Interconnection History and Context

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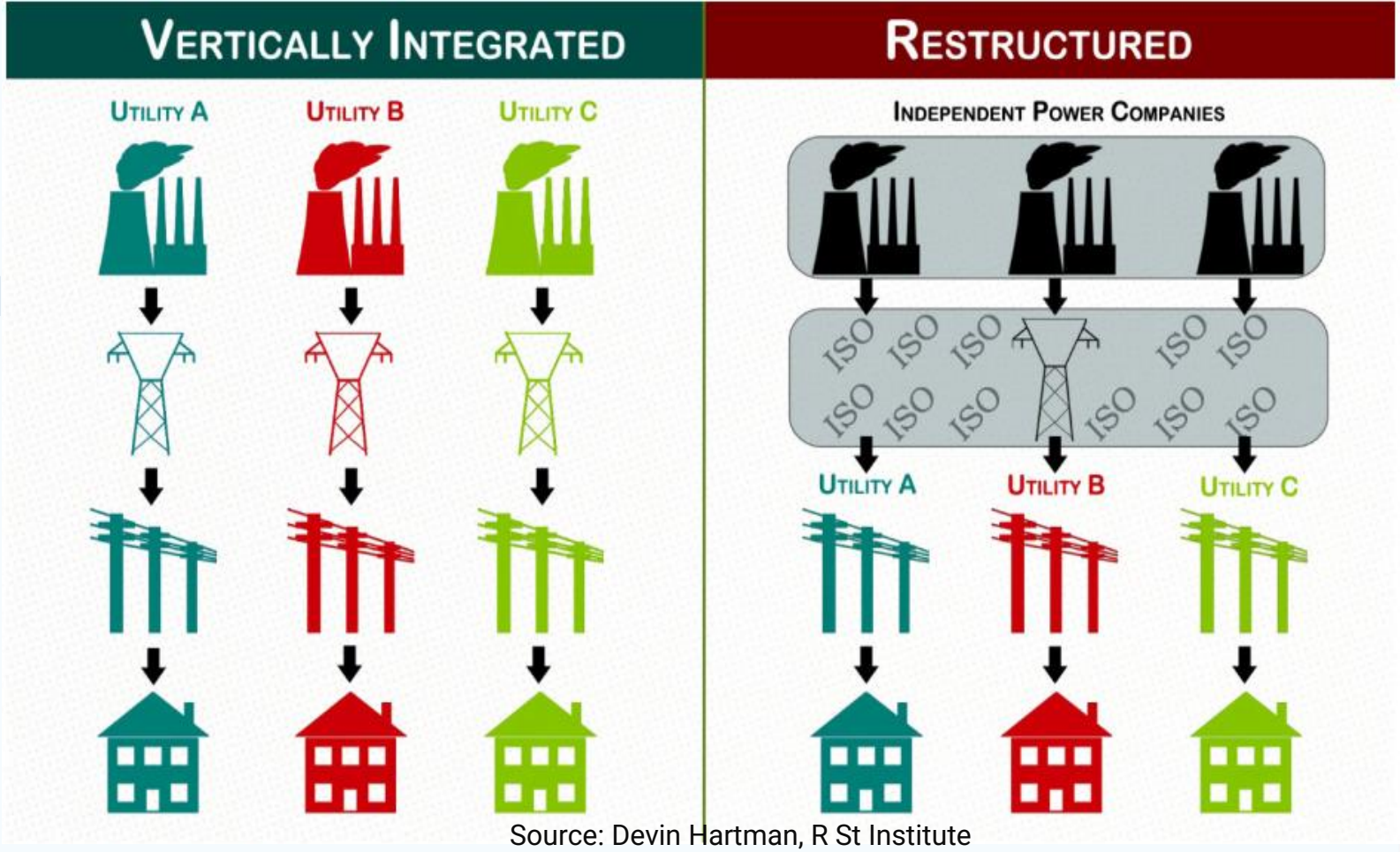
2 Basic Industry Structu

Traditional, since the early 20th Century:

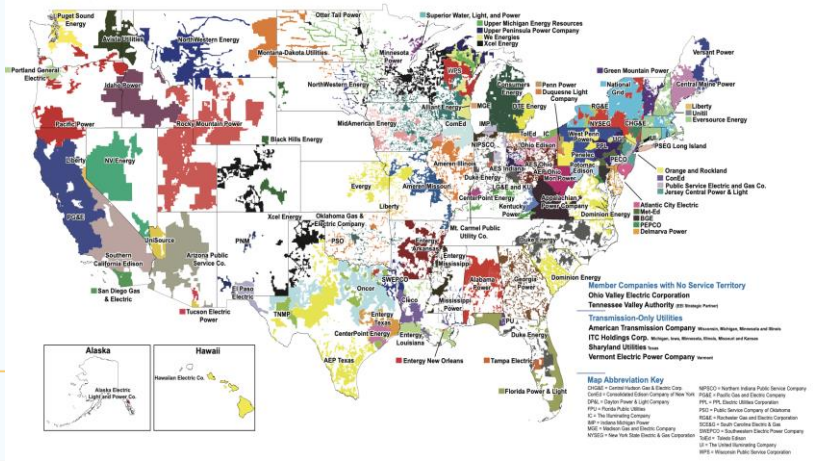
- Generation, transmission, distribution in one company (vertical integration)

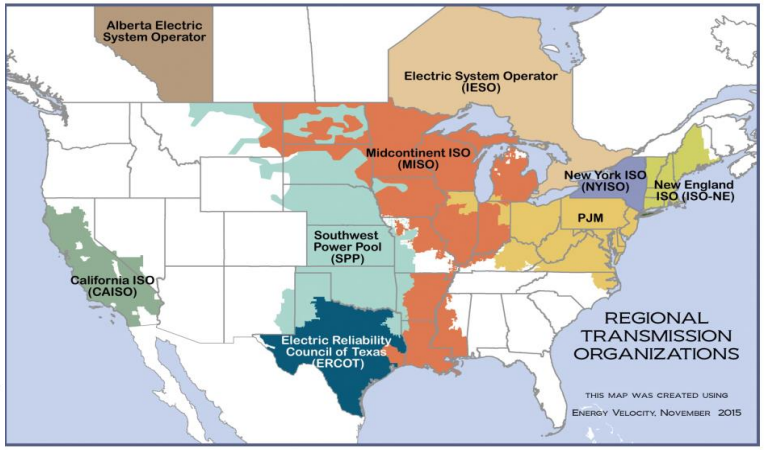
Restructured (starting ~2000):

- Generation divested into Independent Power Producers (IPPs).
- Independent System Operator/Regional Transmission Organization runs transmission.
- Utility owns T&D



Source: Devin Hartman, R St Institute





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Electric Industry Functions Operate Separately

5 General Functions that must be performed in any structure:

- Interconnection
- Transmission Service
- Resource Adequacy
- Generation/load dispatch and balancing
- Transmission operations

Industry restructuring 1995-2005 separated them

On-going challenge: to make them work together effectively

Federal Power Act and Federal Energy Regulatory Commission (FERC) Requirements

Legal requirements:

Rates, terms, and conditions of wholesale energy and transmission must be:

- Just and reasonable
- Not unduly discriminatory or preferential

General framework:

Transmission is a common carrier

Service is provided on an “open access” basis to all parties

Yet, FPA carves out generation and bundled retail service for states. Thus, vertically integrated utilities can still perform the five functions in an integrated bundled fashion.

Interconnection approaches
1990s-2020s

- Pre 2003
  - Non-standard terms and conditions, frequent litigation, opaque, time-consuming
  - Vertical market power concerns (use transmission to favor own generation)
- 2003-2008
  - Order 2003 (2003): standard terms and conditions
    - Large Generator Interconnection Procedures (LGIP), Large Generator Interconnection Agreements (LGIA)
    - Sequential, first-come, first-served.
    - Allows participant-funding in ISO/RTO areas
    - Worked fine for fewer, large plants placed on strong parts of the network.
    - Many smaller and geographically distributed wind plants entered 2005-8, enlarging queues.
  - Order 661 (2005): Interconnection for wind generators

Interconnection approaches
1990s-2020s, cont'd

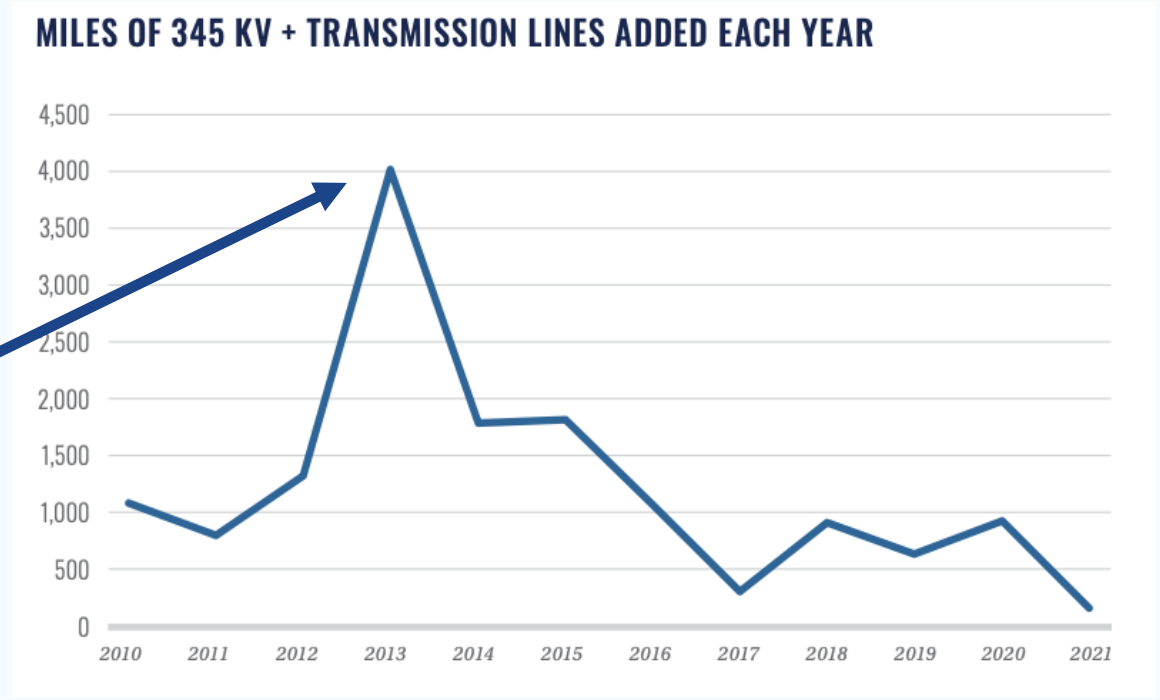
- 2008, 2012 Reforms
  - Two rounds of FERC- and RTO-led ratcheting up requirements on generators—site control, deposits, etc.
  - Massive growth of smaller and widely distributed solar, storage, and wind plants 2018-23.
- 2018 Order 845
  - Greater flexibility on types of interconnection service.
  - Added transparency

Key Organizations in Interconnection

- Transmission Provider: RTO or vertically integrated utility or both
- Transmission Customer: often an independent power producer (IPP). Could be the utility or a neighboring utility.
- Economic regulators: FERC and State Commissions
- Reliability Regulator: North American Electric Reliability Corporation (NERC)
- End-use customer: load-serving entity or large buyer

Lack of Transmission Contributes to Interconnection Logjams

- Many miles of new transmission in 2013, then dropped to a trickle
- Most regions are not planning for future resource mix



https://gridprogress.files.wordpress.com/2022/09/grid-strategies_fewer-new miles_final.pdf

TABLE 2. PLANNING AUTHORITIES CURRENT USE OF EFFICIENT PRACTICES

	Proactive Generation & Load	Multi-Value	Scenario-Based	Portfolio-Based[30]	Joint Interregional Planning
ISO-NE[31]	✗	✗	✗	✓	✗
NYISO[32,33]	✗	✗	✗	✗	✗
– PPTPP only	✓	✓	✓	✓	✗
PJM[34,35]	✗	✗	✗	✗	✗
Florida	✗	✗	✗	✗	✗
Southeastern Regional	✗	✗	✗	✗	✗
South Carolina Regional	✗	✗	✗	✗	✗
MISO (excl. MVP, RIIA)[36]	✗	✗	✗	✗	✗
SPP (ITP)[37,38]	✗	✓	✗	✓	✗
CAISO[39,40]	✓	✗	✓	✗	✓
– TEAM only	✓	✓	✓	✓	✓
WestConnect	✗	✗	✗	✗	✗
NorthernGrid[41]	✗	✗	✗	✗	✗

https://gridprogress.files.wordpress.com/2021/10/transmission-planning-for-the-21st-century-proven-practices-that-increase-value-and-reduce-costs-7.pdf

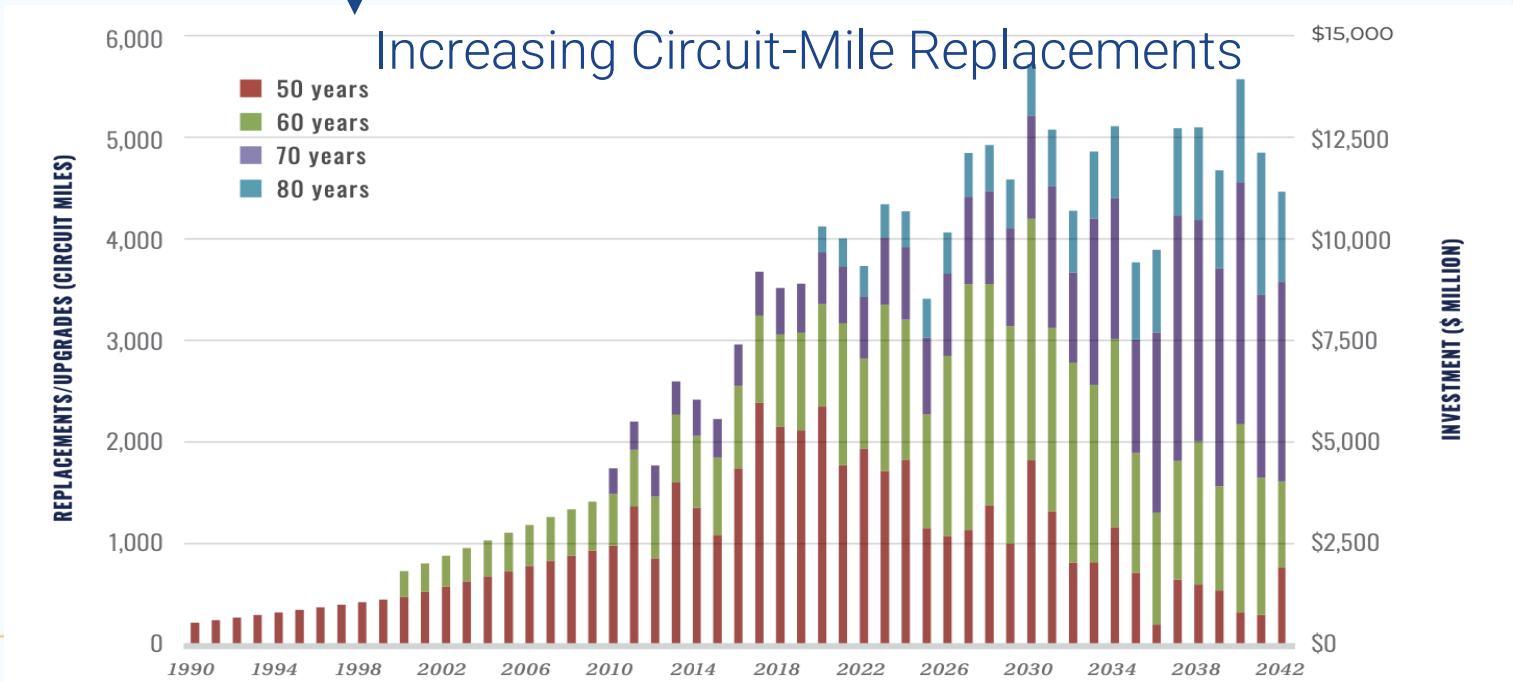
Other Ways to Deliver Power In Addition to New Lines on New Rights of Way Would Also Help Resolve Interconnection Challenges

Grid-Enhancing Technologies

- Power Flow Control
- Dynamic Line Ratings
- Topology Optimization

High-Performance Conductors

- Replace aging wires
  - Composite core
  - Superconductors



https://usea.org/sites/default/files/event-/AEPBoldTransmissionDescription11.13.2015.pdf

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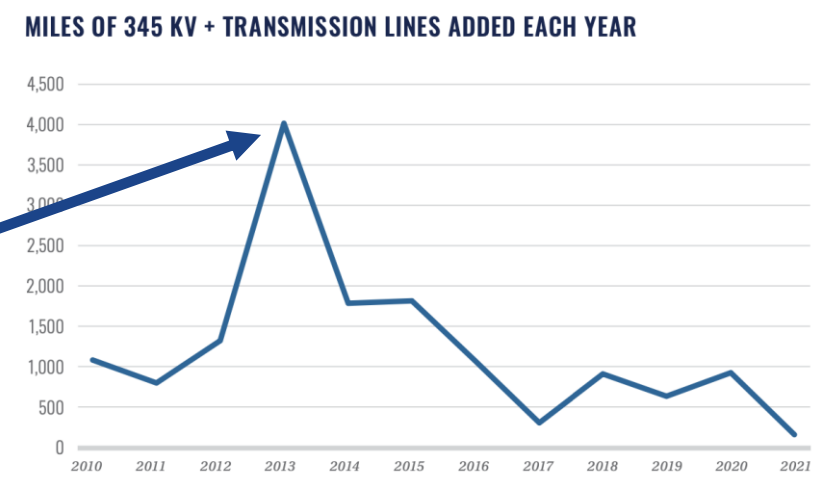
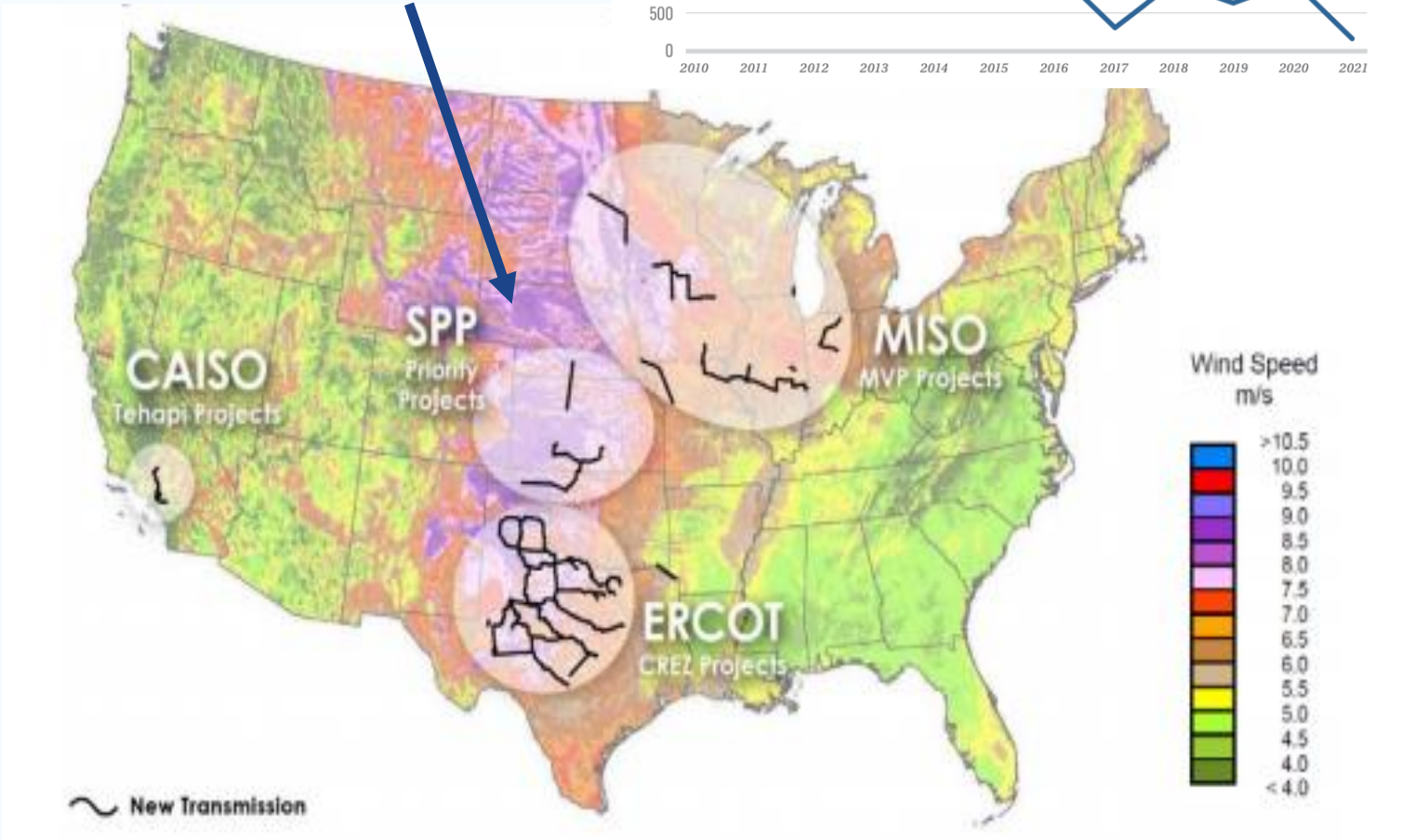
Big transmission CAN be built!

- Planning
  - Proactive,
  - all electricity system benefits,
  - probabilistic/scenario based,
  - portfolio of network upgrades,
  - all technology options

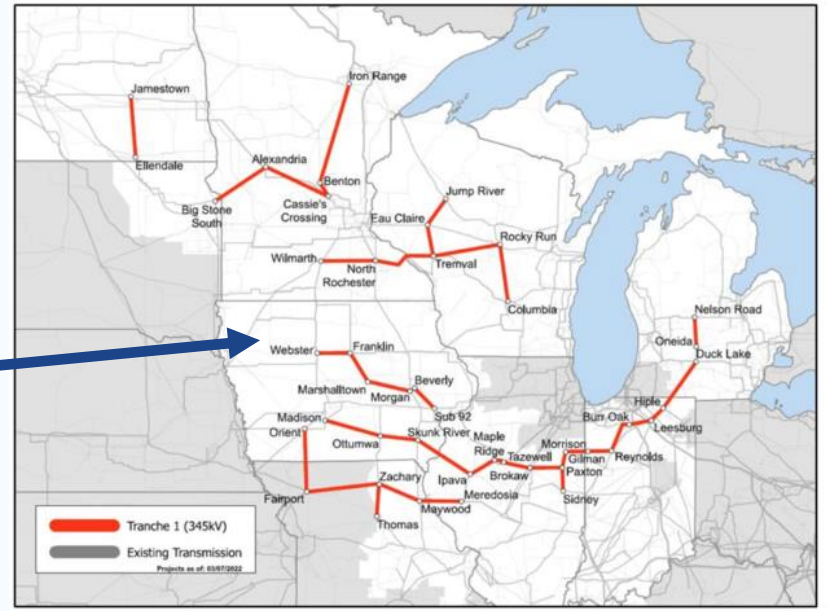


2013 success

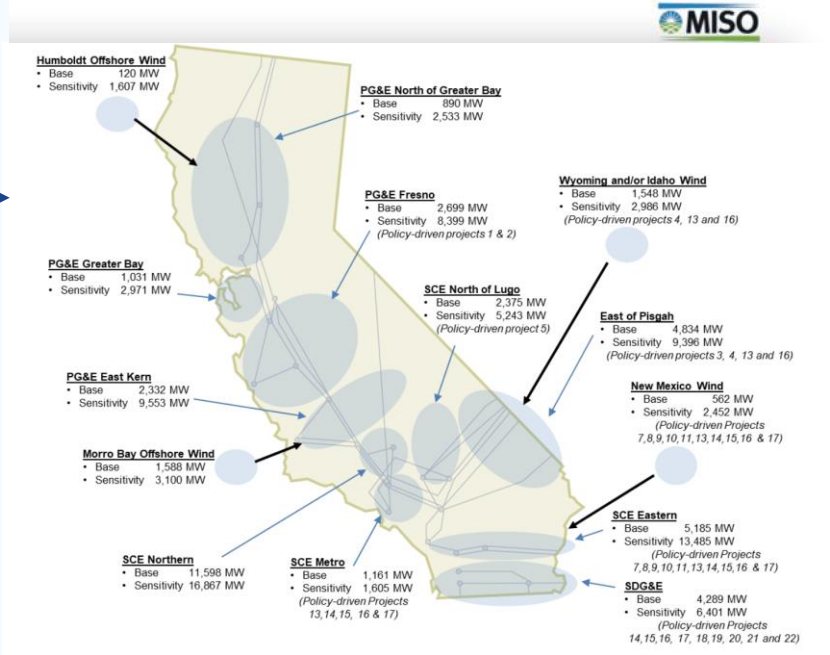


Recent examples of transmission planning that is integrated with interconnection

- MISO Long Range Transmission Plan
- 53 GW of new renewables
- ~$10 billion



- California ISO 2022-23 Transmission Plan
- 4-7 GW of new power needed annually through 2032
- 4.8 GW of out-of-state wind needed—helps resource adequacy
- 45 projects
- $7.3 billion



Interconnection Requirements that Must Be Abided in Today's Circumstances

- Interconnection processes must be timely to be just and reasonable.
  - Queue logjams must be resolved in some way.
- Costs must be minimized to be just and reasonable
  - Incremental small investments in response to each service request cost more per MW delivered than larger investments, due to economies of scale in transmission.
- Cost must be predictable and more certain to be just and reasonable.
  - Complicated, ever-changing incremental cost estimates may no longer be just and reasonable given today's circumstances (different resource mix).
- Interconnection must be effectively integrated with transmission planning, resource adequacy, transmission service, operations.
  - In particular, transmission planning and interconnection have significant overlap.
  - The FERC Planning NOPR may require holistic multi-purpose planning. If so that would likely improve the interconnection process.