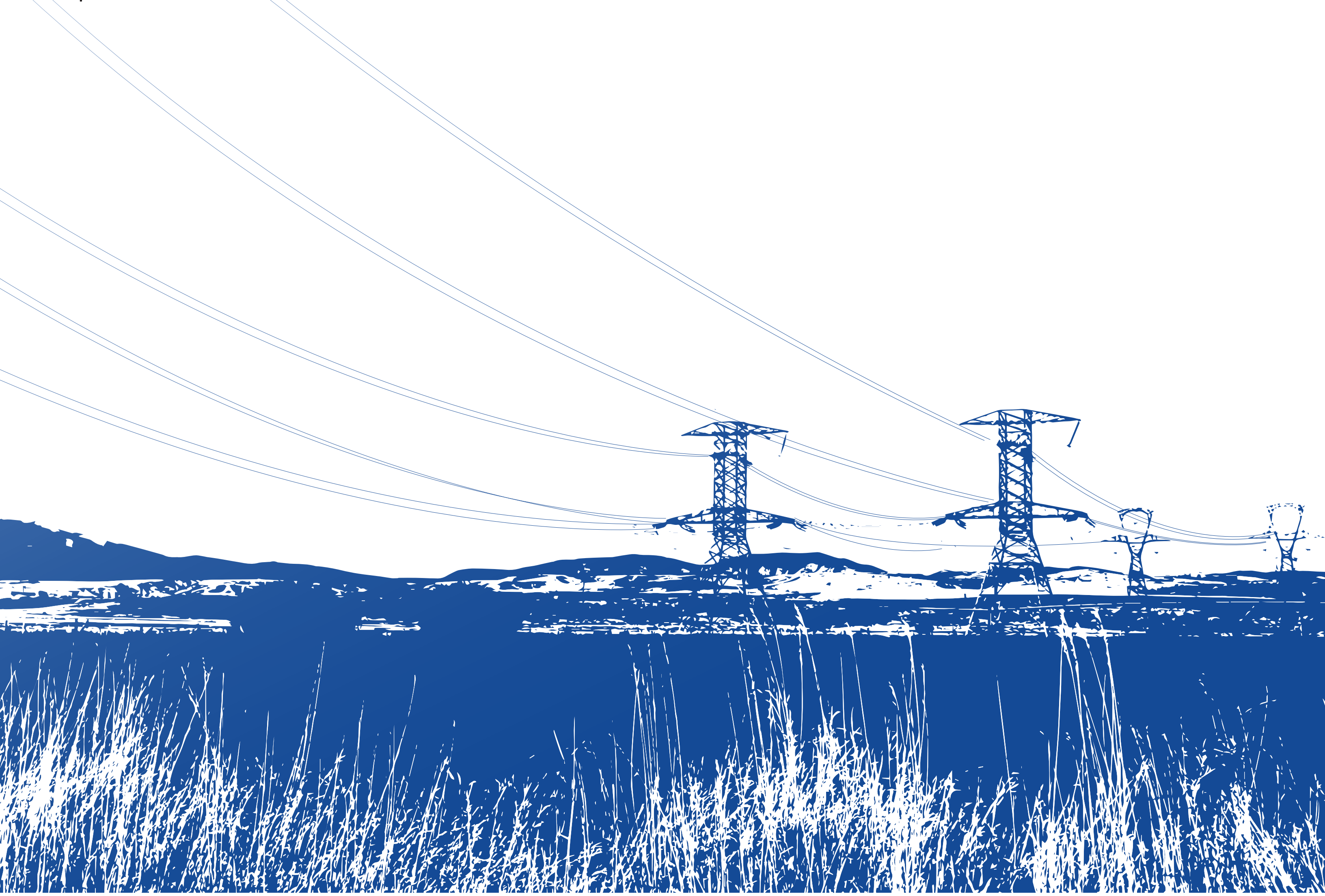
2. MONTANA'S ELECTRIC TRANSMISSION GRID

2A. INTRODUCTION TO THE GRID

The electric transmission and distribution grid serves the vital function of moving power from generating plants to customers and their electric loads (demand). Montana's transmission grid reliably provides this service even though from tim-to-time individual grid elements may suffer outages or be taken down for maintenance. The ownership of and rights to use the transmission system are complex matters, and these issues are further complicated by line congestion on in-state and interstate lines. The way in which electric transmission systems are regulated and operated is also changing, with more regulation at the national level, market formation at the regional level, and increasing amounts of variable generation on the system. The construction of new in-state and interstate transmission lines to expand the capacity of the current grid is a challenging topic, raising questions about property rights, economic development, and the need for new lines. Due in no small part to the complexities mentioned, only one new major transmission has been built in the past two decades in Montana.



- Transmission lines are generally high voltage lines, usually 50 or 69 kilovolts (kV) and higher, that deliver electricity over long distances from generation sources and major substations to population centers or industrial sites. Power lines that deliver power directly to end-use customers, including homes and businesses, are typically considered “distribution lines.” Distribution lines are generally radial in structure, i.e., power flows to end-use loads through distribution lines and does not loop back to other areas of the grid. The support structures for transmission and distribution lines can include single wooden poles, metal structures, and engineered laminated wood structures.

- NorthWestern operates the largest transmission balancing area in Montana. Bonneville Power Administration (BPA) operates a very large system in the Pacific Northwest that extends into the northwest part of Montana. WAPA runs part of its system in the northeast and eastern parts of the state. Montana-Dakota mostly uses WAPA lines in the Eastern portion of the state. Most distribution lines in Montana are owned by NorthWestern, one of 25 distribution cooperatives, or Montana-Dakota.

- Montana spans parts of both the Eastern and Western Interconnections in the U.S. Most of Montana, around 90 percent of its load, is in the Western Interconnection.

- Grid operations in the United States are changing alongside the development of real-time energy markets. In the West, existing market offerings include the California Independent System Operator’s Energy Imbalance Market and Southwest Power Pool’s Western Energy Services. Additional market offerings being discussed include an Enhanced Day-Ahead Market, Markets+ and the possibility of one or more Regional Transmission Organization (RTO).

- Most of Montana is not part of an Independent System Operator (ISO) or RTO, but rather operates within the vertically integrated model of utility regulation. A small portion of Montana in the U.S. eastern grid is part of the Midcontinent ISO (MISO).

2B. HISTORICAL DEVELOPMENT OF TRANSMISSION IN MONTANA

The transmission network in Montana initially developed as a result 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.[55] The earliest long-distance transmission lines were built from the Madison Dam, near Ennis, to Butte and from Great Falls to Anaconda. The latter was, at the time of construction, the longest high-voltage (100 kV) transmission line in the country and is still operational today. These first lines were built in order to power 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 WAPA electric transmission system in Montana began to transport

55 *Montana-Dakota Utilities is not an SPP member or transmission owner, we take transmission service from both SPP and MISO to service our load west of Beulah, ND and everything in SD.*

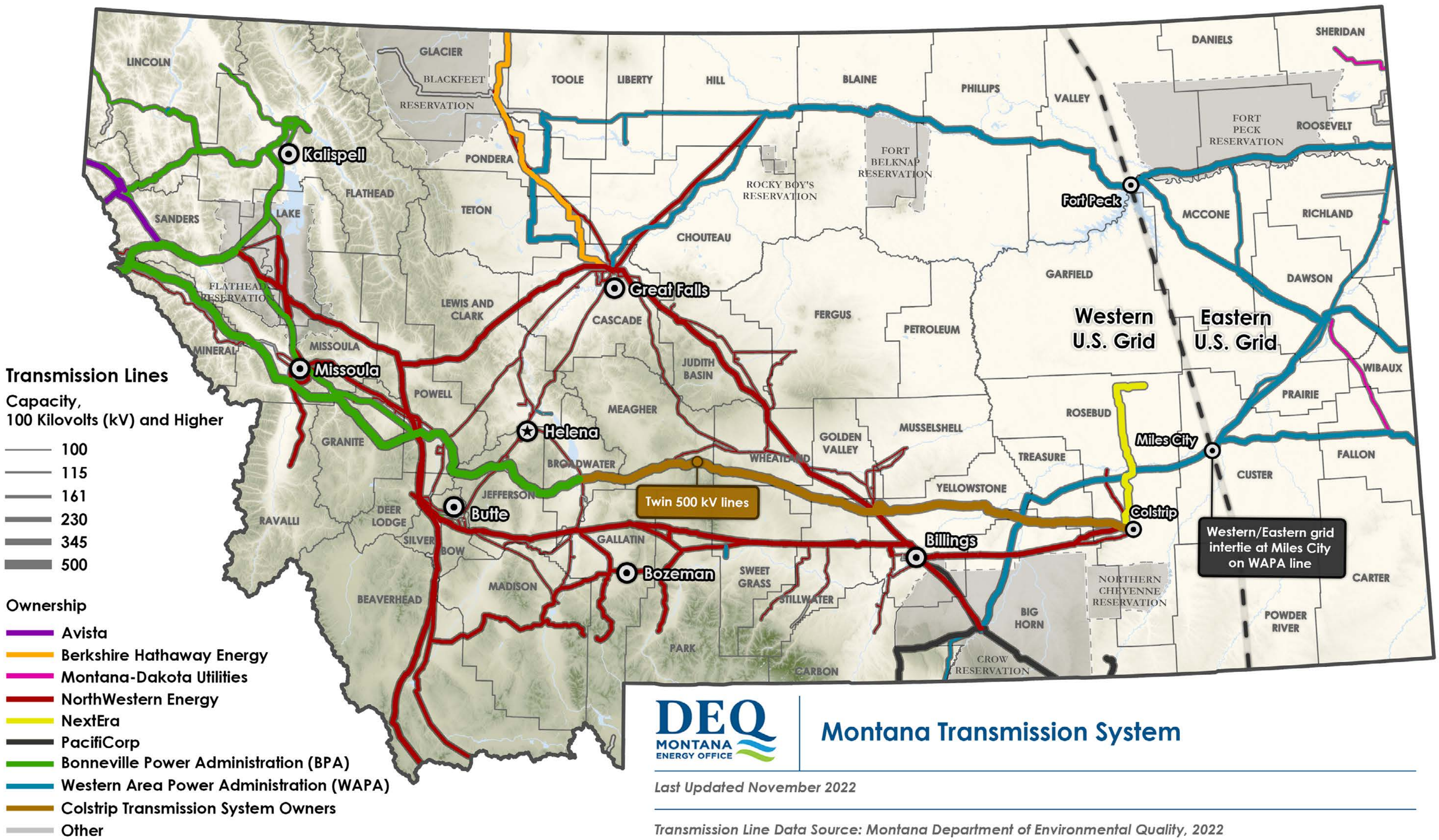
electricity to Fort Peck in the 1930s during construction of the dam there and then to move power to markets following construction of the generators at the dam. WAPA's system continued to grow in northern and eastern Montana as its needs to serve rural electric cooperatives expanded.

Long-distance interconnections between Montana and other states did not develop until around 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 kVs lines that head towards Washington State. The double circuit 500 kV lines are Montana's largest. Importantly, these Colstrip 500 kV lines, built to send power west out of state, are increasingly needed to import power east into NorthWestern's system to meet customer needs. By 2002, the MPC sold off all its generation and transmission holdings, becoming Touch America. Its transmission assets were purchased by NorthWestern and most of its generation was sold to Pennsylvania Power and Light (PPL). NorthWestern later purchased the hydro generation assets from PPL.

2C. CURRENT TRANSMISSION SYSTEM CONFIGURATION

Most in-state electric transmission in Montana is currently owned by NorthWestern Energy and WAPA. BPA has major interstate lines in northwest Montana and PacifiCorp owns a few smaller interstate lines as does Avista. Berkshire Hathaway Energy owns Montana Alberta Tie Ltd (MATL). WAPA lines in eastern Montana cross into North Dakota and serve local Montana loads in the eastern portion of the state. In most cases, Montana-Dakota's distribution service uses WAPA transmission lines and in a few cases co-owns the line. The electric distribution cooperatives in Montana are served by NorthWestern, Montana-Dakota, BPA, and WAPA transmission lines.

Map 2.1 Electric Transmission System



On an annual basis, Montana is an electricity exporting state. Until recently, the state's net electricity exports were 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.[56] With the closure of Colstrip units 1 and 2, that changed in 2020. In that year, only 38 percent of Montana generated electricity was exported.

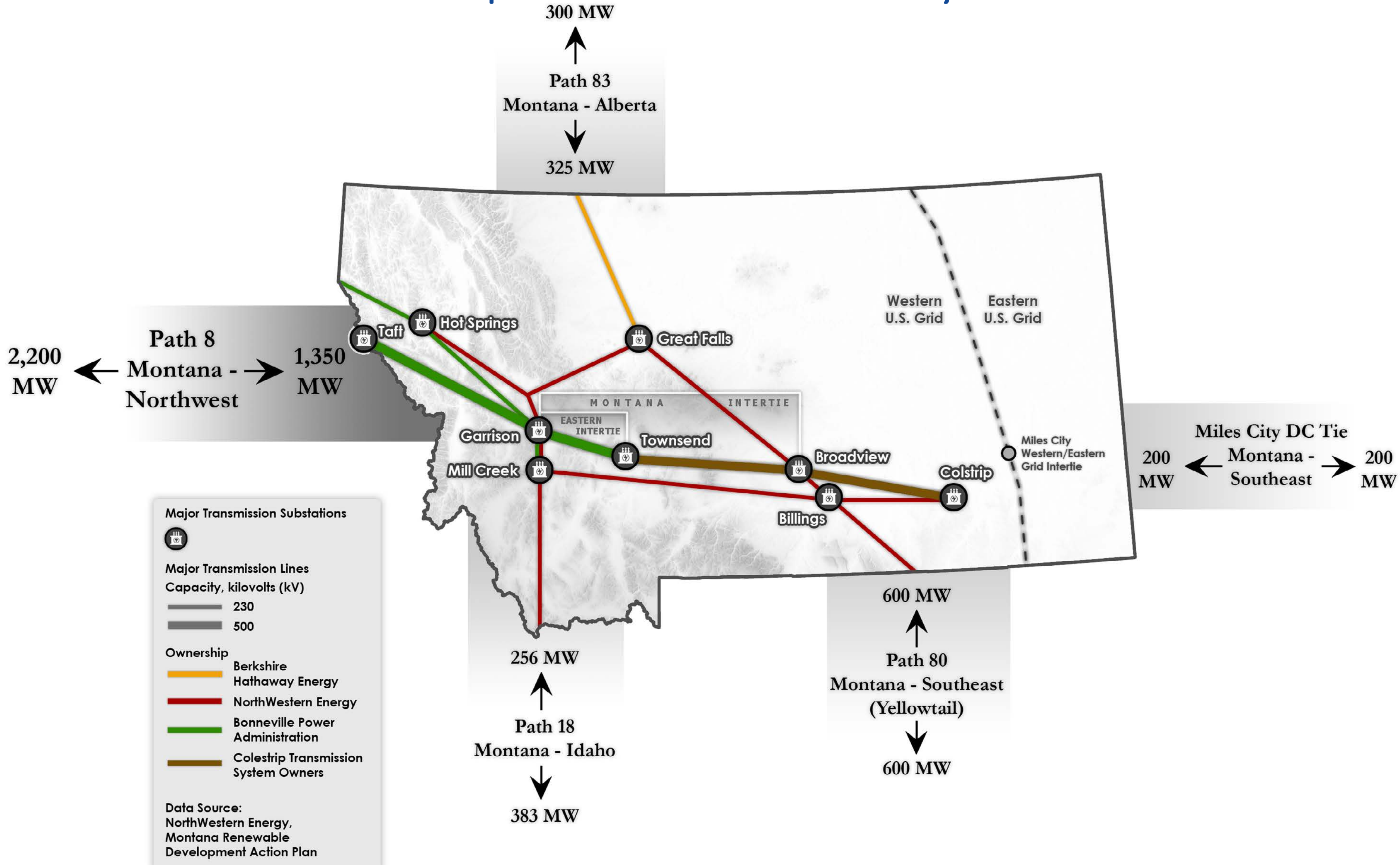
Transmission "paths" are generally groups of transmission lines that carry power within the same general areas along a given direction such as east-west or north-south. A given transmission path can consist of one or more transmission lines that transport electricity from one major electricity "node" 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 area into Idaho, the Grace line and the AMPS line, form what is called "Path 18".

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

- Montana to Northwest – Path 8
- Montana to Idaho – Path 18
- Montana Southeast – Path 80
- Montana to Alberta – Path 83

56 *U.S. Department of Energy, Energy Information Administration, 1990-2021, Form EIA-923 detailed data with previous form data (EIA-906/920).*

Map 2.2 Electric Transmission Pathways



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 increasingly 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 2,200 MW east-to-west whereas Path 18 is small rated at 383 MW north-to-south. The MATL path (Path 83) is rated at approximately 300 MW in both directions at this time and the transfer between Western and Eastern grids at Miles City (Path 80) is 200 MW and infrequently used. It is also important to note that these path rating amounts can change over time.

2D. 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.

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 electrical 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 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 simplified scenario, additional power could still physically flow in either direction up to the full capacity of the line in that particular direction. This is why transmission line operators usually offer a product called non-firm transmission when room is available on otherwise fully scheduled lines.

Electric power travels near the speed of light and is generally consumed at approximately the same moment it is generated. Almost all generated power distributed over the grid must be consumed instantaneously off of the grid. As a result, transmission operators constantly balance electricity supply (generation) and demand (consumption) in every moment. As time progresses, electricity is being stored as inventory in increasingly large quantities in batteries or pumped storage facilities. 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.

Managing the grid is a complicated process that involves significant skilled personnel and automated technology.[57] Historically power was almost exclusively supplied from relatively consistent and/or dispatchable generation sources (e.g., hydro, coal, nuclear, gas) that were built to meet customer loads. The integration of variable resources like wind and solar generation at significant scale on the transmission system, adds complexity to the challenge of balancing transmission systems. The addition of variable resources to the grid has precipitated the deployment of highly flexible resources, including batteries, demand response, gas-fueled generation with quick ramping capabilities, and systems to curtail over-production of wind and solar generation. 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.

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 transmission line 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 capacities are also impacted by congestion of certain lines or paths on the grid and outages on the grid. For example, Path 8 has a 2,200 MW path rating east to west under ideal conditions, but often has a lower rating under real-time 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 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 there is room available (non-firm transmission).

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 very 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.

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 transmission paths aside from the contracted path. These are "unscheduled flows". An unscheduled flow is a result of the difference between the physics of the transmission system and the scheduling paradigm (contract rights). These flows can result in a variety of issues, including but not limited to unplanned loss of generators or load, data errors, and scheduling errors.[58]

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.[59]

57 *There are several high-tech and human mechanisms for balancing supplies and demand on the entire Western Grid and within individual operating areas, like NorthWestern's balancing authority in Montana.*

58 *Byron Woertz, WECC, Manager, System Adequacy Planning.*

59 *Ibid.*

Transmission costs add monthly charges to electricity bills and can result in significantly 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 NorthWestern system and then on either the BPA or Avista system. These charges are necessary to transmit, or "wheel", the power from the NorthWestern system area to Mid-C.[60] These additional costs mean that the wholesale-priced power from generation in NorthWestern'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. Southern California is a good example of a congested area with generally higher prices. This type of transmission fee structure would be very different if Montana utilities were a part of a RTO (see below).

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 NorthWestern, transmission rates for bundled retail customers are determined by the Montana PSC. Wholesale transactions that use NorthWestern'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 NorthWestern 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.

2E. MAJOR GRID INTERCONNECTIONS

The United States transmission network has developed over time into three major interconnected grids or "interconnections", divided roughly along a line that runs through eastern Montana south to Texas. Most of Texas is on its own interconnection. 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). Parts of Alberta and British Columbia are also part of the Western Grid. Most of the eastern and midwestern United States is a single, interconnected, and synchronous electric system as well (U.S. Eastern Grid). Texas is a separate interconnection with its own reliability council and is referred to as the Electric Reliability Council of Texas or ERCOT.

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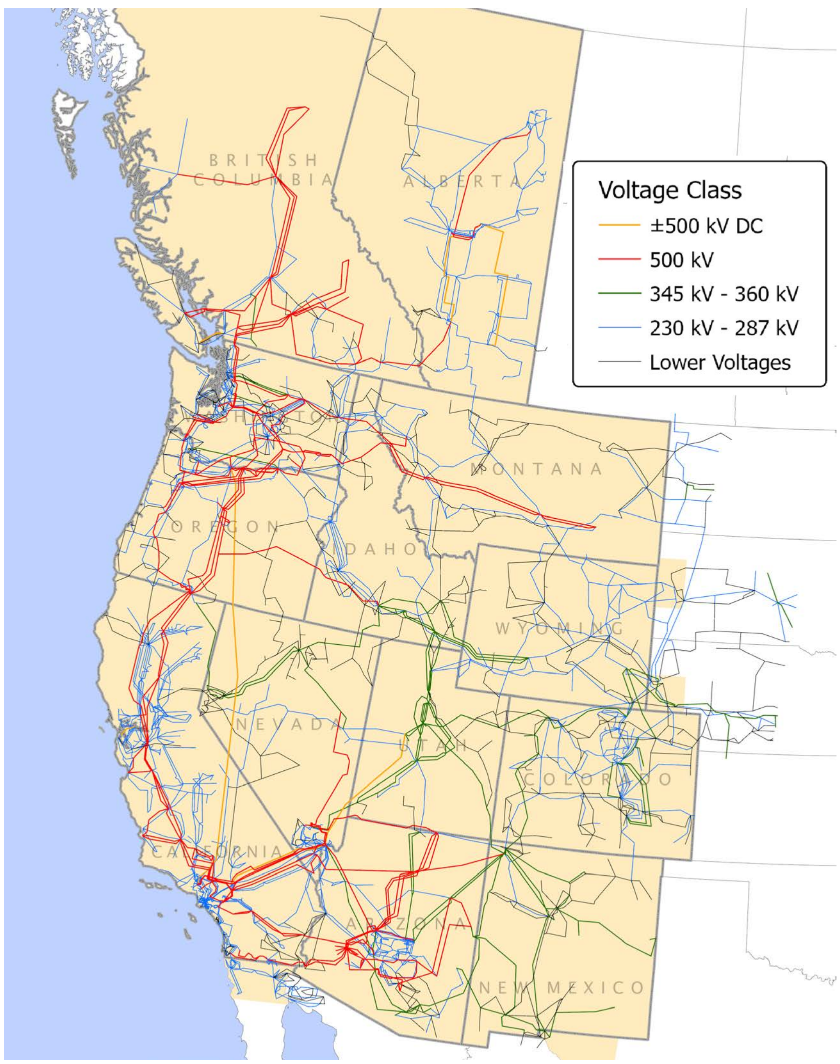
60 *In electric power transmission, wheeling is the transportation of electric energy (megawatt-hours) from within an electrical grid to an electrical load outside the grid boundaries. Two types of wheeling are 1) a wheel-through, where the electrical power generation and the load are both outside the boundaries of the transmission system and 2) 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))

The Eastern and Western grids are not synchronous with each other. Each interconnection is internally in sync at 60 cycles per second, but each system is out of sync with the other systems. They cannot be directly connected because there would be massive instantaneous flows across any such connection. Therefore, the two grids are only minimally tied to each other with seven converter stations that convert AC electricity to Direct Current (DC) then back to AC.[61] One of these stations is located at Miles City. Operated by WAPA, the Miles City Converter Station is capable of transferring up to 200 MW of electricity in either direction from one grid to another.[62] Fort Peck Dam is the only other facility in Montana that bridges the Western and Eastern Interconnections. Hydroelectric generation units at the dam can be directed to either the Western or Eastern Interconnection depending on demand in either interconnect. However, unlike the Miles City Converter Station, Fort Peck Dam does not provide transfer capacity from one grid to the other.

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.

Map 2.3 U.S. Western Electric High-Voltage Grid[63]



61 *National Renewable Energy Laboratory, 2021, "Where the east meets the west: Interconnections seam study shows value in joining U.S. transmission grids", https://www.nrel.gov/news/program/2021/where-the-east-meets-the-west-interconnections-seam-study.html.*

62 *Western Area Power Administration, https://www.wapa.gov/newsroom/Publications/Pages/converter-brochure.aspx.*

63 *Western Electricity Coordination Council.*

Siting, construction and permitting of certain transmission lines in Montana are regulated under the Montana Major Facility Siting Act (MFSA) administered by the DEQ. The purposes of MFSA are to ensure the protection of the state's environmental resources, ensure the 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.

2F. TRANSMISSION SYSTEM RIGHTS

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, provided that 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 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, at any given time, 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 explained above). As of 2022, 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 little incremental firm export capacity out of Montana to the Southwest (Path 18) and to the Northwest (Path 8). Half of the combined 614 MW generating capacity of Colstrip Units 1 and 2 was owned by Puget Sound Energy and served Washington customers; with the retirement of those units in 2020 the allocation of ATC on the Colstrip Transmission System undoubtedly changed but the details of those transmission contracts are not public information. ATC is also constrained in-state on NorthWestern'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 also 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.

2G. 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 other objects. Arcing -- electricity traveling to the ground -- may result. When that happens, the transmission line can fail, instantly stopping electricity flow and affecting connected transmission and distribution system assets. 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 electricity 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 of failure 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 transmission elements out of service on the grid. Within NorthWestern'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 transmission network must be expanded and/or strengthened. Typically, this entails adding transmission lines to the system, replacing components of the system, or rebuilding existing lines to higher capacities.

Another example of reliability limits relates to major transmission paths used to serve distant loads or to make wholesale transactions. Most major paths are rated in terms of the amount of power they can carry based on their strongest transmission element being unavailable (usually a single large line). 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 being out of service, 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. The closing of Colstrip over time could change these limit ratings.

2H. 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 external markets except by using non-firm rights or paying for new transmission lines to be built. When transmission congestion exists, generators may be forced to sell into other locations where buyers pay less for power or to even curtail their power.

In general terms, additional transmission capacity allows more generators to access the grid, promoting competition and lowering prices. Conversely, limited capacity necessitates either energy transaction curtailment or re-dispatch from a generator that bypasses the bottleneck in the system. Transmission congestion can have several different meanings. A transmission path may be described as congested if no rights to use it are for sale. Congestion also 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.

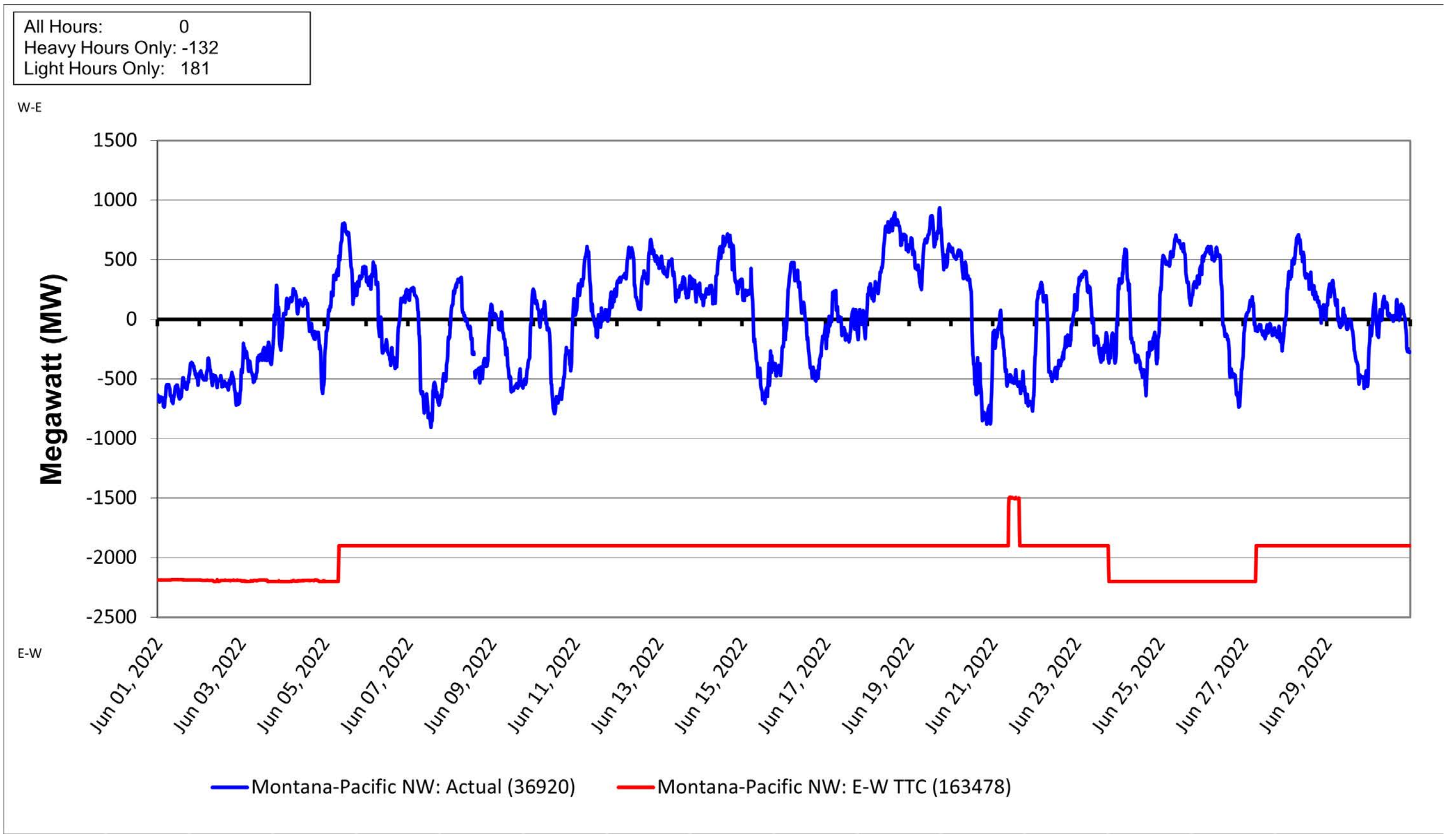
By the first definition, the paths through which generators in Montana send their power west, and that includes West of Hatwai, are mostly congested – and few firm rights are currently available for those paths. By the second definition, the paths west of Montana are congested during a few hours of the 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. It should be noted, that although most transmission lines are not physically congested at a given moment in time, the instances where they are congested seem to be increasing because of electricity moving differently around the grid today and weather disruption of lines become more frequent (e.g., high winds, wildfires).

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. For most hours, flows on paths out of Montana are not heavily loaded. Even a well-used path such as Path 8, usually has physical space available for more electrons.

The most recent month of data from Path 8, the Northwest-Montana cutplane, in June 2022, shows actual flows (in blue) well below Total Transmission Capacity (red line). 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 2.1 Montana-Pacific NW: 15-Min Averages
Actual Loadings: 06/01/2022 - 07/01/2022 (30 Days)[64]



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.

2I. RECENT TRANSMISSION LINE DEVELOPMENTS IN MONTANA

In recent years, there has been a strong interest in developing additional transmission to export Montana's generation potential to other markets. The Western Grid will need substantial new transmission resources in order to replace retiring generation and to meet environmental goals established in many states. Renewable resource mandates in many western states also suggest that a significant portion of newly built resources will be renewable. Most of the plants scheduled for retirement in the U.S. Western Grid are coal and nuclear generation plants.

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.

64 *15-minute average of 2-second SCADA MW readings via PI BPA, https://transmission.bpa.gov/Business/Operations/Paths/. Note: BPA monitors system conditions and provides mitigation as needed per appropriate reliability issues and NERC standards.*

In the last decade, a 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 the rebuild of BPA's 115 kV line from Libby to Troy. NorthWestern replaced a 50 kV line between Three Forks and the Four Corners area with a new 161 kV line. NorthWestern also completed the upgrade to a 161 kV line between Four Corners and Big Sky. At this time, Montana-Dakota has indicated it has no major plans for electric transmission upgrades in Montana.

The Montana to Washington project (M2W) is a long-proposed upgrade to BPA's portion of the dual-circuit 500 kV line and could be used by new generators to access West Coast markets. Similar upgrades on the Colstrip lines have been discussed for central Montana. It 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. Additional transmission constraints exist to the west of this segment in Washington State that would need to be dealt with separately to move power to the specific load centers that the Montana developers are interested in reaching.[65]

New lines connecting Montana to the rest of the Western Grid could potentially increase competition among Montana energy suppliers. This would especially be the case in conjunction with a RTO. 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 lines could also allow substantial new generation to be built in Montana.

On the flip side, 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.[66] As a result, the resulting route was sited away from the interstate highway corridor, opening new corridors through forested areas. Recent experience with the MATL and the proposed Montana States Transmission Intertie (MSTI) transmission lines shows that Montana citizens and landowners are concerned about new line 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.

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65 *Mark Rellar, BPA.*

66 *The original centerline proposed by the Colstrip partners crossing of the Confederated Salish and Kootenai Tribes would not be granted an easement by the tribe to get to the Hot Springs substation. The Colstrip partners got BPA to take over responsibility to build the line from Townsend west. BPA had originally planned to build the line on a right-of-way BPA already owned through the reservation. But during the NEPA process, it was determined that going to the Taft substation was preferable to the one at Hot Springs.*

2J. REGIONAL TRANSMISSION INTEGRATION AND MARKET DEVELOPMENT

REGIONAL TRANSMISSION ORGANIZATIONS

A large portion of the electric load in the U.S. is procured through market transactions overseen by various Regional Transmission Organizations (RTOs) and Independent System Operators (ISOs).[67] These organizations are independent entities that emerged because of guidelines prescribed in FERC Orders 888 and 889 with which FERC sought to introduce competition and efficiency into electricity markets. RTOs/ISOs are charged under these orders with promoting nondiscriminatory access to the grid.[68]

The California ISO (CAISO) is the only ISO or RTO in the western United States. Much of Alberta and British Columbia, which are part of the U.S. Western Grid, are served by their own ISOs. While most of Montana's service area is not part of an RTO, the MISO, which covers much of the Midwest, covers parts of eastern Montana that lie in the U.S. Eastern Grid. Most of the U.S. Western Interconnection is not part of an RTO. From here on, we will use RTO to refer to an ISO or RTO as they are virtually the same thing

RTOs are independent and each one has its own complex rules. RTOs provide open access to the transmission system, and optimize the dispatch of generation across broad areas, rather than have each utility do so. Typically, a fully functional ISO has a single balancing authority and conducts the reliability coordination functions for all member utilities. A utility that does not participate in an RTO, sets their own stacking order and costs, typically with bilateral contracts. An RTO does this for all of its utilities and dispatches generation accordingly. An RTO, in theory, allows all parties to signal their willingness to pay for transmission access and makes more efficient use of the grid. In addition, RTO management results in congestion price signals that encourage economic decisions on the location of new generation and on the expansion of capacity on congested transmission paths. RTOs also over time save utilities and their ratepayers money by allowing better access to cheaper generation and by saving balancing areas the need to build additional generation.

RTO transmission pricing generally avoids pancaked transmission rates (paying a single rate for each balancing authority crossed) and signals the actual amount of congestion on the system. Two types of transmission tariffs under RTOs are postage stamp and license plate rates. With postage stamp rates, transmission costs are recovered uniformly from all loads in a defined market area. With a license plate rate, each utility recovers the costs of its own transmission investments that reflects the costs and usage in the transmission zone within which they are located. RTO's also generally plan transmission expansion for their whole footprint over a larger area, versus each utility doing their own planning.

Discussions about allowing an independent body to take over operation and control of access for the transmission system began in the mid-1990s among transmission owners and other stakeholders in the Pacific Northwest. Effects of an RTO on Montana will need to be examined as the possibility of market formation grows. Talks continue among various entities in the West on expanding energy cost savings. Talks are also occurring on taking an incremental approach and developing certain aspects of RTOs such as Energy Imbalance Markets (discussed below) rather than implementing an RTO all at once. 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 that would be needed to integrate CAISO and the balancing authorities operated by PacifiCorp. The Mountain West Transmission Group, a group of electricity service

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67 *For our purposes here, we will regard RTOs and ISOs as the same thing.*

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