**What Everyone Needs to Know about Transmission:**

**Facts and Sources**

Americans for a Clean Energy Grid

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* **America’s transmission grid is outdated and too inefficient to support a modern economy.** Nearly all aspects of modern life depend on a robust and reliable power grid. According to the American Society for Civil Engineers, most of the nation’s transmission and distribution lines were constructed in the 1950s and 1960s and have a 50-year life expectancy, meaning they have reached or surpassed their intended lifespan.[[1]](#footnote-1) The current grid was planned for a behind-the-times resource mix that is different from what utilities, states, and consumers are calling for in the future.Failure to expand our grid and connect the low-cost, domestic resources of the future is:
	+ Increasing electricity bills for all customers;
	+ Preventing economic development and job creation, especially in rural areas;
	+ Making the nation more vulnerable to grid outages and national security threats;
	+ Blocking development of renewable energy;
	+ Exacerbating the effects of climate change and needlessly exposing many to harmful air pollutants, especially those in marginalized communities; and
	+ Undermining America’s global competitiveness, as other countries have already begun to rapidly modernize and expand their grids.
* **Policy roadblocks in how we plan, pay for, and permit transmission are stunting grid development.** These roadblocks include a dysfunctional and balkanized transmission planning and permitting process and a failure to recognize the benefits an expanded and modernized grid could provide.
	+ In the last decade, regionally planned transmission investment has decreased by 50 percent[[2]](#footnote-2) and almost no new interregional lines have been planned.[[3]](#footnote-3)
	+ At the end of 2019, 734 gigawatts (GWs) of proposed generation were waiting in interconnection queues nationwide, most of which are located in rural areas and almost 90 percent of which are renewable and energy storage projects.[[4]](#footnote-4) These individual generators are often required to pay for shared network facility upgrades to connect to the grid – a cost allocation structure akin to requiring the next car waiting to merge onto the highway to pay for a lane expansion that benefits all users.
	+ Neighboring planning authorities use different and sometimes incompatible models and methods that prevent agreement on interregional lines.
	+ Transmission is generally planned separately for reliability, economic, and public policy purposes, rather than under a holistic approach that considers the joint benefits.[[5]](#footnote-5)
	+ Permitting of lines benefitting many states and the nation is performed at the state and local levels, slowing development of regionally beneficial investments.
* **Congress, the Administration, and FERC can resolve transmission barriers.**
	+ FERC can reform regional and interregional transmission planning and cost allocation methods, while replacing the dysfunctional generator interconnection process at the same time.[[6]](#footnote-6)
	+ Congress and the Administration can assist in the funding of large-scale interstate highway types of transmission lines.
	+ The Administration can support planning studies and stakeholder engagement, and utilize its limited federal backstop siting powers to site transmission lines that would not otherwise be constructed due to regulatory hurdles at the state and local levels.
* **Adopting such transmission policies would deliver huge benefits for America. Specifically, transmission:**
* **Reduces electricity bills.**
* Large-scale transmission cuts consumer electric bills by over $100 billion cumulatively and decreases the average electric bill rate by more than one-third, from over 9 cents per kilowatt-hour (kWh) today to around 6 cents per kWh by 2050, saving a typical household more than $300 per year.[[7]](#footnote-7)
* The NREL Interconnections Seam study found the benefits of a macro grid connecting the Eastern and Western Interconnections to be almost three times the cost, allowing nearly 40 GWs of power to move back and forth on a daily basis.[[8]](#footnote-8)
* America has an abundance of low-cost renewable resources that can reduce electricity bills for families and businesses. Transmission costs tend to be around one-fifth of the cost of generation, and the full delivered cost of energy from remote renewables beats any other option on cost.
* Transmission reduces generation market power by geographically expanding markets and enabling competition from many more suppliers.[[9]](#footnote-9)
* The benefits generated by MISO’s Multi-Value Projects (MVPs) and SPP’s Priority Projects exceeded the costs by 2.2 to 3.5 times.[[10]](#footnote-10) This means a dollar spent on transmission enables access to generation that is $3 to $4 cheaper than would otherwise be available. Withholding transmission is penny-wise and pound-foolish.
* Building bigger saves consumers money. The cost per unit of delivery capacity for high voltage 765 kilovolt (kV) lines is one-fourth as much as lower voltage 230 kV lines.[[11]](#footnote-11)
* A study from the MIT Energy Initiative found that interstate coordination and transmission expansion reduces the cost of zero-carbon electricity by up to 46 percent compared to a state-by-state approach.[[12]](#footnote-12) Building enough local generation to meet load at all times over-builds expensive generation, while transmission is a cheaper way to meet load.
* **Drives high quality domestic manufacturing and construction jobs.**
* Domestic content of transmission is high, so transmission puts Americans to work. Analysis by the Brattle Group indicates that domestic content accounts for 82 percent of the total value of transmission investment, with 61 percent of materials sourced domestically.[[13]](#footnote-13) All transmission construction and O&M work is inherently domestic, and transmission planning, engineering, and logistics work is also typically domestic. Brattle estimated that 65 percent of transmission wires and towers are sourced domestically, while 35 percent of transformers and circuit breakers are domestic.
* Nearly all transmission jobs are union jobs and pay prevailing wages.
* Direct Current (DC) projects create around 4 direct jobs per $1 million of expenditure and a combined total of 11.3 direct, indirect, and induced jobs, while Alternating Current (AC) projects create around 11.5 direct jobs per $1 million of expenditure and a combined total of 27 direct, indirect, and induced jobs.[[14]](#footnote-14)
* Transmission enables renewable energy jobs at a rate of 4 direct jobs per renewable megawatt (MW) and a combined total of 10.64 direct and indirect jobs per renewable MW.[[15]](#footnote-15)
* **Drives economic development and job creation, especially in rural areas.**
* The Vibrant Clean Energy (VCE) study for the Eastern US alone reveals that expanding and modernizing the transmission grid in the region will unleash up to $7.8 trillion in investment in rural America.[[16]](#footnote-16)
* The VCE study for the Eastern US found more than 6 million net new jobs, increasing electric sector employment over five-fold from around 1.3 million to over 7.5 million jobs by 2050 in the Eastern US alone. [[17]](#footnote-17)
* The same is true for the West and for interregional and national macro grid transmission.
* **Makes America’s grid more secure, reliable and resilient.**
* Grid operators and experts say large scale transmission is key to resilience:
* ISO-New England: “The system’s ability to withstand various transmission facility and generator contingencies and move power around without dependence on local resources under many operating conditions…results in a grid that is…resilient.”[[18]](#footnote-18)
* NYISO: “…resiliency is closely linked to the importance of maintaining and expanding interregional interconnections, the building out of a robust transmission system…”[[19]](#footnote-19)
* SPP: “These lines were identified as being economically beneficial for bringing low-cost, renewable energy to market, but their construction has also supported resilience by creating and strengthening alternate paths within SPP.”[[20]](#footnote-20)
* A recent report by national security experts noted: “Our electricity grid’s resilience—its ability to withstand shocks, attacks and damages from natural events, systemic failures, cyber-attack or extreme electromagnetic events, both natural and man-made—has emerged as a major concern for U.S. national security and a stable civilian society.”[[21]](#footnote-21) The report described large scale transmission as a solution: “Transmission buildout is critical to resilience as it can relieve line overloading—or “congestion” in industry jargon—on the existing system, lessening the compounding risks that come with a strained grid that could then be tested by an extreme weather event or an attack incident. Moreover, by enabling further development of renewable energy resources over wider geographic areas, well-planned transmission expansion can make targeted attacks on the grid more difficult to plan and carry out.”[[22]](#footnote-22)
* A National Academies of Sciences, Engineering, and Medicine study of power system resilience noted the need for planning improvements to protect against modern threats:[[23]](#footnote-23) “As the complexity and scale of the grid as a cyber-physical system continues to grow, there are opportunities to plan and design the system to reduce the criticality of individual components and to fail gracefully as opposed to catastrophically.”[[24]](#footnote-24) The study also notes “In most cases, an electricity system that is designed, constructed, and operated solely on the basis of economic efficiency to meet standard reliability criteria will not be sufficiently resilient.”[[25]](#footnote-25)
* **Enhances America’s global competitiveness.**
* Many of the technologies and companies involved in large-scale transmission originate in the US, and there is potential to retake leadership in the global industry.
* China has recently completed five times more high-voltage interregional transmission than Europe, and more than 80 times more than the U.S.[[26]](#footnote-26)
* The European Union is planning and building high-voltage transmission to support the development of offshore wind in the northern seas.
* **Accelerates the adoption of renewable energy.**
* America has an abundance of renewable energy resources. Two-thirds of renewable resource potential is located in 15 central states that only comprise one-third of total electricity consumption, while load centers near the East and West coasts consume the other two-thirds.[[27]](#footnote-27) Transmission is needed to deliver clean energy to population centers.
* Studies show that transmission capacity needs to increase by 2 to 3 times today’s delivery capacity to transition to a decarbonized energy system.[[28]](#footnote-28)
* Variable weather-driven resources like wind and solar can supply over 80 percent of the power system’s electricity at a cost equal to or lower than today’s energy costs, but only if large amounts of energy can move back and forth across and between regions to ensure demand is met in all hours at all locations.[[29]](#footnote-29) Wind and solar facilities that are located at different points on the grid complement each other as they tend to produce energy at different times.
* A clean power sector and decarbonized economy require large-scale transmission.
* High penetration of Distributed Energy Resources (DERs) does not change the need for transmission. In a recent analysis of the benefits of incorporating large amounts of DERs, the detailed modeling study found that almost the same amount of transmission was needed with or without a large amount of DERs.[[30]](#footnote-30)
* **Advances environmental justice.**
* Transmission allows older, dirtier generating units that are near environmental justice communities to be replaced in system dispatch by remote, clean resources.
* A recent study of significant transmission expansion in the Eastern half of the country found, “investing in transmission and renewable energy can improve public health by greatly reducing or eliminating a range of harmful air pollutants over the next decade. These localized air pollutants increase the risk of illness or death from a range of health problems, and have even been linked to increased risk of death from COVID-19. By delivering clean energy to densely populated areas to replace polluting sources of energy, transmission plays a particularly important role in displacing harmful emissions. Many of the most polluting power plants are located in economically disadvantaged communities.”[[31]](#footnote-31) Transmission enables near-elimination of harmful air pollutants, including sulfur dioxide, nitrogen oxides, and particulate matter which cause asthma and other public health problems. [[32]](#footnote-32)
* **Sharply reduces carbon emissions.**
* Decarbonization of the electricity, transportation, and commercial and residential buildings sectors requires a national transmission network.[[33]](#footnote-33)
1. American Society of Civil Engineers, “[Policy Statement 484 - Electricity Generation and Transmission Infrastructure](https://www.asce.org/issues-and-advocacy/public-policy/policy-statement-484---electricity-generation-and-transmission-infrastructure/),” Adopted by the Board of Direction on July 13, 2019. [↑](#footnote-ref-1)
2. Caspary, Goggin, Gramlich, Schneider, “[Disconnected: The Need for a New Generator Interconnection Policy](https://gridprogress.files.wordpress.com/2021/01/disconnected-the-need-for-a-new-generator-interconnection-policy-1.14.21-1.pdf),” at 21, January 2021. [↑](#footnote-ref-2)
3. Pfeifenberger et al., “[Cost Savings Offered by Competition in Electric Transmission](https://brattlefiles.blob.core.windows.net/files/16726_cost_savings_offered_by_competition_in_electric_transmission.pdf),” at 1, April 2019. [↑](#footnote-ref-3)
4. Caspary, Goggin, Gramlich, Schneider, “[Disconnected: The Need for a New Generator Interconnection Policy](https://gridprogress.files.wordpress.com/2021/01/disconnected-the-need-for-a-new-generator-interconnection-policy-1.14.21-1.pdf),” at 10, January 2021. [↑](#footnote-ref-4)
5. *Ibid*., at 25-26. [↑](#footnote-ref-5)
6. Gramlich and Caspary, “[Planning for the Future: FERC’s Opportunity to Spur More Cost-Effective Transmission Infrastructure](https://gridprogress.files.wordpress.com/2021/02/planning-for-the-future.pdf),” at 8-14, January 2021. [↑](#footnote-ref-6)
7. Clack, Goggin, Choukulkar, Cote, and McKee, “[Consumer, Employment, and Environmental Benefits of Electricity Transmission Expansion in the Eastern U.S.](https://cleanenergygrid.org/wp-content/uploads/2020/10/Consumer-Employment-and-Environmental-Benefits-of-Transmission-Expansion-in-the-Eastern-U.S..pdf),” at 4, October 2020. [↑](#footnote-ref-7)
8. Bloom et al., “[The Value of Increased HVDC Capacity Between Eastern and Western U.S. Grids: The Interconnections Seam Study](https://www.nrel.gov/docs/fy21osti/76850.pdf),” at 1 & 7, October 2020. [↑](#footnote-ref-8)
9. Wolak, “[Managing Unilateral Market Power in Electricity](https://web.stanford.edu/group/fwolak/cgi-bin/sites/default/files/files/Managing%20Unilateral%20Market%20Power%20in%20Electricity_Wolak.pdf),” at 8. [↑](#footnote-ref-9)
10. SPP, “[The Value of Transmission](https://www.spp.org/documents/35297/the%20value%20of%20transmission%20report.pdf),” at 5, January 2016, and MISO, “[MTEP17 MVP Triennial Review](https://cdn.misoenergy.org/MTEP17%20MVP%20Triennial%20Review%20Report117065.pdf),” at 4, September 2017. [↑](#footnote-ref-10)
11. American Electric Power, “[Transmission Facts](https://web.ecs.baylor.edu/faculty/grady/_13_EE392J_2_Spring11_AEP_Transmission_Facts.pdf),” at 4, n.d., and PJM, “[The Benefits of the PJM Transmission System](https://pjm.com/-/media/library/reports-notices/special-reports/2019/the-benefits-of-the-pjm-transmission-system.ashx?la=en),” at 9, April 2019. [↑](#footnote-ref-11)
12. Brown and Botterud, “[The Value of Inter-Regional Coordination and Transmission in Decarbonizing the US Electricity System](https://www.cell.com/joule/fulltext/S2542-4351%2820%2930557-2?_returnURL=https%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS2542435120305572%3Fshowall%3Dtrue),” Joule, 5(1), at 115-134, December 2020. [↑](#footnote-ref-12)
13. Pfeifenberger and Hou, “[Employment and Economic Benefits of Transmission Infrastructure Investment in the U.S. and Canada](https://brattlefiles.blob.core.windows.net/files/6534_employment_and_economic_benefits_of_transmission_infrastructure_investmt_pfeifenberger_hou_may_2011_wires.pdf),” at 20, May 2011. [↑](#footnote-ref-13)
14. MISO, “[Economic Impact of MTEP In-Service Projects From 2002-2015](https://cdn.misoenergy.org/Economic%20Impact%20of%20MTEP%20In-Service%20Projects271136.pdf),” July 2015, Pfeifenberger and Hou, “[Employment and Economic Benefits of Transmission Infrastructure Investment in the U.S. and Canada](https://brattlefiles.blob.core.windows.net/files/6534_employment_and_economic_benefits_of_transmission_infrastructure_investmt_pfeifenberger_hou_may_2011_wires.pdf),” May 2011, Duan and Frayer, “[Estimating Macroeconomic Benefits of Transmission Investment with the REMI PI+ Model](http://www.remi.com/wp-content/uploads/2018/05/WIRES-modeling_0501_final-v3.pdf),” May 2018, and Lantx and Tegen, “[Jobs and Economic Development From New Transmission and Generation in Wyoming](https://www.nrel.gov/docs/fy11osti/50577.pdf),” March 2011. [↑](#footnote-ref-14)
15. Aldieri, Grafström, Sundström, and Paolo Vinci, “[Wind Power and Job Creation](https://www.mdpi.com/2071-1050/12/1/45/pdf),” Sustainability, at 16, showing 4.03 direct and 10.64 direct and indirect jobs per MW of wind capacity, and The Solar Foundation, “[National Solar Jobs Census 2018](https://resources.solarbusinesshub.com/images/reports/206.pdf),” at 30, showing 3.3 installation and development jobs per MW for utility-scale solar, rounded up to 4 jobs per MW to account for manufacturing and other supply chain jobs. [↑](#footnote-ref-15)
16. Clack, Goggin, Choukulkar, Cote, and McKee, “[Consumer, Employment, and Environmental Benefits of Electricity Transmission Expansion in the Eastern U.S.](https://cleanenergygrid.org/wp-content/uploads/2020/10/Consumer-Employment-and-Environmental-Benefits-of-Transmission-Expansion-in-the-Eastern-U.S..pdf),” at 4, October 2020. [↑](#footnote-ref-16)
17. *Ibid*. [↑](#footnote-ref-17)
18. [ISO-NE filing](https://elibrary.ferc.gov/eLibrary/filedownload?fileid=14837903) in FERC Docket No. AD18-7, at 15, March 2018. [↑](#footnote-ref-18)
19. [NYISO filing](https://elibrary.ferc.gov/eLibrary/filedownload?fileid=14838201) in FERC Docket No. AD18-7, at 4, March 2018. [↑](#footnote-ref-19)
20. [SPP filing](https://elibrary.ferc.gov/eLibrary/filedownload?fileid=14838083) in FERC Docket No. AD18-7, at 8, March 2018. [↑](#footnote-ref-20)
21. National Commission on Grid Resilience, “[Grid Resilience: Priorities for the Next Administration](https://gridresilience.org/wp-content/uploads/2020/11/NCGR-Report-2020-Full-v2.pdf),” at 1, 2020. [↑](#footnote-ref-21)
22. *Ibid*., at 42. [↑](#footnote-ref-22)
23. National Academies of Sciences, Engineering, and Medicine, [*Enhancing the Resilience of the Nation’s Electricity System*](https://www.nap.edu/download/24836), The National Academies Press, 2017. [↑](#footnote-ref-23)
24. *Ibid*., at 67. [↑](#footnote-ref-24)
25. *Ibid*., at 71. [↑](#footnote-ref-25)
26. McCalley and Zhang, “[Macro Grids in the Mainstream: An International Survey of Plans and Progress](https://cleanenergygrid.org/wp-content/uploads/2020/11/Macro-Grids-in-the-Mainstream-1.pdf),” November 2020. [↑](#footnote-ref-26)
27. David Gardiner and Associates, “[Transmission Upgrades & Expansion: Keys to Meeting Large Customer Demand for Renewable Energy](https://windsolaralliance.org/wp-content/uploads/2018/01/WEF-Corporate-Demand-and-Transmission-January-2018.pdf),” at 12-13, January 2018. [↑](#footnote-ref-27)
28. National Academies of Sciences, Engineering, and Medicine, [*Accelerating Decarbonization of the U.S. Energy System*](https://www.nap.edu/catalog/25932/accelerating-decarbonization-of-the-us-energy-system),” The National Academies Press, at 66, 2021. [↑](#footnote-ref-28)
29. Brown and Botterud, “[The Value of Inter-Regional Coordination and Transmission in Decarbonizing the US Electricity System](https://www.cell.com/joule/fulltext/S2542-4351%2820%2930557-2?_returnURL=https%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS2542435120305572%3Fshowall%3Dtrue),” Joule, 5(1), at 115-134, December 2020, Clack, Goggin, Choukulkar, Cote, and McKee, “[Consumer, Employment, and Environmental Benefits of Electricity Transmission Expansion in the Eastern U.S.](https://cleanenergygrid.org/wp-content/uploads/2020/10/Consumer-Employment-and-Environmental-Benefits-of-Transmission-Expansion-in-the-Eastern-U.S..pdf),” October 2020, Bloom et al., “[The Value of Increased HVDC Capacity Between Eastern and Western U.S. Grids: The Interconnections Seam Study](https://www.nrel.gov/docs/fy21osti/76850.pdf),” October 2020, MacDonald et al., “[Future Cost-Competitive Electricity Systems and Their Impact on US CO2 Emissions](https://www.vibrantcleanenergy.com/wp-content/uploads/2016/09/Future_cost-competitive_electricity_syst.pdf),” Nature Climate Change, January 2016, Vibrant Clean Energy, 2018, “[Minnesota’s Smarter Grid: Pathways Toward a Clean, Reliable and Affordable Transportation and Energy System](https://www.vibrantcleanenergy.com/wp-content/uploads/2018/07/Minnesotas-SmarterGrid_FullReport.pdf),” Climate Institute, “[North American Supergrid: Transforming Electricity Transmission](http://cleanandsecuregrid.org/wp-content/uploads/2017/12/North-American-Supergrid.pdf),” 2017, and Larson et al., “[Net-Zero America: Potential Pathways, Infrastructure, and Impacts](https://environmenthalfcentury.princeton.edu/sites/g/files/toruqf331/files/2020-12/Princeton_NZA_Interim_Report_15_Dec_2020_FINAL.pdf),” December 2020. [↑](#footnote-ref-29)
30. Clack et al., “[Why Local Solar For All Costs Less: A New Roadmap for the Lowest Cost Grid](https://www.vibrantcleanenergy.com/wp-content/uploads/2020/12/WhyDERs_TR_Final.pdf),” at 53, 2020. [↑](#footnote-ref-30)
31. Clack, Goggin, Choukulkar, Cote, and McKee, “[Consumer, Employment, and Environmental Benefits of Electricity Transmission Expansion in the Eastern U.S.](https://cleanenergygrid.org/wp-content/uploads/2020/10/Consumer-Employment-and-Environmental-Benefits-of-Transmission-Expansion-in-the-Eastern-U.S..pdf),” at 17, October 2020. [↑](#footnote-ref-31)
32. *Ibid*. [↑](#footnote-ref-32)
33. Brown and Botterud, “[The Value of Inter-Regional Coordination and Transmission in Decarbonizing the US Electricity System](https://www.cell.com/joule/fulltext/S2542-4351%2820%2930557-2?_returnURL=https%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS2542435120305572%3Fshowall%3Dtrue),” Joule, 5(1), at 115-134, December 2020, Clack, Goggin, Choukulkar, Cote, and McKee, “[Consumer, Employment, and Environmental Benefits of Electricity Transmission Expansion in the Eastern U.S.](https://cleanenergygrid.org/wp-content/uploads/2020/10/Consumer-Employment-and-Environmental-Benefits-of-Transmission-Expansion-in-the-Eastern-U.S..pdf),” October 2020, Bloom et al., “[The Value of Increased HVDC Capacity Between Eastern and Western U.S. Grids: The Interconnections Seam Study](https://www.nrel.gov/docs/fy21osti/76850.pdf),” October 2020, MacDonald et al., “[Future Cost-Competitive Electricity Systems and Their Impact on US CO2 Emissions](https://www.vibrantcleanenergy.com/wp-content/uploads/2016/09/Future_cost-competitive_electricity_syst.pdf),” Nature Climate Change, January 2016, Vibrant Clean Energy, 2018, “[Minnesota’s Smarter Grid: Pathways Toward a Clean, Reliable and Affordable Transportation and Energy System](https://www.vibrantcleanenergy.com/wp-content/uploads/2018/07/Minnesotas-SmarterGrid_FullReport.pdf),” Climate Institute, “[North American Supergrid: Transforming Electricity Transmission](http://cleanandsecuregrid.org/wp-content/uploads/2017/12/North-American-Supergrid.pdf),” 2017, and Larson et al., “[Net-Zero America: Potential Pathways, Infrastructure, and Impacts](https://environmenthalfcentury.princeton.edu/sites/g/files/toruqf331/files/2020-12/Princeton_NZA_Interim_Report_15_Dec_2020_FINAL.pdf),” December 2020 [↑](#footnote-ref-33)