The Future of Energy: Transmission

The Institute for Science & Policy

Denver Museum of Nature & Science December 15th, 2020

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What is transmission?





https://en.wikipedia.org/wiki/Electrical_grid#/media/File:Electricity_Grid_Schematic_English.svg https://www.ferc.gov/industries/electric/indus-act/reliability/blackout/ch1-3.pdf

The Continental United States Electric Grid (2018)





Why is transmission important?

Transmission unlocks:

- Easier decarbonization of electricity grid;
- More efficient electrification of other sectors;
- Reduced electricity costs for all customers;
- > Enhanced reliability of electricity for users;
- Reduction of curtailment of renewables;
- Increased storage and DER integration;
- Interstate markets for electricity.





Many studies have shown the benefits of long distance transmission



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ACEG El Study (2020)

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Renewables are the cheapest source of electricity





Global Heat Transfer Drives Wind & Solar Constantly



Image Credit: Figure 7.5 in The Atmosphere, 8th edition, Lutgens and Tarbuck, 8th edition, 2001

This global heat engine runs **constantly** driving wind and cloud patterns.

Processes *are well understood*.

Driven By Solar Irradiance & Earth-Sun Distance.

Therefore "variability" is a **local effect**.



Variability Of Wind & Solar Shrinks With Larger Areas



Wind & solar can back each other up using their nature



Wind & Solar Are Created By Chaotic Not Random Processes

Therefore, patterns emerge that can be taken advantage of!



Energy Density Accumulates At Predictable Times & Sites Decorrelate Rapidly









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Results from Zero By Fifty (ZBF)



Motivation of ZBF





Resource Siting by 2020



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Resource Siting by 2035



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Resource Siting by 2050



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Installed Capacities



Without HVDC

With HVDC



Generation Stack





Electricity Generation By Technology

Without HVDC





Pollution and GHG Emissions



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Not building an HVDC grid adds \$1 trillion in energy costs by 2050





The United States needs a lot of new transmission to meet its goals



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Operations of a CONUS-wide system





Operations of a CONUS-wide system





Example system running across CONUS





Thank You

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