

2024 Energy Council

9-13-2024

Grid Resiliency

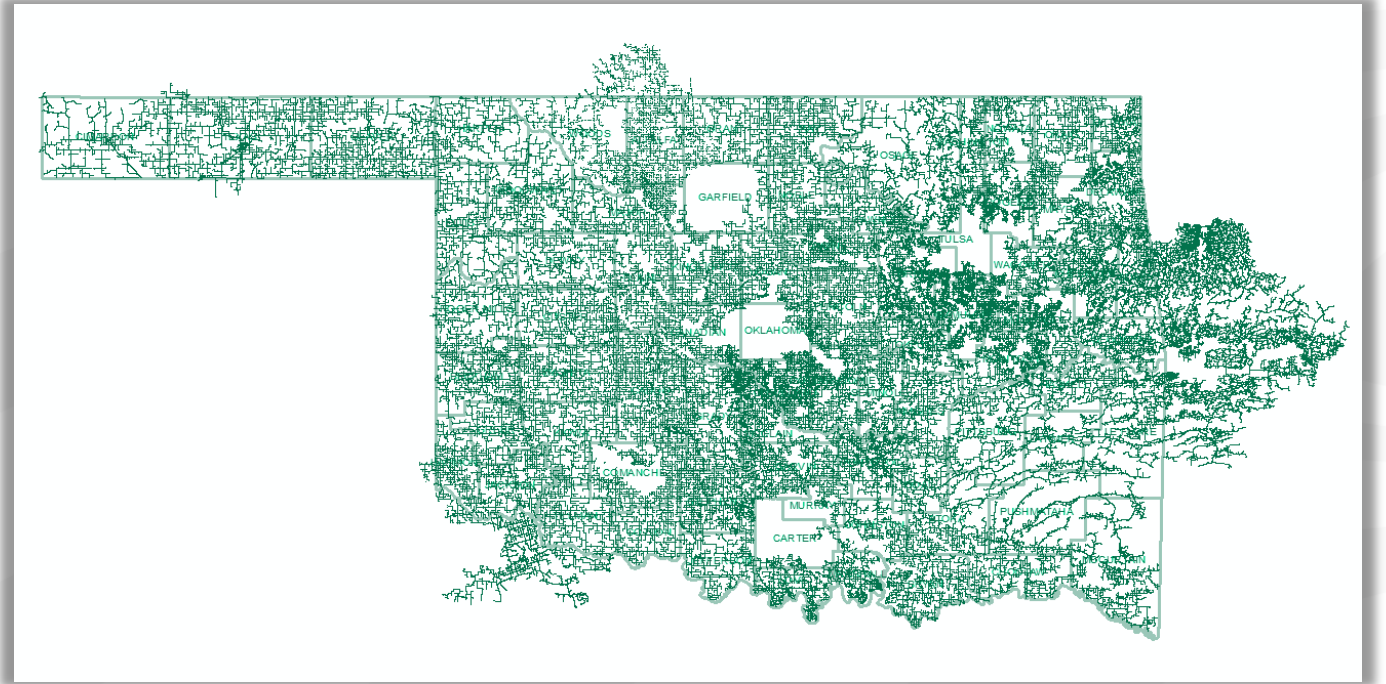


OKLAHOMA'S ELECTRIC
COOPERATIVES

Powering lives **Empowering** communities

Highlights:

- Oklahoma's electric co-ops power more than **1.1 million** Oklahomans
- Serving **527,000+** in-state meters and over **134,000** meters in surrounding states
- Co-ops maintain **118,210** miles of distribution line



***Powering 93% of
Oklahoma's landmass***

Grid Resiliency:

at its most basic level

Ice, Wind, Fire





ICE



OKLAHOMA'S ELECTRIC
COOPERATIVES

ICE



OKLAHOMA'S ELECTRIC
COOPERATIVES



WIND

7 electric poles
Standing 😊



OKLAHOMA'S ELECTRIC
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FIRE



OKLAHOMA'S ELECTRIC
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Finally, Woodpecker

Mitigation Projects

- Shorten line span between poles.
 - Add Iron pole every 4 or 5 poles, at road crossings.
 - Double guy wires
 - Replacing all copper wire with aluminum – lighter
 - Iron poles and longer fiberglass cross arms
 - Lightning arresters and one-shot reclosers
 - Vegetation management
-
- **Making system more resilient through mitigation projects.**



Ductile Iron Pole w/ Fiberglass cross arms

communities



OKLAHOMA'S ELECTRIC
COOPERATIVES



Double Guy Wire

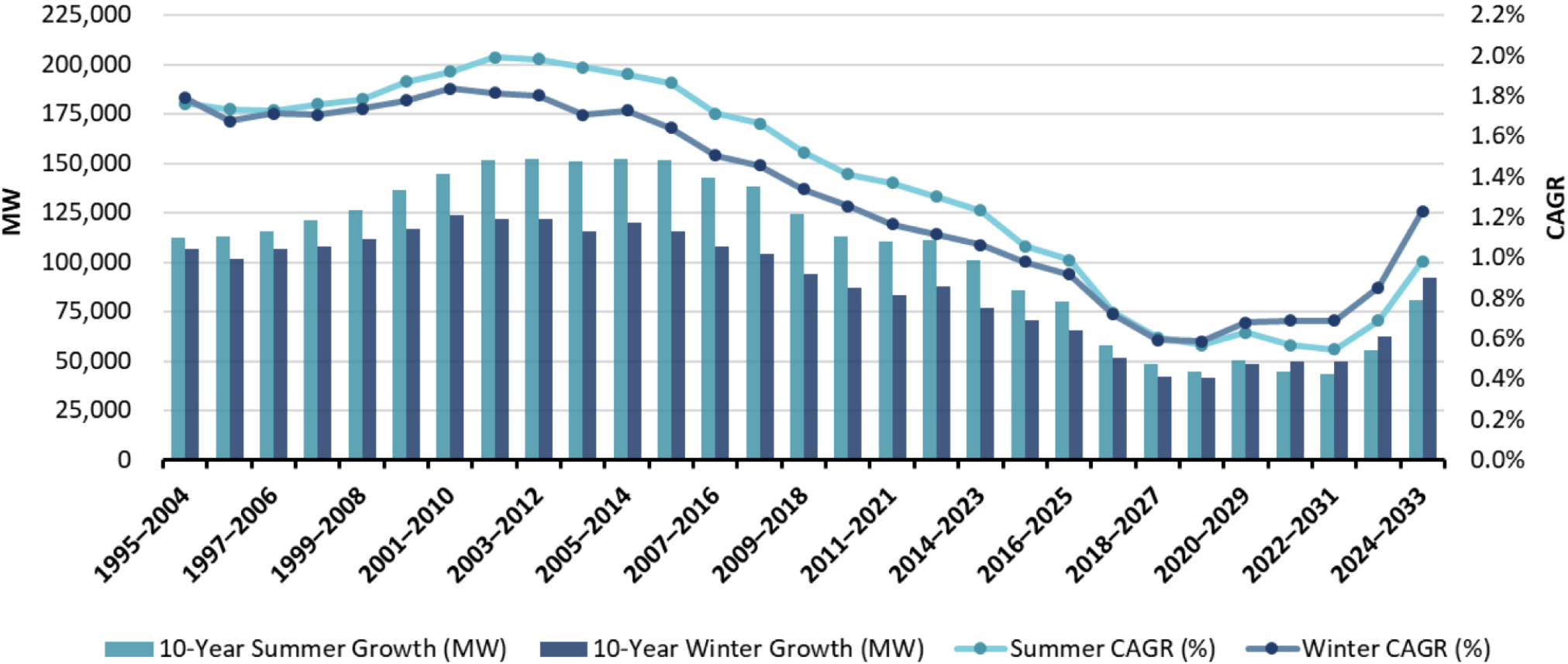


OKLAHOMA'S ELECTRIC
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**Iron Pole
Fiberglass cross arms
Double guy wires
near road crossing
stopped the cascading**

FIGURE ES-1: NERC 10-YEAR SUMMER AND WINTER PEAK DEMAND GROWTH AND RATE PROJECTIONS



Source: NERC, “2023 Long-Term Reliability Assessment,” December 2023, p. 33,
https://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC_LTRA_2023.pdf.

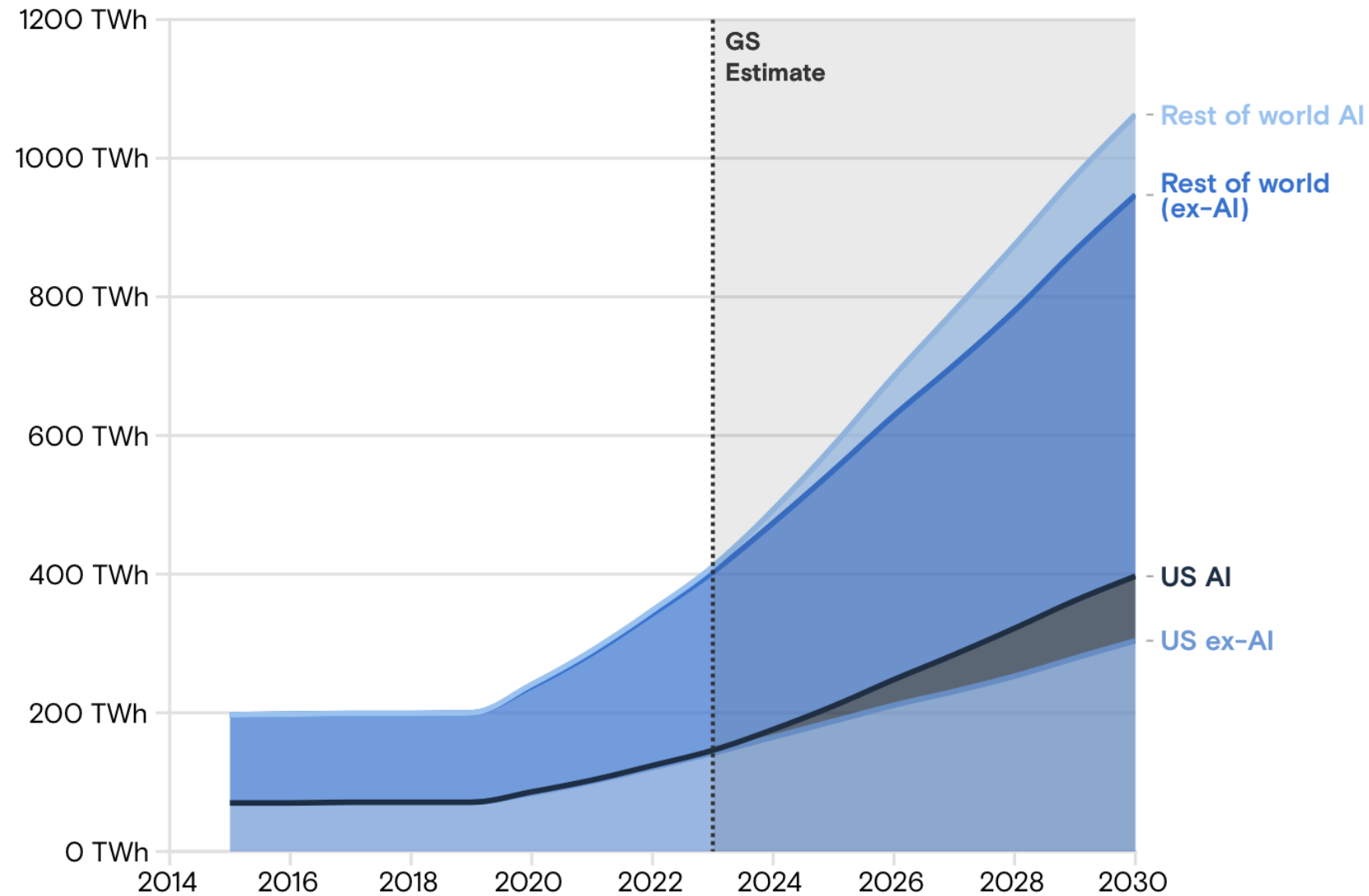
FIGURE ES-2: ELECTRICITY DEMAND DRIVERS, POTENTIAL IMPACTS, AND GROWTH RATES IN THE US (50 STATES)

	Description	Current Capacity (GW)*	Approximate Growth Rate (CAGR)*	Approximate Growth by 2030 (GW)*
A1. Data Centers	Data centers underpin the online economy and support the growth of artificial intelligence.	19	9% through 2030	16
A2. Onshoring & Industrial Electrification	Electrification of the industrial sector is a major pathway to reduce emissions. New sources of electric demand are triggered by the onshoring of manufacturing activity, hydrogen production (e.g., electrolyzers), indoor agriculture, and carbon dioxide removal.	Industrial: 116 Hydrogen Production: 0.07 Indoor Agriculture: 6	Reindustrialization (near-term): 1% through 2025 Hydrogen: 132% through 2030 Indoor Agriculture: 10% through 2035	Reindustrialization: 4.9 Hydrogen: 25 Indoor Agriculture: 5.8
A3. Cryptocurrency Mining	Cryptocurrency mining is the process by which networks of computers generate and release new currencies and verify new transactions.	10–17 (estimated to be around 50% to 90% of data center load in the US)	Unknown and highly volatile (driven by cryptocurrency values, which fluctuate by external factors)	8–15



B1. Transportation Electrification	<p>A growing number of customers purchase electric passenger vehicles as a more climate-friendly alternative to gas vehicles; medium- and heavy-duty vehicles, bicycles, motorcycles, and ferries can all operate on electricity.</p>	<p>6.8 (electric vehicles)</p>	<p>15% through 2040</p>	<p>8.4</p>
B2. Building Electrification	<p>Electrification is a major pathway to decarbonize buildings and can include space heating (e.g., heat pumps), water heating (e.g., heat pump water heaters), and cooking (e.g., electric/induction cook stoves).</p>	<p>50</p>	<p>0%–4% through 2050</p>	<p>7.4</p>
<p>Total 82 GW</p>				

Data center power demand



Source: Masanet et al. (2020), Cisco, IEA, Goldman Sachs Research

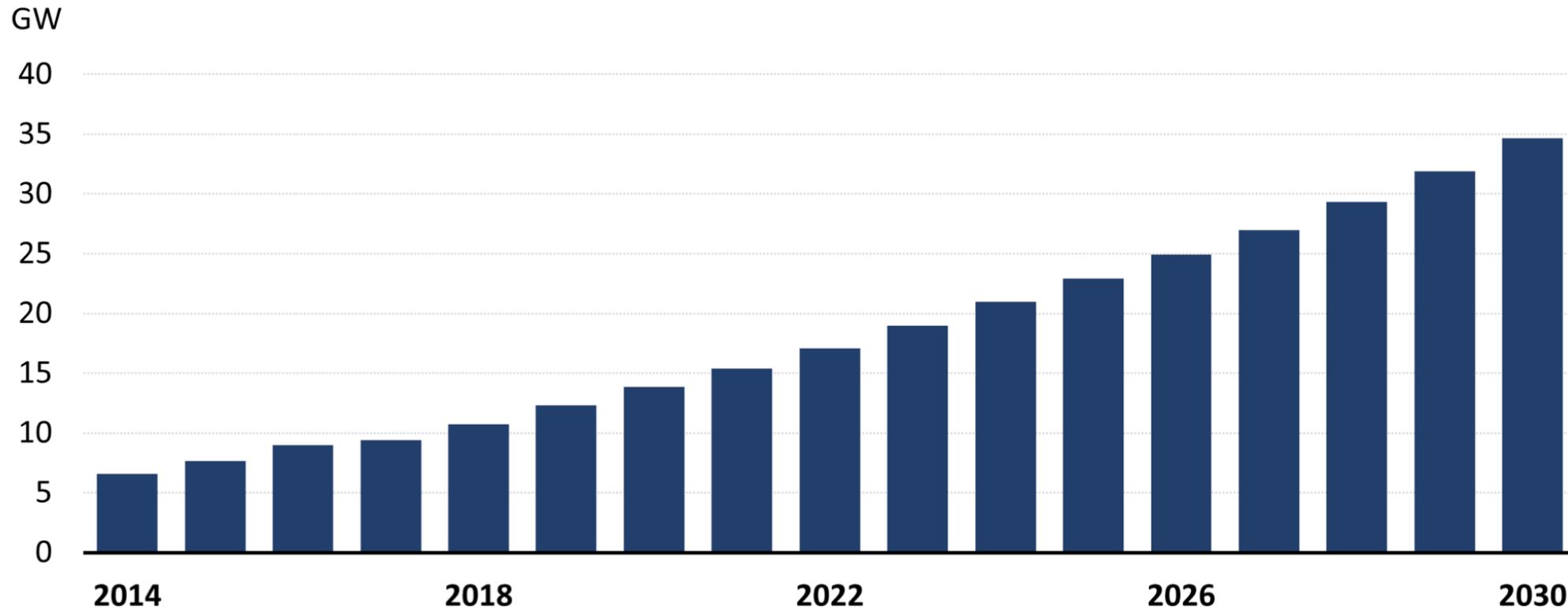
**Goldman
Sachs**



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FIGURE 3: US DATA CENTER DEMAND GROWTH



Notes and source: Demand is measured by power consumption to reflect the number of servers a data center can house. Demand includes megawatts for storage, servers, and networks. From McKinsey & Company, “Investing in the Rising Data Center Economy.” <https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/investing-in-the-rising-data-center-economy>.

Electricity Demand

U.S. Electricity Consumption, Actual & Projected
(TWh)



Source: CoBank analysis

COBANK

19

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OKLAHOMA'S ELECTRIC
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AI Growth

- Google Searches
- GPT Chat
- Autonomous Driving
- Smart Grid Management – Predictive Analytics – Demand management
- Precision Farming
- Healthcare - medical imaging analysis, drug discovery, genomic data
- Finance – trading, fraud detection, customer service
- Retail - customer trends, inventory control
- Manufacturing – Quality control, supply chain management

Basic GPT Chat

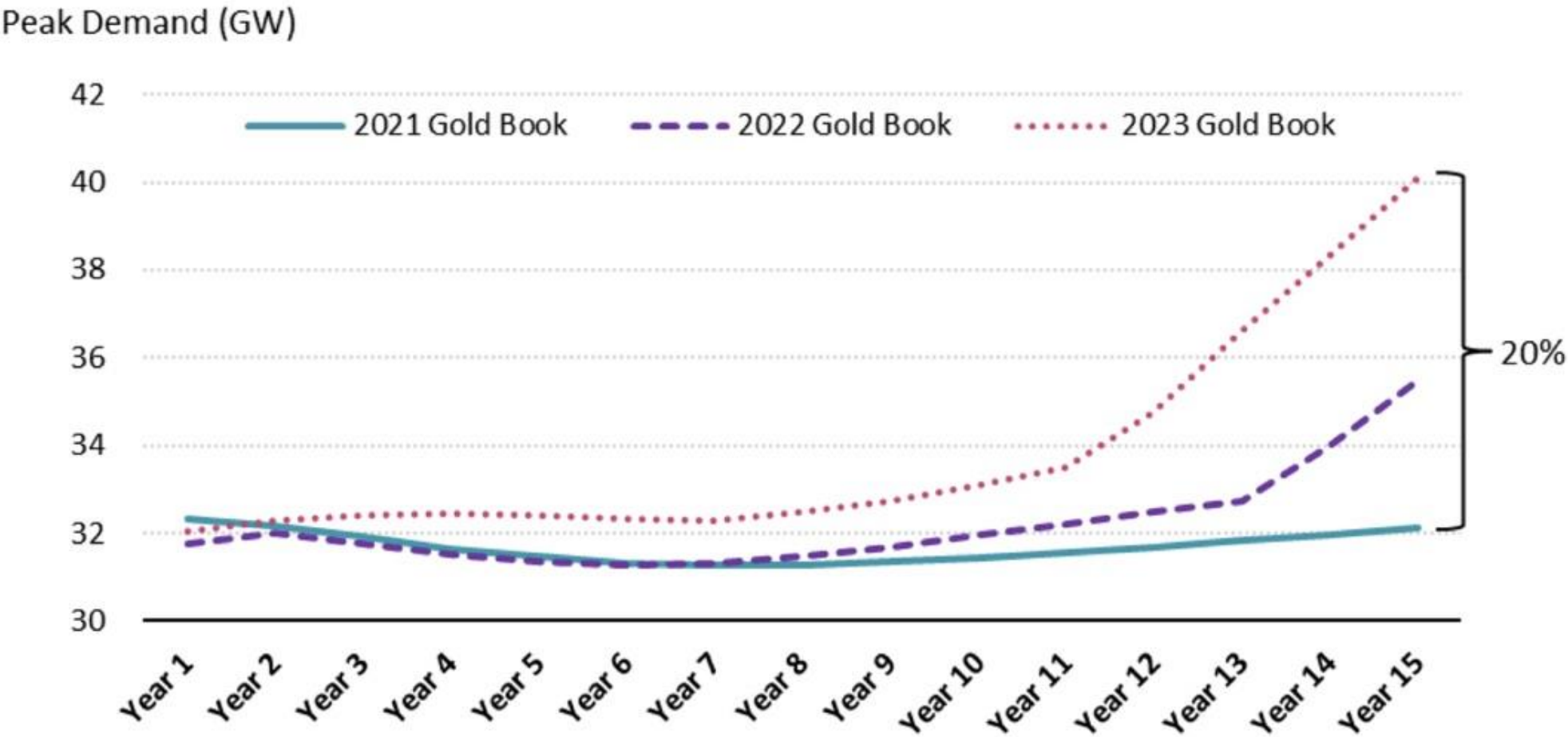
- ChatGPT – 3 built on 175 billion parameters
- WU Dao – Built on 1.75 trillion parameters

Ed Ansett, i3 Solutions Group

Ed Ansett is co-founder and chairman of the i3 Solutions Group

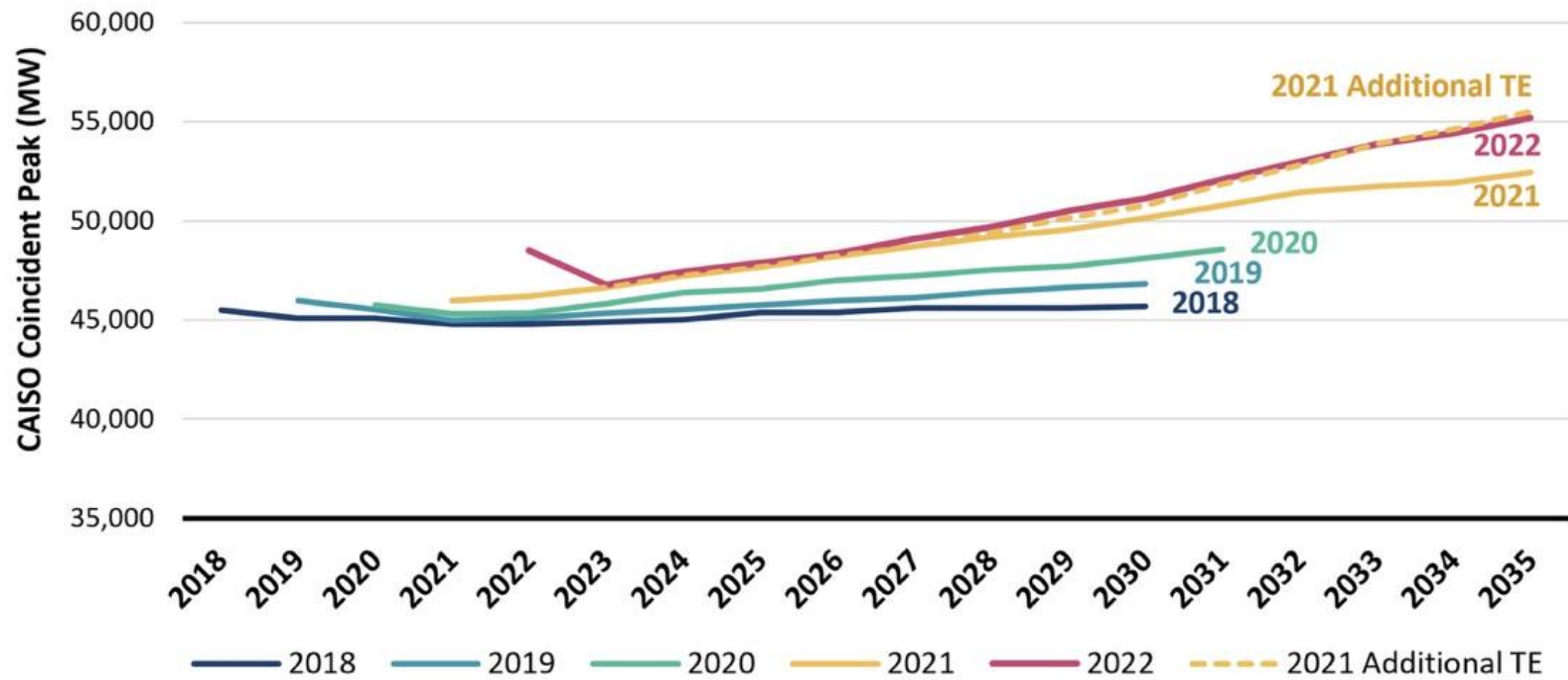


FIGURE 16: PEAK DEMAND FORECASTS FOR NEW YORK



Source: 2021–2023 NYISO Load & Capacity Data Report (Gold Book).

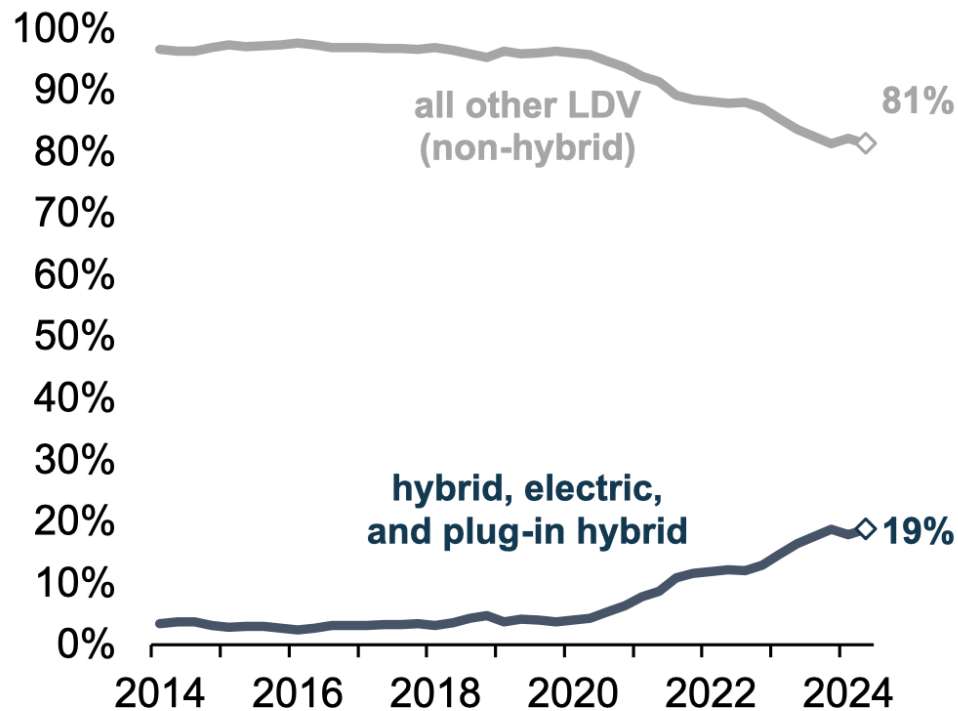
FIGURE 17: CALIFORNIA DEMAND FORECAST CHANGES OVER TIME



Source: California Energy Commission, [Draft 2023 Integrated Energy Policy Report](#), November 13, 2023.

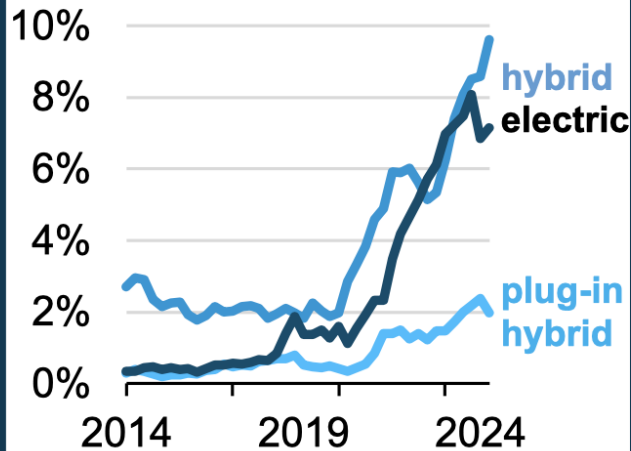
U.S. share of electric and hybrid vehicle sales increased in the second quarter of 2024

Quarterly U.S. light-duty vehicle (LDV) sales by powertrain (Jan 2014–June 2024)
percentage of sales



eia

Breakout of EV and hybrid sales
percentage



Data source: Wards Intelligence

Note: EV=electric vehicles, which include both battery electric and plug-in hybrid electric vehicles



Alternative Fuels Data Center

FUELS &
VEHICLES

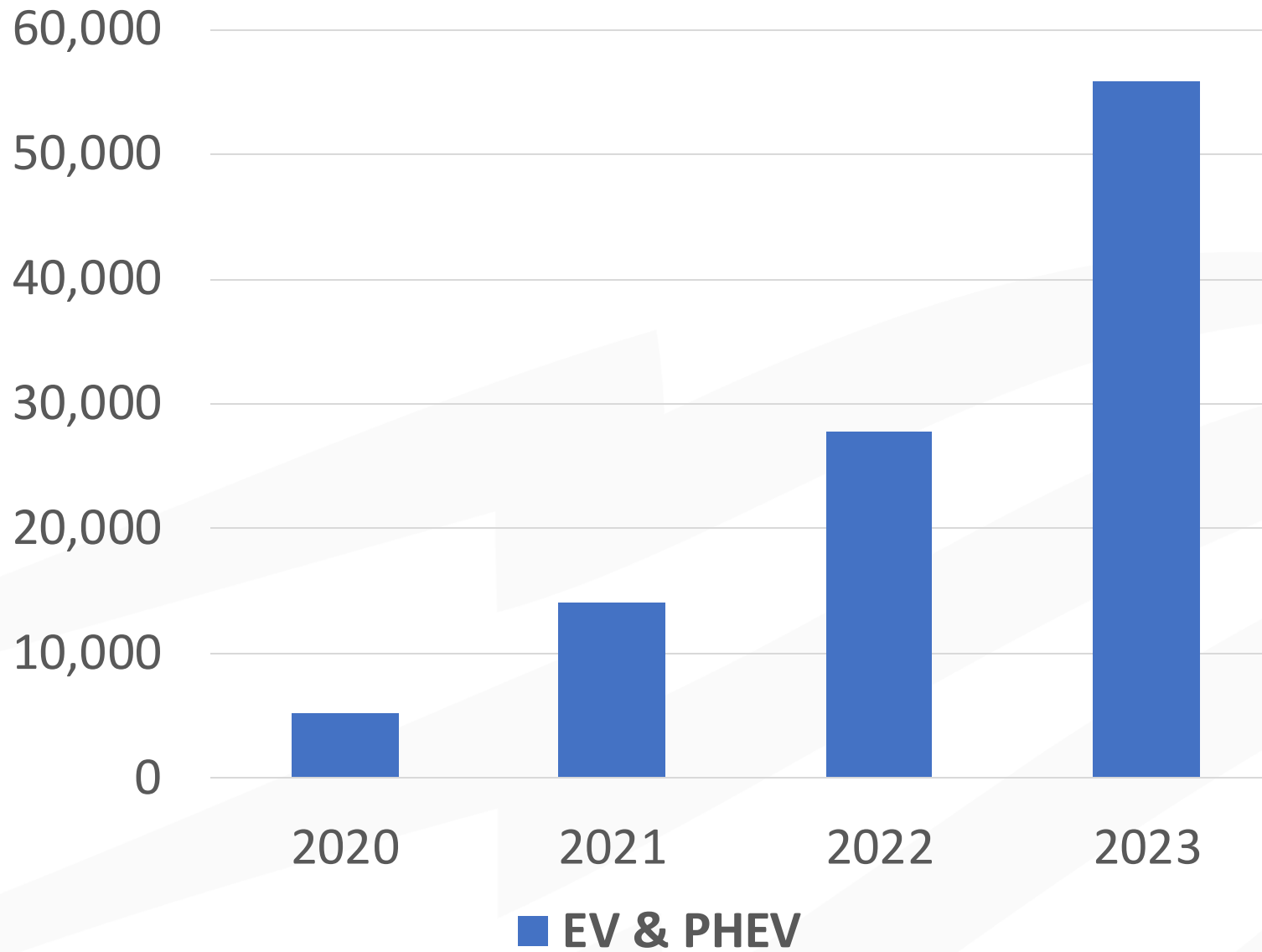
CONSERVE
FUEL

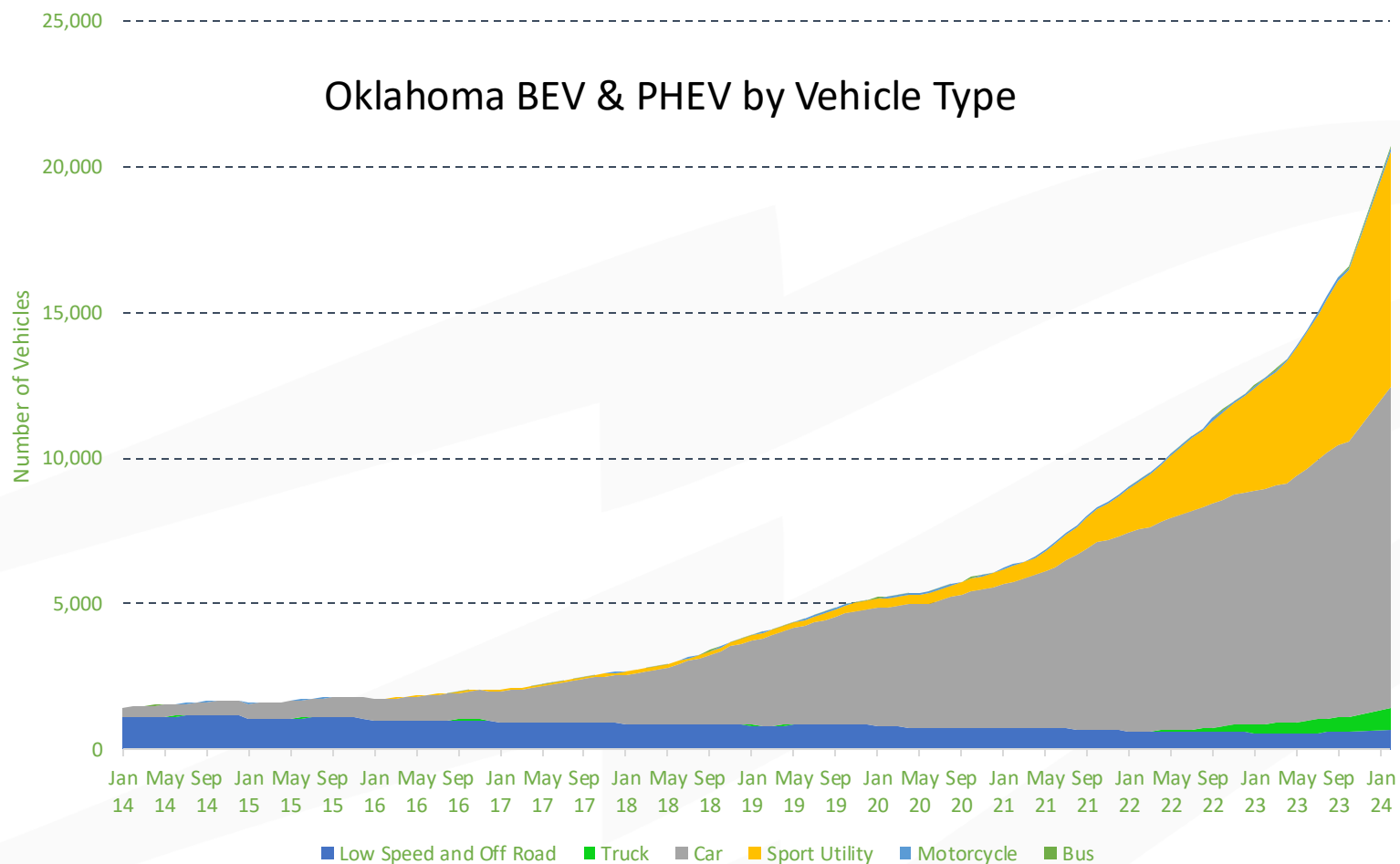
LOCATE
STATIONS

LAWS &
INCENTIVES

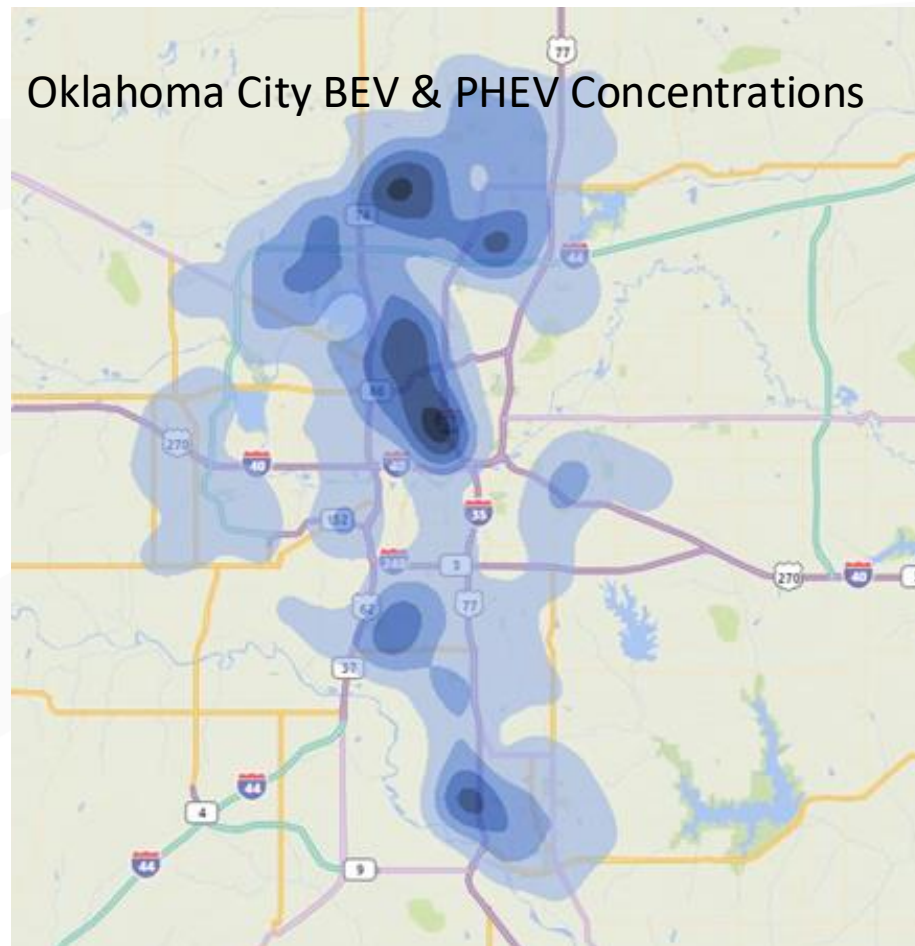
[EERE](#) » [AFDC](#) » [Maps & Data](#)

Vehicle Registration Counts by State





OG+E We Energize Life



2023 EV Registration Increase

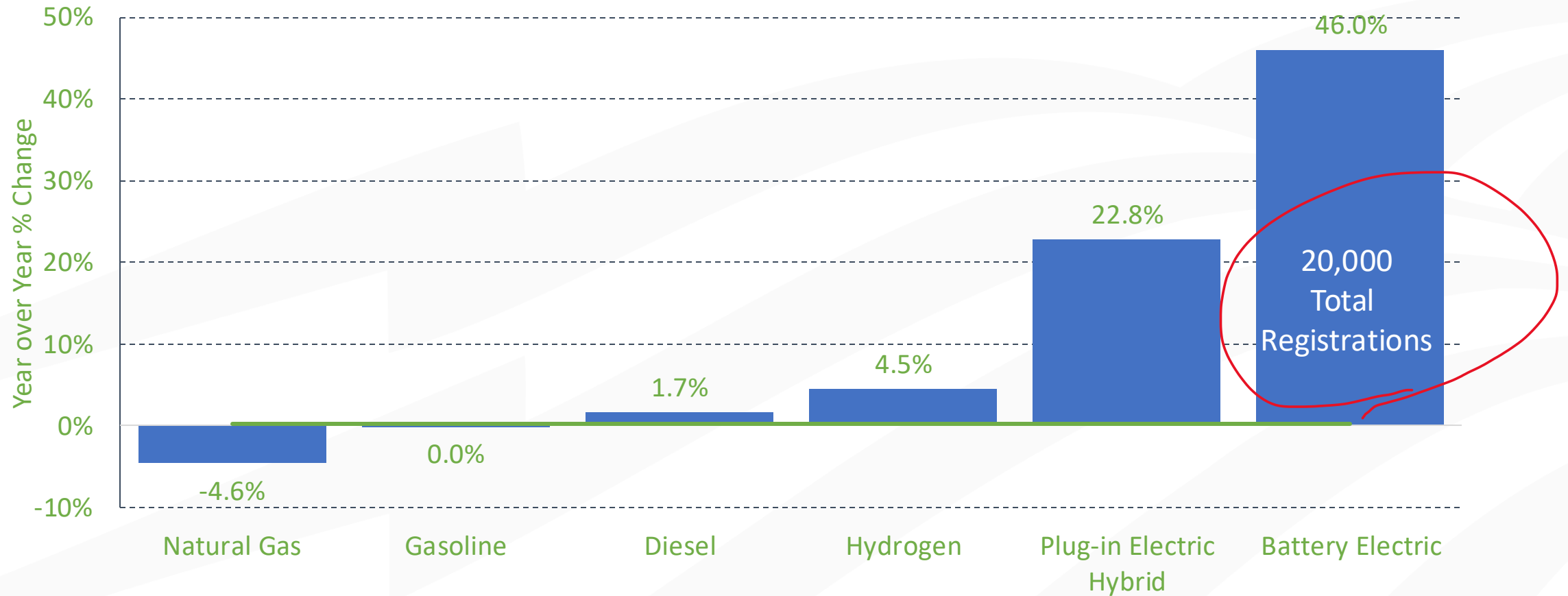


FIGURE 4: PEAK LOAD IMPACT (MW) FROM NEW ONSHORED MANUFACTURING ANNOUNCEMENTS BY ELECTRICITY MARKET REGION TO DATE

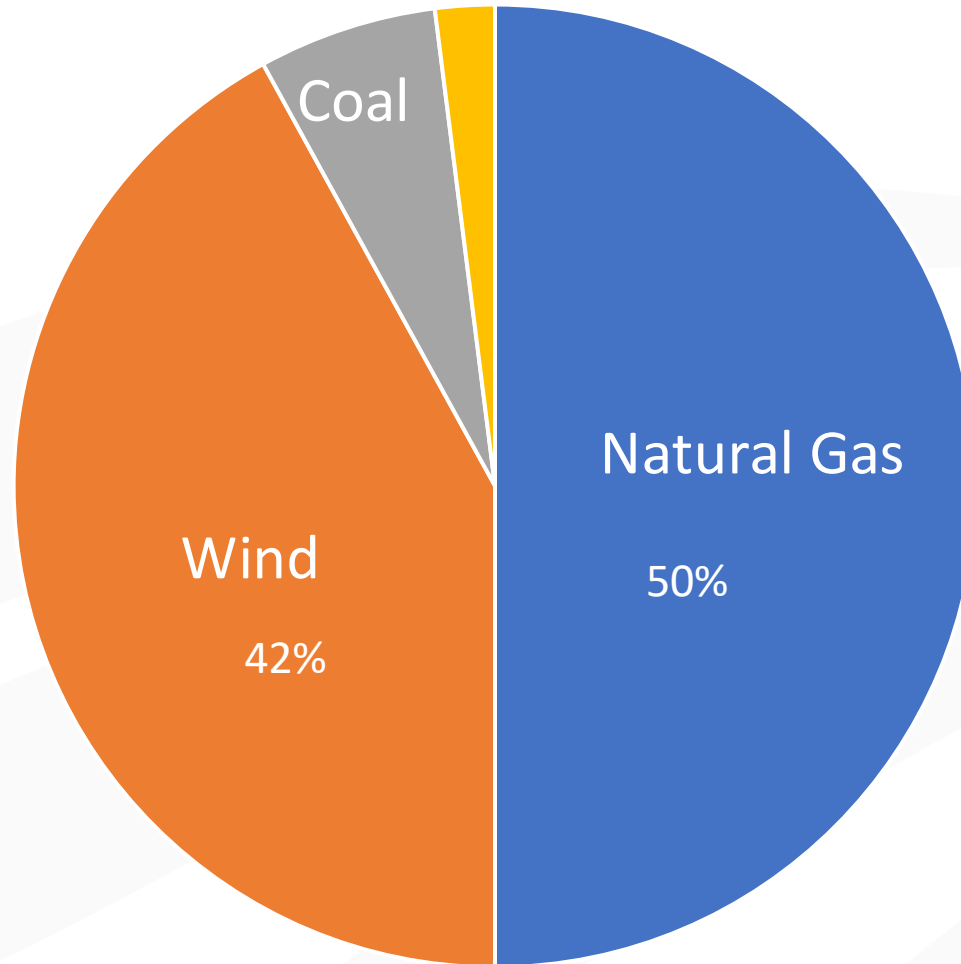
	EV/ Battery	Fuel / Plastic/ Chemical	Metals	Semiconductor/ Electronic	Solar	Wind	Transportation	Other	Total
Southeast	327.3	34.1	8.3	-	25.5	-	-	0.4	395.6
Mountain-South	30.3	2.0	-	170.9	1.6	-	-	-	204.8
Ohio Valley	98.6	4.1	78.7	-	3.5	-	0.0	0.0	185.0
MISO-East	127.5	20.0	-	-	-	-	0.0	-	147.5
South Atlantic	129.8	0.0	1.3	-	1.0	-	-	-	132.1
California	32.3	-	54.8	0.1	9.3	-	-	-	96.5
Mid-Atlantic	-	78.9	0.2	-	0.5	-	6.5	5.5	91.6
Florida	-	-	-	85.0	-	-	-	-	85.0
MISO-South	2.3	52.4	27.4	-	-	-	-	0.0	82.1
New York	12.5	-	-	0.4	0.4	46.8	-	-	60.1
Texas	0.1	52.1	-	-	1.5	-	-	-	53.7
SPP	22.8	-	-	-	-	-	0.1	-	22.9
Pacific	11.6	-	-	-	-	-	-	-	11.6
MISO-North	-	-	0.6	-	0.2	-	-	2.0	2.8
New England	-	-	0.0	-	-	-	-	2.0	2.0
Mountain-North	0.6	-	-	-	-	-	-	-	0.6
Total (MW)	795.7	243.6	171.3	256.4	43.5	46.8	6.6	10.0	1,573.9

Sources and notes: Table adapted from Electric Power Research Institute, "[Reindustrialization, Decarbonization,](#)



OKLAHOMA'S ELECTRIC
COOPERATIVES

2023 Oklahoma Generation



■ Natural Gas ■ Wind ■ Coal ■ Hydro/Other

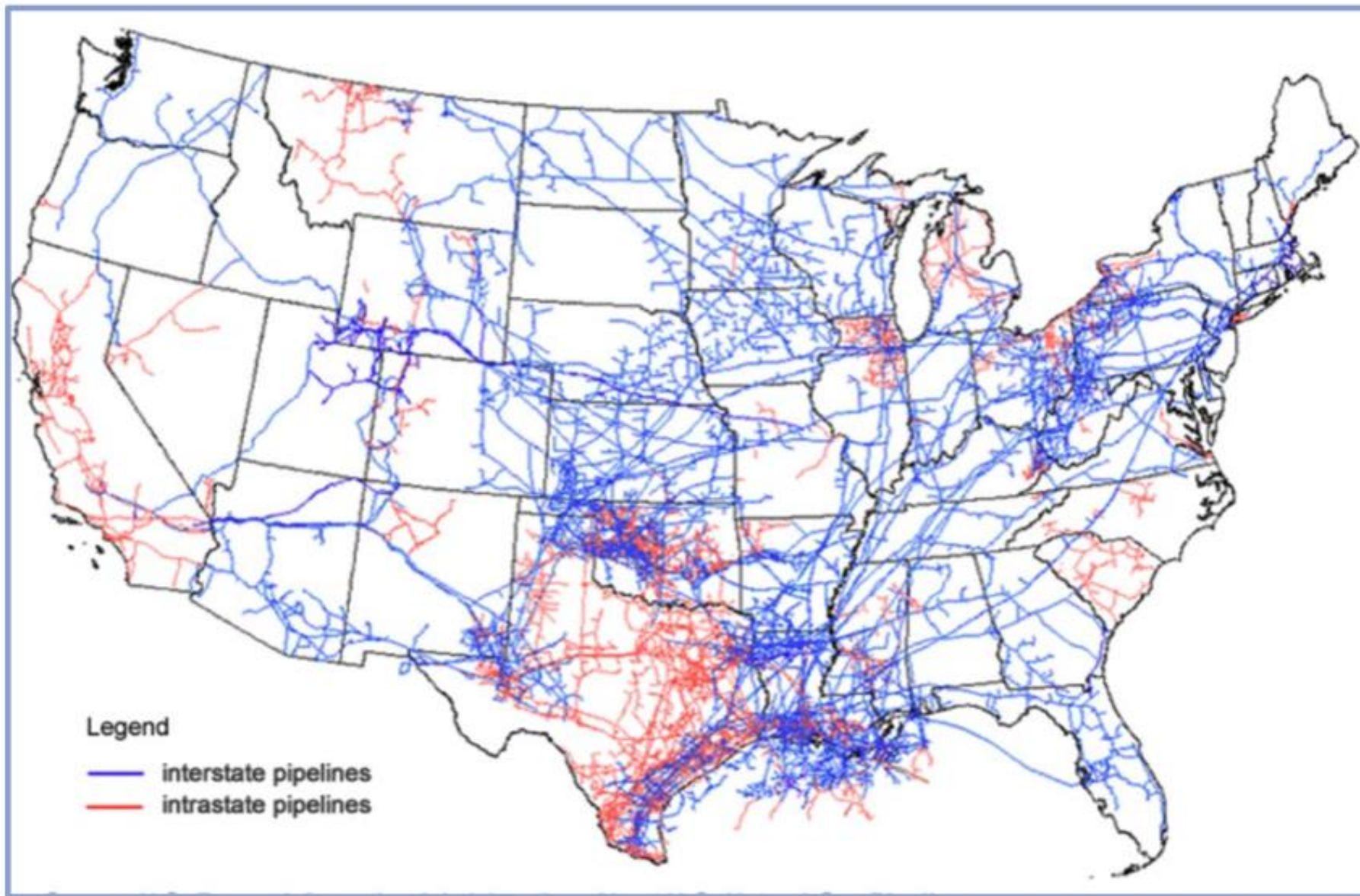


Generation approved for Construction

- WFEC – 2 gas generation units (replacement). 100MW
- KAMO– 1 gas generation unit (new) 455MW +Hyd
- OGE – 2 gas generation units (replacement) 450MW +Hyd
- GRDA – 1 gas generation unit (replace coal) 410MW. +Hyd
- PSO – Current RFP for new generation open

- WFEC – 956 MW Wind, 80 MW Solar 100MW wind 2026
 - 450 MW solar/battery
- KAMO– 1240 MW Wind, Hydro

Figure 26: U.S. Natural Gas Pipeline Map



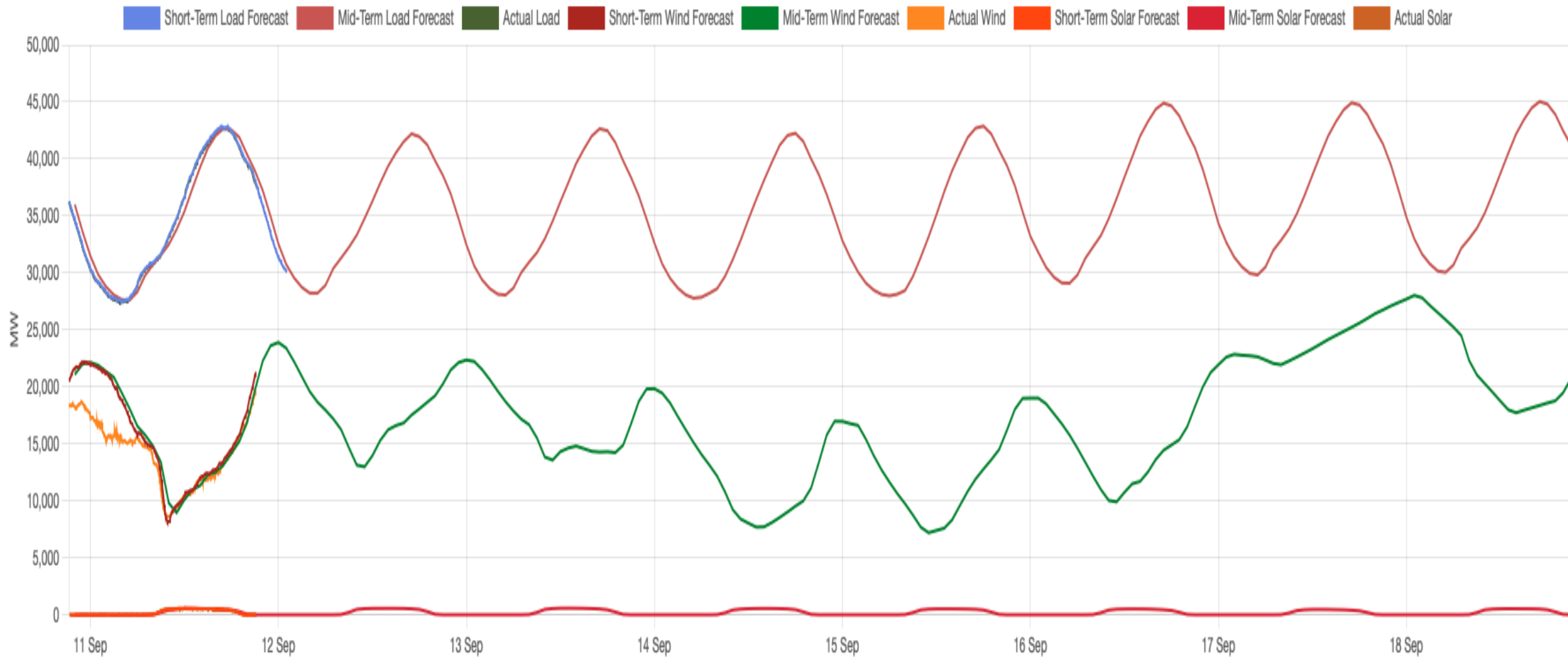
1. Texas—9.25 Tcf—25.4%
2. Pennsylvania—7.41 Tcf—20.4%
3. Louisiana—4.04 Tcf—11.1%
4. West Virginia—2.69 Tcf—7.4%
5. Oklahoma—2.51 Tcf—6.9%



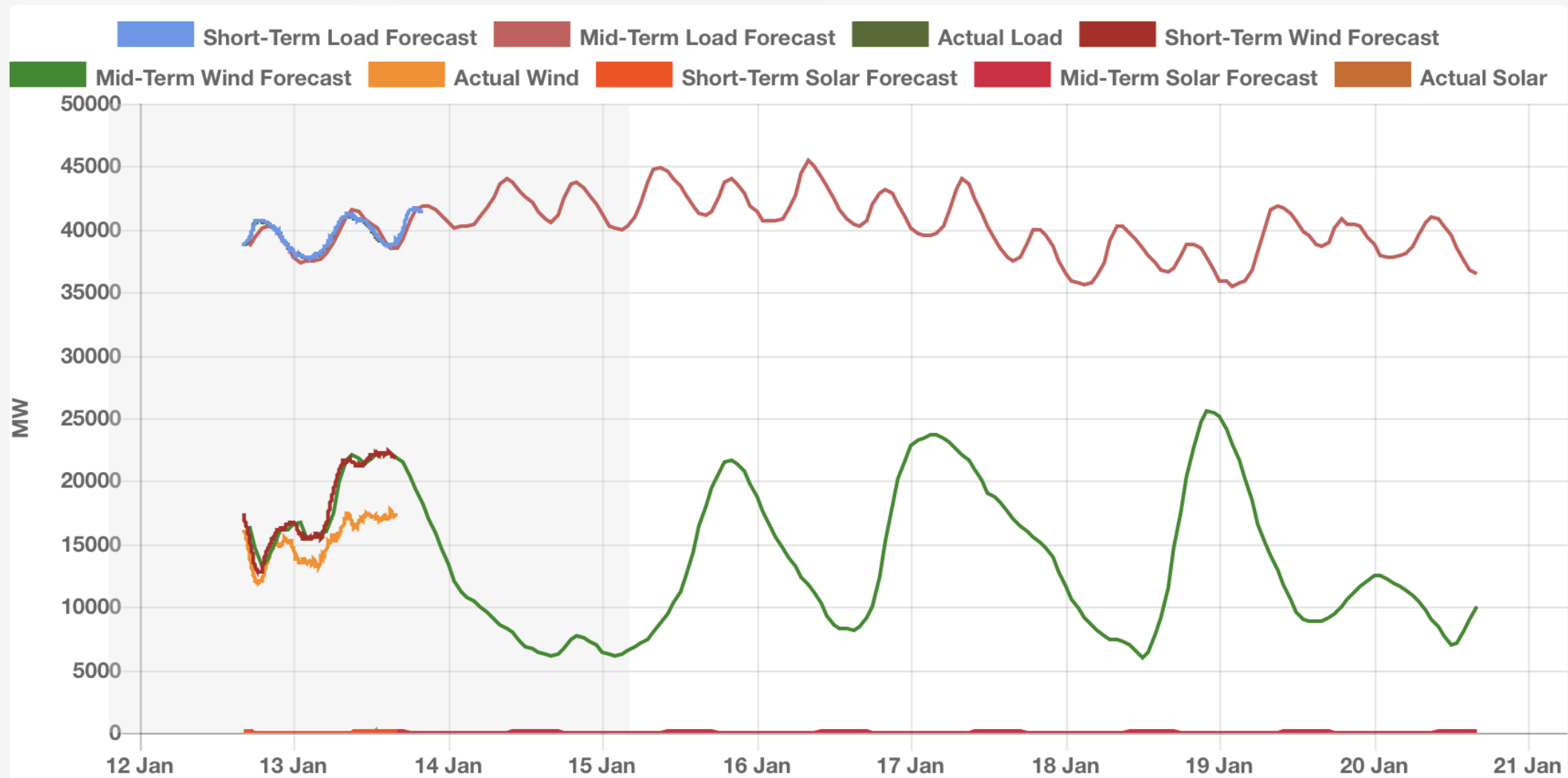
Powering lives **Empowering** communities



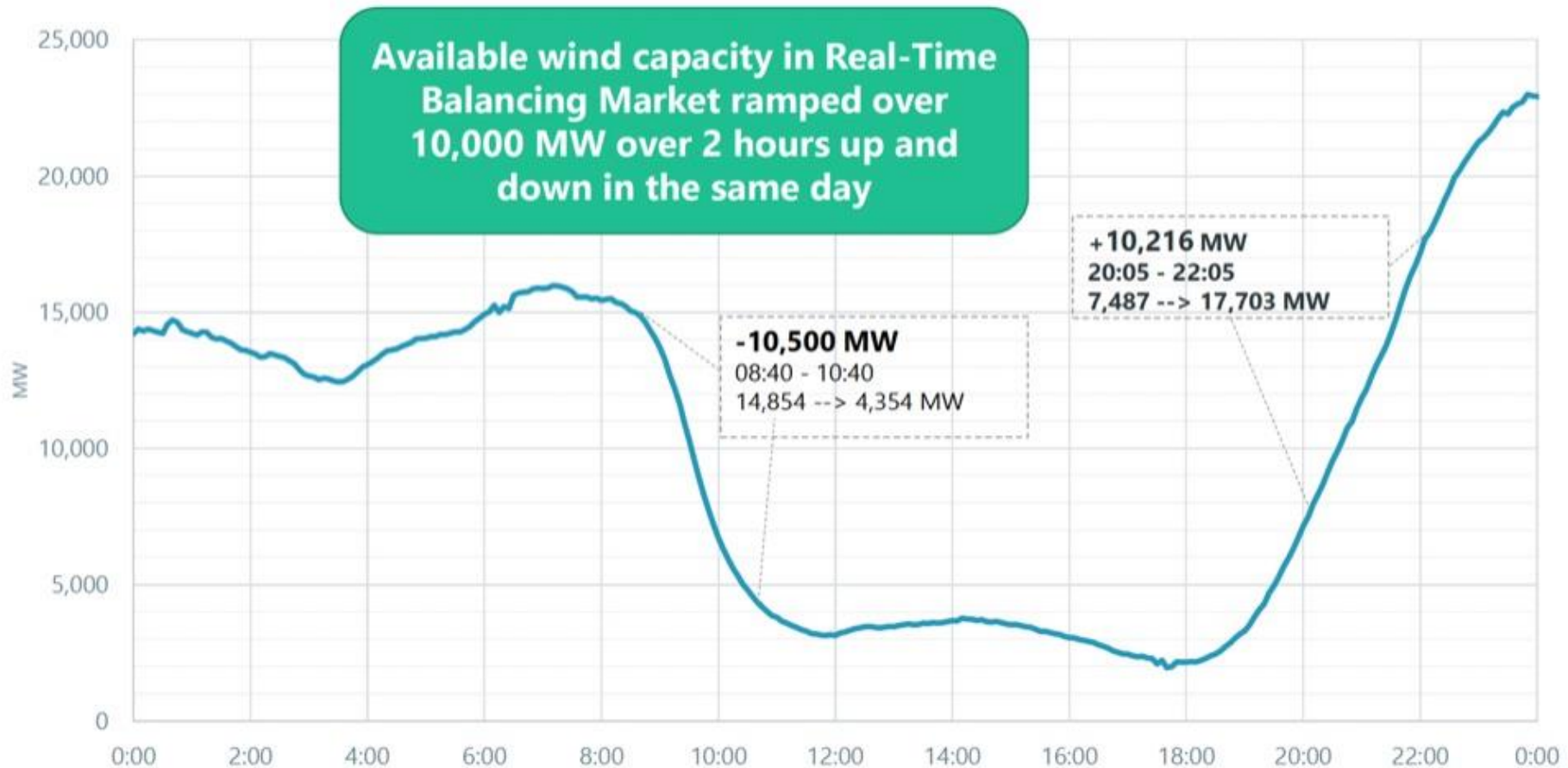
OKLAHOMA'S ELECTRIC
COOPERATIVES



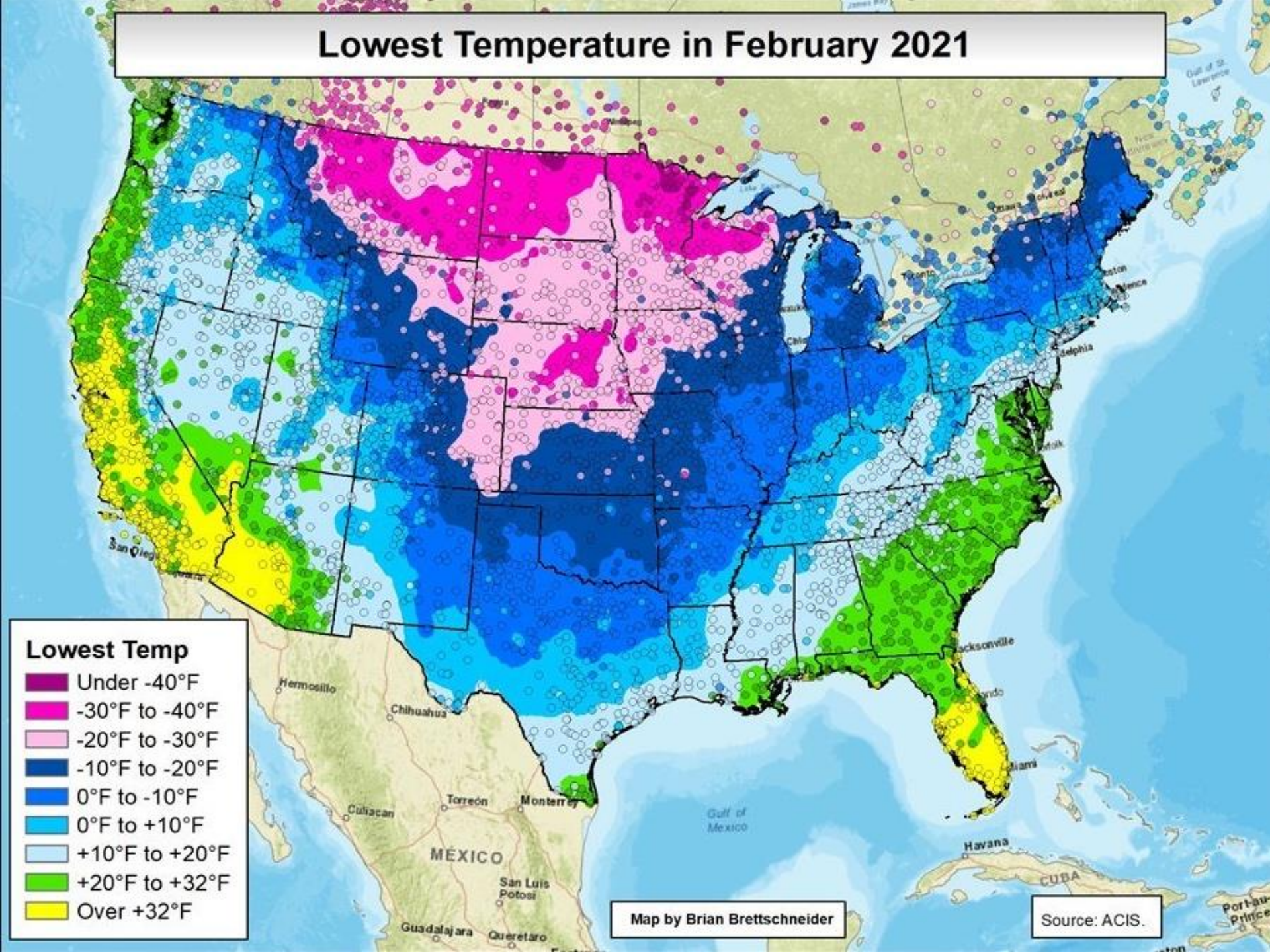
Powering lives **Empowering** communities



WHY FUEL DIVERSITY MATTERS: RECORD UP/DOWN WIND RAMP IN 2 HOURS (10/20/22)



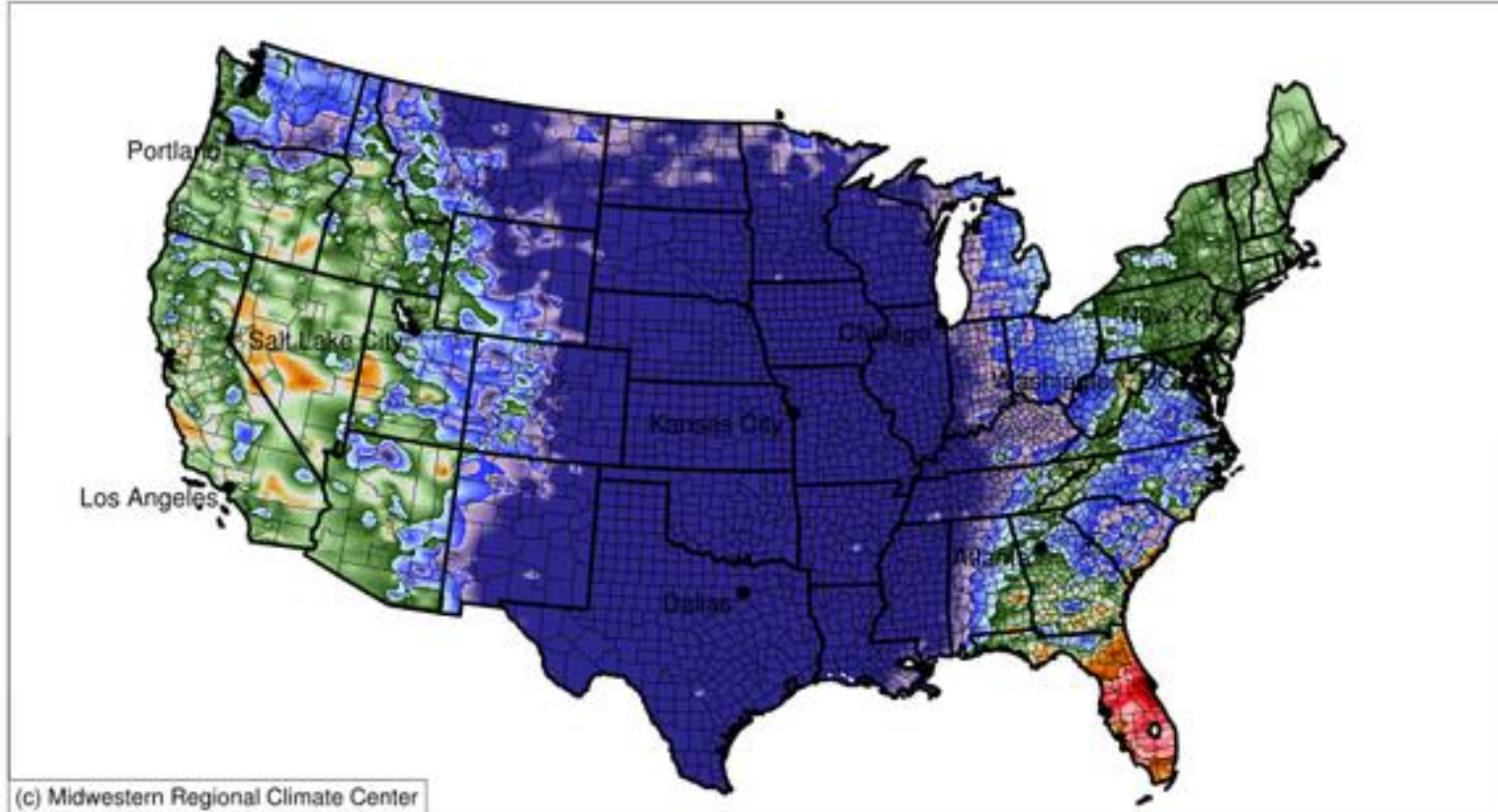
Lowest Temperature in February 2021



OKLAHOMA'S ELECTRIC
COOPERATIVES

Average Maximum Temperature (°F): Departure from 1981-2010 Normals

February 15, 2021 to February 15, 2021

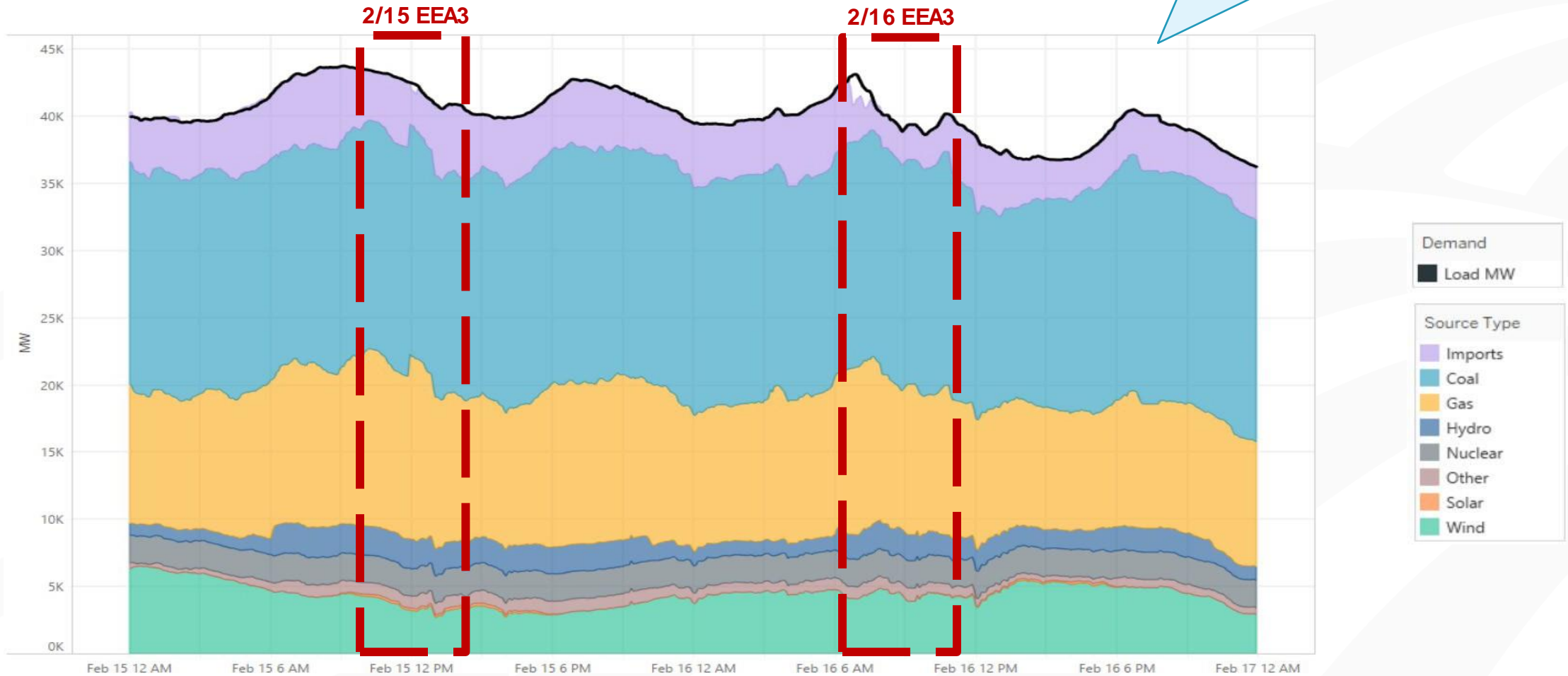


Stations from the following networks used: WBAN, COOP, FAA, GHCN, ThreadEx, CoCoRaHS, WMO, ICAO, NWSLI, Missouri FSA, Missouri Mesonet, Midwestern Regional Climate Center
cli-MATE: MRCC Application Tools Environment
Generated at: 3/11/2021 1:26:11 PM CST



Winter Storm URI

SPP relied on energy from multiple sources, including imports from neighbors

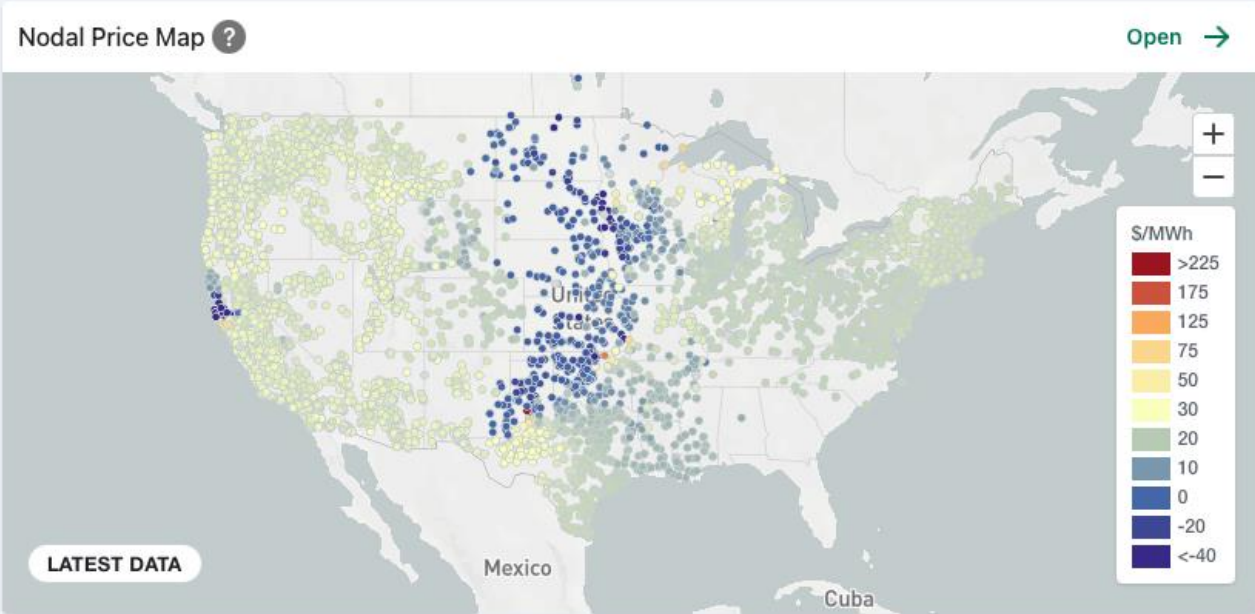


EPA Power Plant Rule

- Existing coal plants that plan to operate after 2038 and new baseload gas plants must reach 90% carbon capture and storage by 2032.
- Coal units retiring before 2039 must co-fire with 40% natural gas beginning in 2030.
- Coal units retiring before 2032 need no new emissions controls.
- EPA deferred finalizing guidelines for existing baseload gas units.
- New peaking gas units must drastically limit operations.
- States must file implementation plans with EPA by June 2026.

- Everywhere
- Electric Reliability Council of Texas
- California ISO
- Southwest Power Pool
- PJM
- Midcontinent ISO
- New York ISO
- ISO New England

ISO	Load (MW)	Net Load (MW)	Price (\$/MWh)	Main Source
ERCOT	57,701	48,816	\$19.20	Natural Gas
CAISO	32,468	27,519	\$25.73	Natural Gas
SPP	36,259	16,022	\$3.33	Wind
PJM	89,217	94,246	\$22.10	Gas
MISO	77,271	63,460	\$22.04	Natural Gas
NYISO	16,717	16,575	\$25.66	Natural Gas
ISONE	11,604	11,631	\$24.00	Natural Gas



LIVE STATUS

Stay up-to-date with the grid

As of: Aug 22, 2024 at 11:26 AM CDT

<div>ERCOT</div> <div>2 MINUTES AGO</div> <table><tr><td>Load</td><td>Price</td><td>Main Source</td></tr><tr><td>71,720 <small>MW</small></td><td>\$18 /MWh</td><td>Natural Gas</td></tr></table>	Load	Price	Main Source	71,720 <small>MW</small>	\$18 /MWh	Natural Gas	<div>California ISO</div> <div>1 MINUTE AGO</div> <table><tr><td>Load</td><td>Price</td><td>Main Source</td></tr><tr><td>27,438 <small>MW</small></td><td>\$24 /MWh</td><td>Solar</td></tr></table>	Load	Price	Main Source	27,438 <small>MW</small>	\$24 /MWh	Solar	<div>Southwest Power Pool</div> <div>2 MINUTES AGO</div> <table><tr><td>Load</td><td>Price</td><td>Main Source</td></tr><tr><td>37,209 <small>MW</small></td><td>\$12 /MWh</td><td>Wind</td></tr></table>	Load	Price	Main Source	37,209 <small>MW</small>	\$12 /MWh	Wind
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37,209 <small>MW</small>	\$12 /MWh	Wind																		
<div>PJM</div> <div>2 MINUTES AGO</div> <table><tr><td>Load</td><td>Price</td><td>Main Source</td></tr><tr><td>89,311 <small>MW</small></td><td>\$15 /MWh</td><td>Gas</td></tr></table>	Load	Price	Main Source	89,311 <small>MW</small>	\$15 /MWh	Gas	<div>Midcontinent ISO</div> <div>1 MINUTE AGO</div> <table><tr><td>Load</td><td>Price</td><td>Main Source</td></tr><tr><td>82,913 <small>MW</small></td><td>\$17 /MWh</td><td>Natural Gas</td></tr></table>	Load	Price	Main Source	82,913 <small>MW</small>	\$17 /MWh	Natural Gas	<div>New York ISO</div> <div>2 MINUTES AGO</div> <table><tr><td>Load</td><td>Price</td><td>Main Source</td></tr><tr><td>16,422 <small>MW</small></td><td>\$22 /MWh</td><td>Hydro</td></tr></table>	Load	Price	Main Source	16,422 <small>MW</small>	\$22 /MWh	Hydro
Load	Price	Main Source																		
89,311 <small>MW</small>	\$15 /MWh	Gas																		
Load	Price	Main Source																		
82,913 <small>MW</small>	\$17 /MWh	Natural Gas																		
Load	Price	Main Source																		
16,422 <small>MW</small>	\$22 /MWh	Hydro																		
<div>ISO New England</div> <div>2 MINUTES AGO</div> <table><tr><td>Load</td><td>Price</td><td>Main Source</td></tr><tr><td>10,999 <small>MW</small></td><td>\$21 /MWh</td><td>Natural Gas</td></tr></table>	Load	Price	Main Source	10,999 <small>MW</small>	\$21 /MWh	Natural Gas	<div>See More →</div>													
Load	Price	Main Source																		
10,999 <small>MW</small>	\$21 /MWh	Natural Gas																		

How To: Analyzing LMPs with a Nodal Price Map

Open →

Grid Notice: SPP is Issuing a Resource Advisory Effective 11:00 a.m. Monday, August 26

Fri, Aug 23 9:14am

Today at 9:14 AM



o bounce-132352-222311@spplist.spp.org <bounce-132352-222311@spplist.spp.org> on behalf of
o Southwest Power Pool <communication@spp.org>

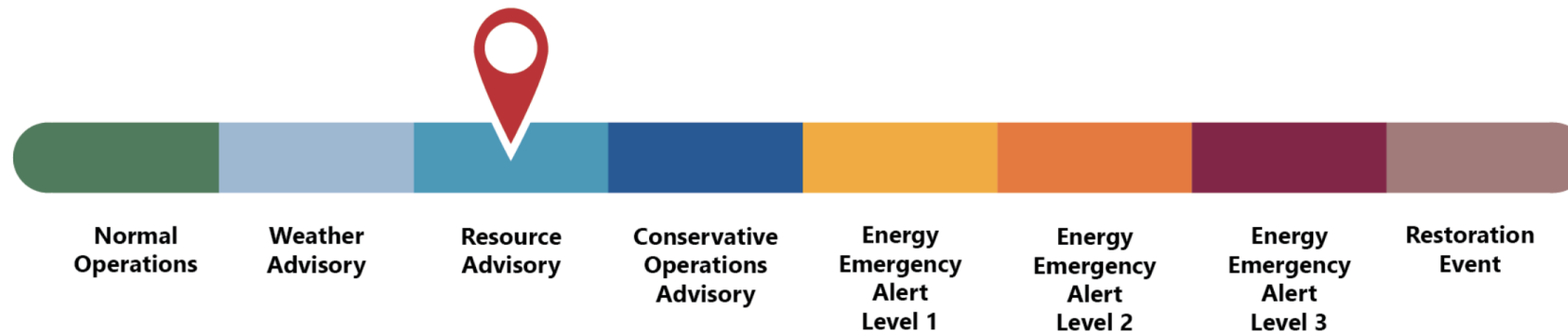
To: o SPP Grid Notice

SPP is issuing a Resource Advisory for the entire Balancing Authority effective 11:00 a.m. CT Monday, August 26 until an anticipated end time of 8:00 p.m. CT Tuesday, August 27.

- **Resource Advisories do not require the public to conserve energy** but are issued to raise awareness of potential threats to reliability among entities responsible for operating transmission and generation facilities.
- This Resource Advisory is being declared based on forecasts of potential high peak loads due to widespread high temperatures, potential increase in resource outages and potential low output from wind and other variable energy resources (*also known as low VER forecast) leading into peak hours.
- To mitigate risks to reliability associated with these factors, SPP may use greater unit commitment notification timeframes, including making commitments before standard day-ahead market procedures and/or committing resources in reliability status.
- SPP will send additional information if necessary.

The following chart shows the relative severity of Resource Advisories:

SOUTHWEST POWER POOL GRID CONDITIONS



Advisories raise awareness and do not require general audiences to take action. SPP member utilities should follow applicable procedures.

Energy Emergency Alerts indicate all available generators are being dispatched to meet region-wide demand. As conditions worsen and reserves become



LIVE STATUS

Aug. 23, 9:46 am

Stay up-to-date with the grid

As of: Aug 23, 2024 at 09:46 AM CDT

ERCOT

JUST NOW

Load	Price	Main Source
68,087 MW	\$17 /MWh	Natural Gas

California ISO

JUST NOW

Load	Price	Main Source
26,403 MW	\$17 /MWh	Natural Gas

Southwest Power Pool

1 MINUTE AGO

Load	Price	Main Source
35,182 MW	\$21 /MWh	Natural Gas

PJM

1 MINUTE AGO

Load	Price	Main Source
88,639 MW	\$14 /MWh	Gas

Midcontinent ISO

JUST NOW

Load	Price	Main Source
79,979 MW	\$17 /MWh	Natural Gas

New York ISO

1 MINUTE AGO

Load	Price	Main Source
16,378 MW	\$22 /MWh	Dual Fuel

ISO New England

1 MINUTE AGO

Load	Price	Main Source
10,562 MW	\$22 /MWh	Natural Gas

[See More →](#)

How To: Analyzing LMPs with a Nodal Price Map

[Open →](#)



LIVE STATUS

Stay up-to-date with the grid

Sunday
Aug. 25, 4:11 pm

As of: Aug 25, 2024 at 04:11 PM CDT

ERCOT

JUST NOW

Load	Price	Main Source
79,030 MW	\$22 /MWh	Natural Gas

California ISO

JUST NOW

Load	Price	Main Source
21,153 MW	\$4 /MWh	Solar

Southwest Power Pool

2 MINUTES AGO

Load	Price	Main Source
50,594 MW	\$24 /MWh	Natural Gas

PJM

2 MINUTES AGO

Load	Price	Main Source
126,378 MW	\$43 /MWh	Gas

Midcontinent ISO

JUST NOW

Load	Price	Main Source
109,263 MW	\$35 /MWh	Natural Gas

New York ISO

2 MINUTES AGO

Load	Price	Main Source
21,355 MW	\$42 /MWh	Dual Fuel

ISO New England

2 MINUTES AGO

Load	Price	Main Source
15,893 MW	\$50 /MWh	Natural Gas

See More →

How To: Analyzing LMPs with a Nodal Price Map

Open →

Map Settings

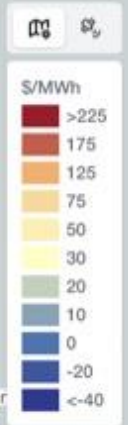
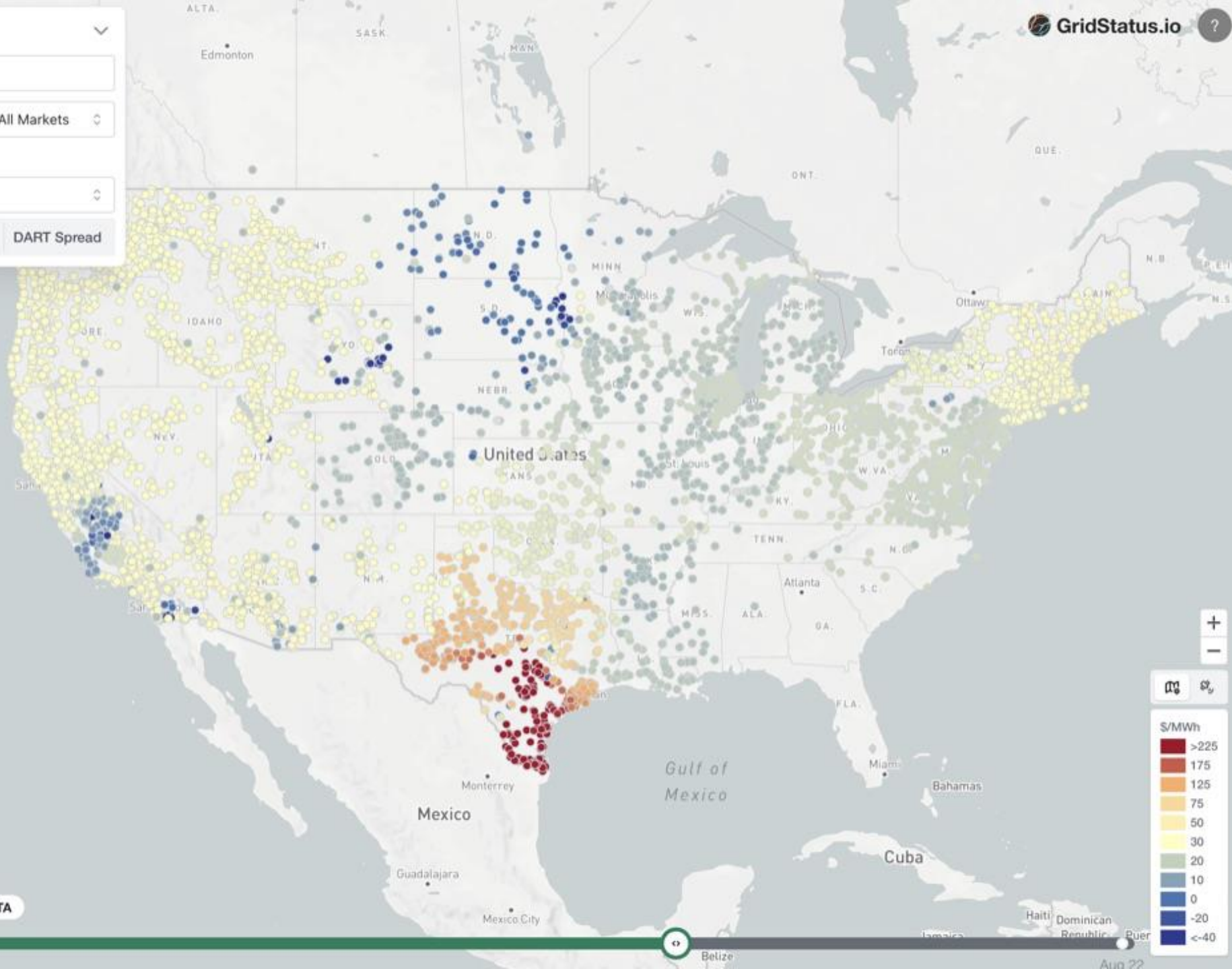
Search Node

Aug 21, 2024 All Markets

Color by ?

LMP

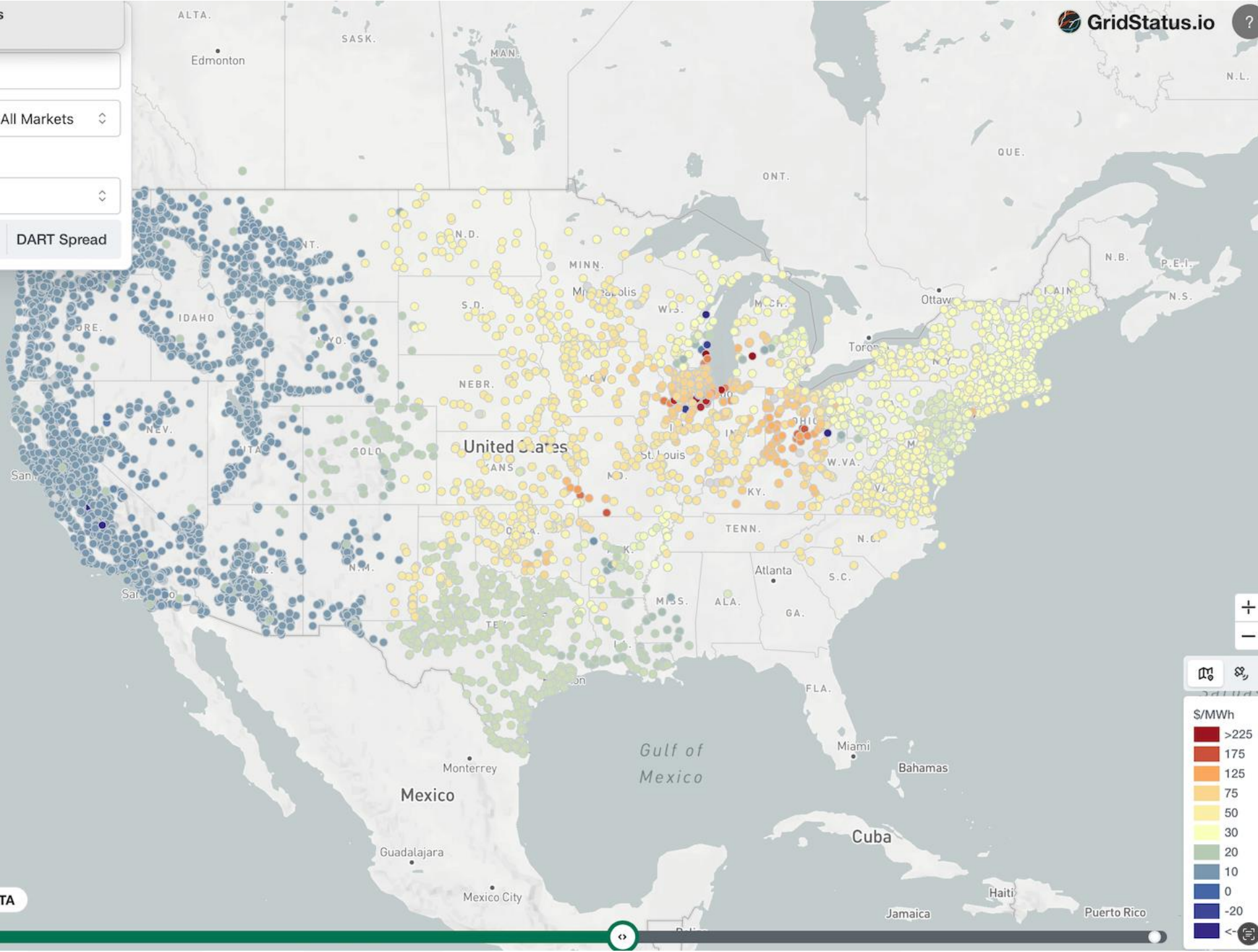
Real Time Day Ahead DART Spread

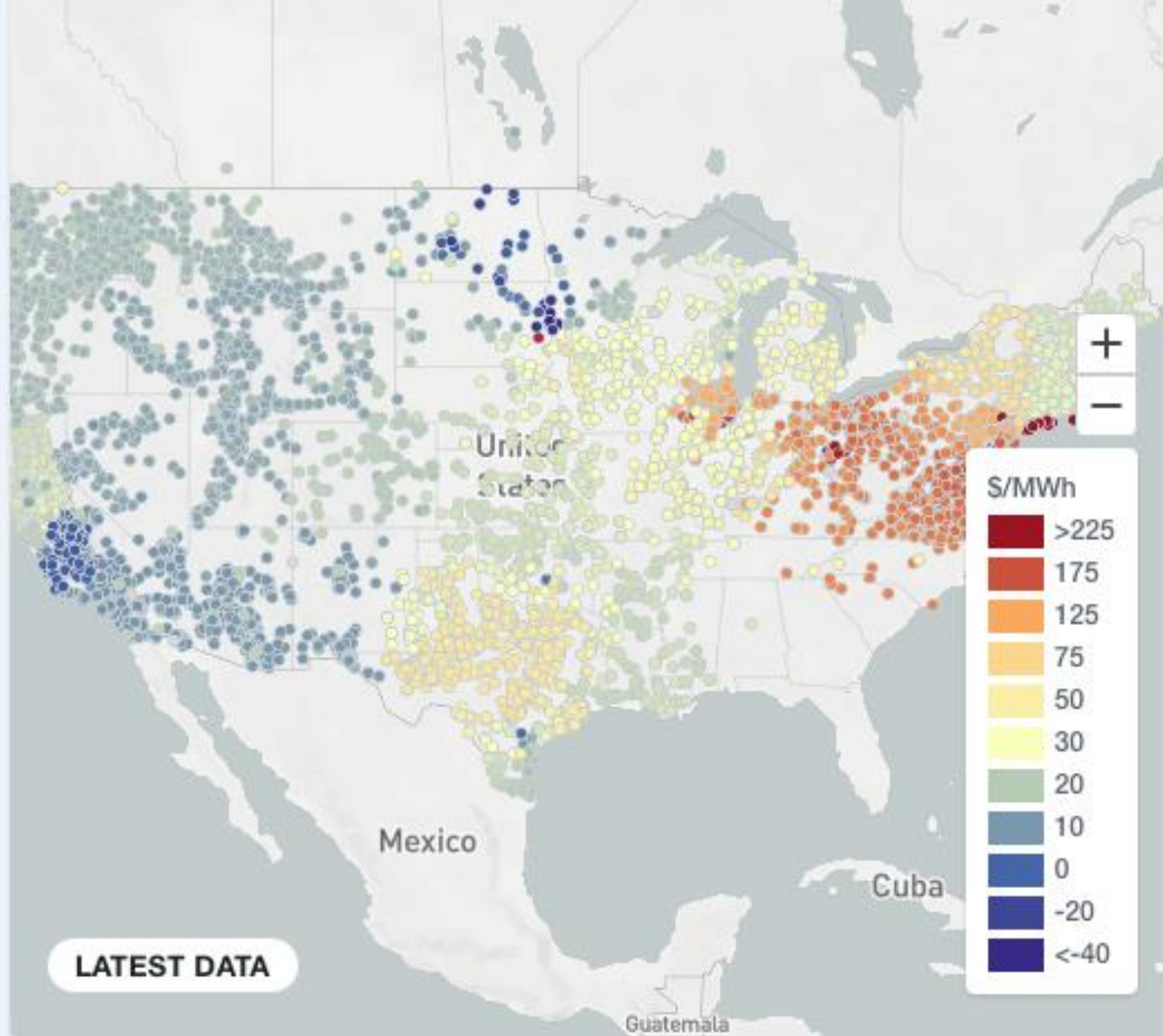


Aug 27, 2024 All Markets

Color by ?

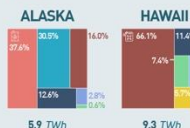
Real Time	Day Ahead	DART Spread
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HAWAII and ALASKA are the only states that generate more than 8% of electricity from oil.



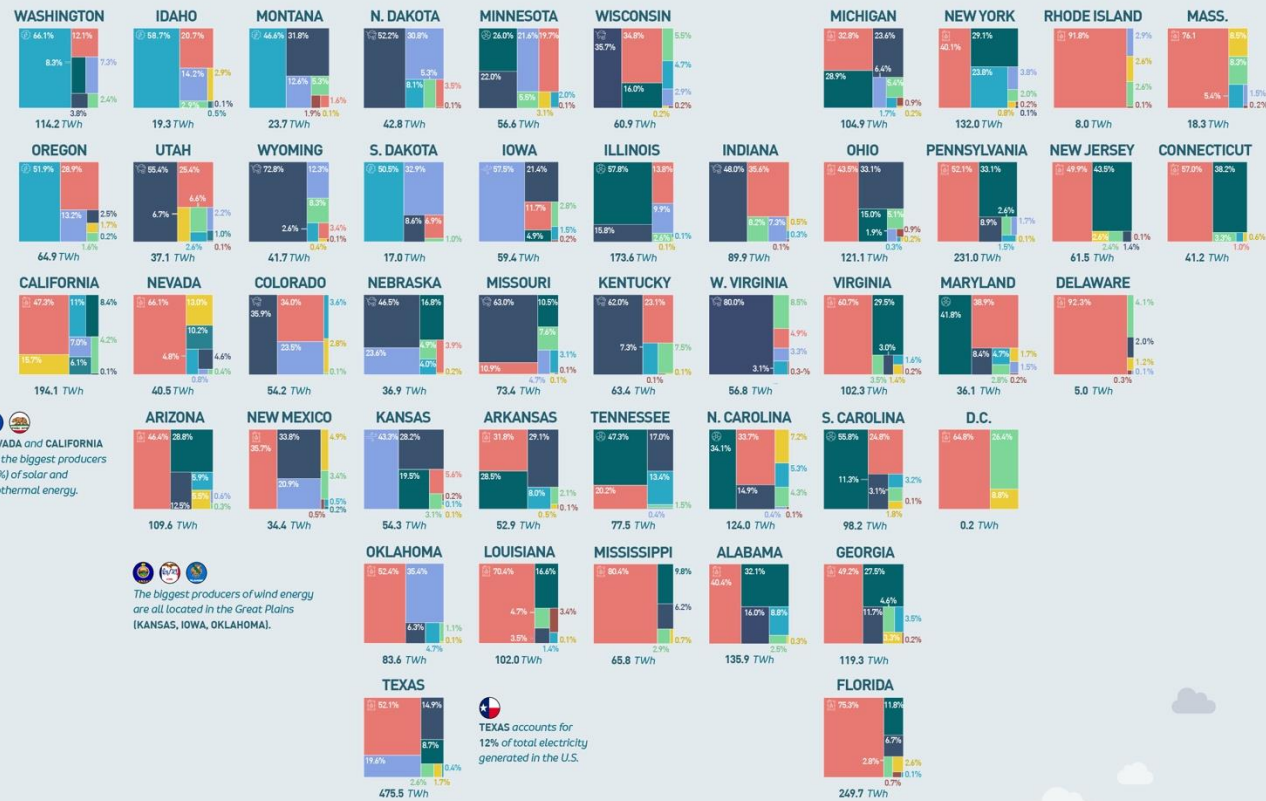
Water-plentiful regions like the PACIFIC NORTHWEST and NEW ENGLAND generated the most hydroelectricity.

ROAD TO DECARBONIZATION U.S. ELECTRICITY MIX

ELECTRICITY GENERATION BY STATE (2020)

The U.S. has made some bold decarbonization pledges, including a carbon pollution-free utilities sector by 2035.

While some states are getting close to eliminating fossil fuels, others have a lot of work to do.



NEVADA and CALIFORNIA are the biggest producers (in %) of solar and geothermal energy.

The biggest producers of wind energy are all located in the Great Plains (KANSAS, IOWA, OKLAHOMA).

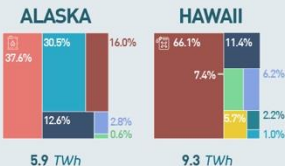
TEXAS accounts for 12% of total electricity generated in the U.S.

Total Electricity Generated (TWh)

MAINE 10.4 TWh

VERMONT 2.4 TWh

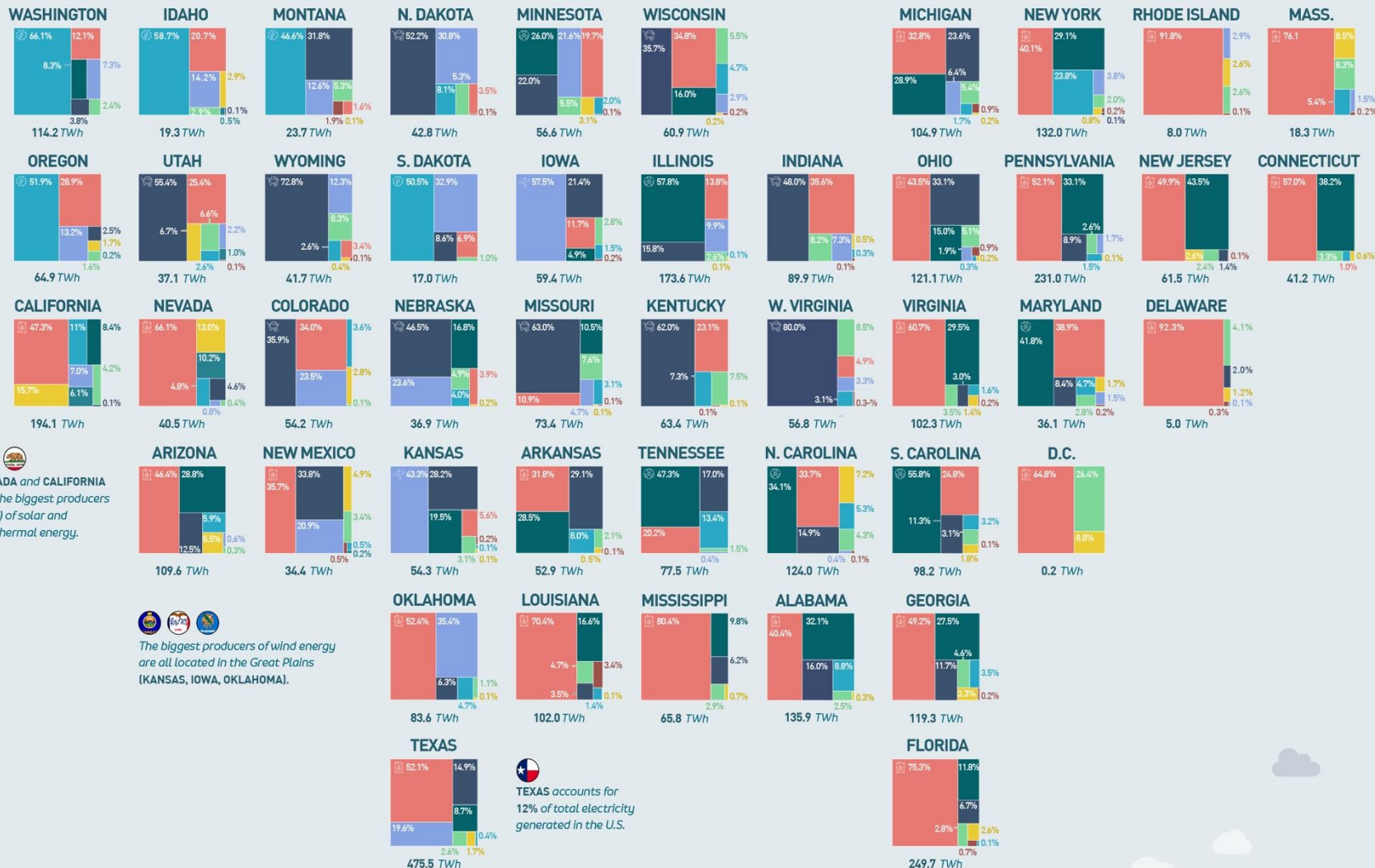
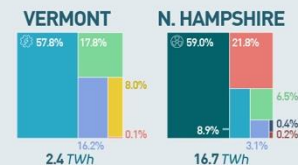
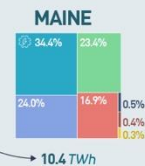
N. HAMPSHIRE 16.7 TWh



Water-plentiful regions like the PACIFIC NORTHWEST and NEW ENGLAND generated the most hydroelectricity.

The U.S. has made some bold decarbonization pledges, including a carbon pollution-free utilities sector by 2035.

While some states are getting close to eliminating fossil fuels, others have a lot of work to do.



NEVADA and CALIFORNIA are the biggest producers (in %) of solar and geothermal energy.

The biggest producers of wind energy are all located in the Great Plains (KANSAS, IOWA, OKLAHOMA).

TEXAS accounts for 12% of total electricity generated in the U.S.



Powering lives **Empowering** communities



OKLAHOMA'S ELECTRIC
COOPERATIVES

Rodd Moesel

Went to Vinita, Oklahoma tonight with several of our Oklahoma Farm Bureau public policy & field services team for a town hall with over 200 Craig County citizens on private property rights as there are many strong emotions dealing with proposed wind towers, solar fields & battery parks in their area!

