasingly, foreign nations. The remaining quarter is consumed in Montana. About 90 percent of what is consumed in Montana is burned to produce electricity, primarily at Colstrip. Minor amounts of residential and commercial heating and some industrial use account for the remainder.

Prior to deregulation in 1997, about 40 percent of the coal-fired electric generation remained in Montana. Nearly 60 percent was transmitted to out-of-state utilities. The majority of coal

burned in Montana still produces electricity for export to Washington and Oregon. That fact is due in large part to the ownership structure of Colstrip. In the early 2000s, Montana Power sold their share of Colstrip to PPL Montana and NorthWestern Energy. Talen Energy bought PPL Montana’s share in 2015.

Over the last decade Michigan, Minnesota, and Montana used about three-quarters or more of all the coal produced in Montana (Figure 14). Since 2010, the trend has remained similar, with nearly 75 percent of coal production still powering Montana, Michigan and Minnesota, and the other 25 percent sold to brokers. After 2002, data on shipments to other countries was not available; however, historically, Montana has shipped coal to Canada. Most exports from Montana mines are currently sold to brokers, who don’t consistently report the final destination for exports.

Figure 14. Destination for Montana coal



Coal Economics in Montana

Since 2002, the average price of coal has increased, and the amount of coal mined has increased along with the number of in-state mining employees (Figure 15). Taxes on coal, despite decreases from historical highs, remain a major source of revenue for Montana, with \$60.4 million collected in coal severance tax in state fiscal year 2015.⁸² That is significantly less than

⁸² A gross proceeds tax of 5 percent goes to both the county and state based on 1990 mills. Another 0.4 percent goes for the Resource Indemnity and Ground Water Assessment Tax that, among other things, pays for reclamation of old, unreclaimed mined areas.

the amount collected in fiscal year 1984, when collections peaked at around \$92 million. Collections dropped in the 1980s and 1990s as tax laws changed, beginning with tax changes made by the 1987 Legislature. Revenues also dropped due to the declining price of coal over time. While the tax rates vary, the rate on most coal in Montana has dropped from 30 percent to 15 percent of price. This drop in rates has had a larger impact on tax collections than the drop in coal prices. The tax structure's impact on coal production is less clear. Production has risen modestly since the cut in coal taxes, and Montana has been able to retain most of its share of the national market.

In addition to severance taxes, gross proceeds taxes are also paid to support the counties where mines are located.⁸³ The 2009 Legislature altered a series of tax laws applicable to coal producers. Severance tax rates for strip mines that recover coal using auger techniques were reduced. County commissioners have been granted authority to provide up to a 50 percent local abatement of coal gross proceeds taxes for up to 10 years at new or expanding underground mines. Montana coal producers also pay a Resource Indemnity Trust tax, federal taxes, and royalties. Federal leasing laws require 49 percent of the royalties collected from development of federal leases be returned to the state. That requirement was lowered from 50 percent in Oct. 2007.⁸⁴ A royalty is also paid on coal-producing land leased from the state.

The cost of transportation to distant markets may also affect the competitiveness of Montana coal. Nearly all coal exported from Montana leaves on BNSF rail lines. Some is later shipped by barge. Due to its remote location, coal shipped from the Powder River Basin (Wyoming and Montana) in 2000 was sold at a high ratio of transportation cost to delivered price, on a per-ton basis, for U.S. coalfields.⁸⁵

Coal was the least expensive fossil fuel used to generate electricity for many years. In recent years, natural gas has closed the price margin when compared to coal. When natural gas was near \$2/dkt in early 2013, it was briefly cheaper than coal on a fuel per MWh basis. Today, both fuels generate about the same amount of electricity nationwide. Wind power is often less costly than both fuels and is often used on a "must-take" basis. Increasingly, the use of coal-fired generation for electricity is linked to potential federal activities and restraints on greenhouse gases. The impact of potential greenhouse gas regulations on the future price and viability of coal-fired generation is uncertain. Montana businesses and elected officials have promoted clean coal technologies in the past, and a number of projects are in the conceptual stage. If

http://revenue.mt.gov/Portals/9/publications/biennial_reports/2014-2016/2016-Biennial-Report-Natural-Resources.pdf

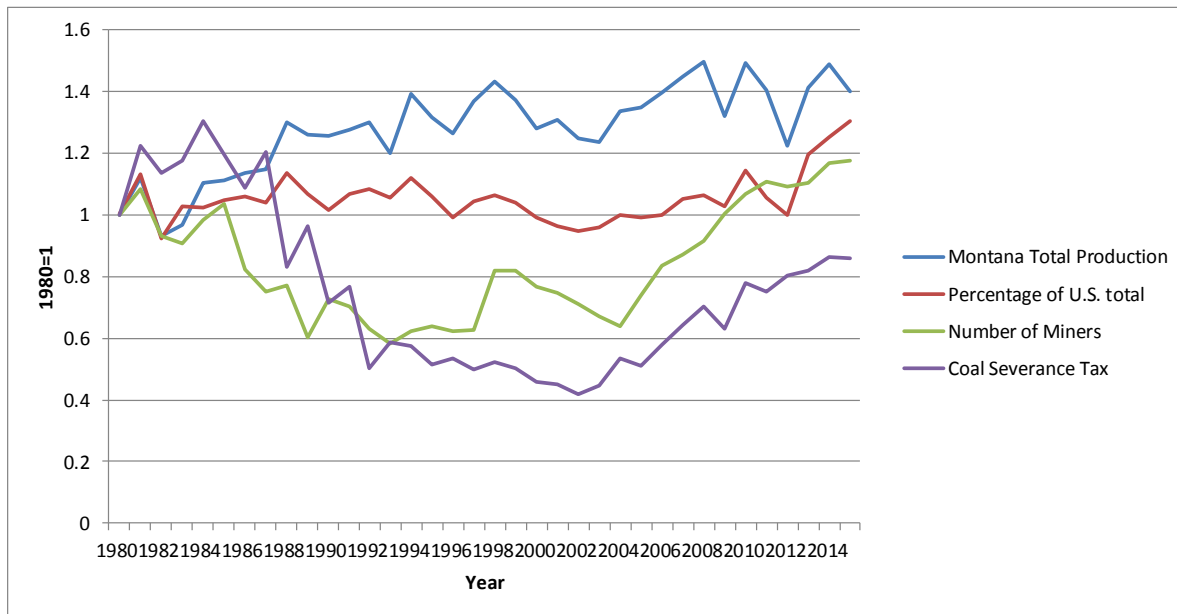
⁸³ Montana DOR, TPR, Rosemary Bender.

⁸⁴ Ibid.

⁸⁵ <https://www.eia.gov/coal/transportationrates/> and *Energy Policy Act Transportation Rate Study: Final Report on Coal Transportation*, EIA, 2000.

greenhouse gas regulations move forward, these clean coal efforts may be critical to maintaining the consumption of Montana's vast coal resources.

Figure 15. Relative Changes in Montana Coal Production, Share of U.S. Market, Number of miners, and Severance Tax Collections, 1980 to 2011 (1980 = 1)



Current Issues in Montana

Impacts from Federal Greenhouse Gas Activities

The Environmental Protection Agency (EPA) under the Clean Air Act (CAA) has been crafting greenhouse gas regulations for new and existing major stationary sources, including power plants, under Section 111 of the CAA. Section 111 performance standards, like much of the CAA, are designed and promulgated through a federal-state partnership. The EPA is authorized to approve a minimum federal “backstop” for regulations, and then allow states to control greenhouse gas emissions beyond that backstop.

In late 2015, EPA finalized carbon dioxide (CO₂) emission performance rates for new fossil fuel-fired power plants. For existing power plants, EPA established the emission rates based on analysis of the best system of emission reduction that had been demonstrated for the particular pollutant and particular group of sources. As part of the federal-state partnership, the EPA left the states to develop and implement control plans that would achieve EPA’s emission performance rates. States had the flexibility to develop plans that met their specific needs, so long as they achieved the prescribed emission performance rates. Examples of possible control measures included retrofit technology at regulated power plants, changes in operation of

plants, and replacing carbon intensive generation with lower-emitting natural gas or zero-emitting renewable generation. On February 9, 2016, the Supreme Court stayed the implementation of the emission performance rates for existing power plants pending judicial review, halting the process. In late 2017, the Trump administration overturned the Clean Power Plan under EPA Administrator Scott Pruitt.

Despite the administration's action on the Clean Power Plan, greenhouse gas-intensive coal generation in the U.S. could be forced to develop a number of retrofits, likely making generation more expensive over time. Most existing coal plants in Montana will likely retire earlier than originally expected as dictated by economics, power contract, politics and consumer demand. This will greatly affect the parts of Montana's economy dependent on coal plants and coal mines. Both NWE and MDU, in their respective resource plans and in recent portfolio purchases, evaluate these issues. Both favor acquisitions of natural gas and wind power for new power. MDU has taken advantage of market purchases from the regional transmission organization (RTO) known as MISO, while NWE continues to purchase some of its energy on the wholesale market with a mix of long-term and shorter-term purchases.

Montana is one of only a few states that have taken steps to implement carbon sequestration legislation (Chapter 474, Laws of 2009). While state law does not mandate the sequestration of carbon dioxide generated from sources, the law provides regulatory certainty to those interested in pursuing such technology. Montana has stated its intent to have jurisdiction over a sequestration program, while recognizing that its regulatory program will need to be in line with federal guidelines.

Coal Exports and Coal Trains and Coal Terminals

In the past, various business interests have proposed shipping coal from the Powder River Basin area in southeastern Montana and Wyoming to the West Coast. Several coal export terminals have been proposed on the coasts of Washington and Oregon, including one inland port on the Columbia River. These terminals would ship coal overseas, mostly to Asia. Concerns have been raised about greenhouse gas emissions and impacts along railroad routes, including some Montana cities and towns, where coal would be shipped to the proposed ports. The U.S. coal industry sees exports as an opportunity to make up for declining domestic demand. The future of proposed coal exports remains in question but could likely have a significant effect on coal production in Montana.

Natural Gas in Montana

Natural gas is a major source of energy for Montana's homes, businesses, and industries. Increasingly, it is also an important fuel for electrical generation, both in state and nationwide. Natural gas consumption is expected to continue to increase in the U.S. with sustained low prices, greater domestic supply, and increasing use in electric generation plants. Montana is part of the North American natural gas market, with prices and availability set more by events outside than inside Montana. Natural gas fracking recently has increased domestic supply, pushing down prices and increasing domestic demand. As natural gas markets become more complex and as fracking transforms the natural gas industry, the price and availability of natural gas will continue to move in ways Montanans have not experienced in previous decades.

Natural Gas Supplies for Montana and In-State Production

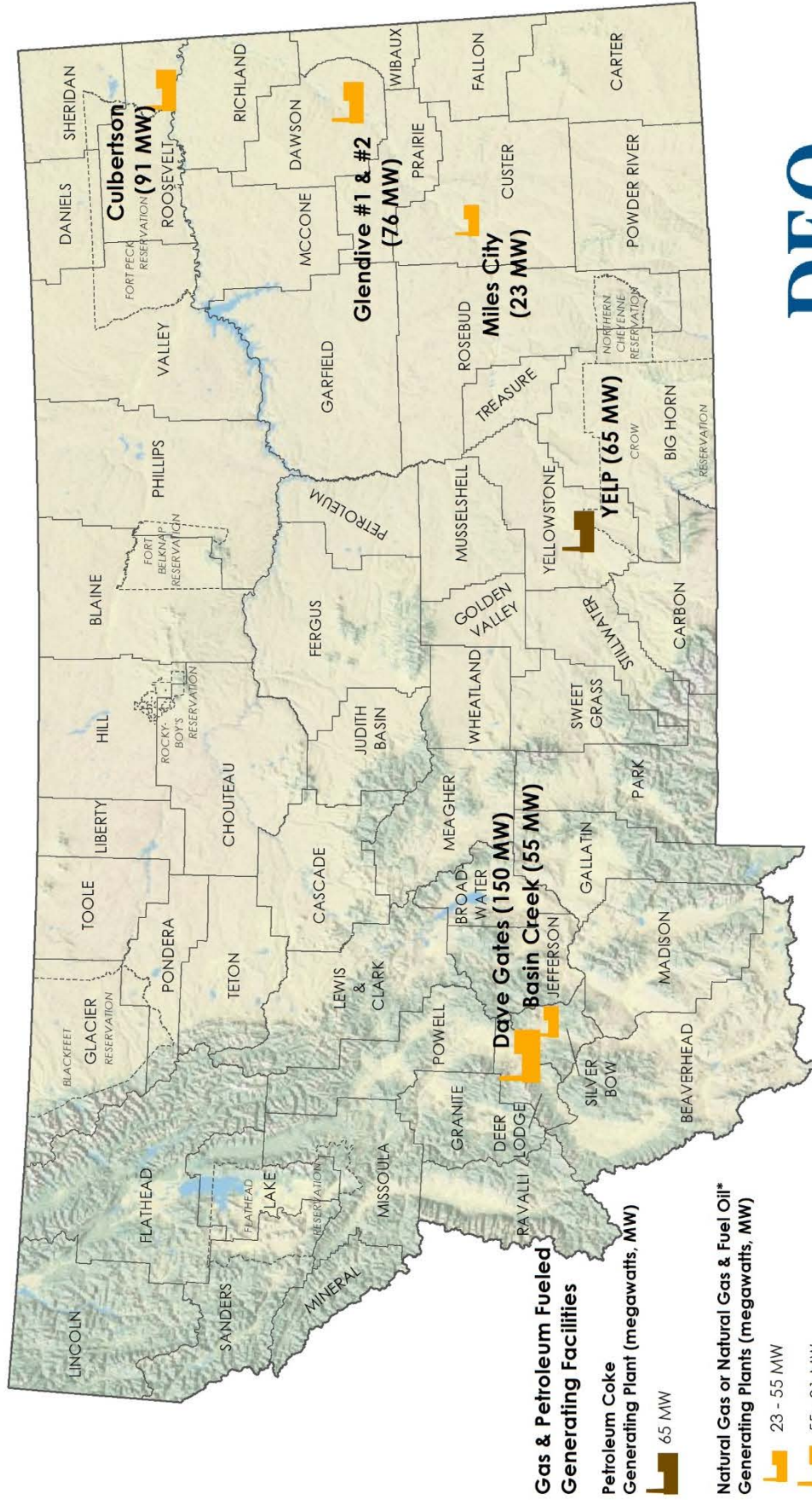
Montana currently consumes more natural gas than it produces. In 2015, Montana produced 51.4 billion cubic feet (Bcf) and consumed 75.0 Bcf.⁸⁶ a significant portion of in-state production is exported, and at least half of Montana's consumption is imported from Canada and other states. This is especially true in the eastern portion of the state where most natural gas produced leaves the state in pipelines, and much of what is consumed is imported from other states. These market patterns of import and export are driven by the trading structure of natural gas contracts, as well as the configuration of pipelines and wells throughout Montana.

From 2012-2016, Montana produced an annual average of about 57.9 Bcf of gas, which is down from the decade before that when the average was around 99 Bcf per year and annual production totals reached as high as 115 Bcf. Reasons for this recent decline in Montana gas production include less associated natural gas from the Bakken oil field, the collapse of coal-bed methane due to economics, a lack of fracking in state, traditional shallow reserves from conventional wells declining, and very few (almost zero) new conventional wells being drilled. From 2011-2015, Montana consumed a total average of 75.3 billion cubic feet (Bcf) of gas, which has held relatively steady since 2000.⁸⁷

⁸⁶ U.S. EIA, 2017. Total consumption for this chapter includes lease, plant and pipeline natural gas use.

⁸⁷ Ibid.

Montana Natural Gas Generation



* Culbertson, Glendive #1 & #2, and Miles City generating stations are rated to operate with either natural gas or #2 fuel oil, but have been predominantly fueled by natural gas in recent years.

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Gas wells in Alberta and Montana provide most of the natural gas supply for Montana customers, a market condition unlikely to change in the future. Reasons include Montana's proximity to Alberta's large gas reserves and the configuration of pipelines within and outside of the state. Supplies from other states including Wyoming and North Dakota also represent a portion of total in-state usage—mostly on MDU's Williston Basin (WBI) natural gas system. With the NorthWestern Energy purchases of natural gas fields in north-central Montana in 2010 and 2013, a larger percentage of gas consumed in Montana will likely be produced in state than in past years.

Domestic, in-state gas wells are located primarily in the north-central portion of the state, although other portions of the state also have wells. In 2015, the northern portion of Montana accounted for 71 percent of total in-state production, the northeastern portion 24 percent, and the south-central portion 3 percent as defined by Montana DNRC.⁸⁸ In-state gas production increased from relatively constant historical levels from 1995 to 2007 and then saw sharp declines in the years since (Figure _). Blaine, Fallon, Hill, and Phillips counties produce the greatest amounts of natural gas in Montana. Powder River County and Richland County have both increased their percentage of the total amount, most of it in "associated gas", with oil production from the Bakken Oil Field. Associated gas is natural gas that is a byproduct from oil wells.

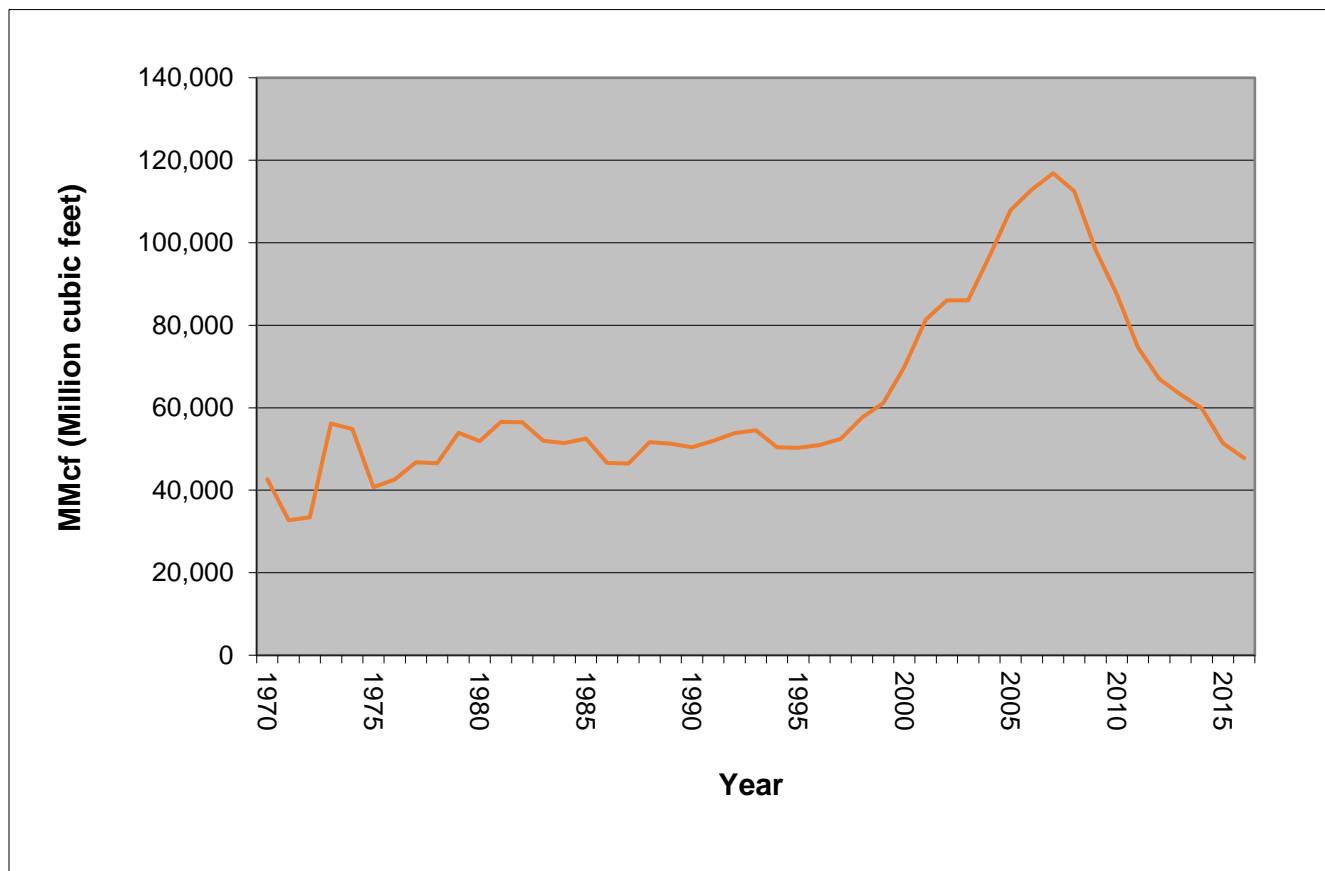
A portion of the gas produced in Hill and Blaine Counties in northern Montana flows into NWE's gas pipeline system and a portion into the Havre Pipeline system. Havre Pipeline delivers 7.0 Bcf total from those wells to be consumed in state on NWE's system.⁸⁹ Gas produced in Fallon, Richland, and Phillips Counties mostly flows into MDU's system, and dependent on the seasonal demand, will flow west to central Montana or east into the state of North Dakota.⁹⁰

⁸⁸ Montana, DNRC, Oil and Gas Conservation Division, Board of Oil and Gas Conservation, ANNUAL REVIEW 2015 Volume 59, http://bogc.dnrc.mt.gov/annualreview/AR_2015.pdf

⁸⁹ Pat Callahan, NorthWestern Energy, August 2017.

⁹⁰ Bob Morman, MDU, 2017

Figure 16. Marketed Natural Gas Production in Montana (1970-2016)



Natural Gas Supplies for the United States

U.S. natural gas supplies are largely domestic, supplemented by imports mainly from Alberta, Canada. A small amount of gas imports arrives from other countries, a portion of which is liquefied natural gas (LNG). Domestic gas production and imported gas are usually enough to satisfy customer needs during the summer, allowing a portion of supplies to be placed into storage facilities for withdrawal in the winter. This is when the additional requirements for space heating cause total demand to exceed production and import capabilities. Natural gas is injected into pipelines every day and transported to millions of consumers all over the country. Much of it travels long distances from production areas to population centers through interstate pipelines owned and operated by pipeline companies. Once the gas arrives at a population center, it is generally delivered to residential customers and other end-use consumers through the complex network of pipes owned and operated by local distribution companies (LDCs).

Total U.S. marketed production of natural gas has risen sharply in recent years. In 2006, production totaled 19.41 trillion cubic feet (Tcf), in 2012, production totaled 25.28 Tcf and in

2016, production increased to 28.29 Tcf.⁹¹ The increase is mostly due to fracking technology. Hydraulic fracturing (commonly called fracking or fracing) is a technique in which water, chemicals, and sand are pumped into a well to unlock the hydrocarbons trapped in shale formations by opening cracks (fractures) in the rock and allowing natural gas to flow from the shale into the well. When used in conjunction with horizontal drilling, hydraulic fracturing enables gas producers to extract shale gas. Without these techniques, natural gas does not flow to the well rapidly, and commercial quantities cannot be produced from shale. Fracking is occurring in diverse areas across the U.S. and has led to environmental and landowner concerns in those areas.⁹² So far, these concerns have not significantly slowed down increased production from natural gas fracking. In terms of technology, natural gas fracking is similar to oil fracking.

According to the U.S. Energy Information Administration (EIA), the top five states producing natural gas (measured as “marketed production”) in 2015 were Texas (7.88 Tcf), Pennsylvania (4.81 Tcf), Oklahoma (2.50 Tcf), Wyoming (1.79 Tcf), and Louisiana (1.78 Tcf). These five states accounted for about 65 percent of marketed natural gas production in the United States in 2015.⁹³ Marketed production from federal offshore wells in the Gulf of Mexico was 1.29 Tcf in 2012, or about 4.5 percent of total domestic production. These amounts are sharply down from 10 years ago when the average annual offshore natural gas production from the Gulf was around 4.0 Tcf. The reason for the change is that onshore fracking and onshore conventional and unconventional production are generally cheaper than offshore production.

The Rocky Mountain states are the primary domestic source of natural gas supply to the Pacific Northwest region, which includes Montana. Alberta is also an important source for the region. Almost all of the recent increase in domestic natural gas production is due to growth in shale gas production using fracking technology. Much of that increase is coming from the Marcellus formation in the Northeast U.S. (explaining Pennsylvania’s high production levels). Onshore production is projected to increase over time, while federal Gulf of Mexico production from existing fields declines, as the current economics of onshore drilling remain more favorable and require lower marginal investments. EIA projects that the United States will become a net exporter of natural gas on average in 2017.⁹⁴ It is important to note that with the volatile nature of the natural gas market, it is hard to predict future production levels.

In 2016, nearly 11 percent or 3.0 Tcf of the total natural gas consumed in the U.S. is imported from other countries. Most of that gas comes from Canada. Aside from Canada, LNG is the other significant source of natural gas imports, although it makes up a small portion of imports.

⁹¹ U.S. EIA, 2017

⁹² <http://geology.com/energy/shale-gas/>

⁹³ U.S. EIA, 2017.

⁹⁴ U.S. EIA *Short Term Energy Outlook*, July 2017. https://www.eia.gov/outlooks/steo/pdf/steo_full.pdf.

LNG imports into the U.S. have fallen sharply since 2006 and are only about 3 percent of overall natural gas net imports.⁹⁵ U.S. exports have ramped up from 0.8 Tcf in 2007 to 2.3 Tcf in 2016. Most of the increase is realized in pipeline shipments to Canada and Mexico. There were 415 natural gas storage sites in the United States in 2016 with a combined total capacity of 9.2 Tcf.⁹⁶

It is difficult to predict precisely how much natural gas is left in North American reserves.

Proved reserves are estimated volumes of hydrocarbon resources that analysis of geologic and engineering data demonstrates with reasonable certainty are recoverable under existing economic and operating conditions. Unproved reserves are the balance of the rest of technically recoverable resources.

According to EIA estimates in 2015, the U.S. had 369 Tcf of proven reserves (about 12 years of current U.S. consumption) and about 1,986 Tcf of unproven reserves.⁹⁷

Natural Gas Consumption in Montana

Recent Montana natural gas consumption averages 65 to 80 Bcf per year (**Figure 9**). Both residential and commercial gas consumption are currently growing slowly, and remain roughly level with 1970s consumption figures. Usage by industry is expected to stay fairly level in the near term unless a large new gas consuming company enters or leaves the state. Traditionally, industrial usage has varied more than other sectors.

In the 1970s, Montana's industrial sector used much more natural gas than it does today, and as a result, total in-state consumption was higher than it is today. The closure of smelters in Anaconda, in particular, contributed to the drop in industrial usage that took place in the 1980s. Other business closures, like those of Columbia Falls Aluminum Company and Smurfit-Stone in the past 15 years, contributed as well. Two relatively new in-state electrical generation facilities are using increasing amounts of natural gas. Total in-state consumption is slowly creeping toward 1970s levels, due mainly to increases in the state's population, a growing commercial base, and natural gas-fired electrical generation.

The 53 MW capacity Basin Creek electric generation plant near Butte began operations in late 2005. Natural gas usage at the Basin Creek plant constitutes a small percentage of Montana's total usage. It is typically used as a peaking resource and when electricity prices are high. The 150 MW capacity Dave Gates Generating Station (DGGs) near Anaconda began operations in

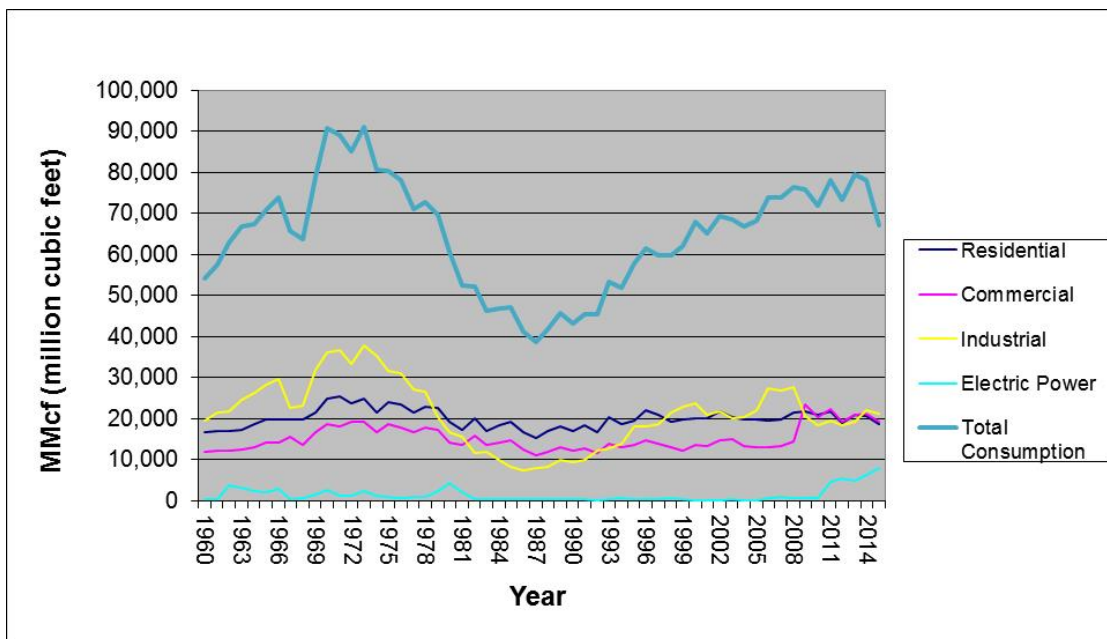
⁹⁵ U.S. EIA, 2017.

⁹⁶ Ibid.

⁹⁷ U.S. EIA website and *Oil and Gas Supply Module, Assumptions to the Annual Energy Outlook*, July 2017, <https://www.eia.gov/outlooks/aeo/assumptions/pdf/oilgas.pdf>.

2011 and also uses a small percentage of Montana’s total. Neither plant functions as a base load resource, and neither plant required extensive upgrades to NWE's pipeline system.⁹⁸ The Culbertson Generation Station, a nearly 90MW facility, began operations in 2010 on the Eastern Electric Grid. The Culbertson Generation Station operates sporadically and not as a base load resource. The facility doesn’t use a sizeable amount of natural gas. A large base load natural gas plant running at high capacity (i.e. 500 MW base load plant) could use half as much natural gas as Montana consumes in a year, but no such plant exists in Montana. Natural gas electric generation in Montana consumed 7.8 Bcf of gas in 2015, about 12 percent of the state total.

Figure 17. Natural Gas Consumption in Montana (1960-2015)



Natural Gas Consumption in the U.S.

In the last 40 years, changes in energy markets, policies, and technologies combined to spur an increase in the total usage of natural gas in the U.S. These changes included:

- Deregulation of wellhead prices under the Natural Gas Policy Act of 1978 and acceleration under the Natural Gas Wellhead Decontrol Act of 1989;
- Deregulation of transmission pipelines by FERC Orders 436 (1985), 636 (1992), and 637 (2000). The FERC orders separated natural gas commodity purchases

⁹⁸ A base load resource is a generation plant that runs constantly or runs a majority of the time at constant levels. Basin and Dave Gates do not run all the time, and ramp their output up and down frequently depending on the needs of NorthWestern Energy’s electric balancing area.

from transmission services, so pipelines transport gas on an equal basis. Order 636 allowed customers to purchase natural gas from a supplier other than the utility that delivers their natural gas;

- Passage of the Clean Air Act Amendments of 1990 and subsequent regulations affecting air quality standards for industries and electricity generators in nonattainment areas, which favor natural gas over other fossil fuels such as coal;
- Potential federal regulation that could constrain carbon emissions;
- Improvements in the efficiency and flexibility of natural gas generation and improvements in exploration and production technologies (e.g. fracking)
- Investment in major pipeline construction expansion;
- Low natural gas prices due to fracking technology implemented in the 2000's.

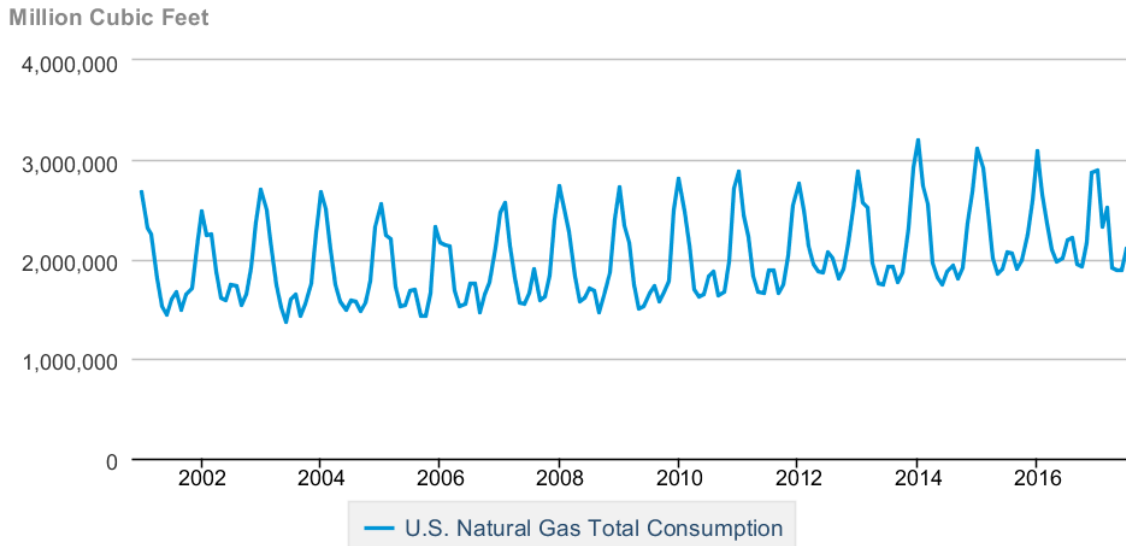
U.S. gas consumption was 27.49 Tcf in 2016. Historically, U.S. natural gas consumption has increased at a steady pace. In 2016, the use of gas for electric generation was the largest natural gas consuming sector in the U.S at 36 percent (10 Tcf), up from 28.6 percent in 2006. That percentage is holding steady. Industrial use of natural gas, the second largest category in the U.S., has been declining in usage and as a share of the total market, although it increased recently due to low gas prices. Chemical and fertilizer industries, for example, have benefited from lower natural gas prices. Residential usage is the third largest category.⁹⁹

U.S. consumption varies a lot seasonally with more natural gas being consumed in winter for heating as seen in the figure below.¹⁰⁰

⁹⁹ U.S. Energy Information Administration

¹⁰⁰ Ibid

Figure 18. U.S. Total Natural Gas Consumption



 Source: U.S. Energy Information Administration

Montana's Natural Gas Pipeline System

Three distribution utilities and two transmission pipeline systems handle more than 99 percent of the natural gas consumed in Montana. The distribution utilities are NWE, MDU, and Energy West, which uses NWE for gas transmission. NWE and the Williston Basin Interstate Pipeline (affiliated with MDU) provide transmission service for in-state consumers and, with a handful of other pipelines, export Montana natural gas. **Figure __** provides an overview of natural gas transmission pipelines in Montana. The red lines show NWE's transmission system and the blue lines are the WBI system serving MDU. Other lines are listed. Distribution lines are typically smaller and serve local customers, whereas transmission lines are larger lines that carry gas from production areas to large consumers and the distribution networks of populated areas.

NWE is the largest provider of natural gas in Montana, accounting for almost 60 percent of all regulated sales in the state according to annual reports from Montana utilities.¹⁰¹ NorthWestern Energy serves Montana natural gas customers in 105 communities, and provides

¹⁰¹ It is important to note that regulated sales do not include most of industrial consumption, because since 1991, industrial consumption has not been reported due to different reporting requirements and processes used by utilities since deregulation. Regulated sales also do not include gas used for pipeline transportation, and gas sales sold to other utilities for resale in Montana, lease and plant fuel, pipeline fuel, or fuel used by utilities.

gas storage and transmission to other parties. NWE provides natural gas transmission and distribution services to about 194,100 natural gas customers in the western two-thirds of Montana (including the Conoco and Cenex oil refineries in Billings). These customers include residences, commercial businesses, municipalities, state and local governments, and industry. NWE's gas transportation system, both long-distance pipeline transmission and local distribution, lies entirely within Montana.¹⁰²

NWE's gas transmission system is regulated by the Montana PSC. The NWE system consists of more than 2,000 miles of transmission pipelines, 5,000 miles of distribution pipelines, and three major in-state storage facilities. NWE's system has pipeline interconnections with Alberta's NOVA Pipeline, the Havre Pipeline Company, the Williston Basin Interstate Pipeline Company, and the Colorado Interstate Gas Company. The Havre pipeline is partially owned by NorthWestern Energy and is regulated by the PSC.¹⁰³

NWE supplies gas by purchasing contracts on the market, with various durations of 2 years or less. The NWE pipeline system receives gas from both Alberta and Wyoming. The price paid for gas in Montana on the northern end of NWE's system is generally tied to prices in Alberta. The price paid for gas coming in on the southern end of Montana's system is generally tied to prices associated with Colorado Interstate Gas. Alberta sends natural gas to Montana primarily through NWE's pipeline at Carway, which ties into TransCanada, and at Aden where it ties in with an independent producer. Most gas exported on NWE's system is exported to Wyoming at CIG.¹⁰⁴

NWE's natural gas delivery system includes two main storage areas. The Cobb storage facility is located north of Cut Bank near the Canadian border. The Dry Creek storage facility is located near the Wyoming border. Natural gas storage provides a critical supply component during the heating season, helps satisfy sudden shifts in demand and supply, and flattens out gas production through the year.

NWE's natural gas transmission system delivers an average of about 42 Bcf of natural gas per year to its customers on average, compared with total annual Montana consumption of nearly 70 Bcf.¹⁰⁵

In 2016, NWE imported 10.7 Bcf or 57 percent of its 18.7 Bcf of regulated sales. NWE's recent acquisition of the Bear Paw natural gas field located south of Havre changed the company's

¹⁰² Tom Vivian, NorthWestern Energy, August 2017.

¹⁰³ Ibid.

¹⁰⁴ John Canavan, NorthWestern Energy, 2017.

¹⁰⁵ Tom Vivian, 2017

procurement mix slightly. NWE used to obtain a larger percentage of its gas from Alberta, but with recent purchases, all of NWE's Montana production is consumed in the state.¹⁰⁶

The NWE pipeline system has a daily peak capacity of 325 MMcf of gas. Core customers, who include residential and commercial business users, use about one-half of the total gas on NWE's system. NWE has the obligation to meet its core customers supply needs. The other half of the system's capacity is used by noncore customers, including industry, local and state governments, and by Energy West, which supplies Great Falls. NWE provides only delivery service for these noncore customers that contract their own gas supply. Peak gas usage occurs on cold weather days when daily demand is often close to peak pipeline capacity. Significantly smaller amounts are used during warm weather.¹⁰⁷

There is little unused firm capacity on the NWE pipeline transmission system. No additional gas user of significant size, such as a large industrial company, could obtain guaranteed, uninterrupted gas delivery on the current system. At times of peak consumer usage, the pipeline is full and could not deliver more gas. In other words, the system's maximum daily capacity is matched by peak daily demand. The projected growth rate of natural gas use on the system is expected to come from core customers. Over the past decade, NWE has expanded its gas transmission capacity by building loops on its current system, which is a second pipe running parallel along a main line. Meeting the demands of new gas-fired electrical generation or a large new industrial facility would likely require significant additional upgrades to the pipeline system.

MDU is the second largest natural gas utility in Montana and accounts for about 25 to 30 percent of all regulated natural gas sales in Montana. Its annual sales in Montana are just under nine Bcf. It distributes natural gas to most of the eastern third of the state, including parts of Billings. MDU uses the Williston Basin Interstate line and NWE pipelines for the transmission of its purchased natural gas in the state. The Williston Basin Interstate NWE systems provide service for other utilities and are regulated at the federal level by FERC. MDU buys its gas from approximately 20 different suppliers throughout the upper Midwest. Of its current gas, MDU is purchasing 10 to 15 percent from producing fields in Montana and about 40 to 50 percent of its supply from the North Dakota Bakken area. These percentages can change depending on seasonal demand. MDU expects future growth to be about 1 percent per year for the near future.¹⁰⁸

¹⁰⁶ John Smith, Manager of Natural Gas Supply, NWE, August 2017.

¹⁰⁷ Tom Vivian, 2017

¹⁰⁸ Bob Morman, MDU, August 2017.

Energy west is the third largest natural gas provider in Montana, accounting for about 10 percent of all regulated gas sales in Montana. Its annual sales are about 3.2 Bcf. It provides gas to the Great Falls area and a small amount to West Yellowstone.

Other operating Montana utilities account for about 1 percent of all gas sales and currently include the Cut Bank Gas Company and Havre Pipeline Company. The Northern Border pipeline (2.2 Bcf/day capacity), which passes through the northeastern part of Montana, is the largest pipeline in the state, but it has only a couple of injection points in Montana. Northern Border feeds the Culbertson Natural Gas Electric Generation Station. In addition, pump stations on the Northern Border pipeline generate heat and that heat is converted to electricity at the Ormat Waste Heat station near Culbertson. The terminus of Northern Border is the U.S. Midwest market.

Measuring Natural Gas Commodity Prices in Montana and the U.S.

Natural gas prices are measured in different ways at different points in the gas supply system. The wellhead price is the price of the gas before it is transported from the well. The wellhead price for natural gas (which varies a bit from region to region) is set in the national wholesale market, which was deregulated by the federal government in 1978. No state, including Montana, can regulate or really control this wholesale market. The wholesale gas prices on the major gas indices, such as the Henry Hub and AECO Hub in Alberta, reflect the wellhead price of gas plus a fee to transport the gas to the particular hub. The Henry Hub Index is measured at the Henry Hub in southern Louisiana, a major pipeline interconnection and transshipment point. It is one of America's largest natural gas indices and provides a nationwide price reference point.

While the Henry Hub price appears to be a good approximation of average U.S. wellhead prices, other hubs located in relatively remote areas, like Wyoming and Alberta, can have significantly higher or lower prices than the Henry Hub due to their location, local pipeline constraints, and local markets. Recently, price spikes in the Northeastern U.S. during the cold winter of 2014 did not occur in the Henry Hub, so price differentials can also occur between different areas in the U.S.

The city gate gas price reflects the wellhead price plus pipeline transmission fees to get the gas to a particular locale or distribution system. The delivered gas price paid by customers is the city gate price plus local distribution fees and other miscellaneous charges from the utility. Transmission and distribution fees are set by utilities, pipeline operators, or both and are regulated by state and federal agencies. Natural gas wholesale prices on the major gas indices (or the commodity market) are measured in several ways. There are spot market prices for immediate sales and market prices for long-term contracts. Spot prices can be volatile and typically represent a small portion of market sales. A 'futures' price is the cost of natural gas

obtained by contract for delivery at some future point at a set price. Larger buyers rather than spot prices generally use futures contracts. NWE, as an example, buys much of its natural gas for its core customers using longer-term contracts (up to 2 years) to lock in an acceptable price and to minimize price risk that can be associated with the spot market. This helps keep the price paid by customers relatively stable in a market that can otherwise experience large price swings. All contracts for NWE are tied to the AECO or CIG index prices, so those contracts will be tied to the natural gas prices in those markets.¹⁰⁹

Due to its location in the western Canada sedimentary basin, the AECO price is often \$0.60/MMBtu to \$1.50/MMBtu cheaper than the Henry Hub price.¹¹⁰ This has kept Montana natural gas prices generally lower than the U.S. average.

The interplay between the supply and demand of Alberta's gas generally has the greatest effect on the gas prices paid in Montana. Recently, the increase in gas supply from fracking has also brought U.S. prices down significantly. This interplay occurs both on a national level and regionally for both supply and demand. Factors on the supply side that may affect natural gas prices include variations in natural gas storage, production, imports, or delivery constraints. Storage levels receive the most attention because of the physical hedge that these levels provide during high-demand periods. The amount of natural gas in storage often is viewed as a barometer of the supply and demand balance in the market. Fracking technology has been the dominant price factor recently, increasing supply and lowering price and preventing recent long-term price swings. Indeed, natural gas prices have been relatively stable since about 2009.¹¹¹

Disruptions caused by severe weather, operating mishaps, or planned maintenance can also cause short-term tightness in natural gas supply. In the summer of 2005, hurricanes along the U.S. Gulf Coast caused more than 800 Bcf of natural gas production to be shut down between August 2005 and June 2006. This was equivalent to about 5 percent of U.S. production over that period and about 22 percent of yearly natural gas production in the Gulf of Mexico. Because of these disruptions, natural gas spot prices at times exceeded \$15 MMBtu in many spot market locations and fluctuated significantly over the subsequent months, reflecting the uncertainty over supplies. On the demand side, temperature changes tend to be one of the strongest short-term influences on gas prices. In the colder states/regions of the country, residential and commercial end users consume more natural gas for heating needs, which places upward pressure on prices. Temperatures also have an effect on prices in the summer as usage increases for electric generation to meet air-conditioning needs. Thus, a very hot summer could also raise

¹⁰⁹ John Smith, NorthWestern Energy, August 2017.

¹¹⁰ <https://seekingalpha.com/article/3984453-aeco-basis-differential-shrinks-natural-gas-daily>

¹¹¹ U.S. EIA, 2017

natural gas prices. In Montana, the highest residential and commercial prices are in the summer and industrial prices are flat throughout the year, generally tracking city gate prices.

The prices and market conditions for related fuels also have an effect on natural gas. Historically in the U.S., most base load electric generation has been delivered from coal, nuclear, and hydroelectric generation. Because natural gas tends to be a higher-cost fuel, natural gas-fired power stations were traditionally used to cover mostly incremental power requirements during times of peak demand or sudden outages of base load capacity. This is changing as an increasing amount of new electricity is fueled by natural gas nationwide. The shift is due to lower gas prices, lower emissions from gas plants compared to coal (and thus less regulation); low initial capital cost for gas plants compared to new coal and nuclear plants, a fast online time, and needed versatility provided by certain natural gas plants to ramp electric output up and down.

Economic activity also is a major factor influencing natural gas markets. When the economy improves, the increased demand for goods and services from the commercial and industrial sectors generates an increase in natural gas demand. The trend is prevalent in the industrial sector, which uses gas as both a plant fuel and a feedstock for many products, like fertilizers and pharmaceuticals. The recent recession lowered natural gas prices, as industrial usage was down. Industrial usage has recently increased to a higher level than before the recession, and prices have stayed relatively constant.

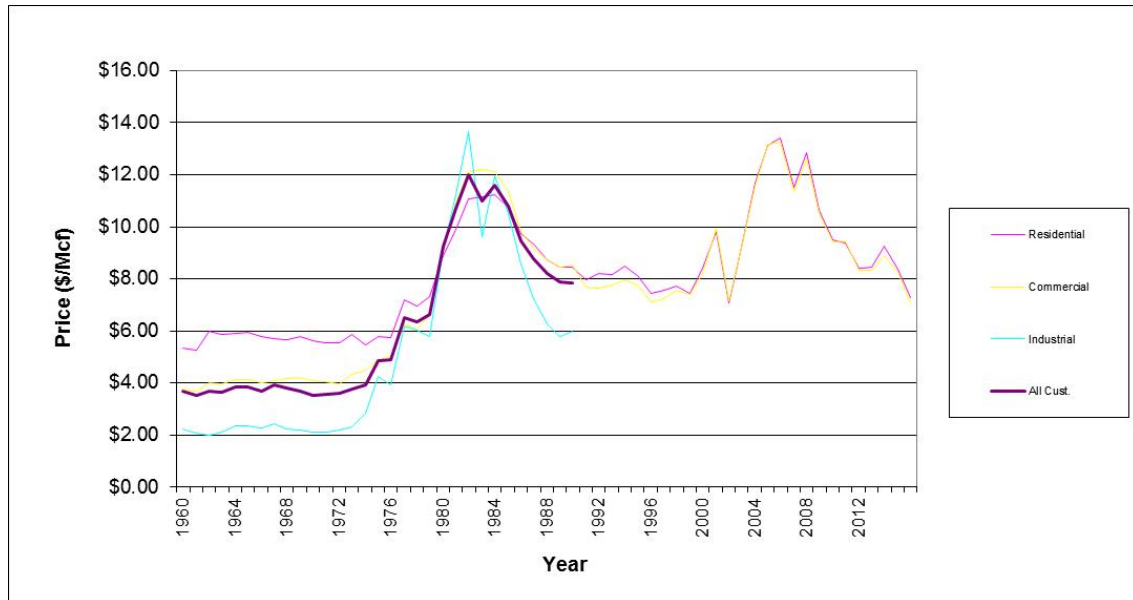
Natural Gas Prices in Montana

Until the late 1970s, delivered gas prices in Montana were relatively low, about \$6/mcf in today's dollars (actual dollars adjusted for inflation). Delivered prices rose considerably through the mid-80s and mostly settled in the \$8-\$12/mcf range using today's dollars (**Figure 12**). In the 1990s, the delivered prices hovered around \$8/mcf. From 2000-2004, delivered gas prices started increasing and showing more variation, rising up to an average of more than \$10/mcf for certain years in Montana. Since late 2005, prices have declined to historical lows. As of July 2016, NWE residential customers pay an average delivered gas price of \$7.26/mcf.¹¹² Figure 20 shows delivered natural gas prices in Montana adjusted for inflation through 2016 and reported in constant 2016 dollars. The delivered prices are the prices residents and businesses see in their final energy bill reflecting all charges. The U.S. delivered price of natural gas averaged just over \$10.06/mcf in 2012.¹¹³

¹¹² NWE natural gas rates, http://www.northwesternenergy.com/documents/MT_Rates/Gas/gsummaries.htm.

¹¹³ U.S. Energy Information Administration, <http://www.eia.gov/naturalgas/>.

Figure 19. Delivered Price of Natural Gas in Montana Adjusted for Inflation, 1960-2016
(in 2016 dollars)



Transmission utilities in Montana, the major utilities being NWE and MDU, are prohibited from earning any profit on the cost of natural gas they purchase. The commodity cost of the gas is simply passed on to its customers. If gas costs increase, they are passed on to customers, and if gas prices go down, the savings are also passed on to customers. Utilities earn their profit through a return on capital investment, including the gas transmission and distribution systems, that is regulated by the Montana Public Service Commission.

The average price of gas purchased by NWE, MDU, and Energy West reflects current gas market conditions, and that price is constantly changing. Any price change requested by NWE and MDU must be approved by the PSC in what is called a tracker hearing. A tracker hearing covers only the cost of purchased gas and not any of the other costs of the utility. Trackers usually are routine procedures, but they can be contentious. NWE computes a new tracker each month to reflect the gas costs it incurs in order to supply its customers. It is important to note that the purchased cost of gas includes transportation costs to the utility's delivery system and, for NWE, variable operating costs associated with owned production properties.

Natural gas prices for Montana consumers are currently in the middle range of historical prices. The average monthly gas bill for an NWE residential customer (based on an average usage of 100 therms per month) went from \$70.89 in 2002 to \$128.83 in April 2006. In 2013, the monthly bill was about \$90 and in 2017, the average monthly bill is about \$78 per month.¹¹⁴ The monthly

¹¹⁴ <http://www.northwesternenergy.com/account-services/whats-included-in-your-total-bill/tariffs-and-rates/rate-comparison-tool>

gas bill for an MDU customer went from \$47.60 in January 2002 to \$92.29 in April 2006. It was about \$59 in 2017. ¹¹⁵

Due to natural gas deregulation, most large industrial customers in Montana contract for gas directly with MDU and Energy West or with other independent suppliers. Industry still uses the local utilities for distribution and transportation services. The gas price for each industrial customer depends on each specific contract, the gas supplier, and the ability of the industry to switch from natural gas to some other fuel if prices get too high. Four of the largest natural gas users in Montana are the four oil refineries in and near Billings and Great Falls. Plum Creek Manufacturing, REC near Butte, and Basin Creek Power Services are also large users in Montana. Montana's major natural gas transmission pipelines also use large amounts of natural gas to pump the product over long distances at appropriate pressures. The refineries in Billings have some flexibility in switching fuels to run operations, so they may not be hit as hard by higher gas prices as other industries. Other large customers, like Montana State University, have less flexibility to switch fuels. Large gas users who buy gas on the spot market, like Montana State University-Billings, could be hurt by high prices and price swings, while other industrial customers with longer-term contracts at lower prices are partially insulated.

Recent Developments

Bakken Production

Fracking will likely keep prices relatively low in the short term and supply high. It may also increase domestic production and lower the amount of natural gas coming from the Gulf. It also will likely keep imports low in the near future and may lead to increased U.S. exports.

Natural gas production has greatly increased in Richland County bordering North Dakota, although this boom has been muted lately with low oil and gas prices. The production in the Bakken has been from associated gas that is produced as a byproduct of oil production, as opposed to the traditional natural gas wells in the north-central part of the state. Richland County is on the edge of the Bakken boom in North Dakota, and oil production, as well as associated gas production, has boomed in the past few years, although not nearly as fast as the boom in North Dakota. Over time, more natural gas is being captured and less is being flared into the atmosphere in that area.

Peaking Plants Locally and Nationwide

The Dave Gates Generating Station (DGGS) is a natural gas fueled electric generation plant used for regulation services. It has a 150-MW capacity and is located near Anaconda. The plant, which began commercial operation in 2011, provides energy necessary to maintain NWE's high-voltage bulk transmission network in Montana. Electricity is a dynamic resource and demand fluctuates on a moment-by-moment basis. The electricity network needs to meet demand at all

¹¹⁵ <https://www.montana-dakota.com/docs/default-source/rates-tariffs/mTNaturalgasratesummary>

times while maintaining voltage and reliability requirements. The electricity generated at DGGs meets this demand around the clock, resulting in a stable, reliable transmission network and reducing NWE's reliance on outside providers for transmission regulation. DGGs provides additional flexibility to integrate Montana renewable power into the existing transmission system. There has recently been talk about appropriating a share of DGGs for base load operations if the hydro dams take on more of the regulating function.

In April of 2015, natural gas overtook coal as the primary fuel for electric generation in the U.S. for the first time ever, and 2016 was the first year in which natural gas produced more electricity than coal. Currently, coal and natural gas produce approximately equal amounts of electricity with fluctuations based largely on changes in fuel prices. More gas generation plants could stress the U.S. natural gas transmission system. A recent analysis by E3 has shown that natural gas transmission pipeline capacity in the U.S. West is currently sufficient to handle increasing natural gas fired electricity except under the most extreme weather and pipeline failure conditions.¹¹⁶ This is different from the situation in the Northeastern U.S. where the infrastructure is currently underbuilt and price fluctuations are often seen during cold snaps. In all parts of the nation, the natural gas system will have to be run with more flexibility to serve increasing demand and diverse end users.

The convergence of the electricity and natural gas markets has implications for regional electricity and natural gas utility systems. New electrical generation facilities that do not use natural gas, for example, will be more attractive options in terms of energy diversity. For example, most utilities in the Northwest have acquired wind generation, in part because of the hedge that fixed-priced wind power could provide against volatile natural gas prices. On the other hand, natural gas is still preferred for new electric generation due to its relatively low initial capital costs, flexibility in ramping up and down, lower emissions than coal, and recent stability in prices.

Future Price Increases and Price Volatility

Although natural gas prices are expected to slowly increase over time, Montanans may be subject to increasing price volatility from extreme or unexpected events. One reason for potentially greater price volatility in Montana is that the integrated U.S. market results in all of the U.S. feeling the effects of unexpected events worldwide, like cold snaps and political turmoil. Foreign supplies of natural gas could be harder to come by as India and China continue to grow rapidly and the Middle East and former Soviet Union continue to experience political turmoil. Because the U.S. is increasingly becoming self-sufficient in natural gas supply, and extreme price volatility has not been seen in the past few years.

¹¹⁶ Natural Gas Infrastructure Adequacy in the Western Interconnection: An Electricity System Perspective, E3.

Over the past 15 years, wholesale electricity and natural gas prices also have become intimately linked. Natural gas power plants command a significant majority of new electric installed capacity in the West, followed at some distance by wind.

Natural gas prices influence electricity demand because they are substitute sources of energy for space and water heating. They also are potential fuels for electrical generation.¹¹⁷ The increasing convergence of the electricity and natural gas markets means that extreme events are likely to simultaneously affect both electricity and gas markets.

Utilities and industry can reduce price risks by buying natural gas at fixed prices, using long-term, and futures contracts. They can also store gas to prevent having to buy on the spot market. Residential and commercial customers can use budget billing to even out gas bills over a given billing year, although this does not protect a customer from yearly fluctuations. Customers can also use less gas through weatherizing and behavioral changes. Electricity efficiency improvements and demand side management may be the biggest bang for the buck to reduce natural gas demand and alleviate price fluctuations.

Recent trends in natural gas markets point out three lessons for Montana. First, natural gas prices are affected by a number of factors beyond the state's control. Second, the growing use of natural gas for electricity generation has the potential to upset the traditional, seasonal patterns of natural gas storage and withdrawals in Montana. Finally, to the extent that the western United States depends on natural gas for new electricity generation, the price of natural gas is a key determinant of future electricity prices.

¹¹⁷ Northwest Power and Conservation Council. *Revised Draft Fuel Price Forecasts for the Fifth Power Plan*, April 22, 2003.

Petroleum and Petroleum Products in Montana

During the 2016 fiscal year, Montana produced about 25.8 million barrels of crude oil, worth more than \$888 million in gross value.¹¹⁸ This oil production accounted for the majority of the \$85 million in oil and gas production tax revenue collected by Montana.¹¹⁹ Approximately ninety-five percent of Montana's crude oil production is exported to other states, primarily North Dakota and Wyoming, while 88 percent of the crude oil refined in Montana is imported from Canada with another 9 percent coming from Wyoming.

The state is home to four refineries, three in the Billings area and another in Great Falls. In total, Montana's refineries have the capacity to refine 205,100 barrels/day (bbl/day) of crude oil. In 2016, Montana's four petroleum refineries exported 37 percent of their refined liquid products to Washington, North Dakota, Wyoming, and additional points east and south. This is slightly below the five-year average of exporting 39 percent of the refined output. Crude oil receipts at Montana's four refineries totaled 66.5 million barrels in 2016. Montana consumed about 31.5 million barrels of refined petroleum products in 2015, which included refinery usage.

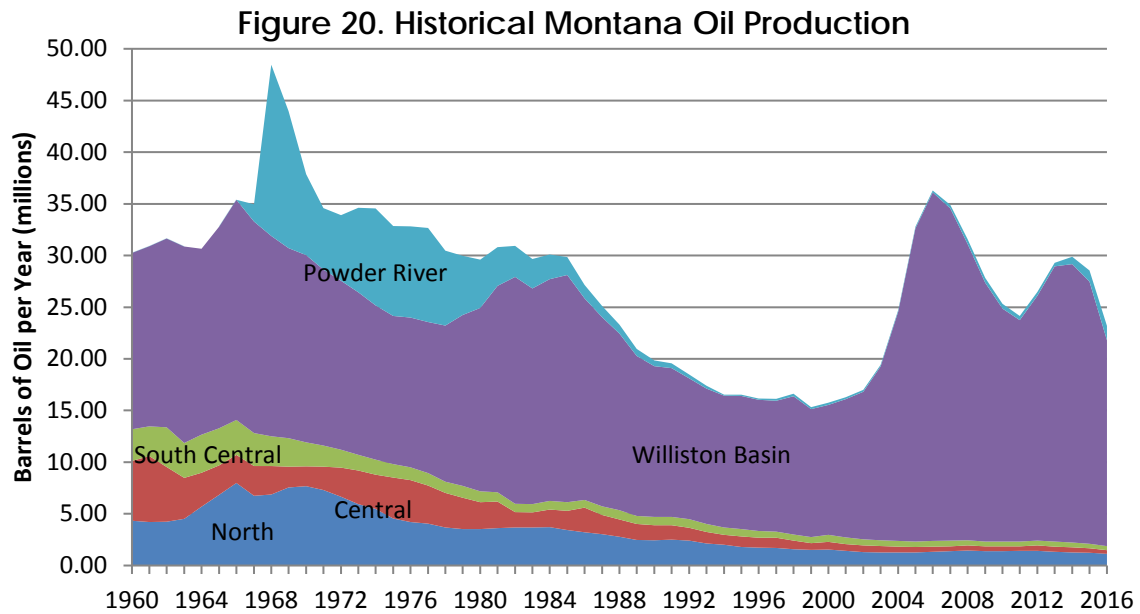
Production History

Oil production in Montana arrived somewhat later than neighboring states. The likely first oil wells drilled in Montana were in the Butcher Creek drainage between Roscoe and Red Lodge, beginning in 1889. Nonproducing wells were drilled within today's boundaries of Glacier National Park in the early 1890s. The state's first oil boom was a discovery in what geologists refer to as the Middle Mosby Dome at Cat Creek, a tributary of the Musselshell River east of Lewistown. Oil was drilled and collected there in early 1920. By 1921, the Cat Creek area accounted 1.3 million barrels (1 barrel = 42 gallons) of production. That was soon followed by the Kevin Sunburst field discovery in 1922. That field would lead production from about 1925 to 1935. A bit west, the Cut Bank oil fields were developed in the mid-1930s and led the state well into the 1950s when oil was discovered in the Williston Basin around 1955. Oil fields were developed in the Sweetgrass Arch in northern Montana, the Big Snowy Uplift in central Montana, the northern extensions of Wyoming's Big Horn Basin in southcentral Montana, and the Powder River Basin in southeastern Montana.

¹¹⁸ Montana Department of Natural Resources and Conservation, Oil and Gas Conservation Division, Annual Review; Montana Department of Revenue, Biennial Report, 2014-2016.

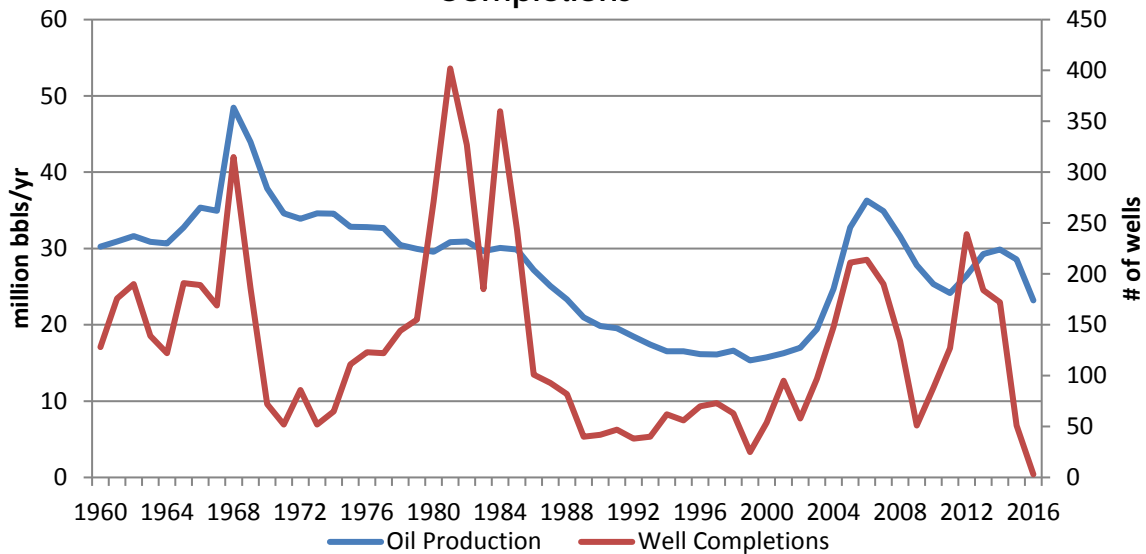
¹¹⁹ Montana Department of Revenue, Biennial Report, 2014-16, p. 123

Montana's petroleum production peaked in 1968 at 48.5 million barrels, the result of cresting Williston Basin production combined with a surge of production from the newly discovered Bell Creek field in the Powder River Basin. Production then declined quickly until 1971, when a series of world oil supply shocks began to push crude oil prices upward, stimulating more drilling that would partially offset production declines through the remainder of the 1970s.



World oil price shocks following the Iran crisis in 1979 sparked a drilling boom, which peaked at 1,149 new wells of all types in Montana in 1981. That year, the average price of Montana crude climbed to almost \$35 per barrel. While the increase in the price of oil encouraged more drilling, it did little to increase Montana production. The drilling boom of the early 1980s produced a high percentage of dry holes and was able only to delay the slow decline of statewide production.

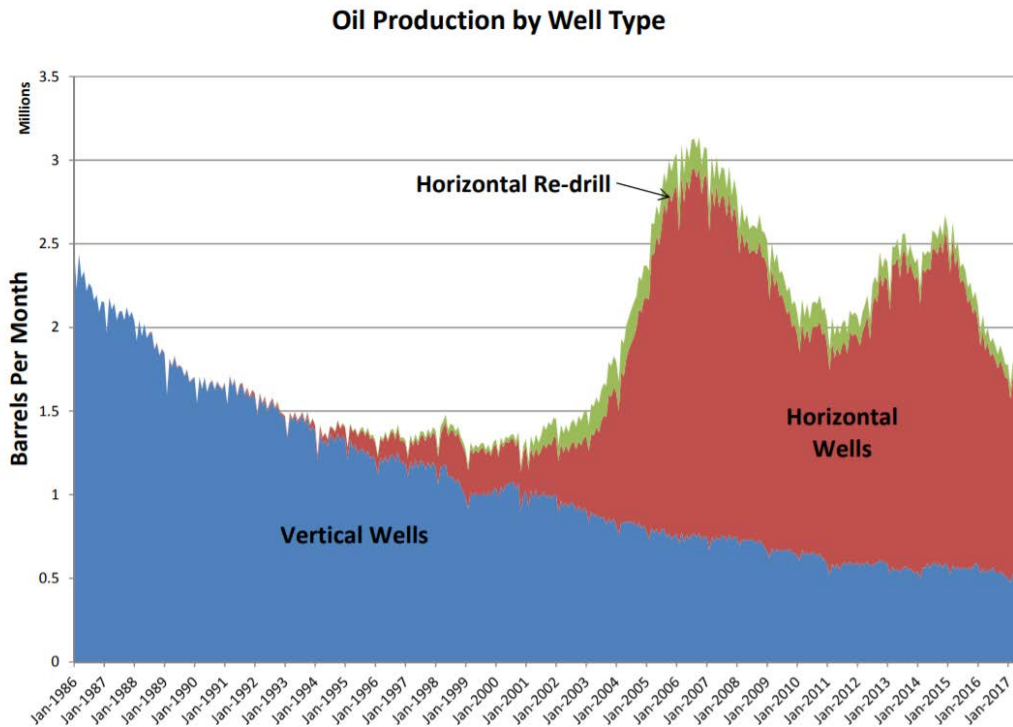
Figure 21. Historical Montana Oil Production and Well Completions



Output increased in the Williston Basin during the early 1980s, but this was matched by a steep decline in output from other areas. Production declined significantly following the drop in world oil prices in 1985, stabilizing at about 16 million bbl/year in the mid-1990s. After 1999, oil production increased sharply as horizontal drilling and hydraulic fracturing techniques began to be implemented more widely in the Williston Basin.

Montana’s recent oil production boom peaked in 2006 when production exceeded 36 million barrels. This was up from a recent historical low of 15 million barrels of oil produced in 1999. More than 50 percent of the 2006 oil production was from the Elm Coulee field in Richland County, part of the larger Bakken formation. While reserves in the area were well known, horizontal drilling techniques, a method that includes drilling a vertical well and then “kicking out” horizontally through the oil-bearing rock formation, were critical in making the field economical to develop. The horizontal well innovations used in the Elm Coulee field would go on to be used to great effect in North Dakota to develop the larger Bakken oil field.

Figure 22. Montana Monthly Oil Production - Vertical vs. Horizontal Wells, 1986-2016

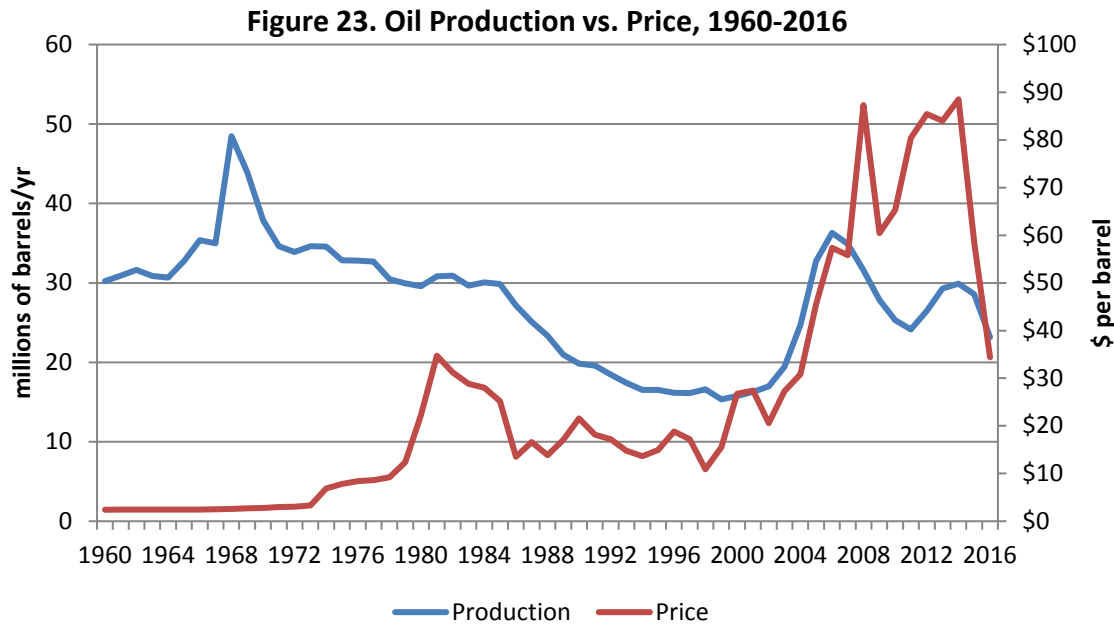


Source: Montana Board of Oil and Gas,

http://www.bogc.dnrc.mt.gov/Misc/Statistics/Production/170619_HorizontalvsVerticalOil.pdf

The Williston Basin, which covers parts of eastern Montana, North Dakota, South Dakota, and Saskatchewan and includes the Bakken and Three Forks formations, is one of the newest large oil-producing regions in the country to produce hundreds of millions of barrels of oil annually. The Williston Basin's production peaked at more than 1.2 million barrels of crude oil production per day in 2014 before production receded with the crash in crude oil prices in the fall of 2014. However, Montana's oil production represents only a small portion of the recent oil production from the larger Williston Basin. Once Montana's Elm Coulee Fields production peaked in 2006, most of the drilling and production attention shifted to the middle of the Bakken formation in North Dakota ahead of the region's overall production peak in 2014. Drilling activity did notice the Montana side of the border from 2011 to early 2014 as high oil prices and infrastructure limitations in North Dakota led to drilling activity spreading away from the center of the Bakken field. With the collapse of crude oil prices in 2014, drilling throughout the Bakken region receded quickly and only began to return in late 2016.

In total, the U.S. Geological Survey (USGS) estimated in April 2013 that the Williston Basin has technically recoverable oil reserves of 7.4 billion barrels, up from the USGS's prior estimate of 3.65 billion barrels in 2008. The upward revision was largely driven by a reassessment of the technical potential of the Three Forks formation, which lies beneath the Bakken formation, because of technology and drilling developments since 2008.



After Montana's recent oil production peak of 36.3 million barrels in 2006, annual oil production slid by a third by 2011 before going through a second, smaller boom beginning in 2012, reaching 29.9 million barrels in 2014. Over the past decade, Montana's drilling rig activity has been largely focused in the western Bakken formation, but exploratory wells have also been drilled in central and northern Montana as additional geologic formations that might lend themselves to horizontal drilling and hydraulic fracturing techniques are explored. In addition, the application of enhanced oil recovery techniques in the Bell Creek field in the Powder River Basin region has resulted in a small production increase for the region from 326,000 barrels produced in 2013 to 1.375 million barrels produced in 2016. However, with the price of crude oil plummeting in late 2014 and with recent-year oil prices stabilizing in the \$45 to \$60 per barrel range, drilling activity has retreated to more proven oil fields like the central Bakken of North Dakota and the Permian and Eagle Ford fields of Texas. Until crude oil prices spike upward again, it is unlikely that Montana will see significant oil exploration or new drilling.

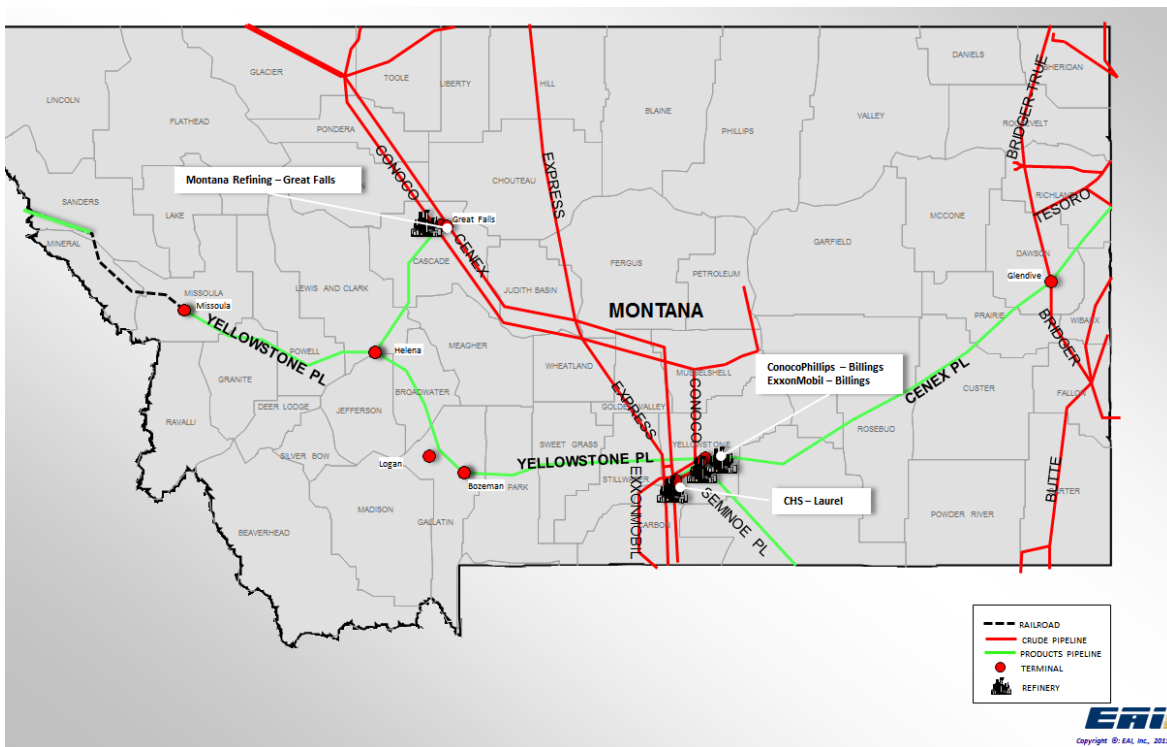
Pipelines

Three crude oil pipeline networks serve Montana's petroleum production regions. One network owned by True Companies bridges the Williston and Powder River Basins in the eastern part of

the state. The Front Range and Glacier Pipelines in Central Montana primarily move crude oil from Canada to Montana refineries in Billings and to points further on in Wyoming. Enbridge's Express pipeline in the same general area transports western Canadian crude through central Montana to Casper, Wyoming with very little of that crude offloaded in state. In addition to the state's crude oil pipelines, three major refined petroleum product pipelines operate in the state, delivering refined petroleum products to many of Montana's larger cities as well as exporting products for use in neighboring states.

The majority of oil production in Montana occurs in the Williston Basin of eastern Montana, which is not connected by crude pipelines to Montana's four refineries. As a result, in 2016, more than 95 percent of Montana oil production was exported from the state, mostly to Wyoming and the Dakotas, through the eastern Montana pipeline system or through unit train shipments originating out of western North Dakota.

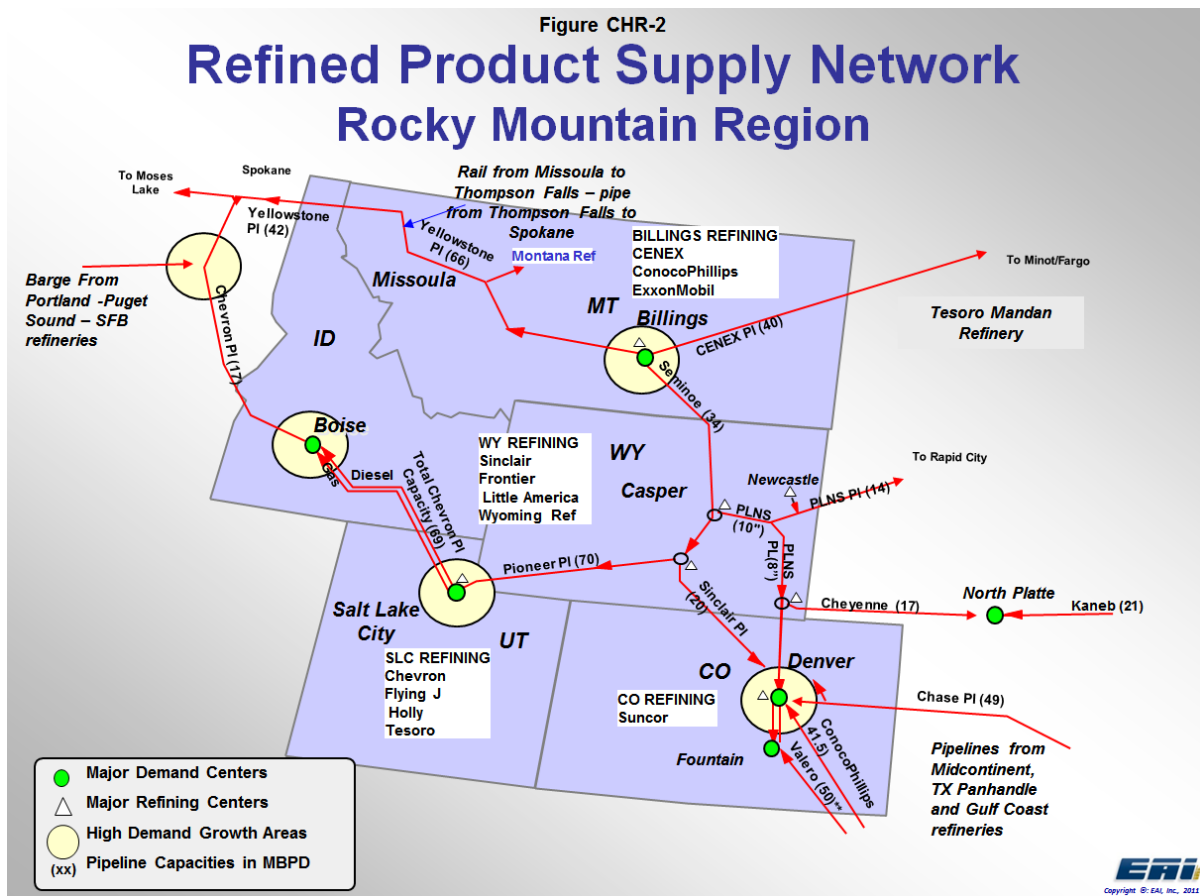
Figure 24. Map of Montana Petroleum Pipelines



Most of the petroleum produced from the Elm Coulee field in Richland County is transported east and joins North Dakota Bakken oil production, where it is transported through Enbridge's North Dakota pipeline system. The completion of the Dakota Access pipeline in 2017 has increased North Dakota pipeline capacity by 470,000 barrels per day, significantly reducing the amount of Bakken crude oil that needs to be transported by rail.

Plans also exist for additional crude oil pipelines to traverse eastern Montana in order to increase the crude oil transportation capacity out of both the Athabasca oil sands region of Canada and the Williston Basin region of North Dakota and Montana. Most notably, 280 miles of the proposed 1,980-mile Keystone XL Pipeline would pass through northeastern Montana as part of its route from Hardisty, Alberta, to Steele City, Nebraska. If built, the Keystone XL pipeline is expected to have an on-ramp for Bakken oil production near Baker.

Figure 25. Existing Refined Product Supply Network in Montana and Neighboring States



The rapid increase in Bakken oil production within North Dakota temporarily resulted in oil companies significantly increasing their use of the region's railways to transport Bakken oil. In 2013, a majority of Bakken oil production was transported by rail rather than pipeline, heading south and east toward Gulf Coast and Mid-Atlantic oil refineries. Rail shipments peaked in 2014 before decreasing year over year. After the Dakota Access pipeline began operation in 2017, train shipments of crude oil from the Bakken region totaled less than 10 percent of the region's production. Seventy percent of the remaining Bakken rail shipments are destined for the U.S.

west coast due to the region's lack of pipeline access. As a result, many oil trains continue to traverse the length of Montana on their way to Washington, California, and British Columbia.

Crude oil shipment by rail hasn't occurred without incident in Montana. Between 2007 and 2016, the state's petroleum pipelines reported 12 significant incidents in which petroleum or refined petroleum products were spilled, totaling 5,877 gross barrels of petroleum spilled and a total of \$160 million in property damage.¹²⁰

The most significant oil spill in terms of property damage during that period was the 2011 spill from ExxonMobil's Silvertip Pipeline at Laurel. The 1,509 barrels of crude oil spilled occurred when the pipeline broke underneath the Yellowstone River, contaminating an 85-mile stretch of the river and resulting in over \$145 million of property damage.¹²¹

Less significant pipeline spills can still disrupt the Montana petroleum industry. The January 2015 pipeline spill on True Oil's Poplar/Bridger pipeline, which runs north to south through eastern Montana, resulted in 758 barrels of oil spilling into the Yellowstone River just west of Glendive, temporarily contaminating the community's drinking water supply. The spill cost True Oil more than \$8 million in cleanup costs, including \$1 million in penalties and supplemental environmental projects. The pipeline only returned to operation weeks after the spill when a new, deeper pipeline path under the Yellowstone River was drilled.

In recent history, the only Montana crude oil spill resulting from a train derailment occurred in 2015 when an oil unit train east of Culbertson spilled 650 barrels. No waterways were affected and no other significant environmental impacts were reported because of the spill.

History of Oil Refineries

Montana's earliest oil refining followed production. The first oil refinery was a small facility built in the Cat Creek area out of parts scavenged from large steam-powered tractors. Two formal refineries were soon constructed at Winnett near the Cat Creek strike. One operated intermittently into the early 1930s. An astounding number of oil refineries were built in Montana during the early decades of oil development and largely followed development of oil fields, beginning with Cat Creek and the larger Mosby Dome in the 1920s. These "tea kettle" refineries were installed close to the oil strikes. Even by the standards of the day, they were inefficient, skimming gasoline off the light oils that sometimes achieved a yield rate of only 50 percent. The remaining kerosene-type fuel oil was sold to the railroad with some residual tars marketed locally.¹²²

¹²⁰ U.S. Department of Transportation, Pipeline & Hazardous Materials Safety Administration, <https://hip.phmsa.dot.gov/analyticsSOAP/saw.dll?Portalpages>.

¹²¹ U.S. Department of Transportation, Pipeline & Hazardous Materials Safety Administration, <https://hip.phmsa.dot.gov/analyticsSOAP/saw.dll?Portalpages>.

¹²² *A History of Petroleum County*, 1989.

Lewistown had two refineries by the early 1920s, both operated until the early 1940s. Two Kevin-Sunburst refineries and two near Cut Bank were built in the 1930s. Construction of refineries along transportation corridors outside of oil fields included ones in Great Falls, Butte, Missoula, and Kalispell. Yale Oil started a refinery in Billings and the Laurel Oil and Refining Company built another down the road in Laurel, both dating from about 1930. These refineries processed oil from fields in northern Wyoming.

The war years further consolidated refining. According to the U.S. Bureau of Mines, 28 refineries operated in Montana at the outset of World War II in 1941; by 1947, there were only 11. In 1961, nine refineries operated at least seasonally in the state. Additional refineries continued to close through the 1960s and 1970s as the state's refining industry consolidated in Billings.

The development of Billings as a refining center saw the rise of refined pipelines to export product out of Montana. The Yellowstone Pipeline from the Billings refineries (owned by Phillips 66) west to the Spokane area was completed in 1954. The 425-mile Oil Basin Pipeline (now Cenex) from Laurel to Minot, North Dakota was also built around this time. Phillips 66 also owns the Seminoe Pipeline that runs south from Billings into Wyoming.

Oil Refineries

Four petroleum refineries currently operate in Montana with a combined refining capacity of 205,100 bbl/day: ExxonMobil (61,500 bbl/day) and Phillips 66 (60,000 bbl/day) in Billings, CHS (59,600 bbl/day) in Laurel and Calumet Montana Refining (24,000 bbl/day) in Great Falls. Montana refineries typically refine 63-68 million barrels of crude oil a year.

A decade after the merger of Conoco Inc. and Phillips Petroleum Co. in 2002, ConocoPhillips spun off its downstream assets (refining and distribution) in 2012 by creating the Phillips 66 holding company. Phillips 66 now operates the Billings refinery previously operated by ConocoPhillips, as well as the Seminoe and Yellowstone refined product pipelines that deliver refined petroleum products south and west from Billings. ExxonMobil also uses the Yellowstone Pipeline.

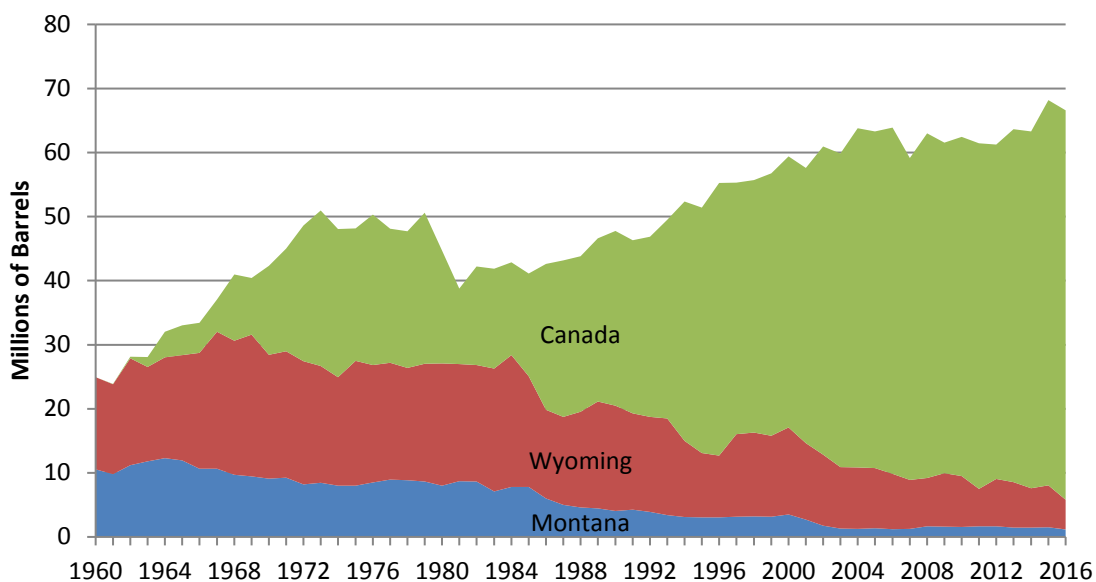
CHS owns one of the three large refineries in the Billings area. They own the Cenex Pipeline LLC refined product pipeline that runs east from Billings to North Dakota. They also own the Front Range crude line that runs south from Canada. Exxon owns the other large refinery in the Billings area and the Silvertip crude pipeline that delivers crude oil from Wyoming.

In 2012, Calumet Specialty Products Partners purchased the Montana Refining Company in Great Falls from Connacher Oil and Gas Limited of Canada. Calumet completed a \$400 million expansion and upgrade of the Great Falls refinery, increasing its operating capacity to 24,000 bbl/day. CHS, ExxonMobil, and ConocoPhillips/Phillips 66 have all invested hundreds of

millions of dollars in recent years to improve the efficiency and performance of their respective refineries in Montana in order to increase their output of high-value refined products without increasing crude oil consumption.

Today, Montana's refineries are primarily refining Canadian crude oil. Shipments from Canada have steadily increased since the late 1960s. As Montana's refining capacity has increased, imports of Wyoming crude have declined, and Montana's oil production has shifted away from areas neighboring the refineries (Figure 21). Between 2012 and 2016, 2.2 percent of the crude oil processed at Montana refineries was Montana crude from oil fields in the Sweetgrass Arch, Big Snowy, and Big Horn regions of the state. Collectively, 88 percent of the refinery crude inputs came from Alberta, Canada, and 9 percent from Wyoming.

Figure 26. Refinery Receipts by Source of Oil, 1960-2016



Almost all refined output from Montana's four refineries is moved by pipeline. The Billings area refineries ship their products to Montana cities and east to Fargo, North Dakota (Cenex Pipeline), to Wyoming and further south (Phillips 66 Seminole Pipeline), and west to Spokane and Moses Lake, Washington (Phillips 66 Yellowstone Pipeline). Montana refinery exports of refined petroleum products meet more than a third of Wyoming's gasoline and distillate fuel consumption, more than a fifth of North Dakota's, and more than a tenth of Washington's.¹²³

Petroleum Products Consumption

After peaking in 2007, Montana's consumption of petroleum products declined by more than 18 percent from 2007 to 2010 before leveling out between 31.5 and 33 million barrels of petroleum

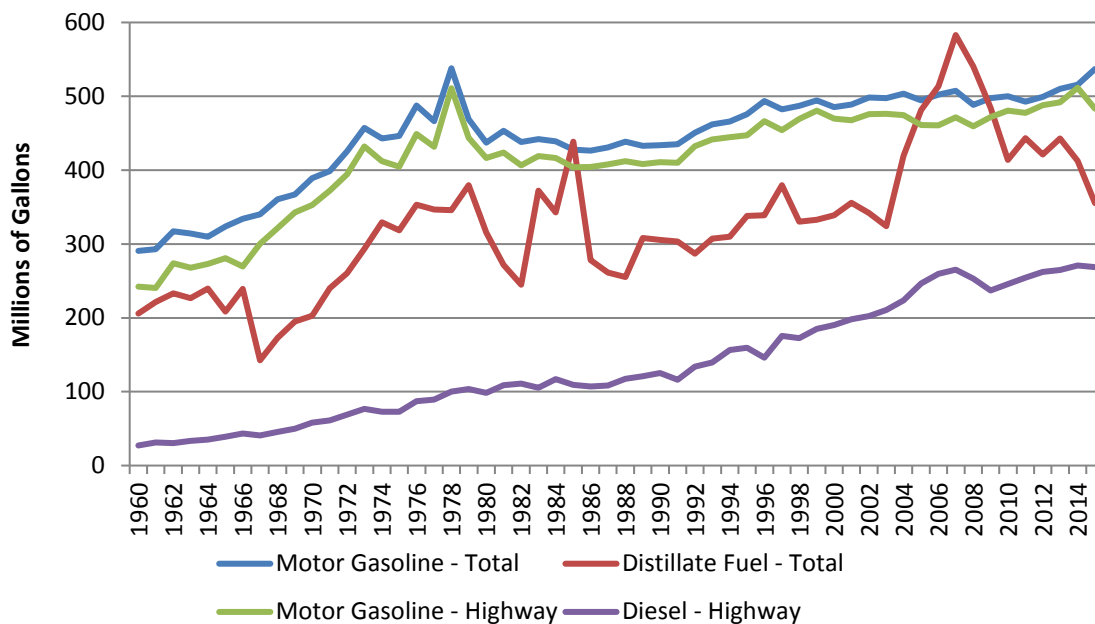
¹²³ U.S. Energy Information Administration State Energy Data System (SEDS),

<https://www.eia.gov/state/seds/>.

products consumed annually since 2011. Montana’s annual petroleum consumption initially peaked at 33 million barrels in 1979. It then drifted lower, settling in the mid-1980s at around 24 million bbl/year. Beginning in the 1990s consumption began to slowly climb once more, hitting a new high of nearly 38 million barrels in 2007. The decline in petroleum consumption since 2007 is a result of both the economic recession, changes in industry, and broader national economic trends, including declining use of personal vehicles and improved fuel economy for new vehicle purchases (Figure 22).

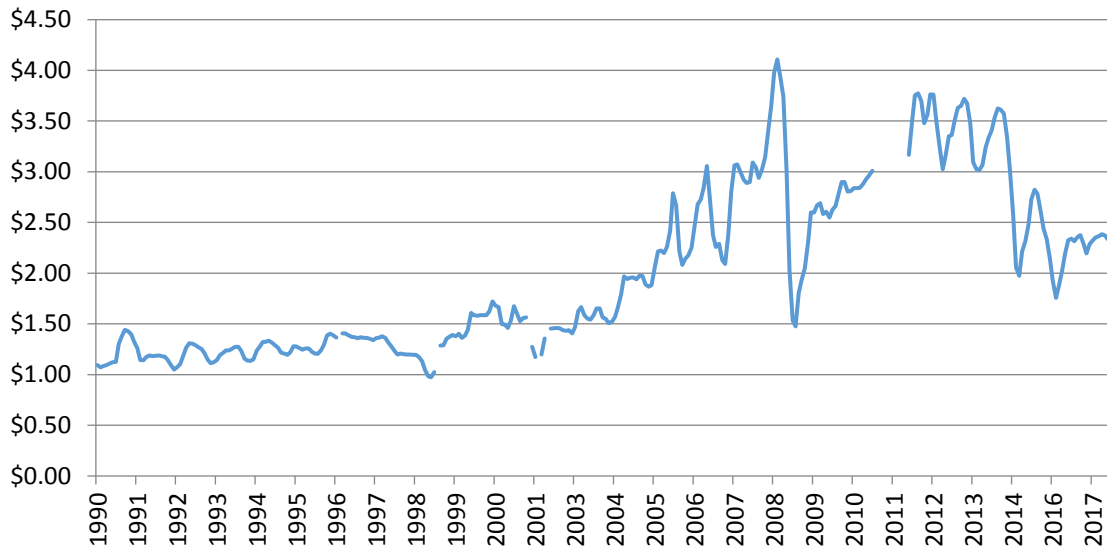
The transportation sector is the single largest user of petroleum and the second largest user of all forms of energy in Montana. In 2015, 40.5 percent of petroleum consumption was in the form of motor gasoline and 27 percent was distillate, mostly diesel fuel. Around 17 percent was consumed in petroleum industry operations.

Figure 27. Montana Petroleum Product Consumption, 1960-2015



While Montana gasoline consumption actually peaked in 1978 at more than half a billion gallons before declining in response to the 1979 oil crisis, recent growth in Montana gasoline consumption left Montana 100,000 gallons short of reaching its 1978 peak in 2015. Flat through most of the 1980s, Montana gasoline consumption began to consistently rise once more in the 1990s, which continued unabated until the 2007 economic recession. Beginning in 2012, the upward trend in Montana gasoline consumption resumed, reaching a level of 537 million gallons of gasoline consumed in 2015. In 2015, 90 percent of Montana motor gasoline consumption was for highway vehicle use, while non-highway vehicles consumed most of the remaining 10 percent. Similarly, the last two years of data for diesel consumption in Montana have been the two highest on record, exceeding the previous peak recorded in 2007. Over the 1996-2015 period, diesel consumption in Montana has increased by 84 percent.

Figure 28. Retail Price of Gasoline in Montana, 1990-2017



* In nominal dollars, some data missing

Between 1999 and 2010, national crude oil prices remained highly volatile, rising from an annual average of \$15.56 per barrel in 1999 to a prerecession annual average peak of \$94.04 per barrel in 2008.¹²⁴ At its peak in July 2008, crude oil was trading at \$145 per barrel before the economic recession caused global crude oil prices to plummet below \$35 per barrel in February 2009. Crude prices again surpassed \$100 per barrel in April 2011 and largely hovered between \$85 and \$100 per barrel until late 2014 when prices crashed once more. Crude prices hit a new floor in February 2016 and have slowly risen since then but have yet to exceed \$60 per barrel nationally as of late 2017. As can be seen in Figure 28, all of these market fluctuations have had a significant impact on the prices being paid at Montana gas pumps.

Fuel use shows a cyclical rise and fall through the year. Use tends to rise during the summer months and taper off during the winter. The winter trough in fuel use is a third lower than the summer peak. This seasonal pattern is caused by variations in the use of Montana's 1 million vehicles, by the increase in tourist traffic during the summer, and by seasonal agricultural uses.

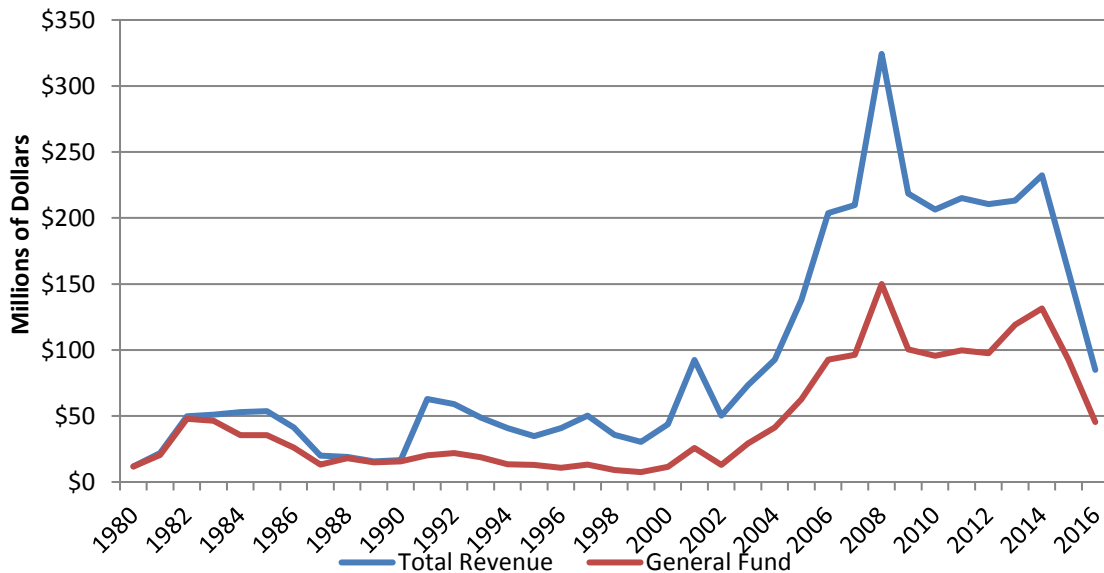
The price of gasoline can vary significantly around the state, a fact that is masked by the data, which is available only as statewide averages. The price of gasoline has a cyclical rise and fall, just like demand for gasoline; however, price lags behind demand, with peak prices tending to appear after the peak driving season.

¹²⁴ http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=p&s=f000000__3&f=m

Petroleum production and state revenue

There are various tax rates for oil and gas production in Montana based on the type of well, type of production, working or non-working interest, date when production began, and the price for which the crude oil is sold. This last point is important because crude oil from the northern Rockies and upper Midwest, including the Bakken region, frequently trades at a discount (\$5-\$15 per barrel) to West Texas Intermediate (WTI) prices because of limited pipeline capacity before the Dakota Access pipeline began operation in 2017 and higher rail costs to transport the oil production to key trading hubs. Despite the discounted price for Montana oil production, overall increases in oil production and crude oil prices between 2004 and 2014 provided the state with substantial tax revenues. With the fall of oil prices, and resulting slide in Montana oil production, Montana tax revenue from the oil and gas industries has fallen significantly in fiscal years 2015 and 2016.

Figure 29. Oil & Natural Gas Production Tax Revenue, 1980-2016



Since Jan. 1, 2006, approximately 50 percent of the revenue generated from oil and natural gas production taxes has been returned to the local county governments where the revenue was generated. Most of the remaining revenue is directed to the state's general fund. Small percentages of oil and gas production revenue are directed to specific state accounts to help fund particular interests, like natural resource protection and the state university system.¹²⁵

¹²⁵ Montana Department of Revenue, Biennial Report, 2014-16

In 2015, state tax revenue from oil and natural gas revenue began to drop precipitously, the result of both renewed oil production declines in Montana and significantly lower oil prices. Increased pipeline capacity in North Dakota may allow the Bakken region's oil production to be sold closer to the West Texas Intermediate benchmark price in the future. However, this impact is small when compared to the halving of crude oil prices over the last five years. Unless there is an oil drilling resurgence in the state, future tax revenue from the oil and natural gas sectors will be dictated by the prices at which each commodity are sold. Both oil and natural gas have a history of significant price volatility but, as of 2017, both are forecast to rise in price moderately over the next several years, diminishing the potential that Montana tax revenue generated from oil and natural gas production will rise to the 2006 to 2014 average of nearly \$200 million.

