

Grid of the Future

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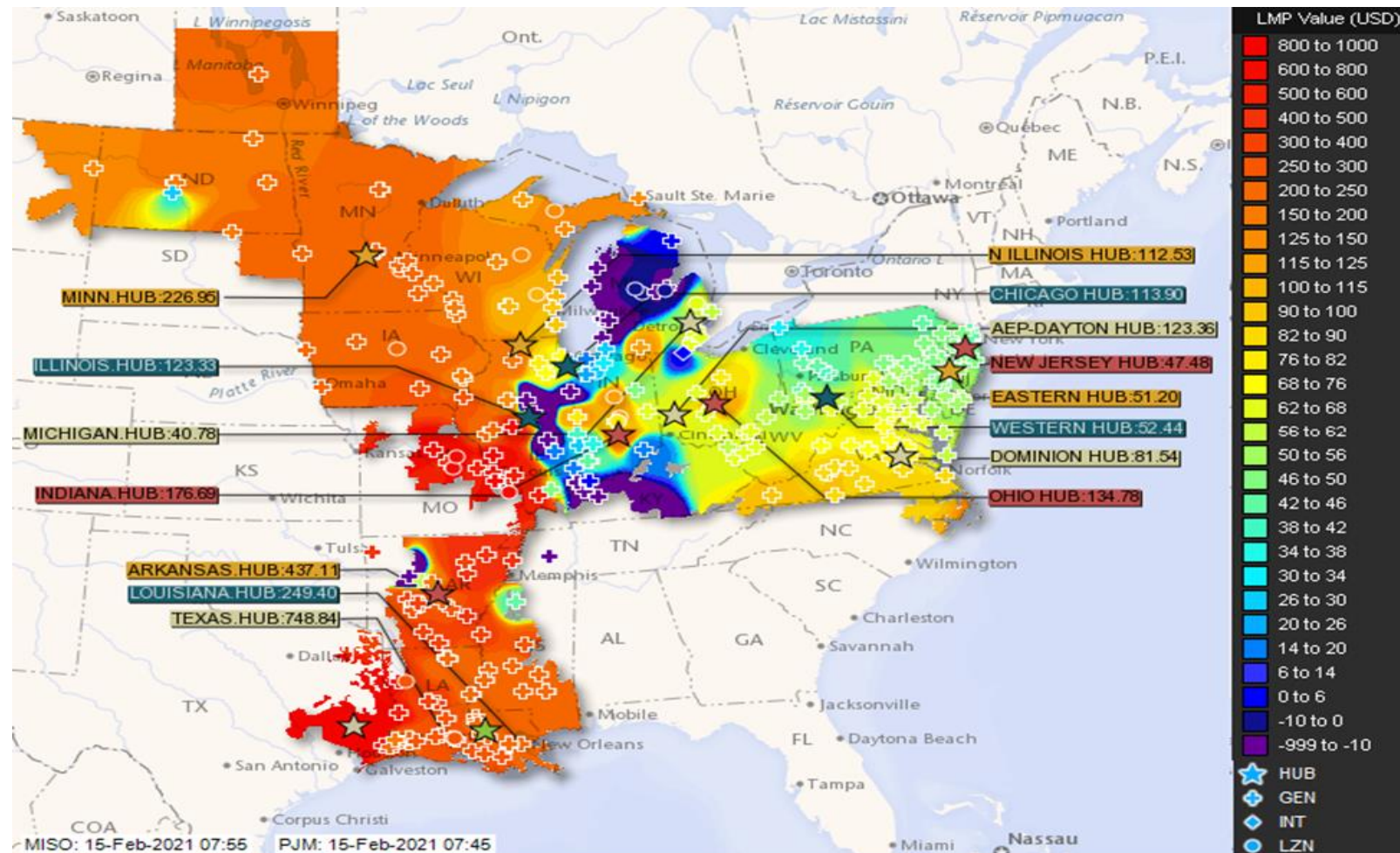
Grid
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Interregional Transmission Keeps the Lights On in Winter Storm Uri Feb 2021

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)

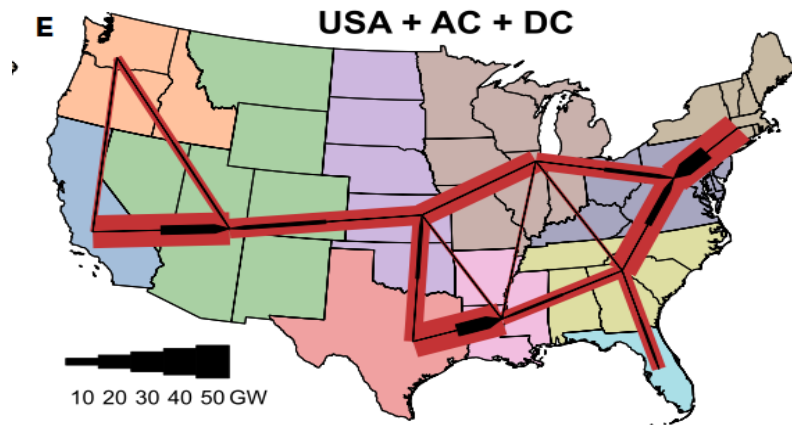
For transmission planning and cost allocation—who is the beneficiary???



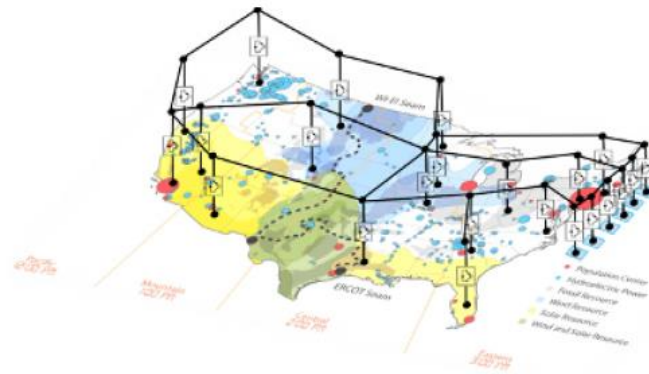
Low-cost decarbonization requires large scale transmission

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://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

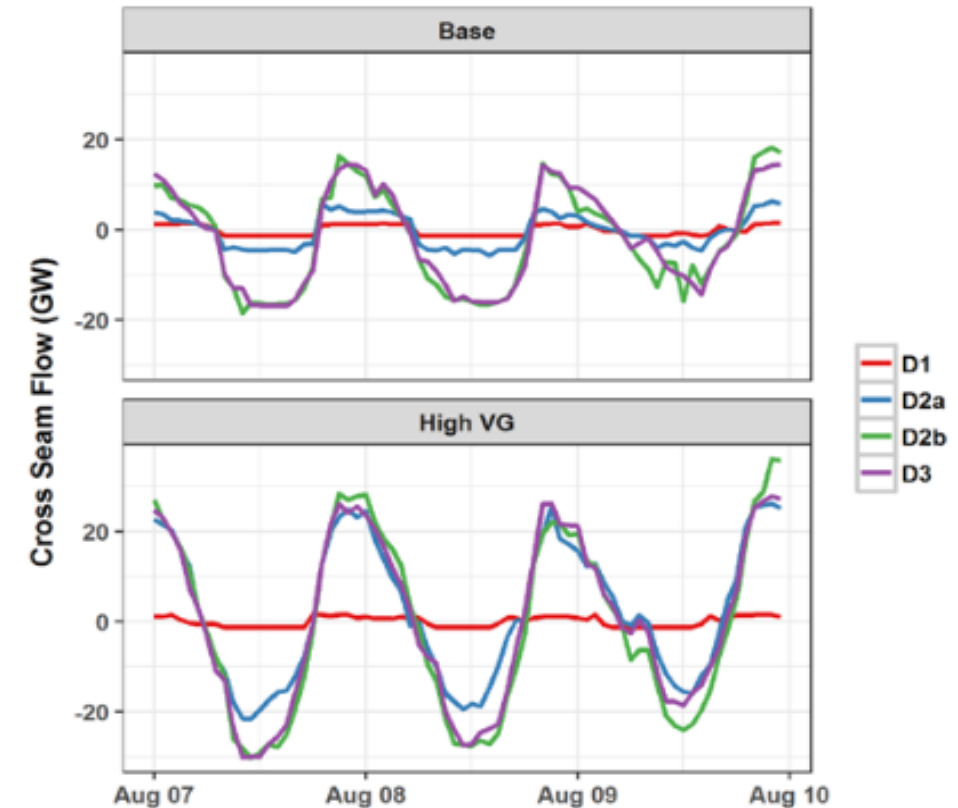


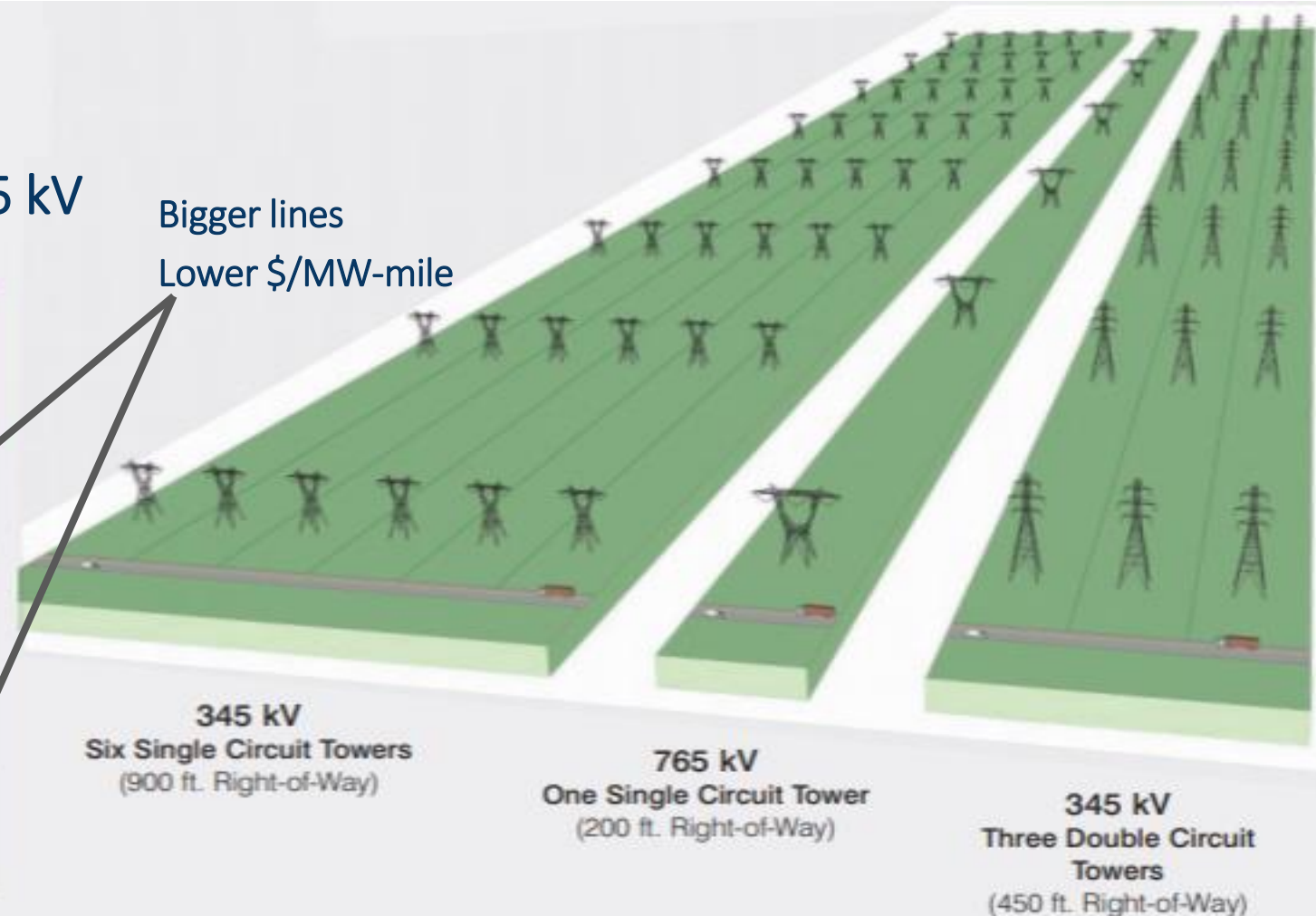
Fig. 3. Cross-seam transmission power flow (B2B and HVDC) during the coincident peak load period. A positive flow is a net export from the EI to the WI; a negative flow is a net import into the EI from the WI. Times are Eastern Standard Time.

Bigger is lower cost in transmission

765kv lines have ~1/6 the losses as 345 kv

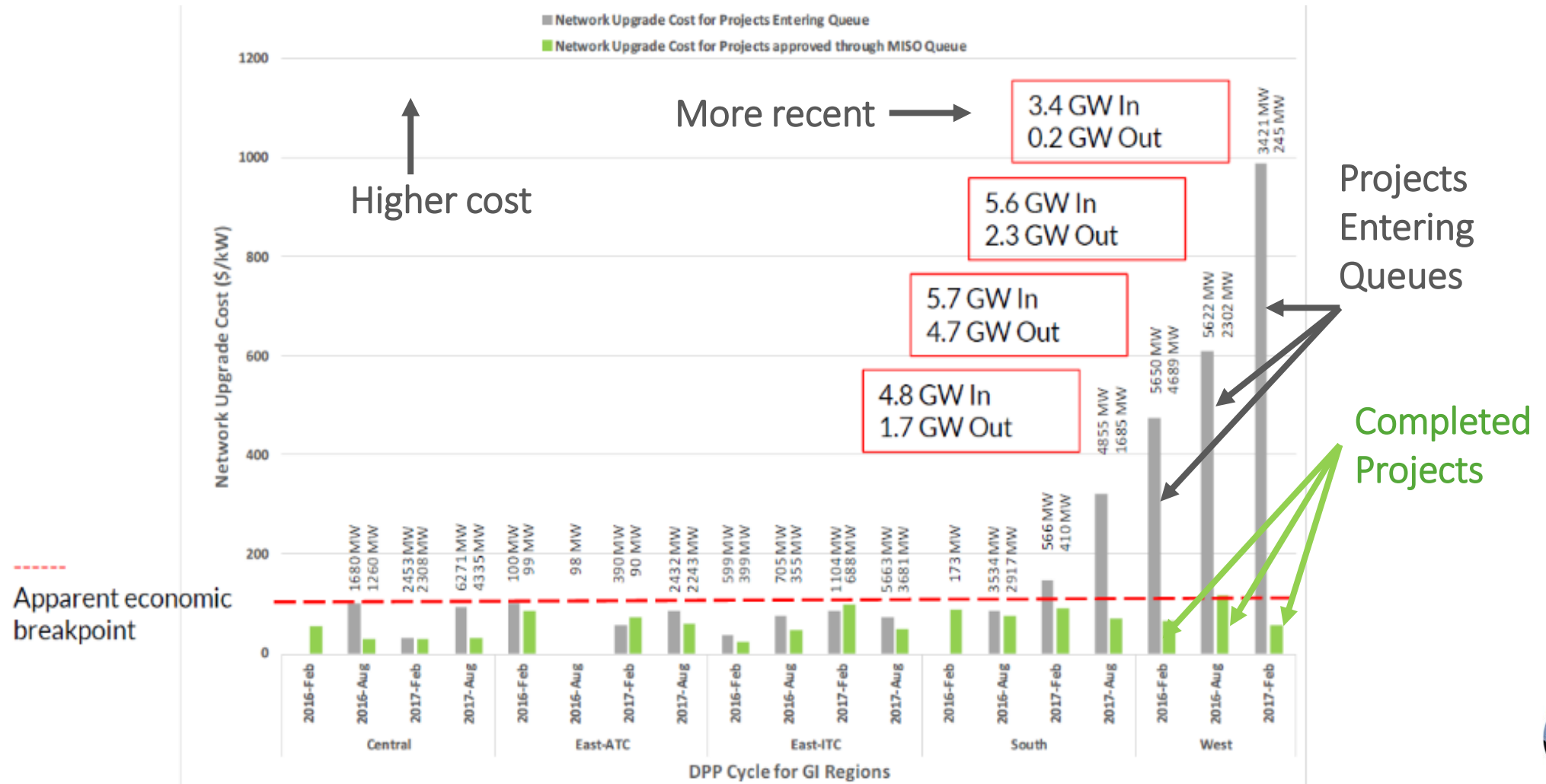
Transmission Voltage (kV)	Cost per Mile (\$/mile)	Capacity (MW)	Cost per Unit of Capacity (\$/MW-mile)
230	\$2.077 million	500	\$5,460
345	\$2.539 million	967	\$2,850
500	\$4.328 million	2040	\$1,450
765	\$6.578 million	5000	\$1,320

Bigger lines
Lower \$/MW-mile



~800 GW of clean energy stuck in interconnection queues

Planning a HV network through an interconnection process costs more than regional planning



First, get the most out of the existing grid

with Grid-Enhancing Technologies (GETs)

See www.watt-transmission.org

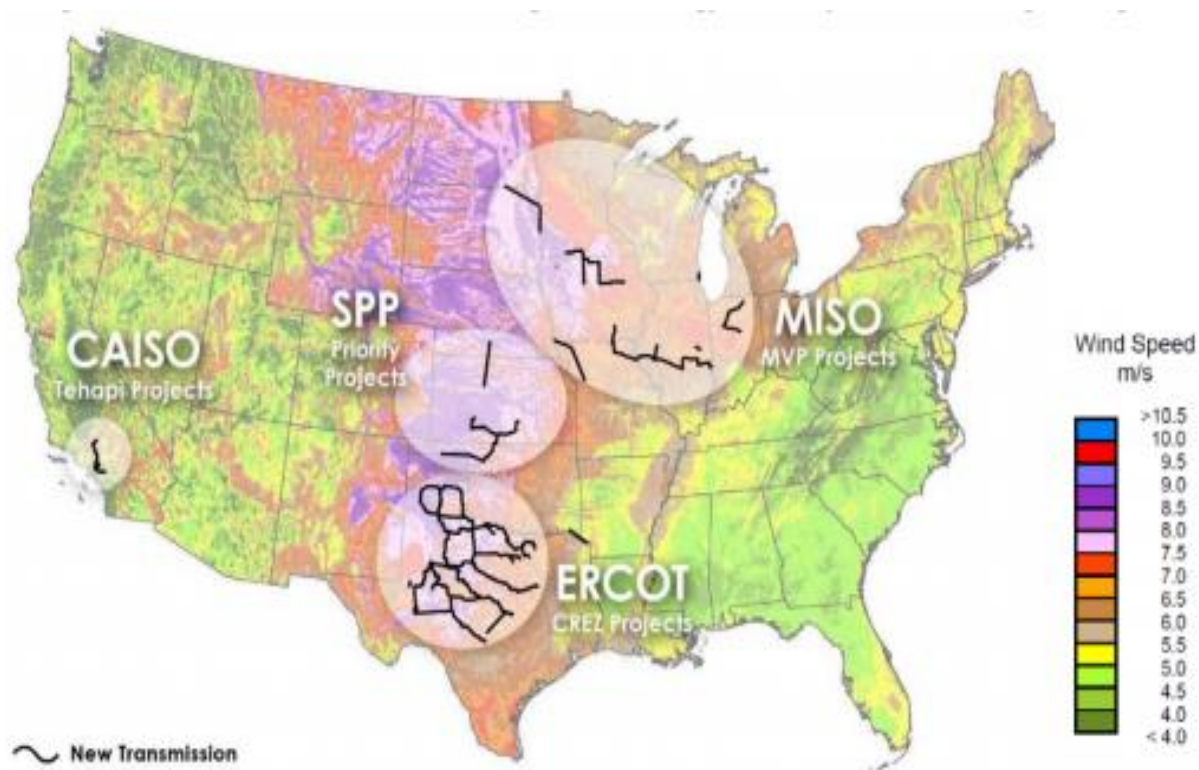
- GET some Dynamic Line Ratings, topology optimization, storage-as-transmission, power flow control
- GETs are
 - VERY low cost, \$0.5m - \$25m
 - deployable in MONTHS
 - scalable
 - modular
 - mobile and re-deployable
- FERC shared savings incentive conference September 2021



Big transmission CAN be built!

Recent US Large-Scale Expansions

- MISO MVP, SPP priority projects, ERCOT CREZ
- 3:1 Benefit-Cost ratios
- Winning formula:
 - Pro-active multi-benefit planning
 - Broad, beneficiary pays allocation



FERC Transmission Initiatives

1. Interconnection reforms
2. Grid-Enhancing Technologies incentives
3. Transmission planning and cost allocation
 - Estimate generation as well as load
 - Multi-benefit, de-silo—congestion, resilience, public policy
 - Resilience scenarios that might afflict a given region
 - Electrification estimates in load forecasts
 - Benefit-cost analysis
 - Inter-regional
 - GETs as solutions



Transmission Policy in the 117th Congress

- 30% Investment Tax Credit for “regionally significant” transmission
- Loans and grant funding for large scale >1000 MW transmission, \$8b
- Anchor tenant loans. \$2.5 billion
- Power Marketing Administration loan authority
- DOE studies and helping with planning. \$100m
- Smart Grid Investment Grants for GETs
- \$800m funding for states to constructively engage in transmission planning
- Restoring federal backstop siting to original intent
- More being added???



Executive Agency Transmission Initiatives

Sec. Granholm: “deploy, deploy, deploy”

- Improve federal permitting
 - DOT: highways
 - DOI: federal lands
- Federal backstop siting
 - DOE and FERC
- Grid Deployment Authority
- WAPA Transmission Infrastructure Program loans
- Loan guarantees—DOE Loan Program Office

