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RESEARCH BRIEF

Facilitating Transmission Expansion to Support Efficent Decarbonization of the Electricity Sector

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Over at least the next 30 years, achieving decarbonization targets will require replacing most fossil-fueled generators with zero carbon wind and solar generation along with energy storage to manage intermittency. However, achieving decarbonization targets in a cost-efficient manner will require significant investments in new intra-regional and interregional transmission capacity. In this paper, I identify and discuss potential reforms to reduce the numerous barriers to planning, building, compensating, and financing this transmission capacity. By comparing and contrasting U.S. and European responses to similar challenges, I provide suggestions for institutional, regulatory, planning, compensation and cost allocation policies that can reduce the barriers to efficient expansion of transmission capacity.

Many governments, electric utilities, and large electricity consumers have committed to deep decarbonization of the electricity sector by 2050 or earlier. To achieve these decarbonization targets, most fossil-fueled generators will need to be replaced with zero carbon wind and solar generation, in addition to energy storage to manage intermittency. However, the best wind and solar resources are located in geographic areas that are often far from the locations of the legacy stock of generating plants and their supporting transmission infrastructure.

It is therefore widely recognized that in order to meet governments' deep decarbonization commitments for the electricity sector in a cost-efficient manner, very substantial investments in intra-regional and interregional transmission capacity will be required to connect wind and solar resources to demand centers, better exploit diversity on the demand and supply sides of bulk power systems, and reduce curtailments of wind and solar as well as the quantity of generation and storage needed to meet reliability criteria.

Despite the potential advantages of expanding transmission capacity to improve access to and make more effective use of wind and solar resources, a number of barriers exist to exploiting these opportunities without violating various reliability criteria. As a result, the necessary transmission

investments are lagging in the U.S., Europe, China and elsewhere.

In this paper, I assess the importance of transmission expansion and its relevant barriers. I begin by discussing the locations of the most attractive wind and solar sites in the U.S., Europe and China, affirming that the best wind and solar resources tend to be fairly remote from load centers, legacy power plants, and/or existing transmission infrastructure.

Next, I review the results of several modeling studies that examine the role that transmission expansion plays in meeting carbon mitigation goals in a cost-efficient manner. I identify the following common conclusion from these studies: in order to achieve deep decarbonization targets relying heavily on wind, solar, and storage at the lowest cost, significant increases in intra and interregional transmission capacity will be required both inside the geographic boundaries of transmission system operators (TSO) and between the current boundaries of two or more TSOs.

I compare the relevant attributes of transmission systems and TSOs in the U.S. and Europe, highlighting commonalities and differences with relevance for transmission expansion within and beyond the geographic boundaries of transmission systems. I then investigate how these attributes bear out in practice by surveying five case studies of national and international transmission expansion projects in the U.S. and Europe: (1) the Pacific Northwest-Southwest AC/DC Intertie; (2) Phase 2 of the HVDC link between Quebec and New England; (3) the Northern Pass Transmission project and the related New England Clean Energy Connect project; (4) the development of additional transmission capacity between France and Spain; and (5) the planned con-struction of additional transmission lines connecting northern and southern parts of Germany.

Building on insights from this survey of selected case studies, I illustrate different types of barriers and poten-tial mitigating solutions. One set of barriers results from stakeholder opposition to major new transmission projects, which can stem from a variety of concerns, such as perceived visual impacts, impacts on recreational values, economic impacts, increased supplies from competitors, and potential health effects. Other types of barriers I identify are organizational barriers resulting from excessively narrow transmission system planning protocols and relevant geographic expanses, barriers created by considering too narrow a range of benefits associated with transmission capacity enhancements, barriers created by disputes over how the costs of these facilities will be allocated to users of the system, barriers resulting from cost recovery and financing barriers, and barriers in the U.S. from the lack of a unified national decarbonization policy.

By comparing and contrasting U.S. and European responses to these challenges, I set out a series of suggestions for institutional, regulatory, planning, compensation and cost allocation policies that can reduce the barriers to efficient expansion of transmission capacity. However, in the U.S., mere adjustments to existing regulations and institutions are unlikely to accelerate investments in the transmission capacity needed to support an efficient decarbonization path.

I conclude that two sets of institutional changes should be high on the agenda for the U.S.: (1) a more holistic approach to considering potential benefits from proposed transmission capacity expansion plans, coupled with expanded use of competitive procurement and determination of who should pay by applying cost causality and beneficiary pays principles; and (2) the creation of a national transmission planning organization that can serve as an umbrella transmission planning organization to evaluate a full range of wide-area transmission project opportunities in meaningful detail.

References

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About the Author

Paul L. Joskow is the Elizabeth and James Killian Professor of Economics at the Massachusetts Institute of Technology (MIT) and President emeritus of the Alfred P. Sloan Foundation. Joskow has been on the MIT faculty since 1972, where he was the head of the MIT Department of Economics from 1994 to 1998 and director of the MIT Center for Energy and Environmental Policy Research from 1999 to 2007. Joskow became president of the Sloan Foundation in 2008 and returned to MIT in 2018. At MIT his teaching and research areas include industrial organization, energy and environmental economics, competition policy, and government regulation of industry. He has served on the boards of the New England Electric System, National Grid PLC, TC Energy, State Farm Indemnity, Exelon Corporation (current), Putnam Mutual Funds (current), and the Whitehead Institute for Biomedical Research.