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Electricity transmission is a low-cost tool for carbon abatement

Analysis using current regional carbon emission factors indicates that building the 22 near-term transmission projects evaluated in the "Transmission Projects Ready to Go" report[1] would reduce CO_2 emissions by around 130 million short tons per year.[2] With the assumption that those lines will operate for 50 years,[3] **the total emissions reductions would total 6.4 billion short tons of CO_2, corresponding to 3-4 years of electric sector CO_2 emissions at their current rate.** If one more conservatively assumes that the emissions displacement rate over the transmission assets' lifetime will approximate the 850 lb/MWh CO_2 emissions rate of gas combined cycle generation, annual emissions savings are around 81 million short tons, or **over 4 billion short tons** over the 50-year life of the transmission lines.

If a 30% Investment Tax Credit (ITC) is used to incentivize the development of new transmission, the total cost to the Treasury is estimated to be under $10 billion.[4] **Therefore, the cost to the federal government of carbon abatement over 50 years using a 30% ITC for transmission is only $1.52/short ton at current emission rates, and $2.41/short ton with a future emissions rate based on the displacement of gas combined cycle generation.** Notably, **the cost to society is almost certainly negative**, given that multiple grid operators have found that planned transmission investments have benefit-cost ratios in excess of 2:1, and in some cases as high as 3.5:1.[5] This is because transmission more than pays for itself by providing consumers with access to lower cost electricity, if the challenges related to transmission cost allocation can be overcome by policies like the transmission ITC.

The above analysis assumes that all of the renewable generation enabled by transmission is additive, given that a lack of transmission is the primary limiting factor for additional renewable deployment in many regions.[6] Under the more conservative assumption that without transmission the same total amount of renewable capacity would be deployed, but just in lower-output wind and solar resource areas, the carbon reduction benefits of transmission are still large.

Comparing NREL estimates for wind and solar capacity factors in the resource areas accessed by transmission against those on the receiving ends of the lines indicates that transmission allows access to 43% capacity factor wind, versus 29% without transmission.[7] Therefore, without transmission, the renewable generation and carbon emissions displacement from investment in the same amount of renewable capacity would be 33% lower. For solar, transmission provides access to 31.8% capacity

[1] https://cleanenergygrid.org/wp-content/uploads/2019/04/Transmission-Projects-Ready-to-Go-Final.pdf
[2] Calculated using an assumed mix of wind and solar generation delivered via each line, and the EPA AVERT tool's regional emission rate to estimate the carbon emissions reductions on the receiving end of each line. https://www.epa.gov/system/files/other-files/2021-09/avert_emission_rates_10-05-21.xlsx
[3] https://www.infrastructurereportcard.org/wp-content/uploads/2017/01/Energy-Final.pdf
[4] Our analysis uses the Joint Committee on Taxation's $9.765 billion score for the cost of the 30% ITC at https://www.jct.gov/publications/2021/jcx-42-21/. This is roughly consistent with our calculation of a $9.98 billion cost of a 30% tax credit applied the $33.278 billion total cost for all 22 of the transmission projects in the Projects Ready to Go report.
[5] For example, see https://cdn.misoenergy.org/MTEP17%20MVP%20Triennial%20Review%20Report117065.pdf and https://spp.org/documents/35297/the%20value%20of%20transmission%20report.pdf.
[6] https://gridprogress.files.wordpress.com/2021/01/disconnected-the-need-for-a-new-generator-interconnection-policy-1.14.21-1.pdf
[7] Assuming wind class 4 can be accessed with transmission, versus an average of class 8 and 9 without transmission, using NREL base year assumptions. https://atb.nrel.gov/electricity/2021/index

factor resources, versus 24.6% without transmission,[8] resulting in 23% lower generation and carbon abatement without transmission. Given that the renewable generation enabled by the 22 transmission projects is around 85% wind and 15% solar, on average renewables' carbon emission displacement would be 31% lower without transmission. The actual carbon emission benefits of transmission are likely even larger, given that transmission enables inter-regional power flows that become essential at high renewable penetrations, and the lower cost of building renewable projects in high resource areas.

Transmission's value for carbon abatement is still large if one assumes that a lack of transmission causes a 31% decrease in the carbon abatement of a given amount of wind and solar investment. Specifically, **over 50 years the 22 transmission projects would reduce carbon emissions by 2 billion short tons at current emission rates, or 1.3 billion tons at the emissions rate of gas combined cycle generation.** Under this more conservative assumption that the same amount of renewable capacity will be built without transmission, the cost of carbon abatement to the federal government with the transmission ITC is **$4.85/short ton assuming the current emissions rate, or $7.67/short ton assuming the power system's future emissions rate approximates the emissions rate of a gas combined cycle generator.**

The following table summarizes the results for the $/short ton cost to the federal government of carbon abatement under the range of assumptions discussed above. **Under all assumptions, pro-transmission policies offer a high-value and low-cost source of carbon emission reductions.** The actual value of transmission likely falls somewhere within the range shown below. As noted above, the societal cost of pro-transmission policies is almost certainly negative given that transmission pays for itself, if challenges related to transmission cost allocation can be overcome by policies like the transmission ITC.

Table 1: Short tons of CO_2 savings over 50 years from 30% Transmission ITC under various assumptions

	Current emissions rate	Future emissions rate
Transmission drives 100% additive renewable deployment	6.4 billion tons	4.1 billion tons
Transmission moves renewable deployment to more productive areas	2.0 billion tons	1.3 billion tons

Table 2: Federal cost per short ton of CO_2 savings for 30% transmission ITC under various assumptions

	Current emissions rate	Future emissions rate
Transmission drives 100% additive renewable deployment	$1.52/ton	$2.41/ton
Transmission moves renewable deployment to more productive areas	$4.85/ton	$7.67/ton

Given their high value, pro-transmission policies could be added or expanded as part of a portfolio of low-cost carbon abatement policy solutions. There are unlikely to be significant diminishing marginal returns from larger amounts of transmission investment, given large economies of scale from transmission investment and the fact that the need for transmission is many times larger than what is currently proposed for development in the near term. For example, multiple studies indicate that the increase in transmission capacity provided by the 22 Transmission Projects Ready to Go is only about 10% of what that will be required to decarbonize the electric sector.[9]

[8] Assuming solar class 2 is available with transmission, versus class 7 without transmission, using NREL base year assumptions. https://atb.nrel.gov/electricity/2021/utility-scale_pv#resource_categorization

[9] https://cleanenergygrid.org/wp-content/uploads/2019/04/Transmission-Projects-Ready-to-Go-Final.pdf, at 12