WESTERN STATES TRANSMISSION INITIATIVE

Webinar 2:
Is more transmission needed in the West? What are the barriers to development?

GRIDWORKS

What is the Western States Transmission Initiative?

Collaboration between Gridworks and CREPC

Focus on transmission planning and cost allocation

- Is the current approach to transmission planning and cost allocation sufficient in the West?
- What changes might be helpful?
- What is the appropriate role for state regulators and energy officials?

Interviews with state officials, utilities, NGOs, tribes, and others throughout the West

Three background webinars

- July 20: *Transmission planning*
- July 27: *Is more transmission necessary for the West? What are the barriers to development?*
- August 16: *Transmission cost allocation*

Transmission planning and cost allocation recommendations to be developed with Working Group of CREPC members

Discussion of recommendations with all of CREPC at fall meeting in Seattle

Grid Strategies

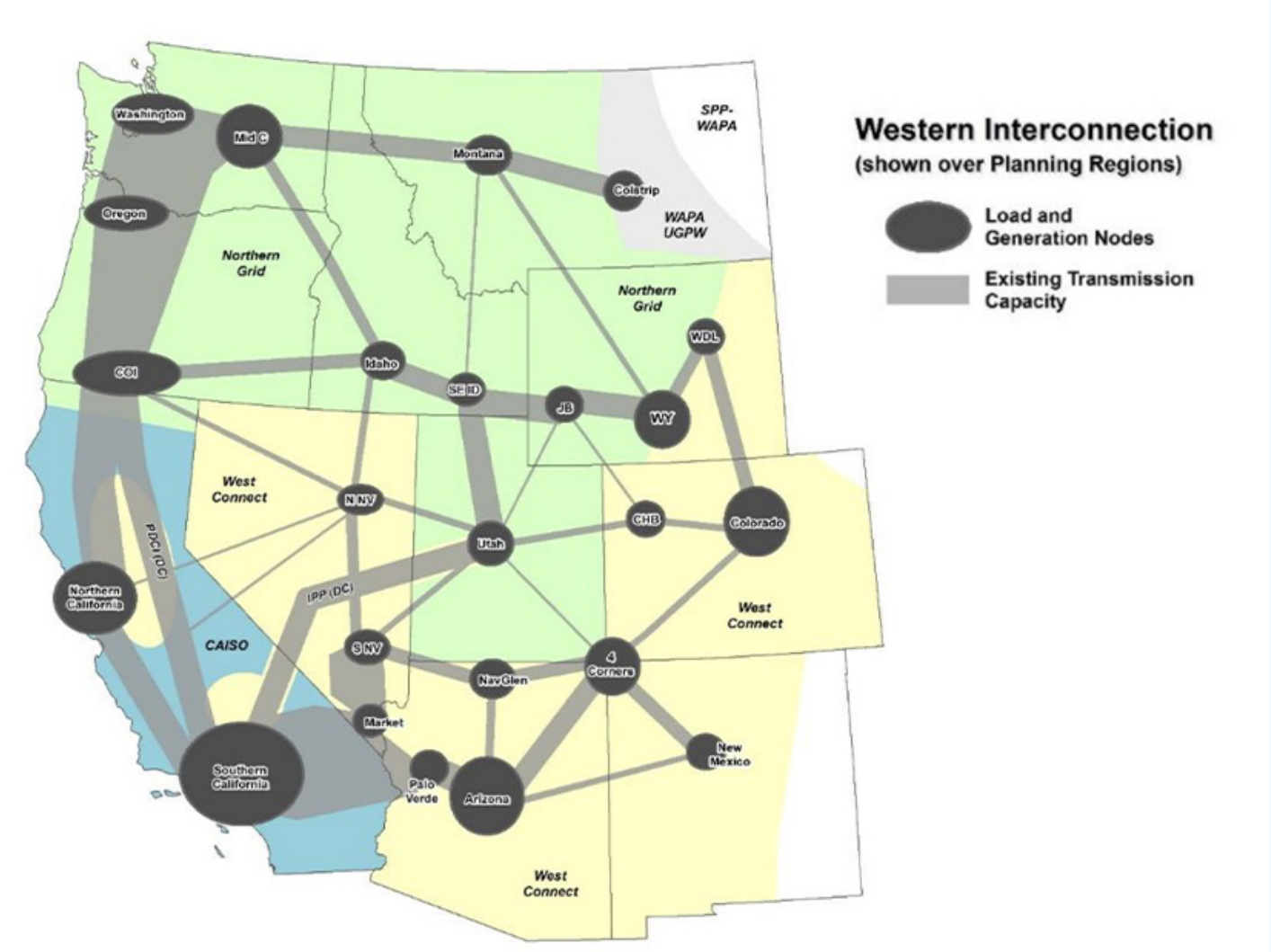
Transmission Needs in the West

Rob Gramlich

CREPC WSTI Webinar

July 2023

Western Loads and Flows Presently



DOE Transmission Needs Study:

West needs to double capacity of some paths

Table VI-3. Median new transmission deployment in all study scenarios in 2030, 2035, and 2040 for all regions.

Region	2020 TW-mi	Scenario Group	New in 2030		New in 2035		New in 2040	
			TW-mi	% Growth	TW-mi	% Growth	TW-mi	% Growth
California	4.29	Mod/Mod	0.06	1.5%	0.07	1.6%	0.08	1.8%
		Mod/High	0.09	2.1%	0.12	2.8%	0.12	2.9%
		High/High	0.05	1.1%	0.16	3.7%	0.23	5.4%
Mountain	3.48	Mod/Mod	1.46	42.1%	1.66	47.9%	1.86	53.5%
		Mod/High	2.28	65.5%	3.14	90.4%	2.88	82.9%
		High/High	3.12	89.7%	6.00	173%	7.69	221%
Northwest	15.24	Mod/Mod	0.03	0.2%	0.04	0.3%	0.08	0.5%
		Mod/High	0.07	0.4%	0.54	3.5%	0.00	0.0%
		High/High	0.62	4.1%	4.71	30.9%	8.54	56.1%
Southwest	5.66	Mod/Mod	0.41	7.3%	0.63	11.2%	0.78	13.7%
		Mod/High	0.93	16.5%	1.87	33.0%	0.81	14.3%
		High/High	2.75	48.7%	6.69	118%	7.64	135%

Source: Utility plan data includes all planned projects and projects under construction above 100 kV from NERC (2020). This data does not include transmission approved by the planners since 2021.

Note: New transmission model results relative to the 2020 system (from Denholm et al. 2022).

Figure VI-6. Comparison of utility transmission development plans with IQR of capacity expansion modeling results for the Moderate/Moderate (top) and Moderate/High (bottom) scenario groups.

GridStrategies

https://www.energy.gov/sites/default/files/2023-02/022423-DRAFTNeedsStudyforPublicComment.pdf

DOE Transmission Needs Study

Interregional Transmission Need

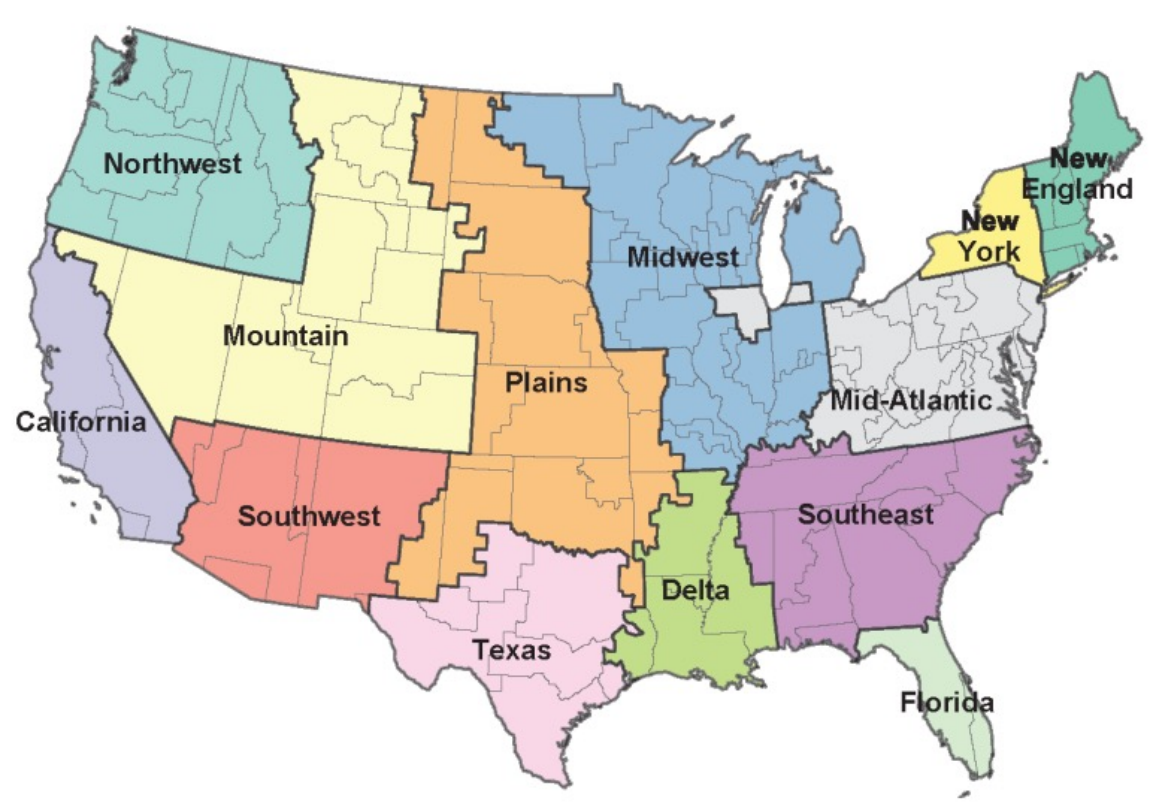


Table VI-4. Median new transfer capacity estimated by all study scenarios in 2030, 2035 and 2040 for all regions.

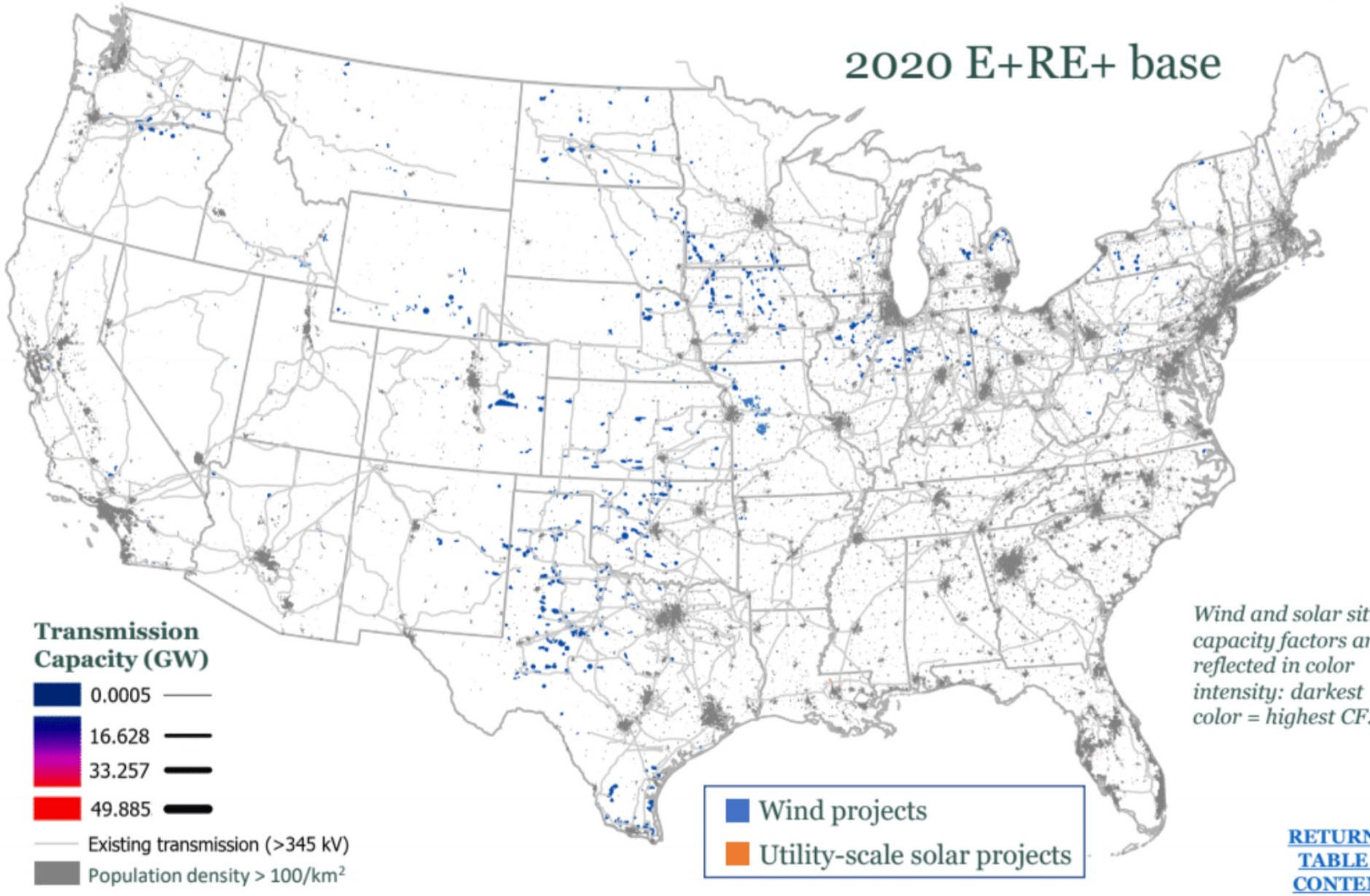
Region	2020 GW	Scenario Group	New in 2030		New in 2035		New in 2040	
			GW	% Growth	GW	% Growth	GW	% Growth
California – Mountain	2.12	Mod/Mod	0.31	14.7%	0.96	45.4%	1.80	84.8%
		Mod/High	0.58	27.3%	1.87	88.1%	4.97	235%
		High/High	1.21	57.0%	2.75	130%	4.31	204%
California – Northwest	5.15	Mod/Mod	0.00	0.0%	0.00	0.0%	0.00	0.0%
		Mod/High	0.00	0.0%	0.13	2.5%	0.00	0.1%
		High/High	0.25	4.8%	1.28	24.9%	1.94	37.7%
California – Southwest	5.23	Mod/Mod	0.00	0.0%	0.14	2.7%	0.22	4.3%
		Mod/High	0.05	0.9%	0.31	5.9%	5.09	97.3%
		High/High	1.90	36.4%	5.31	102%	6.89	132%
Mountain – Northwest	12.7	Mod/Mod	0.00	0.0%	0.09	0.7%	0.51	4.0%
		Mod/High	1.08	8.5%	3.30	26.0%	0.00	0.0%
		High/High	6.25	49.2%	25.7	202%	39.2	308%
Mountain – Southwest	4.06	Mod/Mod	0.04	0.9%	0.09	2.2%	0.38	9.5%
		Mod/High	0.37	9.1%	1.65	40.6%	1.70	41.7%
		High/High	2.08	51.2%	5.24	129%	6.06	149%
Delta – Texas	0.00	Mod/Mod					22.2	
		Mod/High					48.3	
		High/High					106.7	
Mountain – Plains	0.92	Mod/Mod	0.36	39.1%	0.94	102%	1.40	152%
		Mod/High	0.79	85.4%	2.64	287%	11.9	1290%
		High/High	6.10	663%	19.3	2100%	29.2	3170%

Modeled 2020 wind and utility-scale solar capacity; Existing transmission lines (≥ 345 kV).

2020 (modeled)	Wind	Solar
Capacity installed (TW)		
	0.14	0.07
Land used (1000 km²)		
Total	57	1.12
Direct	5.8	1.02
Capital invested (Billion $$_{2018}$)*		
Solar	-	47
Onshore wind	69	-
Offshore wind	-	-
Existing transmission		
Capacity (GW-km)**	320,000	
Increase over 2020	-	

* Excludes investments associated with 2020 pre-existing capacity. Capital is for additional capacity required to meet total modeled wind & solar generation levels.

** Homeland Infrastructure Foundation-Level Data (HIFLD), 2008, as cited in National Renewable Energy Laboratory, Renewable Electricity Futures Study, 2012.



Jenkins, https://netzeroamerica.princeton.edu/

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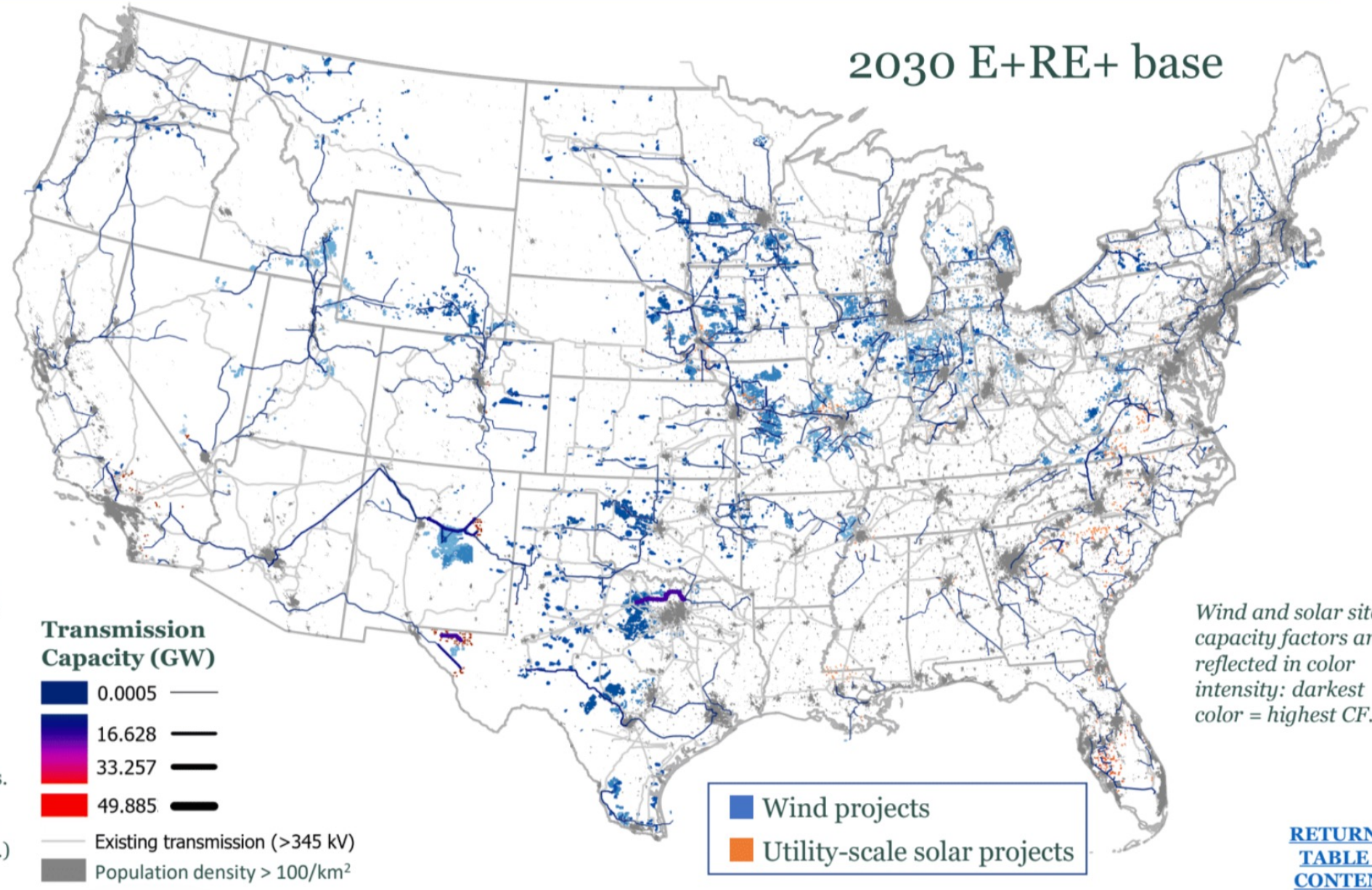
866 GW of wind and solar capacity operating in 2030; transmission capacity grows by 74%.

2030	Wind	Solar
Capacity installed (TW)		
	0.46	0.40
Land used (1000 km²)		
Total	174	8.7
Direct	1.74	7.9
Capital invested (Billion $_{2018}$)*		
Solar	-	450
Onshore wind	490	-
Offshore wind	15	-
Transmission added vs. 2020**		
Capacity (GW-km)	235,000	
Increase over 2020	74%	
Capital in serv (B$_{2018}$)	320	

* Excludes investments associated with 2020 pre-existing capacity. Capital is for additional capacity required to meet total modeled wind & solar generation levels.

** Transmission expansion is mapped to follow existing rights of way (>160 kV); paths are indicative not definitive. Spur lines from solar and wind projects to substations are not shown, but are included in GW-km and investment totals. Capital in service includes capital for transmission expansions and "sustaining capital" (for end-of-life line replacements.)



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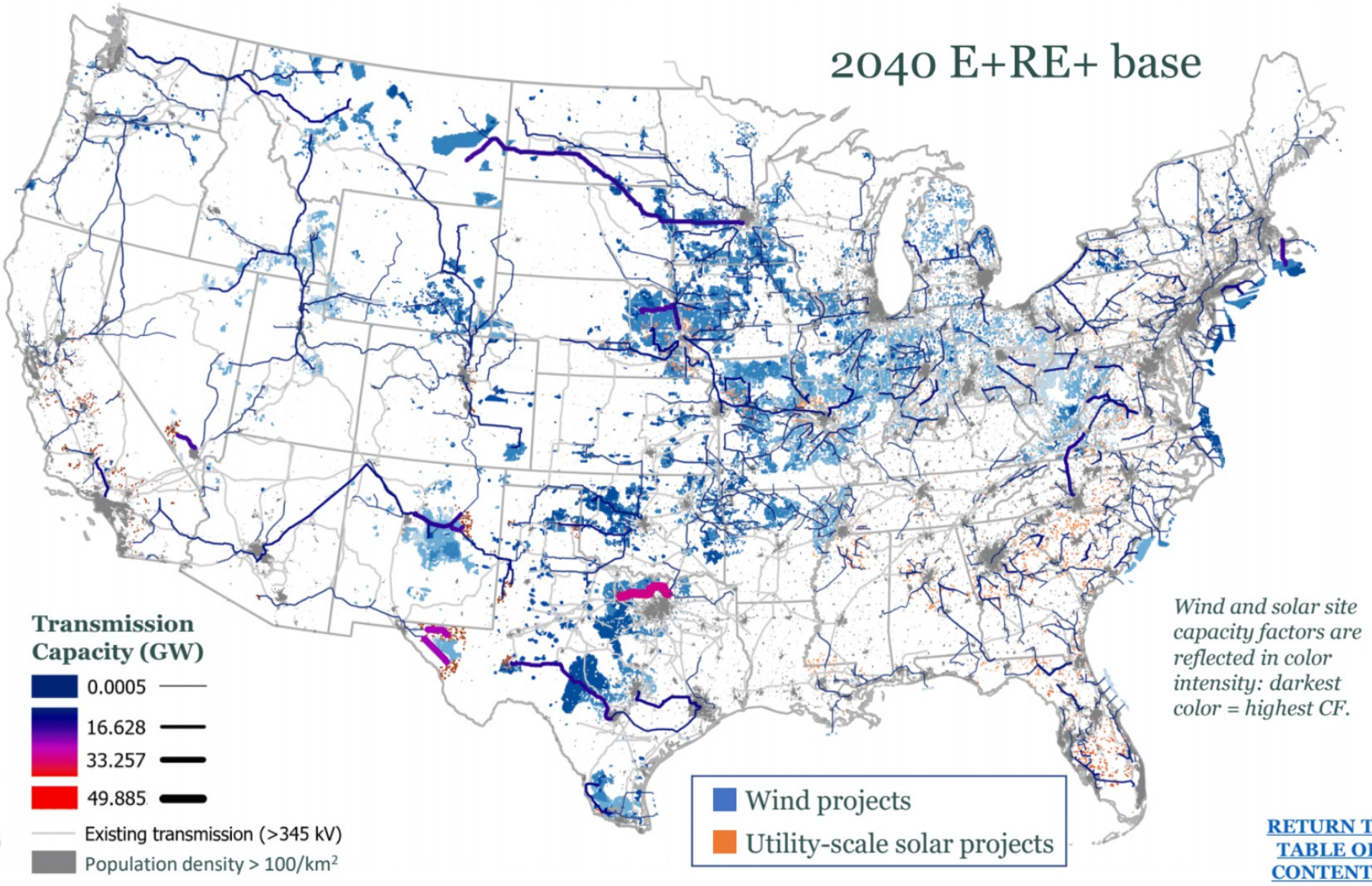
2.7 TW of wind and solar capacity operating in 2040; transmission capacity grows to 2.4x the 2020 level.

2040		
	Wind	**Solar**
Capacity installed (TW)		
	1.42	1.23
Land used (1000 km²)		
Total	493	26.9
Direct	4.9	24.5
Capital invested (Billion $_{2018}$)*		
Solar	-	1,305
Onshore wind	1,497	-
Offshore wind	223	-
Transmission added vs. 2020**		
Capacity (GW-km)	760,000	
Increase over 2020	237%	
Capital in serv (B$_{2018}$)	1,320	

* Excludes investments associated with 2020 pre-existing capacity. Capital is for additional capacity required to meet total modeled wind & solar generation levels.

** Transmission expansion is mapped to follow existing rights of way (>160 kV); paths are indicative not definitive. Spur lines from solar and wind projects to substations are not shown, but are included in GW-km and investment totals. Capital in service includes capital for transmission expansions and "sustaining capital" (for end-of-life line replacements.)



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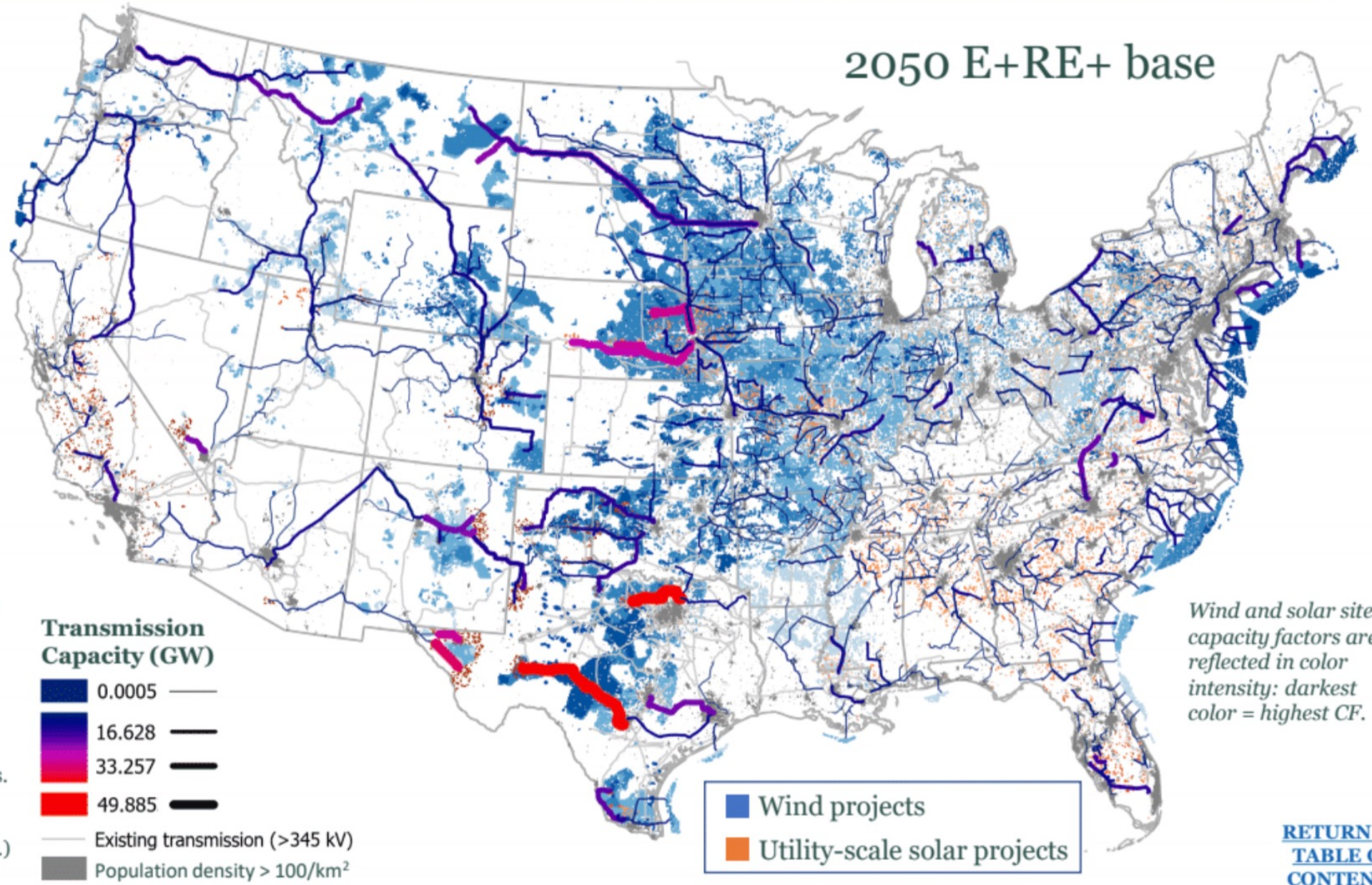
Jenkins, https://netzeroamerica.princeton.edu/

5.9 TW of wind and solar capacity operating in 2050; transmission capacity grows to 5.1x the 2020 level.

2050		
	Wind	**Solar**
Capacity installed (TW)		
	3.07	2.75
Land used (1000 km²)		
Total	1,003	61.2
Direct	10.0	55.7
Capital invested (Billion $$_{2018}$$)*		
Solar	-	2,684
Onshore wind	3,010	-
Offshore wind	594	-
Transmission added vs. 2020**		
Capacity (GW-km)	1,309,000	
Increase over 2020	409%	
Capital in serv (B$$_{2018}$$)	3,560	

* Excludes investments associated with 2020 pre-existing capacity. Capital is for additional capacity required to meet total modeled wind & solar generation levels.

** Transmission expansion is mapped to follow existing rights of way (>160 kV); paths are indicative not definitive. Spur lines from solar and wind projects to substations are not shown, but are included in GW-km and investment totals. Capital in service includes capital for transmission expansions and "sustaining capital" (for end-of-life line replacements.)



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Jenkins, https://netzeroamerica.princeton.edu/

Planned Transmission in the West

- 27 projects
- Over 5,200 miles
- Over $15 billion

SB100 July 22 Workshop Projects

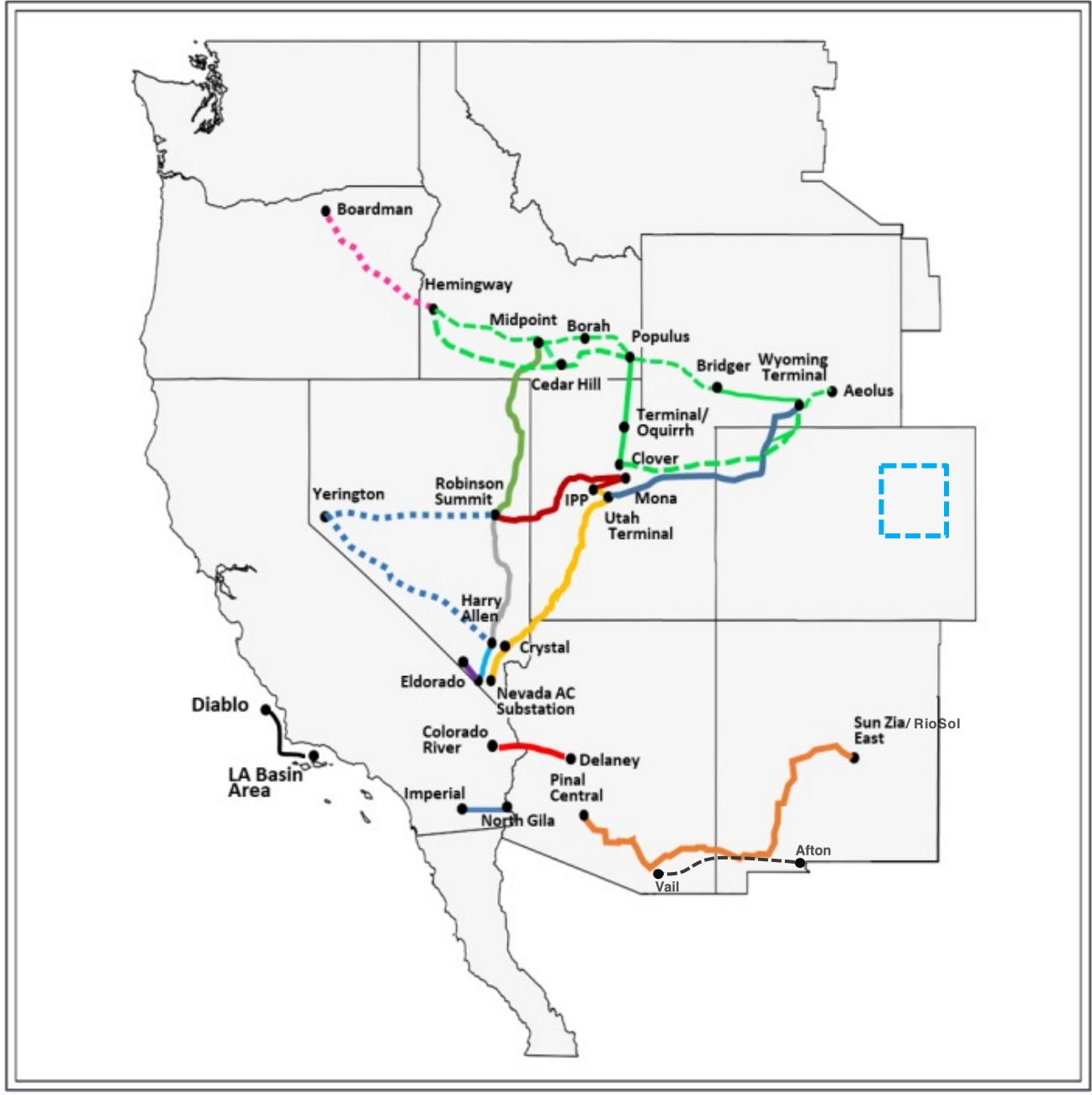
- Sun Zia
- TransWest Express DC
- TransWest Express AC
- SWIP North
- Cross-tie
- GridLiance
- Ten West Project
- Pacific Transmission Expansion
- North Gila – Imperial Valley #2

Existing or Other Relevant Proposed Projects

- Boardman - Hemingway
- Colorado Power Pathway
- Greenlink Nevada
- Gateway Project

Existing Lines

- ON Line
- Desert Link
- Gateway Project Online

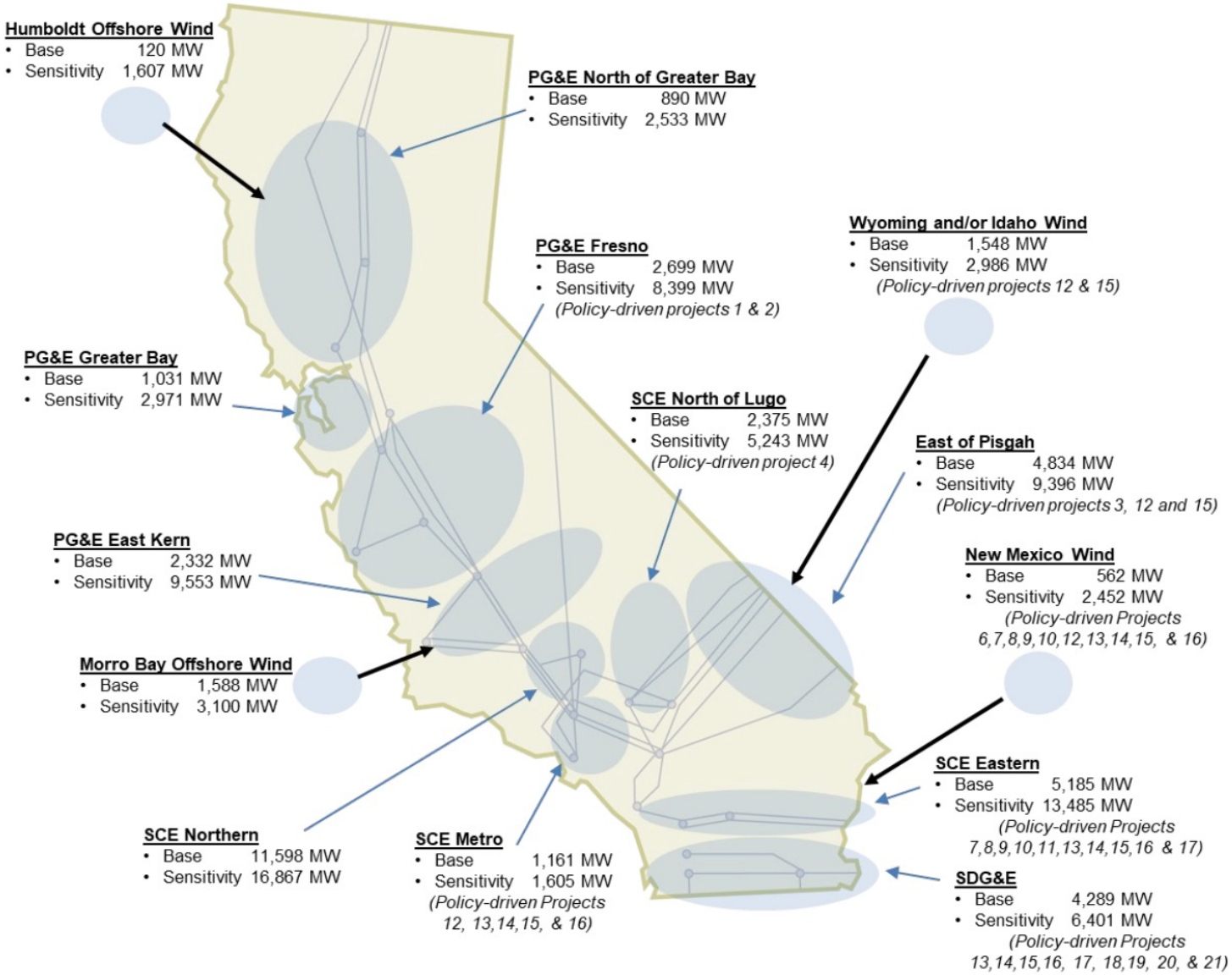


http://www.caiso.com/InitiativeDocuments/Draft20-YearTransmissionOutlook.pdf

California 2022-2023 Transmission Plan

- 7 GW of new power needed annually through 2033
- 4.8 GW of out-of-state wind needed
- 45 projects
- $7.3 billion

Figure ES-1: Transmission Planning Zones and Capacity



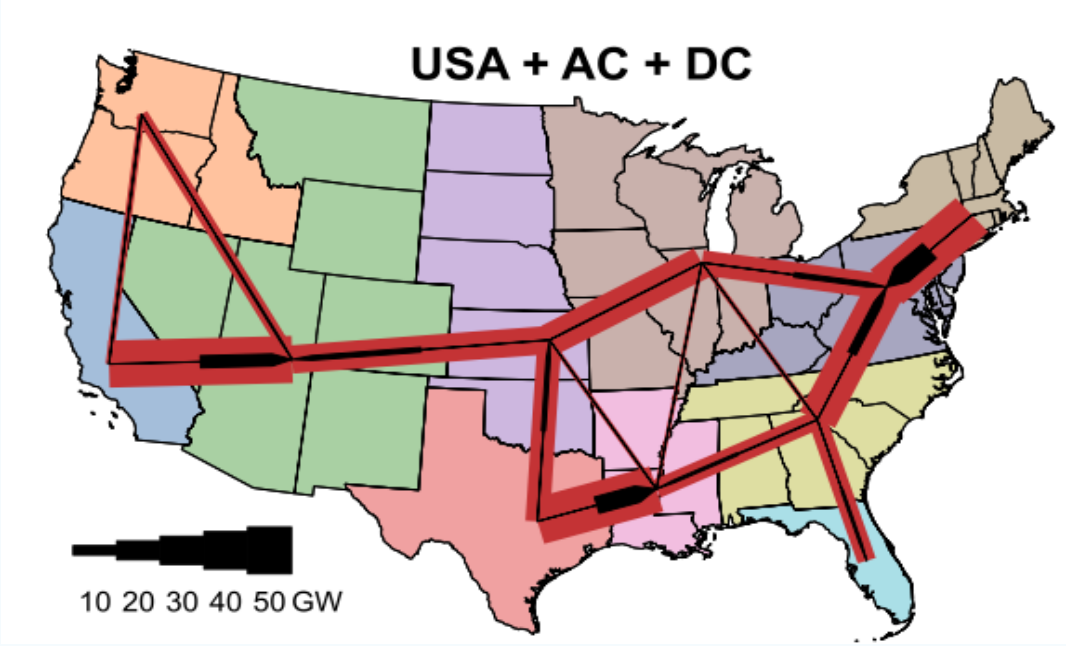
http://www.caiso.com/InitiativeDocuments/ISO-Board-Approved-2022-2023-Transmission-Plan.pdf

Bigger is better—economies of scale

10s of GWs of power transfer back and forth across and between regions

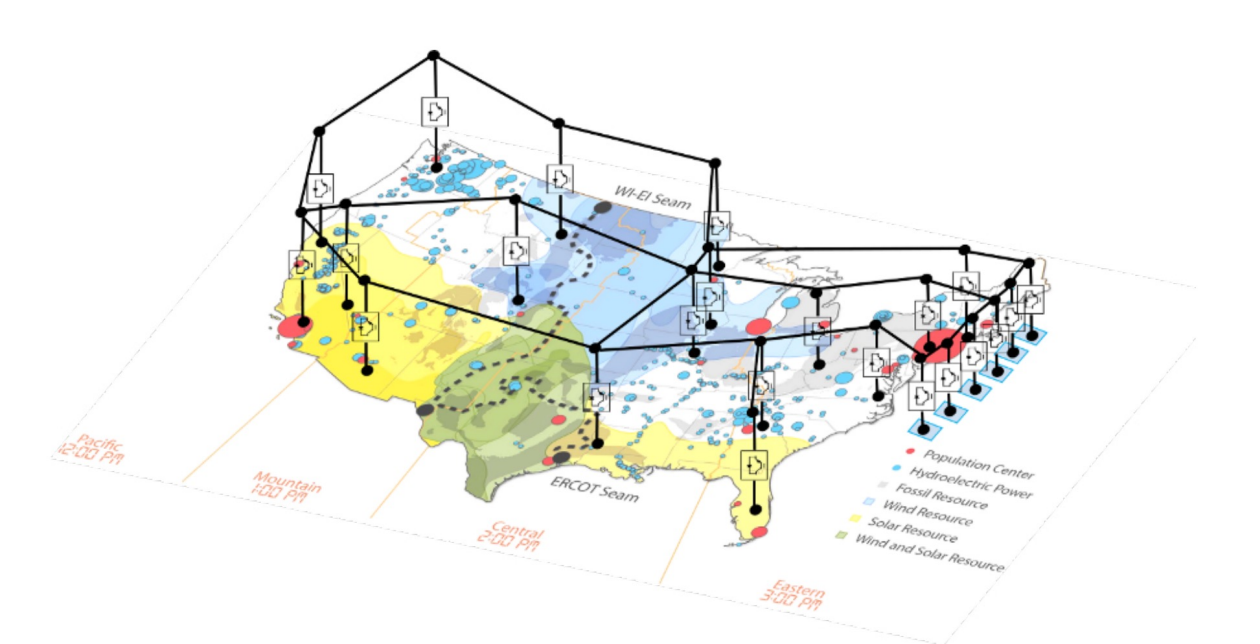
Benefit > cost with 2-3x increase in national transmission capacity

MIT Value of Interregional Transmission Study



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

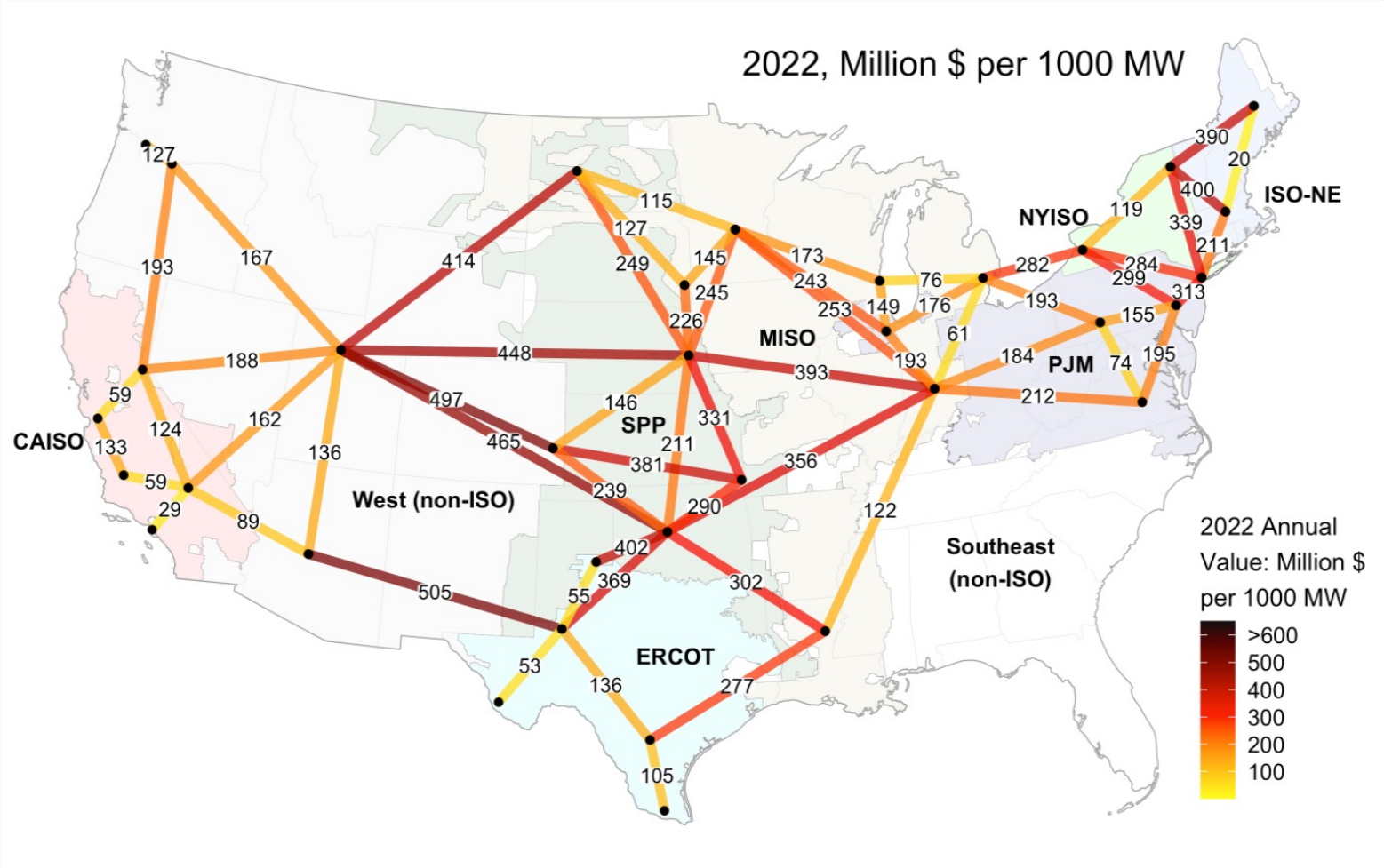
NREL Seams Study (updated by Jim McCalley)



Bloom (NREL), https://cleanenergygrid.org/wp-content/uploads/2020/11/Macro-Grids-in-the-Mainstream-1.pdf

Highest value lines are at the Interconnection Seams

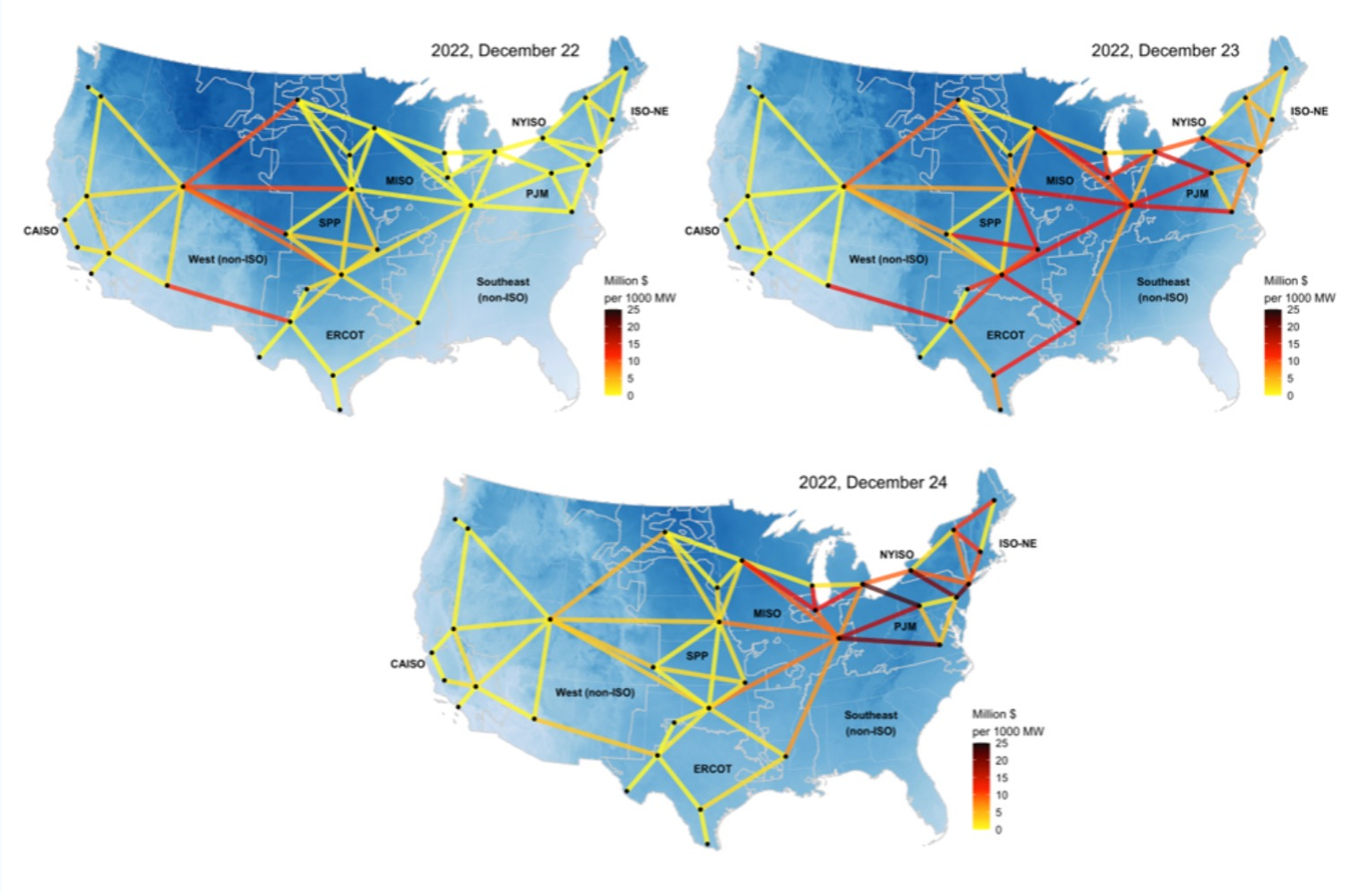
- Value of transmission is increasing and was at its highest in 2022, according to LBNL Study



Millstein (LBNL), https://emp.lbl.gov/news/latest-market-data-show-potential-savings-new

10% of hours accounted for half of the value of a transmission line

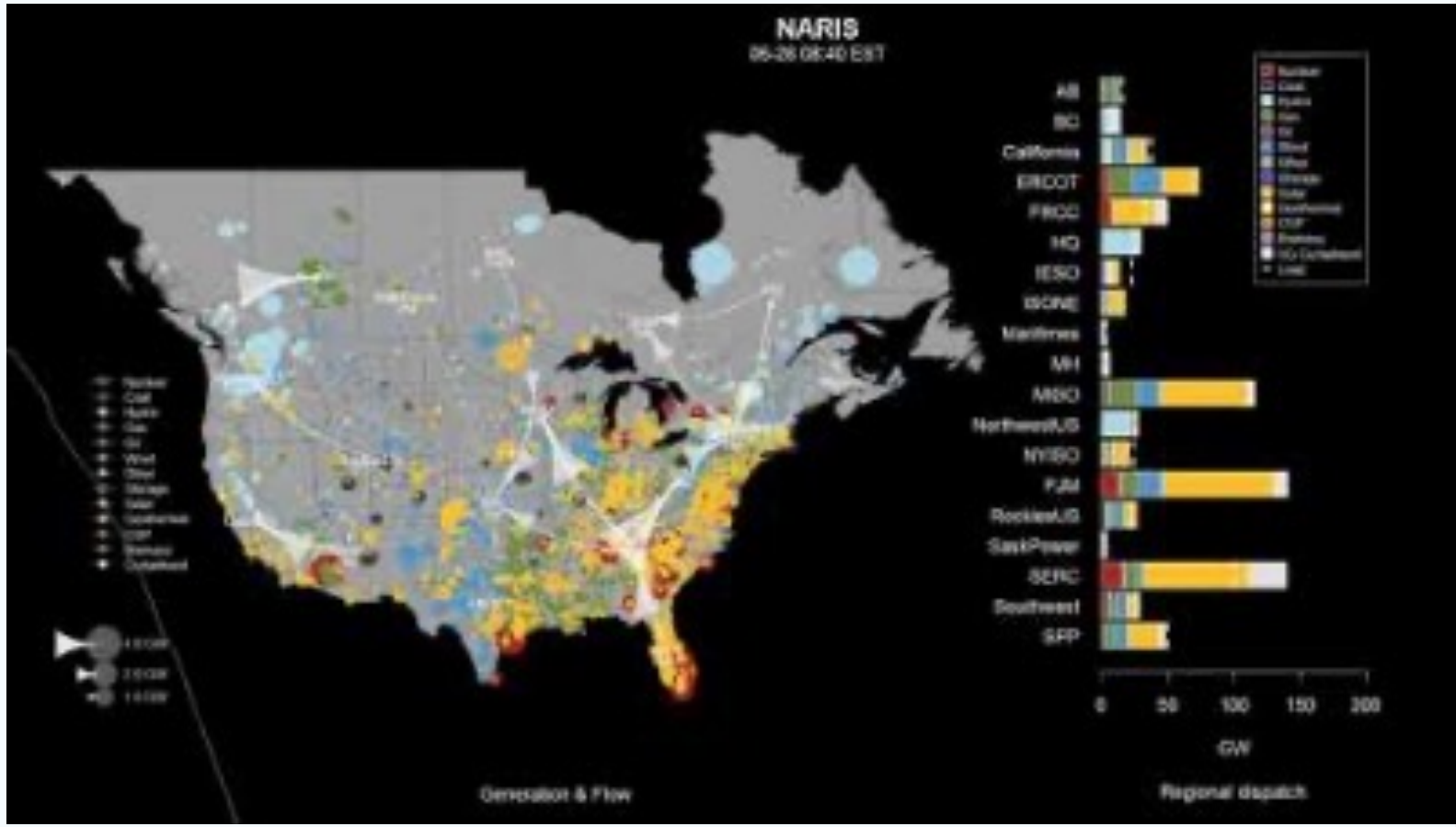
- During Winter Storm Elliot there was significant value to cross-seam transmission as the cold weather event moved from West to East
- “The grid can and should be bigger than the weather.”–Michael Goggin, Grid Strategies



Millstein (LBNL), https://emp.lbl.gov/news/latest-market-data-show-potential-savings-new

Power Flows in the West in 2050

- Bidirectional power flows across the West depending on season
- But significant power flows into California and the Northwest year-round



NARIS Study (NREL), https://www.youtube.com/watch?v=HM9uiv0q7p0&list=PLmIn8Hncs7bGY2DMIxVibs3N8qpSUwxUU&index=1

White Space

- Areas where WECC can enhance and support transmission planning:
  - Enhance WECC's modeling capabilities – emphasis to support 20+ year planning and scenario development; and
  - The development of the Western Assessment of Transmission Trends

- Initial Assessment
  - Year 20 – long duration energy storage with an extended extreme weather event
  - Year 20 – extreme hot weather event
  - Year 20 – extreme cold weather event
  - Year 20 – impacts of compound changes in loads and electrification

Fiscal Responsibility Act

Directive to NERC to perform an interregional transfer capability study.

- **18 months to complete**
- **Scope – focused on entities involved in interstate commerce from one transmission planning region to another**
- **Study will include:**
  - **Current total transfer capability between each pair of neighboring transmission planning regions;**
  - **A recommendation of prudent additions;**
  - **Recommendations to meet and maintain total transfer capability.**