GRID UNITED

Transmission Lunch & Learn

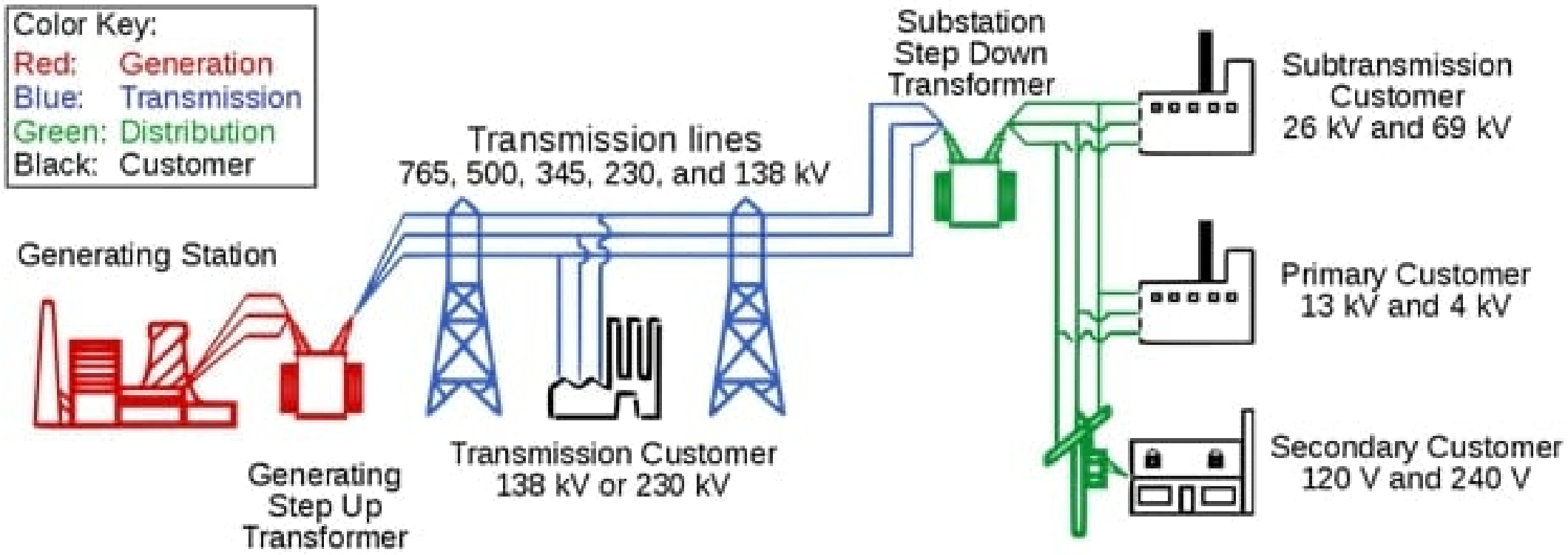
REAL Houston

July 13, 2023

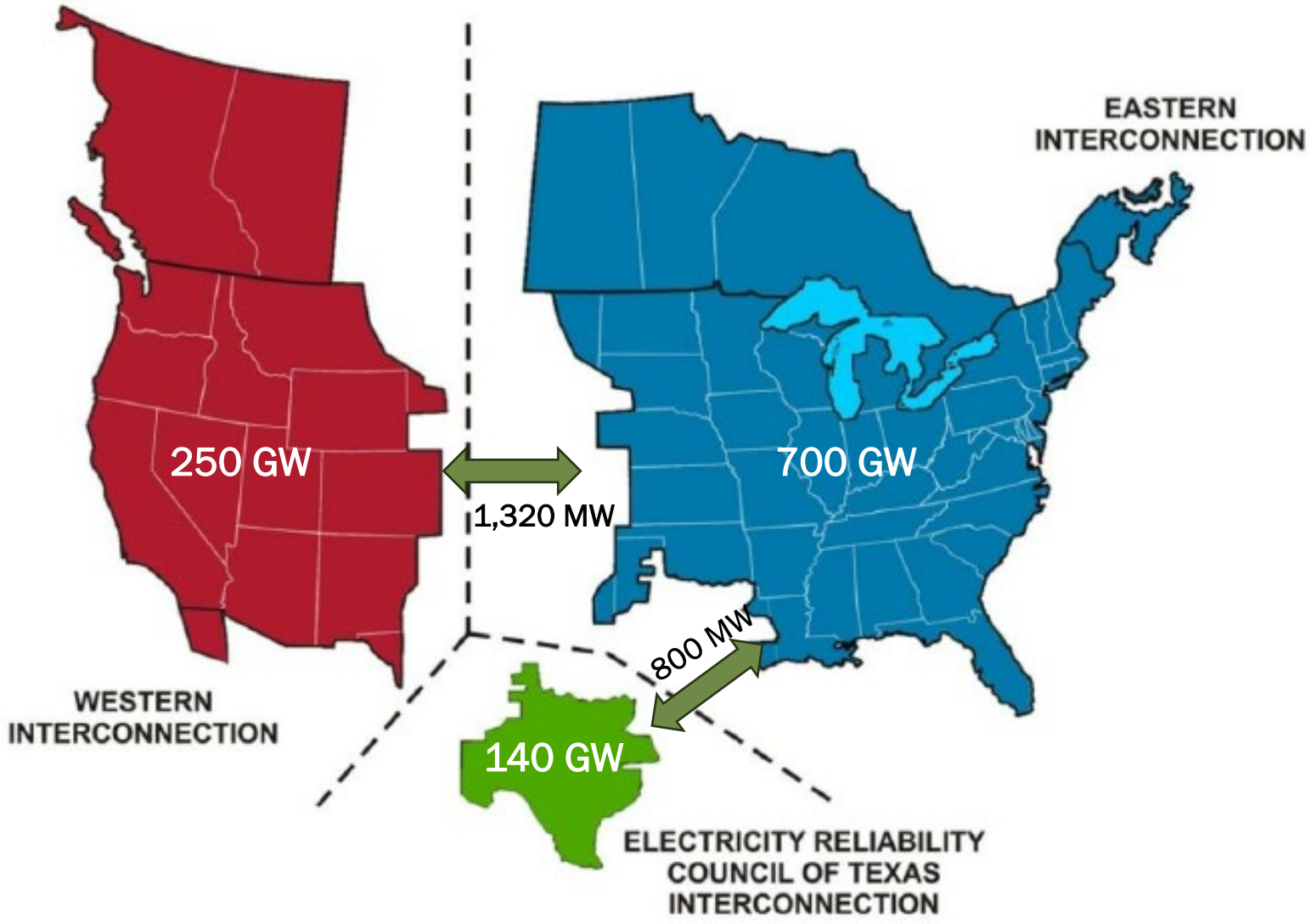
Contents

U.S. Electric Grid Overview

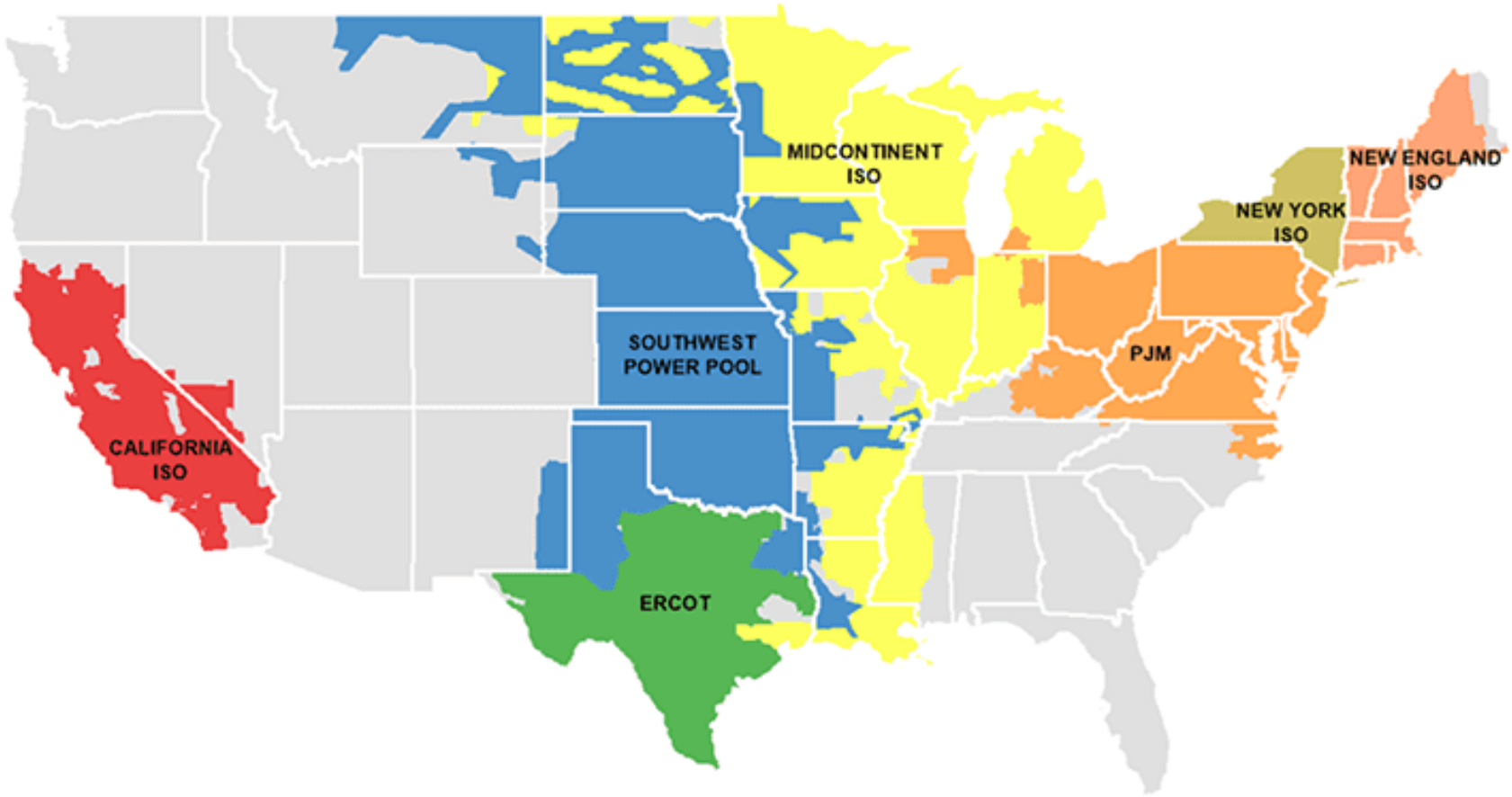
Transmission is the backbone of U.S. electric grid



The U.S. is split into three electric grids



Most (but not all) of U.S. grid is in regional markets



Challenges / Opportunities

Transmission needed to meet ambitious climate goals

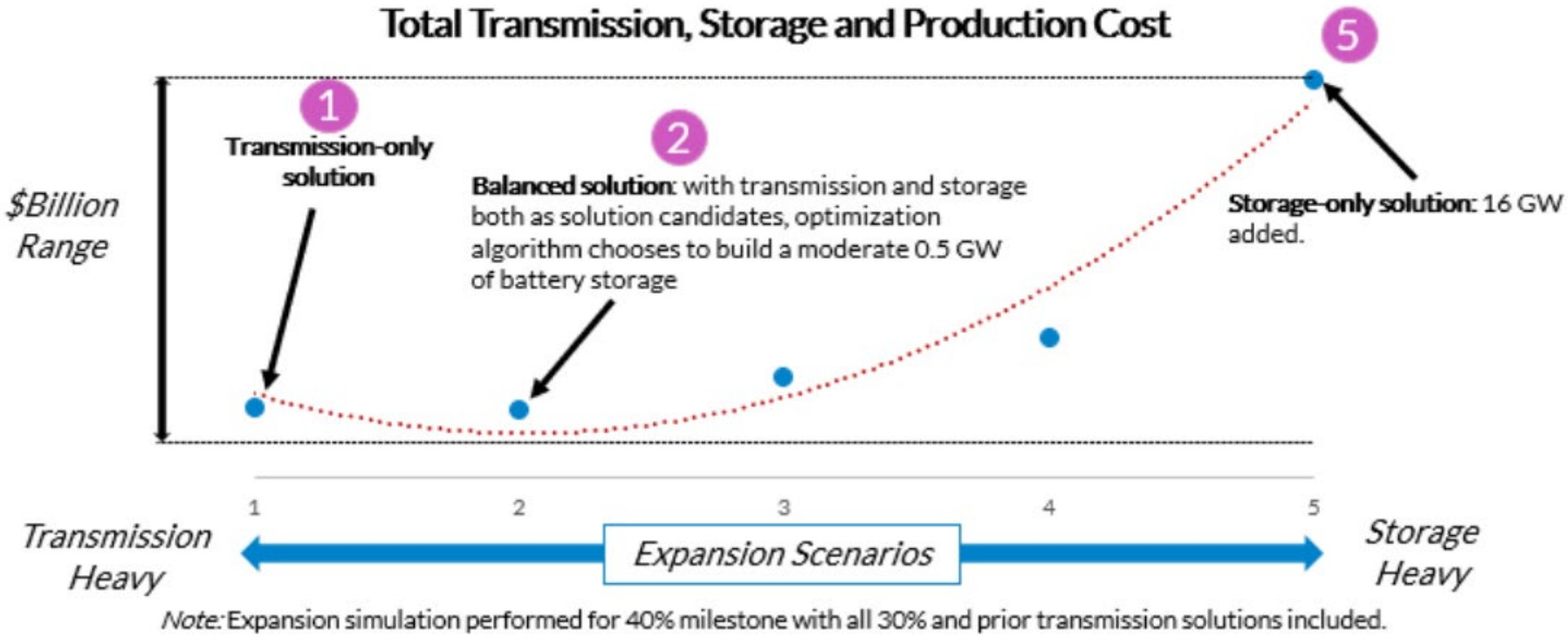
- The US set ambitious climate goals with the Inflation Reduction Act (IRA).
- …but **its potential emissions reductions can only be met with significant transmission expansion.**
  - If transmission buildout continues at its current rate, we will lose **~80%** of the IRA's potential emissions reductions.
- "To unlock the full emissions reduction potential of the IRA**, the pace of transmission expansion must more than double** the rate over the last decade…."
  - This allows rapid addition of clean electricity generation (e.g. from wind and solar).

NO TRANSMISSION → NO TRANSITION

Source: Princeton University - Jenkins, J.D., et al. "Electricity Transmission is Key to Unlock the Full Potential of the Inflation Reduction Act." Rapid Energy Policy Evaluation and Analysis Toolkit (REPEAT Project). Sept. 2022.

Transmission is the “best” battery

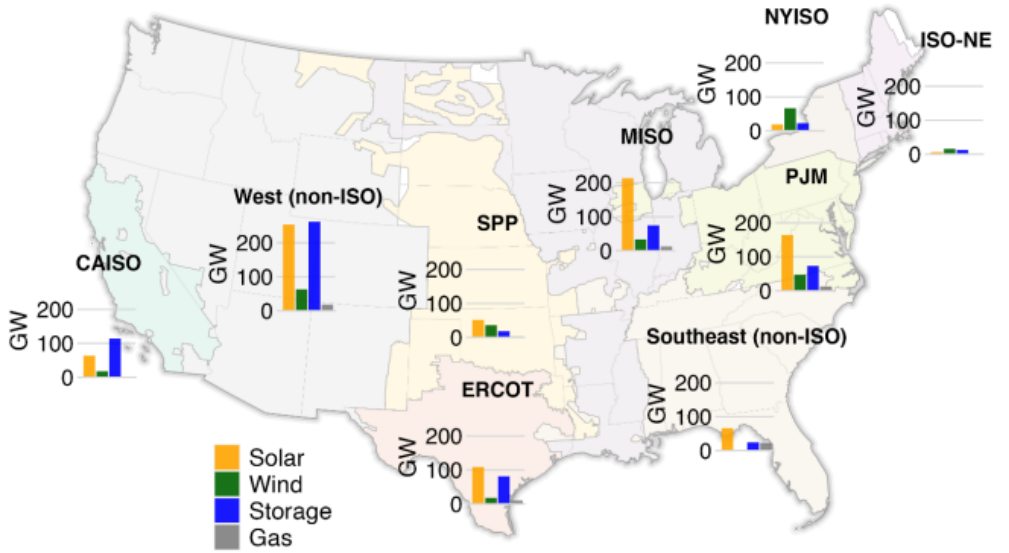
“…Transmission is more cost effective than storage at increasing the renewable energy penetration….”
– MISO’s Renewable Integration Impact Assessment (RIIA)

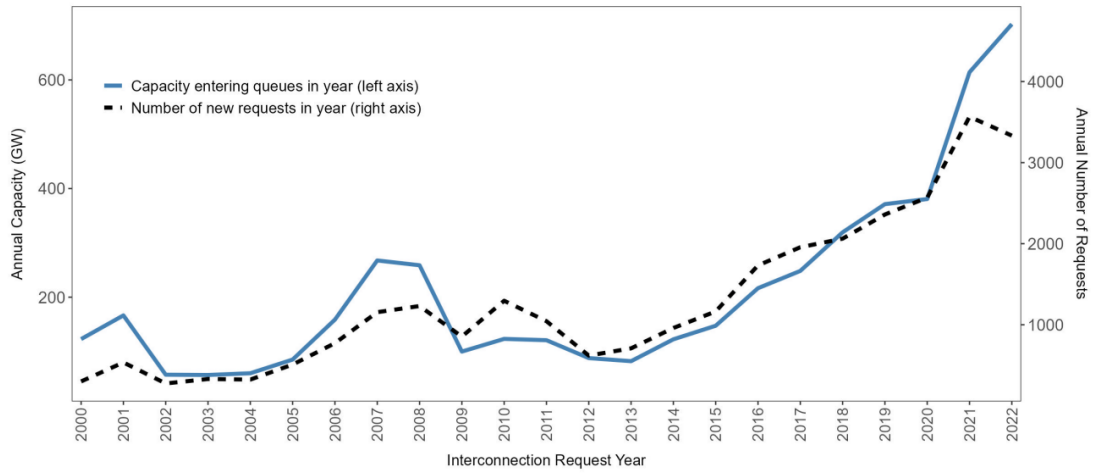


Source: MISO Renewable Integration Impact Assessment (2021)

Interconnection queue backlogged across U.S.

- Over 10,000 projects representing 1,350 MW of generation and 680 GW of storage are actively seeking interconnection
- Majority (1,260 GW) is zero carbon
- Average time projects spend in queues has increased markedly:
  - <2 years in 2008
  - 3 years in 2015
  - 5 years in 2022





Decrease in new requests in 2022 likely driven by "pauses" on new requests in CAISO and PJM (see slide 9).

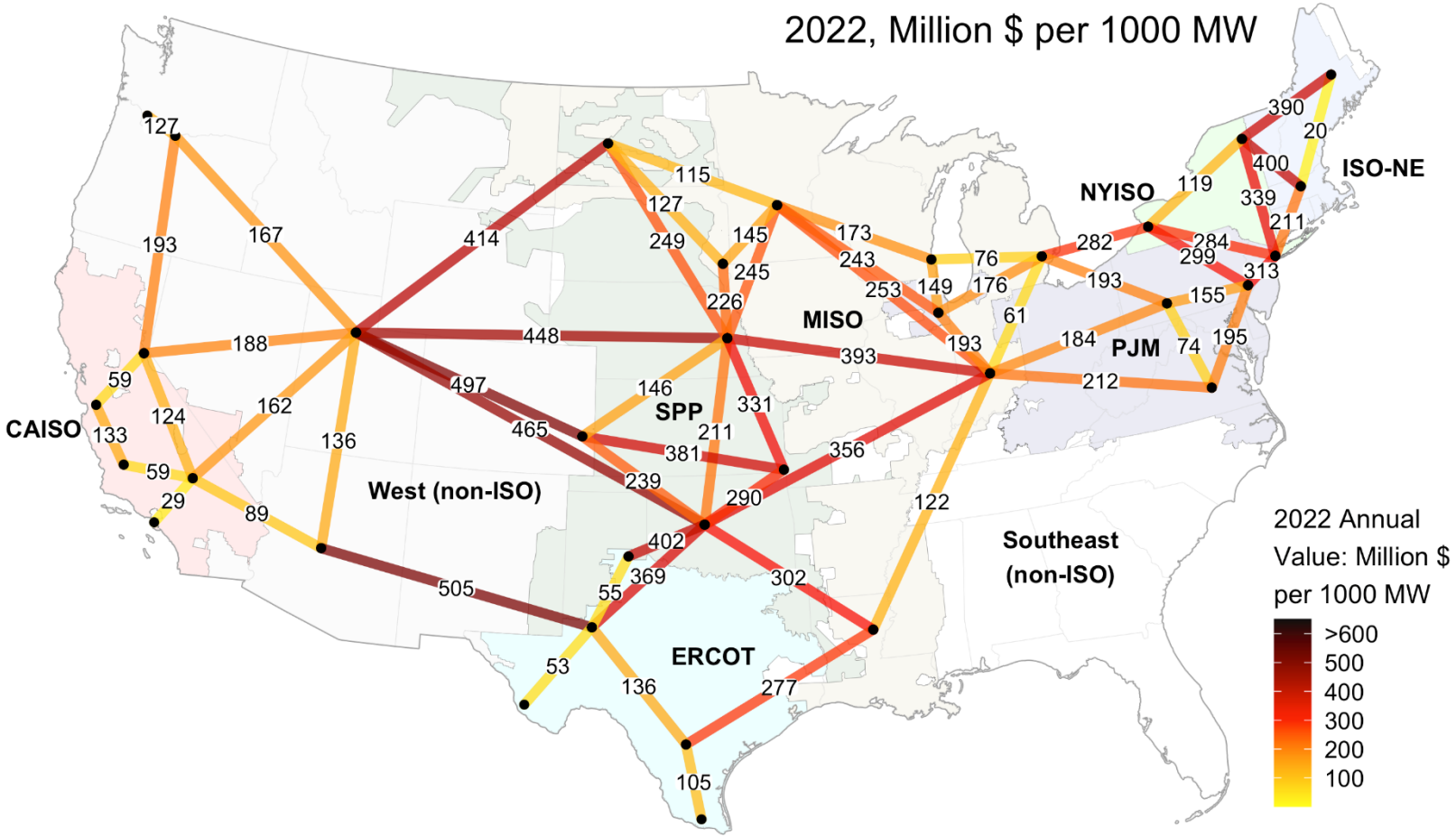
Source: Lawrence Berkeley National Laboratory – Rand, J., et al. "Queued Up: Characteristics of Power Plants Seeking Transmission Interconnection as of the End of 2022." April 2023.

New Transmission Links Can Save Consumers Money

"The latest market data show that the potential savings of new electric transmission was higher last year [in 2022] than at any point in the last decade."

–Lawrence Berkeley National Lab

The annual cumulative value of a hypothetical 1 GW transmission link, based only on hourly energy price arbitrage.

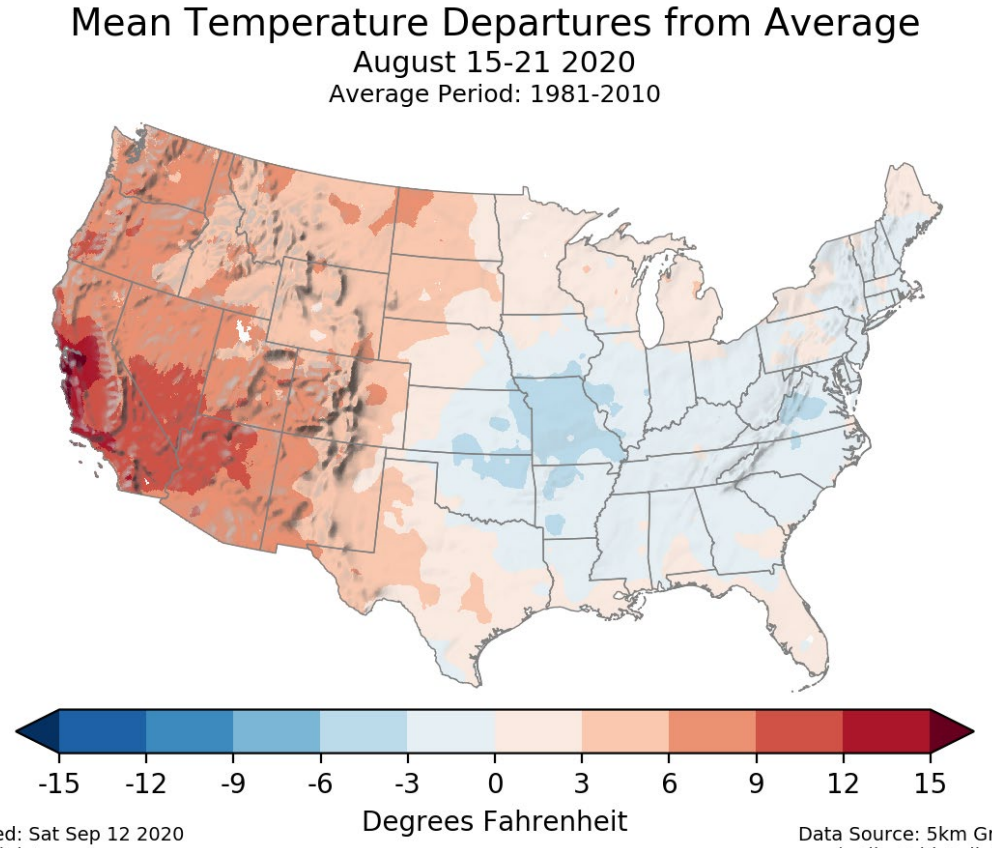


Source: Lawrence Berkeley National Laboratory - Millstein, D., et al. "Electricity and Markets Policy Fact Sheet." Feb. 2023.

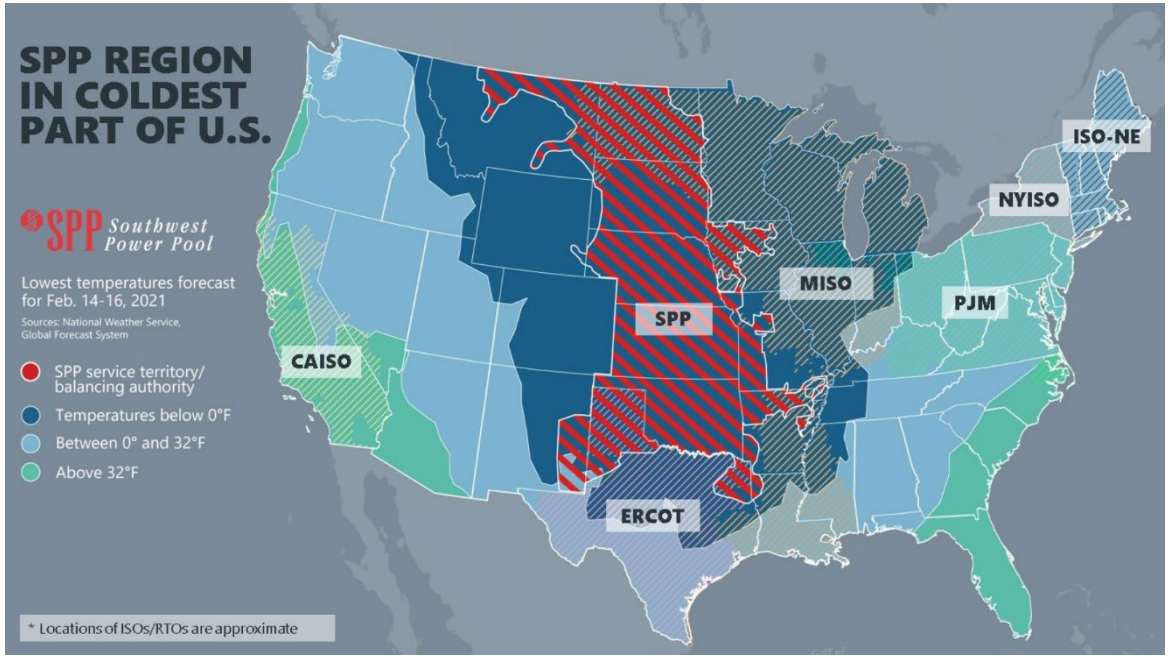
Resiliency During Extreme Weather Events

As the risk of extreme weather events increases with a changing climate, interregional transmission corridors can help mitigate the risk of widespread outages. Extreme weather scarcity events are large scale, but regional in nature, rarely overlapping across regions at the same time or intensity.

When West had extreme heat in August 2020, Midwest was cooler than average.

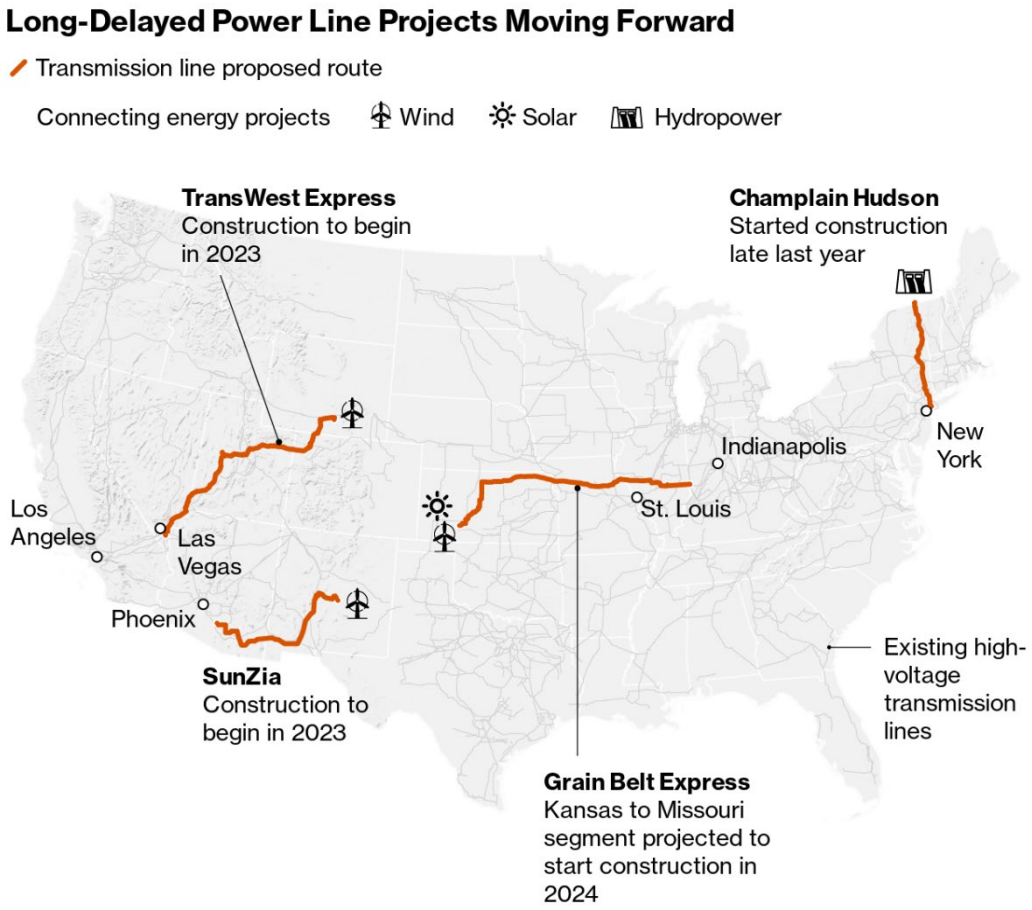


When Midwest had extreme cold in February 2021 (Winter Storm Uri), West was mild.



Big transmission projects have taken too long to get built

Big transmission projects are starting to get built…



…after a VERY long time

Project:	Began development:
TransWest Express	2005
SunZia	2006
Grain Belt Express	2010
Champlain Hudson	2010

Source: Bloomberg News - Eckhouse, B., et al. "Billion-Dollar Power Lines Finally Inching Ahead to Help US Grids." March 6, 2023.

Solutions

CONFIDENTIAL 14

Transmission is in the news

DIVE BRIEF

Electricity prices surged 14.3% in 2022, double overall inflation: US report

Published Jan. 19, 2023

Sundry Photography via Getty Images

Bill Gates · 3rd+
Co-chair, Bill & Melinda Gates Foundation
2h · + Follow

To build a clean grid, we need to build a lot more transmission. Approval of the TransWest Express line is a big deal and represents great progress—but we need even more lines, and we need them fast. This one took 18 years to approve, and we won't reach net zero if we can't build more transmission more quickly.

The New York Times

Why the U.S. Electric Grid Isn't Ready for the Energy Transition

To start with, there is no single U.S. electric grid.

By Nadja Popovich and Brad Plumer June 12, 2023

FT FINANCIAL TIMES

21:12 ◂ Outlook 5G+

Top Stories

The Big Read Electric power

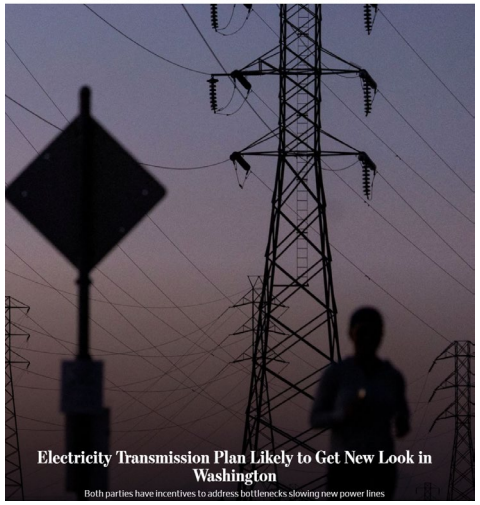
Gridlock: how a lack of power lines will delay the age of renewables

A backlog of wind and solar projects is waiting to connect to infrastructure built for another era, threatening net zero plans

By Attracta Mooney JUNE 10 2023 479

The Couture wind farm in Poitou-Charentes, south-west France, is in limbo. Despite having

THE WALL STREET JOURNAL.



Electricity Transmission Plan Likely to Get New Look in Washington

Both parties have incentives to address bottlenecks slowing new power lines

The New York Times

OPINION
THE EDITORIAL BOARD

We Desperately Need a New Power Grid. Here's How to Make It Happen.

May 4, 2023

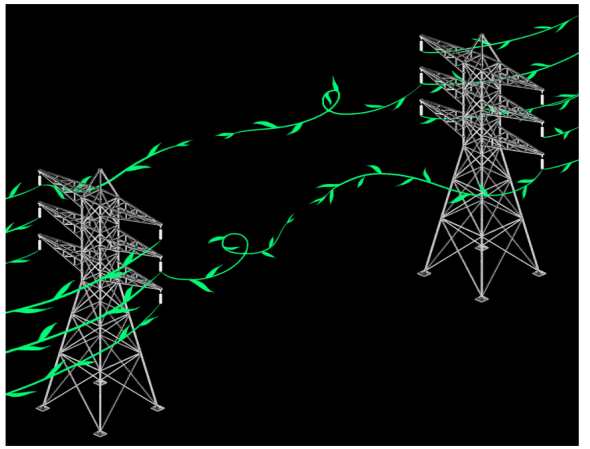


Illustration by Rebecca Chew/The New York Times

Some federal action, but more is needed

- IIJA / Bipartisan Infrastructure Law (2021)
  - Strengthened FERC's backstop siting authority
  - Transmission Facilitation Program ($2.5B DOE fund)
- Inflation Reduction Act (2022)
  - New sources of funding
    - Transmission Facility Financing
    - Funding for Loan Program Office
    - Grants for Interstate Electricity Lines
  - Transmission tax credit stripped from IRA at last minute ☹
- Debt ceiling bill (2023)
  - Established (weak) NEPA deadlines
  - Another transmission study…

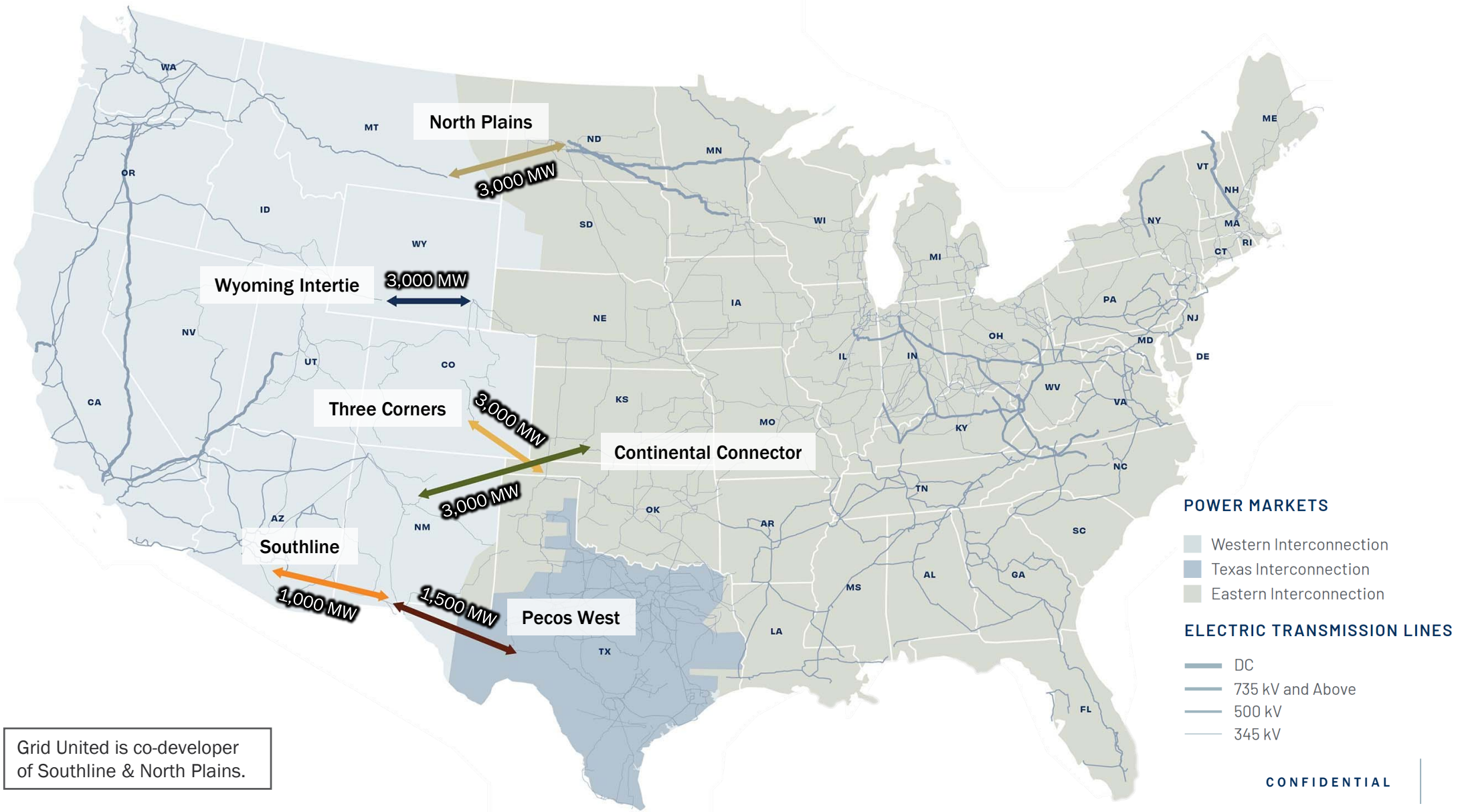
HVDC technology can enforce – and improve – AC grid

HVDC is the preferred technology for moving large amounts of power across long distances—with higher efficiency and smaller footprint than equivalent power AC.

- Lower cost, due to higher efficiency than AC
- Fast, precise bi-directional power flow control
  - Can be strategically used as a firewall to prevent disturbances on one AC grid from spreading to another AC grid
  - Mitigates power imbalances on AC grid
  - Can honor commercial power contracts by controlling flow
    - In contrast, AC's power flows per physical laws.
- Increases grid reliability and resiliency
  - "Black start" capability can jumpstart a grid after a blackout
  - Provides many ancillary services for reliability
  - Dynamic voltage response to grid disturbances in milliseconds
    - Allows increased integration of renewable resources by reducing low-frequency and voltage oscillations

VSC power modules in an HVDC valve hall (© Siemens Energy, 2021)

Grid United Selected Project Portfolio



Grid United is co-developer of Southline & North Plains.