TRANSMISSION PROJECTS READY TO GO: PLUGGING INTO AMERICA'S UNTAPPED RENEWABLE RESOURCES

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Americans for a Clean Energy Grid

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About Americans for a Clean Energy Grid

Americans for a Clean Energy Grid (ACEG) is the only non-profit broad-based public interest advocacy coalition focused on the need to expand, integrate, and modernize the North American high voltage grid.

Expanded high voltage transmission will make America's electric grid more affordable, reliable, and sustainable and allow America to tap all economic energy resources, overcome system management challenges, and create thousands of well-compensated jobs. But an insular, outdated and often short-sighted regional transmission planning and permitting system stands in the way of achieving those goals.

ACEG brings together the diverse support for an expanded and modernized grid from business, labor, consumer and environmental groups, and other transmission supporters to educate policymakers and key opinion leaders to support policy which recognizes the benefits of a robust transmission grid.

About the Macro Grid Initiative

The Macro Grid Initiative is a joint effort of the American Council on Renewable Energy and Americans for a Clean Energy Grid to promote investment in a 21st century transmission infrastructure that enhances reliability, improves efficiency and delivers more low-cost clean energy. The Initiative works closely with the American Wind Energy Association, the Solar Energy Industries Association, the Advanced Power Alliance and the Clean Grid Alliance to advance our shared goals.

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I. Introduction

This report identifies 22 high-voltage transmission projects that could begin construction in the near term if more workable transmission policies are enacted. These shovel ready infrastructure projects can be a significant driver of domestic job creation and economic development across the country. We estimate that the transmission investment itself can create around 600,000 jobs, while the wind and solar deployment enabled by the lines would create an additional 640,000 jobs, bringing the total job creation benefit to around 1,240,000 jobs. As indicated in the map below, most of these lines are designed to access high quality wind and solar resource areas. We estimate that these 22 projects could interconnect around 60,000 MW of new renewable capacity, increasing America's wind and solar generation by nearly 50% from current levels.

Aside from these job creation and economic development benefits, there are other compelling reasons why the power grid should be a primary focus of infrastructure policy. A report card from the American Society of Civil Engineers recently gave America's power grid infrastructure a grade of C minus,[1] noting that much of the grid is aging and congested. American consumers pay billions of dollars per year in higher electric bills because transmission congestion limits their access to lower-cost sources of electricity.[2] Moreover, a lack of strong transmission ties with neighboring power systems was a primary factor contributing to the Texas blackout event in February 2021, as well as other recent electric reliability events.[3]

If completed, the projects identified in this paper would add around 8,000 miles and 42,000 MW of transfer capacity to America's transmission system. For reference, the current U.S. transmission system contains 240,000 circuit miles of transmission that operate at 230 kiloVolts (kV) and above,[4] so these new projects only add about 3% to the total mileage of the transmission system. However all of the proposed lines operate at a high voltage, which allows them to carry more power than typical existing transmission lines with lower losses. As a result, these lines increase the transmission system's transfer capacity by about 11-12%, and enable a 50% increase in domestic wind and solar generation, as discussed below.

The lines are a mix of Alternating Current (AC) and Direct Current (DC), with DC generally used for lines that are longer or at least partially underground or underwater. These projects are shown in the following map and table, and described in more detail in the following section.

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1 American Society of Civil Engineers, A Comprehensive Assessment of America's Infrastructure, (2020), available at: https://infrastructurereportcard.org/wp-content/uploads/2020/12/National_IRC_2021-report.pdf.

2 Jesse Schneider, "Transmission Congestion Costs in the U.S. RTOs," (updated November 12, 2020), available at https://gridstrategiesllc.com/2019/09/17/transmission-congestion-costs-in-the-u-s-rtos/.

3 Michael Goggin and Rob Gramlich, "Observations on Winter Electric Reliability Event in South Central U.S.," (February 17, 2021), available at: https://energycentral.com/c/gr/observations-winter-electric-reliability-event-south-central-us.

4 Theodore U. Marston, "The US Electric Power System Infrastructure and Its Vulnerabilities," (June 15, 2018), The Bridge, National Academy of Engineering, Volume 48, Issue 2, at 31-39, available at: https://www.nae.edu/File.aspx?id=183084.

Figure 1. Map of Proposed Projects

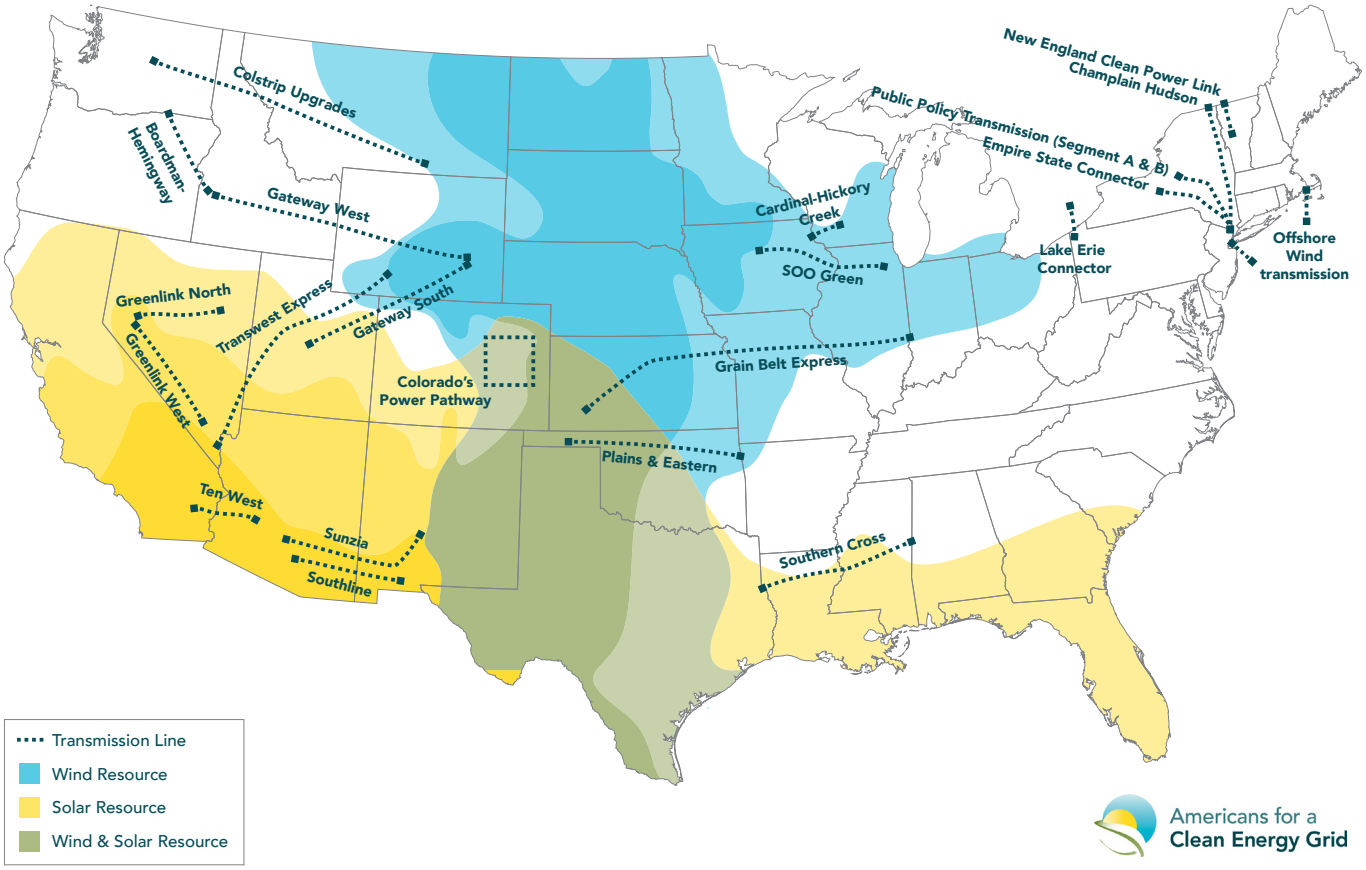

Table 1. Details of Proposed Projects

Region	Project Name	Miles	kiloVolts	AC/DC	Cost $B
New England	NE Clean Power Link	150	320	DC	$1.600
New York	Empire State Connector	265	320	DC	$1.500
	Champlain Hudson	330	300	DC	$2.200
	Public Policy Transmission	100	345	AC	$1.230
Offshore	Multiple Projects	30	300	DC	$1.902
PJM	Lake Erie Connector	73	320	DC	$1.000
ERCOT- Southeast	Southern Cross	400	500	DC	$1.400
MISO	SOO Green	349	525	DC	$2.500
	Cardinal - Hickory Creek	100	345	AC	$0.520
SPP	Grain Belt Express	780	600	DC	$2.300
	Plains and Eastern Oklahoma	400	600	DC	$1.200
West	Transwest Express	730	600	DC	$3.000
	Colorado's Power Pathway	560	345	AC	$1.700
	Greenlink North Nevada	235	525	AC	$0.810
	Greenlink West Nevada	351	525	AC	$1.608
	Gateway South	400	500	AC	$1.900
	Gateway West	1000	500	AC	$2.880
	Boardman to Hemingway	300	500	AC	$1.200
	Ten West	114	500	AC	$0.300
	Sunzia	515	500	AC, DC	$1.500
	Southline	240	345	AC	$0.800
	Colstrip Upgrades	500	500	AC	$0.227
Total		**7,922**			**$33.278**

II. Project Descriptions

1. New England Clean Power Link – DC line mostly running under Lake Champlain and into Vermont, delivering Canadian power to New England.[5]

2. Empire State Connector – DC line delivering renewable energy from upstate New York to New York City.[6]

3. Champlain Hudson – DC line mostly running under Lake Champlain and the Hudson River, delivering Canadian power to New York City.[7]

4. New York public policy transmission – Upgrades to New York's AC transmission system to interconnect more renewable energy.[8]

5. Offshore wind projects – This item accounts for the underwater transmission to interconnect the first phases of proposed offshore wind projects in New York and New England.[9] While other offshore transmission projects will likely be developed to meet state requirements, only the first phase of offshore projects are included in this report as these projects are in relatively advanced development and have signed interconnection agreements, while in many cases the type of interconnection for subsequent projects is still being determined.

6. Lake Erie Connector – DC line under Lake Erie, connecting Ontario with PJM, the grid operator in the Mid-Atlantic and Great Lakes region.[10]

7. Southern Cross – DC line connecting the Electric Reliability Council of Texas (ERCOT) grid with Southeastern power markets through a proposed converter station in Mississippi.[11]

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5 TDI New England, "New England Clean Power Link: Project Development Portal," available at: http://www.necplink.com/.

6 See https://empirestateconnector.com/.

7 See https://chpexpress.com/.

8 NYISO, "NYISO Board Selects Transmission Projects to Meet Public Policy Need," (April 8, 2019), available at: https://www.nyiso.com/-/press-release-nyiso-board-selects-transmission-projects-to-meet-public-policy-need.

9 The cost of $1.9 billion assumes around 2,500 MW of offshore wind capacity at an assumed $762 cost of transmission per kW of offshore wind capacity, per the cost of offshore wind electrical infrastructure indicated in Tyler Stehly, Philipp Beiter, and Patrick Duffy, 2019 Cost of Wind Energy Review, (December 2020), available at: https://www.nrel.gov/docs/fy21osti/78471.pdf.

10 ITC Investment Holdings Inc., "Lake Erie Connector Project," available at: https://www.itclakeerieconnector.com/.

11 Pattern Energy, "Southern Cross Transmission Fact Sheet," (2020), available at: https://southerncrosstransmission.com/wp-content/up-

8. SOO Green – Underground DC line running under existing railroad right-of-way from Iowa to near Chicago.[12]

9. Cardinal - Hickory Creek – New AC line from near Dubuque, Iowa to Madison, Wisconsin. This line is the last of Midcontinent Independent System Operator's Multi-Value Projects (MISO's MVPs).[13]

10. Grain Belt Express – Originally developed by Clean Line to deliver renewable energy from Kansas to PJM, this line was purchased by Invenergy.[14]

11. Plains and Eastern Oklahoma – Originally developed by Clean Line to deliver renewable energy from the Oklahoma Panhandle to Southeast markets via a converter station near Memphis, the Oklahoma portion of this line was purchased by NextEra Energy.[15]

12. Transwest Express – DC line to deliver power from Wyoming's proposed Chokecherry and Sierra Madre wind project to a market hub near Las Vegas, Nevada.[16]

13. Colorado's Power Pathway – New AC lines and upgrades proposed by Xcel's Public Service Company of Colorado to interconnect eastern Colorado renewable resources.[17]

14. Greenlink North Nevada – New AC line across northern Nevada, would enable the interconnection of new renewable resources.[18]

15. Greenlink West Nevada – New AC line connecting southern and northern Nevada, which would also enable the interconnection of renewable resources along its path.

16. Gateway South – PacifiCorp AC project to deliver Wyoming wind to Utah and the Southwest.[19]

17. Gateway West – PacifiCorp AC project to deliver Wyoming wind to the Pacific Northwest.[20]

18. Boardman to Hemingway – AC project to allow Wyoming wind delivered via Gateway West to fully reach the Pacific Northwest.[21]

19. Ten West – New AC line between Arizona and California, connecting the Delaney and Colorado River substations and allowing more solar development.[22]

20. Sunzia – Proposed as either two AC circuits or an AC and DC circuit, could deliver New Mexico

loads/2020/10/SC_factsheet_2020.pdf.

12 See https://www.soogreenrr.com/.

13 MISO, "Regionally Cost Allocated Project Reporting Analysis," (January 2021), available at: https://cdn.misoenergy.org/MVP%20Dashboard%20Q4%202020117055.pdf.

14 Invenergy Transmission LLC, "Grain Belt Express: An Energy Connection for America's Heartland," available at: https://grainbeltexpress.com/.

15 Michelle Froese, "NextEra Acquires Oklahoma Portion of Plains & Eastern Clean Line Transmission Project," (December 27, 2017), available at: https://www.windpowerengineering.com/nextera-acquires-oklahoma-portion-plains-eastern-clean-line-transmission-project/.

16 TransWest Express LLC, "Critical Grid Infrastructure to Connect the West," available at: http://www.transwestexpress.net/.

17 Xcel Energy, "Colorado's Power Pathway," available at: https://www.transmission.xcelenergy.com/Projects/Colorado/colorado-power-pathway.

18 See https://www.nvenergy.com/cleanenergy/greenlink.

19 PacifiCorp, "Gateway South," available at: https://www.pacificorp.com/transmission/transmission-projects/energy-gateway/gateway-south.html.

20 Idaho Power and Rocky Mountain Power, "Gateway West Transmission Line Project," available at: http://www.gatewaywestproject.com/.

21 Idaho Power, "Boardman to Hemingway: A Clean-Energy Pipeline," available at: https://www.boardmantohemingway.com/.

22 State of California Public Utilities Commission, "Delaney Colorado River Transmission Ten West Link Project," (updated December 3, 2020), available at: https://www.cpuc.ca.gov/environment/info/dudek/tenwest/index.htm

renewable resources to Arizona.[23]

21. Southline – AC project between southern New Mexico and Arizona, which will facilitate renewable development.[24]

22. Colstrip Transmission System upgrade – Upgrades to increase the transfer capacity on the existing 500-kV AC transmission line from Montana to the Pacific Northwest, as well as on the Bonneville Power Administration's system, which would enable additional delivery of Montana renewable energy to the region.[25]

[23] See https://sunzia.net/.

[24] Western Area Power Administration, "Projects," available at: https://www.wapa.gov/transmission/TIP/Pages/projects.aspx.

[25] Bonneville Power Administration, "Montana Renewable Resource Development Action Plan," at 25-26, (February 23, 2018), available at: https://www.bpa.gov/Projects/Initiatives/Montana-Renewable-Energy/Documents%20Montana/Planning%20Committee%20MT%20Action%20Plan%202_23%20.pptx.

III. Benefits of Proposed Projects

Investing in transmission gives consumers access to electricity that is more affordable, reliable, and clean. Transmission provides consumers with access to lower-cost forms of electricity generation, including high-quality renewable energy resources. Dozens of studies from grid operators, national laboratories, and others have found that transmission investment provides large net benefits, several times greater than its cost. The Southwest Power Pool (SPP) has found significant net benefits have already been realized from its recent transmission investments, with benefits expected to exceed costs by a factor of 3.5 over the lines' first 40 years.[26] MISO has also found that its MVP projects offer a benefit-to-cost ratio of between 2.2 and 3.4.[27] Similarly, the National Renewable Energy Laboratory Interconnections Seam study found benefit-to-cost ratios of between 1.8 to 2.9 for various transmission configurations.[28]

PJM has found transmission provides its consumers with billions of dollars in benefits by reducing the cost of producing electricity, increasing competition, reducing the need for power plant capacity, increasing power system reliability and resilience, and enabling the region to take advantage of new low-cost gas and renewable resources.[29] In several other studies, utility consultant the Brattle Group has found that transmission provides a similarly wide array of benefits.[30]

These studies note that many benefits of transmission are difficult to quantify, so they were not accounted for in those analyses. Many of those benefits are discussed below. Transmission is also what economists describe as a public good, in that many of the benefits of transmission cannot be realized by the party making the investment, so policy is needed to correct for the resulting underinvestment in transmission.

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[26] SPP, The Value of Transmission, (January 2016), available at: https://www.spp.org/documents/35297/the%20value%20of%20transmission%20report.pdf.

[27] MISO, MTEP17 MVP Triennial Review, (September 2017), available at: https://cdn.misoenergy.org/MTEP17%20MVP%20Triennial%20Review%20Report117065.pdf.

[28] Gregory Brinkman, Joshua Novacheck, Aaron Bloom, and James McCalley, Interconnections Seam Study: Overview, (October 2020), at 32, available at: https://www.nrel.gov/docs/fy21osti/78161.pdf.

[29] PJM, The Benefits of the PJM Transmission System," (April 16, 2019), available at: https://pjm.com/-/media/library/reports-notices/special-reports/2019/the-benefits-of-the-pjm-transmission-system.ashx?la=en.

[30] Judy Chang, Johannes Pfeifenberger, and Michael Hagerty, The Benefits of Electric Transmission: Identifying and Analyzing the Value of Investments, (July 2013), at v, available at: https://cleanenergygrid.org/uploads/WIRES%20Brattle%20Rpt%20Benefits%20Transmission%20July%202013.pdf; Judy Chang, Johannes Pfeifenberger, Samuel Newell, Bruce Tsuchida, and Michael Hagerty, Recommendations for Enhancing ERCOT's Long-Term Transmission Planning Process, (October 2013), Appendix B, available at: http://files.brattle.com/files/6112_recommendations_for_enhancing_ercot%E2%80%99s_long-term_transmission_planning_process.pdf.

Providing Consumers with Access to Clean Energy

Utilities and corporate customers are increasingly buying renewable energy for its economic and environmental benefits, yet transmission constraints are limiting their ability to efficiently tap these resources. We estimate that around 220 million MegaWatt-hours of additional domestic wind and solar generation will be enabled by the 22 transmission lines discussed above, comprising around 60,000 MW of additional renewable capacity. If completed, these transmission projects would drive a nearly 50% increase in wind and solar generation from current levels,[31] allowing wind and solar to grow from 11.6% to 17% of total U.S. electricity supply.[32]

We conservatively estimate that the roughly 42,000 MW of additional transfer capacity enabled by these transmission projects could enable the interconnection of around 60,000 MW of additional renewable capacity in the U.S. Based on the ability to use the geographic diversity of wind and solar resources to obtain a more constant output profile, and the complementarity between wind and solar output profiles, it is typically possible for the nameplate capacity of wind and solar attached to a transmission line to exceed the transfer capacity of the line by around 50%. The output of the renewable generators delivered by these transmission lines would also be high, as they access some of the highest quality wind and solar resources in the country. Wind and solar projects developed in many of the resource areas accessed by these lines can exceed 50% and 30% capacity factors, respectively, which are well above average. Transmission constraints are a major limiting factor to the continued growth of wind and solar generation.[33]

Transmission investment plays a critical role in reducing pollution from fossil power plants located in or near population centers. Transmission allows renewable energy to be delivered to those population centers, displacing the need for the polluting power plant and directly reducing its harmful emissions. In many cases these polluting power plants are located in disadvantaged communities, so transmission can help address environmental justice concerns.

Many studies have confirmed that large-scale transmission expansion is essential for the transition to clean energy. Transmission not only delivers low-cost renewable energy to population centers, but is also essential for accessing a diverse mix of wind and solar resources by enabling large inter-regional flows of power.[34] These studies have quantified the transmission needed to reach high levels of renewable energy, and unfortunately the 22 projects identified in this report provide only a fraction of the total transmission needed to decarbonize the power system.

The 22 proposed projects provide about 17 million MW-miles of transmission capacity (a 1-mile line that can deliver 10 MW of power provides 10 MW-miles). The current U.S. transmission system is about 150 million MW-miles, so these 22 projects would increase its transfer capacity by about 11-12%. As noted above, these projects add about 8,000 miles, or about a 3% increase, to America's 240,000 miles of transmission. That it is possible to increase transfer capacity by 12% with a 3% increase in line miles reflects the use of higher-voltage transmission for these 22 projects, enabling the delivery of more power over longer distances.

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31 EIA, "Table 1.1.A. Net Generation from Renewable Sources: Total (All Sectors), 2011-January 2021," available at: https://www.eia.gov/electricity/monthly/xls/table_1_01_a.xlsx.

32 EIA, "Table 1.1. Net Generation by Energy Source: Total (All Sectors), 2011-January 2021," available at: https://www.eia.gov/electricity/monthly/xls/table_1_01.xlsx.

33 Jay Caspary, Michael Goggin, Rob Gramlich, and Jesse Schneider, Disconnected: The Need for a New Generator Interconnector Policy, (January 2021), available at: https://cleanenergygrid.org/wp-content/uploads/2021/01/Disconnected-The-Need-for-a-New-Generator-Interconnection-Policy-1.pdf.

34 For example, see American Wind Energy Association, Grid Vision: The Electric Highway to a 21st Century Economy, (May 2019), available at: https://cleanpower.org/wp-content/uploads/2021/01/Grid-Vision-The-Electric-Highway-to-a-21st-Century-Economy.pdf, Christopher Clack, Michael Goggin, Aditya Choukulkar, Brianna Cote, and Sarah McKee, Consumer, Employment, and Environmental Benefits of Electricity Transmission Expansion in the Eastern U.S., (October 2020), available at: https://cleanenergygrid.org/wp-content/uploads/2020/10/Consumer-Employment-and-Environmental-Benefits-of-Transmission-Expansion-in-the-Eastern-U.S..pdf.

However, the 17 million MW-miles added by these 22 projects are only about 10% of the transmission investment that is needed to decarbonize the power system. An MIT study found a doubling of transmission capacity would be necessary to decarbonize the power sector, or 150 million additional MW-miles.[35] The Princeton Net Zero America study calls for a tripling of transmission capacity to decarbonize, or 300 million new MW-miles.[36] The NREL Interconnections Seam study, which only reaches 70% carbon-free electricity, calls for around 110 million new MW-miles.[37] NREL's Renewable Energy Futures study called for 200 million additional MW-miles.[38] A recent study for the Eastern Interconnect projected a doubling of transmission capacity to reduce carbon emissions by over 95%,[39] which, scaled to the country, would require 150 million MW-miles.

Jobs

The $33 billion investment in these 22 transmission projects would create around 600,000 new jobs, including 240,000 direct jobs plus 360,000 indirect and induced jobs. The wind and solar deployment enabled by this transmission investment could create an additional 640,000 jobs, bringing the total job creation benefit to around 1,240,000 jobs.

That estimate for jobs created from transmission investment is based on the results of following five studies that used economic input-output models to evaluate the direct and indirect job creation benefits of transmission construction. These results indicate DC projects create around 4 direct jobs per $1 million of expenditure and 11.3 total direct, indirect, and induced jobs, while AC projects create around 11.5 direct jobs per $1 million of expenditure and 27 total direct, indirect, and induced jobs.

Table 2. Studies of Job Creation from Transmission Investment

AC or DC	Construction direct job-years/$1 million	Construction direct, indirect, and induced job-years/$1 million
AC[40]	9 to 14	19 to 35
AC + DC[41]	11.72	NA
AC + DC[42]	4.25	12.5

35 Patrick Brown and Audun Botterud, "The Value of Inter-Regional Coordination and Transmission in Decarbonizing the US Electricity System," (January 20, 2021), Joule, Volume 5, Issue 1, at 115-134, available at: https://www.sciencedirect.com/science/article/abs/pii/S2542435120305572?dgcid=author.

36 Eric Larson et al., Net-Zero America: Potential Pathways, Infrastructure, and Impacts, (December 15, 2020), available at: https://environmenthalfcentury.princeton.edu/sites/g/files/toruqf331/files/2020-12/Princeton_NZA_Interim_Report_15_Dec_2020_FINAL.pdf.

37 Aaron Bloom et al., The Value of Increased HVDC Capacity Between Eastern and Western U.S. Grids: The Interconnections Seam Study, (October 2020), available at: https://www.nrel.gov/docs/fy21osti/76850.pdf.

38 NREL, Renewable Electricity Futures Study," (2012), available at: https://www.nrel.gov/docs/fy13osti/52409-ES.pdf.

39 Christopher Clack, Michael Goggin, Aditya Choukulkar, Brianna Cote, and Sarah McKee, Consumer, Employment, and Environmental Benefits of Electricity Transmission Expansion in the Eastern U.S., (October 2020), available at: https://cleanenergygrid.org/wp-content/uploads/2020/10/Consumer-Employment-and-Environmental-Benefits-of-Transmission-Expansion-in-the-Eastern-U.S..pdf.

40 MISO, Economic Impact of MTEP In-Service Projects from 2005-2015, (July 2015), available at: https://cdn.misoenergy.org/Economic%20Impact%20of%20MTEP%20In-Service%20Projects271136.pdf

41 Dave Swenson, Economic Impact & Job Creation Relative to Large-Scale, High Voltage Transmission Infrastructure, (July 2018), available at http://www2.econ.iastate.edu/prosci/swenson/Publications/The%20Interconnection%20Seam%20Study%20Amended%20Title.pdf

42 WIRES and The Brattle Group, Employment and Economic Benefits of Transmission Infrastructure Investment in the U.S. and Canada, (May 2011), available at: https://brattlefiles.blob.core.windows.net/files/6534_employment_and_economic_benefits_of_transmission_infrastructure_investmt_pfeifenberger_hou_may_2011_wires.pdf.

AC or DC	Construction direct job-years/$1 million	Construction direct, indirect, and induced job-years/$1 million
DC[43]	3 to 4	NA
DC[44]	5.05	11.30

The above estimates do not account for the job creation from the wind and solar deployment enabled by the transmission investment. As noted above, the 42 GW of transmission capacity provided by these transmission lines would likely enable around 60 GW of renewable deployment, as installed renewable capacity can often exceed transmission capacity by around 50% due to diversity in renewable output. At a rate of 4 direct jobs per renewable MW and 10.64 total direct and indirect jobs per renewable MW,[45] the renewable capacity enabled by this transmission investment would yield an additional 240,000 direct jobs and around 640,000 total direct and indirect jobs, bringing total job creation to over 1.2 million jobs.

Other factors could further expand the job creation associated with this investment. A large-scale and sustained investment in transmission in America would incentivize greater domestic manufacturing of transmission equipment, including conductor cables, tower components, transformers and converters, circuit breakers, and other components. 2011 analysis by the Brattle Group indicated that domestic content accounted for 82% of the total value of transmission investment, with 61% of materials sourced domestically.[46] Brattle estimated that 65% of transmission wires and towers were sourced domestically, while transformers and circuit breakers were 35% domestic. In addition to the policies discussed below, a manufacturing tax credit for high voltage transmission facilities could further increase domestic content. All transmission construction and O&M work is inherently domestic, and transmission planning, engineering, and logistics work would also typically be performed domestically. Most transmission jobs are union jobs, and pay well. Transmission investment also provides American businesses and industries with access to low-cost, reliable electricity, which brings jobs to America.

Reliability and Resilience

The tragic power outages in Texas and other parts of the Central U.S. in February 2021 underscore the importance of transmission for electric reliability and resilience. The ERCOT power system has limited transmission ties to other regions, so it was only able to import about 800 MW when it was hit with natural gas supply interruptions, generator outages, and high demand due to extreme cold. In contrast, stronger transmission ties to neighboring regions allowed SPP and MISO to weather the storm with less severe power outages, as they were able to import more than 15 times as much power as ERCOT.

As shown in the bottom half of the chart below, at maximum MISO was importing nearly 9,000 MW from PJM, several thousand MW from TVA, and around an additional 1,000 MW each from Southern Company, Louisville Gas and Electric, and Canada.[47] Total MISO imports were consistently over 13,000

[43] Jinglin Duan and Julia Frayer, "Estimating Macroeconomic Benefits of Transmission Investment with the REMI PI+ Model," (May 2, 2018), available at: http://www.remi.com/wp-content/uploads/2018/05/WIRES-modeling_0501_final-v3.pdf.

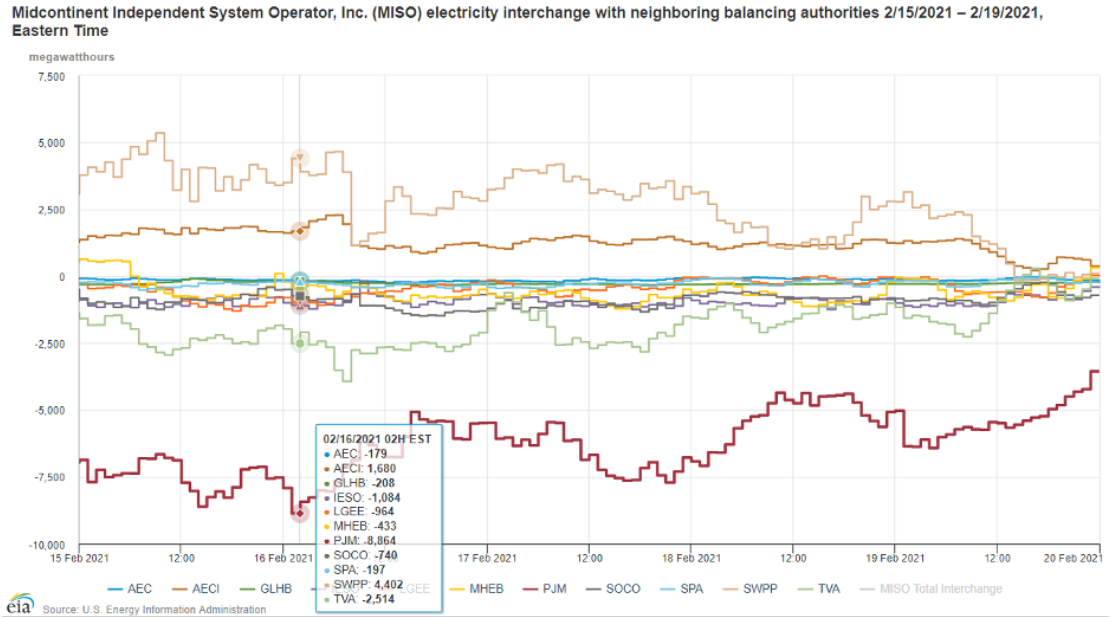
[44] Eric Lantz and Suzanne Tegen, Jobs and Economic Development from Net Transmission and Generation in Wyoming, (March 2011), available at: https://www.nrel.gov/docs/fy11osti/50577.pdf.

[45] Luigi Aldieri, Jonas Grafström, Kristoffer Sundström, and Concetto Paolo Vinci, "Wind Power and Job Creation," Sustainability, (December 18, 2019), at 16, available at: https://www.mdpi.com/2071-1050/12/1/45/pdf, 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, at 30, available at: https://resources.solarbusinesshub.com/images/reports/206.pdf, showing 3.3 installation and development jobs/MW for utility-scale solar, rounded up to 4 jobs/MW to account for manufacturing and other supply chain jobs.

[46] WIRES and The Brattle Group, Employment and Economic Benefits of Transmission Infrastructure Investment in the U.S. and Canada, (May 2011), at 20, available at: https://brattlefiles.blob.core.windows.net/files/6534_employment_and_economic_benefits_of_transmission_infrastructure_investmt_pfeifenberger_hou_may_2011_wires.pdf.

[47] This chart can be made at https://www.eia.gov/beta/electricity/gridmonitor/expanded-view/electric_overview/US48/US48/Interchange-WithNeighbor-5.

MW during the most challenging period from midday February 15 to midday February 16. In turn, MISO was exporting to power systems to its west, delivering over 5,000 MW to SPP, as shown in the top half of the chart.



Stronger transmission ties could have mitigated or even prevented the February power outages in Texas. For example, the proposed Southern Cross transmission line discussed above could have delivered its full capacity of 2,000 MW from the Southeast to ERCOT, enough to power around 400,000 Texas homes during times of peak demand. Multiple such ties could have brought in enough power from regions that were less affected by the cold, like the western and eastern parts of the U.S., to prevent the outages entirely.

Transmission within and between regions has played a critical role in keeping the lights on during other recent severe weather events, including the 2019 Polar Vortex and 2018 Bomb Cyclone cold snaps.[48] Weather events are typically only at their most extreme in areas much smaller than the size of our Eastern and Western Interconnections, so transmission allows surplus electricity supplies to be delivered from neighboring regions that are not experiencing extreme electricity demand or loss of generating supply. A stronger transmission network provides valuable redundancy in case other lines or power sources are unexpectedly taken offline. This provides national security benefits as well, as electricity is essential for powering a range of emergency services, and a stronger grid is less vulnerable to intentional attacks. The reliability value of a stronger grid is high, as power outages are estimated to cost each U.S. household between $28 and $169 annually.[49] Electricity has become essential to almost all personal and commercial activity, and with electrification it is increasingly critical for transportation and building heating.

Transmission also provides other benefits that are not typically quantified, including making power markets more competitive, hedging against fuel price volatility and other sources of uncertainty, and others.[50]

48 American Clean Power, "How Transmission Helped Keep the Lights on During the Polar Vortex," (February 14, 2019), available at: https://cleanpower.org/blog/transmission-helped-keep-lights-polar-vortex/.

49 American Society of Civil Engineers, A Comprehensive Assessment of America's Infrastructure, (2020), available at: https://infrastructurereportcard.org/wp-content/uploads/2020/12/National_IRC_2021-report.pdf.

50 American Wind Energy Association, Grid Vision: The Electric Highway to a 21st Century Economy, (May 2019), available at: https://cleanpower.org/wp-content/uploads/2021/01/Grid-Vision-The-Electric-Highway-to-a-21st-Century-Economy.pdf.

III. Policies to Allow Beneficial Transmission Projects to Move Forward

As a public good, many of the benefits of transmission cannot be realized by the party making the investment, so policy is needed to correct for the resulting underinvestment in transmission. Grid Strategies has labeled the key areas of policy reform needed to enable greater transmission investment the "three Ps:" planning, paying for, and permitting transmission. Proposed policy changes include:

Transmission Investment Tax Credit

A bill has been introduced by Senator Heinrich to create a tax credit to incentivize investments in high-voltage transmission lines.[51] The proposed tax credit is carefully targeted to incentivize these high-voltage transmission projects that are difficult to build but provide large net benefits, but not smaller local grid upgrades utilities are currently able to plan, pay for, and permit.

Based on recent success rates for transmission projects and the many challenges that hinder transmission, we expect less than half of the 22 projects identified in this report will proceed to construction in the near term. That would bring the total transmission investment down from $33 billion if all 22 projects were to proceed, to around $15 billion. With the proposed 30% tax credit, the total federal budget impact of the tax credit for the projects that proceed to construction is likely to be under $5 billion.

Because the intent of the tax credit is to incentivize new transmission investment, additional transmission lines that are not on the list in this paper could be developed, depending on the length of time the tax credit is available. However, the long lead time required to plan and permit transmission, particularly the high-voltage lines targeted by the tax credit, limits the number of new projects that could qualify for a near-term tax credit. The 22 lines listed in this paper were identified through a comprehensive review of regional transmission plans, the North American Electric Reliability Corporation's list of proposed transmission projects, and other sources, and represent all major transmission projects that could proceed to construction in the next few years.

[51] A Bill to Amend the Internal Revenue Code of 1986 to Establish a Tax Credit for Installation of Regionally Significant Electric Power Transmission Lines, S.1016, 117th Congress, (March 25, 2021), available at: https://www.congress.gov/bill/117th-congress/senate-bill/1016/.

A transmission tax credit would provide large net benefits, many times greater than its cost. As outlined above, many studies have documented the large net benefits of transmission for reducing consumer electric bills by providing access to lower-cost sources of electricity generation. A transmission tax credit particularly benefits lower-income individuals, as electricity bills make up a disproportionate share of their total spending.

Given the scale of transmission need discussed above, other policies to enable large-scale expansion of transmission over the longer-term are also needed.

Anchor Tenant

Legislation could be enacted to direct the federal government to directly invest in new transmission lines as an "anchor tenant" customer, and then re-sell that contracted transmission capacity to renewable developers and others seeking to use the transmission line. This would help provide the certainty needed to move transmission projects to construction and overcome what is called the "chicken-and-the-egg problem," in which renewable developers and transmission developers are each waiting for the other to go first due to the mismatch in the length of time it takes each to complete construction.

FERC Transmission Planning and Cost Allocation Reform

The Federal Energy Regulatory Commission (FERC) has authority over how transmission is planned and paid for. FERC can use that authority to break the transmission planning and cost allocation logjams that are preventing large regional and inter-regional lines from being built. Legislation to direct FERC to use that authority could also be helpful.

Streamlined Permitting

While most authority for permitting transmission lines is held by states, federal agencies have authority over lines that cross federal lands. Steps can be taken to streamline and expedite that process, which can currently take a decade or more.

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