Transmission for a Clean Energy Grid

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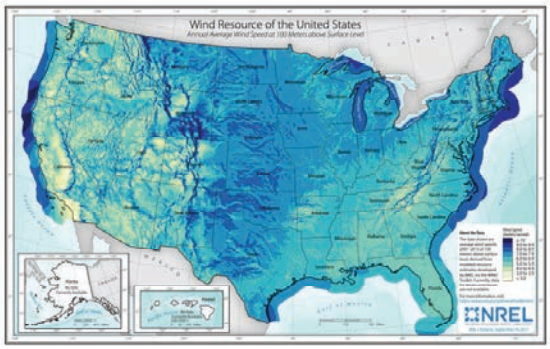
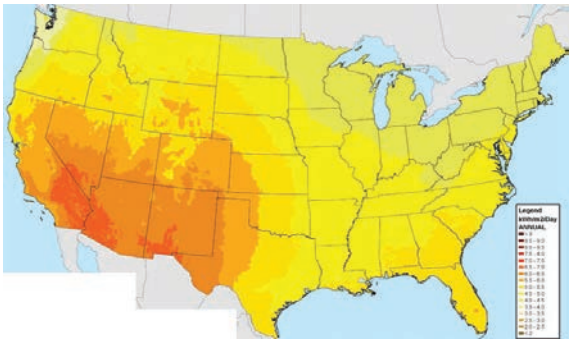
Transmission and Renewable Energy
Inescapable physical properties

1. Best onshore wind and solar far from load. 88% in 15 central states
2. Regional exchange allows system balancing with higher penetration
3. Transmission provides flexibility and optionality in supporting the grid as generators retire, system inertia declines, and extreme weather events become more intense





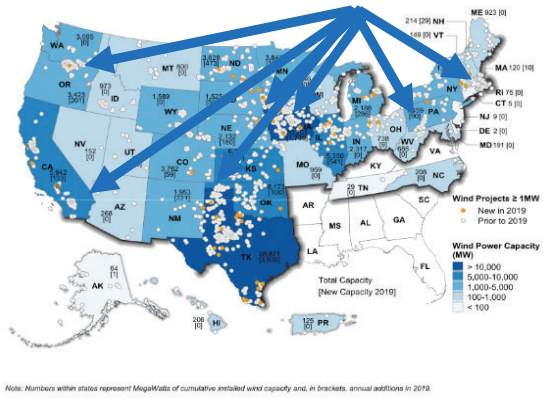
NREL Wind (left, 100m height) and Solar (right) Resource Maps

https://windexchange.energy.gov/maps-data/319 , https://www.nrel.gov/gis/images/map_pv_us_annual10km_dec2008.jpg

Generation is Stuck in Interconnection Queues

- 844 GW of generation – 90% renewables, storage, and hybrids stuck in queues, end of 2020

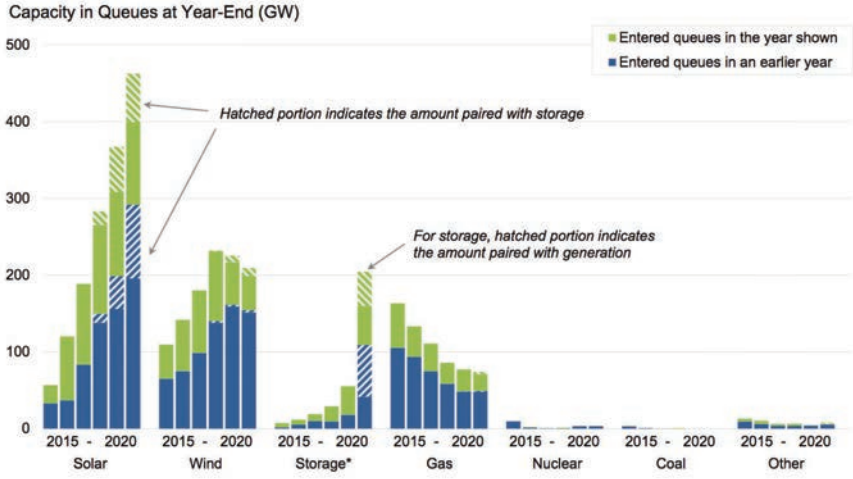
Resource Pockets



Note: Numbers within states represent MegaWatts of cumulative installed wind capacity and, in brackets, annual additions in 2019.

Source: AWEA WindIQ, Berkeley Lab

Wind Project Locations



Projects Entering Interconnection Queues

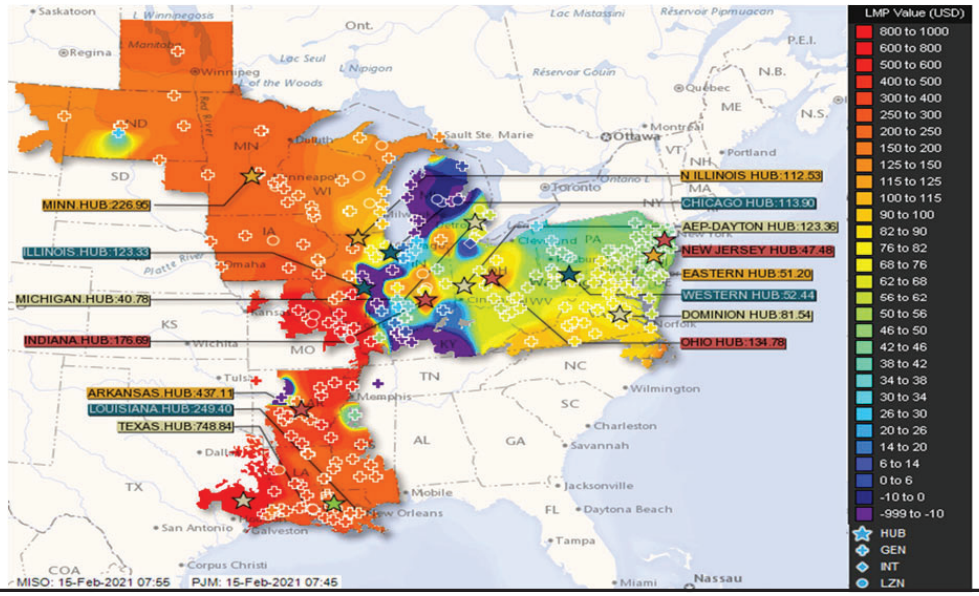
Interregional Transmission Keeps the Lights On

in Winter Storm Uri Feb 2021

MISO imported 13 GW, ERCOT only 0.8 GW (East to West flow)

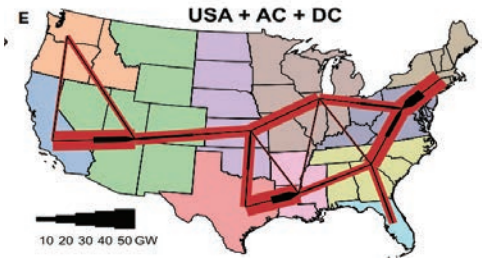
Eastern polar vortex incidents in 2014, 2018 served by Midwest power (West to East flow)

For transmission planning and cost allocation—beneficiaries are on both sides



Low-cost decarbonization requires large scale transmission

10s of GWs of power transfer back and forth across and between regions
2-3x increase in national transmission capacity



https://www.cell.com/joule/fulltext/S2542-4351(20)30557-2

https://cleanenergygrid.org/wp-content/uploads/2020/11/Macro-Grids-in-the-Mainstream-1.pdf

Modeled flows NREL Seam study

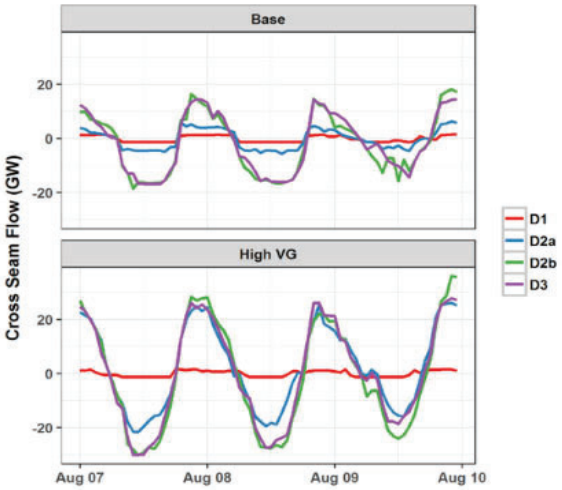


Fig. 3. Cross-seam transmission power flow (B2B and HVDC) during the coincident peak load period. A positive flow is a net export from the EI to the WI; a negative flow is a net import into the EI from the WI. Times are Eastern Standard Time.

Transmission Enabled ½ of US Wind Capacity

Transmission plan	Wind Capacity Enabled (GW)
Tehachapi	4.5
Texas CREZ	14.5
MISO MVP	14
SPP Priority Projects, Balanced Portfolio	6
CO+ME+NV+PAC+BPA	10
Total	49

Title search: Transmission for a Clean Energy Grid

Also available as part of the eCourse
2022 Renewable Energy Law eConference

First appeared as part of the conference materials for the
17th Annual Renewable Energy Law Institute session
"Macro-grid Issues: National and Regional Transmission Infrastructure Trends and Implications for Future Generation Project Development."