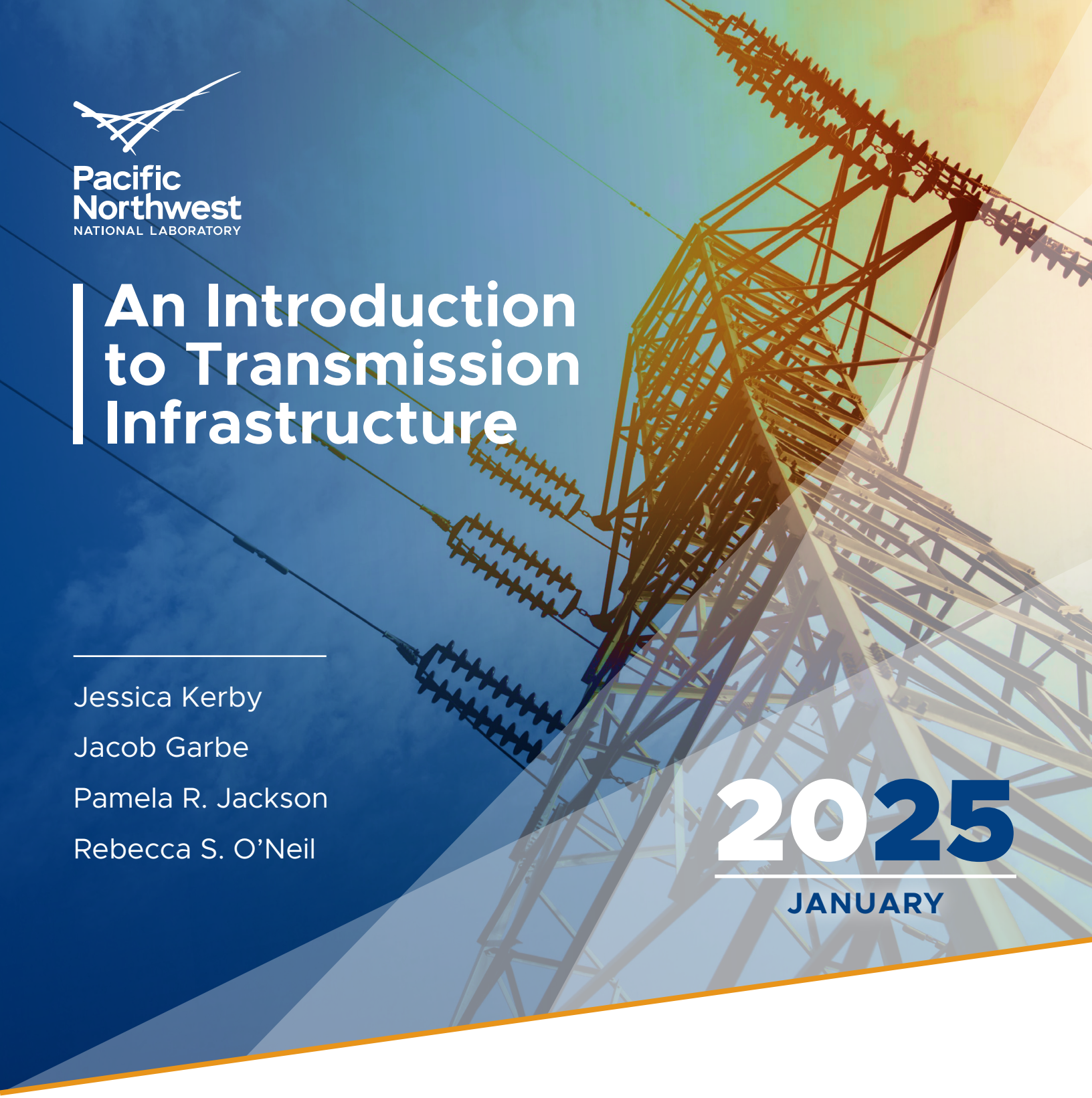

Pacific Northwest
NATIONAL LABORATORY

An Introduction to Transmission Infrastructure

Jessica Kerby
Jacob Garbe
Pamela R. Jackson
Rebecca S. O'Neil

2025
JANUARY

U.S. Department of ENERGY

Prepared for the U.S. Department of Energy
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CONNECTING COMMUNITY BENEFITS WITH TRANSMISSION CORRIDORS
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AN INTRODUCTION TO TRANSMISSION INFRASTRUCTURE

January 2025

Jessica Kerby
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Prepared for
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ABSTRACT

This Introduction to Transmission Infrastructure describes the fundamentals of electric transmission infrastructure. A basic understanding of transmission components and functions helps contextualize the role of transmission within the electric grid and the clean energy transition. Topics on siting, safety, and construction of transmission infrastructure are presented to provide a foundational knowledge of the process required to build out transmission. The document concludes by introducing the multifunctionality and additional benefits of transmission corridors.

This is the first product of the Connecting Community Benefits with Transmission Corridors (ConCord) Initiative. The ConCord Initiative aims to increase public recognition of existing benefits of electric transmission corridors; provide a broad platform and network that describes and shares credible and useful information about public, community, or environmental benefits from transmission corridors; and expand and extend those benefits into current and future transmission infrastructure design.

EXECUTIVE SUMMARY

Transmission infrastructure plays a critical role in assuring that the nation's electric system provides reliable, adequate, secure, flexible, and economic electricity across the United States. The right-of-way, or buffer area, required to allow a safe margin around transmission infrastructure naturally provides an opportunity for additional uses and benefits. Unlocking these benefits requires revisiting and reframing traditional corridor maintenance practices; the upfront effort required often provides cost savings and community benefits in the long term. Examples include habitat preservation, wildfire mitigation, and recreation. Framing transmission infrastructure planning around corridor multifunctionality can increase stakeholder engagement and participation, unlocking additional resources to support a clean energy future. In support of the Connecting Community Benefits with Transmission Corridors (ConCord) Initiative, this Introduction to Transmission Infrastructure provides currently available credible materials with publicly accessible descriptions and diagrams of transmission components and functions.

Transmission lines connect large generating stations across great distances to the substations and distribution systems that deliver local power to residents. There are approximately 590,000 miles of transmission lines networked across the country between the Western, Eastern, and Texas Interconnections.[1] To support the nation's growing electricity demand, electrification efforts, and renewables adoption, an estimated 140,000 miles of transmission lines need to be built out or replaced by 2050.[2]

For transmitting electricity across such great distances, the transmission infrastructure needs to be considerably larger compared to that on the distribution system to accommodate the higher voltages. Transmission tower design, sizing, and how these elements relate to the line voltage are introduced in this document. Diagrams and graphics depicting these relationships help the reader identify these components and convey a sense of scale of these assets.

Siting and safety considerations for transmission infrastructure are critical, due to the high voltage of the electricity being conducted. Transmission lines that cross cities and states require siting and permitting approval from many regulating bodies. Local governments, public utility commissions, siting boards, regional transmission organizations, and the Federal Energy Regulatory Commission can all be involved in this process. Coordinating between these offices and with local communities impacted by the route of transmission lines can be a lengthy process, and transmission planning activities can take many years.

Siting processes require a high level of oversight to maintain safety within the transmission corridors, or the strips of land designated for the siting of transmission assets. The right-of-way is granted to the utility or transmission owner to construct and manage the transmission lines for the lifetime of the asset. As electricity is transmitted across the nation, those siting transmission infrastructure often must procure the rights to use the land that the lines cross by way of an easement. The easement type, compensation strategy, and acquisition process vary across the states. After securing the necessary siting and permitting approval, the construction process can begin, starting from initial surveying to building the towers, stringing the current-carrying wires from tower to tower, and restoring disturbed land.

1 Data from public Homeland Infrastructure Foundation-Level Data (HIFLD) from the Geospatial Management Office (GMO) of the Department of Homeland Security. [Online]. Available: *https://hifld-geoplatform.opendata.arcgis.com/datasets/geoplatform::transmission-lines/about*

2 U.S. Grid Deployment Office, "National Transmission Planning Study," 2024. [Online]. Available: *https://www.energy.gov/gdo/national-transmission-planning-study*.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the Grid Deployment Office (GDO) of the Department of Energy (DOE) for sponsoring the Connecting Community Benefits with Transmission Corridors (ConCord) Initiative.

ACRONYMS AND ABBREVIATIONS

˚F	degrees Fahrenheit
ac	acre(s)
AC	alternating current
ACSR	aluminum conductor steel reinforced
ACSS	aluminum conductor steel supported
ANSI	American National Standards Institute
AW	annealed wire type
BLM	Bureau of Land Management
BMP	best management practice
BOR	Bureau of Reclamation
ConCord	Connecting Community Benefits with Transmission Corridors Initiative
DC	direct current
DoD	Department of Defense
DOE	Department of Energy
EIA	U.S. Energy Information Administration
EMF	electromagnetic field
EMR	electromagnetic radiation
FERC	Federal Energy Regulatory Commission
FS	Forest Service
ft	foot/feet
IVM	Integrated Vegetation Management
GPS	Global Positioning System
GW	gigawatt(s)
Hz	Hertz
kV	kilovolt(s)
kWh	kilowatt hour(s)
MW	megawatt(s)
NEITC	National Interest Electric Transmission Corridors
NERC	North American Electric Reliability Corporation
NPS	National Park Services
PSPS	Public Safety Power Shutoff
PUC	Public Utility Commission
REA	Rural Electrification Administration
ROW	right-of-way
RTO	Regional Transmission Organizations
TEK	traditional ecological knowledge
TW	trapezoidal wire type
V	Volt(s)
W	Watt(s)
Wh	Watt-hour(s)

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1.0 INTRODUCTION

Through innovative approaches and collaborative partnerships, the Connecting Community Benefits with Transmission Corridors (ConCord) Initiative will connect successful models and provide technical tools and resources for evaluating benefits in future transmission infrastructure. ConCord aims to increase public recognition of the potential benefits of electric transmission infrastructure; provide a broad platform and network that describes and shares credible and useful information about community or environmental benefits from physical transmission infrastructure; and expand and extend those benefits into current and future transmission infrastructure. This Introduction to Transmission Infrastructure is the first product of the ConCord Initiative, designed to orient readers to concepts relating to transmission infrastructure within the context of the electric grid, the energy transition, siting, safety, and construction, and benefits of transmission corridors.

1.1 THE ELECTRIC GRID

The electric grid, separated into the transmission and distribution system, contains all the infrastructure required to generate and deliver power to electricity consumers. The transmission system transmits power long distances to local substations, which connect the transmission system to the distribution system that delivers power to local consumers. Transmission and distribution are classifications of electric facilities and lines in the electric grid and are defined as follows:

Transmission: An interconnected group of lines and associated equipment for the movement or transfer of electric energy between points of supply and points at which it is transformed for delivery to customers or is delivered to other electric grids.[3] Transmission lines tend to operate at high voltages, between 100 – 765 kV (kilovolts).

Transformers: Electromagnetic devices that allow the voltage of a circuit (i.e., transmission or distribution line) to be increased (stepped up) or decreased (stepped down) by transferring the electrical energy between circuits wound around magnetic cores. The difference in the number of turns around the cores determines the voltage transfer between circuits. Transformers work with circuits carrying alternating current (AC) rather than direct current (DC) because the frequency variation in AC circuits is required to induce a magnetic flux within the current windings. Transformers decrease the transmission line voltages to a safe level for the distribution system.

Distribution: The electrical facilities that are located behind a transmission-distribution transformer or distribution substation that serve multiple customers. Generally considered to be anything from the distribution substation fence to the customer meter.[4] Distribution lines tend to operate at lower voltages, less than 35 kV.

The size and shape of the towers can be used to visually distinguish between transmission and distribution infrastructure, with transmission being much larger to safely transmit higher voltages. This relationship is depicted in Figure 1, where large electricity generators (left of Figure 1) produce power at 10–25 kV, which is then stepped up to higher voltages (100–765 kV) using transformers for long-distance transmission to substations (middle-right side of Figure 1), which is then stepped down to lower, distribution system voltages (35 kV or less) at

3 SPIDERWG Coordination Subgroup, "SPIDERWG Terms and Definitions Working Document," North American Electric Reliability Corporation, 2020.

4 "The Authoritative Dictionary of IEEE Standards Terms, Seventh Edition," IEEE Std 100-2000, pp. 1–1362, 11 December 2000.

the substation and delivered to end use customers, such as homes and businesses (right-hand side of Figure 1). Increasing the voltage for long distance transmission reduces the current carried along the lines, which mitigates losses due to heat while maintaining the same transfer of power.

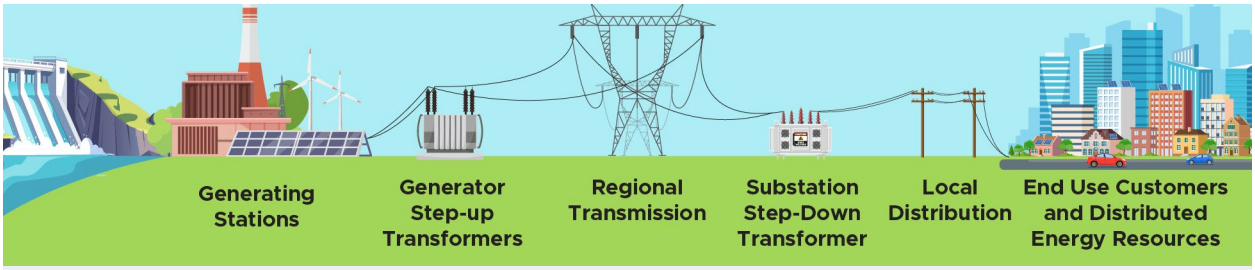

Figure 1. Electric transmission infrastructure from generation (LEFT) to load (RIGHT).

The U.S. electric grid is estimated to have assets worth over $1 trillion[5], with approximately 590,000 miles (mi) of transmission lines,[6] which can be either underground or strung across large towers and poles. The U.S. electric grid has a generation capacity above 1,100 GW, managed by close to 3,500 utility organizations.

1.2 WHY TRANSMISSION IS IMPORTANT TO THE ELECTRIC SYSTEM

The U.S. transmission infrastructure provides energy benefits for electricity consumers across the country. These include the increased reliability, adequacy, resilience, flexibility, and economic benefits that are provided to the nation's electricity system and its consumers.[7]

Reliability: connecting users to a diverse set of power plants, with a certain degree of built in redundancy to assure uninterrupted electricity service.

Adequacy: the ability of the electric system to supply the electrical demand and energy requirements of customers, at all times, taking into account both scheduled and unscheduled outages of power lines and plants.

Resilience: the ability of the electric system to withstand sudden disturbances, such as electric short circuits or unanticipated loss of system facilities.

Flexibility: allows power requirements to be met by a diverse set of generation sources, located most appropriately based on generator requirements.

Economic: allows users to be connected to many different generation sources, not just those located in close proximity, allowing access to inexpensive power generation and shielding users from price spikes and volatility.

These benefits are always kept at the forefront of any long-term transmission planning activities.

5 FERC is the independent agency responsible for regulating the interstate transmission and wholesale sale of electricity and natural gas as well as regulating the price of interstate transport of petroleum by pipeline. Federal Energy Regulatory Commission, "Reliability Primer," 2020. [Online]. Available: *https://www.ferc.gov/media/reliability-primer*

6 Data from public Homeland Infrastructure Foundation-Level Data (HIFLD) from the Geospatial Management Office (GMO) of the Department of Homeland Security. [Online]. Available: *https://hifld-geoplatform.opendata.arcgis.com/datasets/geoplatform::transmission-lines/about*

7 M. H. Brown and R. P. Sedano, "Electricity Transmission: A Primer," National Council on Electric Policy, Denver, Colorado, 2004. [Online]. Available: *https://www.ferc.gov/media/reliability-primer*

1.3 ORIGINS OF THE TRANSMISSION SYSTEM

The concept of the electric grid began in the 1880s, with centralized generators providing power locally to a handful of customers. This early grid operated using direct current at relatively low voltages, around 100 volts (V).[8] In 1885, the electric transformer was invented, allowing newer grids operating with alternating current to step up or down the voltage being carried along wires. This is an incredibly useful property, as line losses occur proportionally to the current within the wire. Stepping up the voltage reduces the current while keeping the power constant, which in turn reduces losses from transporting electricity over longer distances. Transformers became the enabling technology to delocalize the electric grid, allowing generators to deliver electricity to a larger and more distant customer base. These high-voltage lines connecting generators to their customers became known as the transmission system. Thirty years after the invention of the transformer, hundreds of miles of transmission lines had been erected at voltages as high as 130 kV. Standardizing the frequency at which electricity was transmitted to 60 Hz in the 1920s allowed for the interconnection of different electric utilities, creating a diverse and robust electric grid delivering power to most major cities.

In 1936, President Franklin D. Roosevelt's New Deal created the Rural Electrification Administration (REA) "to initiate, formulate, administer, and supervise a program of approved projects with respect to the generation, transmission, and distribution of electric energy in rural areas." At the time, the majority of urban homes had access to electricity; however, very few rural homes or farms had the same access, as there was no economic incentive to build the required infrastructure due to the comparably low utilization rate.[9] The REA was created to provide loans to finance the construction of this required infrastructure. This led to the creation of the Electric Cooperative Corporation Act, establishing rules and guidance for the formation of electricity cooperatives in rural areas, as electric utilities were unwilling to accept the terms of REA loans with such low prospects for economic return.

The REA worked with engineers to determine that rural loads could be served with single-, rather than three-phase lines (two rather than three wires), allowing additional spacing between utility poles. This brought the cost of building out transmission infrastructure in the 1930s down to $825 per mile, far cheaper than the utility estimates of $2,000 per mile. Within 25 years of the program, the REA had facilitated the build out of transmission infrastructure across the country and the formation of rural electric cooperatives, bringing access to electricity to nearly every rural American.

The modern electric grid that connects us all is built upon this foundational work of the late 1800s to mid-1900s. We have continued to build and interconnect new generating stations both large and centralized and small and distributed; add new and strengthen existing lines to harden the grid against extreme weather events; and incorporate advanced control, protection, and monitoring technologies to continually improve grid reliability and resilience.

1.4 AC VERSUS DC

Nearly every transmission line in the U.S. carries AC electricity. In the last few decades, however, there has been a renewed interest in exploring DC transmission as a long-distance solution due to the potential cost and energy savings. During the origins of the transmission system, AC was the most feasible option primarily because transformers gave the ability to transform the voltage of the electricity being transmitted. Technological advances have

8 A. Bose and T. J. Overbye, "Electricity Transmission System Research and Development: Grid Operations," U.S. Department of Energy, 2021.

9 T. Sablik, "Electrifying Rural America," Federal Reserve Bank of Richmond, Richmond, 2020.

since allowed for the integration of DC lines using DC to AC converters and other classes of power systems control devices. While these controls may be more expensive than that required for AC lines, the DC lines themselves provide significant cost savings. For example, AC lines are carried in three phases, but DC lines require one fewer current carrying wire, saving material and labor costs and reducing the tower footprint. Additionally, DC lines can much more efficiently carry high voltages, providing further savings. Notable examples of existing DC transmission projects include submarine DC transmission lines connecting offshore wind projects to the grid. DC lines are also used to connect the seams between the Western, Eastern, and Texas Interconnections, or grid regions of the U.S., without disrupting the frequencies of the interconnects. While there are relatively few DC transmission lines in operation today, many projects are being proposed.

1.5 SCALE OF TRANSMISSION SYSTEM TODAY

There are approximately 590,000 miles of transmission lines across the United States; neither American Samoa nor the Commonwealth of Northern Mariana Islands have any transmission lines.[10] Figure 2 provides a glimpse into the scale of U.S. transmission infrastructure today; the lower voltage transmission lines are shown in a lighter color and the darker lines represent higher voltages.[11]

10 Data from public Homeland Infrastructure Foundation-Level Data (HIFLD) from the Geospatial Management Office (GMO) of the Department of Homeland Security. [Online]. Available: *https://hifld-geoplatform.opendata.arcgis.com/datasets/geoplatform::transmission-lines/about*

11 The U.S. Energy Atlas explorer from the Energy Information Administration (EIA) is an interactive public mapping tool similar to that shown in Figure 2, which provides additional data for each line.

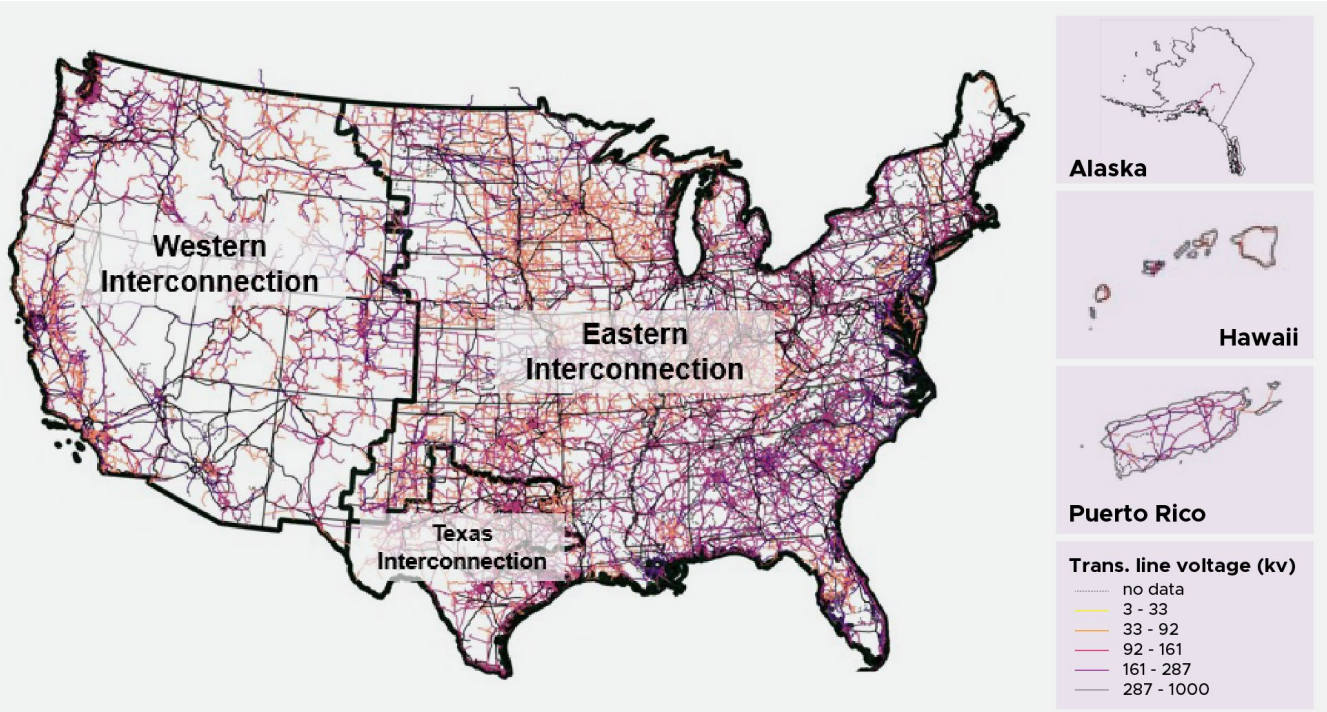

Figure 2. Transmission line map[12] within the U.S. and Puerto Rico colored by voltage ranges. Provides a summary of transmission line miles by voltage and transmission line type.

Table 1 provides a summary of transmission line miles by voltage and transmission line type.

Table 1. The U.S. transmission system by voltage.

Voltage (kV)	AC Transmission Lines (mi)	DC Transmission Lines (mi)
0 – 100	125,558	-
101 – 200	230,222	52
201 – 300	88,952	-
301 – 400	65,458	436
401 – 500	28,986	240
701 - 800	2,411	-
1000	-	844
Total	541,559	1,573

12 Created by Pacific Northwest National Laboratory (PNNL) using open-source geographic information system (GIS) software QGIS. Data from public Homeland Infrastructure Foundation-Level Data (HIFLD) from the Geospatial Management Office (GMO) of the Department of Homeland Security.

13 Data from public Homeland Infrastructure Foundation-Level Data (HIFLD) from the Geospatial Management Office (GMO) of the Department of Homeland Security. [Online]. Available: *https://hifld-geoplatform.opendata.arcgis.com/datasets/geoplatform::transmission-lines/about*

The miles of transmission lines are broken down by state and territory in Figure 3, representing over 94,000 individual lines and a total length that would stretch from New York City to Los Angeles 240 times over.

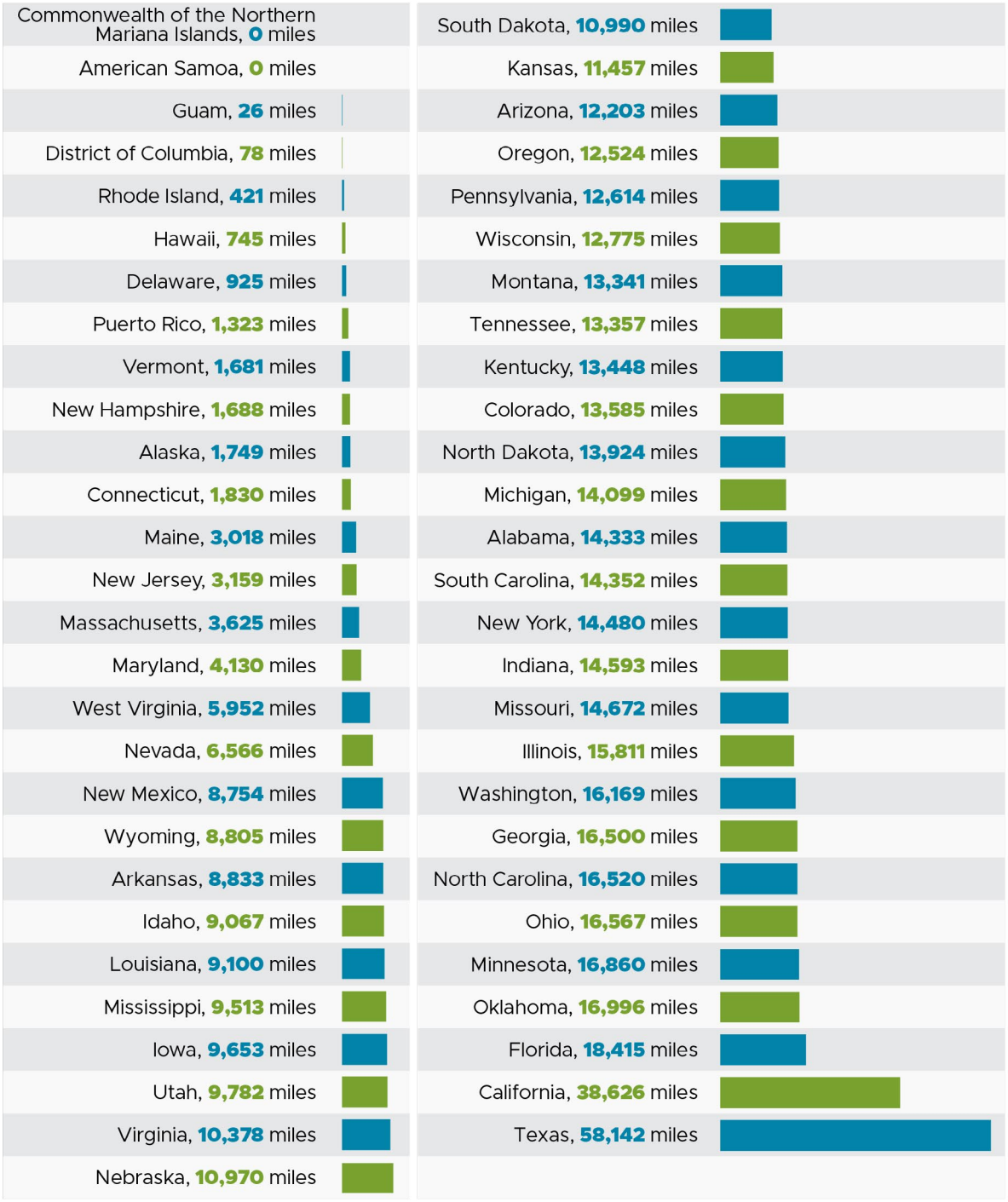

Figure 3. Total miles of transmission lines by state, territory, Washington D.C., and American Samoa. Dataset last updated December 2022.[14]

14 Created by Pacific Northwest National Laboratory (PNNL) using open-source geographic information system (GIS) software QGIS. Data from: Grid Deployment Office, "Coordinated Interagency Transmission Authorizations and Permits Program," 2024.

1.6 THE FUTURE OF THE TRANSMISSION SYSTEM

The nation's goal to achieve a carbon pollution-free power sector by 2035 requires widespread electrification, growth in electric vehicle adoption, and increased economic activity; these efforts are projected to result in increased electric demand through 2050, in all economic scenarios.[15] This increase in electric demand is coupled with increased demand for transmission capacity. In addition, the increased frequency and severity of extreme weather events has focused investments for both new transmission build out as well as hardening of existing transmission assets designed to assure reliability. Transmission outages are most frequently the result of wildfire or severe storms; in 2023, 12 weather related outage events resulted in over 41,000 transmission line miles impacted.[16]

The National Transmission Planning Study[17] was conducted to identify possible strategies to both develop new and upgrade existing transmission lines to support decarbonization, system reliability, and increasing electric demand. It is projected that over 140,000 miles of transmission lines will be replaced in the U.S. by 2050, and studies have estimated that the costs could range from $1 trillion to $2.4 trillion.[18] To facilitate the scale of the expected transmission build out, the Coordinated Interagency Transmission Authorization and Permits (CITAP) Program was created to streamline the federal environmental review and permitting processes required for siting transmission infrastructure. The CITAP Final Rule announcement explained that this improved coordination process, facilitated by the Department of Energy (DOE) rather than the responsibility of individual developers, is expected to reduce the existing 4-year lead time for authorization and permitting by half, while ensuring meaningful engagement with Tribes, local communities, and other energy system stakeholders.

15 EIA's Energy Outlook Scenarios include high and low economic growth, high and low zero-carbon technology cost, high and low oil and gas supply, and high and low oil and gas price.

16 North American Reliability Corporation, "2024 State of Reliability: June 2024," 2024. [Online]. Available: *https://www.nerc.com/pa/RAPA/PA/Performance%20Analysis%20DL/NERC_SOR_2024_Technical_Assessment.pdf.*

17 U.S. Department of Energy, Grid Deployment Office. 2024. The National Transmission Planning Study. Washington, D.C.: U.S. Department of Energy. *https://www.energy.gov/gdo/national-transmission-planning-study.*

18 T. McLaughlin, "Creaky U.S. power grid threatens progress on renewables, EVs," 2022. [Online]. Available: *https://www.reuters.com/investigates/special-report/usa-renewables-electric-grid/*.

2.0 TRANSMISSION INFRASTRUCTURE

Transmission infrastructure can be categorized by the tower structure and size, the voltage on the lines, and the individual electric components that connect it all together. The different combinations of these elements lead to variation in transmission design throughout the U.S. and in other countries.

2.1 TRANSMISSION TOWERS AND VOLTAGE RATINGS

A transmission tower's voltage rating defines the tower's maximum allowable power flow; the higher the rating, the higher the safe allowable power.[19] Transmission towers are designed to keep high-voltage lines adequately separated from one another and their physical surroundings.[20] The voltage on the lines determines the tower height, line spacing, and insulator length required to safely transmit power along the lines. The typical height of transmission towers is between 50 and 180 feet (ft).[21] Transmission towers must also be built to withstand physical stress from weather events and line sagging at high temperatures; these considerations are discussed in greater detail in *Section 3.0*.

There are two main types of transmission tower design: lattice steel towers and tubular steel poles. Either design can be single- or double-circuit type, meaning either one row of current carrying conducting wires or two, which corresponds to whether the lines are stacked horizontally (single) or vertically (double), as shown in Figure 4 and Figure 5 for both tower designs. For safety, the minimum height between the ground and the lowest conductor on a transmission tower is determined by the voltage it carries; this results in double-circuit towers standing much taller than single-circuit towers for the same voltage. Some example line voltages and the associated average tower height are shown in the Table 2 below.

Table 2. Average tower heights for various line voltages

	345 kV Single Circuit	345 kV Double Circuit	500 kV Single Circuit	765 kV Single Circuit
Height (ft)	110–125	160–175	120–135	135–150

19 Midcontinent Independent System Operator, "Transmission Line Ratings Workshop," 2021. [Online]. Available: *https://home.engineering.iastate.edu/~jdm/ee552/MISO-20210115%20Tranmsission%20Line%20Ratings%20Workshop%20Item%2002513055.pdf.*

20 J. Molburg, J. Kavicky and K. Picel, "The Design, Construction, and Operation of Long-Distance High Voltage Electricity Transmission Technologies," Argonne National Laboratory, Argonne, Illinois, 2007.

21 A. Syamsir, L.-W. Ean, M. R. M. Asyraf, A. B. M. Supian, E. Madenci, Y. O. Ozkilic and C. Aksoylu, "Recent Advances of GFRP Composite Cross Arms in Energy Transmission Tower: A Short Review on Design Improvements and Mechanical Properties," Materials, 2023.

22 "American Electric Power - Transmission Facts," [Online]. Available: *https://web.ecs.baylor.edu/faculty/grady/_13_EE392J_2_Spring11_AEP_Transmission_Facts.pdf.*

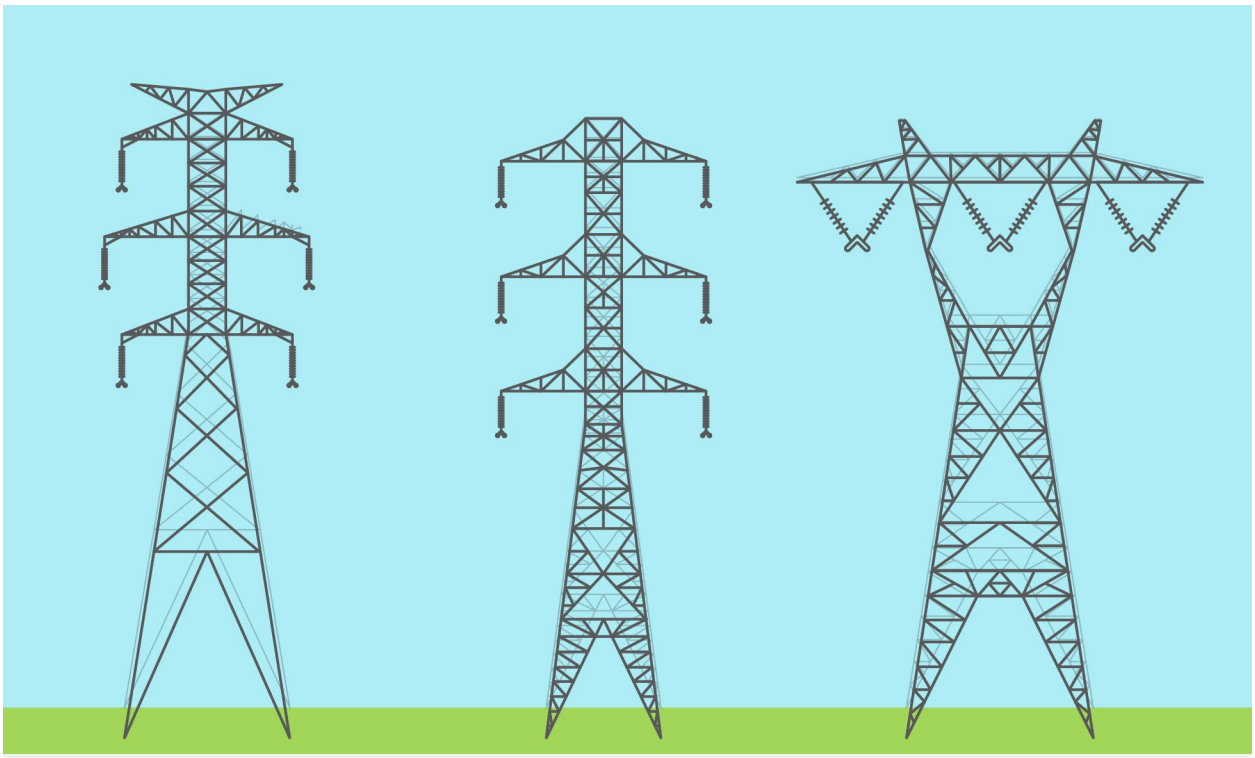

Figure 4. Lattice steel towers (LST): LEFT: 220 kV double circuit, 110–200 ft, MIDDLE: 500 kV double circuit, 150–215 ft, RIGHT: 500 kV single circuit, 80–200 ft.

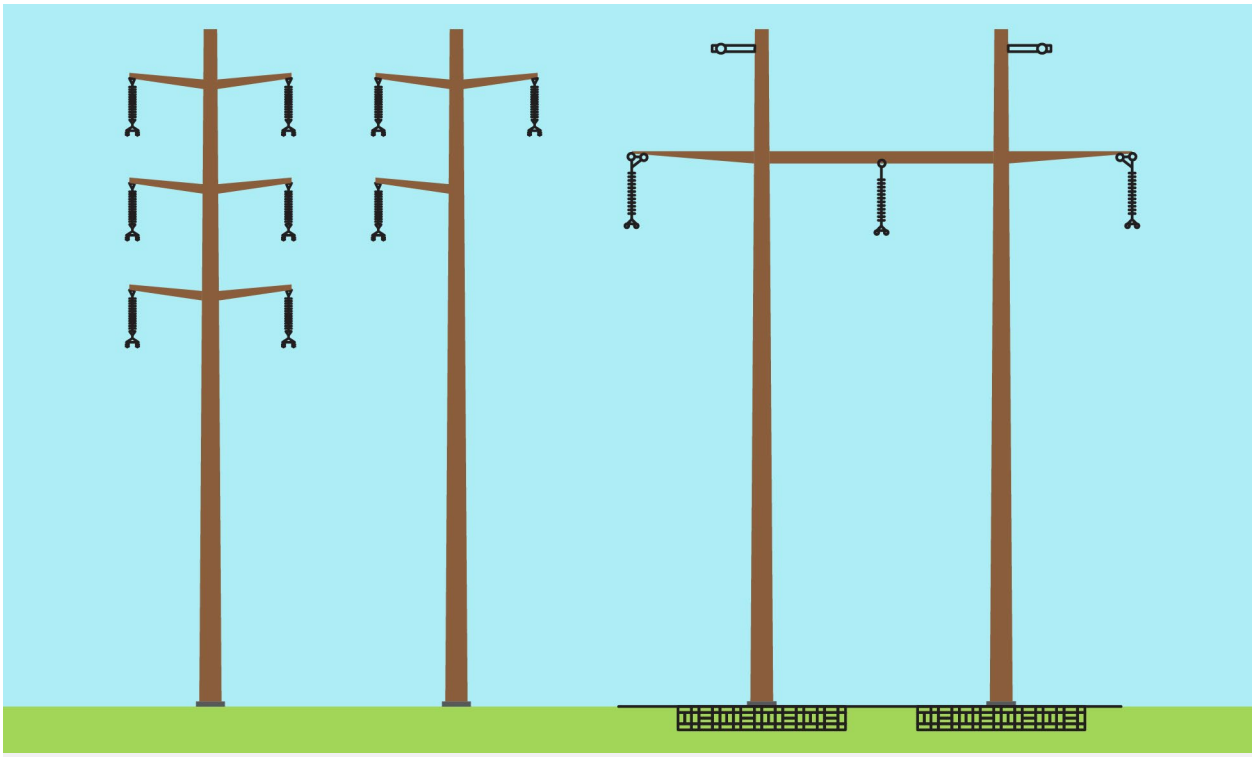

Figure 5. Tubular steel poles (TSP): (LEFT) 220 kV double circuit, 70–200 ft, (MIDDLE) 220 kV single circuit, 70–200 ft, (RIGHT) 220 kV single circuit H-Frame, 55–200 ft.

2.2 TRANSMISSION INFRASTRUCTURE COMPONENTS

While there are various transmission tower types and designs based on voltage rating, the basic structure and core components are universal. The following sections describe transmission tower, conductor, and insulator design and materials.

2.2.1 TOWERS

The key elements of transmission towers are depicted in Figure 6, below.[23]

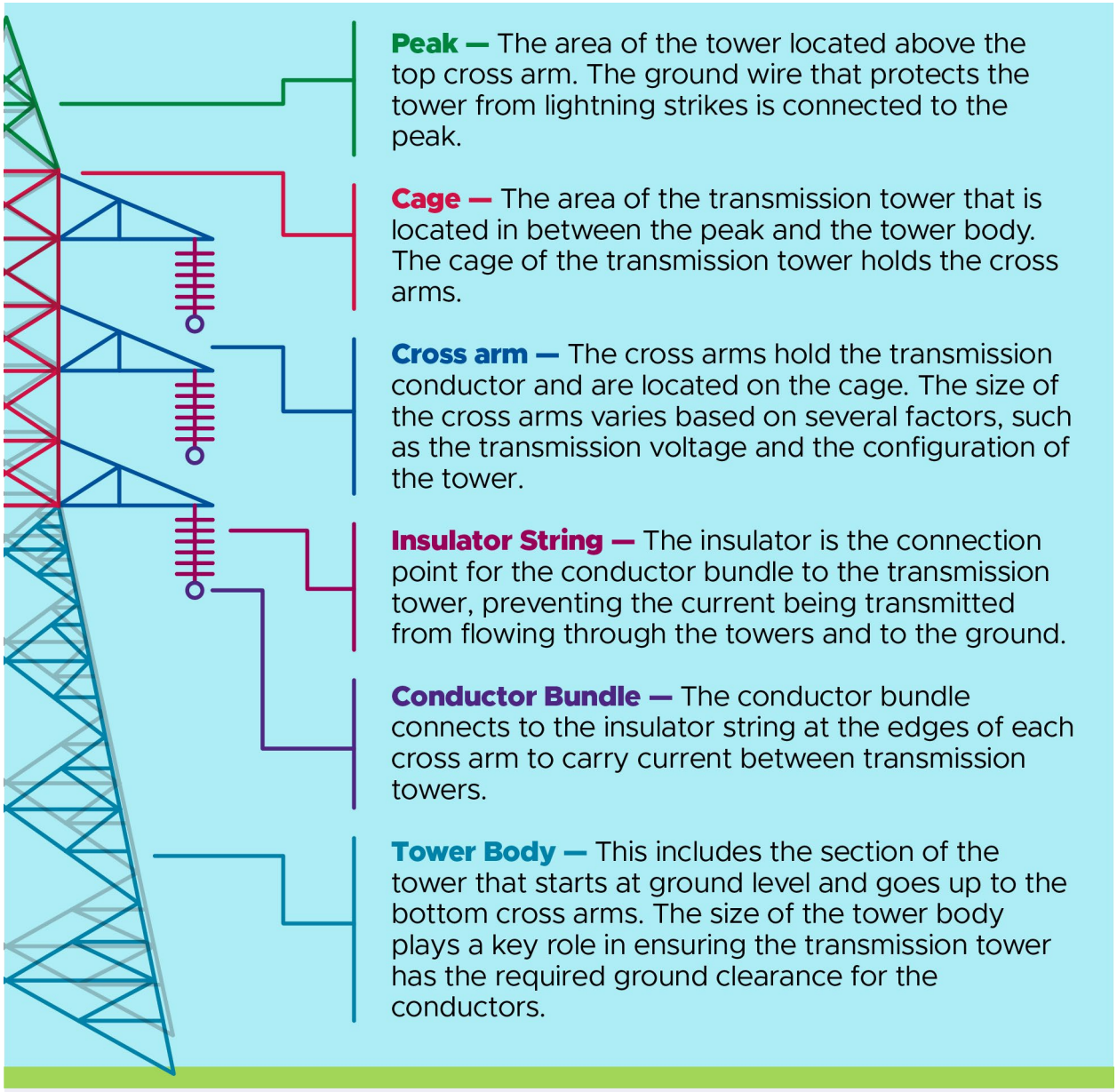

Figure 6. Transmission tower core components.

23 R. Raja, "Electrical Transmission Tower: Types, Design & Parts", Tamil Nadu: Muthayammal Engineering College, 2020. [Online]. Available: *https://www.slideshare.net/RajaR30/electrical-transmission-tower-types-design-and-parts*

Materials

Steel is the most common material for transmission towers due to its high strength. However, wooden and reinforced concrete transmission towers are also used, but are most prevalent in distribution towers and utility poles. Additionally, fiber-reinforced composite materials are beginning to be utilized. Fiber-reinforced composite materials are gaining traction due to their high strength, light weight, good insulation, and resistance to corrosion.[24,25]

2.2.2 CONDUCTORS

The wires that transport electricity across the transmission system are called conductors due to their material ability to conduct electric current. Conductors are wired from transmission tower to tower, connected to the tower's insulators.[26]

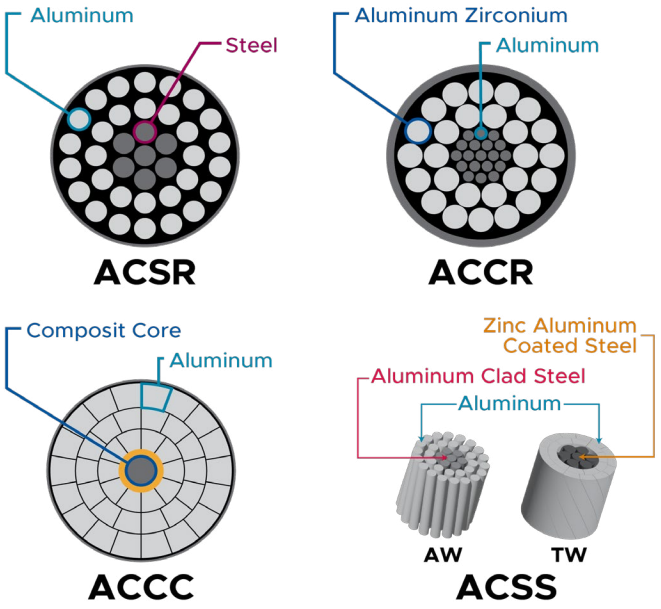

Figure 7. Cross-sections of transmission conductors. TOP LEFT: ACSR, TOP RIGHT: ACCR, BOTTOM LEFT: ACCC, BOTTOM RIGHT: ACSS, annealed wire and trapezoidal wire types.

Materials

Transmission lines are comprised of a system of conductors which can be made from many different conducting materials, with trade-offs between conductivity and material strength. Some examples are below:[27]

Copper: high conductivity, low strength. Historically used, but mechanical strength is the limiting factor.

Aluminum: reduced conductivity (60% that of copper), but much lighter and therefore improved conductivity-to-weight ratio (twice that of copper). Aluminum is also less expensive than copper.

Aluminum/Steel: steel is a poor conductor, but very strong. Steel cores are surrounded by aluminum strands for high strength and conductivity. ACSR, or aluminum conductor steel reinforced conductors are reported with this ratio, e.g., 84/7 has 84 aluminum strands surrounding 7 steel strands at the core. ACSS, or aluminum conductor steel supported conductors, are similar to ACSR conductors, but can carry higher currents at higher temperatures. ACSS wires are typically either trapezoidal wire type (TW) or annealed wire type (AW).

Aluminum/Ceramic: ceramic fibers within a matrix of aluminum allow for even greater strength and less weight. ACCR, or aluminum conductor composite reinforced, also provide increased resistance to heat degradation.

24 L. Wang and Y. Chen, "Structural Design of 35kV Composite Cross-arm," IOP Conf. Ser.: Mater. Sci. Eng., 2019.

25 Duke Energy, "Transmission vs. Distribution Structures," [Online]. Available: *https://p-micro.duke-energy.com/transmissionflorida-customersolutions/transmission-vs-distribution-structures.*

26 Aspen Environmental Group, "Transmission Structures," Aspen, 2014.

27 J. Molburg, J. Kavicky and K. Picel, "The Design, Construction, and Operation of Long-Distance High Voltage Electricity Transmission Technologies," Argonne National Laboratory, Argonne, Illinois, 2007.

2.2.3 INSULATORS

On transmission towers, insulators are mounted to the cross-arms and connect the tower to the conductor. The insulator is necessary to prevent current from flowing from the conductor to the Earth though the tower. The insulators must provide mechanical support for the conductor and must also ensure that the necessary clearance distance is met between the conductor and the tower. There are three main types of insulators: pin type, post, and suspension, defined below.[28]

Pin: has a pin that is secured to the cross arm of the tower. A soft metal thimble separates the porcelain (insulating material) and the hard metal pin so there is no direct contact. Pin type insulators are generally used for voltages up to 33 kV.

Post: similar to a pin-type insulator but has a metal base and a metal cap to allow for more than one unit to be mounted in series. The insulating material is shaped in the form of cones that fit inside one another. Used for supporting bus bars and disconnecting switches in the substations.

Suspension: used for lines above 33 kV due to how expensive pin-type insulators are for higher voltages. Has a disc-shaped insulating material with a metal cap on top and a metal pin on the bottom. Also known as disc or string insulators.

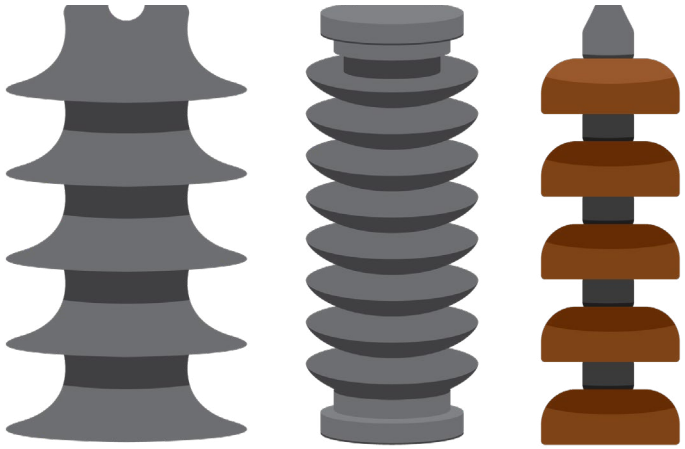

Figure 8. Pin-type insulator (LEFT), Post Insulator (MIDDLE), Suspension insulator (RIGHT).

Materials

Historically, porcelain and glass have been the most common materials for insulators due to their low cost, high strength, and flexible maintenance. Although porcelain and glass are still the most common, polymeric insulators, also referred to as composite insulators, are gaining popularity and beginning to replace the traditional insulator materials due to improved weathering ability, lighter weights, and reduced installation and maintenance costs. Composite insulators consist of three main parts: a fiberglass core, weather sheds, and metal end fittings. The weather sheds are necessary because the core and end fittings by themselves would not be suitable for use in an outdoor high-voltage environment due to factors such as moisture, ultraviolet rays, contamination, and rain, leading to the degradation of the core. The weather sheds are made of polymer materials that cover and protect the core while providing maximum electrical insulation.[29]

28 S. Han, R. Hao and J. Lee, "Inspection of Insulators on High-Voltage Power Transmission Lines," IEEE Transactions on Power Delivery, pp. 2319–2327, 2009.

29 N. E. Chukwuemeka and A. D. Adebayo, "Analysis of Insulators for Distribution and Transmision Network," American Journal of Engineering Research, pp. 138–145, 2019.

3.0 SITING AND SAFETY OF TRANSMISSION INFRASTRUCTURE

Transmission infrastructure is designed to transport high-voltage electricity across large, often remote distances, with little margin for failure. These robust requirements are met with strict siting and safety standards, which are summarized in this section.

3.1 TRANSMISSION CORRIDORS

Corridors are strips of land designated for certain uses, such as by telecommunication, electric and gas utilities, or for transportation highways and railways. Transmission corridors cross through rural and urban areas alike; some examples of these are shown in Figure 9.

Figure 9. Transmission corridors. LEFT: Washington, MIDDLE: Texas, RIGHT: Kentucky

Corridors for utilities can include above- or below-ground transmission. Locally designated corridors have varying regulations at the state and county levels, for which centralized, national statistics are unavailable. The width of a transmission corridor depends on the type of tower design, voltage on the lines, and the surrounding landscape. Corridors are designed to be as wide as necessary to safely isolate the high-voltage transmission lines from nearby structures, vegetation, and activity. Figure 10 gives a sense of the scale of the nation's transmission infrastructure throughout the states.

Federal energy corridors are a particular class of corridors that exist on federal land and are designated by the government for "electricity transmission and distribution facilities" as well as "oil, gas, and hydrogen pipelines".[30] Nearly 82% of the federal energy corridors[31] are on land belonging to the Bureau of Land Management (BLM); 16% are on Forest Service (FS) land; the remaining are sited on the U.S. Fish and Wildlife Service (FWS) land, Bureau of Reclamation

30 West-Wide Energy Corridor Information Center, "Section 368 Energy Corridors", [Online]. Available: *https://www.corridoreis.anl.gov/*.

31 Classified as Section 368 Federal Energy Corridors.

(BOR), Department of Defense (DoD), and National Park Services (NPS) land.[32] A total of 71% of the federal energy corridors incorporate existing rights-of-way (ROWs) that were locally designated for utilities and transportation. These corridors are primarily located in the western U.S. and can be viewed in an interactive mapping tool.[33] The remaining states have not designated federal energy corridors due to the limited federal land available, but they have the option to in the future.[34]

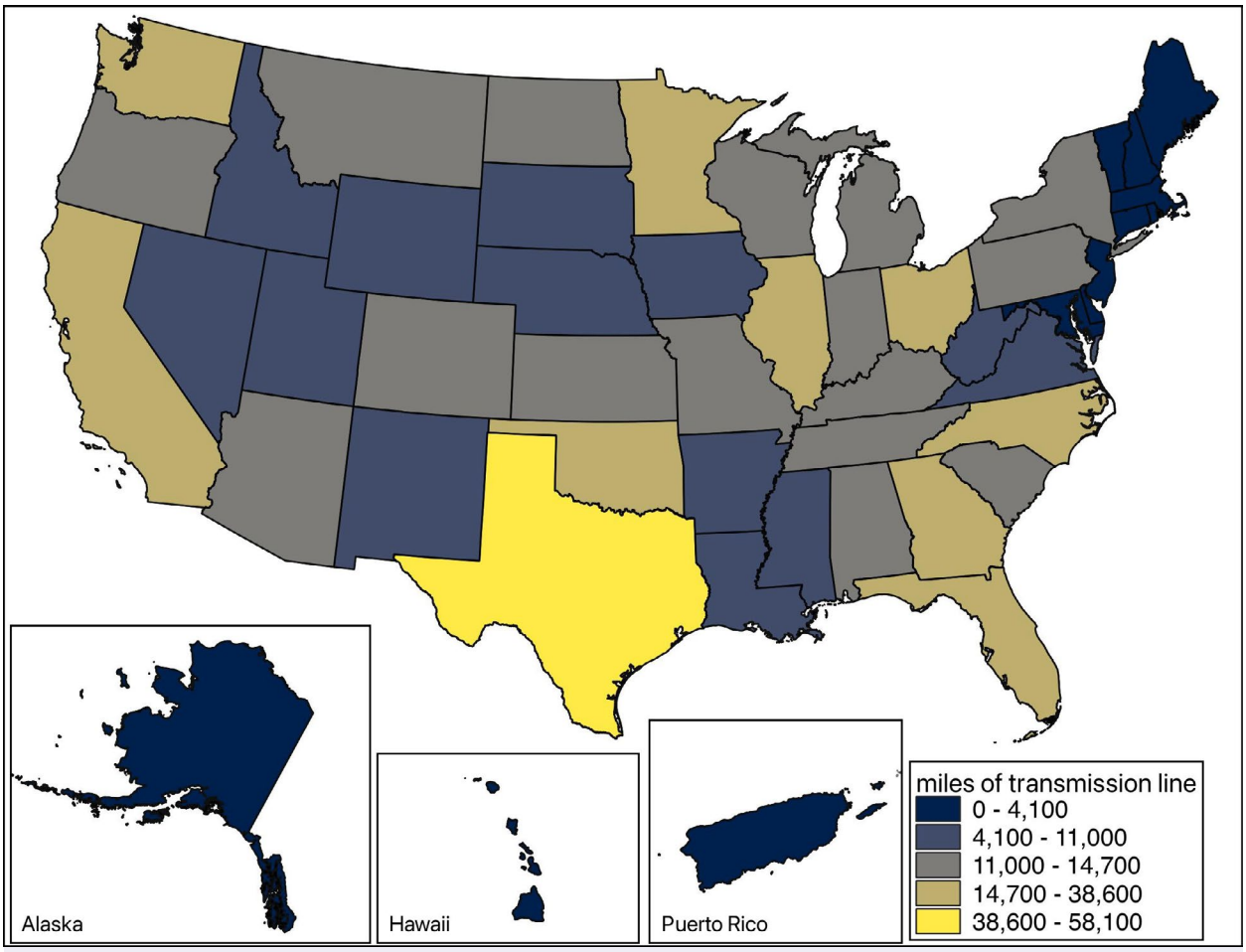

Figure 10. Miles of transmission line per state[35]

32 United States Department of Agriculture Forest Service, "Approved Resource Management Plan Amendments/Record of Decision (ROD) for Designation of Energy Corridors on Bureau of Land Management-Administered Lands in the 11 Western States," 2009.

33 West-Wide Energy Corridors, "Energy Corridor Maps and Geospatial Data," March 2022. [Online]. Available: *https://www.corridoreis.anl.gov/maps/*.

34 J. Krummel, I. Hlohowskyj, J. Kuiper, R. Kolpa, R. Moore, J. May, J. C. VanKuiken, J. A. Kavicky, M. R. McLamore and S. Shamsuddin, "Energy transport corridors: the potential role of Federal lands in states identified by the Energy Policy Act of 2005, section 368(b)," Argonne National Laboratory, 2011.

35 Created by Pacific Northwest National Laboratory (PNNL) by spatially intersecting the transmission line network to state boundaries, then summing the line length per state, using data from public Homeland Infrastructure Foundation-Level Data (HIFLD) from the Geospatial Management Office (GMO) of the Department of Homeland Security. [Online]. Available: *https://hifld-geoplatform.hub.arcgis.com/datasets/geoplatform::transmission-lines/about*.

The DOE is currently in the process of designating National Interest Electric Transmission Corridors (NIETCs)[36] based on the National Transmission Needs Study, which assessed transmission capacity and congestion both historically and projected into the future.[37] The DOE has proposed 10 areas for NIETC designation where transmission is not currently adequate for the nation in regard to outages and electricity rates.[38] It is important to note that while NIETCs can be designated on federal land, they do not necessarily need to be—any geographic area meeting the NEITC criteria can be designated by the Secretary of Energy. The purpose of designating the NIETCs is to provide incentives through easier permitting and siting processes for utilities to build new transmission lines in these preferred areas. The proposed NIETCs range 0.3 mi to 100 mi in width and 12 mi to 780 mi in length. They traverse 20 states from Massachusetts to Wyoming, Kansas to Indiana, Oregon to Nevada, and North Dakota to Texas.

3.2 TRANSMISSION SITING CONSIDERATIONS

Transmission lines stretch across the United States and must interact with other land uses, such as agriculture and forests; parks, recreation, and cultural sites; natural and environmental resources; transportation; housing; and economic developments.[39] Planning identifies the need for transmission (or transmission-like services and equipment) within the power system and may identify paths and locations for these needs. Transmission planning is typically disconnected from the work of siting transmission. The work of designing infrastructure and securing approvals for specific equipment and sites is not contemplated in transmission planning. Federal Energy Regulatory Commission (FERC) is the federal agency responsible for regulating interstate transmission of electricity and oversees regional transmission planning. FERC issued Order 1920 in 2024 that advanced a new framework for identifying benefits and assigning beneficiaries in support of more accurate evaluation and cost allocation. The order influences siting decisions by creating opportunities for "right-sizing" the scale of transmission and emphasizing equipment upgrades and other improvements to existing routes and lines.[40]

Permitting and siting requirements are led by state and local jurisdictions, each with a different approach to siting transmission; see *Appendix* for more details. Certain states have independent siting committees or boards, which may be composed of independently appointed individuals or sitting commissioners and agency authorities. Jurisdiction may be coordinated within the state energy office, an environmental regulatory authority, or the state utility regulatory commission. Jurisdiction for state siting may be linked to transmission line length, power rating, and whether the transmission crosses multiple county boundaries within the state. State siting can be standards-based, which means that if certain conditions are met, a siting certificate is authorized. State actions are not always organized into a central authority; requirements may be spread into individual permits that a transmission developer must acquire. For example, a state environmental authority may regulate air or water quality, a county may regulate the

36 U.S. Grid Deployment Office, "National Interest Electric Transmission Corridor Designation Process," 2024. [Online]. Available: *https://www.energy.gov/gdo/national-interest-electric-transmission-corridor-designation-process*.

37 U.S. Grid Deployment Office, "National Transmission Needs Study," 2023. [Online]. Available: *https://www.energy.gov/gdo/national-transmission-needs-study*.

38 U.S. Grid Deployment Office, "National Interest Electric Transmission Corridor Designation Process," 2024. [Online]. Available: *https://www.energy.gov/gdo/national-interest-electric-transmission-corridor-designation-process*.

39 W. H. Smith Jr., "Mini Guide on Transmission Siting: State Agency Decision Making," National Council on Electric Policy, 2021. *https://pubs.naruc.org/pub/C1FA4F15-1866-DAAC-99FB-F832DD7ECFF0*

40 187 FERC ¶ 61,068. Order 1920 (2024). "Building for the Future Through Electric Regional Transmission Planning and Cost Allocation."

land use permit, and a Certificate of Public Convenience and Necessity (CPCN, or similar term) may be needed from the public utility commission. These certificates confirm that the line is important for safe and reliable electricity service.[41]

Transmission permitting and siting can also require federal permitting and environmental review, depending on the size of the project, routes across governance boundaries, and whether additional concerns are identified, such as wildlife impacts. Federal review for transmission lines commonly involves National Environmental Policy Act (NEPA) environmental review to assess the potential environmental impacts of a proposed project, and depending on the significance of the impact, the federal agency may conduct an Environmental Assessment (EA) or Environmental Impact Statement (EIS). An EA is used to assess whether a project has the potential to cause significant environmental impact, followed by an EIS if the project is determined to significantly impact the quality of the human environment.

For transmission, adverse environmental effects can have either short-term impacts limited to the construction phase or longer-term impacts that span into the project's operation. Some examples of the impact categories often included in EISs for transmission are impacts to agriculture and soils, air quality, vegetation, wildlife, endangered species, cultural resources, geography, land use and recreation, noise, socioeconomic, visual resources, waste management, water resources, wetlands, and fire safety. Impacts can vary by project and location or be consistent across environmental review documents.

The EIS process has four steps: (i) publishing of a Notice of Intent (NOI) to inform the public and describe the mechanisms of participation; (ii) publishing the Draft EIS (DEIS), for which the public has a minimum of 45 days to review and comment; (iii) publishing a final EIS which includes responses to public comments; and (iv) a Record of Decision (ROD) describing the different alternatives considered and explaining the Agency's final decision.[42]

Timelines for the NEPA process for transmission can vary significantly between projects. In review of all recent transmission NEPA documents, the shortest period between start and finish, from NOI to ROD, was 2.3 years; the longest period spanned 14 years.[43] The Council on Environmental Quality (CEQ) completed a review and found that across all federal agencies, not just limited to transmission projects, the average EIS completion time from NOI to ROD was 4.5 years.[44]

41 See, e.g. Maryland Public Service Commission, "Public Utilities Article Sections 7-207 and 7-208, Certificate of Public Convenience and Necessity (CPCN)," 2024. [Online]. Available: *https://www.psc.state.md.us/wp-content/uploads/CPCN-Process_REVISED-7-2024.pdf*.

42 See 40 CFR Part 1502.

43 For example, the Big Eddy-Knight Transmission project's notice of intent issued in June 2009 and the record of decision issued in September 2011, spanning 2.3 years. Department of Energy, "Bonneville Power Administration; Big Eddy-Knight Transmission Project," 2009. Federal Register. [Online]. Available: *https://www.energy.gov/nepa/articles/eis-0421-notice-intent-prepare-environmental-impact-statement*; Department of Energy, Bonneville Power Administration, Big Eddy-Knight Transmission Project: Notice of Availability, Record of Decision," 2011. [Online]. Available: *https://www.federalregister.gov/documents/2011/09/26/2011-24610/big-eddy-knight-transmission-project*.
The SunZia Southwest Transmission project was unique in that a supplemental FEIS was developed. The project first issued a NOI in May 2009 and the project's final ROD was issued May 2023, taking 14 years. U.S. Department of the Interior Bureau of Land Management, "Notice of Intent To Prepare an Environmental Impact Statement and Possible Resource Management Plan Amendments for the SunZia Southwest Transmission Project in Arizona and New Mexico," 2009. [Online]. Available: *https://www.federalregister.gov/documents/2009/05/29/E9-12512/notice-of-intent-to-prepare-an-environmental-impact-statement-and-possible-resource-management-plan*.
U.S. Department of the Interior Bureau of Land Management, "SunZia Southwest Transmission Project Right-of-Way Amendment Final Environmental Impact Statement and Proposed Resource Management Plan Amendment; Record of Decision," 2023. [Online]. Available: *https://eplanning.blm.gov/public_projects/2011785/200481766/20078613/250084795/20230517%20SunZia%20ROD_508.pdf*.

44 Reviewed projects had a final EIS published between January 1st, 2010, and December 31st, 2018, and a ROD was issued by June 18th, 2019. Executive Office of the President Council on Environmental Quality, "Environmental Impact Statement Timelines (2010-2018),"2020. [Online]. Available: *https://ceq.doe.gov/docs/nepa-practice/CEQ_EIS_Timeline_Report_2020-6-12.pdf*.

3.2.1 EASEMENTS

Critical to the transmission siting process is securing an easement or a legal agreement that allows one party to utilize the land of another for a particular purpose. For transmission infrastructure, an easement outlines the agreement between a utility and a landowner in which the utility acquires the rights to utilize the owner's land to build and maintain a transmission line. The physical land agreed upon in the easement is the ROW for the transmission infrastructure. Most easements for transmission infrastructure are not subject to termination or expiration; once they are signed, the utility and landowner are bound to the easement, which becomes part of the property record. In the agreement, landowners will receive compensation for the use of their land, which is typically a one-time payment based on market value. The land within the ROW can still be utilized by landowners for purposes that do not interfere with operation and maintenance of the transmission line, which can include agricultural and recreational uses.[45] The process to acquire land for a ROW and develop an easement differs by local and state regulations. For more insight on the acquisition process, see the ***Easement Process Example*** callout box, which details the state of Washington's acquisition process.

3.2.1.1 TYPES OF EASEMENTS

There are several types of easements, which can vary by state. Land types include agricultural land easements for crops and pastures to protect productive soil, grazing, or historical resources.[46] Wetland reserve easements allow protection and improvements of wetlands. Historic conservation easements allow the owner to continue to use the property, but the current or subsequent owner agrees to preserve it based on prescribed standards.[47] There are also easements for uses such as trails for scenic beaches or recreational river access.[48, 49]

Residential easements can allow for private or public access either agreed on by the owner or involuntarily for a specific purpose and may or may not be time constrained.[50] For example, an easement in a residential area could include an easement by necessity for use of a driveway permitting access to someone's property behind the driveway. Utility easements in residential land allow utilities such as water, electric, gas, and internet to access the property to service their equipment or trim trees.

3.2.1.2 SAFETY AND RIGHT-OF-WAY

A ROW is a type of easement granted to a utility or transmission owner that grants the right to use and access the land directly below a transmission line according to the terms of the

45 Xcel Energy, "Understanding Easements and Rights-of-Way," 2021. [Online]. Available: *https://www.transmission.xcelenergy.com/staticfiles/microsites/Transmission/Files/PDF/Resources/Understanding-Easements.pdf*.

46 United States Department of Agriculture, "Agricultural Land Easements - Oregon," [Online]. Available: *https://www.nrcs.usda.gov/programs-initiatives/ale-agricultural-land-easements/oregon/agricultural-land-easements-oregon*.

47 Restore Oregon, "Historic Conservation Easements," 2021. [Online]. Available: *https://restoreoregon.org/historic-conservation-easements/*.

48 "National Parks, Military Parks, Monuments, and Seashores," [Online]. Available: *https://www.law.cornell.edu/uscode/text/16/460bb-2#k*.

49 "Wild and Scenic Rivers," [Online]. Available: *https://www.law.cornell.edu/uscode/text/16/1286#c*.

50 Schorr Law, "What are the Different Types of Easements in California?," 2023. [Online]. Available: *https://schorr-law.com/different-types-of-easements*.

easement.[51] Establishing ROWs are critical to providing adequate safety margins between transmission lines and surrounding infrastructure and vegetation, as well as access to the lines for inspection and maintenance. The ROW along a transmission corridor contains an active portion, where the transmission lines are sited, and an inactive portion or buffer zone in which non-active components and vegetation can exist. Vegetation within a transmission ROW must be maintained at a minimum clearance distance that depends on the line voltage and the altitude, to prevent sparks and flash-over to the vegetation.[52] The buffer zones depicted vary depending on the line voltage, urban vs. rural setting, tower type, and utility service territory. Generally, the higher the line voltage, the wider the buffer zone required to maintain safety. Rights-of-way typically vary between 50 and 200 ft, depending on these factors. NERC provides the minimum safe distance from the centerline of the circuit to the edge of an active transmission line ROW by voltage, shown in Figure 11..

Table 3. Minimum distance from center line of circuit to edge of active transmission line rights-of-way[52]

Voltage (kV)	Minimum Distance to Edge of Active Rights-of-Way (ft)[53]
69–138	37.5
139–240	50
231–345	75
346–500	87.5
501–765	100

Transmission lines are designed to sag slightly to avoid too much tension, but extreme outdoor temperatures and heat from high loads can cause transmission lines to lengthen as the metal expands.[54] This is another reason why adequate spacing between the ground and conductors is key for safety. High winds can also cause transmission lines to sag and sway, which is why transmission line ROWs extend beyond the physical footprint of the tower. The extent to which the transmission line sags depend on several factors such as line materials, the distance between towers, and the load on the lines.[55] For high-voltage transmission lines swinging from high wind speeds, the horizontal reach can be 32–66 ft.[56] The National Electric Safety Code specifies minimum safe clearance distances between conductors and the ground under maximum sag or heavy ice or wind conditions, based on voltage level.[57]

51 Duke Energy Corporation, "What is a right of way?," 2024. [Online]. Available: *https://www.duke-energy.com/community/trees-and-rights-of-way/what-is-a-right-of-way*.

52 NERC Vegetation Management Standard Drafting Team, "Transmission Vegetation Management NERC Standard FAC-003-2 Technical Reference," NERC, Princeton, NJ, 2009.

53 North American Electric Reliability Corporation, "NERC Vegetation Management Standard," 2010.

54 A. U. Mahin, S. N. Islam, F. Ahmed and M. F. Hossain, "Measurement and Monitoring of Overhead Transmission Line Sag in Smart Grid: A Review," IET Generation, Transmission & Distribution, vol. 16, no. 1, pp. 1-18, 2022.

55 H. Keyhan, G. McClure and W. G. Habashi, "Dynamic Analysis of an Overhead Transmission Line Subject to Gusty Wind Loading Predicted by Wind–Conductor Interaction," Computers & Structures, vol. 122, pp. 135-144, 2013.

56 North American Wood Pole Council, "Fire Protection for Wood Utility Poles and Crossarms," 2024. [Online]. Available: *https://woodpoles.org/Issues/Fire-Protection*.

57 The Institute of Electrical and Electronics Engineers, Inc, "2023 National Electrical Safety Code (NESC): C2-2023," New York, 2022.

Because every stretch of conductor along a corridor must always maintain safe clearance with its surroundings, many devices and techniques have been developed to perform real-time monitoring of line sag.[58] Direct measurement via cameras, laser scanners, or Global Positioning

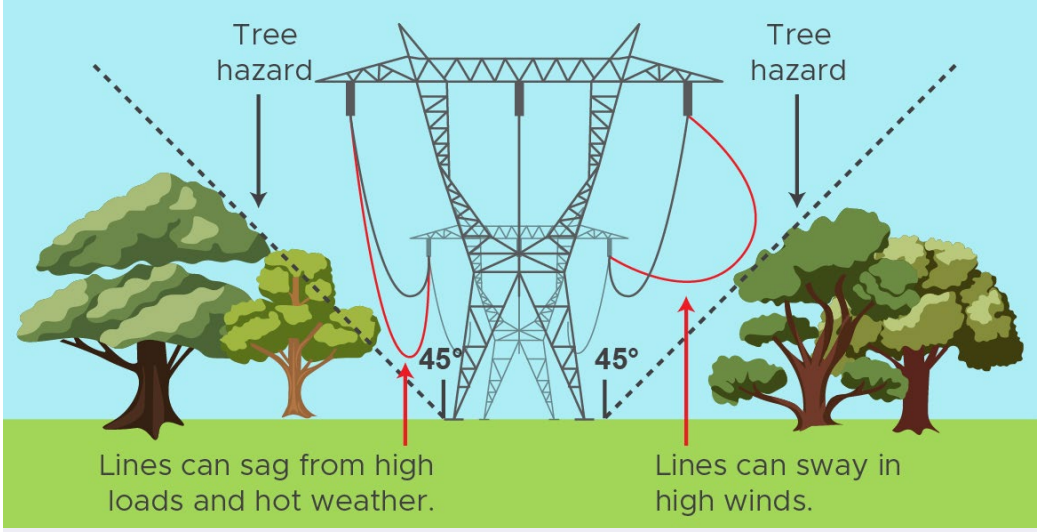

Figure 11. Transmission line sag and sway due to high loads, weather, and high winds.

System (GPS) can be used to measure sag; indirect methods can be used to calculate sag based on tension, temperature, span length, and more. In order to maintain safe operating conditions, grid operators monitoring transmission line sag may need to reduce the current flow along a line if the sag becomes too great. Line sag is one of the primary reasons that conductor material selection must strike a balance between both the electrical conductivity and mechanical strength of a material or composite.

Well-managed ROWs are necessary to maintain safety and grid reliability. A primary concern is that vegetation could interfere with transmission lines, as shown in Figure 12. To avoid interaction between vegetation and transmission lines, the American National Standards Institute (ANSI) requires minimum clearance distances from trees and other obstructions that vary based on the voltage of the line, as well as the species of tree and its growth characteristics. Figure 12 depicts this clearance distance, the no tree zone, as well as guidance for safe vegetation practices beyond the ROW.

Traditional vegetation management strategies include mechanical clearing, which removes all trees and brush from within the active ROW; selective mechanical tree removal, which involves removing tall-growing tree species but preserves low-growing trees and shrubs; low volume foliar selective herbicide treatment, which applies herbicide to all tall-growing tree species at less than 10 ft tall; and side pruning, where tree limbs that have grown to or are nearly encroaching on active ROWs are pruned or their branches are removed.[59]

Advanced methods of vegetation management are increasingly utilized by utilities and rights-of-way managers to balance the operational cost and labor-intensive management of cutting trees with the ecological benefits of natural methods of suppressing unwanted vegetation. Integrated vegetation management (IVM) is a structured process that ensures the primary requirements of the ROW are met (height, access) while fostering ecologically appropriate

58 Y. Chen and X. Ding, "A Survey of Sag Monitoring Methods for Power Grid Transmission Lines," IET Generation, Transmission & Distribution, pp. 1419–1441, 2023.

59 NERC Vegetation Management Standard Drafting Team, "Transmission Vegetation Management NERC Standard FAC-003-2 Technical Reference," NERC, Princeton, NJ, 2009.

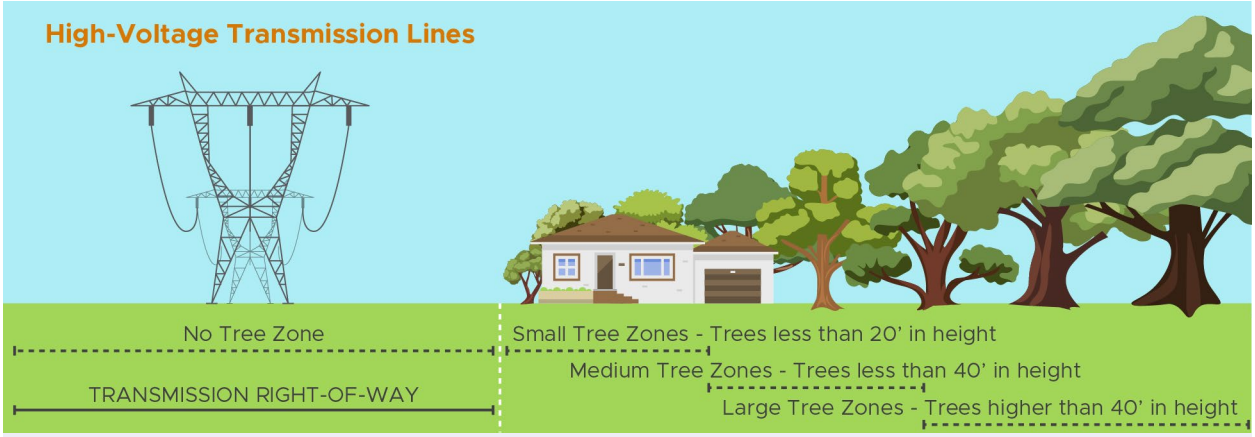

Figure 12. Guidelines for vegetation in a transmission line right-of-way.

vegetation. Entities offer third-party accreditation of IVM approaches specifically for ROW corridors.[60] IVM is also established in independent technical standards for best practices in corridor vegetation management.[61]

Wildfires are another threat to transmission lines. The extreme heat from wildfires is such that the concern is not simply whether it burns, but whether it can maintain mechanical strength when subject to temperatures above 2,000 degrees Fahrenheit (°F). At those temperatures, metal warps as it loses strength and the compounds and rebar in the concrete poles can be damaged. An innovative structural hardening measure that can be employed for existing or new wooden poles is wrapping them in a fire-protecting material. Pole wraps can be made of wire or fiberglass mesh coated in a material designed to swell when exposed to heat (intumescent coating). Fire-wrapped wooden poles have been demonstrated to maintain most of their structural integrity when exposed to these extreme temperatures during testing and in the field.

There is active investment in wildfire protection measures to harden utility assets. Announced in 2023, the DOE's Grid Resilience Innovation Partnerships (GRIP) Program, administered by the DOE's Grid Deployment Office, are large-scale investments in grid reliability and resilience in partnership with utilities. Approximately a quarter of the first round of funding was directed towards wildfire mitigation strategies such as fire-resistant poles, covered power lines, undergrounding, sensors and monitoring, and vegetation management.[62]

3.2.1.3 COMPENSATION STRATEGIES

Landowner negotiations for transmission infrastructure easements are subject to state and local regulations, and as such have no standard national format. Despite these differences, the negotiation process is generally similar. After contacting the landowner and assessing the location where the transmission infrastructure would be located, the developer prepares all necessary documents and works with an appraiser to develop a compensation plan for each easement. Although a one time payment is the standard compensation method for easements,

60 Right-of-Way Stewardship Council, "Technical Requirements of Stewardship Accreditation for Integrated Vegetation Management (IVM) practices on electric transmission, natural gas, and liquid petroleum pipeline ROWs," Updated technical standards in progress as of September 2024. [Online]. Available: *https://rowstewardship.org/ivm.php*.

61 Codified in ANSI A300 (Part 7) best practices for tree care management in IVM.

62 Grid Deployment Office, "Protecting our Electric Grid from Wildfire," 2023. [Online]. Available: *https://www.energy.gov/gdo/articles/protecting-our-electric-grid-wildfire*.

there are alternative approaches such as an annual payment for lost crop production over a limited number of years, an annual payment per-pole on the landowner's property, or royalty payments for landowners. These alternative approaches may enable the utility to earn more landowner support for a transmission project.[63]

Easement Process Example

When federal aid is involved in projects that require a ROW acquisition, the region's local agency coordinator must be notified as early in the process as possible. For example, in Washington state, the process is initiated by a local agency with approved ROW procedures by the Washington State Department of Transportation's Local Programs Division. The preferred method for local agencies to acquire a ROW is to purchase fee rights or temporary and permanent easements. A ROW plan is required to specify the property required to build and maintain the project.

Before an appraisal for the land, a corridor hearing must be held, the final environmental approval must be obtained, and the ROW plan that includes the parcels of land must be submitted. Each parcel that will be acquired by negotiation must undergo at least one appraisal. A determination of value will then be prepared by a review appraiser for each parcel of land. A ROW funding estimate is required to be submitted when there is federal funding in the ROW phase of the project.

An appraisal review must take place after the initial submission to ensure that requirements put forth by state law are followed and include proper compensation. The review includes an estimate of just compensation for the landowner, a list of buildings on the land considered to be part of the property to be acquired, and a statement that the estimate has been reached independently and is based on factual data.

When initiating a negotiation, a summary of the appraisal must be included with the amount deemed as just compensation. Negotiation must be carried out to come to an agreement before administrative settlements, which may be necessary to determine the value of the acquisition.[64,65]

3.3 TRANSMISSION LINE CONSTRUCTION

The timing and specifics of the transmission line construction process vary, but generally proceed through the following steps.[66]

Soil surveys and property staking: field surveys conducted to determine mechanical properties of soil. ROW agents request access to the property and coordinate between soil boring contractor and property owner. Final pole locations are determined and staked in the field with tree clearing limits, ROW boundaries, and property features. For example, 345 kV lines typically require 150-ft wide easements.

Construction access and tree clearing: construction access routes to ROWs are typically 25–30 ft wide to accommodate the drill rig, concrete trucks, and crane delivery to the site. Tree clearing and vegetation removal occurs, and often matting is put down to prevent compaction of wet or soft soil.

63 A. Berry, "Getting Right-of-Way Right: Landowner Compensation for Electric Power Transmission RIghts-of-Way," Lincoln Institute of Land Policy, Bozeman, MT, 2013.

64 Washington State Department of Transportation, "Right of Way - Local Agency Guidelines," 2023. [Online]. Available: *https://wsdot.wa.gov/publications/manuals/fulltext/M36-63/Lag25.pdf*.

65 Washington State Department of Transportation, "Right of Way Manual," 2020. [Online]. Available: *https://wsdot.wa.gov/publications/manuals/fulltext/m26-01/row.pdf*.

66 Xcel Energy, "Transmission Line Construction Process," Xcel Energy Inc., Colorado, 2020. [Online]. Available: *https://www.transmission.xcelenergy.com/staticfiles/microsites/Transmission/Transmission%20Line%20Construction.pdf*.

Mobilizing equipment and delivering material: including a crane, drill rig, concrete truck, boom trucks, trailers, structures, steel casing, and rebar cages.

Foundation construction: can be either drilled pier or direct embed foundations. Drilled pier foundations are 6–9 ft in diameter and 20–40 ft deep. Reinforced steel and anchor bolts are placed in the drilled hole and the concrete is poured. Direct embed foundations are 3–5 ft in diameter and 15–30 ft deep. The pole base is placed in the drilled hole and backfilled with rock, soil, or concrete.

Installing the structure: poles are assembled at the foundation site and set in place with cranes or other equipment.

Stringing conductor: conductors are pulled from one structure to the next through a pulley system temporarily placed on the structures. Once pulled through, the conductor is attached to the insulators, after which the pulleys are removed. Bird diverters, spacers, and galloping devices are also installed.

Land restoration: once completed, the ROW is cleaned and restored. Tile and fences are repaired, rut removal, decompaction, tilling, seeding, and wetland restoration are all possible restoration activities.

4.0 MULTIFUNCTIONALITY OF TRANSMISSION CORRIDORS

As discussed, building new transmission can be a lengthy process, one which requires participation from numerous stakeholders, from permitting and approvals boards to the communities through which transmission lines are sited. One way to engage stakeholders in a collaborative process at this scale is to leverage established approaches for multi-use of transmission corridors. These uses convey additional benefits of transmission infrastructure beyond just the improvements to the electric grid.

For example, co-locating transmission lines with transportation rights-of-way, such as highways and interstates, is a great opportunity for corridor multifunctionality. Federal and state policy have promoted co-location and created coordination mechanisms between energy planners and transportation system authorities.[67], [68] In addition to potential development benefits, public benefits from co-location could include avoided impact to cultural, visual, and environmental resources and avoided property condemnation or restricted land use. Practical barriers to co-location of transportation ROW and transmission include accessibility, interaction of uses, and collaborative governance. Initial analysis from advocates shows that there is extensive demand for co-location if transmission is to be developed at scale and speed.[69],[70] Other innovative multifunctionality use cases are described below.

4.1 HABITAT CONSERVATION & WILDFIRE MITIGATION

The space in a corridor required to maintain safe transmission operations can be managed not just to avoid interaction with vegetation, but to promote habitat conservation and an opportunity to improve the local ecosystem. There are many organizations and programs to encourage owners of linear infrastructure to participate in conservation efforts, such as the Rights-of-Way as Habitat Working Group, Wildlife Habitat Council, and Million Pollinator Garden Challenge, that provide measurable impacts. Utilities have begun to incorporate principles of environmental stewardship into transmission corridor planning and maintenance, the results of which can have a positive impact on local wildlife, especially for climate-vulnerable pollinators.[71]

In addition, such habitat restoration and preservation efforts can reduce long-term maintenance costs through environmental stewardship.[72] Traditional utility vegetation management practices tend to be reliability-focused vegetation removals, whereas integrated vegetation management (IVM) looks at the wider picture and longer timescales by promoting

67 U.S. Department of Transportation Federal Highway Administration, "Memorandum: State DOTs Leveraging Alternative Uses of the Highway Right-of-Way Guidance," Washington, DC, 2021.

68 Wisconsin State Legislature, "2021-22 Wisconsin Statutes & Annotations § 1.12(6)," 2024 [Online]. Available: *https://docs.legis.wisconsin.gov/statutes/statutes/1/12/6*.

69 The Nature Conservancy, "Power of Place - West," 2022. [Online]. Available: *https://www.nature.org/content/dam/tnc/nature/en/documents/TNC_Power-of-Place-WEST-Executive_Summary_WEB_LR.pdf*.

70 M. Putnam and L. Rogers, "NextGen Highways Feasibility Study for the Minnesota Department of Transportation: Buried High-Voltage Direct Current Transmission," NGI Consulting; The Ray; Great Plains Institute Satterfield Consulting; Tracy Warren; and 5 Lakes Energy, 2022.

71 Right-of-Way Stewardship Council, "Accreditation Standards for Accessing IVM Excellence," Right of Way Stewardship Council, 2016.

72 J. Golden, "Moving From Compliance to ROW Stewardship," 2023. [Online]. Available: *https://www.tdworld.com/vegetation-management/article/21264363/moving-from-compliance-to-row-stewardship*.

desirable, stable, and low growing plant communities, reducing wildlife habitat fragmentation, and promoting geographic diversity. Integrated vegetation management can also aid in wildfire mitigation by selectively spraying herbicides to target brush and other vegetation that can become ladder fuels. Ladder fuels are vegetation that burn with very high flames, bringing wildfires from the ground up into the trees and accelerating the spread of a fire. When ladder fuels are removed from transmission corridors, those corridors provide much needed fuel breaks that can slow the spread of wildfires.

4.2 RECREATION

Transmission corridors can also be co-located with recreation, such as trails or parks. Electric utilities have begun to partner with trail managing agencies, governments, and communities to build safe and accessible multi-use areas by building transmission along existing trails, building trails along transmission corridors, or developing the two in coordination from the onset.[73] The Rails-to-Trails Conservancy found that at time of writing, 400 trails from their trail database were located in electric utility corridors.[74] Regulations can support such combined land use. For example, a Colorado law requires notification for potential trails along powerlines when applying for transmission development and allows contracts with public and private entities for recreational trails.[75]

4.3 WEALTH-BUILDING

Transmission corridors also represent an economic opportunity for local communities to grow their wealth in cooperation with transmission developers. This can take the form of lease payments, direct and indirect ownership, and other forms of transfers like profit sharing. Community-owned or operated entities like community land trusts and community development financial institutes may have an important role to play in increasing community participation and ensuring that local community members receive direct financial benefits from transmission. Tribal entities, in particular, have been successful in partnering with utilities for transmission development and using the proceeds to benefit their local communities.[76] Expanding opportunities for communities to participate in and receive direct financial benefits from ROWs could play an important role in the acceptance of transmission development and have follow-on effects by promoting economic development for local communities.

The multiple community benefits that transmission corridors are uniquely suited to provide can bring additional stakeholders and resources to the table, energizing local communities and accelerating the build out of much-needed transmission infrastructure. Coordinating these stakeholders, streamlining these processes, and socializing case studies and lessons-learned will be key to maximizing the benefits of transmission infrastructure and accelerating the pace of deployment.

73 Rails to Trails Conservancy, "Trails and Utilities," 2024. [Online]. Available: *https://www.railstotrails.org/trail-building-toolbox/utilities/*.

74 C. Matteson, "New Power Generation: Trails and Utilities in Wisconsin & across the US," 2021. [Online]. Available: *https://www.railstotrails.org/resource-library/resources/new-power-generation-trails-and-utilities-in-wisconsin-across-the-us/*.

75 Colorado General Assembly, "HB22-1104: Powerline Trails," 2022. [Online]. Available: *https://leg.colorado.gov/bills/hb22-1104*.

76 Morongo Band of Mission Indians, "Morongo Becomes First Native American Tribe to be Approved as a Participating Transmission Owner in Nation," 2021. [Online]. Available: *https://morongonation.org/news/morongo-becomes-first-native-american-tribe-to-be-approved-as-a-participating-transmission-owner-in-nation/*.

5.0 COMMON QUESTIONS ABOUT TRANSMISSION INFRASTRUCTURE

This section provides a set of common questions about transmission infrastructure and brief answers.

Q: What do transmission lines do?

A: Transmission lines transport electricity across large distances, connecting remote generators and local electric distribution grids. Transporting electricity across such large distances requires the electricity to be stepped up to a very high voltage to reduce losses. For this reason, transmission towers must be larger, creating greater space between the lines and the ground for safety.

Q: What do transmission lines sound like?

A: While transmission lines typically make very little noise, transporting electricity through conducting wire creates an electric field around the transmission line. If this field becomes strong enough and there is sufficient moisture in the air, an electric discharge can ionize the surrounding air, which can sound like a humming or crackling noise.[77]

Q: Can you park a car or truck under a transmission line?

A: The National Electric Safety Code establishes the required clearance height of transmission lines based on the voltage they carry. This height factors in line sagging due to heavy loading, high winds, ice, and high heat. These design considerations ensure the safety of those nearby or beneath transmission lines. However, there is a possibility that the electric field around the transmission lines can induce a voltage on the metal frame of a vehicle if parked on a nonconductive surface like dry rock, especially in humid weather.[78] If this happens, you can receive an electric shock when you touch the vehicle; this is referred to as a nuisance shock,[79] which is comparable in sensation to household static electricity. However, the rubber tires of the vehicle are usually enough to prevent an induced voltage.

Q: Can you climb a transmission tower?

A: First, it is illegal to climb transmission towers in many states. Second, it is highly dangerous, as these towers are designed to separate the high-voltage electricity they transport from you and the surrounding infrastructure. Workers that must climb towers to perform maintenance do so with an abundance of both climbing and electrical training and use appropriate safety gear.

Q: Who owns transmission lines?

A: Transmission infrastructure is most commonly owned by the electric utilities that deliver electricity within that region. Transmission lines can also be owned by developers who charge load-serving entities to use their lines. A third option, transmission infrastructure can be owned by independent transmission companies that connect more than one utility service territory.[80]

77 ATCO Electric, "Will you hear the transmission line?," [Online]. Available: *https://electric.atco.com/content/dam/web/projects/projects-overview/noise-and-transmission-lines.pdf*.

78 Bonneville Power Administration, "Living and Working Safely around High-Voltage Power Lines," BPA, 1998.

79 Western Area Power Administration, "Living and Working Around High-Voltage Power Lines." WAPA, 2021.

80 M. Robertson and K. Palmer, "Transmission 102: Building New Transmission Lines," Resources for the Future, 2023.

Q: How big are transmission towers?

A: Transmission towers range in height from roughly 50 ft to 200 ft tall.[81] The difference in height depends on the voltage of the electricity being transported and the design of the tower to ensure a minimum safe distance between the wires and the ground.

Q: Are transmission lines bad for your health?

A: Transmission lines produce both electromagnetic fields (EMF) and electromagnetic radiation (EMR), the strength of which decreases with distance from the lines. By the time these reach the ground, their strength is relatively minimal and generally considered low risk.[82] Many studies have been conducted to determine whether long-term exposure[83] to EMF and EMR from power lines pose any health risks, however, consensus has not yet been reached. Presently, no study has identified a biological mechanism or response to EMF in order to directly measure any potential human health impacts.

81 Aspen Environmental Group, "Transmission Structures," Aspen, 2014.

82 U.S. Environmental Protection Agency, "Electric and Magnetic Fields from Power Lines," 2023.

83 Most studies define long-term exposure as living beneath or nearby power lines.

GLOSSARY

Adequacy: the ability of the electric system to supply the electrical demand and energy requirements of customers, at all times, taking into account both scheduled and unscheduled outages of power lines and plants.

Alternating Current (AC): electric current with frequency that varies, or alternates, between high and low frequencies as time passes. The U.S. electric grid operates primarily using AC current as its voltage can be changed by passing through electric transformers.

Cage: the area of the transmission tower that is located in between the peak and the tower body. The cage of the transmission tower holds the cross arms.

Circuit: a complete path for electric current to flow. A circuit contains a current source, conductors, and a load.

Conductor: the current-carrying wires that transfer, or conduct, the flow of electricity.

Cross arm: hold the transmission conductor and are located on the cage. The size of the cross arms varies based on several factors, such as the transmission voltage and the configuration of the tower.

Decarbonization: the process of removing or eliminating carbon-polluting, or carbon dioxide emitting generators and processes from all sectors of our economy, including the electric, industrial, and transportation sectors.

Direct Current (DC): electric current with frequency that remains constant in time.

Distribution: the portion of an electric grid that delivers electric energy from the substation to the customer.

Easement: a legal agreement that outlines the agreement between a utility and a landowner in which the utility acquires the rights to utilize the owner's land to build and maintain a transmission line.

Electrification: the process of converting or replacing systems that rely on non-electric fuel sources, such as natural gas or fuel oil, to electrically powered systems.

Electric Demand/Load: the rate of electricity consumption. Electric demand tends to refer more generally to electric consumption, whereas electric load is often specific to one device. The terms are often used interchangeably.

Energy: the amount of electricity being measured, in watt-hours (Wh). Utility bills typically report energy consumption in kWh, or kilowatt hours, which are 1000 Wh.

Flexibility: allows power requirements to be met by a diverse set of generation sources, located most appropriately based on generator requirements.

Frequency: the rate of change of alternating current, measured in Hertz (Hz), which is 1/s . The frequency at which the U.S. electric grid transmits electricity is 60 Hz, standardized to protect electrical equipment throughout the grid.

Generation: the conversion of energy into electricity. Different generators convert different types of energy, such as turbines that can convert kinetic energy (motion) into electricity by rotating a magnet surrounded by copper coils to induce an electric current, or photovoltaic generators (photovoltaic panels), that convert the energy from photons of light striking solar cells into electricity by way of the photovoltaic effect.

Insulator: devices made of poorly conducting, or electrically insulating material that connect transmission conductors to transmission towers to keep the electric current passing through the conductors from discharging through the tower.

Integrated Vegetation Management (IVM): a strategy for managing the vegetation surrounding transmission infrastructure that integrates both safety and reliability goals with habitat preservation, wildfire mitigation, and environmental stewardship.

Interconnection: the legal agreement governing the physical connection of a generation resource to the electric grid. An interconnection agreement is required before energizing a system capable of exporting electricity onto the grid and details the system requirements and export limits of the connecting resource.

Peak: the area of the tower located above the top cross arm. The ground wire that protects the tower from lightning strikes is connected to the peak.

Pin-type insulator: has a pin that is secured to the cross arm of the tower. A soft metal thimble separates the porcelain (insulating material) and the hard metal pin so there isn't any direct contact. Generally used for voltages up to 33 kV.

Post-type insulator: similar to a pin type insulator but has a metal base and a metal cap to allow for more than one unit to be mounted in series. The insulating material is shaped in the form of cones that fit inside one another. Used for supporting bus bars and disconnecting switches in the substations.

Power: a measure of the change in energy over time, in watts (W). Large generators or collections of generators might measure their power output in megawatts (MW) or gigawatts (GW), which are 106 W and 109 W, respectively.

Reliability: the ability to withstand grid disturbances such as instability, uncontrolled or unscheduled events, cascading failures, or loss of system components. Transmission connects users to a diverse set of power plants, with a certain degree of built-in redundancy to ensure uninterrupted electricity service.

Right-of-way: a type of easement granted to a utility or transmission owner that grants the right to use and access the land directly below a transmission line according to the terms of the easement.

Sag: high current load, temperatures, or wind can cause transmission lines to droop down lower than they would under "normal" operating conditions. Transmission lines are designed to sag to accommodate such circumstances while still remaining a safe distance from nearby vegetation or structures.

Security: the ability of the electric grid to withstand sudden disturbances, such as electric short circuits or unanticipated loss of system facilities.

Substation: substations connect the transmission system to the distribution system and contain a series of transformers and electrical protection equipment designed to step down the high-voltage electricity delivered by the transmission system to safer, lower voltages to be distributed to end use customers.

Suspension-type insulator: used for lines above 33 kV due to how expensive pin insulators are at higher voltages. Has a disc-shaped insulating material with a metal cap on top and a metal pin on the bottom. Also known as disc or string insulators.

Tower Body: this includes the section of the tower that starts at ground level and goes up to the bottom cross arms. The size of the tower body plays a key role in ensuring the transmission tower has the required ground clearance for the conductors.

Transformer: an electric device that allows the voltage of alternating current to be stepped up or down to higher or lower voltages. Stepping up to higher voltages allows transmission of electricity over greater distances with reduced electrical losses. Stepping down to lower

voltages allows safe distribution of electricity to customers.

Transmission: an interconnected group of lines and associated equipment for the movement or transfer of electric energy between points of supply and points at which it is transformed for delivery to customers or is delivered to other electric grids.

Transmission Corridor: strips of land designated for certain uses, such as by telecommunication, electric, and gas utilities, or for transportation highways and railways.

Voltage: the force that pushes electric current through a conductor, measured in volts. High-voltage transmission lines tend to be on the order of kV, or 1000s of volts.

APPENDIX

Alabama - Alabama Public Service Commission
AL Code § 11-50A-25 (2023) The public service commission shall prescribe minimum standards regarding the placement and construction of transmission lines, substations, and related facilities used in the transmission of electricity that are owned and operated by the authority. No plant, property, or facility for the production, transmission, delivery, or furnishing of electricity shall be constructed by the authority if such facility is to be owned exclusively by the authority until the issuance by the public service commission of a certificate of convenience and necessity pursuant to Section 37-4-28. AL Code § 37-4-150 (2023) (2) ELECTRIC TRANSMISSION FACILITY: Any transmission line, substation, equipment, or other facility at a design voltage greater than 35,000 volts.
Alaska - Regulatory Commission of Alaska
Alaska Stat. § 42.05.990 (4) "public utility" or "utility" includes every corporation whether public, cooperative, or otherwise, company, individual, or association of individuals, their lessees, trustees, or receivers appointed by a court, that owns, operates, manages, or controls any plant, pipeline, or system for (A) furnishing, by generation, transmission, or distribution, electrical service to the public for compensation; [...] Alaska – Stat. Ann. §§ 42.05.221 et seq. (a) A public utility may not operate and receive compensation for providing a commodity or service without first having obtained from the commission under this chapter a certificate declaring that public convenience and necessity require or will require the service. Where a public utility provides more than one type of utility service, a separate certificate of convenience and necessity is required for each type. A certificate must describe the nature and extent of the authority granted in it, including, as appropriate for the services involved, a description of the authorized area and scope of operations of the public utility.
Arizona - Arizona Corporation Commission - Arizona Power Plant and Transmission Line Siting Committee
ARS 40-360(10) 10. "Transmission line" means five or more new structures that span more than one mile in length as measured from the first structure outside of the substation, switchyard or generating site to which the line connects to the fifth structure and that are erected above ground and support one or more conductors designed for the transmission of electric energy at nominal voltages of one hundred fifteen thousand volts or more... 40-360.03. A. Except as provided in subsection B of this section, every utility that plans to construct a plant or transmission line, or both, in this state shall first file with the commission an application for a certificate of environmental compatibility.
Arkansas - Arkansas Public Service Commission
AR Code § 23-18-503 (2023) (6) "Major utility facility" means: [...] (B) For the sole purpose of requiring an environmental impact statement under this subchapter, an electric transmission line and associated facilities including substations of: (i) A design voltage of one hundred kilovolts (100 kV) or more and extending a distance of more than ten (10) miles; or (ii) A design voltage of one hundred seventy kilovolts (170 kV) or more and extending a distance of more than one (1) mile; or AR Code § 23-3-201 (2023) (a) New construction or operation of equipment or facilities for supplying a public service or the extension of a public service shall not be undertaken without first obtaining from the Arkansas Public Service Commission a certificate that public convenience and necessity require or will require the construction or operation.
California - California Public Utilities Commission

Cal. Pub. Util. Code § 1091.

1091. In addition to the requirements of Article 1 (commencing with Section 1001) and any other provision of law, every electrical and every gas corporation proposing to construct or modify any electric or gas plant within the state, or line, or extension, which will in the case of an electrical plant, line, or extension add generating capacity in excess of 50 megawatts, or in the case of a gas plant, line, or extension cost in excess of fifty million dollars ($50,000,000), or proposing to construct any electric or gas plant out-of-state of which at least twenty-five percent (25%) of the costs will be borne by the corporation, shall comply with this article.

From the website:

Projects between 50 kV and 200kV require a Permit to Construct from the CPUC, which consists primarily of an environmental review pursuant to CEQA. The Commission process generally does not analyze the need for or economics of these projects.

Projects over 200kV require a Certificate of Public Convenience and Necessity (CPCN) from the Commission. The Commission's CPCN process analyzes the need for the project and the economics of the project as well as the environmental impacts of the project.

Colorado - Colorado Public Utilities Commission

4 CCR 723-3

3001. Definitions. [...] (ll) "Transmission facilities" are those lines and related substations designed and operating at voltage levels above the utility's voltages for distribution facilities , including but not limited to related substation facilities such as transformers, capacitor banks, or breakers that are integral to the circuitry of the utility's transmission system.

3206. Construction or Extension of Transmission Facilities.

(a) No utility and no cooperative electric association which has voted to exempt itself pursuant to §40-9.5-103, C.R.S., may commence new construction, or extension of transmission facilities or projects until either the Commission notifies the utility that such facilities or projects do not require a certificate of public convenience and necessity or the Commission issues a certificate of public convenience and necessity. Rural electric cooperatives which have elected to exempt themselves from the Public Utilities Law pursuant to §40-9.5-103, C.R.S., do not need a certificate of public convenience and necessity for new construction or extension of transmission facilities or projects when such construction or expansion is contained entirely within the cooperative's certificated area.

(b) CPCN requirements for new transmission facilities. New transmission facilities that require a CPCN pursuant to this paragraph are not in the ordinary course of business. However, any utility may request a CPCN for any new transmission facility that does not require a CPCN under this paragraph. All utilities and electric cooperative associations subject to paragraph (a) of this rule shall be required to file a CPCN application for all new transmission facilities that meet one of the following criteria:

(I) Transmission facilities designed at 230 kV or above, even if initially operated at a lower voltage. However, a radial transmission line designed at 230 kV or above that serves a single retail customer and terminates at that customer's premises will not require a CPCN application.

(II) Transmission facilities designed at 115 kV or 138 kV, if:

(A) The facilities do not meet the noise and magnetic field thresholds in paragraphs (e) and (f) of this rule; or

(B) The Commission determines that the facilities are not in the ordinary course of business.

Connecticut - Connecticut Department of Energy and Environmental Protection - Connecticut Siting Council

C.G.S. §16-50i(a).

Sec. 16-50i. Definitions. As used in this chapter:

(a) "Facility" means: (1) An electric transmission line of a design capacity of sixty-nine kilovolts or more, including associated equipment but not including a transmission line tap, as defined in subsection (e) of this section;

C.G.S. §16-50k.

Sec. 16-50k. Certificate of environmental compatibility and public need. Transfer. Amendment. Excepted matters. Waiver. (a) Except as provided in subsection (b) of section 16-50z, no person shall exercise any right of eminent domain in contemplation of, commence the preparation of the site for, commence the construction or supplying of a facility, or commence any modification of a facility, that may, as determined by the council, have a substantial adverse environmental effect in the state without having first obtained a certificate of environmental compatibility and public need, hereinafter referred to as a "certificate", issued with respect to such facility or modification by the council.

Delaware - Delaware Public Service Commission

§ 203E. Certificate of public convenience and necessity for new electric transmission utilities.

(a) Except as provided in § 203A(a)(3) of this title, no person or entity shall begin the business of an electric transmission utility providing transmission facilities, as defined in § 1001(26) of this title, without having first obtained from the Commission a certificate that the present or future public convenience and necessity requires, or will be served by, the operation of such business.

(b) A person or entity seeking to begin the business of an electric transmission utility in this State shall first make application to the Commission for a certificate of public convenience and necessity approving the person or entity as an electric transmission utility authorized to provide transmission facilities.

§ 1001. Definitions.

As used in this chapter, unless the context otherwise requires: [...] (9) "Distribution facilities" means electric facilities located in Delaware that are owned by a public utility that operate at voltages of 34,500 volts or below and that are used to deliver electricity to customers, up through and including the point of physical connection with electric facilities owned by the customer.

District of Columbia - Public Service Commission of the District of Columbia

2100 APPLICABILITY

2100.1 This Chapter shall govern the construction of electric generating facilities, overhead transmission lines designed to carry sixty-nine thousand (69,000) volts or more, underground transmission lines in excess of sixty-nine thousand (69,000) volts as well as any substations connected to such lines

2100.2 No person shall construct an electric generating facility in the District of Columbia for the purpose of selling electricity unless the Commission first determines, after notice and a hearing that the construction of the facility is in the public interest. Nor shall any person construct an overhead transmission line designed to carry sixty-nine thousand (69,000) volts or greater, or substation connected to such line, unless the project has been approved in accordance with this Chapter. Unless specifically required by law or other provision of this Chapter, Commission approval shall not be required for the routine repair and replacement activities necessary to maintain an electric generating facility or transmission line.

Florida - Florida Department of Environmental Protection

The Transmission Line Siting Act (TLSA), Sections 403.52-.5365, Florida Statutes (F.S.), is the state's centralized process for licensing electrical transmission lines that: Are 230 kilovolts (kV) or larger; Cross a county line; and, Are 15 miles or longer.

An applicant can request to use the act for a line less than 15 miles long or if within one county.

If a line is to be constructed entirely within certain rights-of-way, the TLSA may not apply; however, this does not relieve the utility from the obligation to obtain the necessary individual permits and approvals. This exemption is date-dependent if it is for a transmission line as defined in the TLSA. See Section 403.524(2)(c), F.S.

Georgia - No consolidated authority

O.C.G.A. 22-3 grants the right of eminent domain and condemnation for siting of transmission lines to electric utilities in Georgia

GA Code § 22-3-161 (2023)

(a) On and after July 1, 2004, before exercising the right of eminent domain for purposes of constructing or expanding an electric transmission line described in subsection (a) of Code Section 22-3-160.1, the utility shall select a practical and feasible route for the location of the electric transmission line. In selecting the route for the location of the electric transmission line, the utility shall consider existing land uses in the geographic area where the line is to be located, existing corridors, existing environmental conditions in the area, engineering practices related to the construction and operation of the line, and costs related to the construction, operation, and maintenance of the line.

(b) After the utility has selected the preferred route for the location of an electric transmission line, the utility shall attempt in good faith to negotiate a settlement with each property owner from whom the utility needs to acquire property rights for the line. In connection with the negotiations, the utility shall provide the property owner with a written offer to purchase the property rights, a document that describes the property rights, and a drawing that shows the location of the line on the owner's property.

Hawaii - Hawaii Public Utilities Commission

HI Rev Stat § 269-1 (2023)

"Public utility":

(1) Includes every person who may own, control, operate, or manage [...] any plant or equipment, or any part thereof [...] for the production, conveyance, transmission, delivery, or furnishing of light, power, heat, cold, water, gas, or oil [...].

§269-7.5 Certificates of public convenience and necessity. (a) No public utility, as defined in section 269-1, shall commence its business without first having obtained from the commission a certificate of public convenience and necessity.

§269-27.5 Construction of high-voltage electric transmission lines; hearing. Whenever a public utility plans to place, construct, erect, or otherwise build a new 46 kilovolt or greater high-voltage electric transmission system above the surface of the ground through any residential area, the public utilities commission shall conduct a public hearing prior to its issuance of approval thereof. Notice of the hearing shall be given in the manner provided in section 269-16 for notice of public hearings.

Idaho - Idaho Public Utilities Commission

ID Code § 61-118 (2023)

ELECTRIC PLANT. The term "electric plant" when used in this act includes all real estate, fixtures and personal property owned, controlled, operated or managed in connection with or to facilitate the production, generation, transmission, delivery or furnishing of electricity for light, heat or power, and all conduits, ducts or other devices, materials, apparatus or property for containing, holding or carrying conductors used or to be used for the transmission of electricity for light, heat or power.

ID Code § 61-516 (2023)

(a) "Electric transmission facilities" means the construction of high voltage transmission lines with an operating level capacity of two hundred thirty thousand (230,000) volts or more and associated substations and switchyards.

ID Code § 61-526 (2023)

61-526. CERTIFICATE OF CONVENIENCE AND NECESSITY. No street railroad corporation, gas corporation, electrical corporation, telephone corporation or water corporation, shall henceforth begin the construction of a street railroad, or of a line, plant, or system or of any extension of such street railroad, or line, plant, or system, without having first obtained from the commission a certificate that the present or future public convenience and necessity require or will require such construction

Illinois - Illinois Commerce Commission

220 ILCS 5/3-105) (from Ch. 111 2/3, par. 3-105)

Sec. 3-105. Public utility.

(a) "Public utility" means and includes, [...] (1) the production, storage, transmission, sale, delivery or furnishing of heat, cold, power, electricity, water, or light, except when used solely for communications purposes;

(220 ILCS 5/8-406) (from Ch. 111 2/3, par. 8-406)

Sec. 8-406. Certificate of public convenience and necessity.

(a) No public utility not owning any city or village franchise nor engaged in performing any public service or in furnishing any product or commodity within this State as of July 1, 1921 and not possessing a certificate of public convenience and necessity from the Illinois Commerce Commission, the State Public Utilities Commission, or the Public Utilities Commission, at the time Public Act 84-617 goes into effect (January 1, 1986), shall transact any business in this State until it shall have obtained a certificate from the Commission that public convenience and necessity require the transaction of such business. A certificate of public convenience and necessity requiring the transaction of public utility business in any area of this State shall include authorization to the public utility receiving the certificate of public convenience and necessity to construct such plant, equipment, property, or facility as is provided for under the terms and conditions of its tariff and as is necessary to provide utility service and carry out the transaction of public utility business by the public utility in the designated area.

[...] For purposes of this Section and Section 8-406.1 of this Act, "high voltage electric service line" means an electric line having a design voltage of 100,000 or more.

Indiana - No consolidated authority

IC 8-1-38-1 “Electric transmission facility”

Sec. 1. (a) As used in this chapter, “electric transmission facility” means a high voltage transmission line with a rating of at least one hundred (100) kilovolts and related transmission facilities and controls.

IC 8-1-38-9 Construction, ownership, operation, maintenance, and upgrade of electric transmission facilities; right of first refusal

Sec. 9. (a) An incumbent electric transmission owner has the right to construct, own, operate, and maintain the following:

(1) An electric transmission facility that has been approved for construction through a regional transmission organization planning process and that connects to an electric transmission facility owned by the incumbent electric transmission owner.

(2) Upgrades to an existing electric transmission facility owned by the incumbent electric transmission owner if the upgrades have been approved for construction through a regional transmission organization planning process.

Iowa - Iowa Utilities Board

Iowa – Iowa Code §§ 478 et seq., Electric Transmission Lines.

478.1 Franchise.

1. A person shall not construct, erect, maintain, or operate a transmission line, wire, or cable that is capable of operating at an electric voltage of sixty-nine kilovolts or more along, over, or across any public highway or grounds outside of cities for the transmission, distribution, or sale of electric current without first procuring from the utilities board a franchise granting authority as provided in this chapter 478.16 Electric transmission lines — federally registered planning authority transmission plans.

1. As used in this section, unless the context otherwise requires:

a. “Electric transmission line” means a high-voltage electric transmission line with a capacity of one hundred kilovolts or more and any associated electric transmission facility, including any substation or other equipment.

478.18 Supervision of construction — location.

1. The utilities board shall have power of supervision over the construction of a transmission line and over its future operation and maintenance.

Kansas - Kansas Corporation Commission

66-1,177. Electric transmission lines; definitions. As used in this act, the following terms shall have the meanings ascribed to them herein:

(a) “Electric utility” means every public utility, as defined by K.S.A. 66-104, which owns, controls, operates or manages any equipment, plant or generating machinery for the production, transmission, delivery or furnishing, of electricity or electric power;

(b) “Electric transmission lines” means any line or extension of a line which is at least five (5) miles in length and which is used for the bulk transfer of two hundred thirty (230) kilovolts or more of electricity

66-1,178. Same; siting of electric transmission lines; permit required; application, contents; hearings. (a) No electric utility may begin site preparation for or construction of an electric transmission line, or exercise the right of eminent domain to acquire any interest in land in connection with the site preparation for a construction of any such line without first acquiring a siting permit from the commission.

Kentucky - Public Service Commission of Kentucky - Electric Generation and Transmission Siting Board

KY. Rev. Stat. Ann. §§ 278

278.700 Definitions for KRS 278.700 to 278.716.

As used in KRS 278.700 to 278.716, unless the context requires otherwise: [...]

(5) “Nonregulated electric transmission line” means an electric transmission line and related appurtenances for which no certificate of public convenience and necessity is required; which is not operated as an activity regulated by the Public Service Commission; and which is capable of operating at or above sixty-nine thousand (69,000) volts; 278.714 Application for certificate to construct nonregulated electric transmission line or carbon dioxide transmission pipeline -- Granting or denial -- Public hearing -- Local public information meeting -- Fee.

(1) No person shall commence to construct a nonregulated electric transmission line or a carbon dioxide transmission pipeline without a construction certificate issued by the board.

Louisiana - Louisiana Public Service Commission

I. APPLICABILITY: [...] site selection, right-of-way acquisition activities, expropriation proceedings or vegetation clearing, [...] may be performed prior to submitting an Application or receiving certification.

II. DEFINITIONS:

a. Transmission Facility: For the purposes of this General Order only, the term

"Transmission Facility" shall be defined to include a system of structures, wires, insulators and associated hardware, but not including switching or substations, that carry electric energy over distances and that are located in whole or in part within the State of Louisiana, regardless of whether the line provides electric service to customers within the state, and that would be constructed and operated at or above a nominal 100 kV, exceeds one mile in length, and the estimated cost to construct exceeds $20 million. [...]

Maine - Maine Public Utilities Commission

§3131. Definitions

As used in this subchapter, unless the context indicates otherwise, the following terms have the following meanings.

[...] 5. Transmission capacity. "Transmission capacity" means an entitlement to transmission services over a transmission line with a capacity greater than 100 kilovolts for periods greater than 3 years.

§3132. Construction of transmission lines prohibited without prior order of the commission

Except as provided in subsection 1-B, a person may not construct any transmission line covered by subsection 2 or rebuild or relocate any transmission line as investigated by the commission under subsection 3 unless the commission has issued a certificate of public convenience and necessity approving construction.

§3132-A. Construction of transmission or subtransmission projects prohibited without approval of the commission

A person may not construct any transmission project or subtransmission project without approval from the commission. For the purposes of this section, "transmission project" means any proposed new or upgraded transmission substation infrastructure that is capable of operating at 69 kilovolts or more. "Subtransmission project" means any proposed new or upgraded transmission line, substation component or associated infrastructure that is capable of operating at less than 69 kilovolts and projected to cost in excess of $5,000,000.

Maryland - Maryland Public Service Commission

(3) (i) Except as provided in paragraph (4) of this subsection, unless a certificate of public convenience and necessity for the construction is first obtained from the Commission, a person may not begin construction of an overhead transmission line that is designed to carry a voltage in excess of 69,000 volts or exercise a right of condemnation with the construction.

[...] 2. On issuance of a certificate of public convenience and necessity for the construction of an overhead transmission line, a person may acquire by condemnation, in accordance with Title 12 of the Real Property Article, any property or right necessary for the construction or maintenance of the transmission line.

Massachusetts - Massachusetts Department of Telecommunications and Energy - Energy Facilities Siting Board

Section 69G. As used in section sixty-nine H to sixty-nine R, inclusive, the following words and terms shall have the following meanings:— [...]

''Facility'', (1) a generating facility; (2) a new electric transmission line having a design rating of 69 kilovolts or more and which is one mile or more in length on a new transmission corridor; (3) a new electric transmission line having a design rating of 115 kilovolts or more which is 10 miles or more in length on an existing transmission corridor except reconductoring or rebuilding of transmission lines at the same voltage; (4) an ancillary structure which is an integral part of the operation of any transmission line which is a facility;

Section 69J. No applicant shall commence construction of a facility at a site unless a petition for approval of construction of that facility has been approved by the board and, in the case of an electric or gas company which is required to file a long-range forecast pursuant to section sixty-nine I, that facility is consistent with the most recently approved long-range forecast for that company. In addition, no state agency shall issue a construction permit for any such facility unless the petition to construct such facility has been approved by the board and the facility conforms with any such long-range forecast.

Section 69K. Any electric, gas or oil company which proposes to construct or operate facilities in the commonwealth may petition the board for a certificate of environmental impact and public interest with respect to such facility.

Michigan - Michigan Public Service Commission

460.562 Definitions.

Sec. 2.

(g) “Major transmission line” means a transmission line of 5 miles or more in length wholly or partially owned by an electric utility, affiliated transmission company, or independent transmission company through which electricity is transferred at system bulk supply voltage of 345 kilovolts or more.

(k) “Transmission line” means all structures, equipment, and real property necessary to transfer electricity at system bulk supply voltage of 100 kilovolts or more.

460.565 Transmission line; certificate required.

Sec. 5.

An electric utility, affiliated transmission company, or independent transmission company shall not begin construction of a major transmission line for which a plan has been submitted under section 4 until the commission issues a certificate for that transmission line. Except as otherwise provided in section 9, a certificate of public convenience and necessity under this act is not required for constructing a new transmission line other than a major transmission line or for reconstructing, repairing, replacing, or improving an existing transmission line, including the addition of circuits to an existing transmission line.

Minnesota - Minnesota Public Utilities Commission

216B.02 DEFINITIONS.

§Subdivision 1.Scope. For the purposes of this chapter, the terms defined in this section have the meanings given them.

[...] Subd. 4.Public utility. “Public utility” means persons, corporations, or other legal entities, their lessees, trustees, and receivers, now or hereafter operating, maintaining, or controlling in this state equipment or facilities for furnishing at retail natural, manufactured, or mixed gas or electric service to or for the public or engaged in the production and retail sale thereof...

216B.24 CONSTRUCTION OF MAJOR FACILITY; FILING PLANS.

Subdivision 1.Major utility facility defined. The words “major utility facility” means: [...] (2) an electric transmission line and associated facilities of a design capacity of 125 kilovolts or more; [...] ; provided, however, that the words “major utility facility” shall not include electric or gas distribution lines and gas gathering lines and associated facilities as defined by the commission.

Subd. 2.Construction plan filed; rules. Under rules as the commission may prescribe, every public utility shall file with the commission, within the time and in the form as the commission may designate, plans showing any contemplated construction of major utility facilities.

Subd. 3.Applicability to municipalities. The provisions of this section shall apply to the construction of major utility facilities by a municipally owned gas or electric utility.

216B.243 CERTIFICATE OF NEED FOR LARGE ENERGY FACILITY.

Subd. 2.Certificate required. No large energy facility shall be sited or constructed in Minnesota without the issuance of a certificate of need by the commission pursuant to sections 216C.05 to 216C.30 and this section and consistent with the criteria for assessment of need.

216B.2421 DEFINITION OF LARGE ENERGY FACILITY.

Subd. 2.Large energy facility. “Large energy facility” means:

(1) any electric power generating plant or combination of plants at a single site with a combined capacity of 50,000 kilowatts or more and transmission lines directly associated with the plant that are necessary to interconnect the plant to the transmission system;

(2) any high-voltage transmission line with a capacity of 300 kilovolts or more and greater than one mile in length in Minnesota;

(3) any high-voltage transmission line with a capacity of 100 kilovolts or more with more than ten miles of its length in Minnesota;

Mississippi - Mississippi Public Service Commission

§ 77-3-3. Definitions.

[...] (d) The term "public utility" includes persons and corporations, or their lessees, trustees and receivers now or hereafter owning or operating in this state equipment or facilities for:

(i) The generation, manufacture, transmission, distribution, provision, or furnishing of electricity to or for the public, whether an individual person or an entity or a collection of persons or entities, for compensation;...

§ 77-3-14. Certificate of public convenience and necessity required for construction of electrical generating and transmitting facilities; commission to maintain analysis of electricity needs in state.

(1) Notwithstanding the provisions of Section 77-3-11, Mississippi Code of 1972, and Section 77-3-13, Mississippi Code of 1972, no public utility or other person shall begin the construction of any facility for the generation and transmission of electricity to be directly or indirectly used for the furnishing of public utility service in this state, even though the facility be for furnishing the service already being rendered, without first obtaining from the commission a certificate that the public convenience and necessity requires, or will require, such construction.

Missouri - Missouri Public Service Commission

386.020. Definitions. — As used in this chapter, the following words and phrases mean:

[...] (14) "Electric plant" includes all real estate, fixtures and personal property operated, controlled, owned, used or to be used for or in connection with or to facilitate the generation, transmission, distribution, sale or furnishing of electricity for light, heat or power; and any conduits, ducts or other devices, materials, apparatus or property for containing, holding or carrying conductors used or to be used for the transmission of electricity for light, heat or power;

393.170. Approval of incorporation and franchises — certificate. — 1. No gas corporation, electrical corporation, water corporation or sewer corporation shall begin construction of a gas plant, electric plant, water system or sewer system, other than an energy generation unit that has a capacity of one megawatt or less, without first having obtained the permission and approval of the commission.

Montana - Montana Department of Environmental Quality

75-20-104. Definitions. In this chapter, unless the context requires otherwise, the following definitions apply:

[...] (10) "Facility" means:

(a) each electric transmission line and associated facilities of a design capacity of more than 69 kilovolts [...]

75-20-201. Certificate required -- operation in conformance -- certificate for nuclear facility -- applicability to federal facilities. (1) Except for a facility under diligent onsite physical construction or in operation on January 1, 1973, a person may not commence to construct a facility in the state without first applying for and obtaining a certificate of compliance issued with respect to the facility by the department.

Nebraska - Nebraska Public Service Commission - Nebraska Power Review Board

N.R.S. 75-710.

Electric line; construction or voltage increase; application required, when.

If the voltage of any electric line described in section 75-709 will exceed fifteen thousand volts and such line will be within one-quarter mile of any existing electrical or communication line of any other person or signal line of any railroad or if the voltage of such electric line will exceed seven hundred volts and such line will be within five hundred feet of the electrical or communication line of any other person or signal line of any railroad, application to construct the line shall be made to the commission, except that no application shall be required for any line which will not exceed fifteen thousand volts, which will not exceed six hundred sixty feet in length, and which will be more than seventy-five feet from any existing electrical or communication line of any other person or signal line of any railroad.

70-1012. Electric generation facilities and transmission lines; construction or acquisition; application; approval; when not required.
(1) Before any electric generation facilities or any transmission lines or related facilities carrying more than seven hundred volts are constructed or acquired by any supplier, an application, filed with the board and containing such information as the board shall prescribe, shall be approved by the [Nebraska Power Review Board]

N.A.C. TITLE 291 - NEBRASKA PUBLIC SERVICE COMMISSION - CHAPTER 7 - TRANSMISSION LINES RULES AND REGULATIONS

002 TRANSMISSION LINES CARRYING A VOLTAGE IN EXCESS OF 700 VOLTS.

002.01 AUTHORITY TO CONSTRUCT. No person or company shall construct, or cause to be constructed, any line for the transmission of electric current in excess of fifteen thousand (15,000) volts, if the proposed line is within onequarter (.25) mile of any existing electrical or communication line of any person or corporation, or signal line of anyrailroad, without filing an application with the Commission and having same granted, unless allowed under Section002.06C of this chapter

Nevada - Public Utilities Commission of Nevada
NRS 704.187 Use of deferred accounting by certain electric utilities; procedure; limitations. [...] (c) "Electric utility" means any public utility or successor in interest that: (1) Is in the business of providing electric service to customers; NRS 704.79875 "High-voltage transmission infrastructure" defined. "High-voltage transmission infrastructure" means bulk transmission lines capable of transmitting electricity at a voltage of 345 kilovolts or more, and associated electrical substations and substation expansions to accommodate the transmission lines. NRS 704.330 Public utility to obtain certificate of public convenience and necessity; exceptions; terms and conditions; orders to cease and desist; duplication of service; boundaries of certain service areas. 1. Except as otherwise provided in this section, any person owning, controlling, operating or maintaining or having any contemplation of owning, controlling or operating any public utility shall, before beginning such operation or continuing operations or construction of any line, plant or system or any extension of a line, plant or system within this State, obtain from the Commission a certificate that the present or future public convenience or necessity requires or will require such continued operation or commencement of operations or construction. NRS 704.860 "Utility facility" defined. "Utility facility" means: [...] 2. Electric transmission lines and transmission substations that: (a) Are designed to operate at 200 kilovolts or more; (b) Are not required by local ordinance to be placed underground; and (c) Are constructed outside any incorporated city. NRS 704.865 Permit required to construct utility facility; transfer of permit; exemptions; waiver of exemption. 1. A person, other than a local government, shall not commence to construct a utility facility in the State without first having obtained a permit therefor from the Commission. The replacement of an existing facility with a like facility, as determined by the Commission, does not constitute construction of a utility facility. NRS 704.873 Commission has exclusive jurisdiction to determine need for utility facilities of certain public utilities; other permitting entities precluded from considering need. If a public utility that is subject to the provisions of NRS 704.736 to 704.754, inclusive, applies to the Commission for a permit for the construction of a utility facility: 1. The Commission has exclusive jurisdiction with regard to the determination of whether a need exists for the utility facility; and 2. No other permitting entity may consider, in its review of any application for a permit, license or other approval for the construction of the utility facility, whether a need exists for the utility facility.
New Hampshire - New Hampshire Site Evaluation Committee
162-H:2 Definitions. – [...] II. "Certificate" or "certificate of site and facility" means the document issued by the committee, containing such terms and conditions as the committee deems appropriate, that authorizes the applicant to proceed with the proposed site and facility. [...] VII. "Energy facility" means: [...] (c) An electric transmission line of design rating of 100 kilovolts or more, associated with a generating facility under subparagraph (b), over a route not already occupied by a transmission line or lines. (d) An electric transmission line of a design rating in excess of 100 kilovolts that is in excess of 10 miles in length, over a route not already occupied by a transmission line. (e) A new electric transmission line of design rating in excess of 200 kilovolts. 162-H:5 Prohibitions and Restrictions. – I. No person shall commence to construct any energy facility within the state unless it has obtained a certificate pursuant to this chapter. Such facilities shall be constructed, operated and maintained in accordance with the terms of the certificate. Such certificates are required for sizeable changes or additions to existing facilities. Such a certificate shall not be transferred or assigned without approval of the committee.
New Jersey - New Jersey Board of Public Utilities

N.J. Admin. Code § 14:5-1.2

"Distribution line" means a primary electric voltage line, wire, or cable operating at greater than 600 volts, including supporting structures and appurtenant facilities that would not be considered a transmission line.

"Transmission line" means an electrical line, wire, or cable, (including the supporting structures) and appurtenant facilities that transmits electricity from a generating plant to electric substations or switching stations. An electric transmission line usually has a rating exceeding 69 kilovolts.

New Mexico - New Mexico Public Regulation Commission

62-3-3. Definitions.

[...] G. "public utility" or "utility" means every person not engaged solely in interstate business and, except as stated in Sections 62-3-4 and 62-3-4.1 NMSA 1978, that may own, operate, lease or control:

(1) any plant, property or facility for the generation, transmission or distribution, sale or furnishing to or for the public of electricity for light, heat or power or other uses;

62-9-1. New construction; ratemaking principles.

A. No public utility shall begin the construction or operation of any public utility plant or system or of any extension of any plant or system without first obtaining from the commission a certificate that public convenience and necessity require or will require such construction or operation.

62-9-3. Location control; limitations.

B. A person, including any municipality, shall not begin the construction of any plant designed for or capable of operation at a capacity of three hundred thousand kilowatts or more for the generation of electricity for sale to the public within or without this state, whether or not owned or operated by a person that is a public utility subject to regulation by the commission, or of transmission lines in connection with such a plant, on a location within this state unless the location has been approved by the commission. For the purposes of this section, "transmission line" means any electric transmission line and associated facilities designed for or capable of operations at a nominal voltage of two hundred thirty kilovolts or more, to be constructed in connection with and to transmit electricity from a new plant for which approval is required.

New York - New York State Public Service Commission

Public Service Law Section 120 - Definitions

[...] 2."Major utility transmission facility" means:

(a)an electric transmission line of a design capacity of one hundred twenty-five kilovolts or more extending a distance of one mile or more, or of one hundred kilovolts or more and less than one hundred twenty-five kilovolts, extending a distance of ten miles or more, including associated equipment, but shall not include any such transmission line located wholly underground in a city with a population in excess of one hundred twenty-five thousand or a primary transmission line approved by the federal energy regulatory commission in connection with a hydro-electric facility; and

[...] Public Service Law Section 121

Certificate of environmental compatibility and public need

1.No person shall [...] commence the preparation of the site for the construction of a major utility transmission facility in the state without having first obtained a certificate of environmental compatibility and public need (hereafter in this article called a "certificate") issued with respect to such facility by the commission.

Public Service Law Section 121 - Certificate of environmental compatibility and public need

1.No person shall [...] commence the preparation of the site for the construction of a major utility transmission facility in the state without having first obtained a certificate of environmental compatibility and public need (hereafter in this article called a "certificate") issued with respect to such facility by the commission.

North Carolina - North Carolina Utilities Commission

NC Gen Stat § 62-3 (2023)

[...]23) a. “Public utility” means a person, whether organized under the laws of this State or under the laws of any other state or country, now or hereafter owning or operating in this State equipment or facilities for: 1. Producing, generating, transmitting, delivering or furnishing electricity, piped gas, steam or any other like agency for the production of light, heat or power to or for the public for compensation;

§ 62-100 [...]

(7) The term “transmission line” means an electric line designed with a capacity of at least 161 kilovolts.

§ 62-101. Certificate to construct transmission line.

(a) No public utility or any other person may begin to construct a new transmission line without first obtaining from the Commission a certificate of environmental compatibility and public convenience and necessity. Only a public utility as defined in this Article may obtain a certificate to construct a new transmission line, except an entity may obtain a certificate to construct a new transmission line solely for the purpose of providing interconnection of an electric generation facility.

(b) A transmission line for which a certificate is required shall be constructed, operated, and maintained in conformity with the certificate. A certificate may be amended or transferred with the approval of the Commission.

(c) A certificate is not required for construction of the following lines:

(1) A line designed to carry less than 161 kilovolts; [...]

North Dakota - North Dakota Public Service Commission

49-22-03. Definitions.

1. “Certificate” means the certificate of site compatibility or the certificate of corridor compatibility issued under this chapter;

[...] 6. “Electric transmission facility” means an electric transmission line and associated facilities with a design in excess of one hundred fifteen kilovolts. “Electric transmission facility” does not include:

a. A temporary electric transmission line loop that is:

(1) Connected and adjacent to an existing electric transmission facility that was sited under this chapter;

(2) Within the corridor of the sited facility and does not cross known exclusion or avoidance areas; and

(3) In place for less than one year; or

b. An electric transmission line that is less than one mile [1.61 kilometers] long.

7. “Facility” means an electric energy conversion facility, electric transmission facility, or both.

8. “Permit” means the permit for the construction of an electric transmission facility within a designated corridor issued under this chapter

49-22-07. Certificate of site compatibility or route permit required.

1. A utility may not begin construction of an electric energy conversion facility or an electric transmission facility in the state without first having obtained a certificate of site compatibility or a route permit from the commission pursuant to this chapter. The facility must be constructed, operated, and maintained in conformity with the certificate or permit and any terms, conditions, or modifications of the certificate or permit.

Northern Mariana Islands - Commonwealth Utilities Corporation

Extension of electrical distribution lines at standard voltages, described in part 200, to supply electric service to any applicant shall be designed, constructed, operated, maintained and owned by CUC. Non-CUC owned electric lines beyond CUC’s point of delivery must be constructed and maintained without expense to CUC and must conform to standards for electric line construction acceptable to CUC.

*Service at any voltage is subject to the CUC’s approval

Ohio - Ohio Public Utilities Commission - Power Siting Board

As used in Chapter 4906. of the Revised Code:

[...] (B)(1) “Major utility facility” means:

(a) Electric generating plant and associated facilities designed for, or capable of, operation at a capacity of fifty megawatts or more;

(b) An electric transmission line and associated facilities of a design capacity of one hundred kilovolts or more;

Section 4906.04 | Certificate required for construction of major utility facility

No person shall commence to construct a major utility facility in this state without first having obtained a certificate for the facility. The replacement of an existing facility with a like facility, as determined by the power siting board, shall not constitute construction of a major utility facility. Such replacement of a like facility is not exempt from any other requirements of state or local laws or regulations. Any facility, with respect to which such a certificate is required, shall thereafter be constructed, operated, and maintained in conformity with such certificate and any terms, conditions, and modifications contained therein. A certificate may only be issued pursuant to Chapter 4906. of the Revised Code.

Oklahoma - No consolidated authority

Okla. Admin. Code § 165:35-43-2 - Definitions

“Transmission Line” means a set of conductors, insulators, supporting structures, and associated equipment used to move power at 60 kilovolts (kV) or above

Oregon - Oregon Department of Energy - Oregon Energy Facility Siting Council

Oregon Revised Statutes

469.300 Definitions

[...] (11)(a) “Energy facility” means any of the following: [...] (C) A high voltage transmission line of more than 10 miles in length with a capacity of 230,000 volts or more to be constructed in more than one city or county in this state, but excluding:

(i) Lines proposed for construction entirely within 500 feet of an existing corridor occupied by high voltage transmission lines with a capacity of 230,000 volts or more;

(ii) Lines of 57,000 volts or more that are rebuilt and upgraded to 230,000 volts along the same right of way; and

(iii) Associated transmission lines.

469.320 Site certificate required; exceptions.

(1) Except as provided in subsections (2) and (5) of this section, no facility shall be constructed or expanded unless a site certificate has been issued for the site thereof in the manner provided in ORS 469.300 to 469.563, 469.590 to 469.619, 469.930 and 469.992. No facility shall be constructed or operated except in conformity with the requirements of ORS 469.300 to 469.563, 469.590 to 469.619, 469.930 and 469.992.

ORS 758.015

Certificate of public convenience and necessity

When any person, as defined in ORS 758.400 (Definitions for ORS 758.015 and 758.400 to 758.475), providing electric utility service, as defined in ORS 758.400 (Definitions for ORS 758.015 and 758.400 to 758.475), or any transmission company, proposes to construct an overhead transmission line which will necessitate a condemnation of land or an interest therein, it shall petition the Public Utility Commission for a certificate of public convenience and necessity setting forth a detailed description and the purpose of the proposed transmission line, the estimated cost, the route to be followed, the availability of alternate routes, a description of other transmission lines connecting the same areas, and such other information in such form as the commission may reasonably require in determining the public convenience and necessity.

Pennsylvania - Pennsylvania Public Utility Commission

52 § 57.1 Definitions

[...] Electric supply line—The wires or cables, with the necessary supporting or containing structures and appurtenances, used in connection with an overhead or underground system of a public utility, providing electric power, located on a public highway or utility right-of-way and used to transmit or distribute electric energy

[...] Eminent domain application—An application filed with the Commission by a public utility for a certificate of public convenience for approval of the exercise of the power of eminent domain to acquire rights-of-way for the construction, operation and maintenance of an aerial transmission line.

[...] HV transmission line or HV line—An overhead electric supply line with a design voltage greater than 100,000 volts.

Rhode Island - Rhode Island Public Utilities Commission - Rhode Island Energy Facility Siting Board
R.I. Gen. Laws § 42-98-3 [...] (e) "Major energy facility" means facilities for the extraction, production, conversion, and processing of coal; facilities for the generation of electricity designed or capable of operating at a gross capacity of forty megawatts (40 MW) or more; transmission lines of sixty-nine (69) Kv or over; § 42-98-4. License required. No person shall site, construct, or alter a major energy facility within the state without first obtaining a license from the siting board pursuant to this chapter.
South Carolina - South Carolina Public Service Commission
South Carolina Code of Laws Title 58 - Public Utilities, Services and Carriers CHAPTER 33 Utility Facility Siting and Environmental Protection SECTION 58-33-20.Definitions. [...] (2) The term "major utility facility" means: (b) an electric transmission line and associated facilities of a designed operating voltage of one hundred twenty-five kilovolts or more; provided, however, that the words "major utility facility" shall not include electric distribution lines and associated facilities. (8) The term "certificate" means a certificate of environmental compatibility and public convenience and necessity. [...] SECTION 58-33-110.Certificate required before construction of major utility facility; transfer and amendment of certificate; exceptions; emergency certificates. (1) No person shall commence to construct a major utility facility without first having obtained a certificate issued with respect to such facility by the Commission.
South Dakota - South Dakota Public Utilities Commission
49-41B-2. Definition of terms. (7) "Facility," any energy conversion facility, AC/DC conversion facility, transmission facility, solar energy facility, or wind energy facility, and associated facilities; (8) "Permit," the permit issued by the commission under this chapter required for the construction and operation of a facility; 49-41B-2.1. Transmission facility defined. For the purposes of this chapter, a transmission facility is: (1) An electric transmission line and associated facilities with a design of more than one hundred fifteen kilovolts. However, if the transmission line is less than two thousand six hundred forty feet, does not cross any public highway, and eminent domain is not used to obtain right of way, the transmission line is not a transmission facility for purposes of this chapter; [...] 49-41B-4. Permit required before construction of facility after certain date. No utility may begin construction of a facility in the state on or after July 1, 1979, without first having obtained a permit issued with respect to such facility by the Public Utilities Commission pursuant to this chapter.
Tennessee - Tennessee Public Utility Commission

Tenn. Code Ann. § 65-4-101

[...]

(A) "Public utility" means every individual, copartnership, association, corporation, or joint stock company, its lessees, trustees, or receivers, appointed by any court whatsoever, that own, operate, manage or control, within the state, any interurban electric railway, traction company, all other common carriers, express, gas, electric light, heat, power, water, telephone, telegraph, telecommunications services, or any other like system, plant or equipment, affected by and dedicated to the public use, under privileges, franchises, licenses, or agreements, granted by the state or by any political subdivision thereof.

Tenn. Code Ann. § 65-4-201

(a) No public utility shall establish or begin the construction of, or operate any line, plant, or system, or route in or into a municipality or other territory already receiving a like service from another public utility, or establish service therein, without first having obtained from the commission, after written application and hearing, a certificate that the present or future public convenience and necessity require or will require such construction, establishment, and operation, and no person or corporation not at the time a public utility shall commence the construction of any plant, line, system, or route to be operated as a public utility, or the operation of which would constitute the same, or the owner or operator thereof, a public utility as defined by law, without having first obtained, in like manner, a similar certificate;

Texas - Public Utility Commission of Texas

UTILITIES CODE - TITLE 2. PUBLIC UTILITY REGULATORY ACT - SUBTITLE B. ELECTRIC UTILITIES - CHAPTER 31. GENERAL PROVISIONS - SUBCHAPTER A. GENERAL PROVISIONS

Sec. 31.002. DEFINITIONS.

[...] (6) "Electric utility" means a person or river authority that owns or operates for compensation in this state equipment or facilities to produce, generate, transmit, distribute, sell, or furnish electricity in this state. The term includes a lessee, trustee, or receiver of an electric utility and a recreational vehicle park owner who does not comply with Subchapter C, Chapter 184, with regard to the metered sale of electricity at the recreational vehicle park.

[...] (19) "Transmission and distribution utility" means a person or river authority that owns or operates for compensation in this state equipment or facilities to transmit or distribute electricity, except for facilities necessary to interconnect a generation facility with the transmission or distribution network, a facility not dedicated to public use, or a facility otherwise excluded from the definition of "electric utility" under this section, in a qualifying power region certified under Section 39.152, but does not include a municipally owned utility or an electric cooperative.

(20) "Transmission service" includes construction or enlargement of facilities, transmission over distribution facilities, control area services, scheduling resources, regulation services, reactive power support, voltage control, provision of operating reserves, and any other associated electrical service the commission determines appropriate, except that, on and after the implementation of customer choice, control area services, scheduling resources, regulation services, provision of operating reserves, and reactive power support, voltage control, and other services provided by generation resources are not "transmission service."

SUBCHAPTER B. CERTIFICATE OF CONVENIENCE AND NECESSITY

Sec. 37.051. CERTIFICATE REQUIRED. (a) An electric utility may not directly or indirectly provide service to the public under a franchise or permit unless the utility first obtains from the commission a certificate that states that the public convenience and necessity requires or will require the installation, operation, or extension of the service.

Utah - Utah Public Service Commission - Utility Facility Review Board

UT. Code. Ann. §54-2-1.

[...] (10) “Electric plant” includes all real estate, fixtures, and personal property owned, controlled, operated, or managed in connection with or to facilitate the production, generation, transmission, delivery, or furnishing of electricity for light, heat, or power, and all conduits, ducts, or other devices, materials, apparatus, or property for containing, holding, or carrying conductors used or to be used for the transmission of electricity for light, heat, or power.

[...] (23) (a) “Public utility” includes every railroad corporation, gas corporation, electrical corporation, distribution electrical cooperative, wholesale electrical cooperative, telephone corporation, telegraph corporation, water corporation, sewerage corporation, heat corporation, and independent energy producer not described in Section 54-2-201 where the service is performed for, or the commodity delivered to, the public generally, or in the case of a gas corporation or electrical corporation where the gas or electricity is sold or furnished to any member or consumers within the state for domestic, commercial, or industrial use.

54-4-25 Certificate of convenience and necessity prerequisite to construction and operation-- Electrical suppliers. (1) Except as provided in Section 11-13-304, a gas corporation, electric corporation, telephone corporation, telegraph corporation, heat corporation, water corporation, or sewerage corporation may not establish, or begin construction or operation of a line, route, plant, or system or of any extension of a line, route, plant, or system, without having first obtained from the commission a certificate that present or future public convenience and necessity does or will require the construction.

54-18-102 Definitions.

[...] (4) “High voltage power line” means: (a) an electrical high voltage power line with a nominal voltage of 230 kilovolts or more; and (b) an upgraded high voltage power line.

54-18-303 Application for land use permit. (1) Before a public utility may file a land use application for a proposed high voltage power line, the public utility shall, in accordance with Subsection (2), identify a proposed corridor in the public utility’s land use application after: (a) providing a notice of intent in accordance with Section 54-18-301; and (b) conducting the public workshops in accordance with Section 54-18-302

Vermont - Vermont Public Utility Commission

§ 231. Certificate of public good; abandonment of service; hearing

(a) A person, partnership, unincorporated association, or previously incorporated association that desires to own or operate a business over which the Public Utility Commission has jurisdiction under the provisions of this chapter shall first petition the Commission to determine whether the operation of such business will promote the general good of the State and shall at that time file a copy of any such petition with the Department...

§ 248. New gas and electric purchases, investments, and facilities; certificate of public good

[...] (A) no company, as defined in section 201 of this title, and no person, as defined in 10 V.S.A. § 6001(14), may begin site preparation for or construction of an electric generation facility, energy storage facility, or electric transmission facility within the State that is designed for immediate or eventual operation at any voltage; and

(B) no such company may exercise the right of eminent domain in connection with site preparation for or construction of any such transmission facility, energy storage facility, or generation facility, unless the Public Utility Commission first finds that the same will promote the general good of the State and issues a certificate to that effect.

Virginia - Virginia State Corporation Commission

Code of Virginia

§ 56-265.1. Definitions. [...] (b) “Public utility” means any company that owns or operates facilities within the Commonwealth of Virginia for the generation, transmission, or distribution of electric energy for sale,

§ 56-265.2. Certificate of convenience and necessity required for acquisition, etc., of new facilities.

A. 1. Subject to the provisions of subdivision 2, it shall be unlawful for any public utility to construct, enlarge or acquire, by lease or otherwise, any facilities for use in public utility service, except ordinary extensions or improvements in the usual course of business, without first having obtained a certificate from the Commission that the public convenience and necessity require the exercise of such right or privilege.

[...] 2. For construction of any transmission line of 138 kilovolts and associated facilities, a public utility shall either (i) obtain a certificate pursuant to subdivision 1 or (ii) obtain approval pursuant to the requirements of (a) § 15.2-2232 and (b) any applicable local zoning ordinances by the locality or localities in which the transmission line will be located.

Washington - Washington State Energy Facility Site Evaluation Council (EFSEC)

RCW 80.50.020 Definitions.

[...] (4) "Associated facilities" means storage, transmission, handling, or other related and supporting facilities connecting an energy plant with the existing energy supply, processing, or distribution system, including, but not limited to, communications, controls, mobilizing or maintenance equipment, instrumentation, and other types of ancillary transmission equipment, off-line storage or venting required for efficient operation or safety of the transmission system and overhead, and surface or subsurface lines of physical access for the inspection, maintenance, and safe operations of the transmission facility and new transmission lines constructed to operate at nominal voltages of at least 115,000 volts to connect a thermal power plant or alternative energy facilities to the northwest power grid. However, common carrier railroads or motor vehicles shall not be included.

[...] (6) "Certification" means a binding agreement between an applicant and the state which shall embody compliance to the siting guidelines, in effect as of the date of certification, which have been adopted pursuant to RCW 80.50.040 as now or hereafter amended as conditions to be met prior to or concurrent with the construction or operation of any energy facility.

RCW 80.50.060

Energy facilities to which chapter applies—Applications for certification—Forms—Council's duties—Potential effects to tribal cultural resources.

[...] (b) If applicants proposing the following types of facilities choose to receive certification under this chapter, the provisions of this chapter apply to the construction, reconstruction, or enlargement of these new or existing facilities: [...] (iii) Electrical transmission facilities: (A) Of a nominal voltage of at least 115,000 volts; and (B) located in more than one jurisdiction that has promulgated land use plans or zoning ordinances;

West Virginia - West Virginia Public Service Commission

West Virginia Code

§24-2-11a. Requirement for certificate of public convenience and necessity before beginning construction of high voltage transmission line; contents of application; notice; hearing; criteria for granting or denying certificate; regulations.

(a) No public utility, person or corporation may begin construction of a high voltage transmission line of two hundred thousand volts or over, which line is not an ordinary extension of an existing system in the usual course of business as defined by the Public Service Commission, unless and until it or he or she has obtained from the Public Service Commission a certificate of public convenience and necessity approving the construction and proposed location of the transmission line.

Wisconsin - Public Service Commission of Wisconsin

Wisconsin Statute

196.01 Definitions.

[...] (5) (a) Public utility means, except as provided in par. (b), every corporation, company, individual, association, their lessees, trustees or receivers appointed by any court, and every sanitary district, town, village or city that may own, operate, manage or control any toll bridge or all or any part of a plant or equipment, within the state, for the production, transmission, delivery or furnishing of heat, light, water or power either directly or indirectly to or for the public.

196.49 Authorization from commission before transacting business; extensions and improvements to be approved; enforcement of orders; natural gas.

(1) (am) Except as provided in s. 196.50 (1) (am), no public utility not legally engaged in performing a utility service on August 1, 1931, in any municipality may commence the construction of any public utility plant, extension or facility, or render service in such municipality directly, or indirectly by serving any other public utility or agency engaged in public utility service or otherwise, unless the public utility has obtained a certificate from the commission authorizing it to transact public utility business.

196.485 Transmission system requirements. [...] (h) "Transmission facility" means any pipe, pipeline, duct, wire, line, conduit, pole, tower, equipment or other structure used for the transmission of electric power as determined by the public service commission on the basis of factors for identifying a transmission facility that are specified in the orders of the federal energy regulatory commission under 16 USC 824d and 824e.

196.491 Strategic energy assessment; electric generating facilities and transmission lines; natural gas lines. [...] (3) CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY. (a) 1. Except as provided in sub. (3b), no person may commence the construction of a facility unless the person has applied for and received a certificate of public convenience and necessity under this subsection. A person who proposes to construct a large electric generating facility may apply for a certificate for that facility and for another certificate for an associated high-voltage transmission line for which a certificate under this subsection is required by submitting a single application...

Wyoming - Wyoming Public Service Commission
Wyoming Statute § 37-1-101. Definitions. [...] (vi) “Public utility” means and includes every person that owns, operates, leases, controls or has power to operate, lease or control: [...] (C) Any plant, property or facility for the generation, transmission, distribution, sale or furnishing to or for the public of electricity for light, heat or power, including any conduits, ducts or other devices, materials, apparatus or property for containing, holding or carrying conductors used or to be used for the transmission of electricity for light, heat or power; § 37-2-205. Certificate of convenience and necessity; hearings. (a) Except as provided in this subsection, no public utility shall begin construction or complete the purchase of a line or plant, or of any extension of a line or material addition to a plant, without having first obtained from the commission a certificate that the present or future public convenience and necessity require or will require such construction or purchase.

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