Estimating the Climate Impacts of the Energy Permitting Reform Act of 2024 Transmission Provisions

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INTRODUCTION

On July 22, the US Senate's Energy and Natural Resources Committee released draft Energy Permitting Reform Act of 2024 (EPRA) language. The bill includes 19 sections with wide-ranging impacts for energy infrastructure and resource extraction.

In this Brief, we estimate the effect of the (draft) EPRA transmission provisions on greenhouse gas emissions. We find:

- Together, the EPRA and FERC Order 1920 would accelerate transmission expansion by 2–4x over today's rate.
- New transmission would help the US grid deploy large amounts of clean energy, helping to meet expected load growth and displace fossil fuel electricity generation.
- In our central scenario, we estimate the EPRA would help build clean energy that would reduce grid emissions by 6.5 Gt CO_2 equivalent (CO_2e), cumulatively through 2050.

TRANSMISSION PROVISIONS IN THE EPRA

We identify four EPRA sections that will impact transmission, which we summarize in order of significance to transmission expansion:

- **Interregional transmission planning and cost allocation – §402** directs the Federal Energy Regulatory Commission (FERC) to release an interregional transmission rule in six months that requires neighboring planning regions (excepting ERCOT in Texas) to 1) jointly plan transmission between their control areas using specific reliability and affordability benefits and 2) define how they will allocate the cost of those lines. FERC is to approve these plans if they are "just and reasonable."
- **FERC permitting and cost allocation – §401** establishes a process to backstop permitting and allocate costs to jurisdictional and non-jurisdictional entities (excepting ERCOT in Texas) for a transmission line if the line is deemed in the national interest and is 100 kV or higher. FERC can issue a permit for the line if a state takes more than one year to decide on a permit. Utilities (including independent transmission developers) requesting this §401 permit must file a cost allocation tariff for the permitted line for FERC to approve. Section §401 removes the need for the Department of Energy to define National Interest Electric Transmission Corridors (NIETCs) that limit the geographies where FERC can issue permits. For transmission lines requesting §401 permitting, FERC will be the lead agency for National Environmental Policy (NEPA) reviews.
- **Categorical Exclusions – §209** directs the Secretaries of the Interior and Agriculture to define categorical exclusions under NEPA that should accelerate upgrading transmission and distribution lines in existing rights-of-way or otherwise previously disturbed land, including by using advanced conductors and grid-enhancing technologies. §209 would benefit both regional and interregional transmission expansion.
- **Accelerating legal decisions – §101** shortens the window to legally challenge agency decisions for energy or mineral projects to 150 days. Further, §101 requires agencies and courts to make prompt decisions when considering energy and mineral projects and cases. §101 applies to both regional and interregional transmission, as well as other energy projects (including fossil fuel projects).

Additional context

The EPRA would impact both regional and interregional transmission expansion. For regional transmission, the EPRA would build on FERC Order 1920 that requires proactive regional transmission planning, which most regions are not conducting today. EPRA §401 and §402 mirror Order 1920 language and clearly indicates that FERC should oversee transmission planning, permitting, and cost allocation in the public interest. The EPRA interregional planning provisions specifically state that they should build upon regional transmission plans. Together with the permitting and cost allocation processes in §401, these portions of the bill will likely boost transmission expansion over what we would see from Order 1920 alone.

For interregional transmission, the EPRA creates a new planning regime from whole cloth where essentially none exists today. The clear intent, and likely outcome, will be new interregional transmission and closer coordination between neighboring grid operators.

For additional information, Grid Strategies LLC created a transmission process flow chart that includes EPRA provisions.

METHODOLOGY AND ASSUMPTIONS

Here we describe our methodology and assumptions at a high level. In the Appendix, we detail our methodology and assumptions further.

Methodology

To estimate the EPRA's emissions impacts from transmission, we start by assessing how regional and interregional transmission expansion will accelerate given the EPRA and FERC Order 1920. We then estimate how much that expanded transmission will reduce emissions by calculating how much clean energy that transmission would enable and how much fossil-fuel generation (and associated emissions) that clean energy would displace, as shown in the graphic below. We attribute all emissions reductions from interregional transmission to the EPRA and a fraction of emissions reductions from regional transmission to the EPRA.

We take a "bottom-up" approach to estimate how new transmission planning processes will yield expanded transmission, using historical planning processes as a guide. We assume that Order 1920 and the EPRA will spur grid planners to build regional transmission at a similar rate as MISO with its Multi-Value Project (MVP) and Long-Range Transmission Planning (LRTP) processes. We assume that EPRA §402 will spur grid planners to add interregional transfer capacity to meet a target fraction of their peak demand. We believe this approach captures the political and economic realities that constrain transmission planning and is reasonable as long as the grid remains transmission constrained. The 2.6 TW of projects backlogged in today's interconnection queues suggest transmission will remain a constraint in the near and midterm; in the longer term, anticipated load growth (including from AI, manufacturing, electrification, and other needs) will likely justify continued transmission expansion through 2050. We revisit the validity of this assumption in Finding 2.

We evaluate regional and interregional transmission separately. To estimate regional transmission buildout, we use MISO's MVP and LTRP processes as a guide and assume that grid regions plan and build transmission proportionally to what MISO achieved, adjusted for peak load.

To estimate interregional transmission buildout, we assume that EPRA §402 pushes regions to strive for a minimum transfer capability in proportion to their peak load and then continue to increase that capability as their load grows.

We further assume that the EPRA benefits the 22+ TW-miles of already-proposed transmission projects through the new permitting and cost-allocation provisions. We account for these already-proposed projects by assuming they kickstart regional and interregional expansion, coming online faster than new planning processes could if they were starting from square one.

Our approach complements capacity expansion modeling approaches that examine what the ideal economic transmission and generation expansion plans would be. We believe that our approach better captures the stakeholder challenges that currently limit transmission expansion. However, capacity expansion modeling better assesses the multiple options available to grid planners (for example, using lower-quality, local generation with lower transmission costs instead of ideal generation that requires transmission).

We note that in our calculations, we except ERCOT because neither Order 1920 nor the EPRA apply to ERCOT.

We outline our methodology further in the Assumptions section below and in Appendix B.

Regional Transmission Assumptions

To calculate regional transmission buildout:

1. We use MISO's MVP and LRTP planning as an upper bound for successful regional planning and assume that all planning regions (excepting ERCOT) build transmission at half of MISO's rate (600 GW-miles/year), scaled for peak load. We assume the United States as a whole builds at half of MISO's rate to balance Order 1920's ambition, the EPRA's new siting and cost allocation provisions, the limitations of stakeholder processes, and some US regions' hesitancy to build too much transmission too quickly.
2. We assume that US peak load (which we use to set the rate of transmission planning) grows linearly to double in 2050. We believe doubling load is a conservative estimate that takes into account expectations for near-term data center and manufacturing additions and coming vehicle, heat pump, hydrogen, and industrial loads. Most analyses show that if the United States were to decarbonize end uses by 2050, load would more than double (and these analyses do not assume significant load growth from data centers or manufacturing).
3. We assume new transmission enables grid operators to add 32 GWh per year of wind and solar energy per GW-mile. We base this estimate on estimates for generation additions from planned transmission lines in the *Transmission Ready to Go* report.
4. We assume that clean energy displaces emissions at a rate of 0.6 tons/MWh, which is the approximate life-cycle emissions rate of gas generators.[i] This assumes that gas remains the marginal generation source on most grids, that clean energy will likely displace some higher-emitting coal generation, and that, especially at high penetrations, new clean energy can compete with other non-emitting generation.
5. We assume that the EPRA and regional planning processes accelerate the buildout of the ~15 TW-miles of already-planned regional transmission projects, so that the first new regional transmission energizes in 2029. This 2029 start date is sooner than what one would expect from entirely new planning processes beginning in 2025.

Interregional Transmission Assumptions

We estimate the EPRA-driven interregional transmission buildout by:

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[i] The most efficient combined cycle generators emit 0.5 tons/MWh from combustion, while peaker plants are less efficient. Upstream methane leakage increases gas generation life-cycle emissions. Today's carbon emitting generation emits an average of 0.64 tons/MWh from combustion (source: EIA).

1. Assuming that planning increases interregional transfer capacity in proportion to regional peak loads. Specifically, we assume that grid planning regions built interregional transmission so that they can import (and export) 20% of their peak load to neighbouring regions. This 20% estimate is likely lower than the economic optimum; for example, the Massachusetts Institute of Technology (MIT) used capacity expansion modelling to find that 30% transfer capacity was economically optimum.[ii] We assume that interregional transmission lines average 100 miles long (to allow us to estimate interregional transmission build in GW-miles instead of GW).
2. Assuming linear load growth to double load in 2050, that new transmission brings online 32 GWh per GW-mile, and that new generation displaces 0.6 tons/MWh. These assumptions are the same ones we use for regional planning.
3. Assuming that the EPRA and regional planning processes accelerate the buildout of the ~7 TW-miles of already-planned interregional transmission so that the first new interregional transmission energizes in 2030, earlier than a new interregional planning process would otherwise energize new projects.

[ii] The proposed BIG WIRES legislation would have required a 30% interregional transfer minimum.

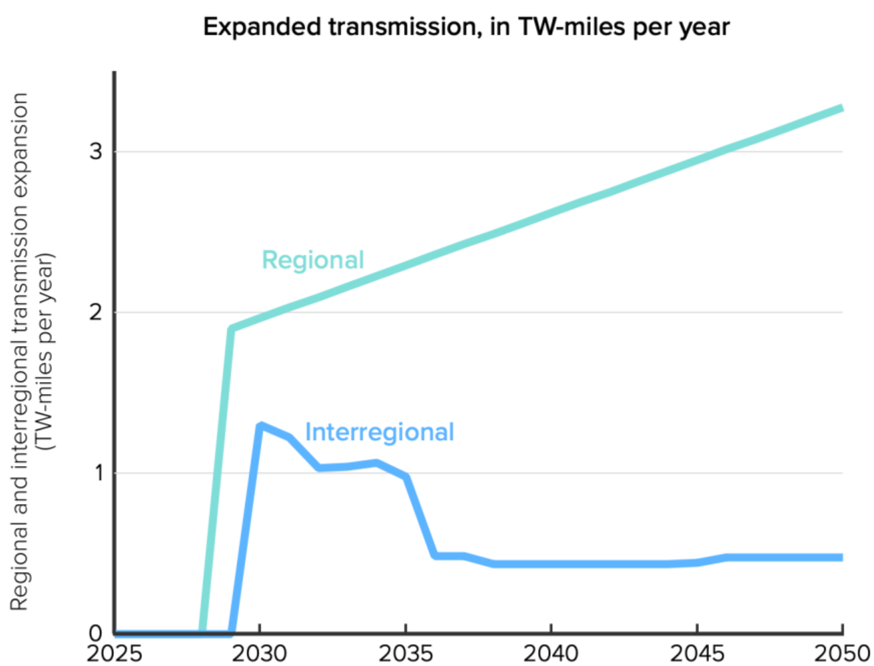
FINDING #1: Together, the EPRA and FERC Order 1920 dramatically accelerate transmission expansion.

In recent years, US transmission has expanded at approximately 1 TW-mile per year. In our estimation of Order 1920 and the EPRA impacts, we calculate that combined regional and interregional transmission would expand at 2–4 TW-miles per year (see Exhibit 1). These regional and interregional projects would likely displace some (but not all) other transmission planning. For example, some local reliability upgrades would likely be needed in addition to regional planning projects.

In Exhibit 1, interregional buildout (light blue) starts faster and then decreases because some regions currently have much less than the target interregional transfer capability (20% of peak load in our central scenario). The buildout continues for a number of years because we limit interregional transfer capability buildout in each year to 2% of the region's peak load.

As discussed above, we assume that even with new EPRA §402 interregional planning requirements, planning regions will build to "only" 20% interregional transfer capability. This assumption (by definition) leads to smaller interregional buildout than that found by MIT researchers, who used capacity expansion modeling and determined 30% was the economic optimum.

Exhibit 1. Estimated regional and interregional transmission expansion from Order 1920 and the EPRA. This transmission expansion is in addition to continued local projects, such as those needed to meet local reliability needs.



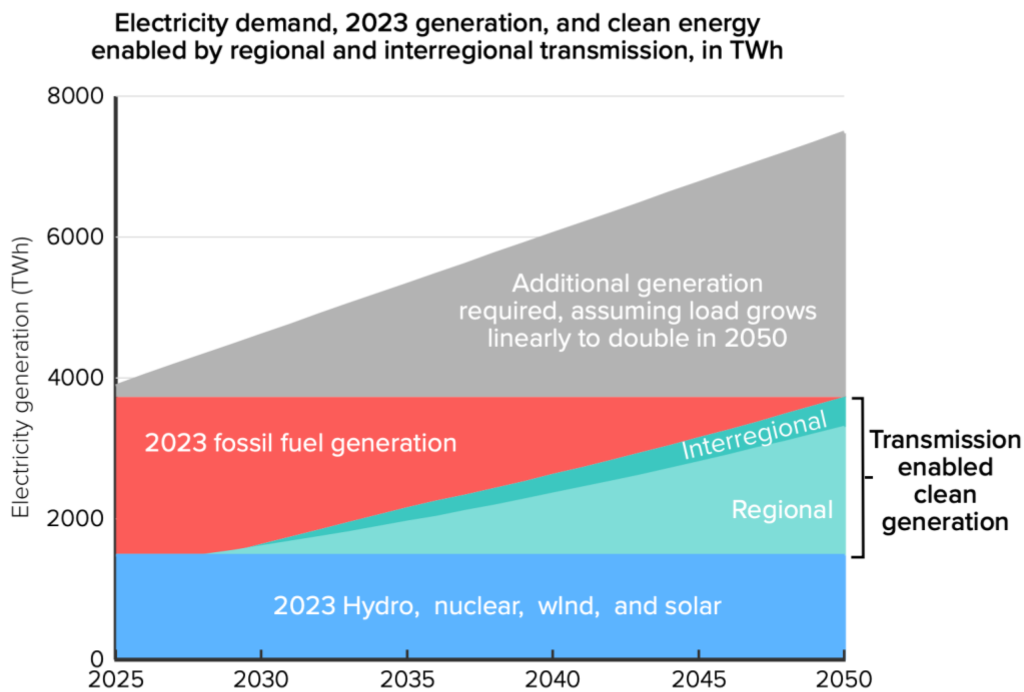
FINDING #2: At the rates modeled, accelerated regional and interregional deployment would help meet growing load and displace fossil fuels.

Load growth and the opportunity to displace more-expensive fossil fuel generation provide an economic justification for rapid clean energy deployment. As shown in Exhibit 2, our estimates for how the EPRA and Order 1920 would expand regional and interregional transmission would help meet this opportunity, but more generation would be needed.

Exhibit 2 shows 2023 carbon-free generation (light blue), 2023 fossil fuel generation (red), additional required generation assuming load grows linearly to double in 2050 (gray), and modeled transmission-enabled clean generation (teal). In the figure, we show transmission-enabled clean energy displacing fossil fuel generation to show how far existing and transmission-enabled clean energy go toward meeting total required generation.

Modeled transmission-enabled clean energy is comparable to 2023 fossil fuel generation. However, existing clean energy (blue) and modeled transmission-enabled clean energy supply only about half of needed generation in 2050. Thus, our analysis implies that EPRA-supported processes will not overbuild transmission to the extent that it would be uneconomic. In fact, the transmission expansion in Exhibit 1 is less than half of that found in the Net Zero America capacity expansion analysis. To meet total electricity demand (including the gray in Exhibit 2), grid operators can deploy more clean energy on the existing grid and continue to use fossil fuel generation.

Exhibit 2. Electricity demand, 2023 generation, and clean energy enabled by regional and interregional transmission (TWh)



FINDING #3: Modeled regional and interregional transmission expansion reduces grid emissions by 14.3 Gt CO_2e through 2050.

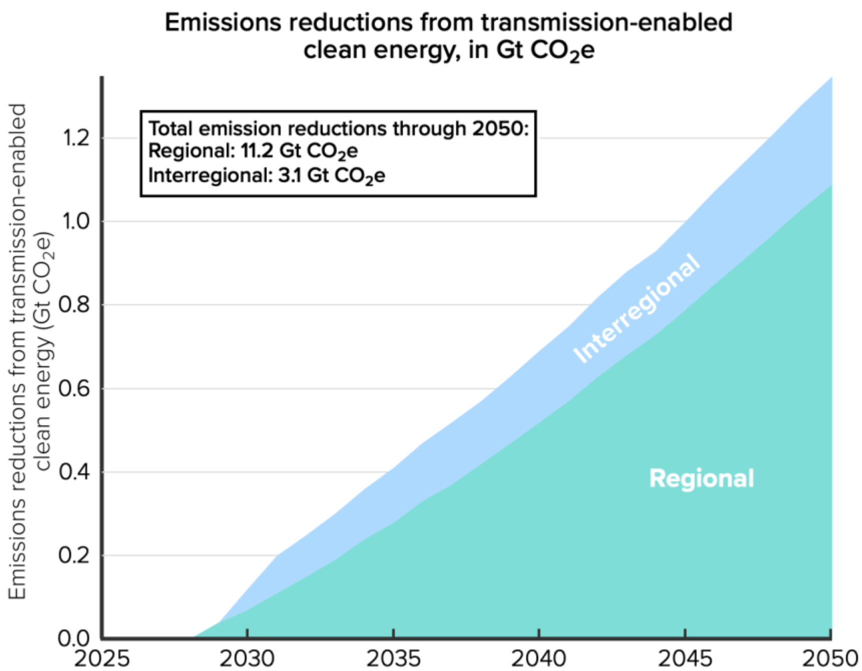
Exhibit 3 shows the yearly emissions reductions that result from transmission-enabled clean energy. Each year new transmission enables new clean energy to connect to the grid, displacing either existing fossil fuel generation or new fossil fuel generation that would be needed to meet growing load.

Cumulatively through 2050, the modeled regional transmission reduces emissions 11.2 Gt CO_2e and the modeled interregional transmission reduces emissions 3.1 Gt CO_2e (the area of the Exhibit 2 curves). In 2050, expanded transmission helps reduce grid emissions by 1.35 Gt CO_2e per year.

Given the near total lack of interregional transmission planning today, we believe it reasonable to attribute 3.1 Gt CO_2e reductions to the EPRA for interregional transmission. Further, given the important ways the EPRA benefits regional transmission (as discussed above, the EPRA directly aids siting and cost allocation of regional lines and indirectly helps with regional planning), we estimate that the EPRA is responsible for ~30% of regional transmission expansion or 3.4 Gt CO_2e.

Together, using the stated interregional and regional assumptions, we estimate the EPRA transmission provisions would reduce cumulative US greenhouse gas emissions through 2050 by 6.5 Gt CO_2e. For context, in 2023, US electricity generators [emitted] 1.4 Gt CO_2e.

Exhibit 3. Emissions reductions from transmission-enabled clean energy. Note, regional transmission benefits from both FERC Order 1920 and the EPRA, as described in the text.



APPENDIX A: Sensitivities

Below, we estimate greenhouse gas reductions using different sets of assumptions.

Exhibit A1. Estimation of regional and interregional GHG reductions with different assumptions. We include our central case as the top data row. As indicated in the main text, only a portion of the regional GHG reductions (we suggest 30%) should be attributed to the EPRA. We highlight changed assumptions that increase GHG reductions from the central case in green. We highlight changed assumptions that reduce GHG reductions from the central case in red.

Load Growth	Clean Enabled	Regional Build rate	Transfer used for IR planning	Regional GHG reductions	IRT GHG reductions
2050 Load vs today	(GWh/year per GW-mile)	% of MISO rate	% of peak	Gt/year in 2050, Gt total through 2050	Gt/year in 2050, Gt total through 2050
200%	32	50%	20%	**1.1, 11.2**	**0.26, 3.1**
200%	32	50%	30%	**1.1, 11.2**	**0.53, 6.1**
250%	32	50%	20%	**1.3, 13.0**	**0.39, 4.4**
250%	32	50%	30%	**1.3, 13.0**	**0.74, 8.1**
250%	32	65%	20%	**1.4, 14.6**	**0.74, 8.1**
200%	20	50%	20%	**0.68, 7.0**	**0.16, 1.9**
200%	32	35%	20%	**0.77, 7.9**	**0.26, 3.1**
150%	32	50%	20%	**0.89, 9.5**	**0.15, 1.9**

Description of sensitive assumptions and outputs

Below, we clarify the meaning of the headings in the Exhibit above.

Load Growth – 2050 load, as a percent of 2023 load. Increasing load growth increases emissions reductions because we assume transmission expansion is proportional to load.

Clean Enabled – Amount of delivered clean energy enabled by each GW-mile of expanded transmission. Emissions reductions vary *linearly* with Clean Enabled.

Regional build rate – Fraction of MISO's recent transmission buildout (MVP and LTRP) rate in that the US averages for regional transmission buildout with Order 1920 and the EPRA. MISO averaged 5 GW-miles per system peak.

Transfer used for IR (interregional) planning – This is the target interregional transfer capability each region strives for in planning. Lower values result in less ambitious interregional transmission expansion and smaller emissions reductions.

Regional GHG reductions –The first number is the grid greenhouse gas reductions in the year 2050 in Gt CO_2 equivalent from regional transmission buildout. The second number is the cumulative greenhouse gas reductions through 2050, again in Gt CO_2 equivalent from regional transmission buildout.

IRT (Interregional transmission) GHG reductions –The first number is the grid greenhouse gas reductions in the year 2050 in Gt CO_2 equivalent from interregional transmission buildout. The second number is the cumulative greenhouse gas reductions through 2050, again in Gt CO_2 equivalent from interregional transmission buildout.

APPENDIX B: Detailed methodology and assumptions

Regional Transmission

MISO's MVP planning built out approximately 600 GW-miles per year and the LRTP Tranches are expected to add further transmission at a similar rate. LRTP Tranche 1 will build ~470 GW-miles per year through 2030, with additional buildout expected through Tranches 2 and 3.

With Order 1920 and the EPRA Act, we estimate that national regional transmission buildout will scale with peak load. Given MISO's 120 GW peak, MISO regional planning is yielding 600 GW-miles/year ÷ 120 GW = 5 GW-miles/year per GW peak.

Given the successful MISO state collaboration and the regions' dispersed geography, we anticipate other regions would build transmission (in GW-miles) more slowly than MISO, adjusted for peak. In our central analysis, we assume the national average (including MISO) is half that of MISO.

Currently, US peak load is 740 GW. Subtracting ERCOT (85 GW), remaining peak load is approximately 655 GW. We then scale yearly peak out to 2050 assuming linear load growth. In our central analysis, we assume US peak load doubles in 2050. We choose linear load growth to approximate the potential "waves" of new (potentially nonlinear) loads, with data centers and manufacturing occurring first, followed by transportation electrification, space heating, green H_2 production, and industrial electrification.

We assume that the first regional transmission projects are completed in 2029. We chose 2029, even though it is earlier than one could expect Order 1920 compliance to produce new projects, because in 2023 there were already ~15 GW-miles of projects at various stages of development. We note that the EPRA's siting and cost allocation provisions and Order 1920 are likely to ensure that these projects are built. One pathway is that utilities and/or developers could take these projects to FERC directly via EPRA's §401 provisions.

Once we have yearly transmission build, we multiply this buildout by the typical amount of clean energy this would enable. We use an average value of 32 (GWh/year)/(GW-mile), based on estimates of the generation expected to connect to the projects listed in the 2023 Grid Strategies *Transmission Ready to Go* report and detailed examination of planned generation additions to the Colorado Power Pathway project. This value for enabled clean energy will, of course, vary regionally and could be smaller or lower depending on the project and how well the grid operator leverages the line. As an upper end, developers could connect wind, solar, storage, and dispatchable generation to use a line to its maximum capacity in nearly all hours of the year. For a 100-mile line, this would yield 88 (GWh/year)/(GW-mile).[iii]

Once we have clean energy added, we sum the total deployed clean energy in each year and multiply by the displaced emissions rate of 0.6 tons/MWh to get reduced emissions. This emissions rate, close to the average life-cycle emissions for natural gas generation, is reasonable as long as enabled clean energy generation does not approach total needed energy. As shown in Exhibit 2, expected load growth ensures this remains the case through 2050.

Interregional transmission

We assume that grid operators plan and build interregional transmission to meet a fixed fraction of the region's peak load. We start by examining each planning region's peak load and current interregional transmission, using our 2023 analysis.

We then calculate each planning region's yearly peak load using the same methodology used for regional planning above.

[iii] Invenergy has stated that they hope to use exactly this approach to make the most of their Grainbelt Express project from SPP to MISO and PJM.

We then assume each region will strive to plan and build transfer capacity to meet a fixed fraction of their load. Botterud, Knittel, Parson, and Senga used capacity expansion modeling to determine that the economically ideal minimum transfer capacity between regions was ~30%. As our central case, we assume that each region strives for 20% transfer capacity, as there remain barriers to interregional transmission even with better planning.

In each year, we assume that each region builds transmission transfer capacity at whichever is smaller: the additional transmission needed to meet the planning target or 2% of the planning region's peak load. This prevents regions with low transfer capacities today from building an unrealistic amount of transmission in the first few years.

To obtain GW-miles of interregional transmission from GW transfer capacity, we assume that "in-region" transmission projects are 100 miles long. This length is slightly smaller than the average length found by MIT using capacity expansion modeling.[iv]

Once we have yearly interregional transmission build in GW-miles, we use the same methodology used for regional transmission to calculate clean energy additions and displaced emissions.

[iv] Botterud, Knittel, Parson, and Senga found that for 2035, the economic interregional transfer was 56 GW and 13,520 GW-miles, corresponding to a length of approximately 240 miles, spanning both neighbors. Our 100 miles for "in region" transmission distance corresponds to an average of 200 miles across both neighbors.