More Transmission:
A Major Obstacle to Carbon-Free Electricity by 2035

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"Multiple studies have determined that a multibillion-dollar build-out of transmission is needed to fully unleash renewable energy on the grid."[i]

President Biden has announced a number of goals for reducing U.S. greenhouse gas emissions. One is a reduction of 50-52 percent (compared to 2005 levels) by 2030; another is net zero emissions by 2050; and yet a third is carbon-free electricity by 2035.

Achieving the president's carbon-free electricity goal would require staggering changes to the electricity grid over the next 15 years. We have written before about the obstacles to making these huge changes which include adding massive amounts of wind power (both onshore and offshore), solar power, battery storage, possibly nuclear power, possibly hydrogen-powered turbines, possibly carbon capture technologies, and possibly other technologies that would replace fossil fuels while, at the same time, providing essential reliability services to keep the lights on 24/7. (Possibly means these technologies are too expensive right now or need further development in order to guarantee they can be deployed widely within the next 15 years.)

The electricity grid is already shifting to lower- and zero-carbon electricity sources. In fact, the U.S. electric sector has reduced its carbon emissions by 33 percent below 2005 levels.[ii] At the same time this shift is occurring, technologies are being developed that can help achieve even deeper carbon reductions.

Several studies have estimated the amounts of new electric generating capacity that would have to be built by 2035. These studies project the need for massive amounts of new wind and solar power. (Studies also project the need for other technologies that are being developed, but new wind and solar account for the bulk of new resources to decarbonize the grid.) For example, the Electric Power Research Institute projected a need for 900,000 megawatts (MW) of new wind and solar capacity, plus other technologies, at a cost of $1.5 trillion.[iii] Princeton projected roughly 600,000 MW of additional wind and solar, plus other technologies, at a cost of more than $1.1 trillion.[iv] EVA projected 1.6 million MW of new wind and solar, plus other technologies, at a cost of $905 billion.[v] For the sake of simplicity, we average these estimates and, therefore, assume that 1 million MW of new wind and solar capacity (plus other technologies[vi]) would be needed to generate carbon-free electricity within 15 years at a cost likely to exceed $1 trillion. One million MW of new

wind and solar power is almost the size of the current U.S. electricity supply which relies on natural gas, coal, nuclear, and (to a much lesser extent) wind and solar.[vii]

It would be challenging enough to build more than 1 million MW of new electric generating capacity over the next 15 years, but new transmission capacity would also be needed to get new wind and solar power to consumers. As an MIT paper put it, *"…transmission construction — particularly inter-state and inter-regional transmission — faces multiple challenges. Transmission lines typically require permits from multiple federal agencies and from each state and local jurisdiction within their path; the multi-party benefits of transmission make cost allocation difficult; and like any type of energy infrastructure, transmission can engender local opposition."*[viii] J.P. Morgan Asset Management called transmission upgrades one of the *"four big obstacles to faster deep decarbonization."*[ix]

Some estimates for transmission buildouts range from a doubling of current transmission capacity to an increase of 60 percent.[x] Estimated costs of additional transmission also vary widely from $200 billion to $670 billion.[xi] However, the biggest transmission obstacle is time. Some transmission projects are taking as long as 17 to 20 years to complete, which suggests that building out all of the transmission necessary to decarbonize the grid could take until at least 2040 or later.

ScottMadden has written a white paper that provides background on the nation's transmission system and explains many of the obstacles to adding new transmission capacity.[xii] These are a few takeaways from the paper:

- There are major challenges and obstacles at every stage of a transmission project. These stages include planning, cost allocation, interconnection queues, ratemaking, siting, and permitting.
- Approvals by federal, regional, state, and local stakeholders with different mandates and authorities add time and uncertainty to transmission development.
- Financial incentives by themselves cannot overcome the obstacles and challenges that confront transmission projects.
- Because of existing federal, regional, state, and local policies that govern transmission development, it is unlikely that sufficient transmission can be planned and built in time to meet a 15-year decarbonization goal.

Given transmission and other obstacles, someone might ask why don't we at least try to achieve carbon-free electricity by 2035, even if the effort falls short? The short answer is that trying and failing could be worse than not trying at all. Shifting too quickly to large amounts of wind and solar power could make the electricity grid less reliable and less resilient. It will take time and patience to develop and deploy reliable and affordable technologies to make up for the times when the wind isn't blowing and the sun isn't shining. California had rolling blackouts last August during a heat

wave when the sun set in the evening, but there were not enough backup electricity sources to call on.

According to Murphy's Law, "Nothing is as easy as it looks. Everything takes longer than you expect. If anything can go wrong, it will at the worst possible moment." Let's keep that in mind as we consider the prospect of making profound changes within 15 years to the nation's electricity system.

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[i] *"4 proposals to watch in Manchin's big energy bill,"* Jeremy Dillon and James Marshall, E&E News, June 22, 2021.

[ii] By 2019, U.S. electric sector emissions had declined from 2.4 billion tonnes to 1.61 billion tonnes, a reduction of 33 percent since 2005. U.S. EPA, *"Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019,"* April 2021. https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions

[iii] *"Powering Decarbonization Strategies for Net-Zero CO2 Emissions,"* Electric Power Research Institute (EPRI), February 2021.

[iv] *"Net-Zero America: Potential Pathways, Infrastructure, and Impacts, Interim Report, Princeton University,"* Larson et al, December 15, 2020.

[v] *"Clean Energy Bills Impact Analysis,"* Energy Ventures Analysis (EVA), June 2021. Analysis to be released in early July.

[vi] Besides wind and solar, these studies also project differing amounts of nuclear, battery storage, hydrogen, and carbon capture.

[vii] According to *AEO 2021*, U.S. electric power sector generating capacity is expected to total 1.12 million MW this year. Wind and solar capacity represent 17 percent of this total.

[viii] *"The Value of Inter-Regional Coordination and Transmission in Decarbonizing the US Electricity System,"* Patrick R. Brown and Audun Botterud, Joule 5, 1–20, January 20, 2021.

[ix] *"2021 Annual Energy Paper*," Michael Cembalest, JP Morgan Asset and Wealth Management, May 2021.

[x] *Ibid* and *"Net-Zero America: Potential Pathways, Infrastructure, and Impacts, interim report, Princeton University,"* Larson et al, December 15, 2020.

[xi] EPRI estimates additional transmission at $200 billion. Princeton estimates $670 billion.

[xii] *"Transmission in the United States – What Makes Developing Electric Transmission So Hard?"* ScottMadden, June 2021. www.AmericasPower.org