CLEAN POWER ANNUAL **2020**

AMERICAN CLEAN POWER®

ACP sincerely thanks its member companies and other organizations for their contributions to the industry data provided in this report. ACP strives to provide the best information on the clean power industry—for the industry and by the industry—and therefore welcomes your comments.

We unite the power of the renewable energy industry.

The American clean power sector is providing cost-effective solutions to the climate crisis while creating jobs, spurring investment, and driving innovation.

The American Clean Power Association enables the transformation of the U.S. power grid to a low-cost, reliable and renewable power system. By uniting the power of wind, solar, transmission and storage companies and their allied industries, both public and private, we are championing policies that enable the continued and aggressive growth in renewable energy in the United States.

Introduction

Letter from ACP CEO Heather Zichal

Dear ACP Members:

Just skim the day's headlines or spend a few minutes watching the news, and it's clear we're living through a monumental period of change. After eighteen months of near lock-down and economic shut-down, we're all reimagining what a return to "normal" looks like. At the same time, we're reminded that "normal" isn't coming back anytime soon: none of us want to imagine the climate change exacerbated droughts, wildfires and record-breaking heat waves, as the "normal" we would choose to embrace. Rebuilding the economy and combatting the climate crisis are the best mutually reinforcing win-win we could ask for, to create great jobs and healthier outcomes putting American clean power to work towards a better tomorrow. Crisis is meeting opportunity.

The potential and the reality are unmistakable:

- **Even during a global pandemic, 2020 was a record year for new clean power installations, bringing 26,490 megawatts (MW) of new capacity online.**
- **The U.S. now has enough clean energy capacity to power over 50 million homes, definitive proof the clean energy transition is well underway.**

With this change moving America forward comes a once-in-a-generation job creation engine. Over 415,000 Americans across all 50 states already have direct clean energy jobs, and the clean energy workforce could number over 1 million by 2030. That is exactly the kind of opportunity we must seize as we put Americans back to work. Finding, training, and preparing enough workers to fill these jobs is a test we're eager to meet as we rebuild and decarbonize our economy.

Such a time of change and transition, along with record-breaking growth, also created the need for a new model of clean energy advocacy. That's why I was so excited and honored to lead the launch of the American Clean Power Association (ACP) this year. By uniting the power of wind, solar, storage, and transmission companies and their allied industries, we can enable the transformation of the U.S. power grid to a low-cost, reliable and renewable power system. With your help, we're building a 21st clean energy economy.

As part of ACP's inaugural year, I'm pleased to present our first ever Clean Power Annual—a detailed look at everything clean energy from jobs, investment, and environmental benefits to key market data, information on industry leaders, and so much more. Some of the key trends from this year's report include:

Renewables rebuild our economy

Beyond creating jobs in all 50 states, clean power projects brought online in 2020 represent roughly $39 billion dollars in project investments, and since 2005, total project investment is estimated at $334 billion. Clean energy also drives nearly unmatched investment into rural communities—last year alone, the clean power industry paid an estimated $1.7 billion in state and local taxes and nearly $800 million in land lease payments to landowners across the U.S.

Letter from ACP CEO Heather Zichal

Clean energy is red, white, and blue

Eighty-four percent of Congressional districts are home to clean energy projects, manufacturing facilities, or both, and there are direct clean energy jobs in all 50 states. Traditionally red and blue states, and some purple ones, all topped the clean energy leaderboard in 2020—Texas added the most clean power capacity last year with 6,320 MW, followed California with 2,193 MW, Florida with 1,267 MW, Iowa with 1,218 MW, and Oklahoma with 1,182 MW.

Clean energy dominates new power additions

- **Wind power was the #1 choice of utility-scale power generation in 2020, capturing 50 percent of new additions, while solar was #2 with 26 percent of the market.**
- **Combined wind, solar, and battery storage power represent 78 percent of new power additions for the year. In total, they supplied nearly 11 percent of the country's electricity in 2020.**
- **Iowa led all states with 57.6 percent of electricity generated from clean power in 2020. Rounding out the top five are Kansas (43.4 percent), Oklahoma (35.5 percent), South Dakota (32.9 percent), and North Dakota (30.8 percent).**
- **10 states source at least 20 percent of their electricity from renewables.**

Renewables are cutting carbon, creating cleaner air, and keeping Americans healthier

- **Wind and solar power reduce emissions and deliver long-term health benefits.**
- **Every year, wind and solar projects avoid 71 million cars' worth of carbon dioxide.**
- **Decreases in NOx, SO2, and particulate matter delivered an estimated $16 to $41 billion in 2020 alone in long-term health benefits**

The path forward

It's no longer a question of whether the country will embrace a future powered by clean energy. Now, it's a matter of when. We have precious little time to avert climate change's worst impacts, and Americans need good-paying jobs and opportunities today, not down the road. That's why we must match policy to potential. With your help, we can create a better future powered by affordable, reliable, clean energy.

Best,

Heather Zichal, CEO
American Clean Power

2020 Clean Power Top Facts

Wind, utility solar, and battery storage power capacity tops 170 GW following a record

26 GW
of installations in 2020.

The U.S. has enough installed utility wind and solar **capacity to power over**

50 million homes.

Wind and solar power were the #1 and #2 choice of utility-scale power generation across all energy types in 2020. Wind, solar, and battery storage power represented 78% of new power additions in 2020.

Business demand for clean power set a record as corporate buyers announced over 10 GW of new clean power contracts in 2020.

Eight states **added over 1 GW of clean power** to the grid in 2020. Each GW = at least

$1.4 billion
in investment.

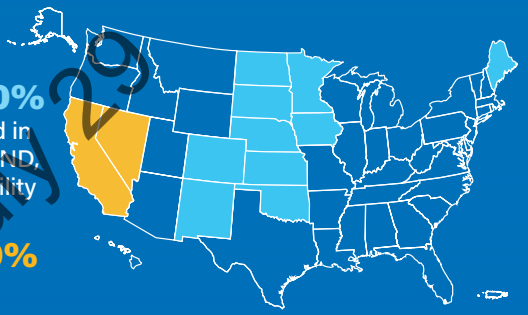
Iowa and Kansas generate more electricity from wind turbines than any other energy technology. **More than 40% of each state's electricity is produced from wind power.**

Iowa is the first state where **WIND generates the majority of the state's electricity.**

By the end of 2020, **seven states** issued procurements or state targets totaling nearly 30 GW of offshore wind capacity.

Two-thirds of U.S. states have at least 1 GW of operating wind, utility solar, or battery storage power capacity.

Wind energy delivers over 20% of the electricity produced in 10 states (IA, KS, OK, SD, ND, ME, NE, CO, MN, NM). Utility **solar energy delivers over 10%** in two states (CA, NV).



Clean power reduces carbon emissions and improves air quality. Wind and solar generation prevented 327 million metric tons of CO_2 from being released into the atmosphere. **That's equal to taking over 71 million cars off the road.**

The clean power pipeline continues to swell—there are now nearly 90 GW of projects underway representing over

$120 billion
in new investment.

Clean power supports economic development, delivering

over $2.5 billion

every year in state and local tax payments and landowner lease payments.

Clean power is **red, white, and blue** with projects or manufacturing facilities in **84% of Congressional districts and jobs in all 50 states.**

10.7%

Wind is America's #1 source of renewable electricity.
Combined with solar, these clean power technologies deliver 10.7% of the nation's electricity.

Wind and solar are the most affordable sources of new electricity in most of the country, and costs continue to fall. Wind costs are 70% lower since 2009. Solar costs are down 90%.

2020 Clean Power Activity

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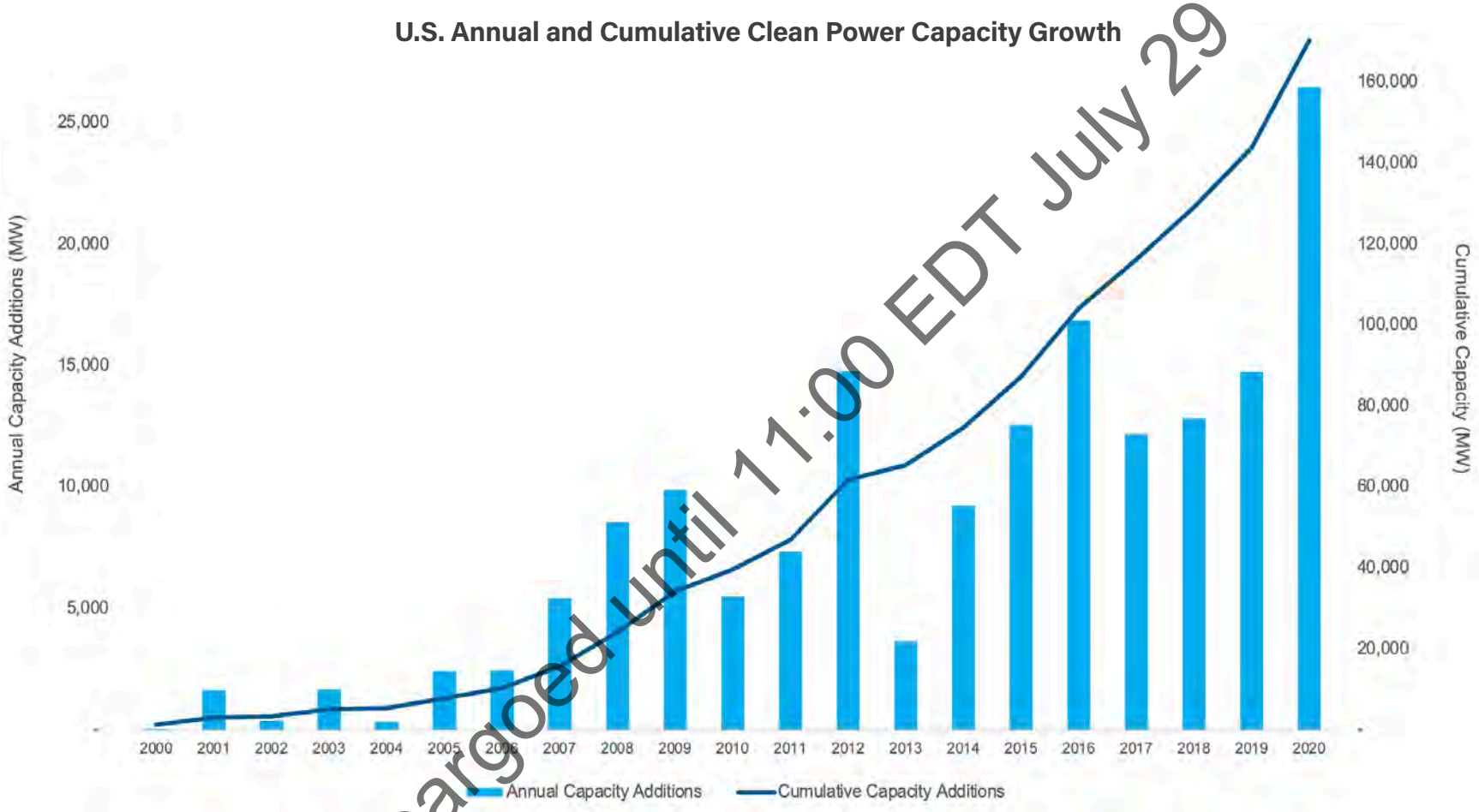
Annual and Cumulative Clean Power Capacity

Clean power achieves banner year of installations at over 26 GW



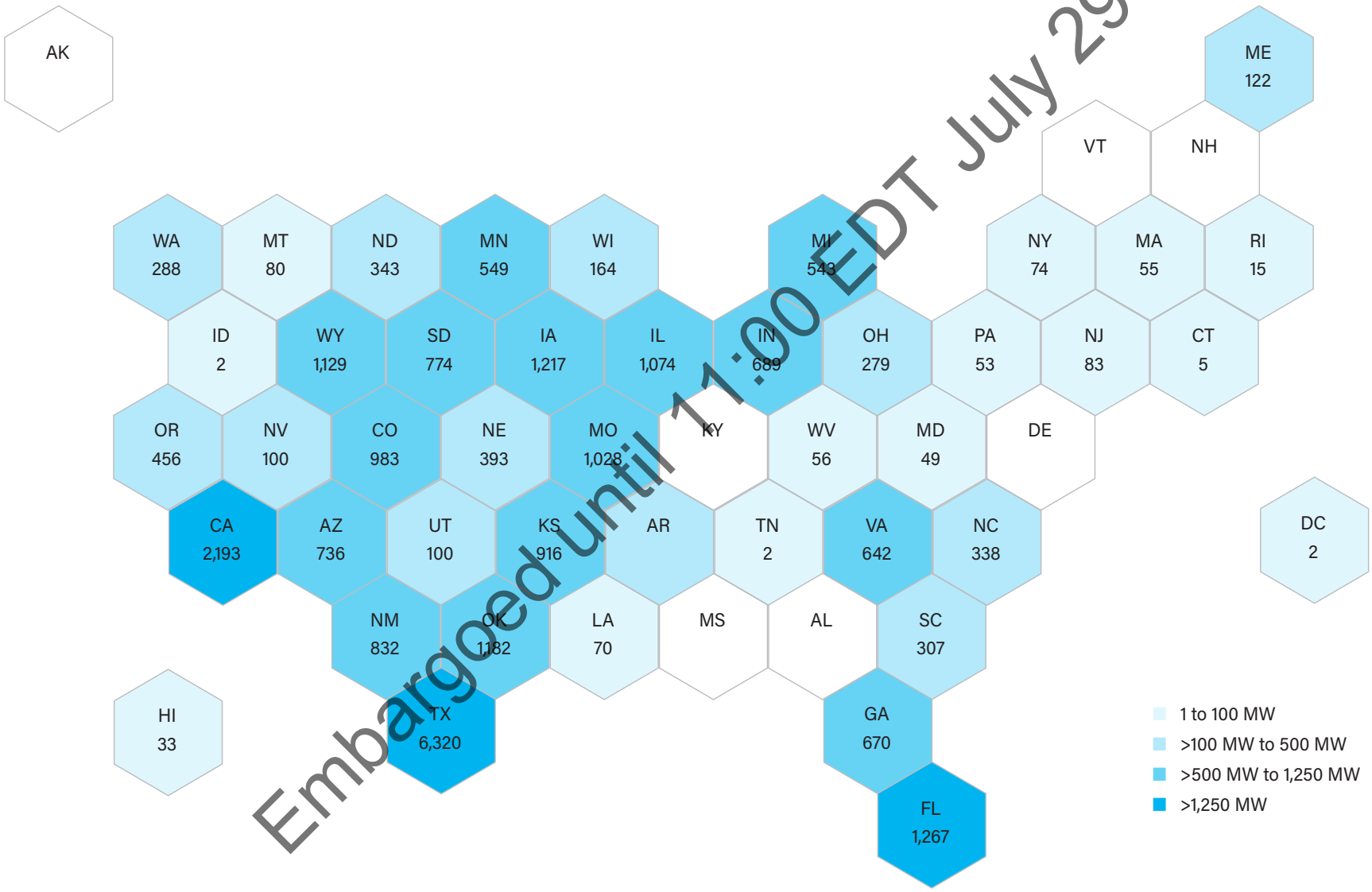
The U.S. electricity sector added 16,836 MW of wind power, 8,894 MW of utility solar, and 760 MW of battery storage for a grand total of 26,490 MW installed.

This brings cumulative total installed clean power capacity to 170,378 MW by the end of 2020. The only other competitor to clean power was natural gas with 7,283 MW installed.

The clean power capacity added in 2020 reflects major capital investments. The 26,490 MW of new clean power plants brought online represents roughly $39 billion dollars in project investments. Since 2005, total project investment is estimated at $334 billion.

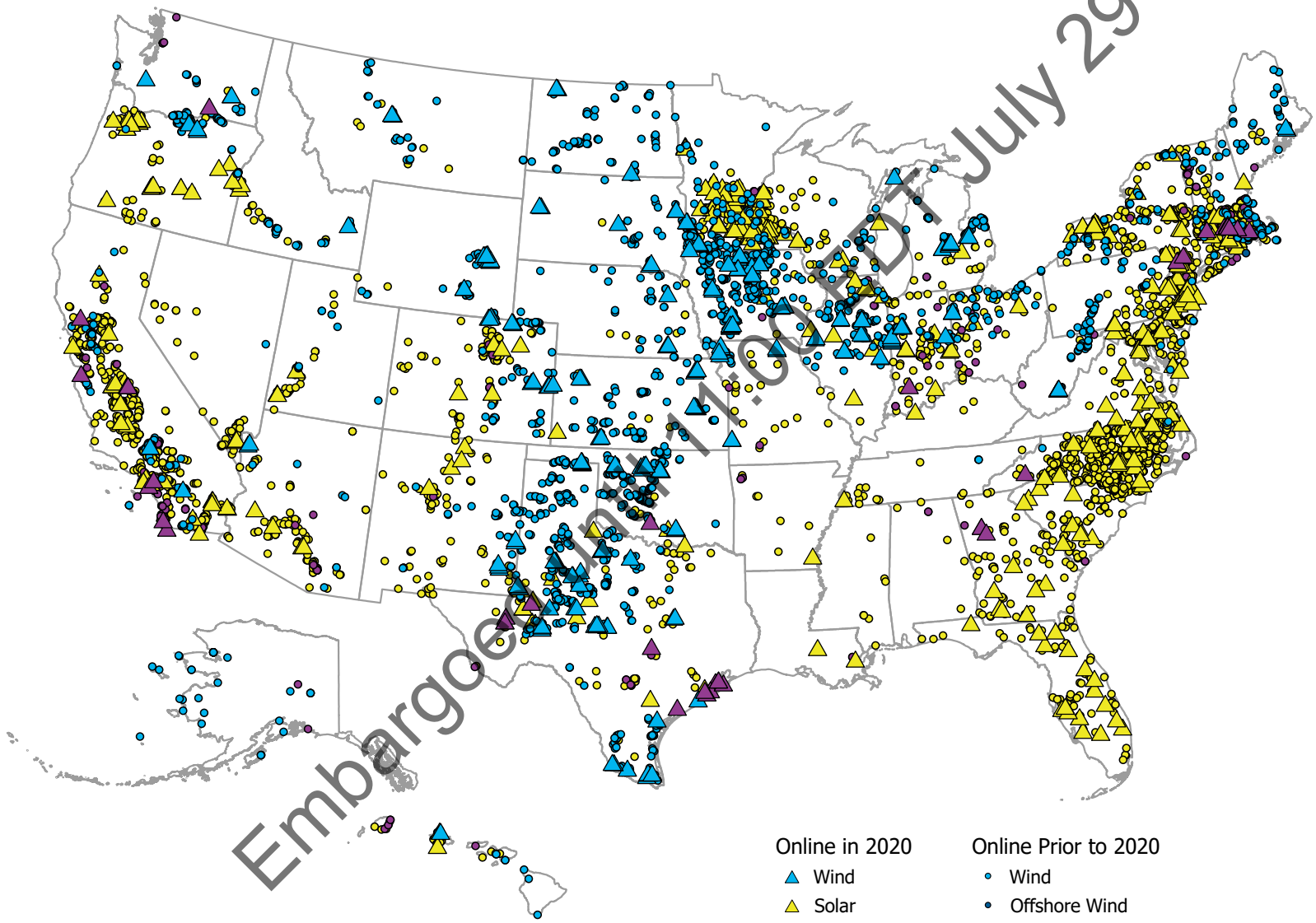
Clean Power Capacity Installations in 2020

Industry built over 400 clean power projects across 43 states



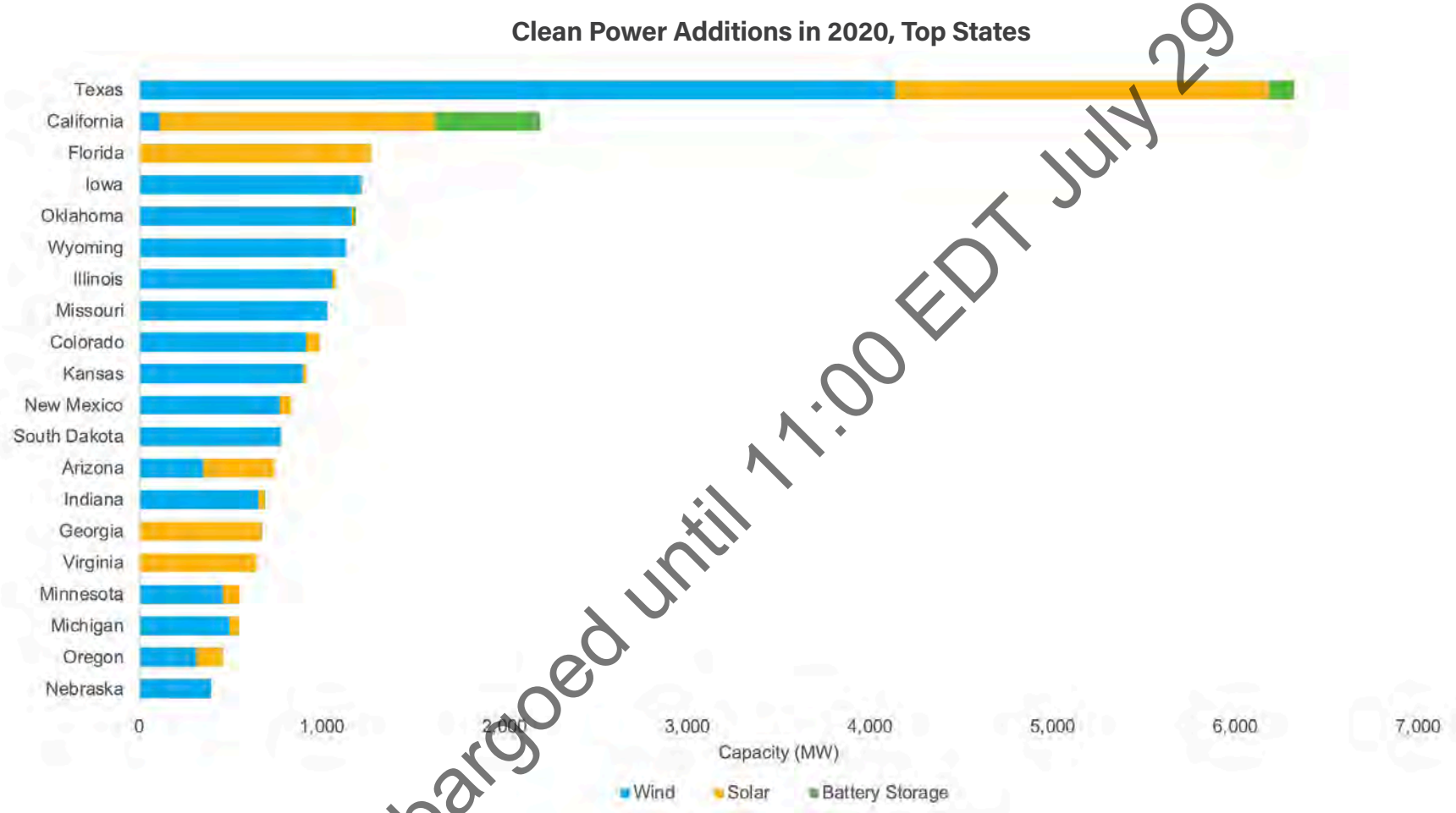
U.S. Clean Power Projects

Projects generate renewable energy in all 50 states



Clean Power Additions, Top States

Clean power is the #1 source of new capacity in California, Midwest, Plains, Mountain West, Northwest, and Texas



Texas added the most clean power capacity in 2020 with 6,320 MW, followed by California with 2,193 MW, Florida with 1,267 MW, Iowa with 1,217 MW, and Oklahoma with 1,182 MW.

Texas led all states in land-based wind capacity additions with 4,137 MW and utility-scale solar capacity additions with 2,044 MW. California led in battery storage additions, with 573 MW of capacity.

Texas leads all states with 37,443 MW of cumulative clean power capacity installed, followed by California (20,354 MW), Iowa (11,394 MW), Oklahoma (9,395 MW), and Kansas (7,058 MW).

State Capacity Rankings

Two-thirds of U.S. states are Giga-states with 1 GW each of clean power capacity

U.S. Clean Power Capacity Rankings

Rank	State	Capacity Additions in 2020 (MW)
1	Texas	6,320
2	California	2,193
3	Florida	1,267
4	Iowa	1,217
5	Oklahoma	1,182
6	Wyoming	1,129
7	Illinois	1,074
8	Montana	1,028
9	Colorado	983
10	Kansas	916
11	New Mexico	832
12	South Dakota	774
13	Arizona	736
14	Indiana	689
15	Georgia	670
	Rest of U.S.	**5,481**

Rank	State	Cumulative Capacity(MW)
1	Texas	37,443
2	California	20,354
3	Iowa	11,394
4	Oklahoma	9,395
5	Kansas	7,058
6	Illinois	6,600
7	Colorado	5,385
8	Minnesota	5,316
9	North Carolina	5,064
10	Oregon	4,290
11	North Dakota	3,989
12	New Mexico	3,457
13	Florida	3,436
14	Washington	3,422
15	Indiana	3,280
	Rest of U.S.	**40,494**

Rank	State	One Year Growth Rate
1	Louisiana	3500%
2	Missouri	100%
3	Virginia	99%
4	Arkansas	81%
5	Wyoming	69%
6	Florida	58%
7	South Dakota	50%
8	South Carolina	46%
9	Georgia	46%
10	New Mexico	32%
11	Ohio	32%
12	Arizona	31%
13	Indiana	27%
14	Michigan	24%
15	Colorado	22%
	Rest of U.S.	**14%**

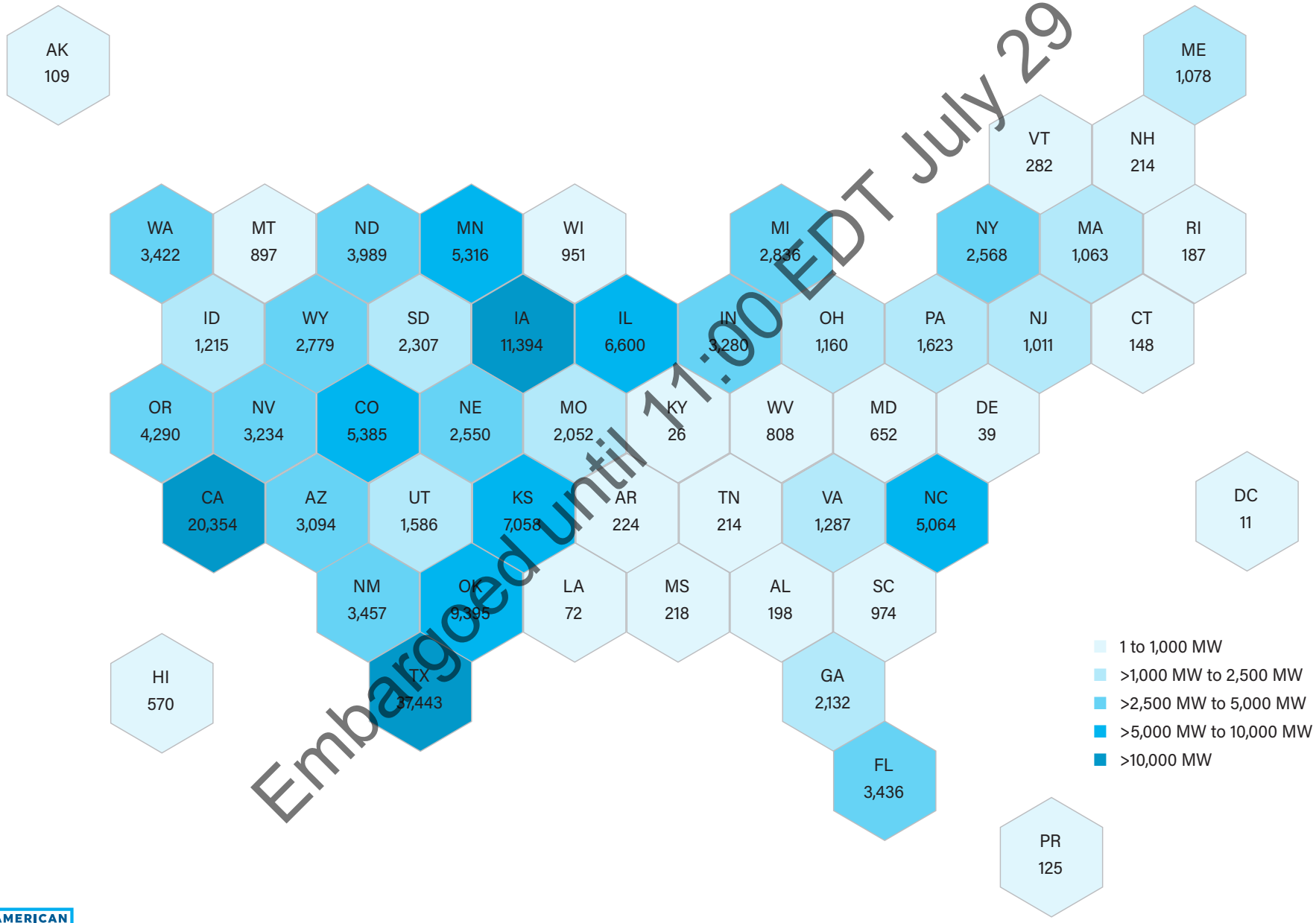
Eight states added over 1 GW each of clean power to the grid in 2020. Each GW added represents at least $1.4 billion in investment. Two-thirds of U.S. states are in the clean power gigawatt club with at least 1 GW of operating wind, utility solar, or battery storage power capacity.

In 2020 the top 10 states for new installed annual capacity were Texas (6,320 MW), California (2,193 MW), Florida (1,267 MW), Iowa (1,217 MW), Oklahoma (1,182 MW), Wyoming (1,129 MW), Illinois (1,074 MW), Missouri (1,028 MW), Colorado (983 MW) and Kansas (916 MW).

Total cumulative capacity for top 10 states includes most of the same states with Texas (37,443 MW), California (20,354 MW), Iowa (11,394 MW), Oklahoma (9,395 MW), Kansas (7,058 MW), Illinois (6,600 MW), Colorado (5,385 MW), Minnesota (5,316 MW), North Carolina (5,064 MW), and Oregon (4,290 MW).

Clean Power Capacity, by State

Texas is the clean power leader; 9 states have 5 GW or more installed

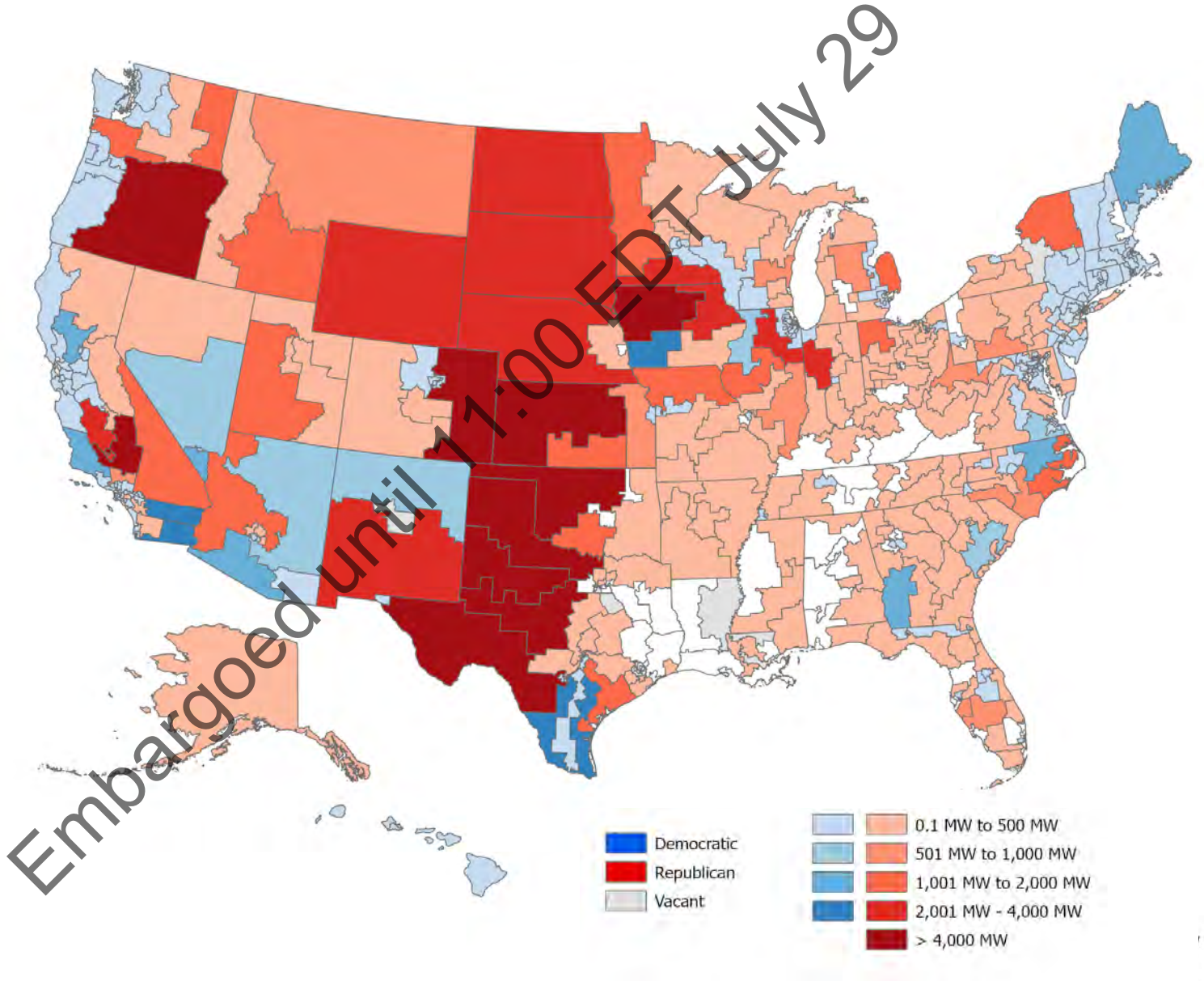


Clean Power Capacity by U.S. Congressional District

Projects and/or manufacturing present in 84% of U.S. congressional districts

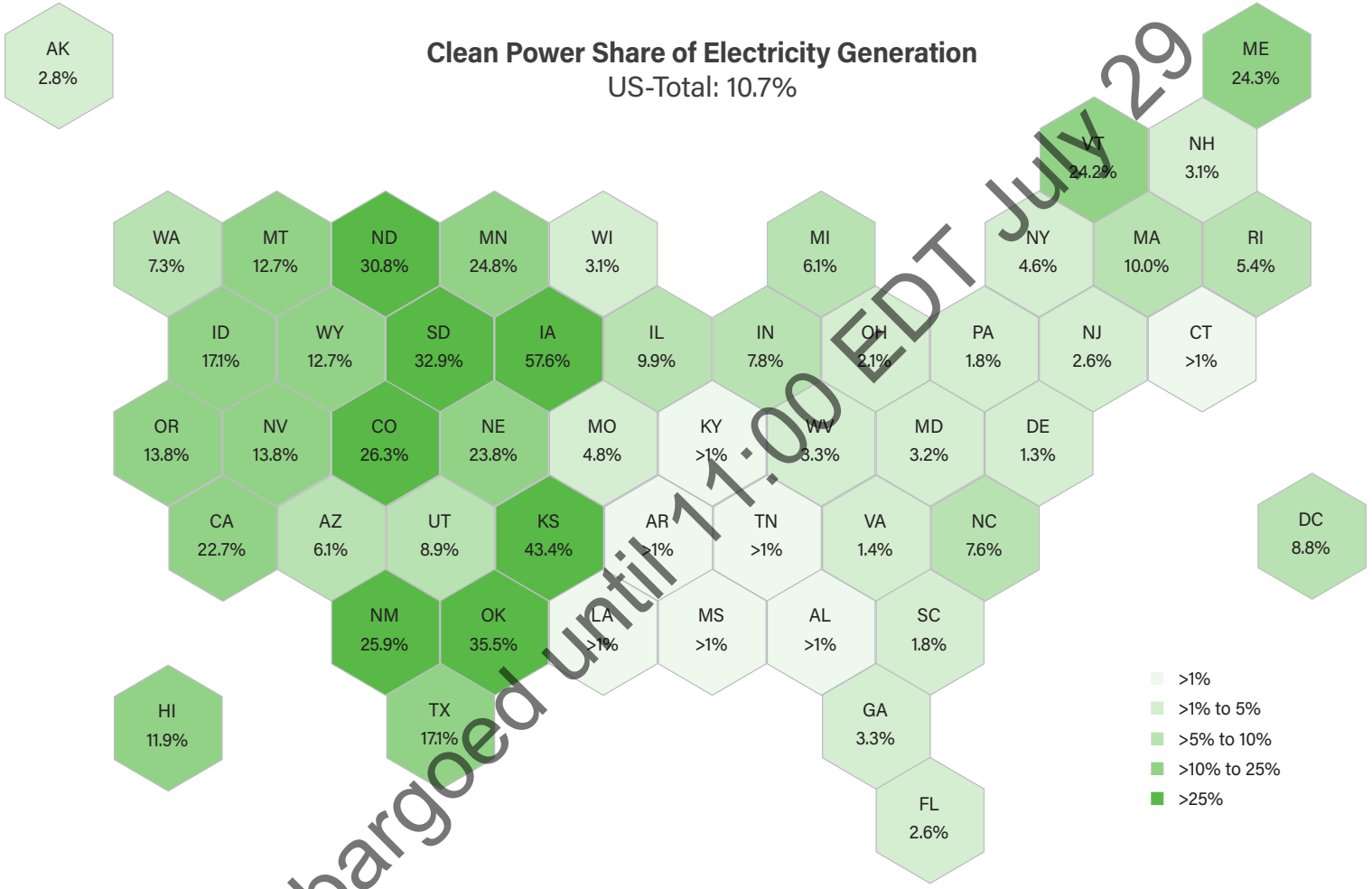
Clean power is red, white, and blue with projects or manufacturing facilities in 84% of congressional districts and jobs in all 50 states. These districts feel the local economic benefits of wind, solar and energy storage projects.

In 2020, the clean power industry paid an estimated $1.7 billion in state and local taxes and nearly $800 million in land-lease payments to landowners across the U.S. Since wind and solar projects operate reliably and profitably for more than 25 years, these local economic benefits become an equally reliable revenue stream in thousands of communities across the U.S.



Clean Power Share of Electricity Generation

Wind and solar provided 10.7% of the nation's electricity in 2020



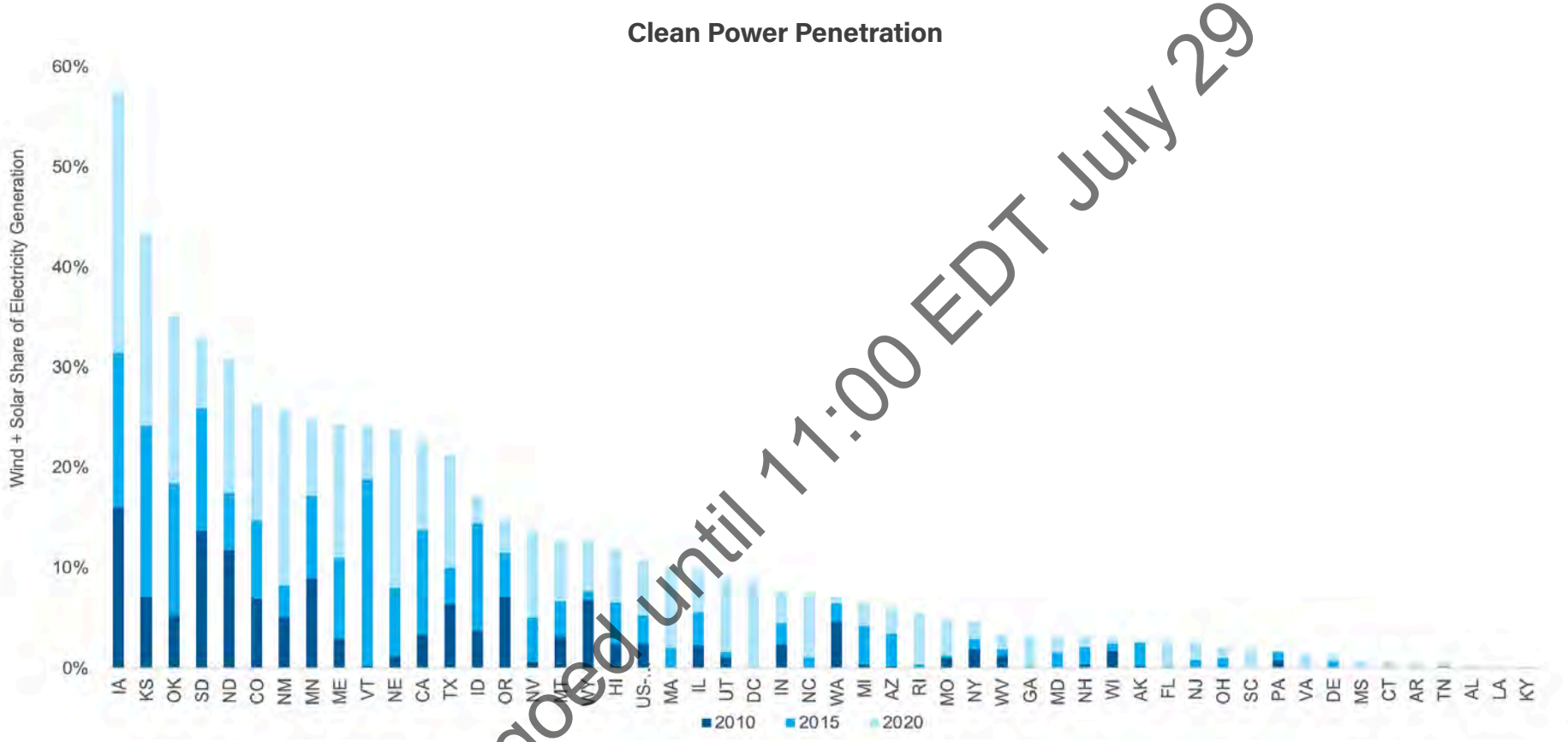
By the end of last year 20 U.S. states were sourcing double-digit percentage levels of wind and solar energy. Iowa holds an impressive lead at 57%, followed by Kansas at 43%. Oklahoma, South Dakota, and North Dakota are all in the 30% range. The eight next states in the ranking order are in the 20% and above clean power penetration range followed by another eight states in the 10% and above range. The remaining 24 states are between 1% and 10% clean power penetration.

The noticeable pattern of top performers coincides with the windiest Midwest states and since there is more than double the wind power capacity installed nationally than solar energy it is the states with excellent wind resources and high levels of wind plants in operation that also rank high in market shares of overall clean power.

Source: ACP, EIA

Penetration of Clean Power over time

Seven states generate at least 25% of their electricity from wind and solar



Wind and solar energy are becoming key resources in many states' electricity portfolio. Wind was the largest source of electricity generation in both Iowa and Kansas in 2020, while solar was the second largest source of electricity in California and Nevada. This is the second year in a row that wind energy has been the number one source of electricity for a state.

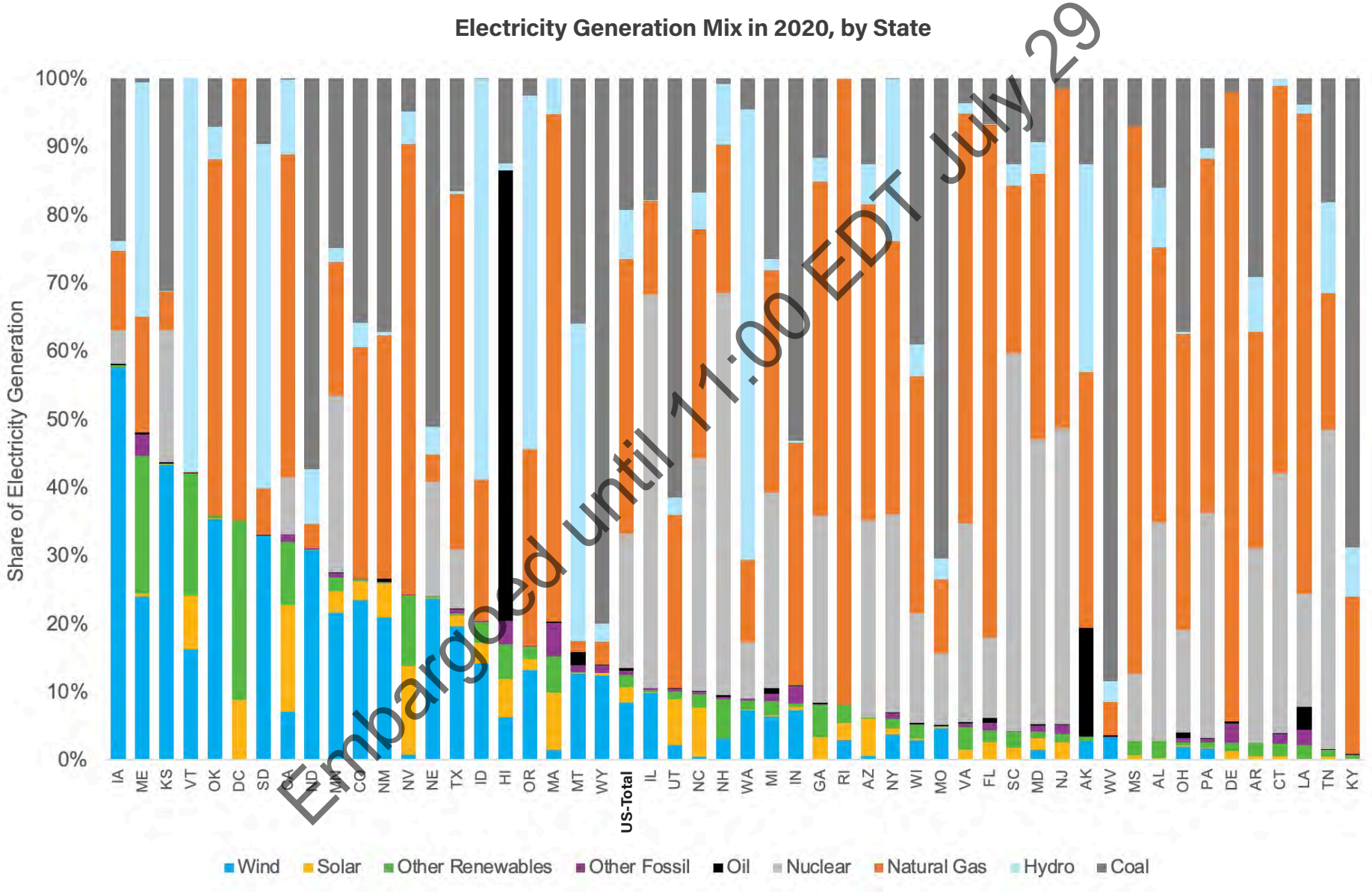
Wind and solar power's share of electricity generation has grown significantly at the state level during the last decade. In 2010, 11 states produced more than 5% of their electricity from wind and solar while three states exceeded 10% wind and solar generation. By 2015, 21 states produced at least 5% of their electricity from wind and solar and 13 states generated over 10%, with three states (Iowa, Kansas, and South Dakota) reaching over 20%. Five years later, the number of states exceeding 5% of electricity generation from wind and solar increased to 30; 14 states generate over 15%, and five states produce more than 30% of their electricity from wind.

At the national level, the share of wind and solar electricity generation has grown from just 2.3% in 2010 to 10.7% in 2020.

Source: ACP, EIA

Electricity Generation Mix by State

Iowa leads all states by generating 57% of its electricity from wind and solar



Source: ACP, EIA

State Generation Rankings

Texas produces the most clean electricity; Iowa leads clean power penetration

State Clean Power Generation Rankings

Rank	State	Clean Power Share (%)
1	Iowa	57.6%
2	Kansas	43.4%
3	Oklahoma	35.5%
4	South Dakota	32.9%
5	North Dakota	30.8%
6	Colorado	26.3%
7	New Mexico	25.9%
8	Minnesota	24.8%
9	Maine	24.3%
10	Vermont	24.2%
11	Nebraska	23.8%
12	California	22.7%
13	Texas	21.2%
14	Idaho	17.1%
15	Oregon	14.8%

Rank	State	Clean Generation (MWh)
1	Texas	100,896,585
2	California	44,158,997
3	Iowa	34,174,172
4	Oklahoma	29,638,724
5	Kansas	23,572,071
6	Illinois	17,203,857
7	Colorado	14,241,103
8	Minnesota	13,997,509
9	North Dakota	13,183,213
10	Oregon	9,624,835
11	North Carolina	9,479,302
12	New Mexico	8,889,128
13	Nebraska	8,771,310
14	Washington	8,373,080
15	Indiana	6,971,294

Another way to look at state rankings of clean power generation is the total annual energy production (AEP) measured in total megawatt-hours (MWh) generated. While there may be a high penetration rate of 57% clean power in Iowa, the total electricity demand load generated in the state is much less than load demanded in much bigger states.

When looking at total clean power generation of the much larger population states of Texas and California, they overwhelmingly take the lead for total generation produced from clean power even if their clean power penetration percentages (21.2%) and (22.7%) are relatively low.

In Texas, for example, the 100,896,585 MWh generated from clean power plants is more than double California at 44,158,997 MWh. That is more than three times Iowa, which leads in percentage of clean power penetration.

Source: ACP, EIA

U.S. Electricity Sector

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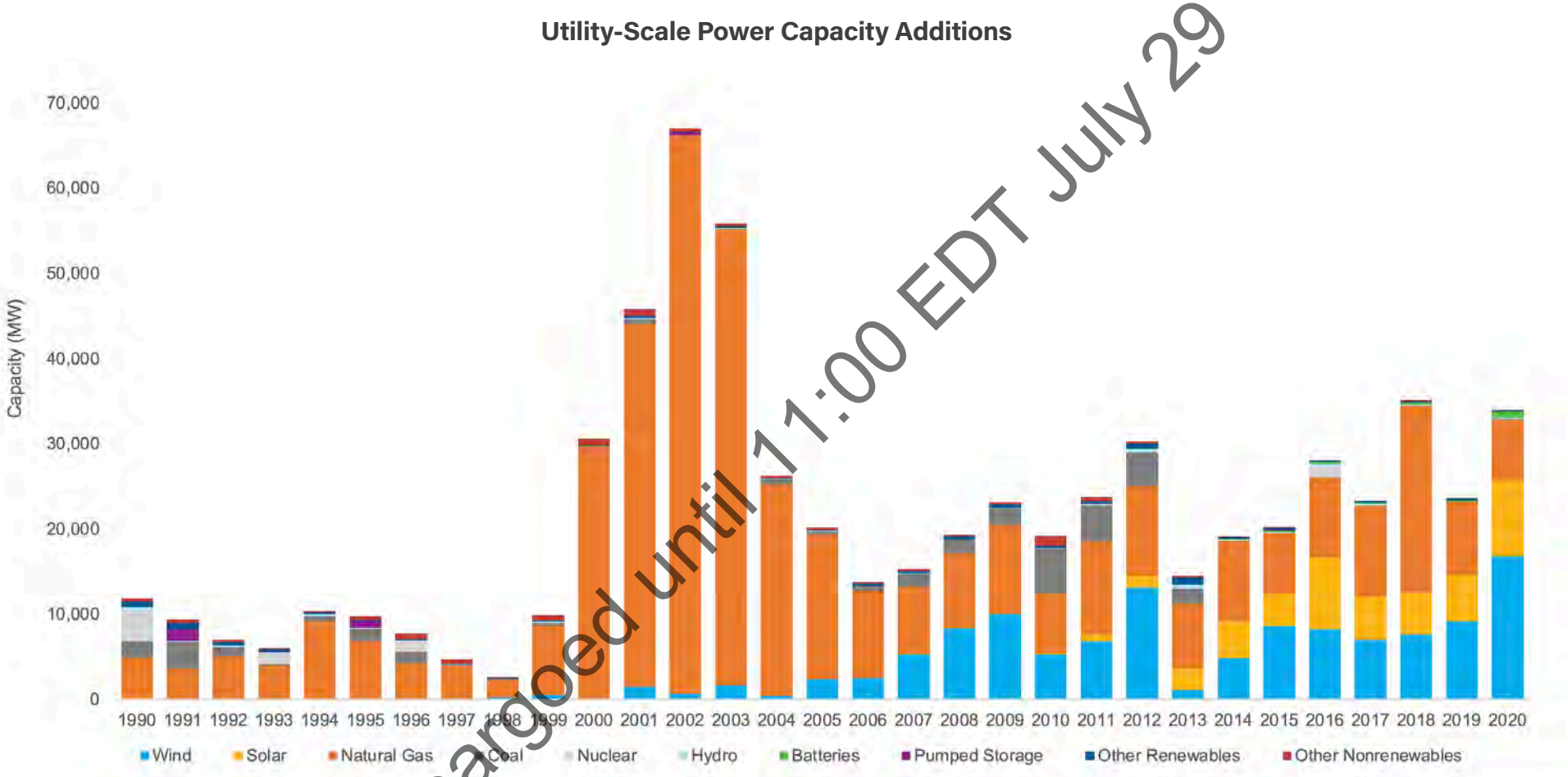
Annual Utility-Scale Power Capacity Additions

Clean power captured 78% of utility-scale power additions in 2020



The U.S. electricity sector added 35,133 MW of new generating capacity in 2020. Clean power represented 78% of total installations at 26,490 MW. Wind captured 50% of utility-scale power installations in 2020 with 16,836 MW, while solar captured 26% with 8,894 MW and batteries 2% with 760 MW. The only other generation competitor to clean power was natural gas with 7,149 MW installed.

Natural gas power plants continue to be installed at significant levels but only once in the last five years has more natural gas capacity come online than renewables.

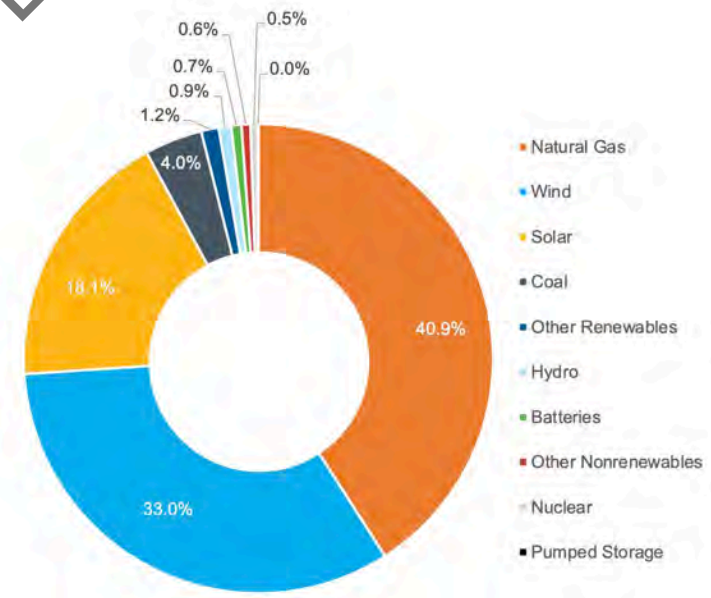
Source: ACP, EIA

Utility-Scale Power Capacity Addition Market Share, 2011-2020

Renewables captures majority of market over past decade

Looking at the past decade of annual power plant capacity additions the combination of renewables and battery energy storage topped 52% market share, with natural gas plants following at 41%. Coal holds 4%, but no significant levels of coal capacity have been added since 2013.

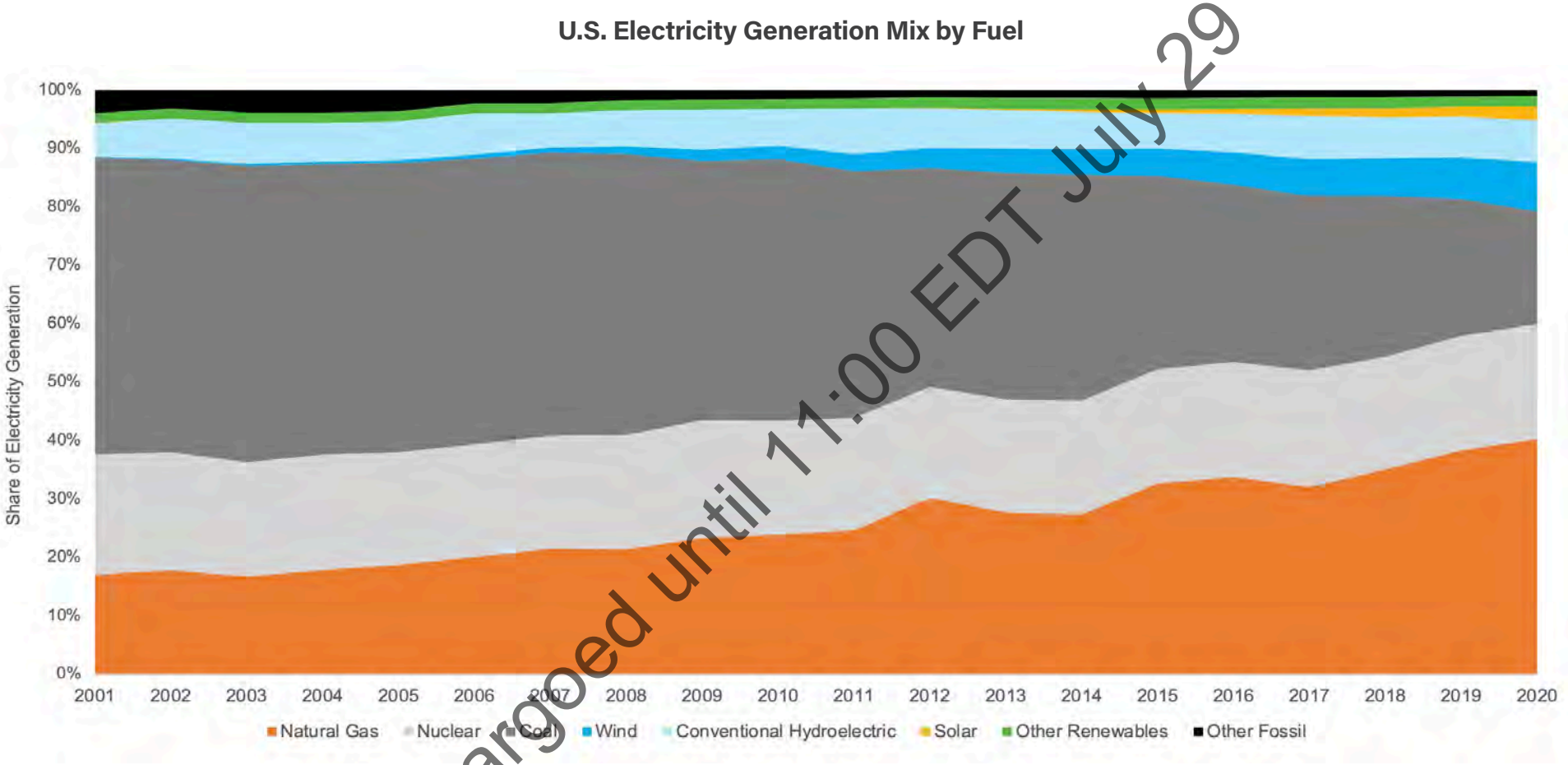
Utility-Scale Power Capacity Addition Market Share, 2011-2020



Source: ACP, EIA

U.S. Electricity Generation Mix by Fuel

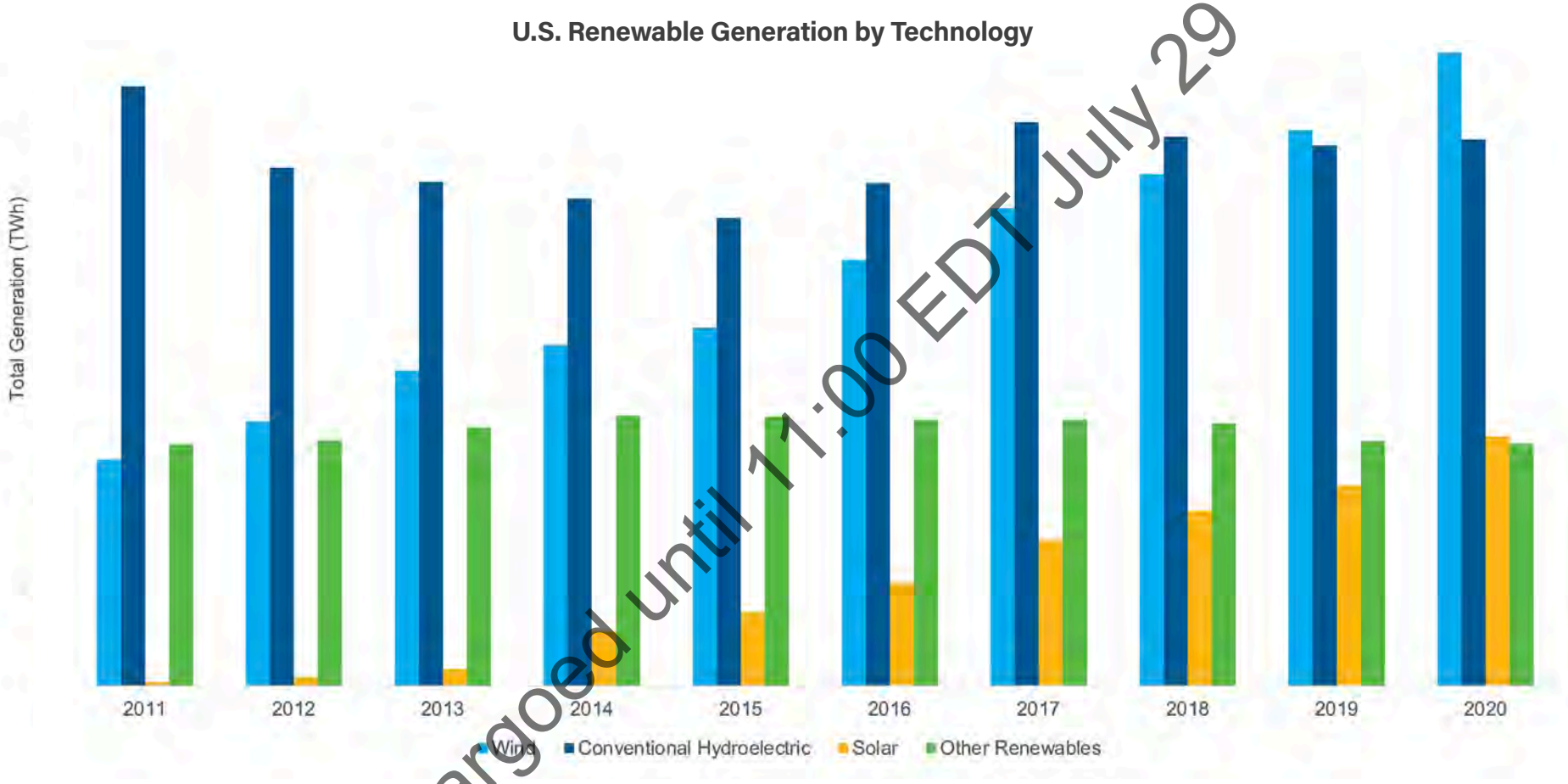
Wind and solar provide 10.7% of nation's electricity



In 2020 natural gas represented 40% of U.S. electricity sector generation, followed by nuclear with 20%, and coal at 19%. The combination of wind and solar and other non-hydro renewables is 12% (19% if including hydroelectric). Fossil fuel still reigns because of natural gas but market share will inevitably drop as coal plants shutter and GW levels of renewables continue to be added to the grid on an annual basis for the foreseeable future.

U.S. Renewable Generation by Technology

Wind energy is the largest source of renewable electricity generation in the country



A further breakdown of the annual MWh generation market share within all renewables (and including conventional hydroelectric) shows wind at 38%, hydroelectric at 33%, solar PV and thermal at 15%, and other renewables at 14%.

U.S. Electricity Markets

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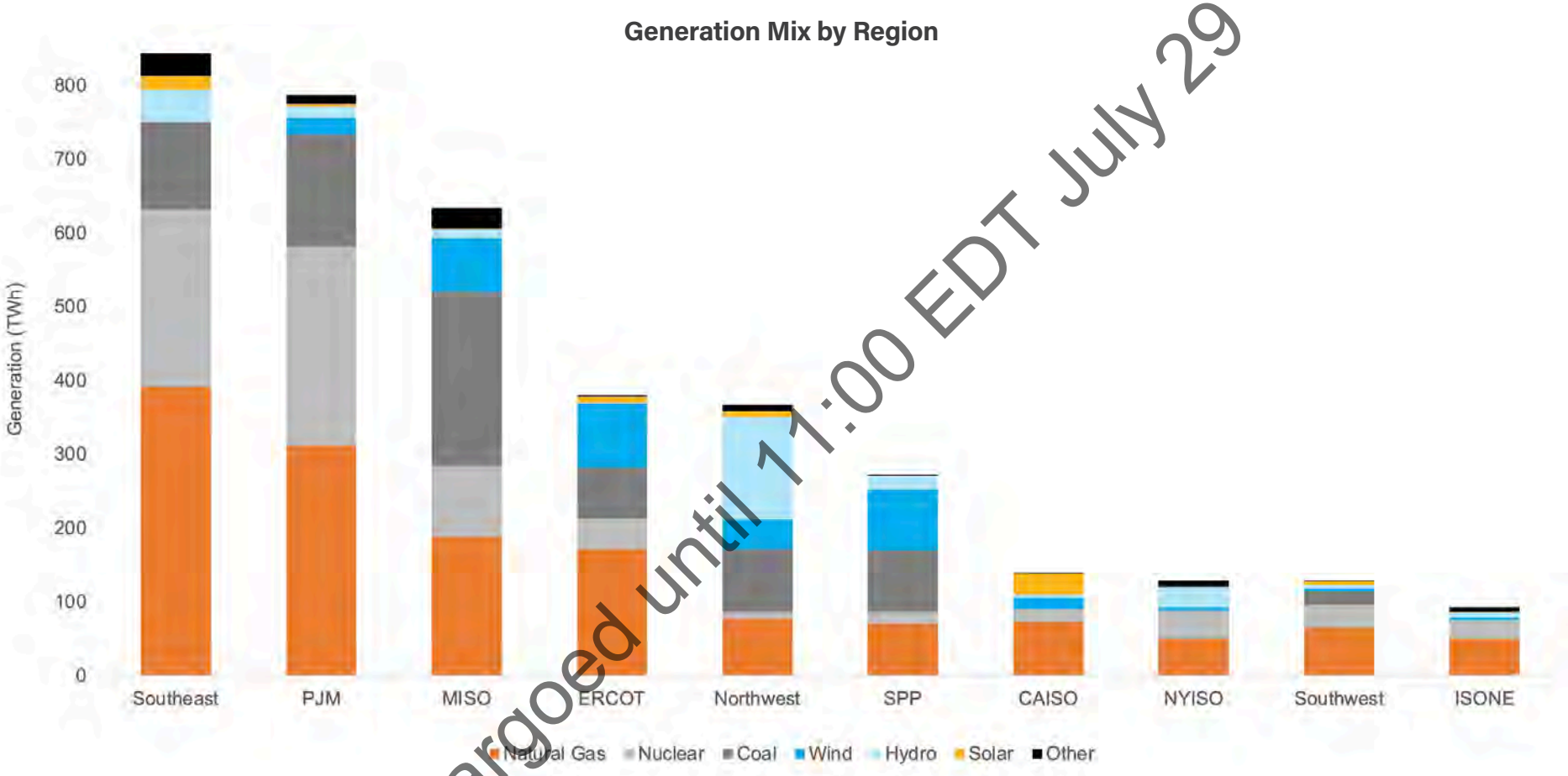
U.S. Electricity Generation Mix by ISO/RTO

Wind becomes largest electricity provider in SPP



The generation mix differs in each market depending on a mix of where legacy power plants such as coal and nuclear were built years ago, and the geographic attributes that favor some technology over others.

For example, abundant hydropower resources in the Northwest push its generation up to 38% in the region, while it is in the single percentage digits in other regions. Coal likewise has higher penetration in the interior regions of the country located closer to coal mines.

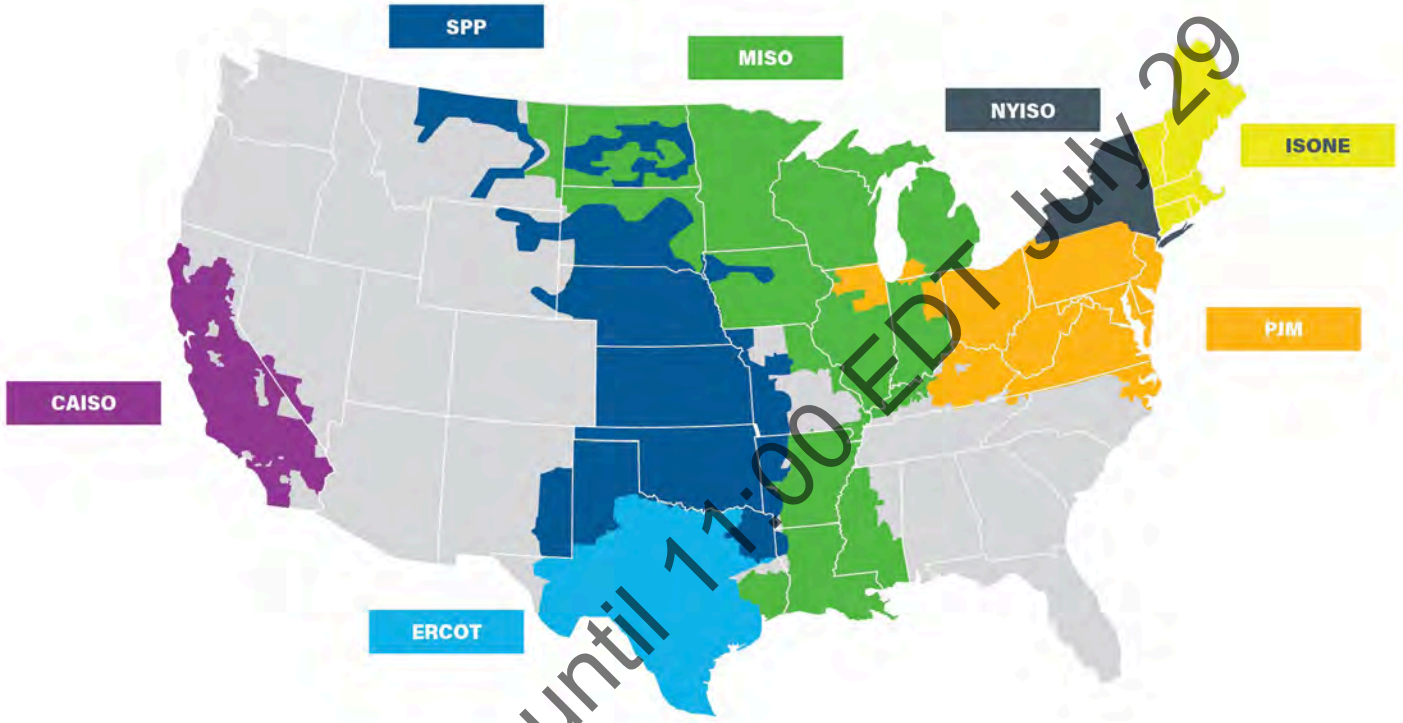
The story of renewables in these regions likewise follows natural resources with the windy interior regions of SPP and ERCOT with the highest proportions at 30% and 23% percent, respectively.

Solar built at large utility scale is still relatively new to the U.S. market but growing faster than any other fuel and reached a high of 21% in California with its world-class solar insolation and supportive state policies that encourage renewables.

Source: EIA

Wind and Solar Records

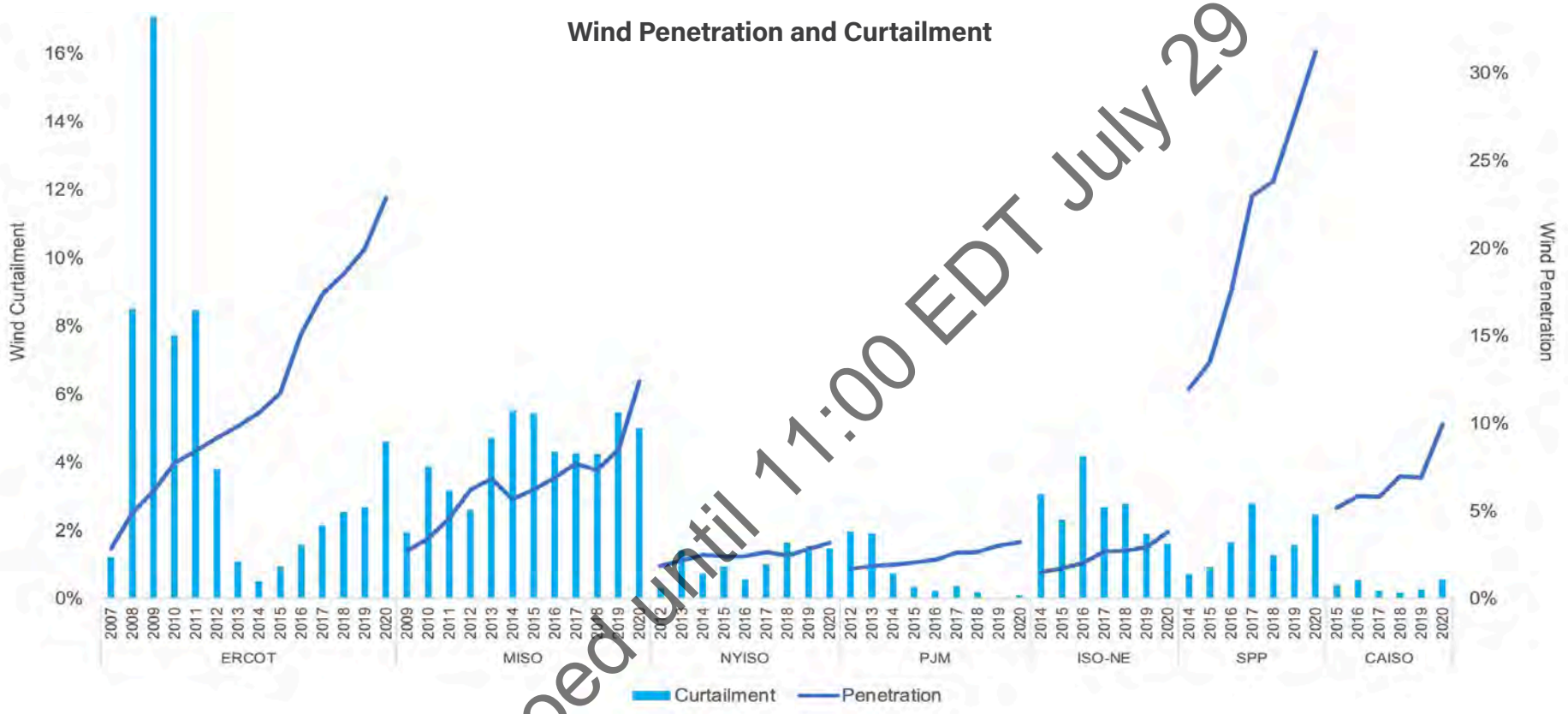
Output and penetration records continue to be set in regional markets



		CAISO	ERCOT	SPP	MISO	PJM	NYISO	ISONE
WIND	Installed Wind Capacity (MW)	6,952	25121	27,448	22082	1522.9	1985	1400
	Record Wind Output (MW)	5,754	22,893	21,133	20,699	8,961		1238.403
	Record Wind Output Date	May (2021)	1/14/21	3/29/21	3/30/21	1/21/21		2/25/21
	2020 Wind Generation Share	10%	23%	31%	12%	3%	3%	4%
	Record Wind Penetration		60.40%	81.85%		12%		11%
	Record Wind Penetration Date		1/30/21	3/29/21		5/2/21		4/23/21
SOLAR	Installed Solar Capacity (MW)	14,106	3974	189	464	1779.5	2251	3994
	Record Solar Output (MW)	13,205	4,768	228		2,899.50		1478.126
	Record Solar Output Date	May (2021)	1/27/21	3/31/21		5/2/21		3/13/21
	2020 Solar Generation Share	20.8%	2.2%	0.2%	0.1%	0.4%	0.0%	0.4%
	Record Solar Penetration		12.10%			4%		6%
	Record Solar Penetration Date		1/27/21			5/2/21		5/1/21

Wind Penetration and Curtailment

In 2020 curtailment picked up in four of the seven observed RTO/ISO markets



Curtailment of wind power results from transmission inadequacy and other forms of grid and generator inflexibility. Adding transmission capacity greatly reduces curtailment while also allowing new wind energy development in high-quality wind resource areas. Increasing wind penetration is often associated with increasing curtailment but is not always the case.

In 2020 curtailment picked up in four of the seven observed RTO/ISO markets, with the largest increase in ERCOT, rising to 4.6%. This is an increase from 2.7% the year before and an increase from an average of 2.0% over the previous five years. Penetration rates there continued to rise to 22.9%, which is to be expected with more projects coming online in 2020.

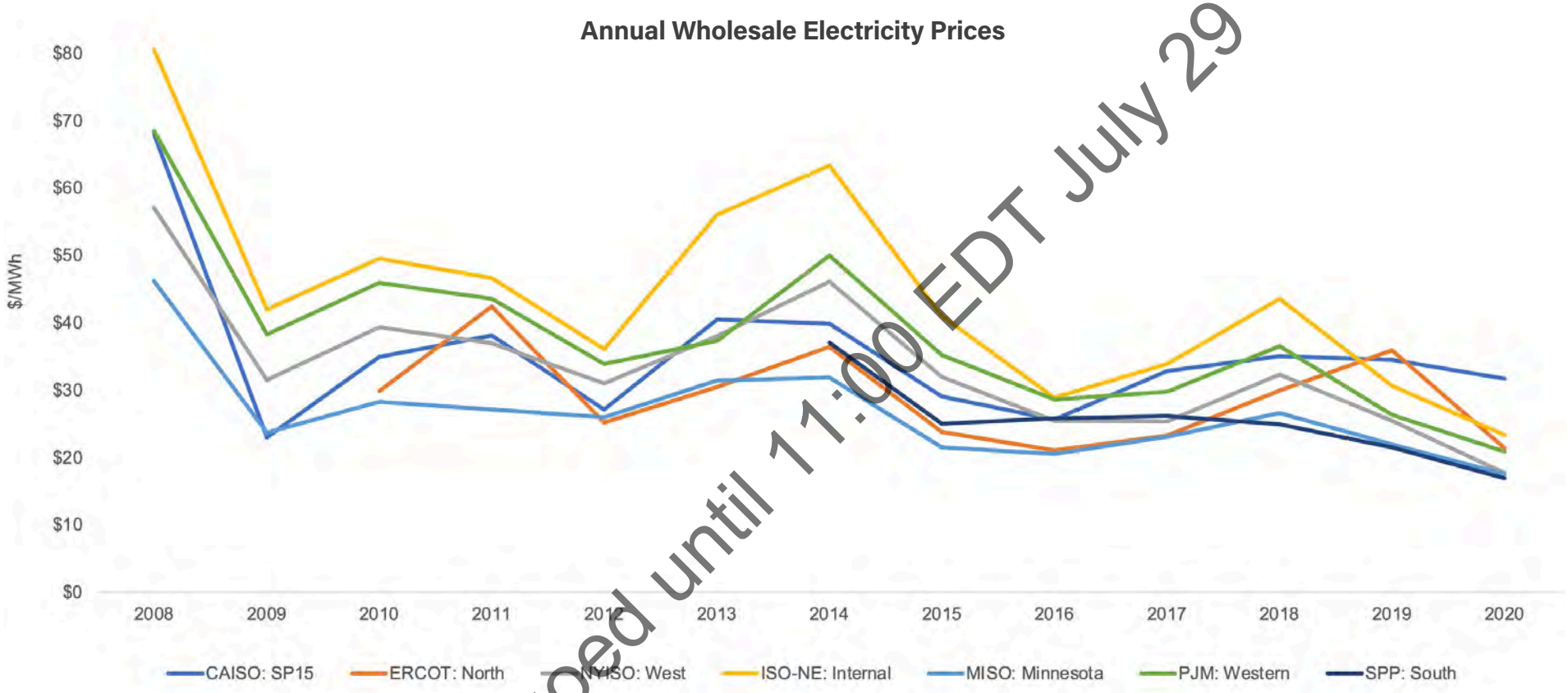
The three remaining RTO/ISO markets (ISO-NE, SPP, CAISO) that saw curtailment increases were much more modest increases all below one percentage point. MISO saw a slight decrease but continues to hold the highest average annual curtailment at 5% in 2020, down from 5.5% the year before.

SPP increased its lead for penetration rate, rising to 31.2%, up from 27.5% the year before. It has managed this increase while keeping curtailment rates down around 2.4% in 2020, owing partly to recent transmission investments.

During the years of 2012 and 2014 SPP invested almost $3.4 billion of capital investment in 348 transmission upgrades and studies have shown it resulted in cost savings to ratepayers and enabled the rapid deployment of significant new wind capacity, which drove its wind penetration above 30% last year.

Annual Wholesale Electricity Prices

Average wholesale electricity price in 2020 experienced 28.4% year over year decrease



One of the starkest impacts of the Covid-19 pandemic on the economy was on full display across the board with significant decreases in average wholesale electricity prices. The shift to remote work for employees fortunate to have that flexibility left thousands of empty office buildings throughout the country, reducing electricity demand to heat and cool buildings. Likewise, many businesses and industries reduced output, manufacturing, and other business cycles due to the pandemic-induced economic recession, further eroding electricity demand.

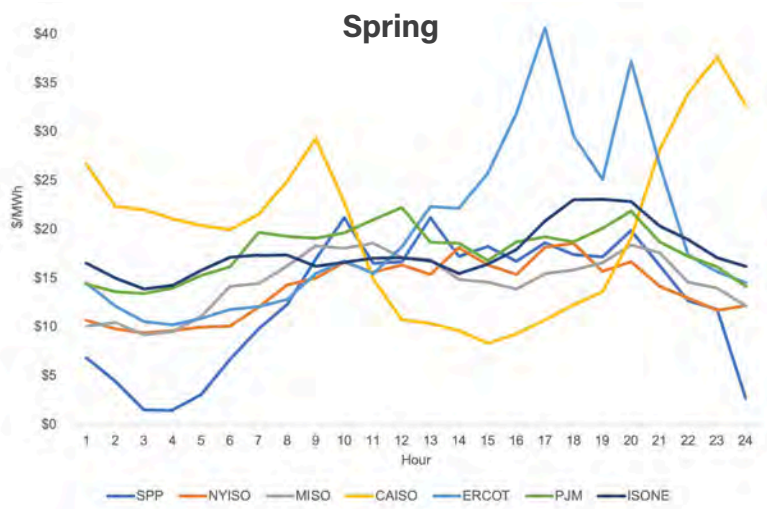
The average wholesale electricity price across the observed markets in 2020 dropped to $21.39/MWh from $28.07/MWh in 2019, a 28.4% year-over-year decrease. Pricing ranged from as low as $16.97/MWh in SPP to CAISO at $31.70/MWh. This was anomalous, pandemic-driven pricing and demand has already begun to rebound as employees return to office buildings and a myriad of businesses recover and increase output.

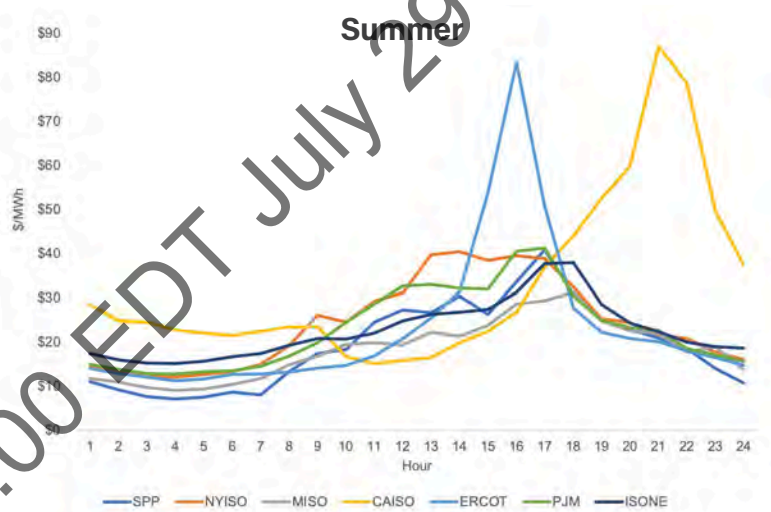
Average wholesale electricity prices are defined as average annual, around-the-clock, real-time prices. The prices are derived from one or more major trading hubs in each of the seven ISO and RTO markets.

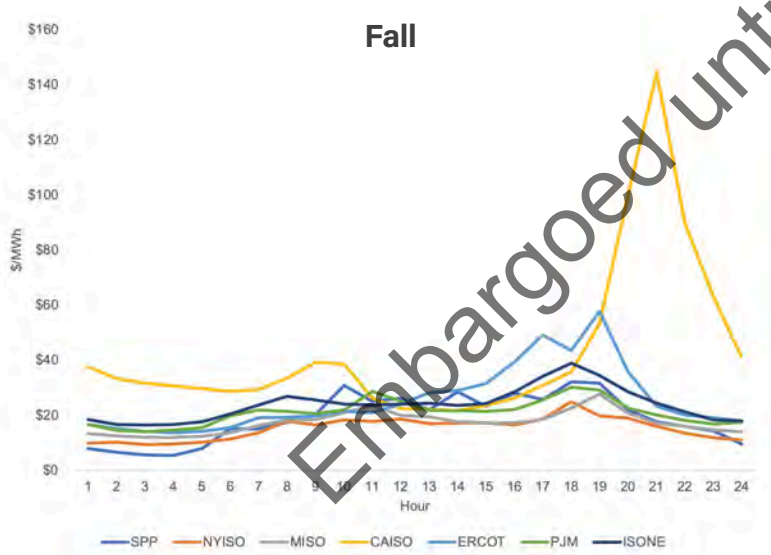
Data Source: S&P Global. Based on prices at proxy power hubs in each ISO.

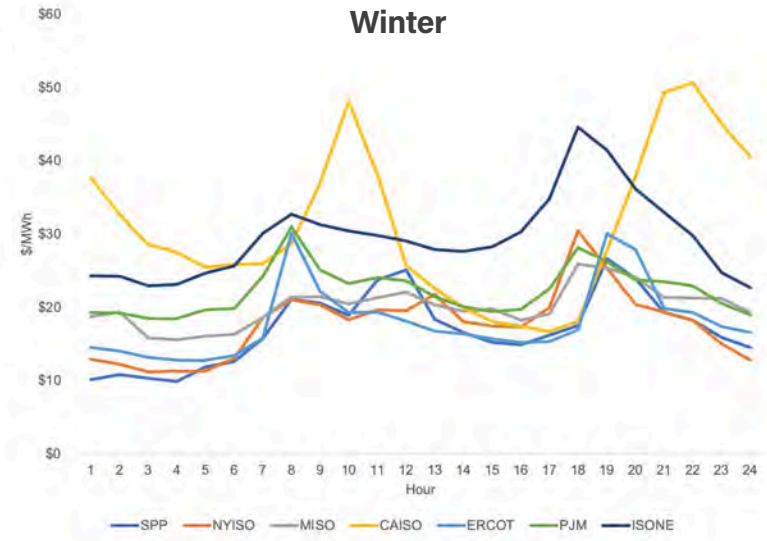
Hourly Wholesale Electricity Prices in 2020

Hourly wholesale prices vary significantly by region and season



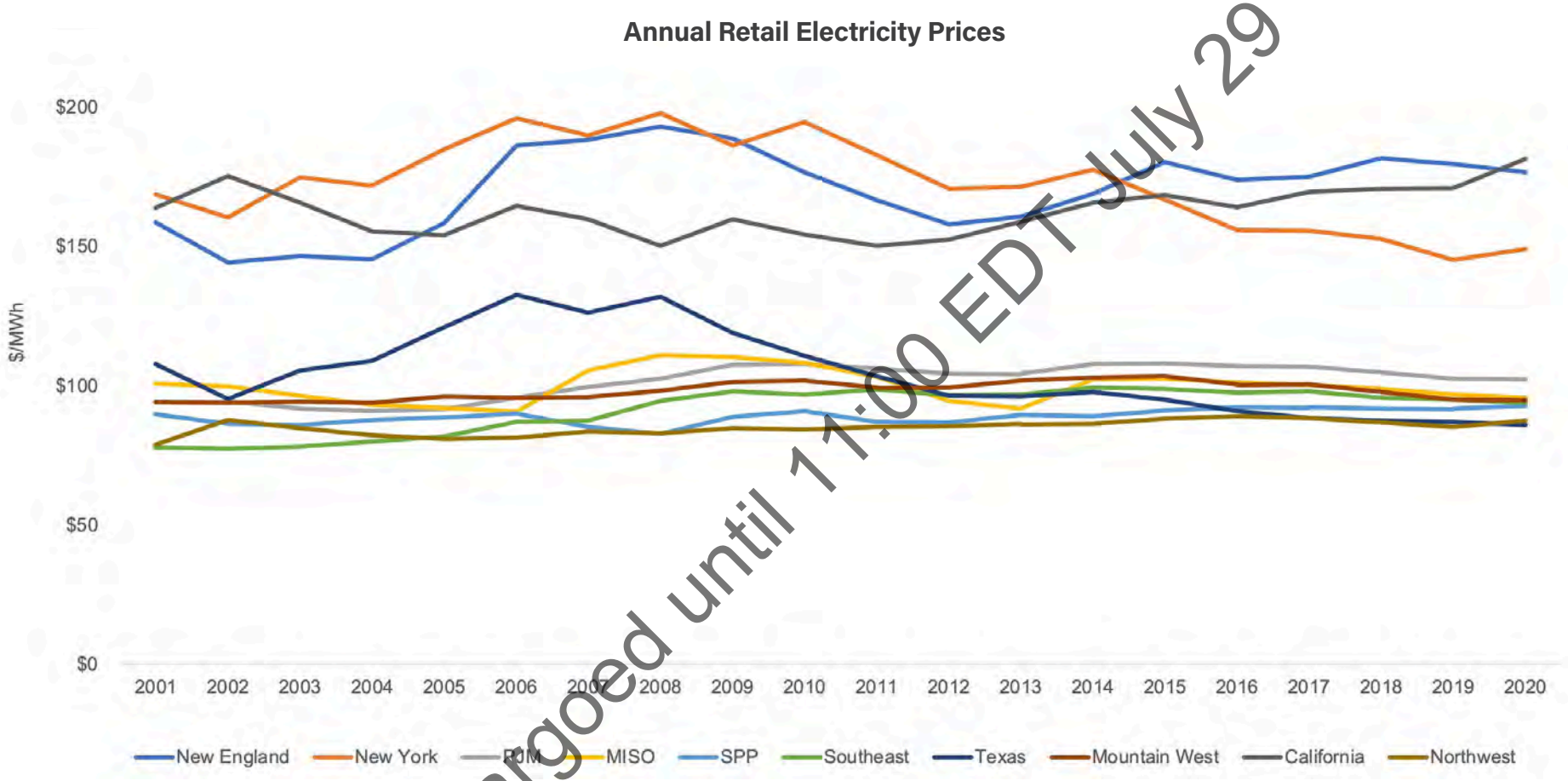






Regional Retail Electricity Prices

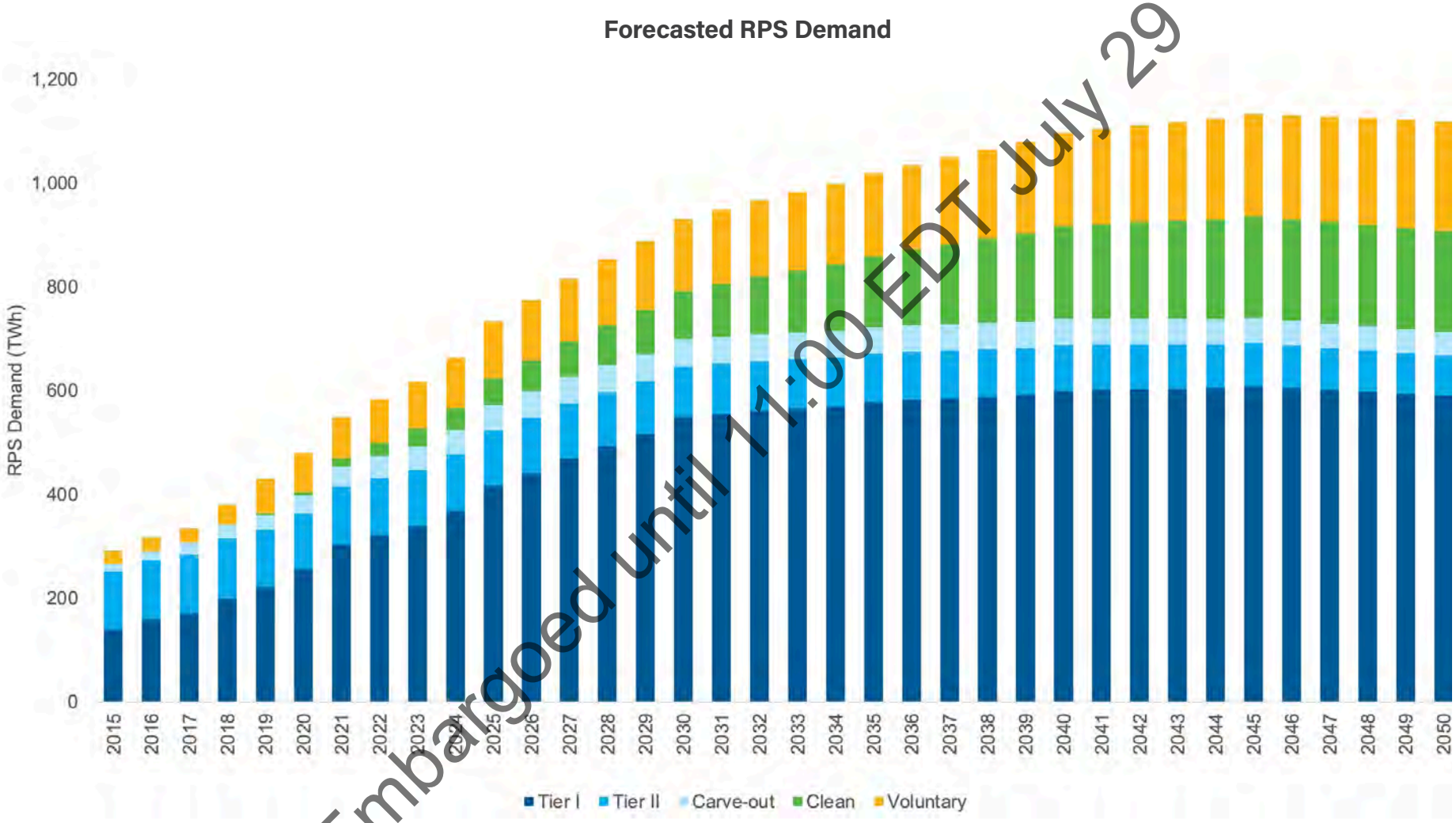
Retail prices relatively flat in real terms over past two decades



Average retail electricity prices did not see the same year-over-year stark decrease that wholesale electricity prices experienced in 2020 due to the pandemic. This is largely because most retail electricity consumers have contracts for power at a fixed per kWh rate. Pricing went slightly down year over year in six markets (New England, PJM, MISO, Southeast, Texas, Mountain West) and gained slightly in four markets (NY, SPP, CA, Northwest).

RPS Demand Forecast

RPS is a foundation of clean energy demand and multiple states advanced their binding goals



Source: BNEF

RPS Demand Forecast

RPS is a foundation of clean energy demand and multiple states advanced their binding goals

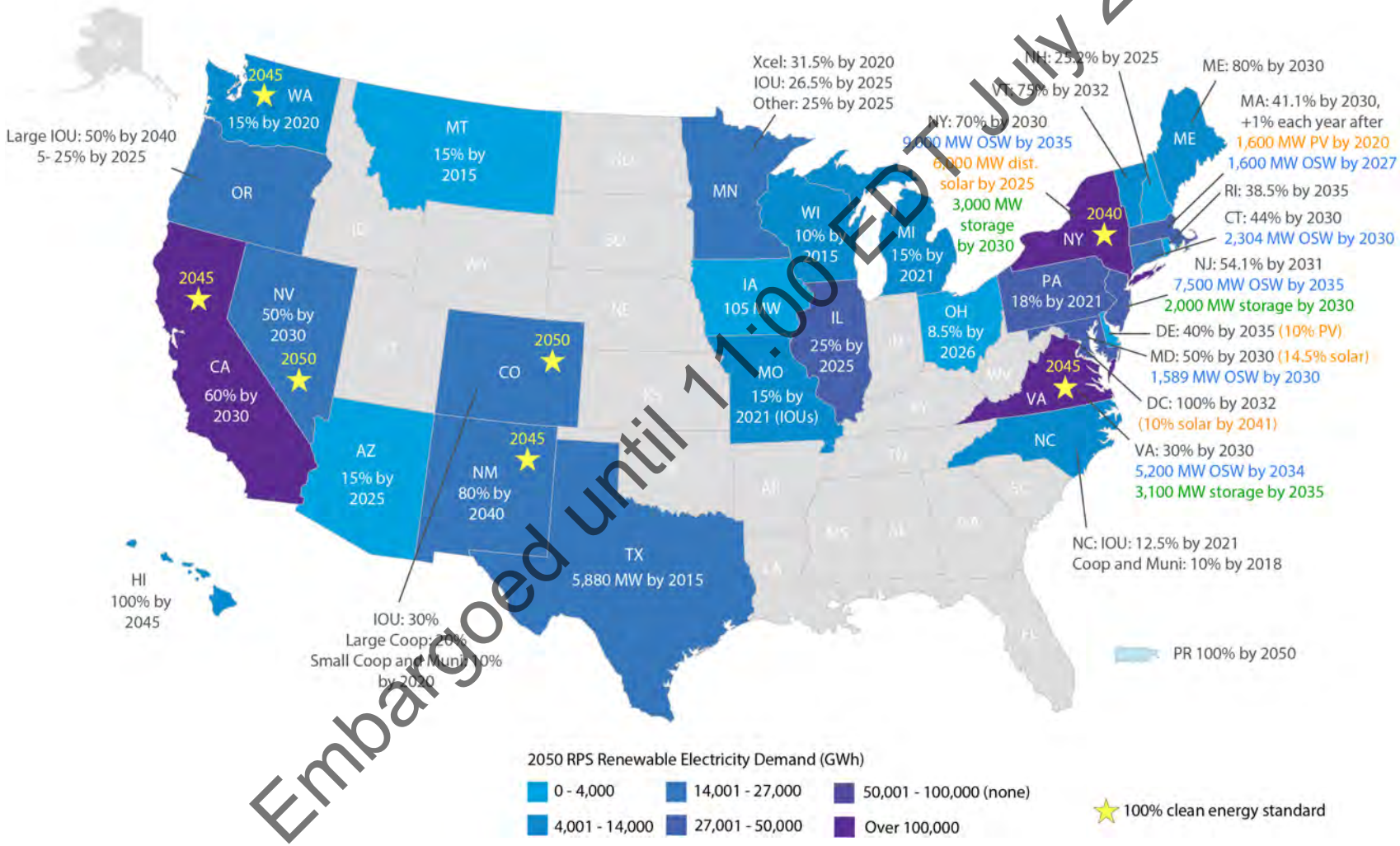
Currently 30 states, as well as the District of Columbia and Puerto Rico, have RPS/CES policies in place requiring anywhere from 10% to 100% of total electricity sales in the state to be generated from renewable resources.

In 2020 these policies broadly saw improvements to support more clean energy:

- Governor Northam signed the Virginia Clean Energy Act (VA SB 851 / HB 1526), into law. The bill establishes a 100% CES for the state and requirements for Dominion Energy Virginia's development of qualified offshore wind projects to have an aggregate rated capacity of no less than 5,200 megawatts by January 1, 2034.
- In November, the Arizona public utility commission ("Arizona Corporation Commission" or ACC), which sets energy policy in the state, passed new amendments to the state's energy rules on a variety of topics including: a 100% reduction in carbon emissions by 2050, with interim targets, an All-Source Request for Proposal (RFP) requirement, a more transparent Integrated Resources Planning (IRP) process, a 50% renewables by 2035 standard, a 100% clean by 2050 standard. The deadline for the 100% clean standard was extended to 2070 in 2021.
- In September, Michigan Gov. Gretchen Whitmer signed Executive Order (EO) 2020-182 and Executive Directive 2020-10 to create the MI Healthy Climate Plan, which puts Michigan on a path towards becoming fully carbon-neutral by 2050. The order also includes an intermediate goal of 28% reduction below 1990 levels of greenhouse gas emissions by 2025. Within days, the Michigan Public Service Commission affirmed the Governor's executive orders and pledged to work towards the goals outlined in the EO's.
- The New York State Department of Public Service and the New York State Energy Research and Development Authority published a White Paper introducing an expanded Clean Energy Standard, including a 70% by 2030 RPS policy.
- Minnesota (SF 1456/HF 1405), Clean Energy First, passed the Senate Energy and Utilities Finance and Policy Committee. The package would help the state transition to a clean energy economy, establish transmission planning, and provide consideration for local workers. Requires utilities to reduce emissions to 60% or 80% of 2005 levels by 2030.

RPS Policy Map

30 States, DC, and PR have RPS policies in place



Clean Power + Transmission

AMERICAN CLEAN POWER

CLEAN POWER ANNUAL **2020**

Miles of Transmission Completed in the U.S.

Build continues but modestly compared to earlier in the decade

In the past decade, the electricity industry has deployed over 25,000 miles of transmission lines to deliver generation to market and maintain grid reliability. This translates to an annual average of 2,500 miles of new transmission lines per year, though transmission deployment recently peaked in 2013 and new transmission build has been relatively modest since. In 2020, 1,706 miles of transmission projects were completed, down from 1,921 the year before. Near-term transmission projects still in development could support tens of thousands of megawatts of additional wind capacity, but these projects must be approved and built in a timely manner.

Source: S&P Global

Clean Power Projects and Transmission Built since 2015

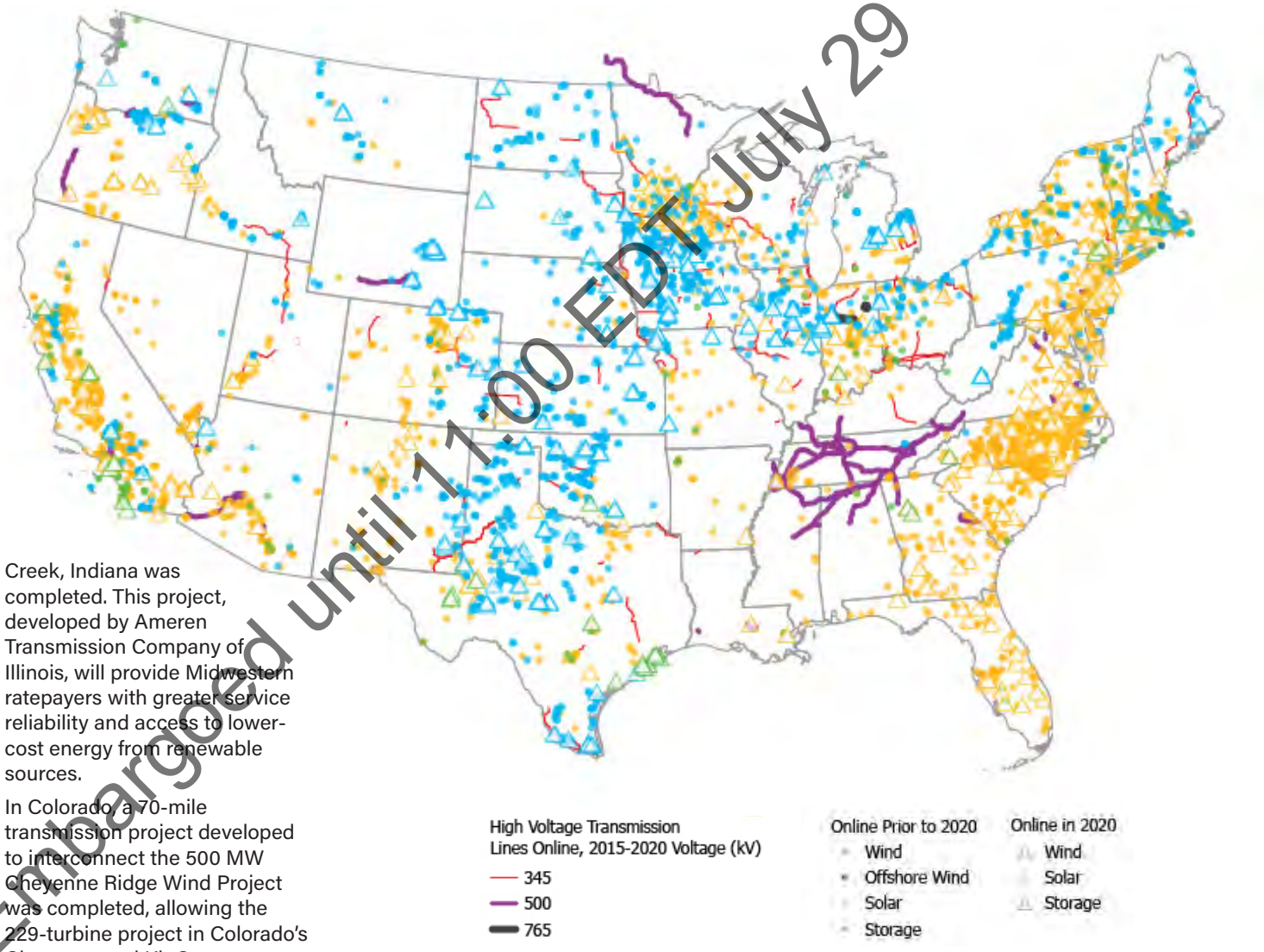
In 2020, over 1,400 miles of high-voltage transmission lines were brought online across the U.S.

Since 2015, over 11,000 miles of high-voltage (345 kV or higher) transmission lines have been constructed across the U.S. Many of these projects were undertaken with the goal of moving electricity generated from renewable sources to load centers. For example, the Tehachapi Renewable Transmission project, a 173-mile 500 kV line in Southern California that was completed in 2016, was designed to connect 4,500 MW of electricity from renewable and other generators in Kern County, California to load centers in Los Angeles and San Bernardino County.

In 2020, over 1,400 miles of high-voltage transmission lines were brought online across the U.S. One of these projects, the roughly 357-mile Great Northern Transmission Line connecting hydroelectric generation in Manitoba, Canada to load centers in Minnesota, spanned international borders.

Transmission development remains a key bottleneck to the deployment and interconnection of low-cost, renewable generation resources. However, there were some notable achievements in 2020. Among other projects, a 145-mile segment of the 375-mile now-energized Illinois Rivers Project, a 345 kV line connecting Palmyra, Missouri and Sugar Creek, Indiana was completed. This project, developed by Ameren Transmission Company of Illinois, will provide Midwestern ratepayers with greater service reliability and access to lower-cost energy from renewable sources.

In Colorado, a 70-mile transmission project developed to interconnect the 500 MW Cheyenne Ridge Wind Project was completed, allowing the 229-turbine project in Colorado's Cheyenne and Kit Carson counties to begin commercial operation in August 2020.



Transmission Development Activity

There are nearly 13,000 miles of transmission lines in development across the U.S.

Key	Project Name	States
1	Bakersfield – Solstice Line	TX
2	BB2 Line	NM
3	Cheyenne Ridge Transmission Line	CO
4	Valley to Dooms Rebuild	VA
5	Duff – Coleman Line	IN, KY
6	Eddy County – Kiowa Line	NM
7	Gateway West – Segments 2 and 3	WY
8	Great Northern Transmission Line	MN
9	Harry Allen – Eldorado Transmission Line	NV
10	Pana – Mt. Zion – Kansas – Sugar Creek (MVP 11)	IL, IN
11	Solstice – Sand Lake Line	TX
12	Tuco – China Draw; Tuco – Yoakum – Hobbs	TX, NM
13	Valiant - NW Texarkana	OK, TX

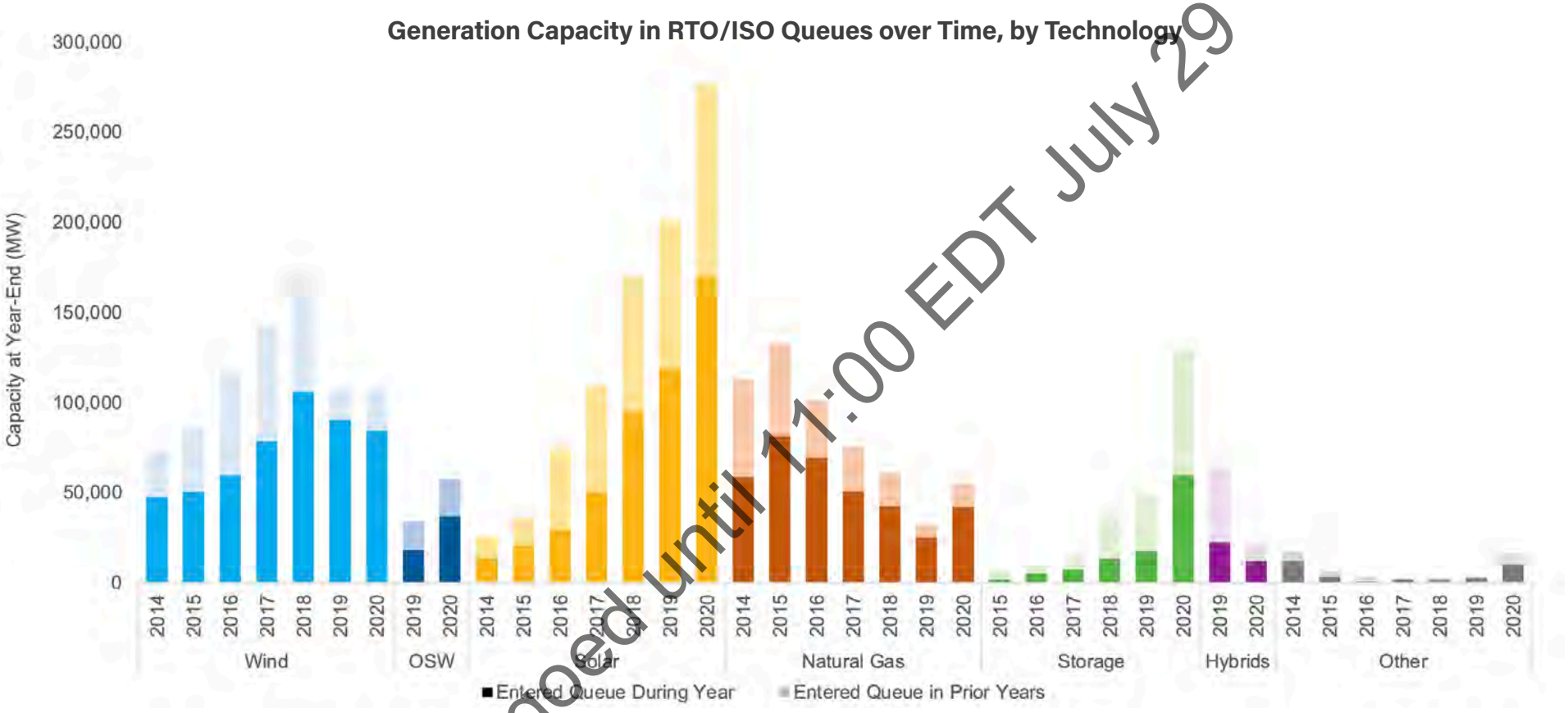
As the demand for renewable generation grows, the need for additional transmission capacity increases. As of 2020, there are nearly 13,000 miles of transmission lines in development across the country. While many of these projects are in the early stages of development, some key projects have begun or will soon commence construction.

In August 2020, Rocky Mountain Power announced it had applied for regulatory approval for a 142-mile segment of the approximately 400-mile Gateway South Transmission Line Project. Gateway South is a portion of the Energy Gateway Transmission Expansion, a set of approximately 2,000 miles of new transmission line segments being developed by PacifiCorp in concert with other utilities that will enhance reliability and deliver electricity from existing and new generation resources, including wind, throughout the Western U.S. Portions of this project have already been completed, with additional segments expected to be placed in service in the coming years.

Other projects, such as the Empire State Line, a new 20-mile 345 kV transmission line being developed by NextEra and the Western Spirit Transmission Line, a 155-mile 345 kV line being developed by the New Mexico Renewable Energy Transmission Authority (RETA) and Pattern Energy, have received final approvals, and are slated to begin construction in early 2021.

Capacity in RTO/ISO Interconnection Queues over Time

Nearly 277 GW of solar, 130 GW of storage, and 107 GW of wind in interconnection queue backlogs



Interconnection queues are essentially a waiting list of proposed power projects seeking a grid connection in coming months and years. While most projects that apply for interconnection are not subsequently built, data from these queues nonetheless provide a good general indicator for mid-term trends in market, developer, and investor interest.

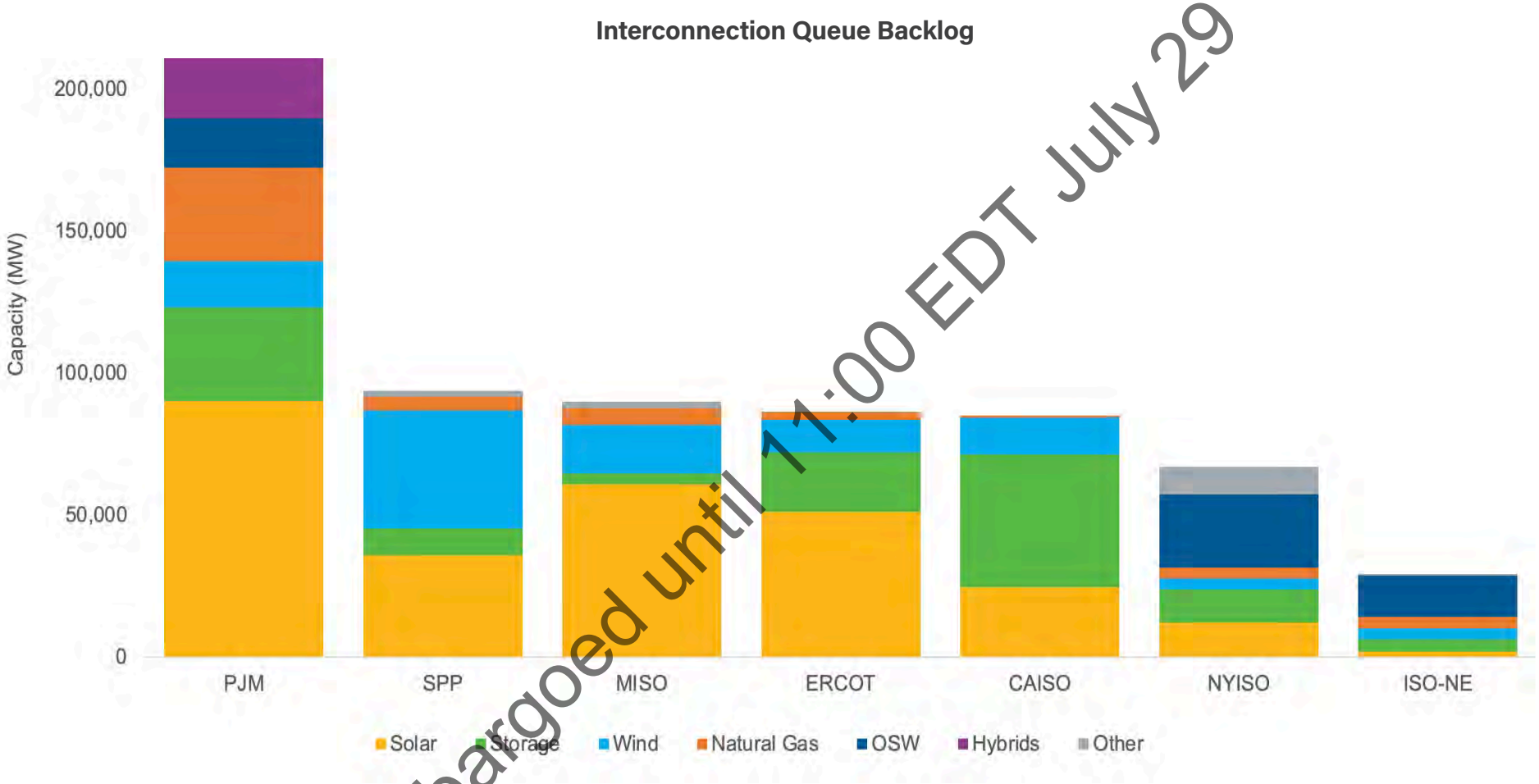
The trends toward clean power growth and overwhelming market share are unmistakable. Nearly 277 GW of solar projects, 130 GW of storage projects, and 107 GW of wind projects were in interconnection queue backlogs across the country at the end of 2020.

The total market share of all clean power projects that entered the major RTO/ISOs in 2020 was 92% and a total of 230.4 GW of capacity. The only non-renewables and storage capacity is represented by natural gas at 5% and "other" at 2% with 19.5 GW combined. No coal or nuclear or new large hydropower are in the queues.

The total market share of all clean power projects that entered the major RTO/ISOs prior to 2020 was 87% clean power, totaling 363 GW. The only non-renewables and storage capacity is represented by natural gas at 10% and "other" at 2.5% with 52.3 GW combined. No coal or nuclear or new large hydropower are in the queues.

Interconnection Queues

No coal or nuclear or new large hydropower are in the queues



A closer look at the proportions of technology types in the major RTO/ISOs shows solar with by far the highest market share with 42% of total capacity. Energy storage follows with 19%, land-based wind 16%, offshore wind 9%, natural gas 8%, and hybrids (renewables + storage) and "other" each at 3%.

Variations within each RTO/ISO are partly a reflection of the economic viability of each resource in those markets. For example, the 57.7 GW of offshore wind up for grid connection study is only in PJM, NYISO, and ISO-NE, since all offshore projects under development currently are in the Northeast and along the Eastern seaboard. The energy storage backlog is highest in CAISO where a huge solar market is a complementary resource and the state established ambitious goals for energy storage.

Clean Power Development and Ownership

AMERICAN CLEAN POWER

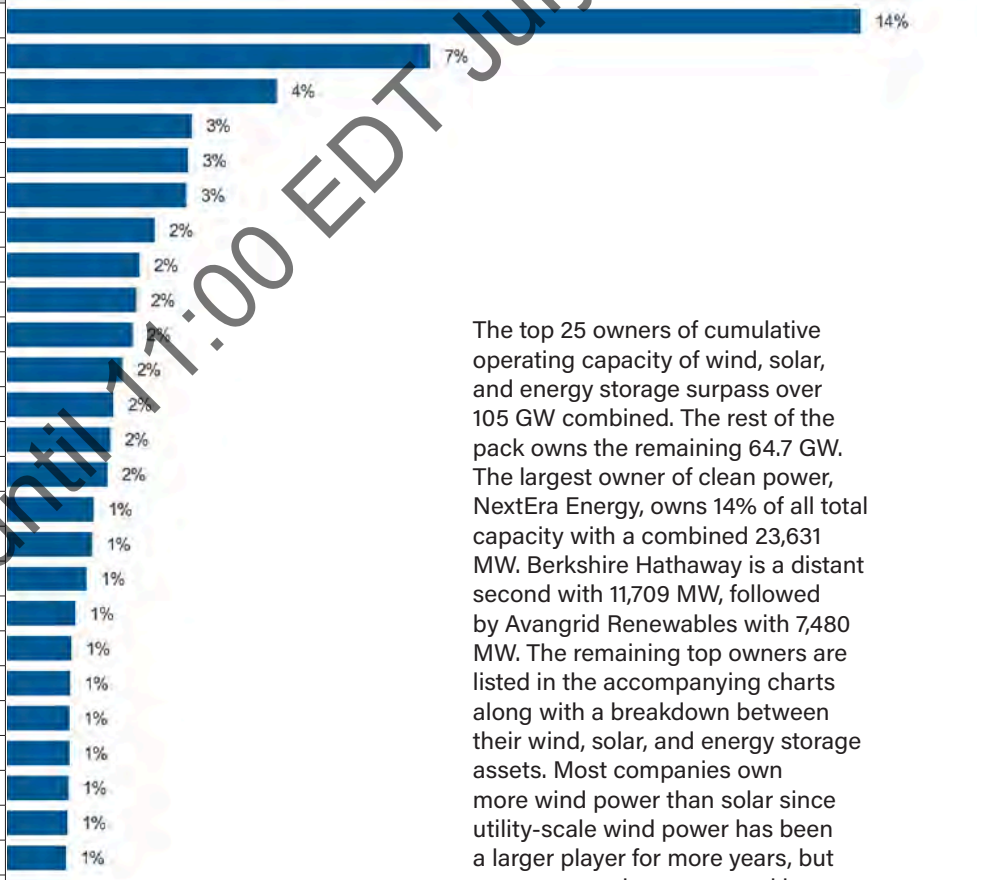
CLEAN POWER ANNUAL **2020**

Cumulative Clean Power Ownership

Top 25 owners of clean power plants own over 105 GW of operating capacity

Rank	Company	Wind	Solar	Storage	Total Capacity
1	NextEra Energy	18,148	5,339	144	23,631
2	Berkshire Hathaway Energy	10,085	1,622	2	11,709
3	Avangrid Renewables	7,369	111		7,480
4	EDP Renewables	4,999	137		5,136
5	Clearway	3,505	1,530		5,035
6	ENEL Green Power	4,385	586		4,971
7	RWE Renewables	3,966	117	10	4,093
8	EDF Renewables	3,179	513		3,692
9	Xcel Energy	3,600	4	1	3,604
10	Southern Company	2,017	1,465		3,482
11	Duke Energy	1,452	1,687	55	3,193
12	Invenergy	2,694	200	65	2,958
13	Brookfield Asset Mgmt	2,267	607		2,874
14	Consolidated Edison	423	2,357		2,780
15	Dominion	151	2,260		2,411
16	AES	1,140	1,154	66	2,360
17	ENGIE	1,862	360	4	2,226
18	Allitant Energy	1,893	6		1,899
19	Pattern Energy	1,809			1,809
20	Blackrock	1,746			1,746
21	Capital Dynamics	382	1,347	2	1,731
22	Ørsted A/S	1,693	37		1,730
23	Leeward Renewable Energy	1,716			1,716
24	ALLETE	1,679	10		1,689
25	John Hancock	1,515	123	18	1,656
	Other	**38,312**	**24,998**	**1,456**	**64,766**

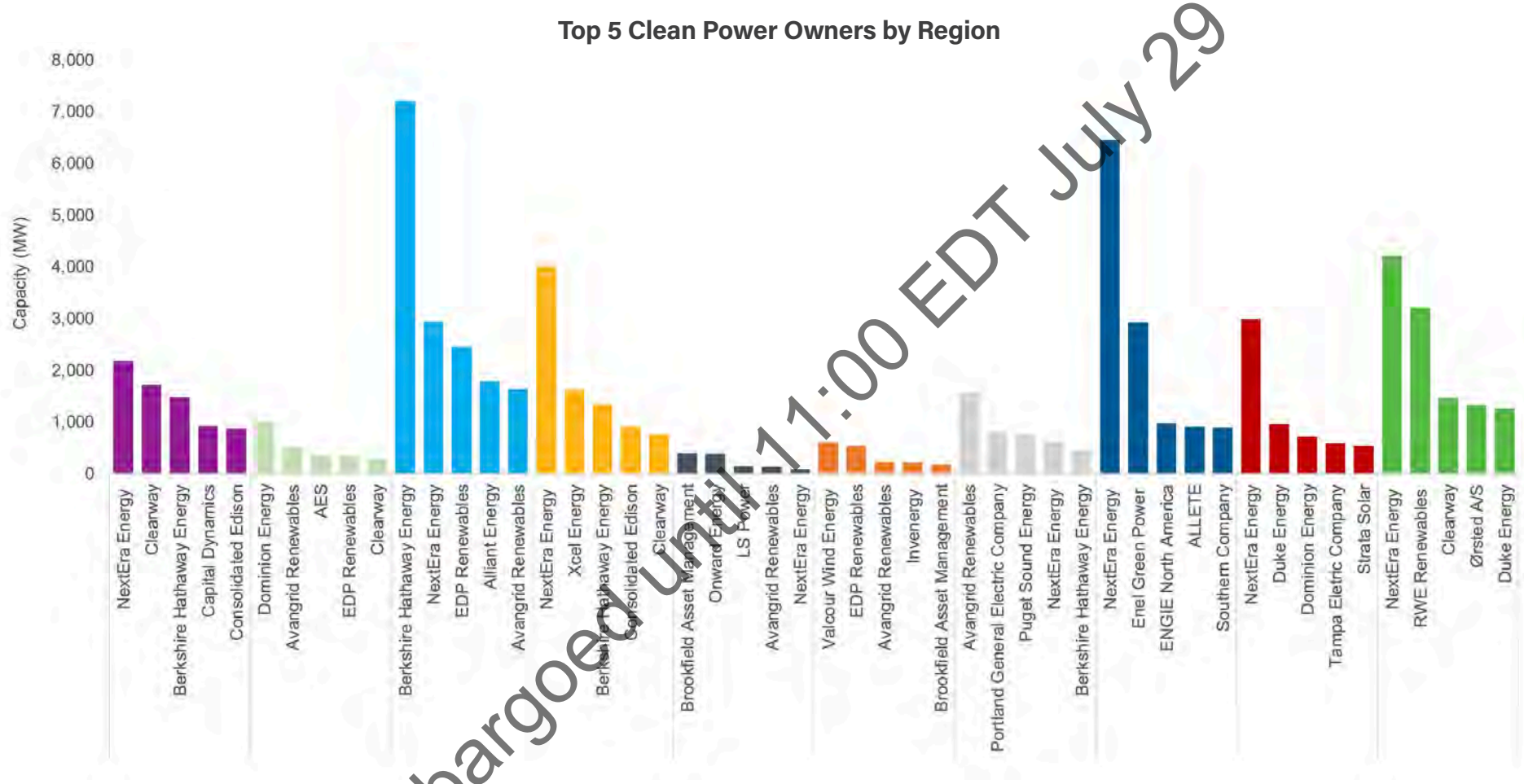
Cumulative U.S. Clean Power Capacity Ownership Market Share



The top 25 owners of cumulative operating capacity of wind, solar, and energy storage surpass over 105 GW combined. The rest of the pack owns the remaining 64.7 GW. The largest owner of clean power, NextEra Energy, owns 14% of all total capacity with a combined 23,631 MW. Berkshire Hathaway is a distant second with 11,709 MW, followed by Avangrid Renewables with 7,480 MW. The remaining top owners are listed in the accompanying charts along with a breakdown between their wind, solar, and energy storage assets. Most companies own more wind power than solar since utility-scale wind power has been a larger player for more years, but some owners have amassed large solar holdings including a few that own more solar than wind, such as Consolidated Edison, Dominion Energy, AES, and Capital Dynamics.

Top Owners Regionally

NextEra is the largest owner in most regions



Clean power project owners vary considerably in their choice of plant location and regional market. Regionally, NextEra Energy is the largest owner in Texas, the Plains, the Mountain West, and the Southeast, and is a top five owner in California, the Midwest, New England, and the Northwetst. NextEra is the only company with a first-place position in multiple regions.

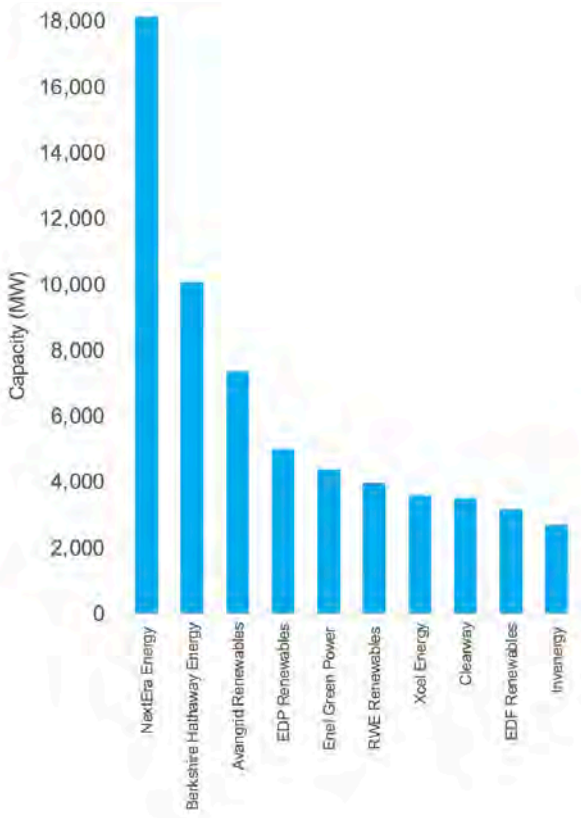
Berkshire Hathaway Energy's assets are primarily located in Iowa and Wyoming, Enel Green Power is concentrated in the Plains, and RWE Renewables is concentrated in Texas. Avangrid Renewables is present in many regions, but leads in the Northwest, while Clearway enters the top five ranking in California, the Mid-Atlantic, the Mountain West, and Texas.

Outside California and the Southeast, these regional rankings are largely underpinned by wind power capacity ownership; California rankings are a mix of wind and solar resources, while the Southeast is concentrated on solar given the paucity of wind in the region.

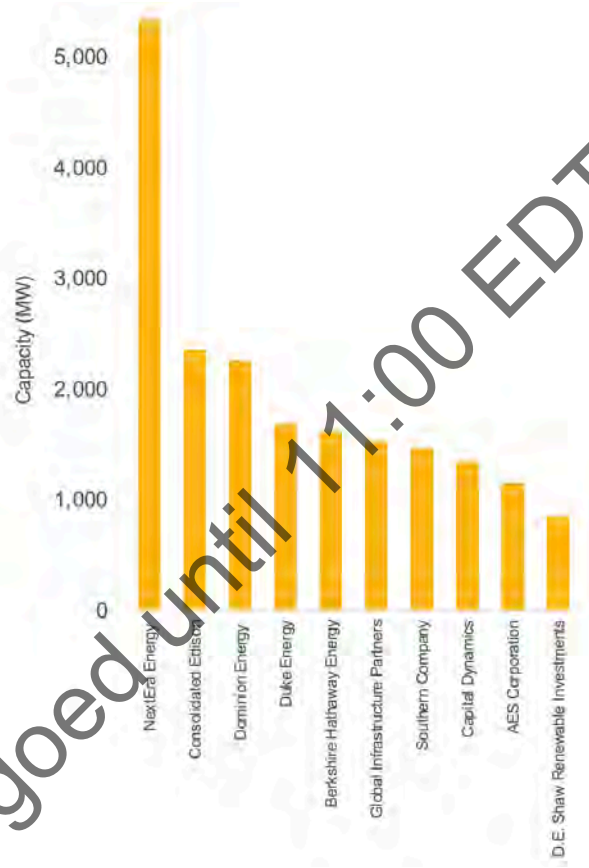
Top Owners by Technology

NextEra leads wind and solar ownership; LS Power is top battery storage owner

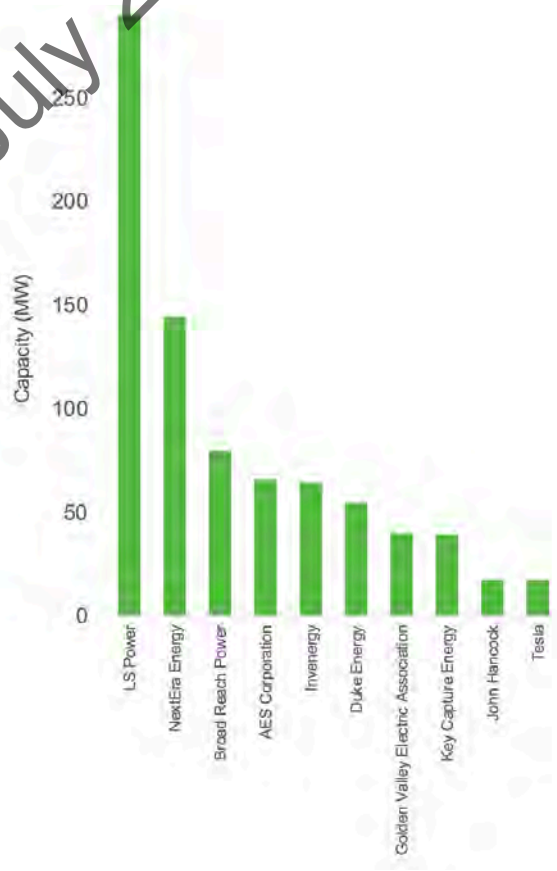
Top Wind Owners



Top Solar Owners



Top Battery Storage Owners



When assessing the top owners by technology, the rankings shift somewhat with NextEra still leading in wind and solar but surpassed in energy storage by LS Power. Top wind companies below NextEra and Berkshire Hathaway include the well-known developers with European lineage that played a big role in establishing a mature wind industry in the U.S. This includes Avangrid Renewables, EDP Renewables, Enel Green Power, RWE Renewables, among others.

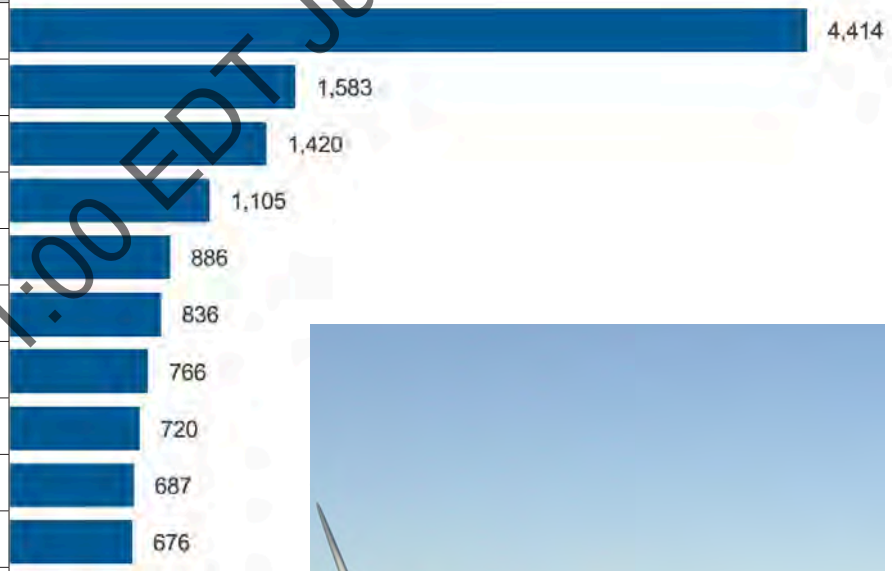
The top ranking by solar technology also shows the presence of some companies with all or most of their assets on the East Coast where solar resources and demand is strong and wind is relatively less competitive. These also include a greater regulated utility presence versus IPPs. Examples include Consolidated Edison, Dominion Energy, Duke Energy and Southern Company.

Owners of 2020 Clean Power Capacity

NextEra extended its dominance with leading additions in 2020

U.S. Clean Power Capacity Ownership Market Share, 2020

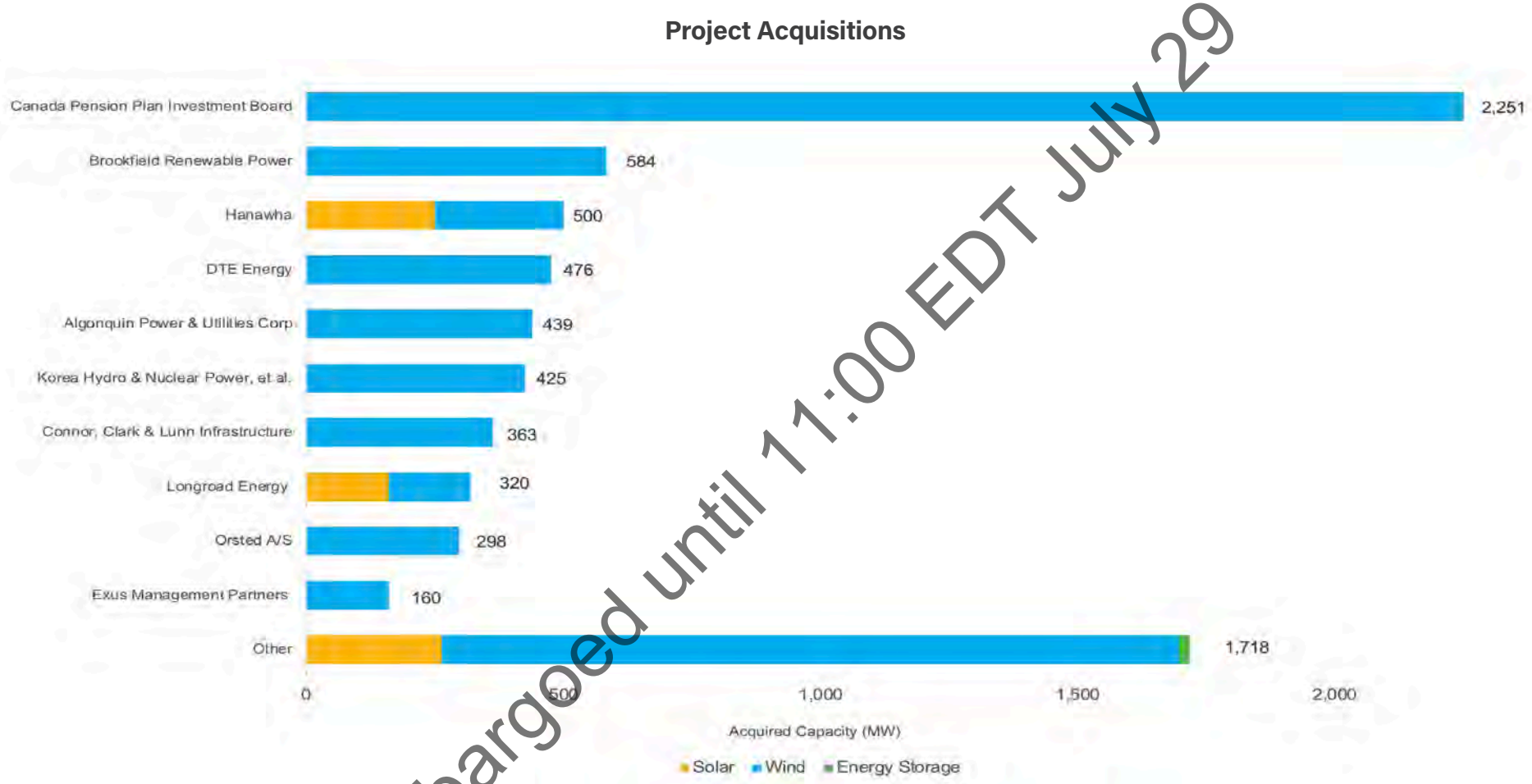
Rank	Company	Wind	Solar	Storage	Total Capacity
1	NextEra Energy	2,898	1,506	10	4,414
2	ENGIE North America	1,357	225	1	1,583
3	Xcel Energy	1,420			1,420
4	Berkshire Hathaway Energy	1,105			1,105
5	Enel Green Power	486	400		886
6	EDF Renewables	557	279		836
7	Clearway	569	197		766
8	RWE Renewables	720			720
9	Alliant Energy	684	3		687
10	Ørsted A/S	676			676
	Other	6,365	6,284	749	13,398



The largest owner of cumulative operating clean power capacity, NextEra Energy, was also the largest owner of new capacity brought online in 2020. It installed 4,414 MW, with 2,898 MW of wind, 1,506 solar and 10 MW storage. The remaining top developers were well below that capacity, as noted in the chart.

Clean Power Project Acquisitions in 2020

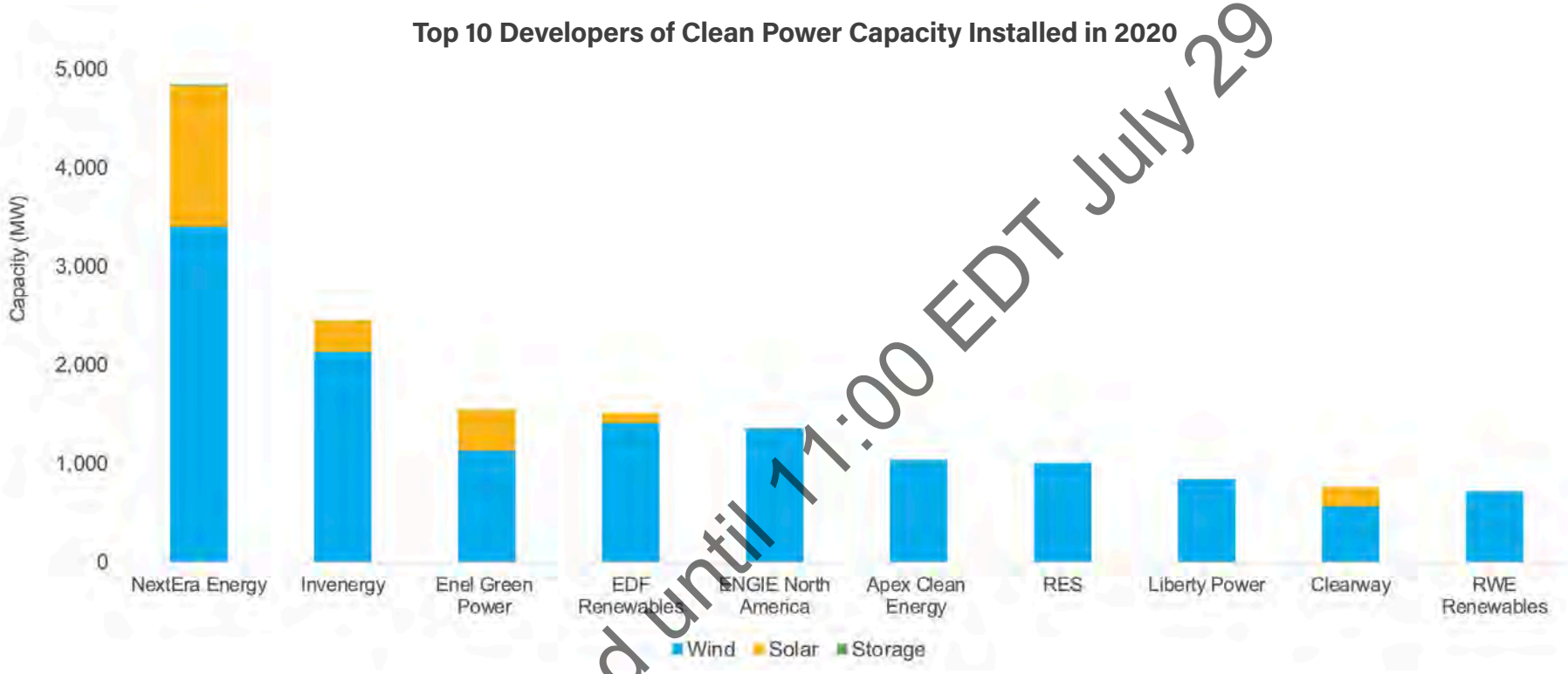
12.3 GW of clean power project capacity changed ownership hands in 2020



Each year major projects exchange ownership and 2020 was no exception. Approximately 12,336 MW of clean power project capacity was sold and acquired. The largest single transaction was the Canada Pension Plan Investment Board acquiring Pattern Energy and its 2,250 MW portfolio of operating projects. TerraForm Power also sold significant capacity of 1,009 MW between 584 MW sold to Brookfield Renewable Power and 425 MW to Korea Hydro & Nuclear Power, et al. In many of these cases, large companies with significant financial means—often not experts in project development—acquire projects as financial investments. Large wind and solar plants are relatively low-risk investments with proven long-term predictable revenue returns.

Top Developers of Clean Power Capacity Installed in 2020

Top 2020 ranking of owners vs top developers highlights different company core competencies and financial strategies



In many cases the largest developers of clean power capacity commissioned each year are also the largest owners of that capacity. But just as often the companies that own new project capacity were not the main developers behind that project and instead acquired it at Commercial Operation Date (COD). Every company has its own range of reasons and strategies for whether they develop projects for self-ownership or to sell off or if they prefer to buy completed projects brought to fruition by other developers.

Xcel Energy, for example, like many other regulated utilities, prefers to acquire projects that are developed by other companies. This is common behavior with regulated utilities that do not have the specialized core competency to undertake the lengthy development process. They pay a premium for a completed project and the developer behind the project secures profit margin to reward their often-lengthy development efforts.

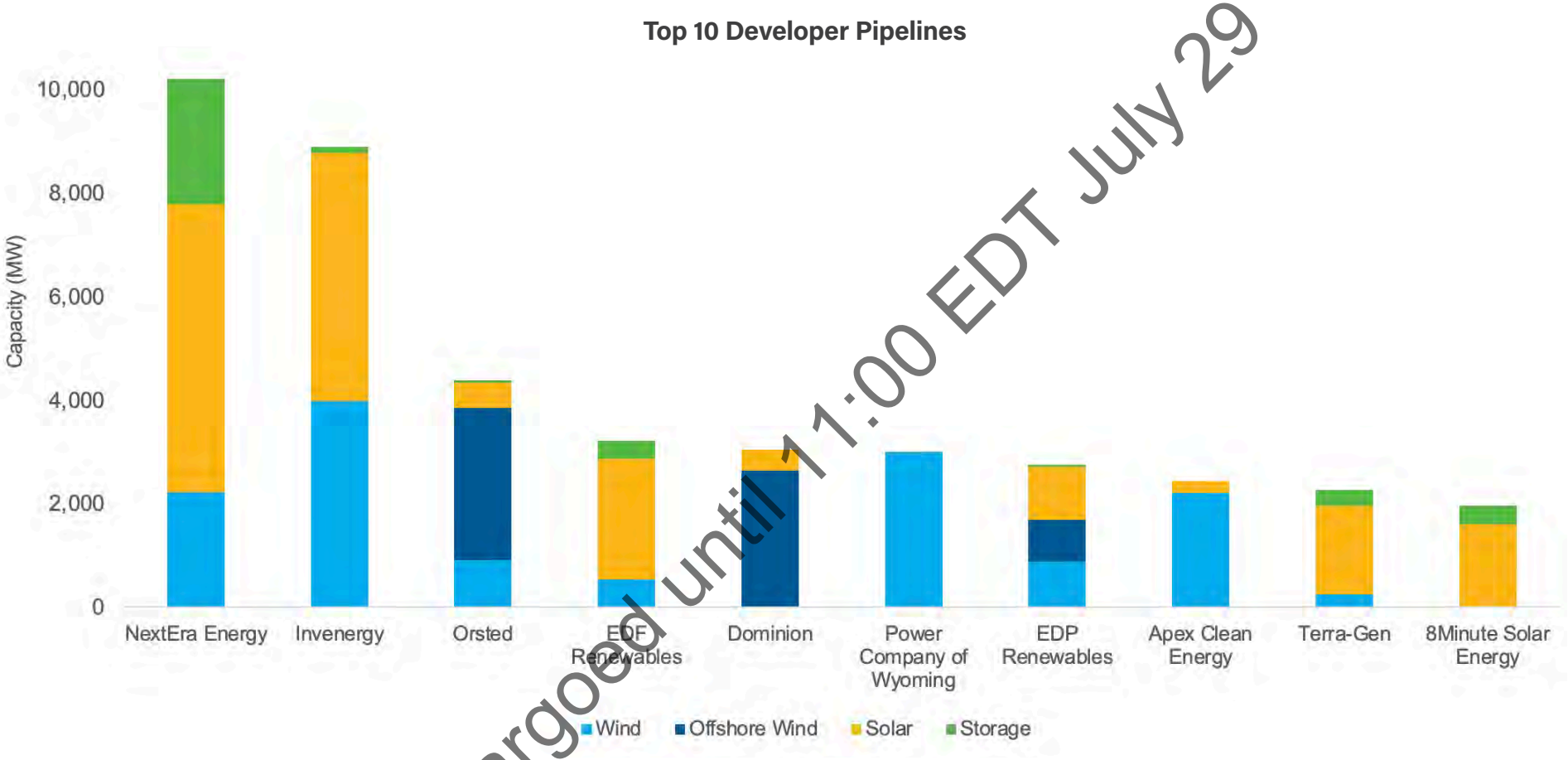
Likewise, Berkshire Hathaway is not the developer behind the 1,105 MW of new wind brought online under its ownership in 2020. Berkshire Hathaway is a large diversified financial firm with significant motivation and track record owning clean power projects, but chooses to acquire most of its clean power assets at COD.

Companies on the list of top developers but not top owners in 2020 have the core competencies and patience for the lengthy development process and often sell completed projects at COD. Examples include Apex Clean Energy and RES Americas.

Different companies also naturally have different financial situations and different appetites for project ownership and make decisions to own and operate based on their unique financials, ability to monetize project-related tax credits, etc.

Largest Developer Pipelines

NextEra and Invenergy lead developer rankings



ACP tracks developer pipelines, which is defined as total capacity of projects actively under construction or in advanced development with a signed PPA, equipment order, or announcement from a regulated utility. This provides insight of upcoming projects. Many of the expected developers are present in this ranking, however there are some companies outside the usual developer rankings. This includes the Power Company of Wyoming with 3,000 MW of wind in advanced development, and 8Minute Solar Energy with 1,880 MW of wind. No large offshore projects have yet started construction but companies with advanced offshore development are joining this list of top developer pipelines. This includes Ørsted with 4,386 MW under PPA and Dominion Energy with 2,640 under a rate base agreement. Another notable data takeaway is NextEra Energy with almost as much energy storage in advanced development as wind.

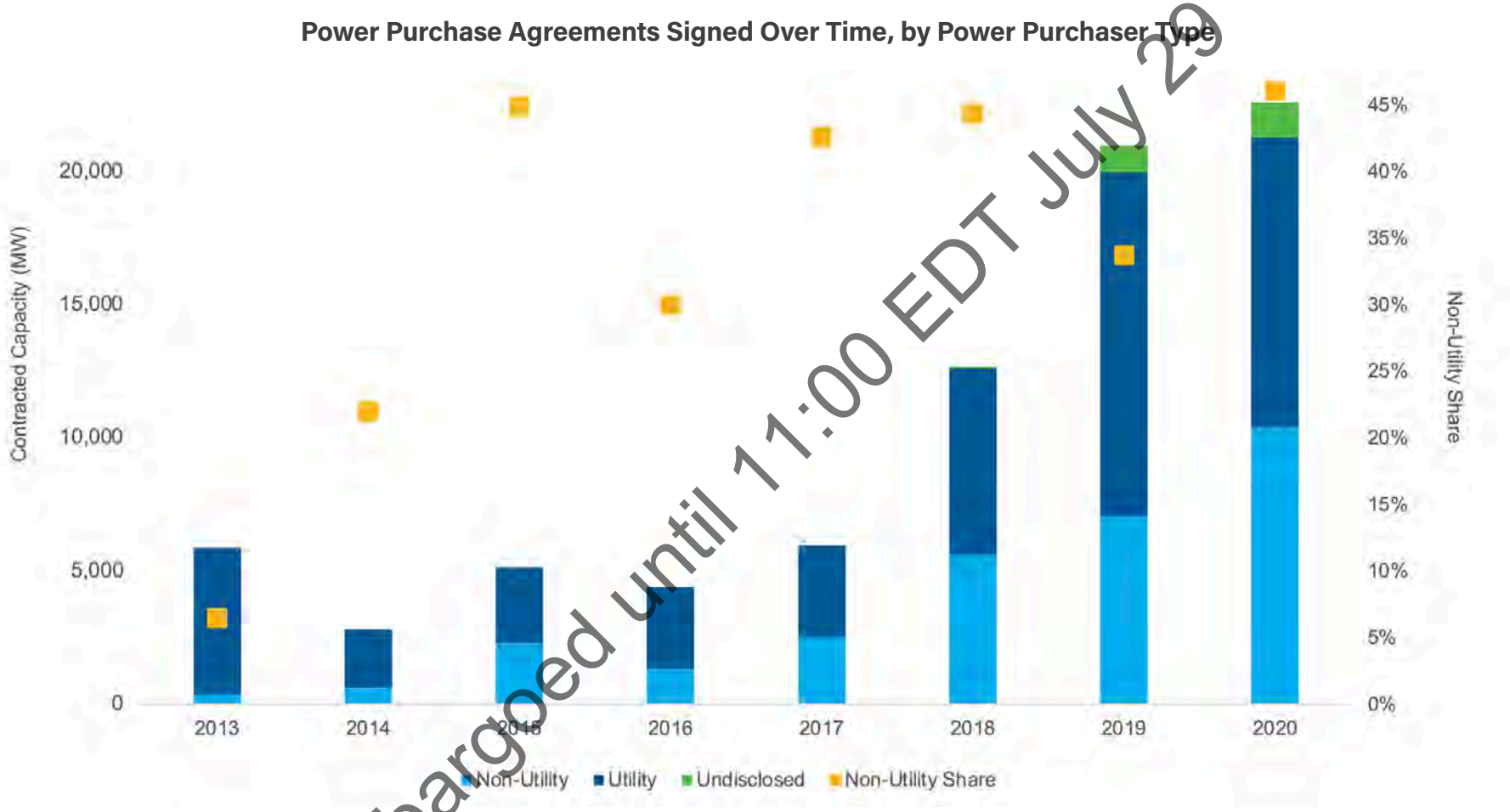
Clean Power Procurement

AMERICAN CLEAN POWER

CLEAN POWER ANNUAL **2020**

Power Purchase Agreement Announcements by Buyer Type

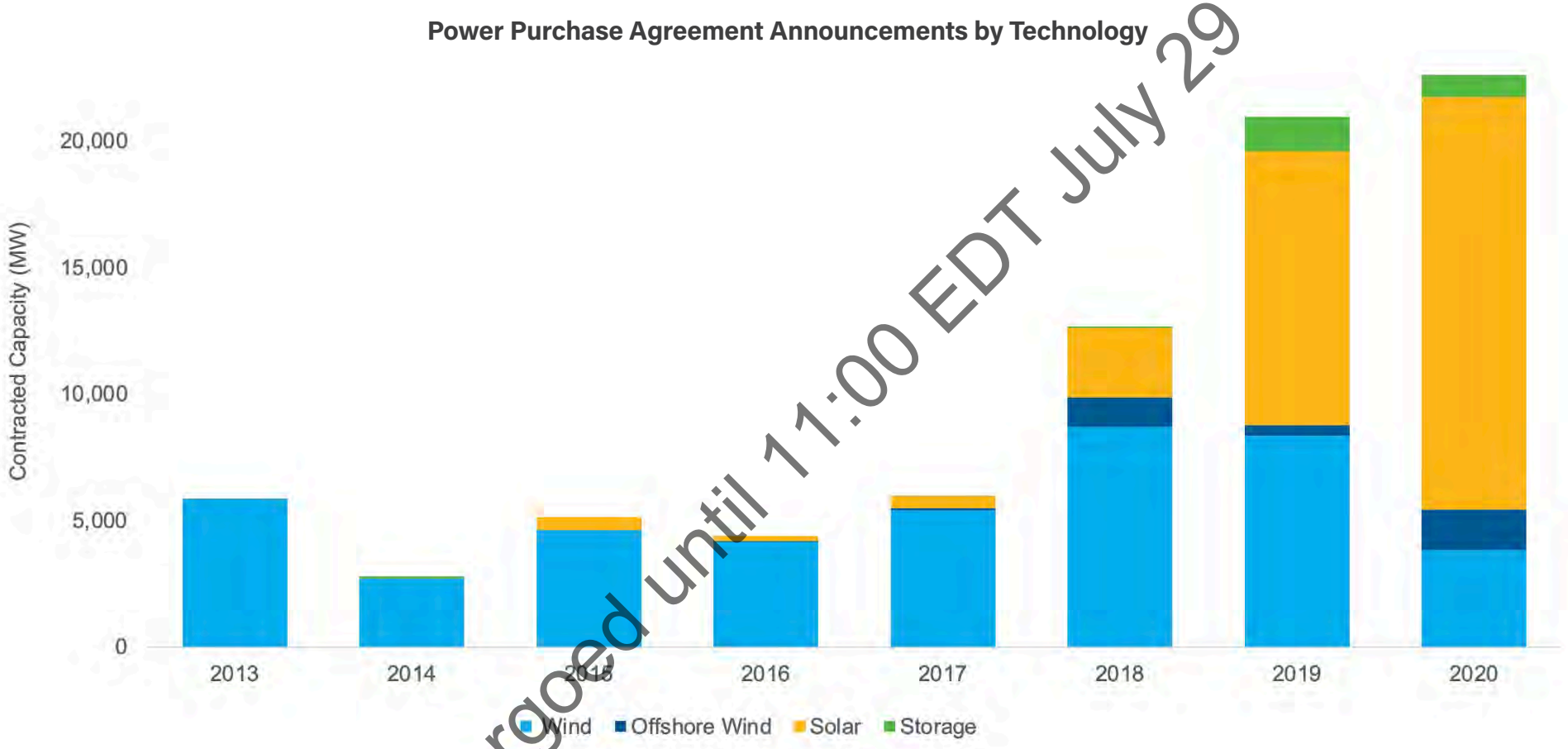
Utility and C&I customers both contracted over 10 GW of new clean power in 2020



Long-term power purchase agreements (PPAs) continue to be the preferred offtake for wind, solar and storage projects. Last year witnessed a record amount of new clean power purchase announcements as utilities and non-utilities announced contracts for 22,610 GW. Agreement announcements grew 8% over the 20,980 MW announced in 2019. Utilities slightly led the way, signing PPAs totaling 10,854 MW, representing 48% of total PPAs. The non-utility sector almost reached an equal level with 10,417 MW (46%). This is up from 34% the year before and 44% in 2018. Non-utility purchasers are primarily corporate customers.

Power Purchase Agreement Announcements by Technology

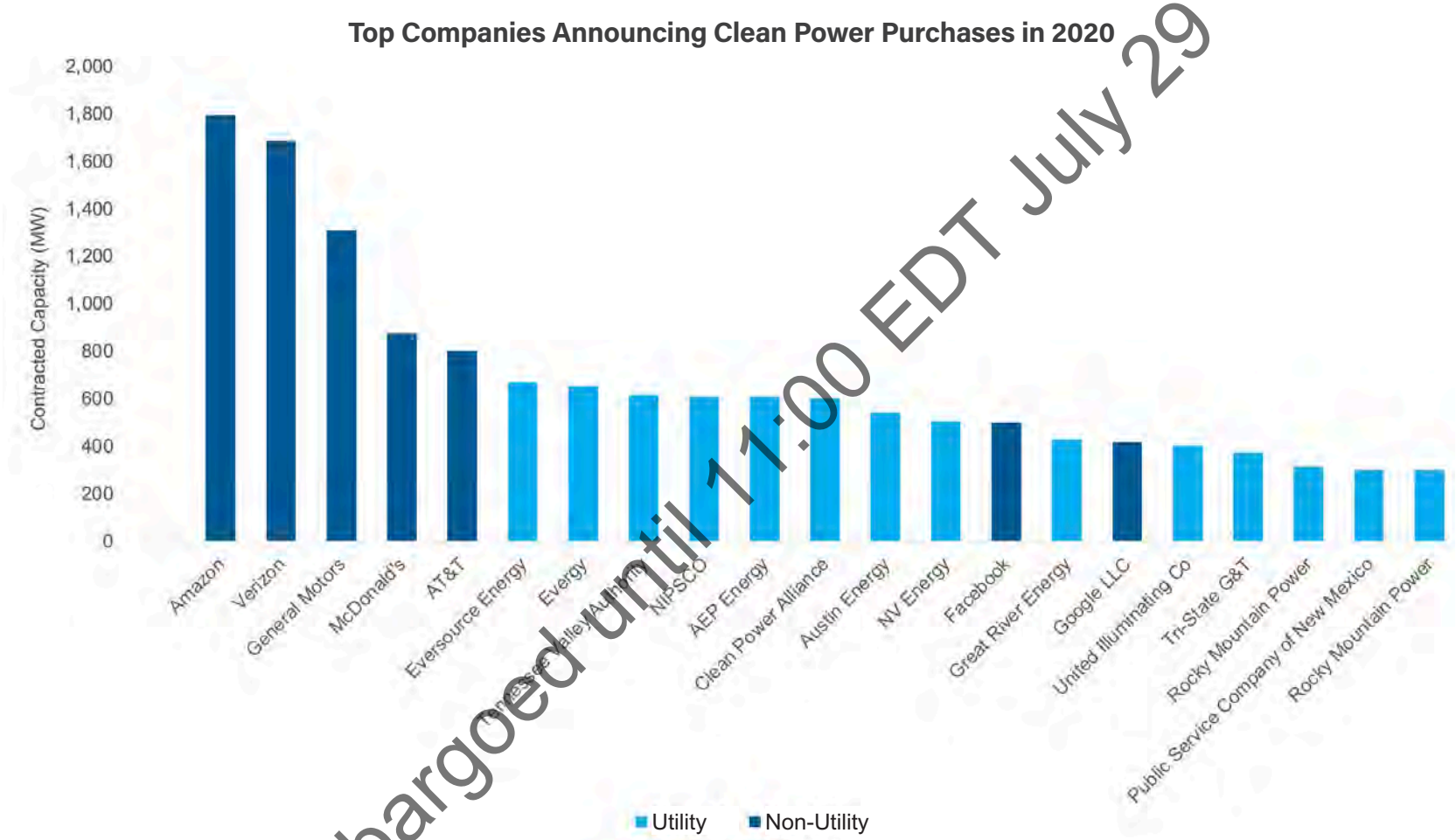
Surge in utility solar PPAs underpins growth in purchase announcements



For the second straight year, more PPAs were announced for utility solar than for wind. Solar PPA announcement volume grew 50% from 2019 to top 16,298 MW signed in 2020. By comparison, land-based wind saw 3,830 MW of contracts announced and offshore wind announcements totaled 1,608 MW. Energy storage also saw 875 MW signed in 2020, down from 1,369 MW signed in 2019.

Top Companies Announcing Clean Power Purchases in 2020

Amazon top non-utility purchaser in 2020; Eversource Energy top utility purchaser



The top five companies signing clean power purchase agreements in 2020 were all non-utility buyers. Amazon led all corporate buyers with 1,795 MW, followed by Verizon (1,685 MW), General Motors (1,309 MW), McDonald's (2,079 MW), and AT&T (1,708 MW). Eversource Energy was the largest utility buyer with the announcement of PPAs for offshore wind projects Park City Wind and Mayflower Wind.

Overall, 14 different buyers announced clean power purchases of 500 MW or more in 2020.

Clean Power Buyers

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Top Clean Power Purchasers

Xcel and Berkshire are top clean power purchasers

Demand for clean power has broadened significantly over the last decade as an increasingly diverse group of customers seek to procure wind and solar power. Investor-owned utilities are the largest purchaser group, followed by municipalities and cooperatives. Relatively new to the scene are corporate buyers who are increasingly turning to clean energy sources to power their business operations.

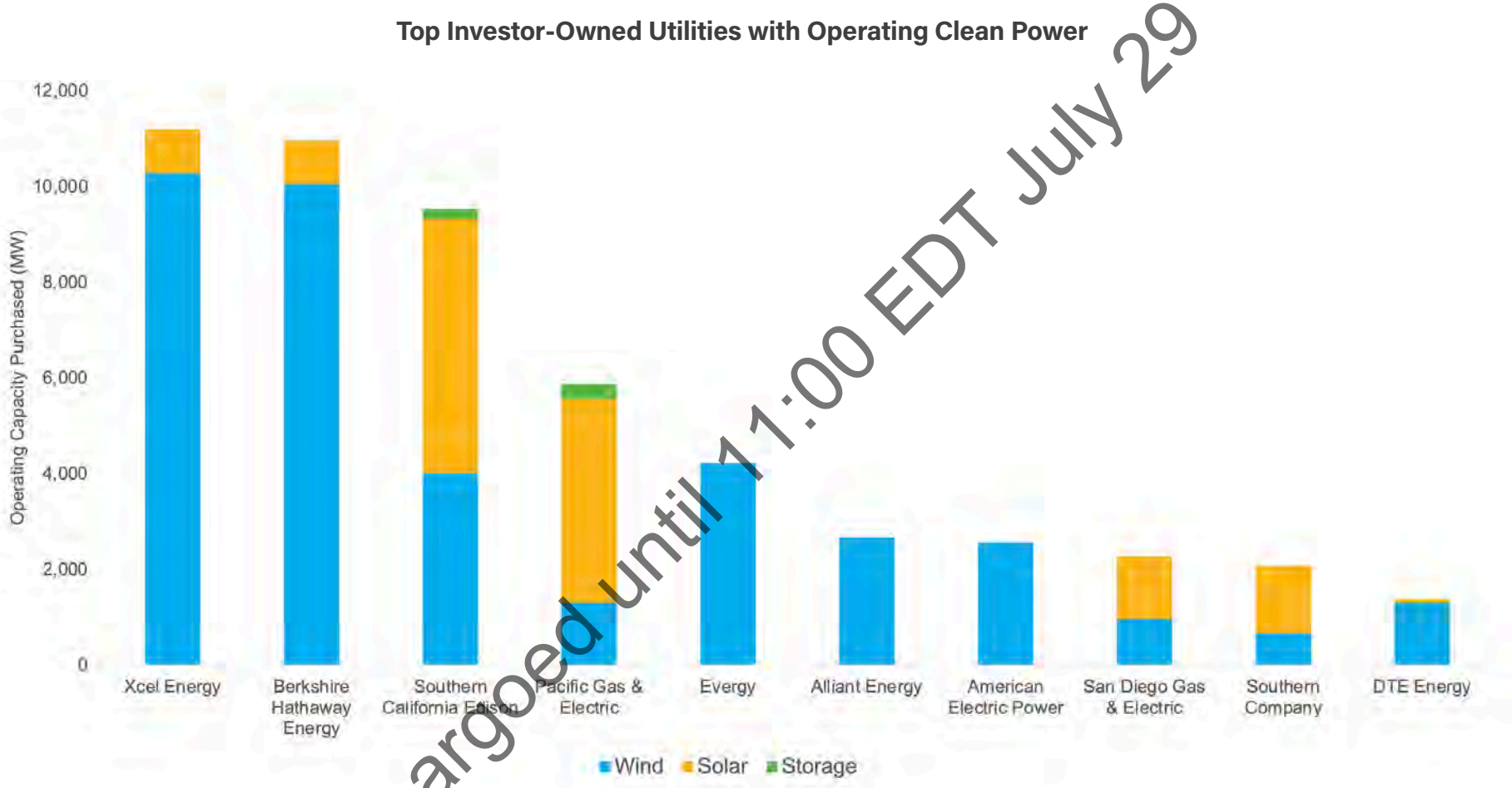
Xcel Energy and Berkshire Hathaway Energy are the two largest clean power purchasers based on power capacity operating at the end of 2020. With just over 11 GW contributing to its electricity mix across the Midwest and Mountain West, Xcel Energy delivers a increasingly clean energy to its customers. The same goes for Berkshire Hathaway Energy, which has just shy of 11 GW on its system. Southern California Edison rounds out the top three.

While no corporate buyer is on the top 10 list of clean power purchasers in 2020, the rush of contracts signed over the last couple years all but guarantee one or more breaks onto the list once those projects reach commercial operation.

The top 10 purchasers of clean power are responsible for roughly 30% of all wind, solar, and battery storage in operation.

Top 20 Investor-Owned Utilities with Clean Power on System

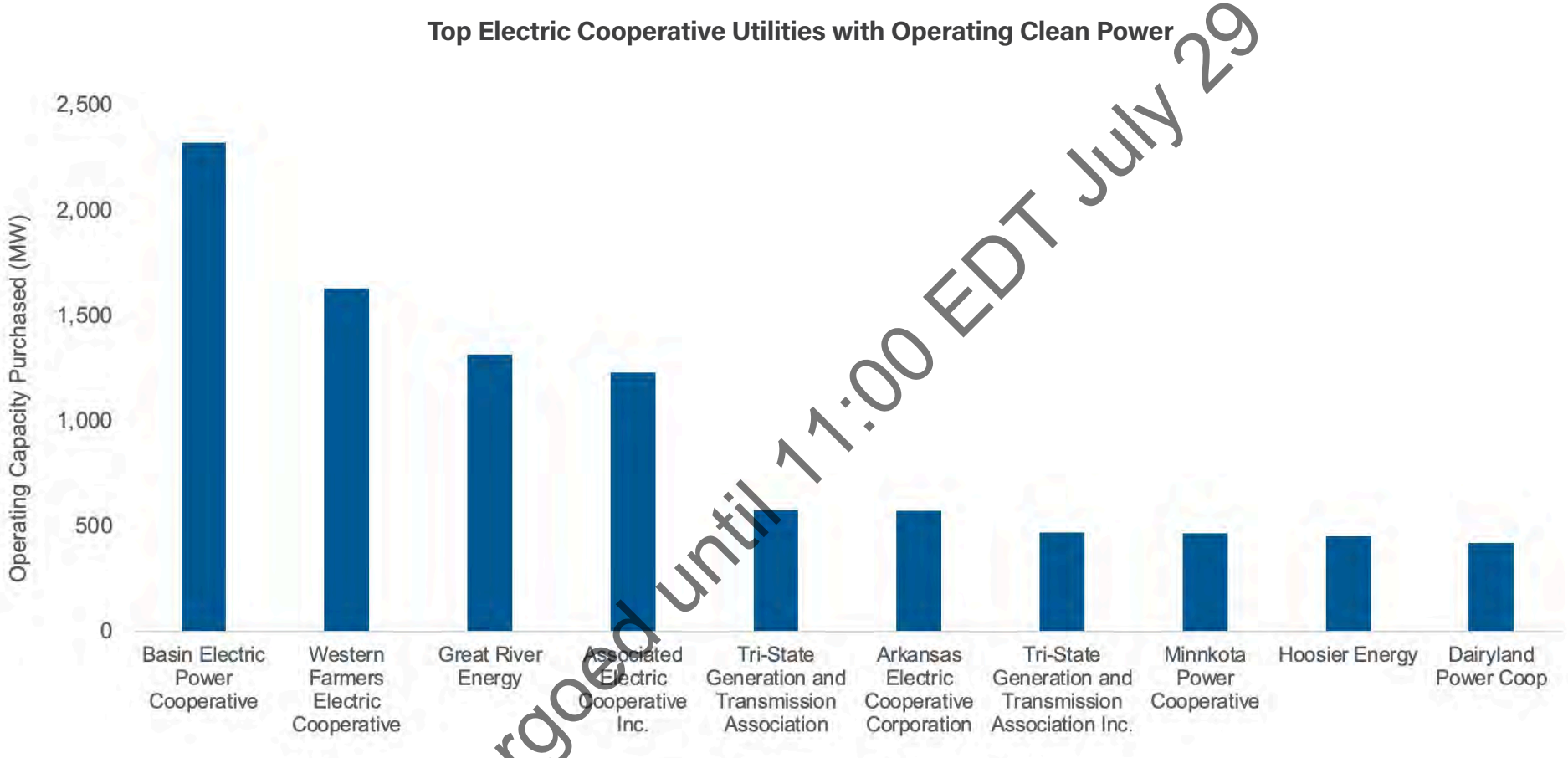
Xcel and Berkshire utilities have the most wind, solar, and storage on their system



Investor-Owned Utilities (IOUs) were the earliest adopters utility-scale clean power generation so naturally they would have the largest cumulative capacity under operation. For the top 5 largest buyers, Xcel Energy takes the lead with 11,205 MW, followed by Berkshire Hathaway Energy (10,962 MW), Southern California Edison (9,522 MW), Pacific Gas & Electric (5,870 MW), and Evergy (4,217 MW). While both Southern California Edison and Pacific Gas & Electric have sizable supplies of wind, their main clean power resource is solar.

Top 10 Electric Cooperatives with Clean power on System

Basin Electric remains the largest cooperative with clean power



At least 55 electric cooperatives owned or purchased clean power capacity as of the end of 2020, totaling nearly 13,000 MW.

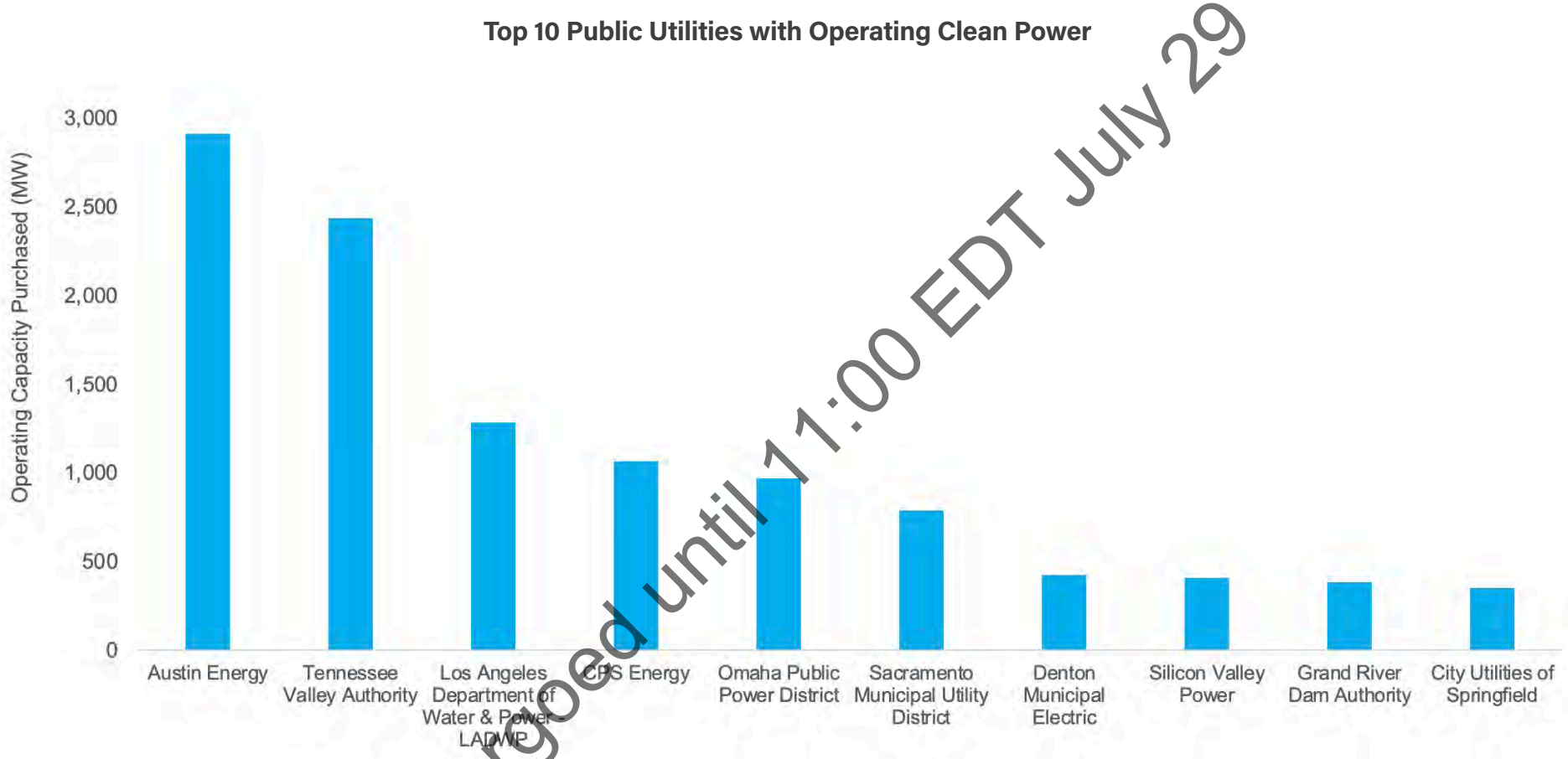
Basin Electric Power Cooperative with 2,320 MW continues to have the most on its system among electric cooperatives.

It primarily serves load in windy North Dakota, so wind power is almost entirely its clean energy portfolio.

The remaining top five in order are: Western Farmer's Electric Cooperative, Great River Energy, Associated Electric Cooperative Inc., and Tri-State Generation and Transmission Association. The combined top 10 electric cooperatives procure over 9,446 MW of clean power.

Top 10 Public Utilities with Clean Power on System

Austin Energy tops list of public utilities, but recent TVA purchasers are propelling it to the top



More than 80 public power utilities and public utility districts own or contracted clean power by the end of 2020, totaling almost 16 GW of capacity. The top 10 alone represent over 11,283 MW of capacity. Austin Energy surpasses TVA to claim top clean power public utility with nearly 3 GW of clean power capacity surpassed the previous leader Tennessee Valley Authority. They are followed by Los Angeles Department of Water & Power, CPS Energy and Denton Municipal Electric. The total top 10 public utilities represent 9,836 MW of clean power capacity.

Top C&I Purchasers of Clean Power

The top 10 corporate purchasers of clean power exceed 20 GW of capacity

Large U.S. corporations are also very large buyers of clean power capacity as renewable energy fits with their corporate sustainability and de-carbonization goals, and in many cases has the added benefit of being cost competitive with other generation procurement options.

By the end of 2020, the top 5 Commercial and Industrial (C&I) buyers of clean energy were Amazon (3,265 MW), Google (3,152 MW), Facebook (3,111 MW), AT&T (2,079 MW) and General Motors (1,708 MW), based on total amount of clean energy contracted.

Note: Includes both operating and announce projects

Economic Benefits

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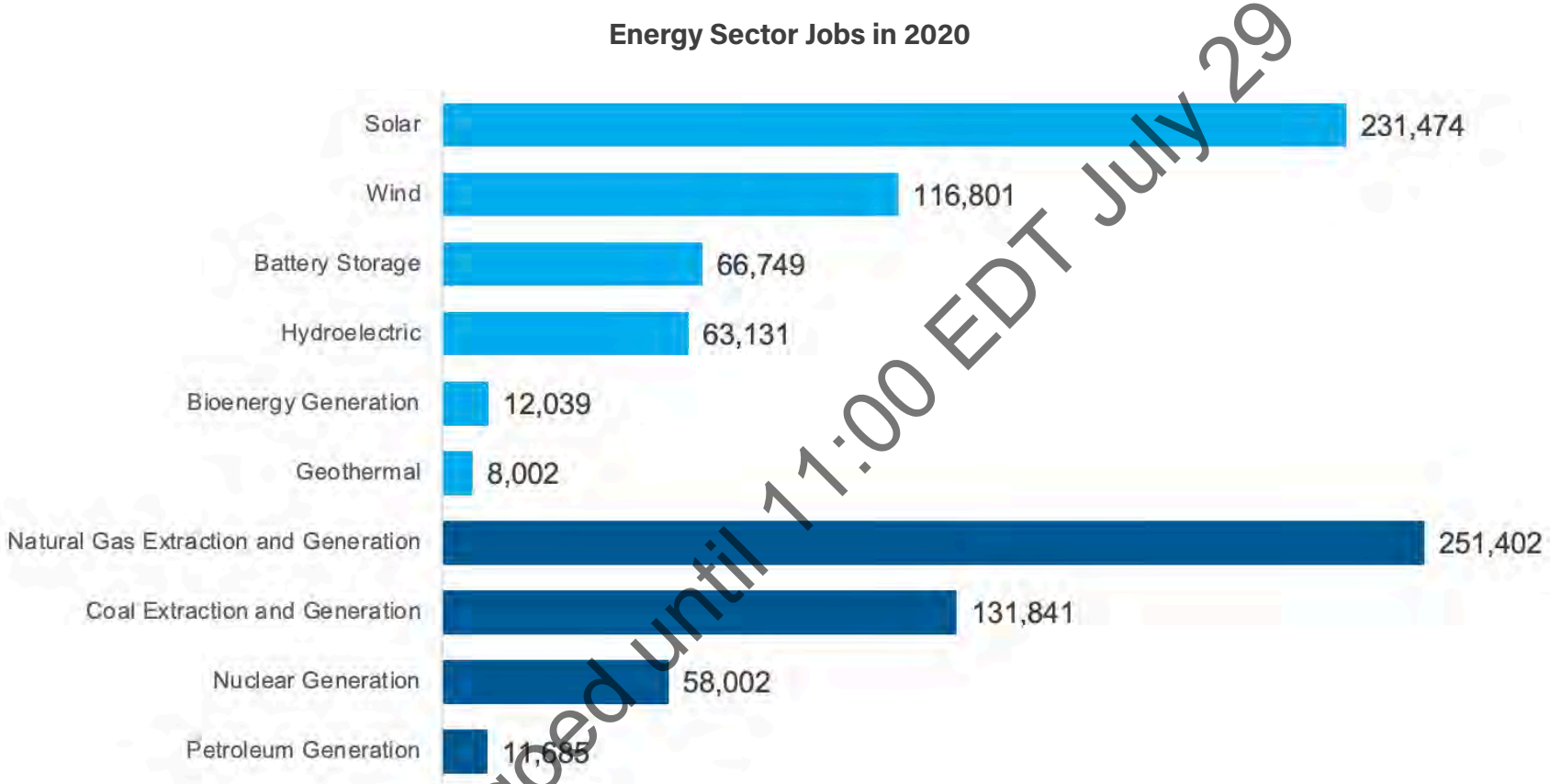
Clean Power Jobs in 2020

Wind, solar, and energy storage sectors employed 415,000 workers in 2020



According to BW Research and ACP's Clean Energy Labor Supply 2021 report, wind, distributed and utility-scale solar, and battery storage sectors employed over 415,000 workers at the end of 2020 supporting project development and operations, construction, maintenance, manufacturing, and other supply chain activities.

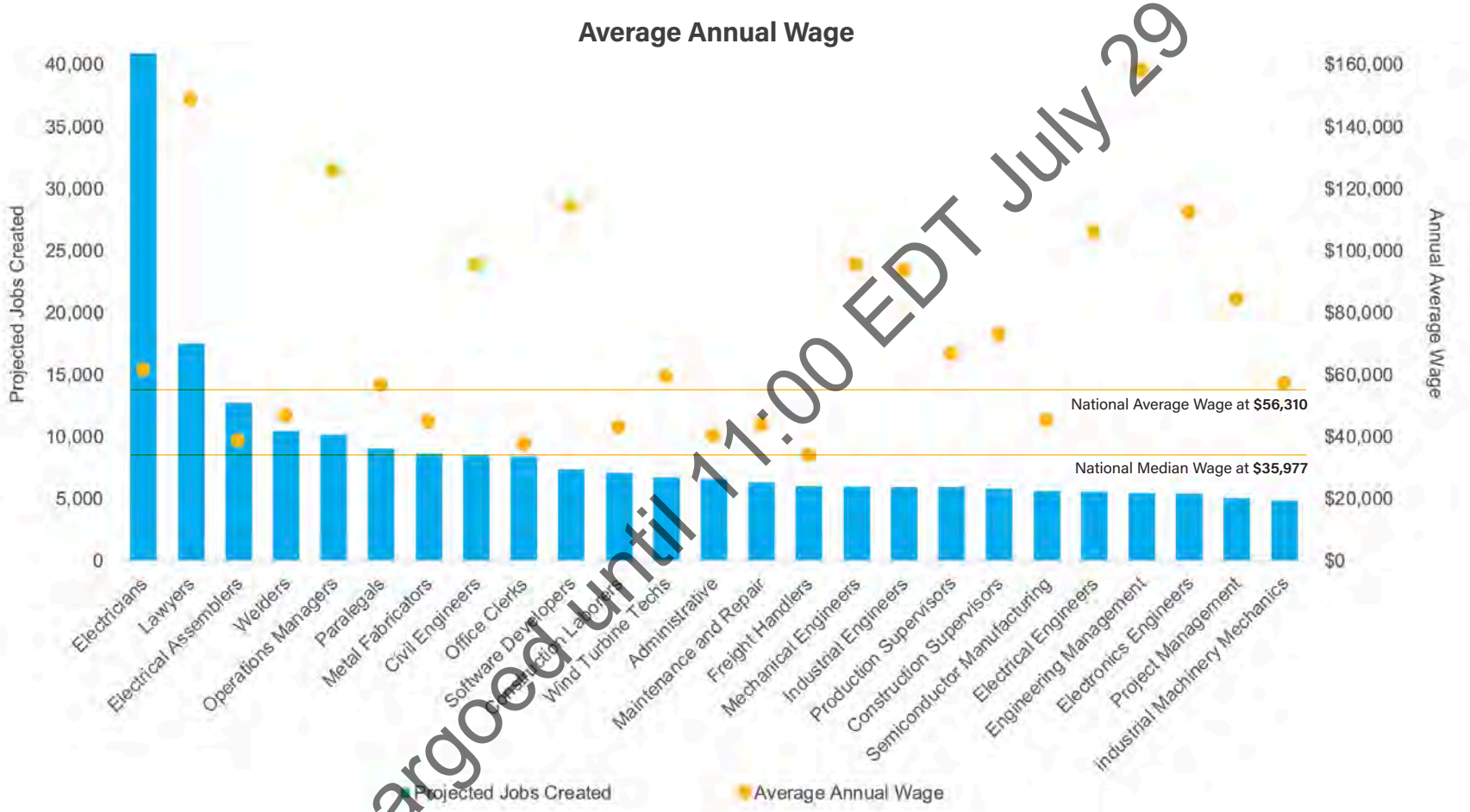
The solar sector makes up most of clean power employment with 231,474 estimated majority-time workers. The wind sector employed 116,801 workers in 2020, while battery storage employed 66,749. These estimates represent direct employment.

There are currently more workers employed by U.S. clean power than in the coal extraction and generation, natural gas extraction and generation, and petroleum generation sectors combined.

Source: 2021 USEER. Solar includes majority-time utility-scale and distributed solar employment.

Projected Occupation Growth and Wages

Generating 50%–70% of U.S. electricity from renewables would create 5–6 million job-years



Clean power sector employment is expected to grow significantly in coming years, widening the gap between clean power and traditional fossil fuel electricity generation sectors. This trend is expected to continue, with the potential for even larger growth in clean power employment as the country looks to further decarbonize the power sector.

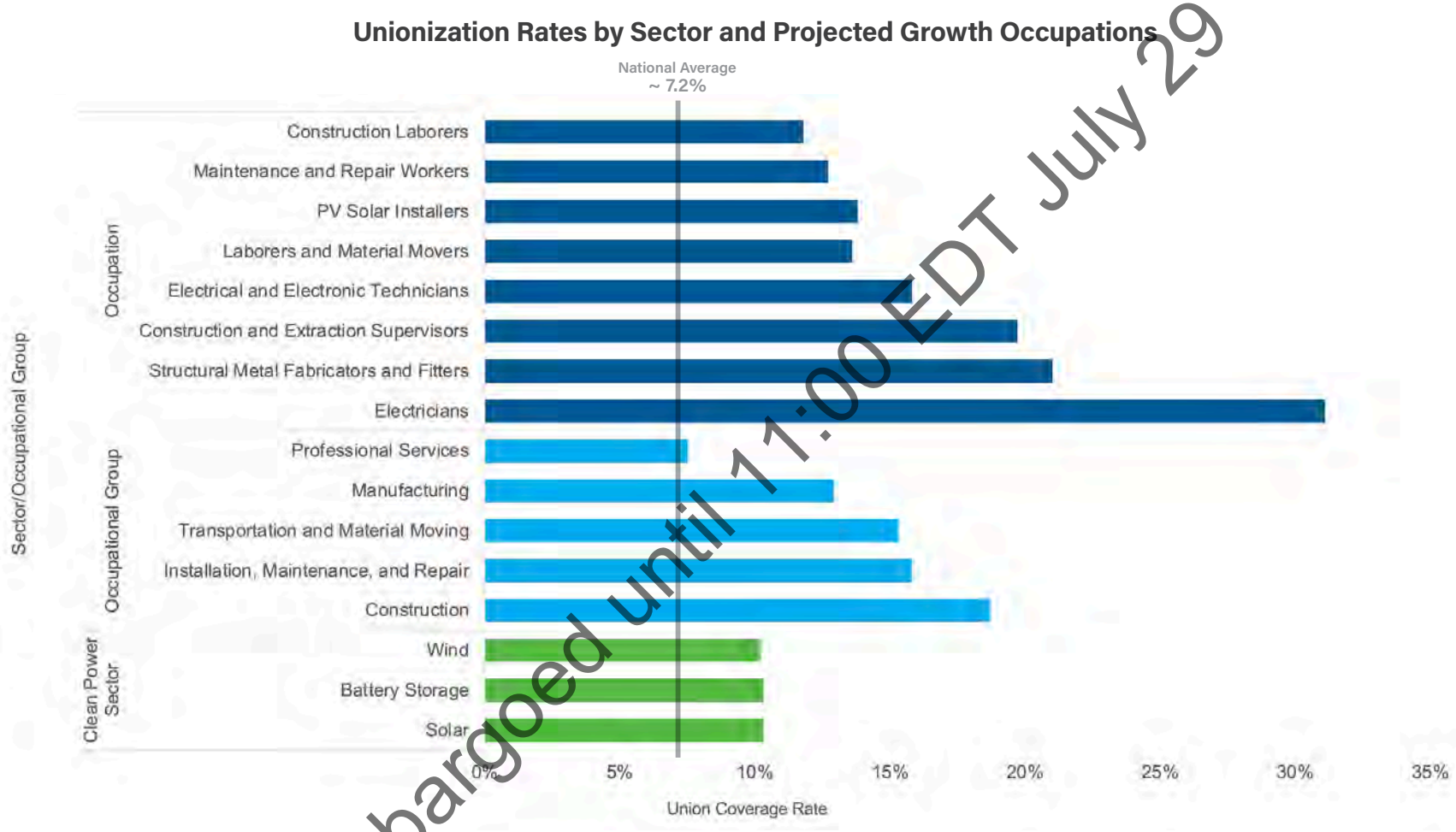
According to the 2021 Clean Energy Labor Supply report co-authored by BW Research and ACP, deploying enough clean power capacity to generate 50% - 70% of U.S. electricity from renewables would create 5 – 6 million job-years across the offshore and land-based wind, distributed and utility-scale solar, and battery storage sectors over the next decade.

Wind turbine technicians and PV solar installers, currently the first and third fastest-growing occupations, respectively, according to the U.S. Bureau of Labor Statistics, are expected to grow even faster than before as wind and solar deployment rises above 50% penetration.

Source: ACP, BW Research

Unionzation Rate By Sector and Projected Growth Occupations

Unionization rates across the wind, solar, and battery storage sectors are above the national private sector average



Unionization rates across the wind, solar, and battery storage sectors sit at or above 10.2%, compared to the national private sector average of 7.2%. Construction (18.7% unionization) and manufacturing (12.9%) are expected to see significant job growth.

Within these professions, individual occupations such as electricians (31.1% unionization) and structural metal fabricators and fitters (21.0%), both of which will be in high demand, have some of the highest unionization rates across the country.

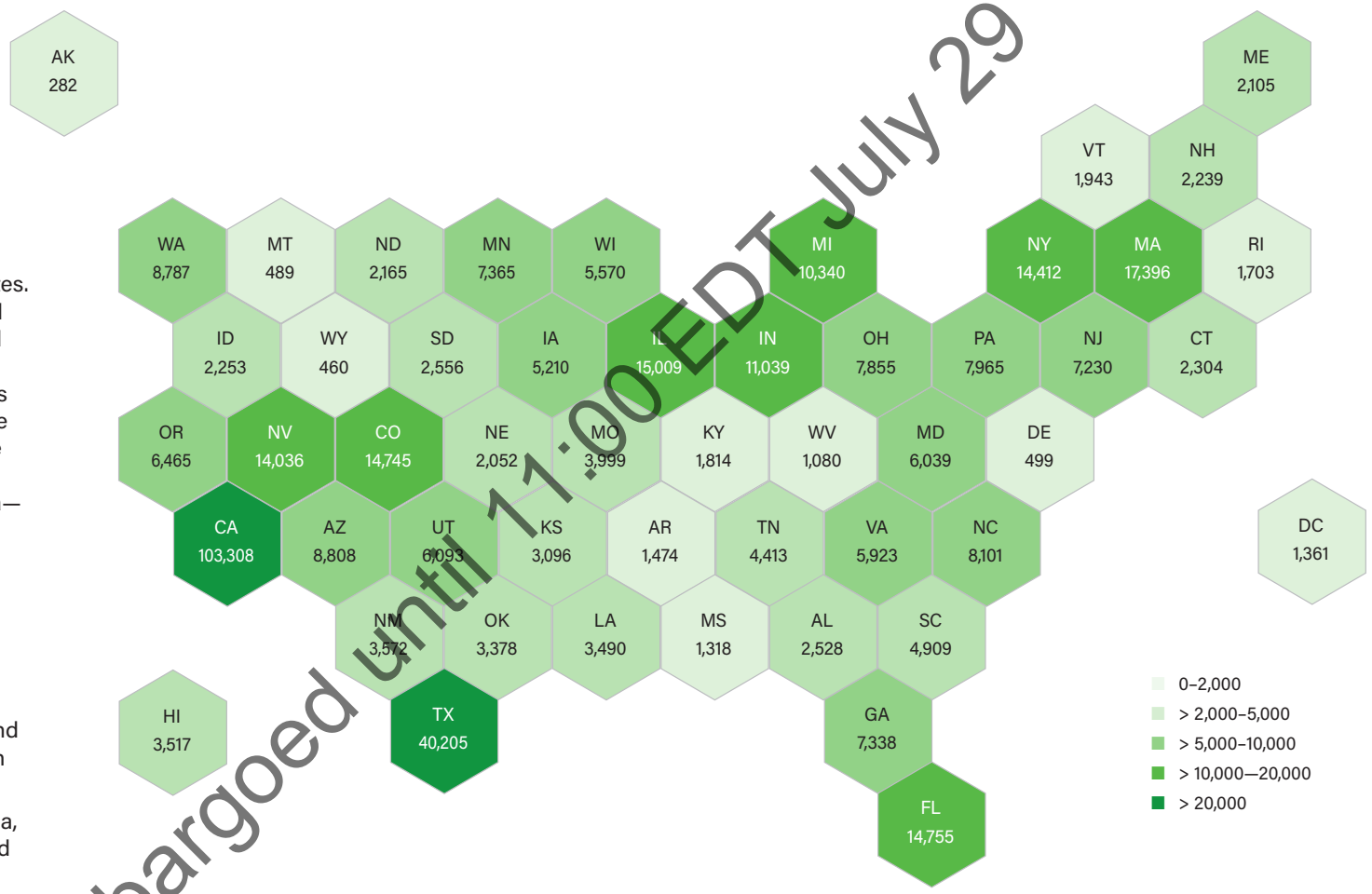
Clean Power Jobs in 2020 by State

Clean power employs workers in all 50 states

The clean power workforce is spread across the country, in politically red states and blue states. While jobs are often concentrated in states with high solar and wind resources, such as California and Texas, clean power employment is distributed fairly evenly across the states on a per capita basis. More than a third of total solar industry employment is found in California—roughly 83,000 jobs.

As a proportion of total state employment, solar employment in California is comparable to many other states, including Hawaii, Nevada, Vermont, Utah, Massachusetts, and New Mexico. Texas hosts roughly 22% total wind energy employment, or more than 25,400 jobs.

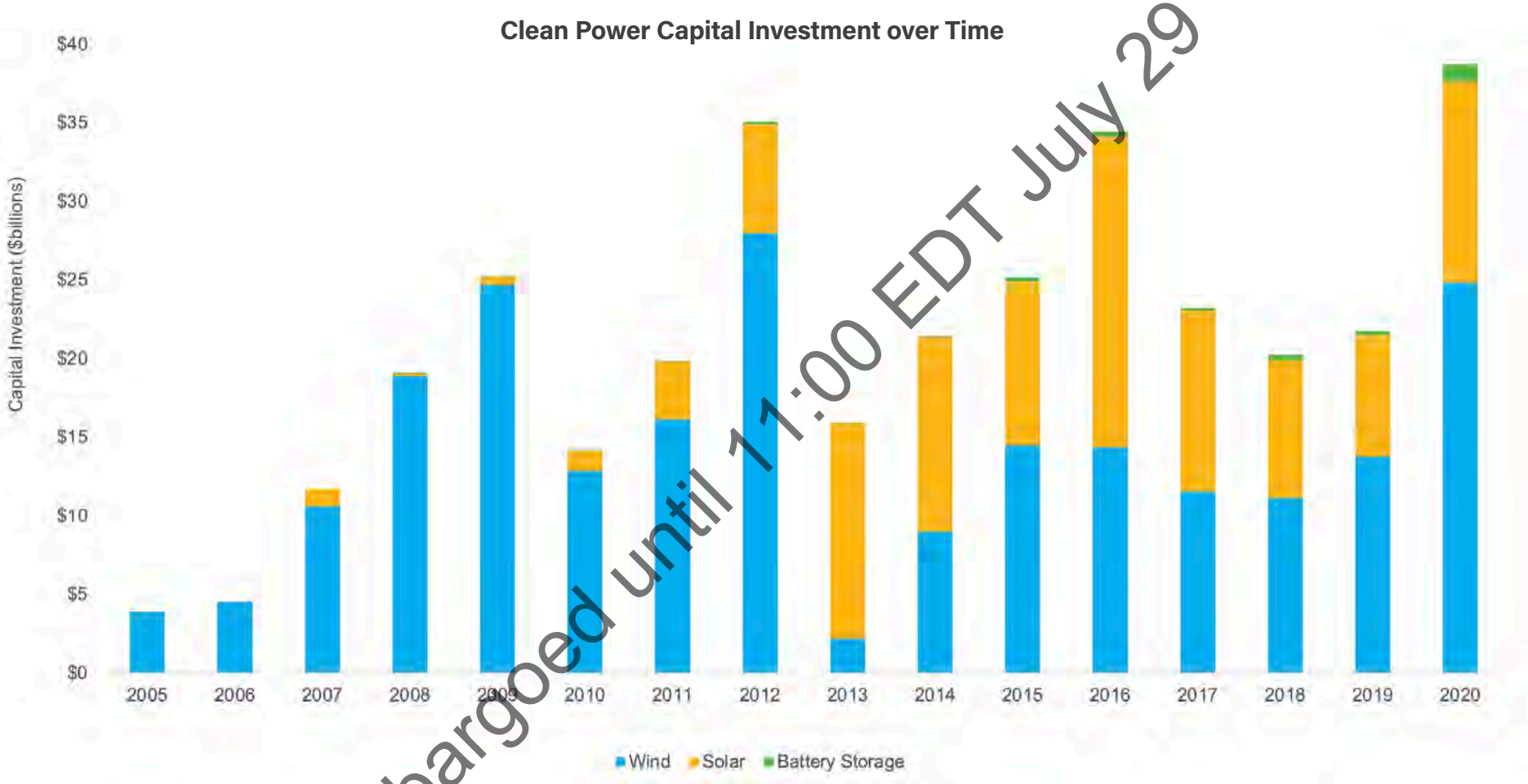
However, per capita, South Dakota, North Dakota, Colorado, Iowa, and Indiana have a greater share of wind energy jobs. Similarly, while California accounts for the largest total amount of battery storage jobs in the nation, on a per capita basis, Nevada, Vermont, Massachusetts, and Idaho employ more individuals in the storage sector.



Source: 2021 USEER. Solar includes majority-time utility-scale and distributed solar employment.

Clean Power Project Capital Investment over Time

The clean power industry invested $39 billion in renewable projects in 2020



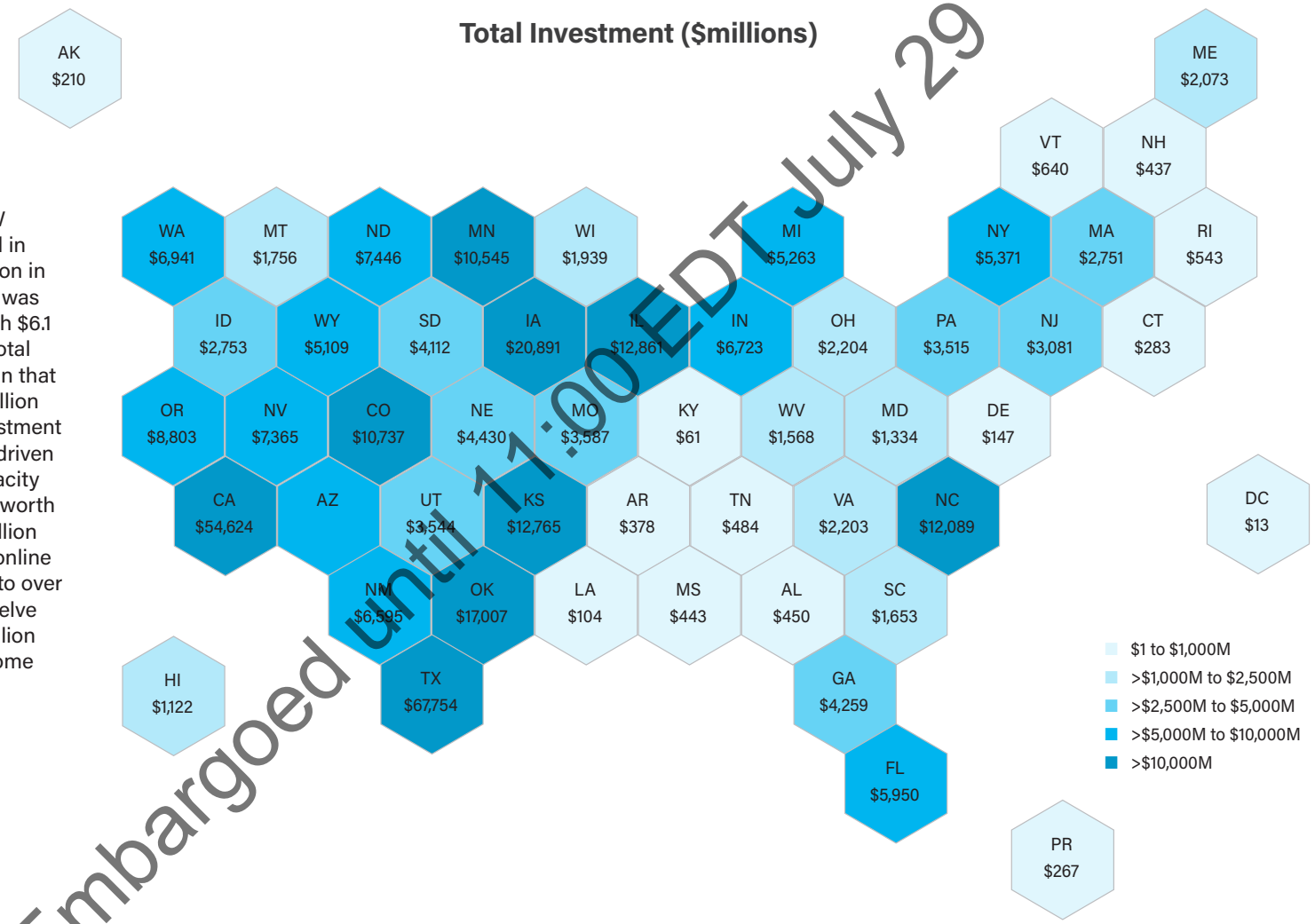
Investments in clean power serve as a significant driver of economic development across the U.S., especially in rural areas. In addition to project investment and job creation, the clean power industry provides billions of dollars of revenue in the form of land lease payments and property, state, and local taxes each year.

In 2020, the wind industry invested $25 billion in projects across the country. Utility-scale solar developers invested a further $13 billion, which when combined with wind and storage, brings total 2020 investments to $39 billion.

Capital Investment by State

Texas is home to the largest amount of clean power project investment of any state at nearly $68 billion

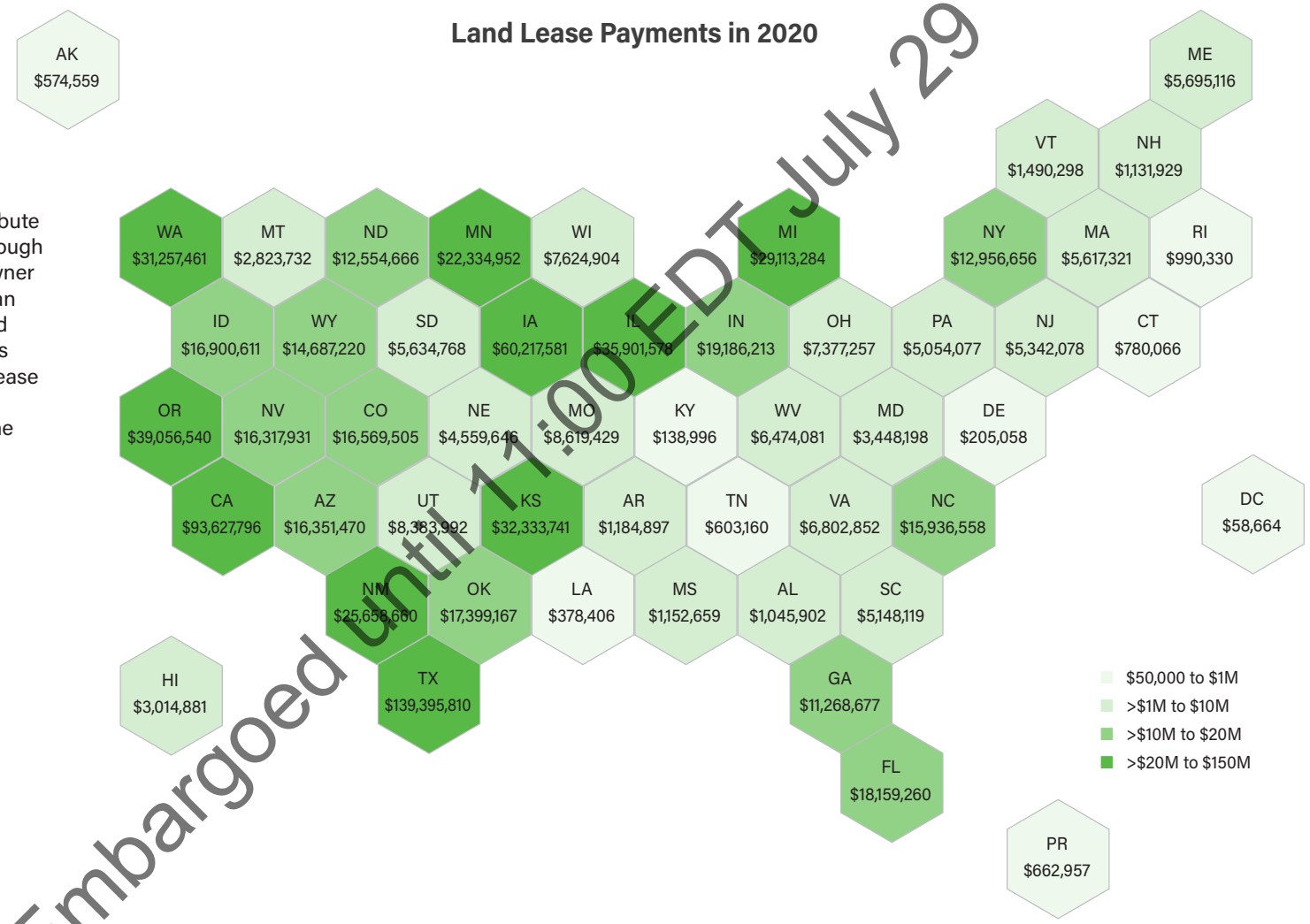
Texas led the nation at 6,320 MW of clean power capacity installed in 2020, representing over $9.2 billion in project investment. Much of this was driven by wind development, with $6.1 billion, or roughly two-thirds of total clean power project investment in that state. California, at nearly $3.2 billion of total clean power project investment in 2020, follows Texas. This was driven largely by solar and storage capacity additions; just under $2.2 billion worth of solar projects and nearly $1 billion worth of storage projects came online in 2020 in California, in addition to over $160 million in wind projects. Twelve other states had more than $1 billion worth of clean power projects come online in 2020.



Annual Land-Lease Payments

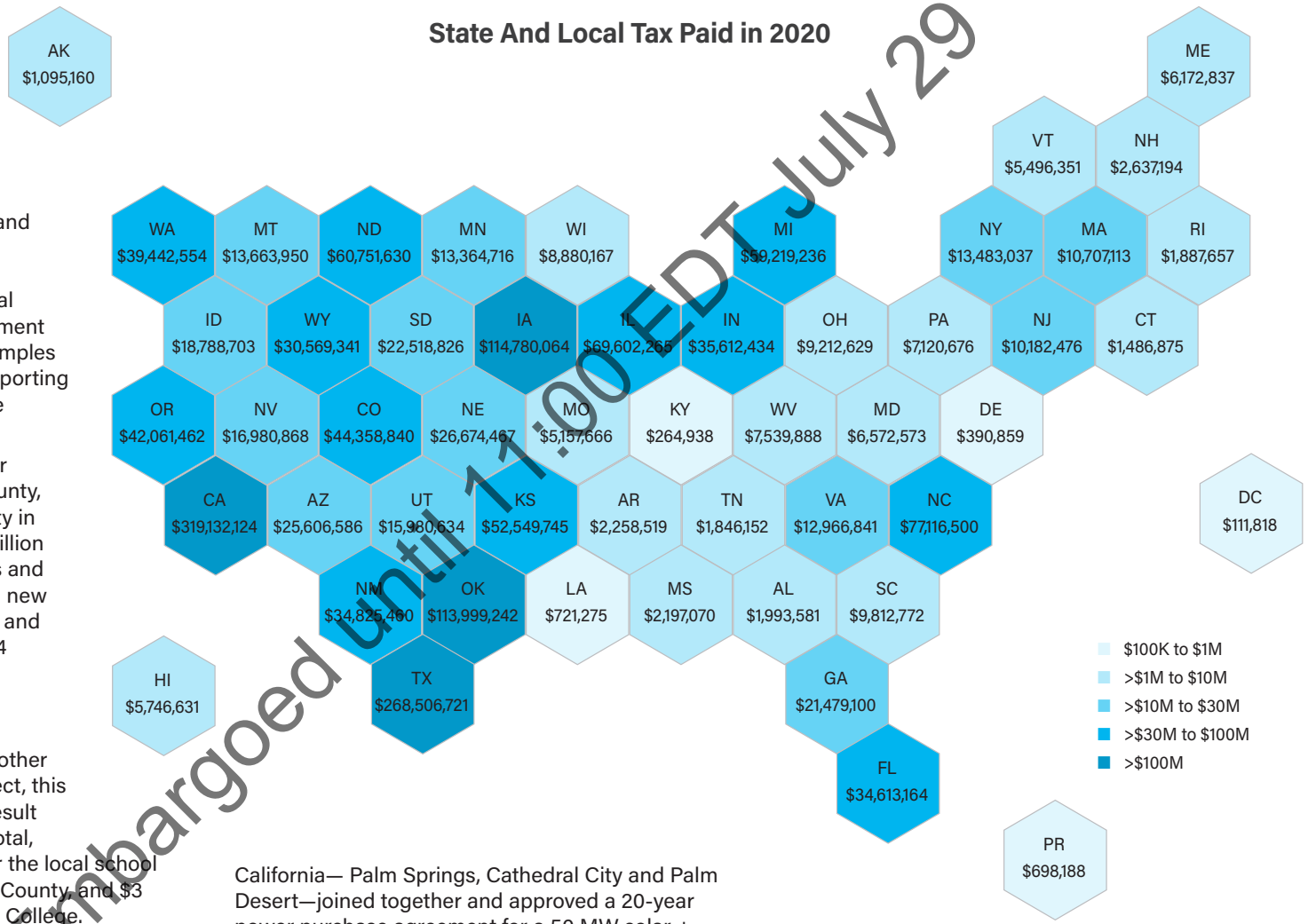
Industry provides at least $800 million in land-lease payments

Clean power projects also contribute directly to local communities through annual tax payments and landowner lease payments. In 2020, the clean power industry paid an estimated $1.7 billion in state and local taxes and nearly $800 million in land-lease payments to landowners across the U.S. That means each year the industry contributes at least $2.5 billion to local communities.



State and Local Tax Payments

In 2020, the clean power industry paid an estimated $1.7 billion in state and local taxes



In addition to capital investment and lease payments, annual property, income, and sales tax payments provide valuable revenues for local school districts and other government services. There are countless examples of renewable energy projects supporting the local economy where they are installed.

For example, the 300 MW Pioneer Prairie Wind Farm, in Mitchell County, Iowa is the largest taxpaying entity in the county, providing nearly $2 million in new revenue per year for roads and bridges. The wind plant paid for a new courthouse without raising taxes, and local school budgets grew by $3.4 million in 5 years.

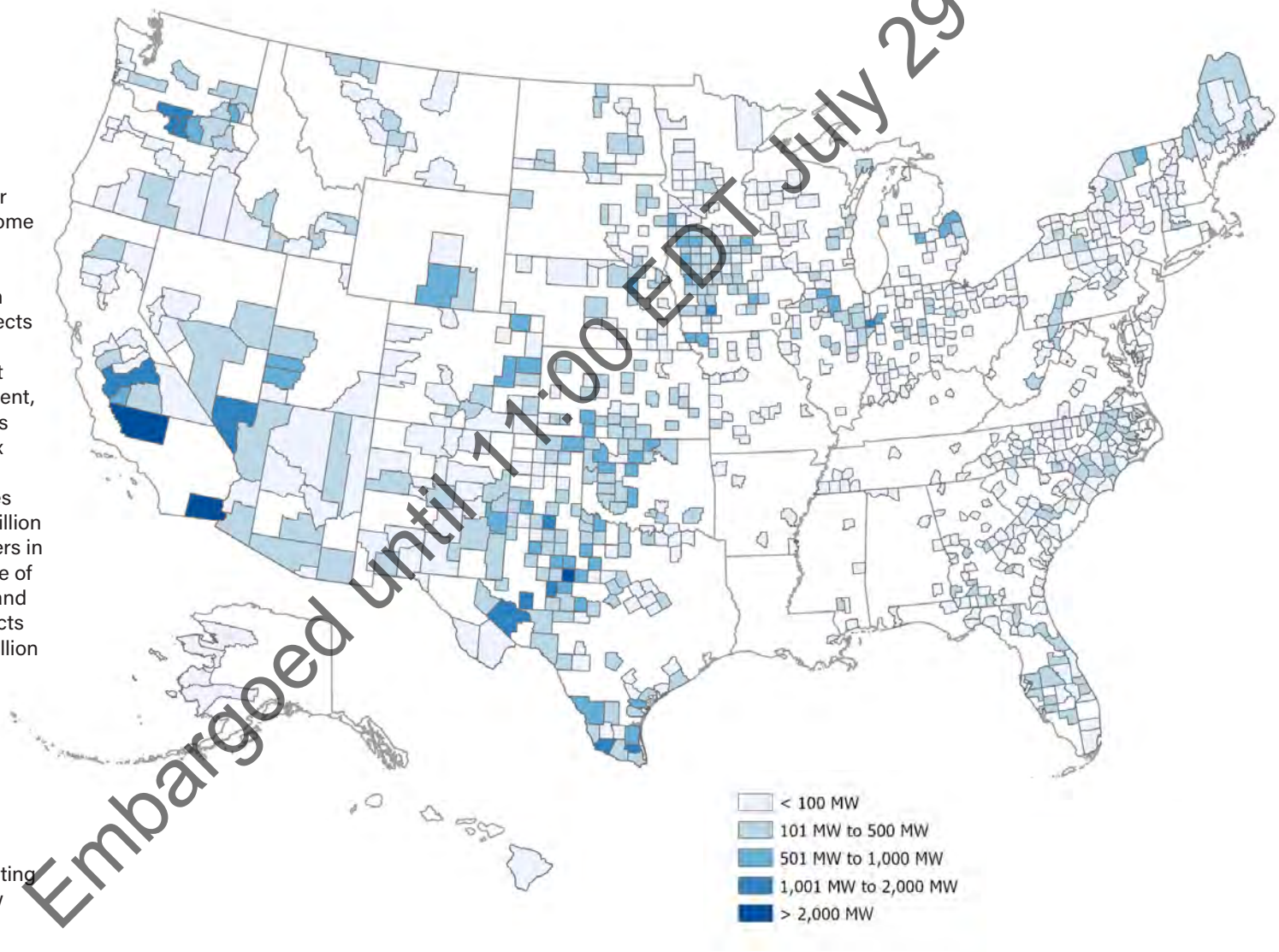
The 100.5 MW first phase of the Spearville Wind Energy Facility in Ford County, Kansas provides another example. Over the life of the project, this first phase alone is expected to result in almost $15 million of funds in total, including more than $5 million for the local school district, almost $4 million to Ford County, and $3 million to Dodge City Community College.

Solar projects – especially as they become large-scale projects – are also providing tangible local economic benefits with examples across the country. For example, three cities in Southern California— Palm Springs, Cathedral City and Palm Desert—joined together and approved a 20-year power purchase agreement for a 50 MW solar + storage project located in Tulare County, California. This purchase of solar energy along with local wind energy is set to save Palm Springs residents an estimated $13 to $50 million over the next 20 years.

Clean Power Installed in Low-Income Counties

Nearly 80% of U.S. clean power capacity is installed in low-income counties

Nearly 80% of U.S. clean power capacity is installed in low-income counties, or counties where the median household income falls below the national median household income. These projects create economic opportunities in the communities that need it most, providing local employment, land-lease payments, as well as property, income, and sales tax revenues. Online clean power projects in low-income counties delivered an estimated $677 million in lease payments to landholders in 2020, providing a steady source of income for ranchers, farmers, and other landowners. These projects represent a cumulative $266 billion in private capital investment. Clean power development is expected to continue in low-income areas. Approximately 51% of land-based wind, solar, and battery storage capacity under construction or in advanced development is in low-income counties, representing an additional $63 billion in new project investment.



Clean Power Environmental Benefits

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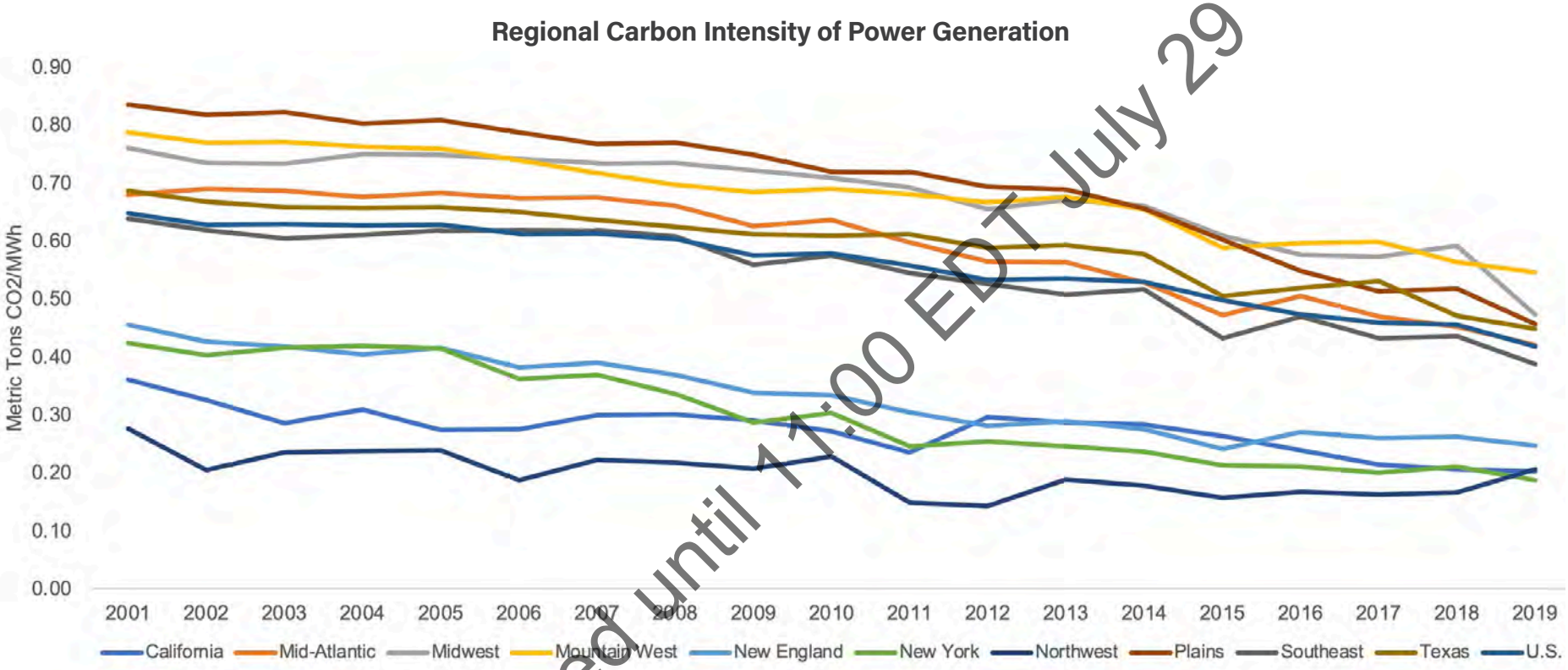
Carbon Intensity of Electricity Markets

Carbon emissions in the U.S. electric grid have fallen over 35% since 2001



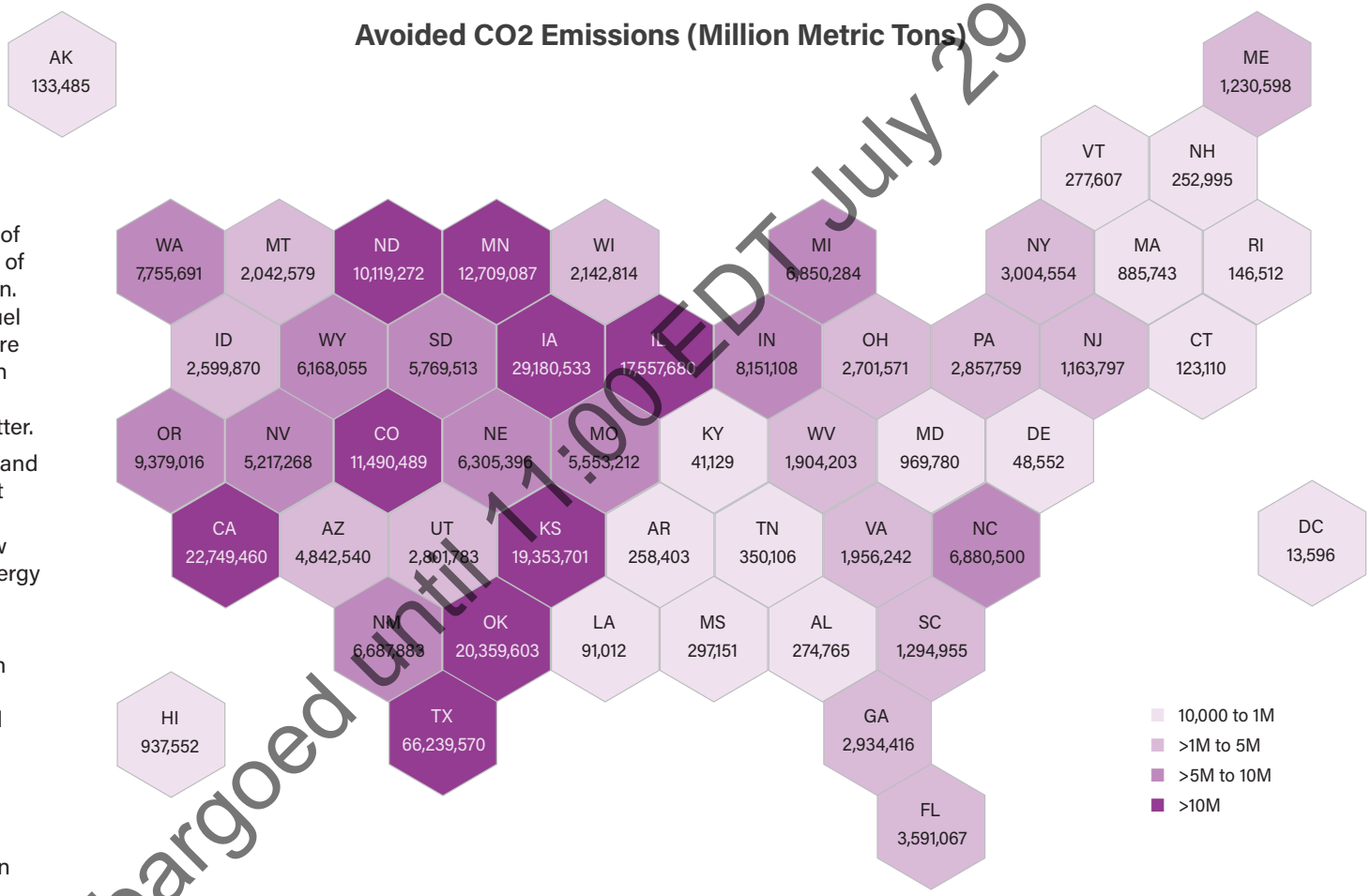
The carbon emission intensity of the U.S. electric grid has fallen over 35% since 2001, from 0.65 metric tons of CO_2 per megawatt-hour of electricity generated in 2001 to 0.42 metric tons per megawatt-hour in 2019. The growth of renewable energy, as well as more stringent environmental regulations, increased use of natural gas fired generation, and decreased use of coal generation has led to this reduction in carbon intensity.

In 2019, California surpassed the Northwest as the least carbon-intensive electric grid in the country, emitting 0.2 metric tons of CO_2 per megawatt-hour. This change is partly attributable to the increasing use of solar generation in that state. Despite increased renewable deployment, the Midwest, Plains, and Texas are the most emissions-intensive grids in the country with at least 0.45 metric tons of CO_2 emitted per megawatt-hour due to a large share of generation from coal-fired plants in these regions.

The Plains region has experienced the largest reduction in emission intensity of electricity generation since 2010. The power plant fleet in that region emitted 0.72 metric tons per megawatt-hour in 2010 compared to 0.46 metric tons per megawatt-hour in 2019. States in the Plains region are also among the leaders in wind power generation. Iowa, for example, leads the U.S. with over 57.5% of electricity generation from wind energy. The Midwest has seen the second-largest reduction in emission intensity on an absolute basis, as CO_2 emissions per megawatt-hour in the region dropped from 0.71 metric tons to 0.47 metric tons.

Carbon Dioxide Emissions Avoided by Wind and Solar Power in 2020

In 2020, wind and solar generation avoided the equivalent of 71 million cars' worth of carbon emissions



Wind and solar power have some of the lowest environmental impacts of any source of electricity generation. These technologies do not burn fuel to generate electricity and therefore do not emit any air pollutants such as carbon dioxide, sulfur dioxide, nitrogen oxides, or particulate matter.

The electricity generated by wind and solar often results in an equivalent decrease in electricity production at another power plant. Due to low marginal costs, wind and solar energy typically displace generation from fossil-fuel powered plants.

In 2020, wind and solar generation avoided an estimated 327 million metric tons of CO_2 being released into the atmosphere, or roughly 71 million cars' worth of carbon emissions.

The 35,017 MW of wind and solar power capacity under construction at the end of 2020 will reduce an additional 62 million metric tons of CO_2 per year once operational. This would bring total emissions reductions from U.S. wind and solar energy to around 389 million metric tons of CO_2 per year.

SOX and NOX Emissions Avoided by Wind and Solar Power in 2020

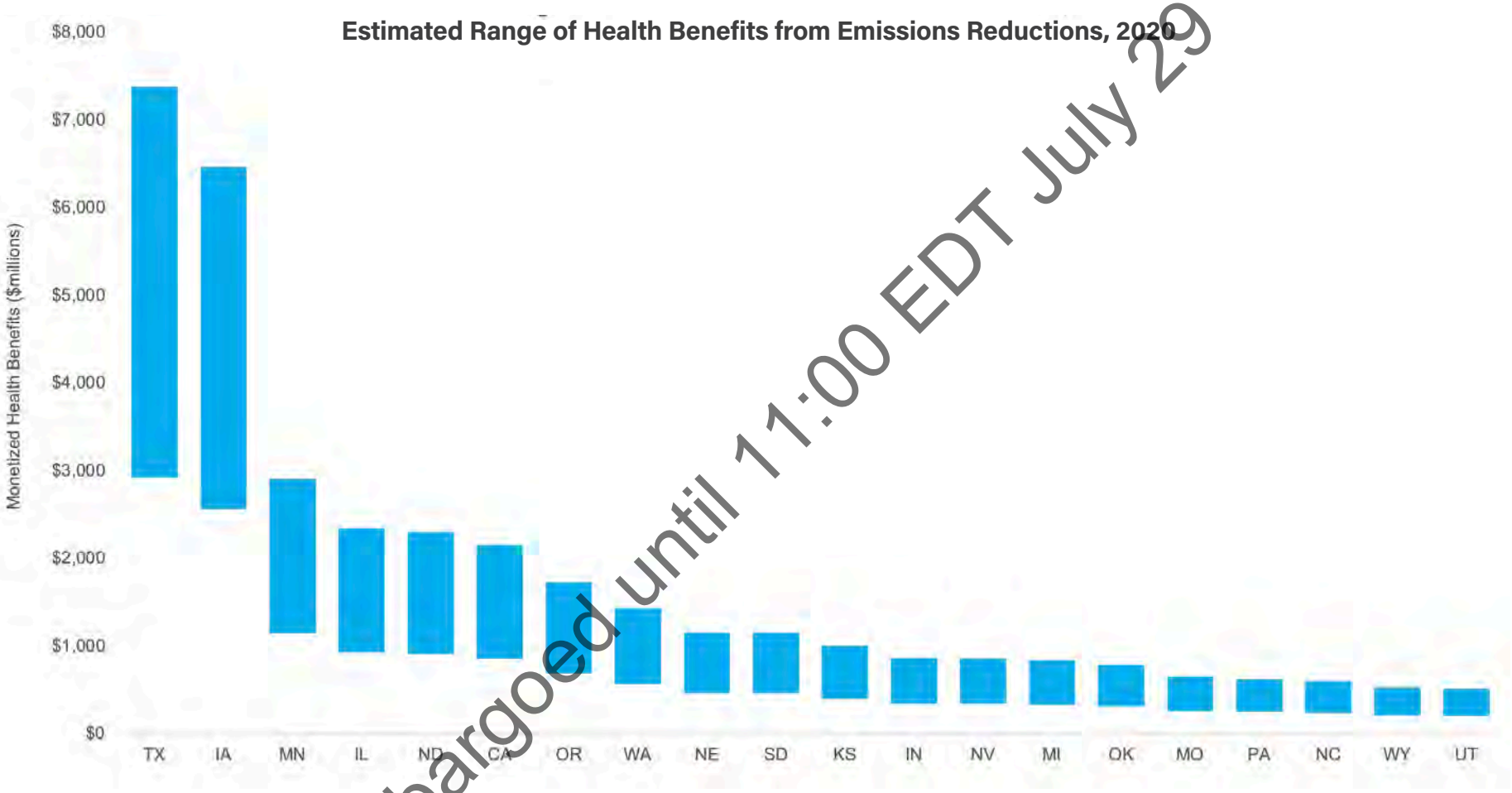
Over 460,000 metric tons of SOX and NOX avoided last year

SO2 and NOx Emissions Avoided, 2020

Wind and solar energy prevented roughly 12,000 metric tons of particulate matter (PM2.5) from being released. In addition, wind and solar energy avoided roughly 245,000 metric tons of nitrogen oxides and 219,000 metric tons of sulfur dioxide in 2020, air pollutants that form particulate matter in the atmosphere that triggers asthma attacks and creates smog.

Health Benefits

In 2020, clean power generated health benefits with an economic value between $16–$41 billion



The U.S. Environmental Protection Agency (EPA) CO-Benefits Risk Assessment (COBRA) model estimates the economic value of the health benefits associated with reductions in emissions of particulate matter (PM2.5), sulfur dioxide (SO2), and nitrogen oxides (NOX), among other pollutants.

These health benefits include avoided deaths, asthma-related emergency room visits, work loss days and other pollution-related health impacts. The model estimates the present value of the benefits that accrue over 20 years due to a single-year reduction in emissions.

In 2020, avoided PM2.5, SO2, and NOX emissions are expected to generate health benefits with an economic value between $16–$41 billion, based on EPA COBRA modeling using a 3% and 7% discount rate.

Clean Power Manufacturing

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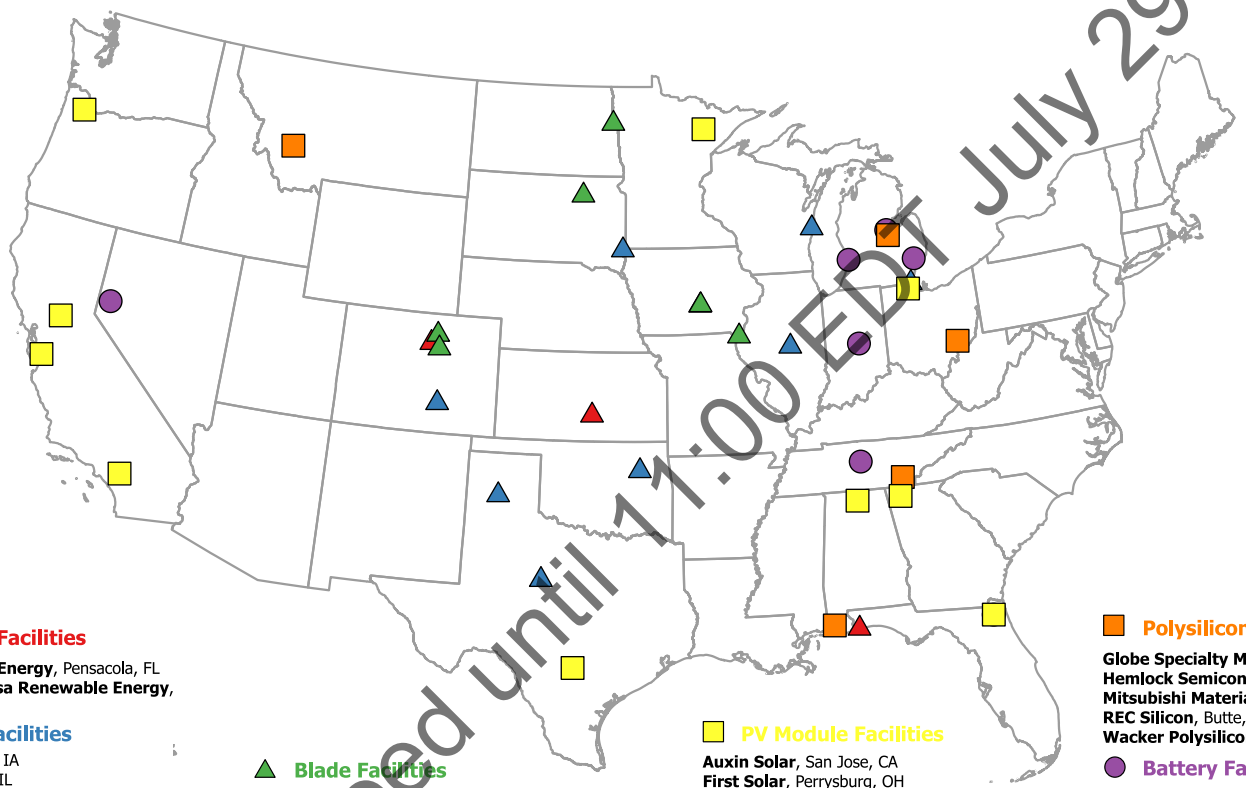
Major Wind, Solar, or Storage Manufacturing Locations

Wind, solar, and storage manufacturing jobs total 77,658



Turbine Facilities

GE Renewable Energy, Pensacola, FL
Siemens Gamesa Renewable Energy, Hutchinson, KS

Tower Facilities

Arcosa, Newton, IA
Arcosa, Clinton, IL
Arcosa, Tulsa, OK
Broadwind Towers, Abilene, TX
Broadwind Towers, Manitowoc, WI
GRI Renewable Industries, Amarillo, TX
Marmen Energy, Brandon, SD
Ventower Industries, Monroe, MI
Vestas North America, Pueblo, CO

Blade Facilities

LM Wind Power, Grand Forks, ND
Molded Fiber Glass, Aberdeen, SD
Siemens Gamesa Renewable Energy, Fort Madison, IA
TPI Composites, Newton, IA
Vestas North America, Windsor, CO
Vestas North America, Brighton, CO

PV Module Facilities

Auxin Solar, San Jose, CA
First Solar, Perrysburg, OH
Hanwha Q CELLS, Dalton, GA
Heliene, Mountain Iron, MN
Jinko Solar, Jacksonville, FL
LG, Huntsville, AL
Mission Solar Energy, San Antonio, TX
Sunergy, Hillsboro, OR
SunSpark Technology, Riverside, CA

Polysilicon Facilities

Globe Specialty Material, Waterford, OH
Hemlock Semiconductor, Hemlock, MI
Mitsubishi Materials, Theodore, AL
REC Silicon, Butte, MT
Wacker Polysilicon, Charleston, TN

Battery Facilities

Clarios, Holland, MI
EnerDel, Indianapolis, IN
Envision Energy, Smyrna, TN
LG Chem, Troy, MI
Saft America, Jacksonville, FL
Tesla, Panasonic, Sparks, NV
Xalt Energy, Midland, MI

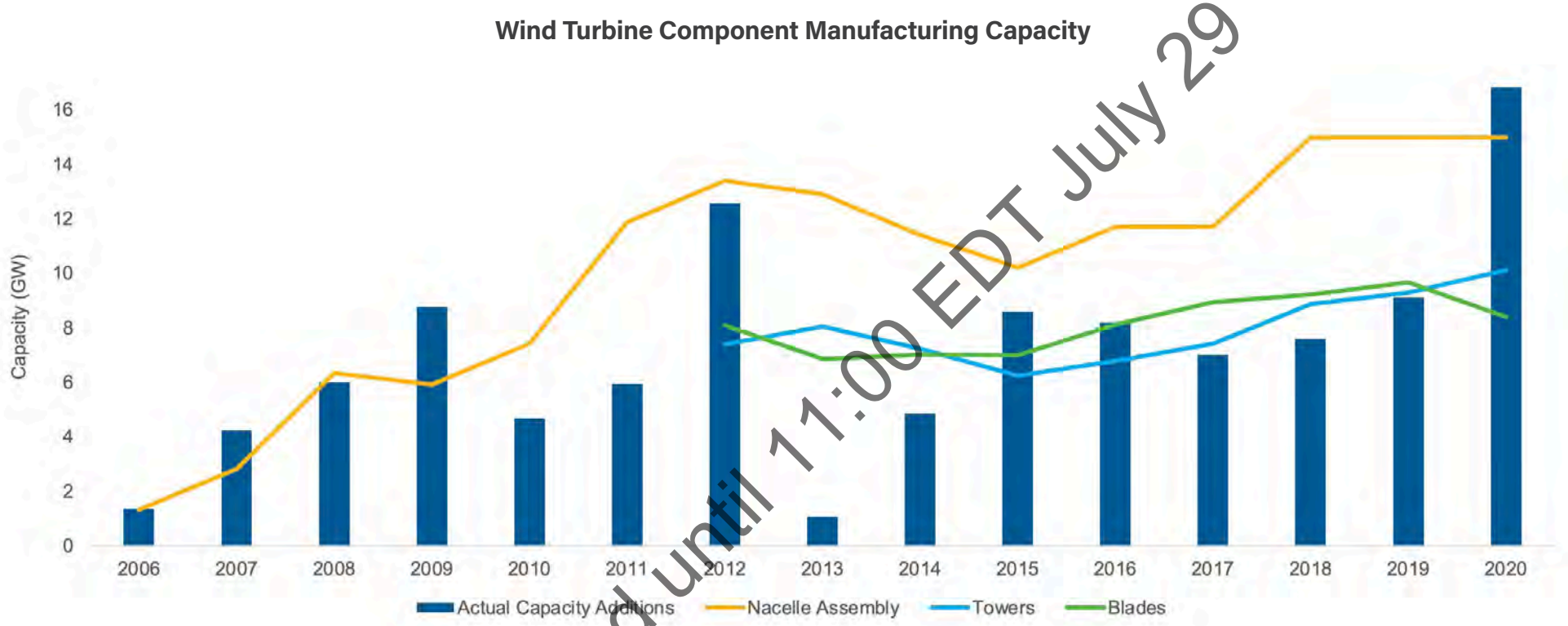
There are 39 major clean power manufacturing facilities that make primary components for wind, solar, and battery storage plants. These include 18 wind-related plants, nine solar module plants, seven battery plants, and five polysilicon plants all spread across 21 states.

Considering all manufacturing, not just major components, wind, solar, and battery storage support 77,658 manufacturing jobs. This total includes 23,878 wind manufacturing jobs, 41,870 solar manufacturing (both distributed and utility scale), and 11,910 battery storage manufacturing jobs.

Major components include wind turbine towers, blades, and nacelles, solar modules and cells, and batteries and battery chemical components.

Wind Component Manufacturing Production Capacity

18 wind-related manufacturing plants in 11 different states produce major wind turbine components



U.S.-based factories make everything from major components such as blades, towers, rotor hubs, generators and gearboxes, to internal components such as bearings, slip rings, brake systems, fasteners, power converters and sensors. Colorado and Iowa continue to lead the U.S. in the number of facilities that manufacture the major utility-scale wind turbine components (i.e., blades, towers, nacelles).

When including subcomponent manufacturing, Ohio is the leading state for manufacturing facilities, with 61 active plants. Texas with 46 facilities, Illinois (34), Pennsylvania (32), Wisconsin (28), North Carolina (27) and Michigan (27) are also wind energy supply chain leaders. In total, there are over 500 wind-related manufacturing facilities in 44 states.

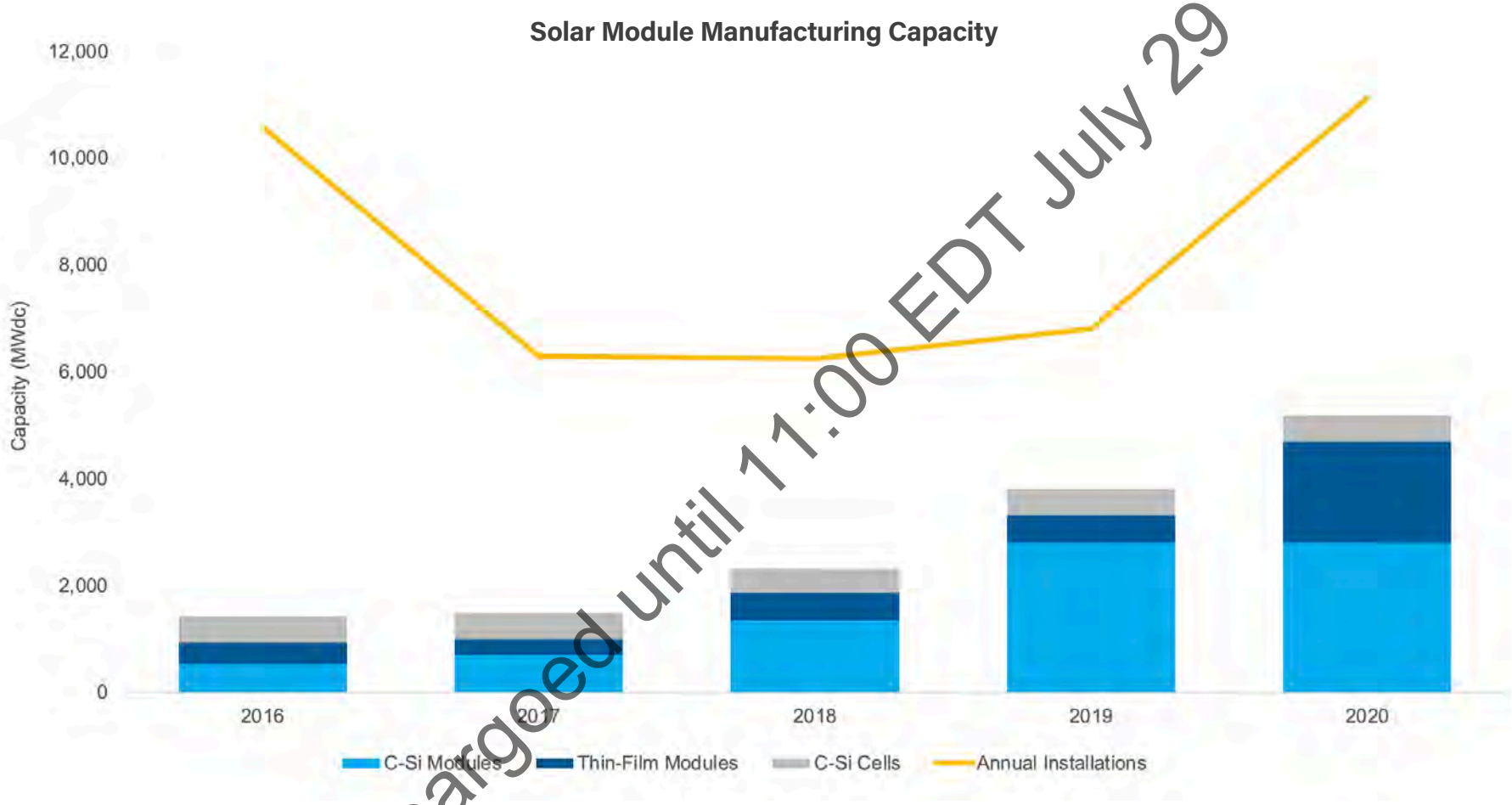
At the end of 2020, 18 wind-related manufacturing plants located in 11 different states produce major wind turbine components. Those plants include six utility-scale blade facilities, nine tower facilities and three turbine nacelle assembly facilities.

The wind turbine nacelle assembly manufacturers with production facilities located in the U.S.—GE, Siemens Gamesa and Vestas—have the capacity to assemble approximately 15,000 MW annually. The six blade manufacturing facilities have the capacity to produce approximately 10,000 individual blades annually (around 9.2[1] GW approximately). The nine tower manufacturing facilities in operation at year-end 2019 can produce approximately 3,750 towers annually, which can satisfy around 10 GW or more of capacity (and even more as nameplate capacities increase).

[1] In 2021, Vestas announced it would transition its Brighton blade facility into a tooling shop and Molded Fiber Glass announced it will close its South Dakota blade facility in August.

Solar Component Manufacturing Production Capacity

Domestic solar PV module manufacturing capacity has increased to around 5.2 GW



The U.S. has steadily increased its domestic solar manufacturing capacity over the years from around 1,420 MW of capacity in 2016 to 5,190 MW by the end of 2020. Most of the growth occurred in the past two years with increased module production.

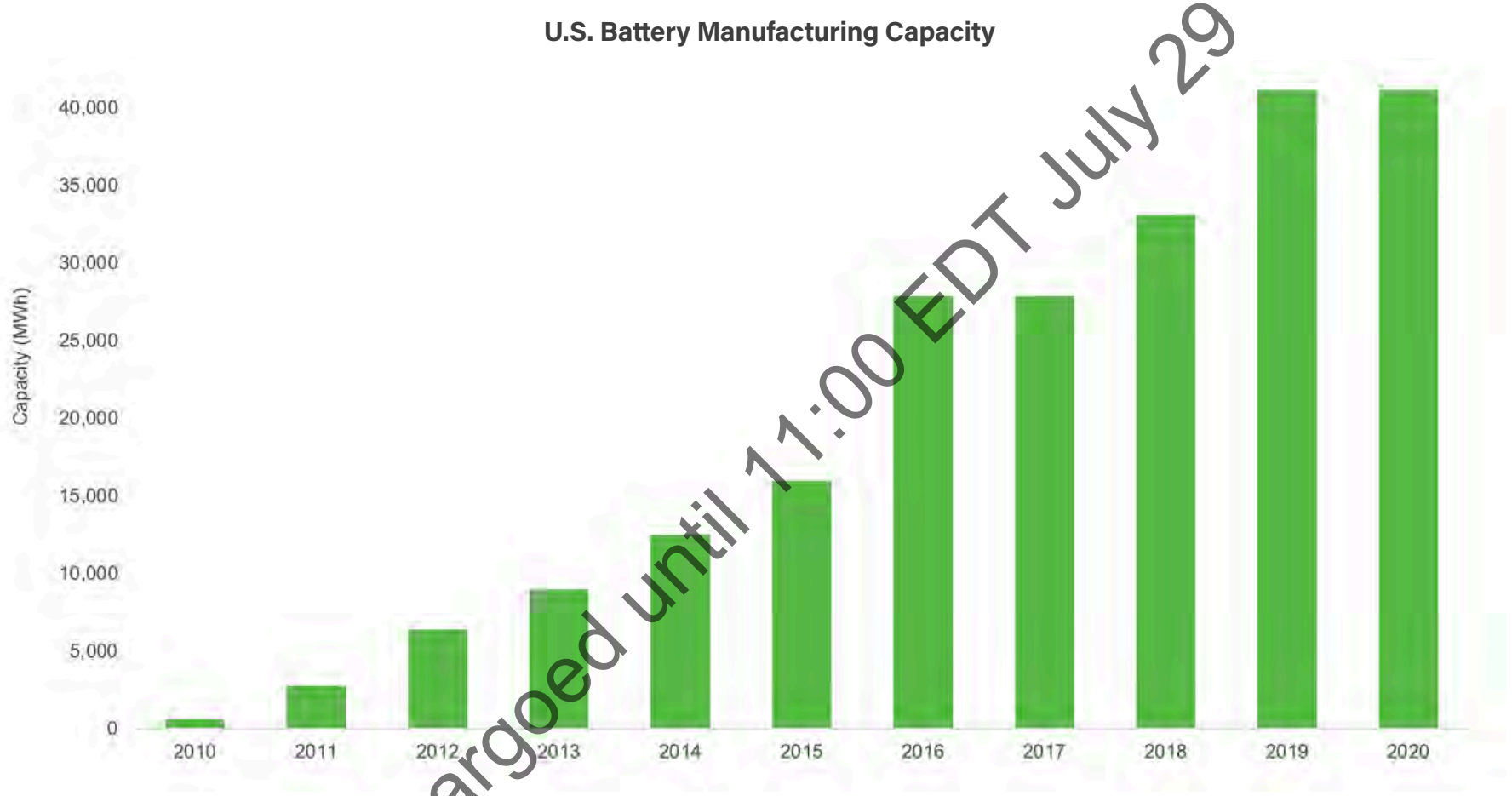
Thin film solar took a jump upward in 2020 as U.S. based First Solar more than doubled its capacity from 520 MW to 1,900 MW and it aims to reach 2,400 MW by 2022.

Notably, however, the total capacity production in the U.S. is well below what is installed in a given year, for example the roughly 8,000 MW installed in 2020 significantly eclipsed the 5,190 MW of total US production capacity.

Estimates include excess plant capacity and does not reflect exact annual production estimate. Source: NREL

Storage Component Manufacturing Production Capacity

41 GWh of battery storage production is set to grow to over 100 GWh by 2022



Battery energy storage production capacity has steadily increased from just 600 MWh in 2010 to over 41,116 MWh at the end of 2020. Capacity is expected to reach almost 100 GWh by the end of 2022. Tesla's Nevada Gigafactory, LG Chem's joint investment with GM in Ohio, and SK Innovation's investment in a factory in Georgia are expected to be the main contributors. Battery costs have dropped as technology is refined and economies of scale in manufacturing have been achieved.

Battery storage is increasingly in demand – especially when combined with solar plants to enable peak generation in the late afternoon to be shifted a few hours into the evening which is generally peak demand on the electricity grid.

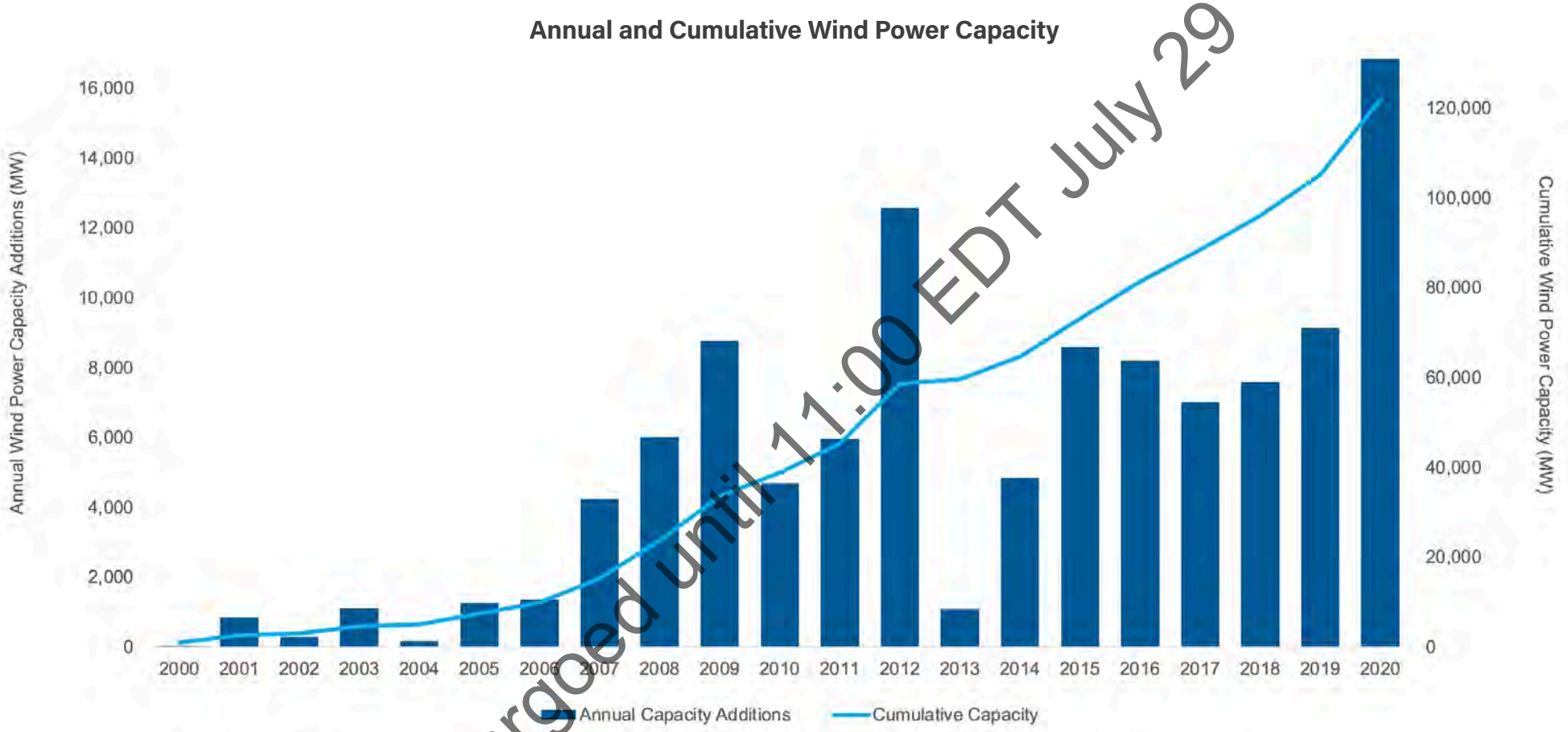
Market overlap between both fast-growing sectors of utility-scale energy storage and electric vehicles ensures that manufacturing capacity will continue to increase and increasingly be augmented by imported equipment. The majority of U.S. battery production supports the electric vehicle industry.

Source: BNEF

Land-Based Wind Market

Annual and Cumulative Wind Power Capacity

Record 16,836 MW installed in 2020 brings cumulative year-end capacity to almost 122 GW



The U.S. wind market installed a record amount of capacity in 2020 with 6,027 wind turbines installed totaling 16,836 MW. Record-setting levels were widely expected since the PTC for wind had been extended in 2016 and developers were given up to four years to bring a project online to qualify for the full credits.

The last record level of wind deployment in 2012 with 12,572 MW also was largely the result of a tax credit cycle.

The Covid-19 pandemic caused supply chain constraints and delays but the U.S. wind market was able to navigate many of these challenges successfully. Cumulative operating capacity stood at 121,985 as of the end of 2020. Covid-related delays and flexibility from the Treasury Department regarding PTC eligibility sets 2021 to be a similarly large year.

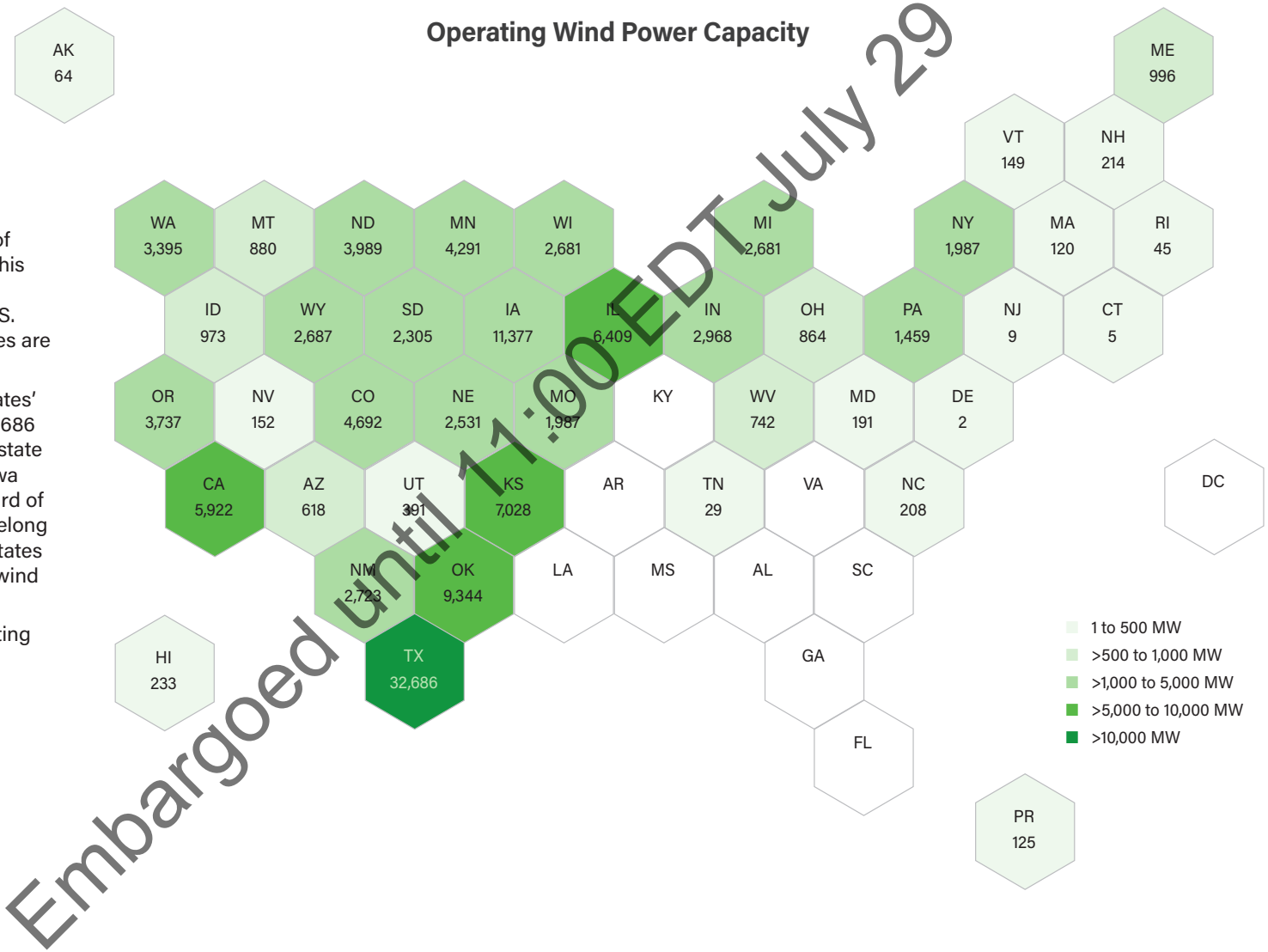
Operating Wind Power Capacity

Wind is the largest renewable power source on the electric grid

The 16,836 MW installed in 2020 brought the U.S. to 121,985 MW of cumulative operating capacity. This map shows many of the projects are in the central plains of the U.S. where world-class wind resources are located.

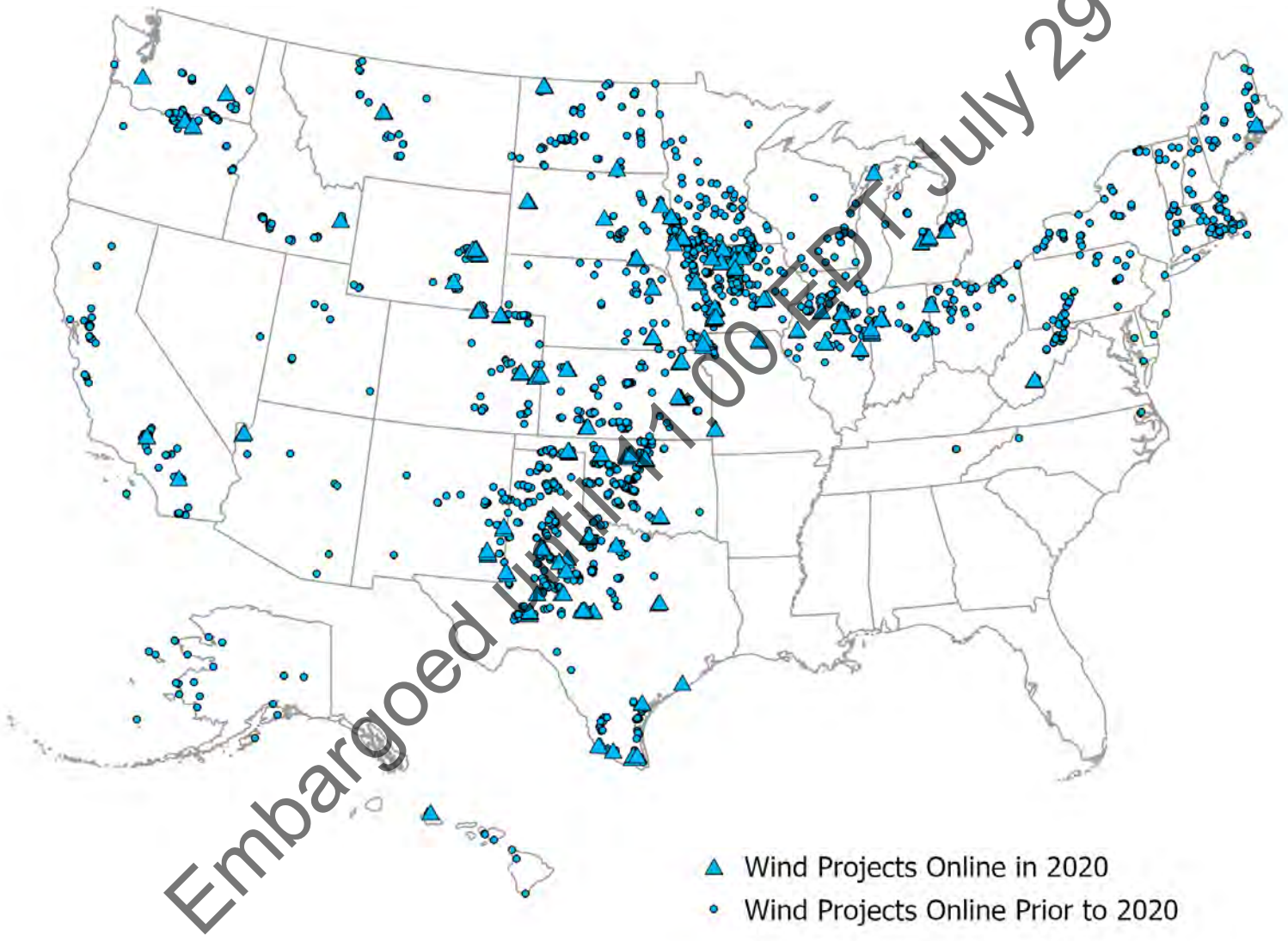
Texas vastly exceeds all other states' operating wind capacity with 32,686 MW operating. The next closest state for total operating capacity is Iowa with 11,377 MW, or less than a third of Texas. A total of 20 states now belong to the gigawatt-club, while five states contain over 5 GW of operating wind power.

There is commercial wind operating in 41 U.S. states.



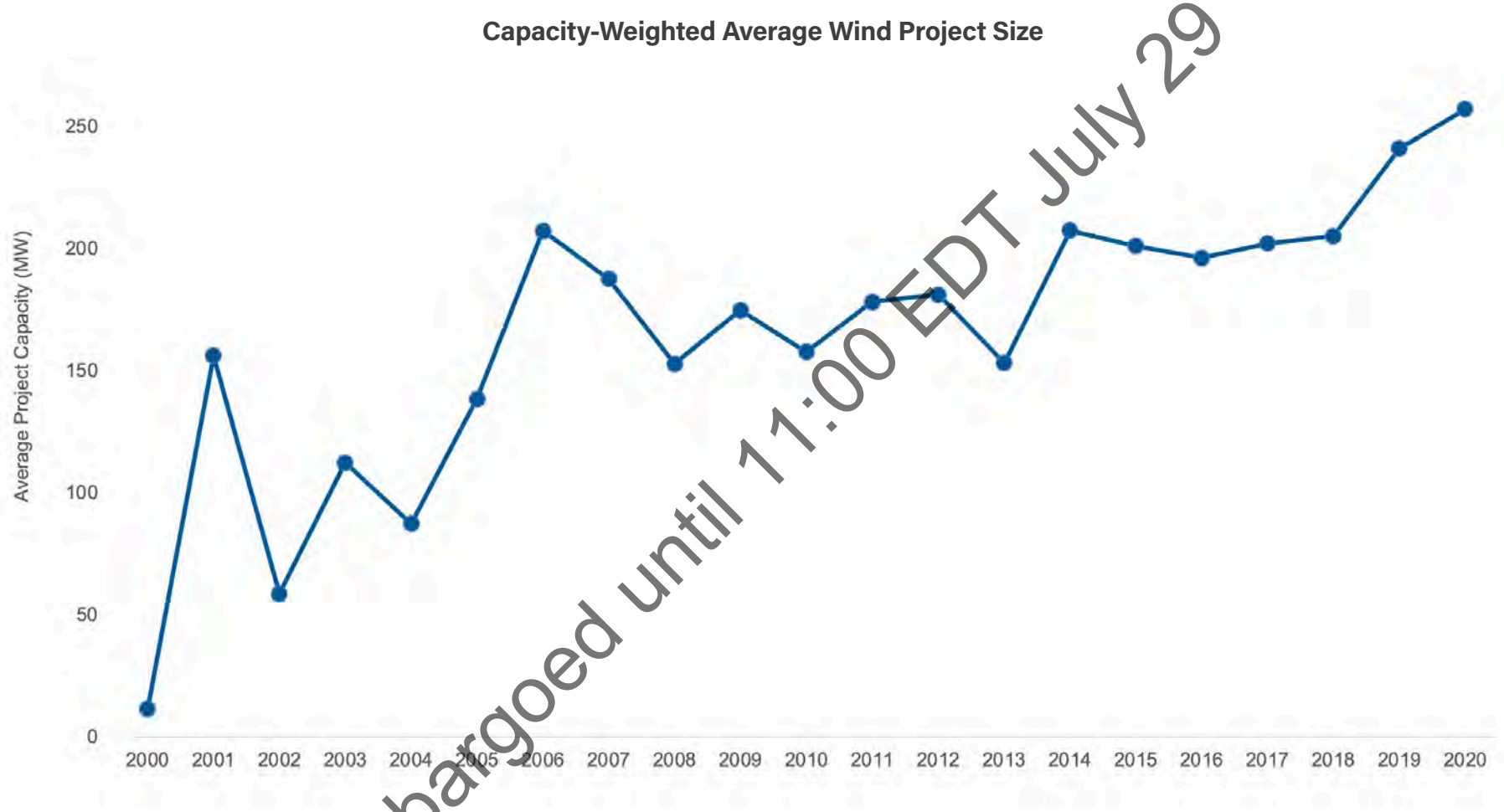
Land-Based Wind Projects

Over 1,200 wind projects across 41 states



Capacity-Weighted Average Wind Power Project Size

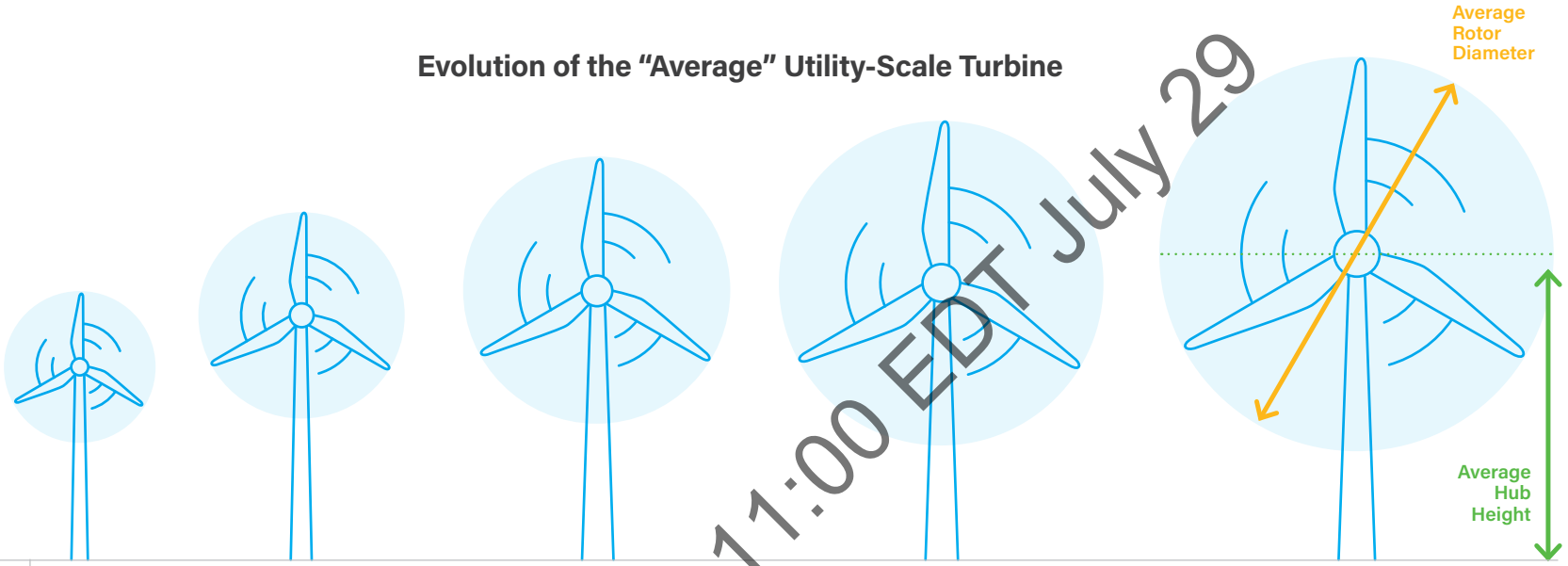
More multi-MW turbines are pushing average project sizes larger



The average size of wind plants has slowly and steadily increased over time. It had plateaued around 200 MW from 2014 through 2018. However, 2019 and 2020 saw a notable increase in average project size up to 257 MW. This is partly the result of wind turbine OEMs bringing new larger multi-MW nameplate turbines to the market, allowing more MW per installed turbine and/or more overall project output for the same equivalent project footprint.

Average Wind Turbine

Average 2020 wind turbine: 90-meter hub height, 125-meter rotor diameter and 2.7 MW capacity

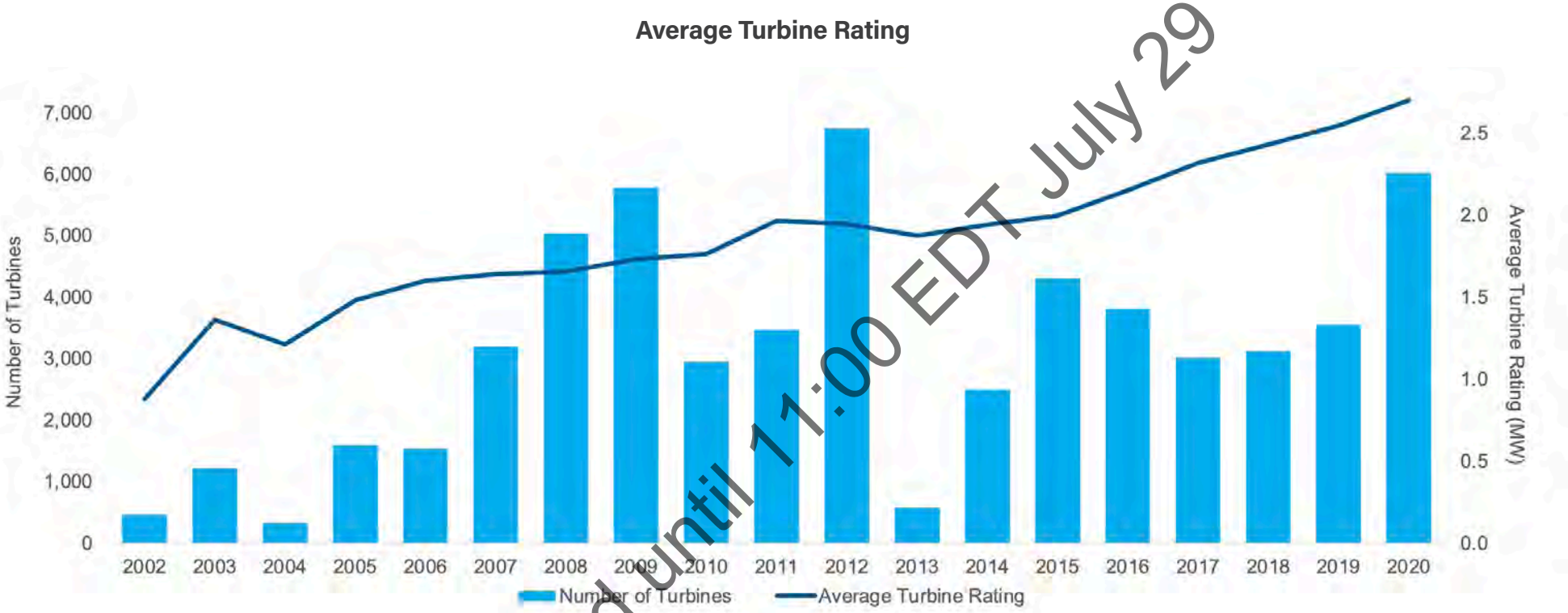


YEAR	2000	2005	2010	2015	2020
Average Hub Height	58m	75m	80m	82m	90m
Average Rotor Diameter	48m	65m	84m	102m	125m
Homes Powered	180	416	459	670	933

A total of 6,027 wind turbines were installed in 2020. The average hub height of turbines installed in 2020 reached 90 meters and the average rotor diameter spanned 125 meters. The average wind turbine size increased in 2020 to 2.7 MW, up from 2.5 MW the year before. Pushing up the averages are new turbine offerings in the 4 MW and 5+ MW range—sizes that were unheard of a few years ago in the U.S.

Average Turbine Rating and Count over Time

Wind turbines in the 3+, 4+ and even 5+ MW nameplate capacity are now increasingly being deployed



Wind turbine nameplate capacity rating has crept up steadily over the years, enabled largely by wind turbine rotor diameter increases and other component advances. The average wind turbine size increased in 2020 to 2.7 MW, up from 2.5 MW the year before.

This data point, however, hides that fact that large multi-MW turbines from most OEMs are increasingly entering the annual installation rankings. As background, the U.S. wind market has relatively much more vast open spaces compared to Europe, so installing many turbines in the 2 MW plus or minus size range for many years made economic sense.

Europe's smaller available project footprints and population density led to a quicker adoption of turbines in the 3+, 4+ and even 5+ MW nameplate capacity so more MW could be installed from fewer wind turbines.

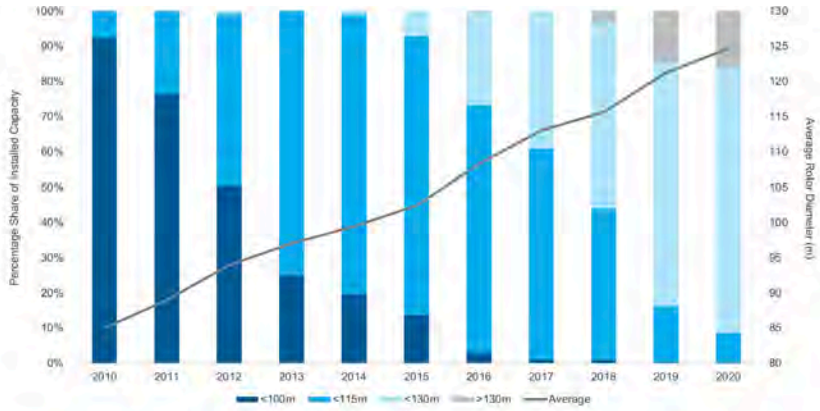
Those turbines are now increasingly being deployed as U.S. developers see more limited project site options and the value proposition of the same relative MW output with fewer turbines becomes more compelling. The largest turbines deployed in 2020 by OEM include:

- Vestas North America: Total of 1,071 MW from its V150-4.2 and 477 MW from its V136-4.3
- Siemens Gamesa Renewable Energy: Total of 320 MW from its SG 4.5-145 units
- GE Renewable Energy: 2 units of its GE 5.0-127
- Goldwind Americas: 202 MW of its GW 155-4.2S units

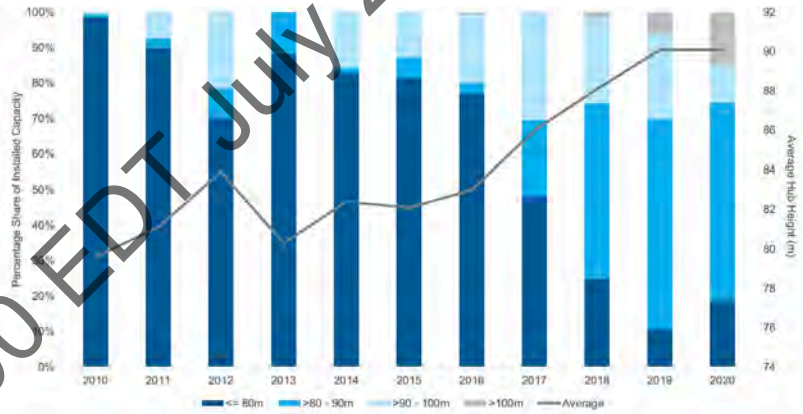
Wind Turbine Characteristics

Declining specific power boosts capacity factors

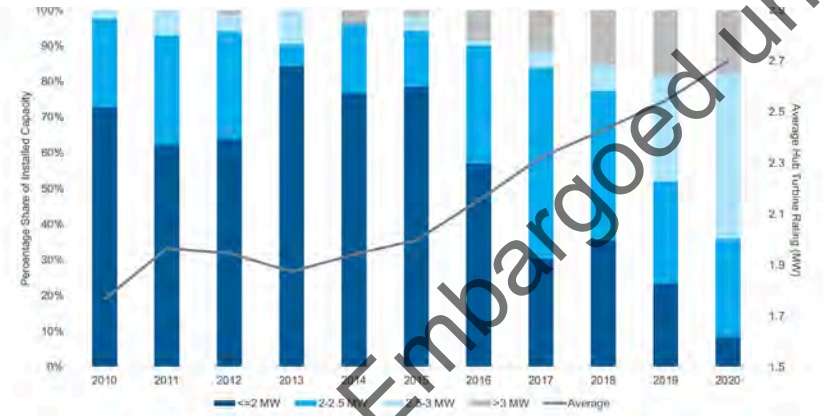
Rotor Diameter



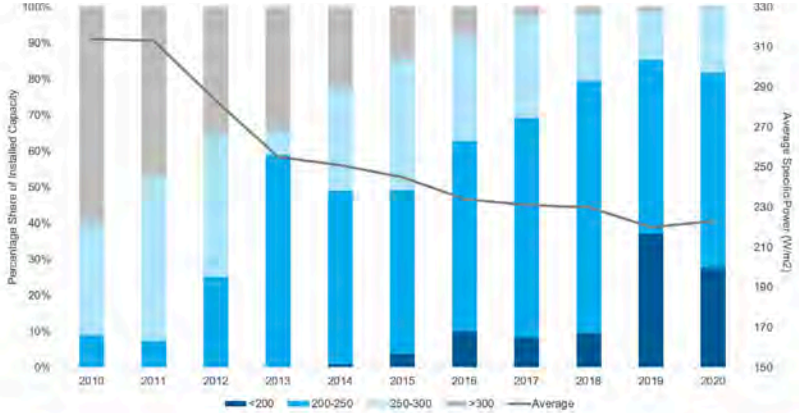
Hub Height



Turbine Rating



Specific Power



Wind Turbines Installed in 2020, by Rating

No big surprises in the perennial market share competition

Manufacturer	Model	Capacity
GE Renewable Energy	GE 1.5-82.5	2
	GE 1.7-100	55
	GE 1.7-103	96
	GE 2.1-116	19
	GE 2.3-116	984
	GE 2.5-116	198
	GE 2.5-127	1,230
	GE 2.7-116	1,176
	GE 2.8-127	4,863
	GE 3.8-137	217
	GE 5.0-127	10
Goldwind Americas	GW 155 - 4.2S	202
Nordex USA Inc.	AW125/3150	151
	AW140/3000	300
Siemens Gamesa Renewable Energy	G132-3.465	585
	SG 2.3-108	23
	SG 2.7-129	438
	SG 3.4-132	72
	SG 4.5-145	320
	SWT-2.415-108	92
Vestas North America	V110-2.0	672
	V110-2.2	66
	V112-3.0	57
	V112-3.45	41
	V120-2.0	180
	V120-2.2	2,189
	V126-3.3	73
	V126-3.45	176
	V136-3.45	28
	V136-3.6	522
	V136-3.7	107
	V136-3.8	144
	V136-4.3	477
	V150-4.2	1,071

Data of wind turbines installed by make, model and rating in 2020 provides an interesting comparative assessment of which models were the most popular among the leading OEMs.

GE led overall total capacity during the year with 8,850 MW of capacity, representing 53% of total annual 2020 market share.

Its 2.8-127 model was the overwhelming best seller representing more than half of total orders and 4,893 MW from that model alone.

The next two most popular models were the 2.5-127 (1,230 MW) and the 2.7-116 (1,176 MW), each (14% and 13% of GE orders, respectively). GE had no models installed in the 4 MW range but 2 units installed of its 5.0-127 unit.

Vestas took second place for total capacity installed in 2020 with 5,803 MW, or 34% total annual market share. The most popular Vestas turbine was its V120-2.0 unit (2,189 MW), representing 38% of Vestas' turbine market share. Second was its V150-4.2MW units, with 1,071 MW installed by that model, representing 18% of Vestas' market share.

Vestas had the most different models deployed in 2020 among all the OEMs with 14 different model configurations. It also had the most 4MW+ capacity with 1,548 MW from the combination of its V150-4.2 units and its V136-4.3 units.

Siemens Gamesa Renewable Energy took third place and installed a total of 1,530 MW, or 9% total annual market share. Its most popular model was its G132-3.465 (585 MW), followed by its 2.7-129 (438 MW).

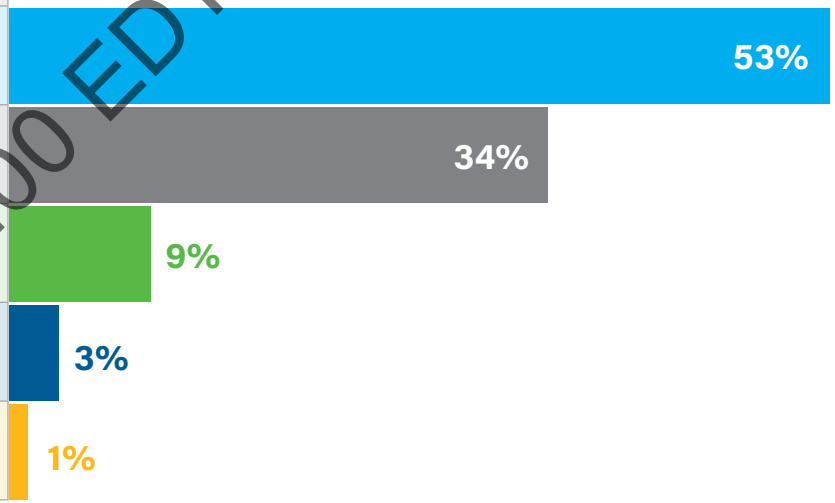
Nordex USA took fourth place with 451 MW installed, representing 3% market share. It deployed 300 MW of its AW140/3000 and 151 MW of its AW125/3150 units. These are the former Acciona wind turbine platform, following Nordex's acquisition in 2016 of Acciona's wind turbine business.

China-based Goldwind has continued a minor 1% annual market share foothold in the U.S. with 202 MW of its GW 155 - 4.2S turbines installed in 2020.

Turbine OEM Market Share, 2020

GE tops turbine market rankings

Company	Number of Turbines	Capacity, MW
GE Renewable Energy	3,306	8,850
Vestas North America	2,140	5,803
Siemens Gamesa Renewable Energy	465	1,530
Nordex USA Inc.	148	541
Goldwind Americas	48	202



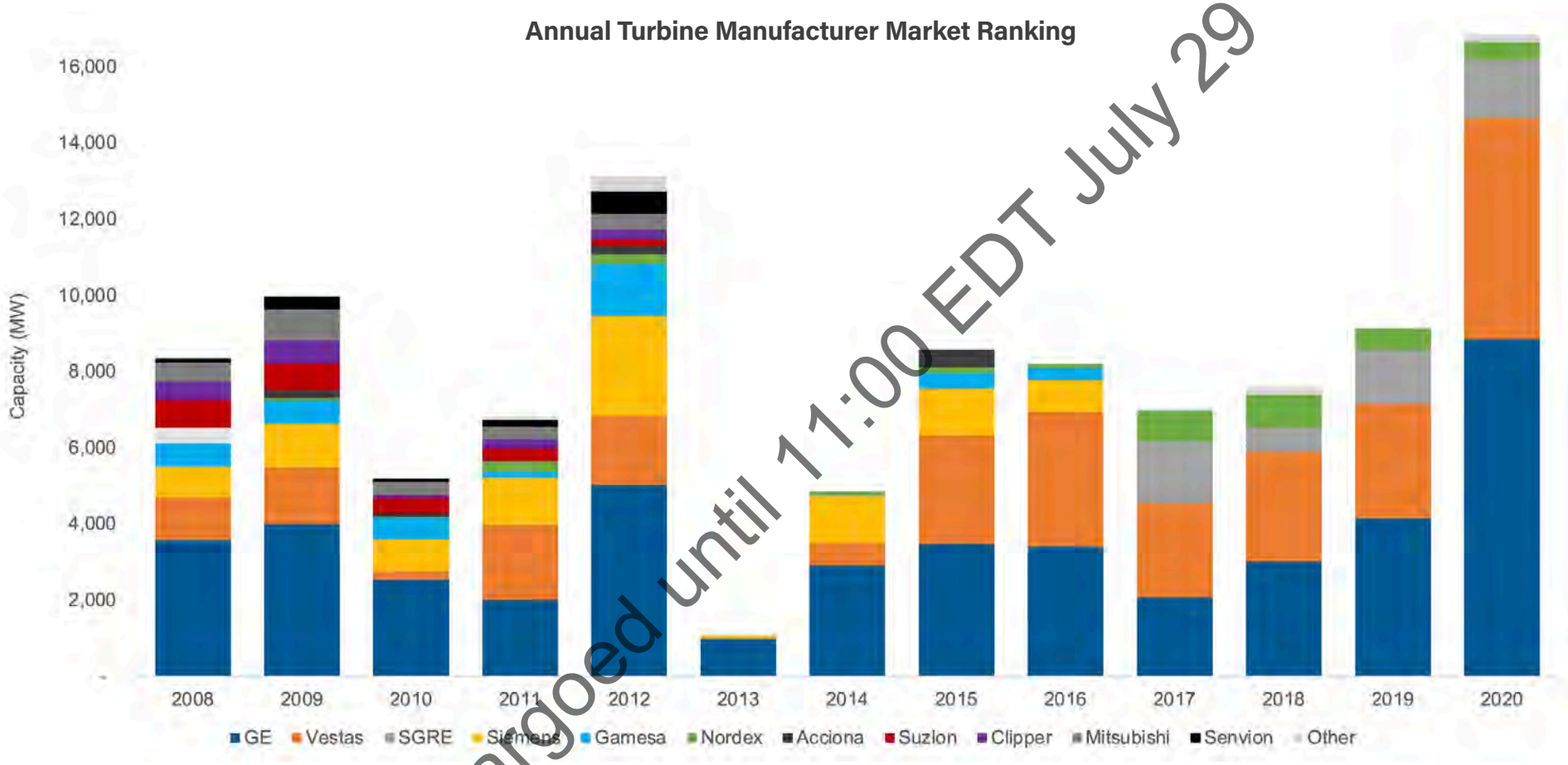
Wind turbine OEM market share is a highly tracked data metric of the U.S. market because only three to four companies vie for dominance in the market. GE Renewable Energy in almost every year except 2016 and 2017 has maintained the most market share driven partly by its advantage as the only U.S. based wind turbine OEM.

In 2020 it retained 53% of the market. However, internationally based rivals have made significant supply chain investments in the U.S. to compete.

Second place rival Danish-based Vestas achieved 34% market share in 2020. Spain-based Siemens Gamesa followed with 9%, Germany-based Nordex USA followed at 3%, and China-based Goldwind brought up the rear at 1%.

Annual Wind Turbine OEM Market Share

GE, Vestas, and Siemens Gamesa dominate U.S. market



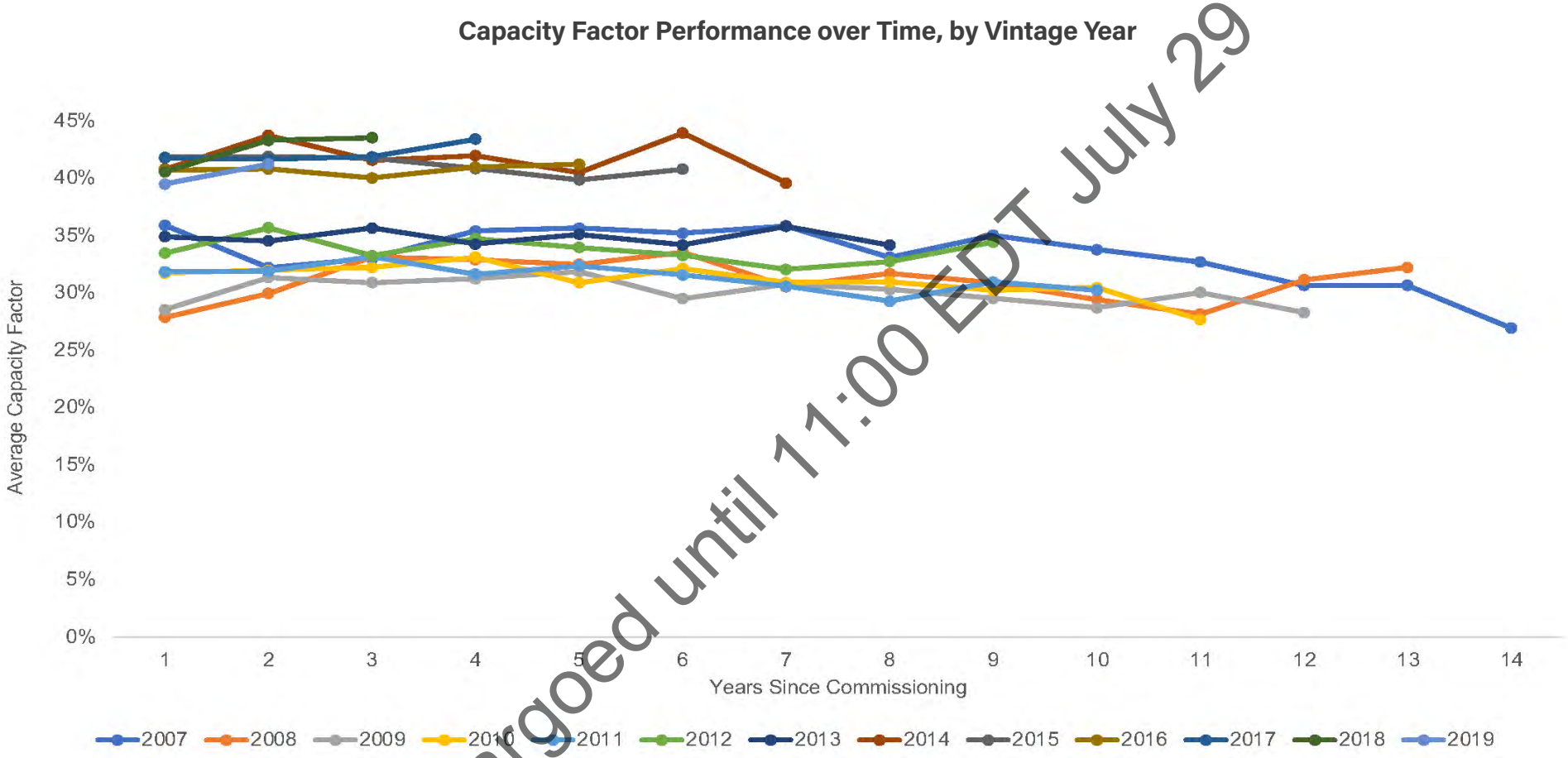
As noted in the year 2020 wind turbine OEM market share, the U.S. market is heavily dominated by "the big three" wind turbine OEMs: GE Renewable Energy, Vestas, and Siemens Gamesa. Nordex USA is strong fourth place competitor.

In the earlier days of the U.S. and international wind markets, there were many more wind turbine OEMs with 11 significant players around a decade ago. However, like most maturing industries the wind sector over the years saw a series of mergers, acquisitions, and market exits that reduced the number of competitors.

The "big three" all have next-generation offshore wind turbines in advanced and pre-commercial development so they will likely retain top three dominance as offshore wind starts to play a larger role in the U.S. wind market.

U.S. Wind Vintage Capacity Factors over Time

Wind turbines demonstrate stable production over time



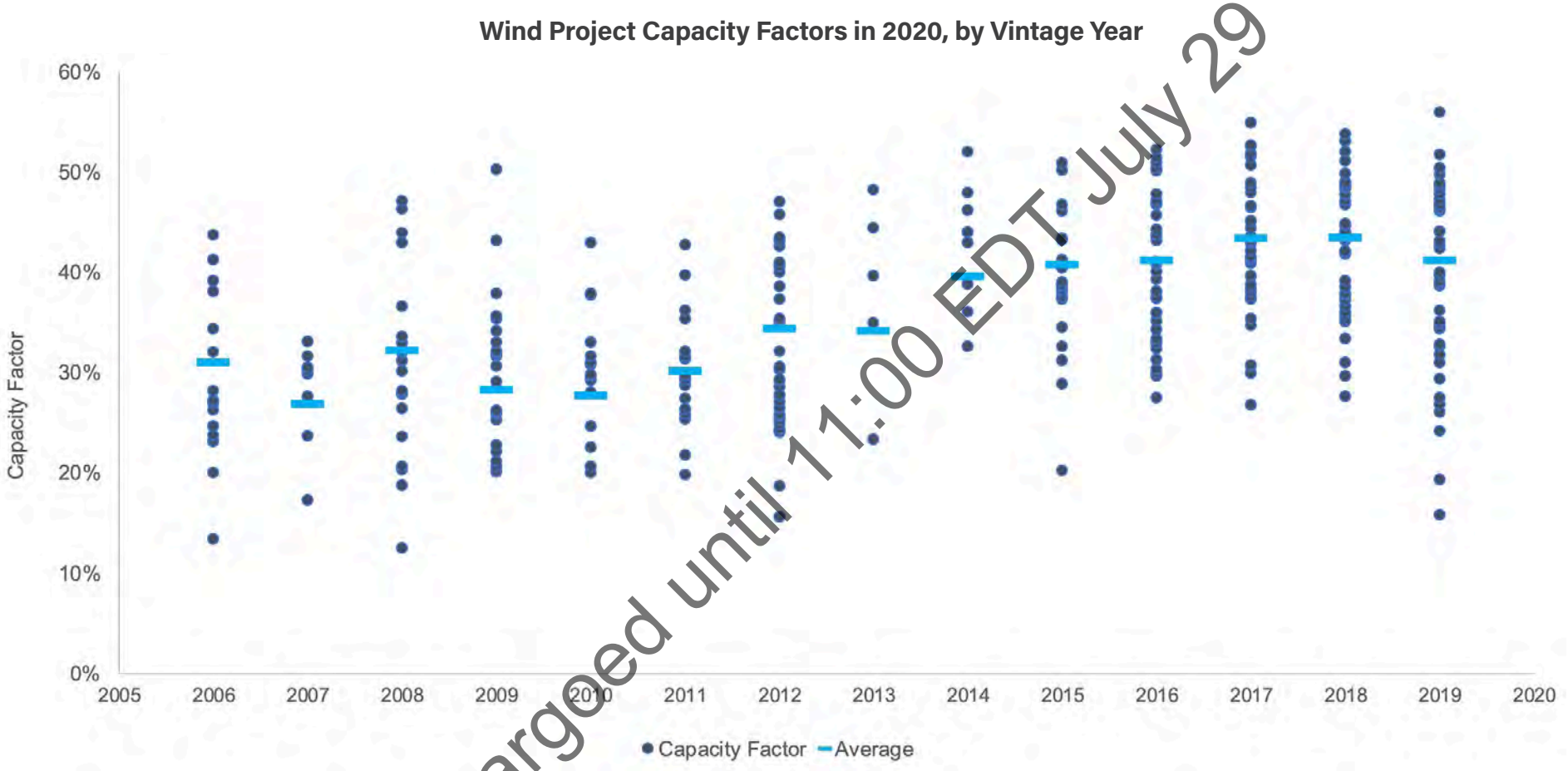
The U.S. wind power fleet continues to be more efficient at harnessing the nation's world-class wind resource and converting it to electricity. This is a testament to the improved performance of new wind turbines, which are achieving capacity factors of 40% to 50% and higher.

This chart graphing vintage year of turbines installed, and their average capacity factor in each operating year provides a key takeaway that even older turbine vintages continue to deliver consistent performance with very little degradation in capacity factor.

This suggests that as the fleet-wide average broke the 40% capacity factor barrier around 2014-2015, these wind plants should continue to provide consistently efficient performance well into the 20-25 or more years of operational life.

Wind Capacity Factors in 2020, by Vintage

Capacity factors over 40% common since 2014



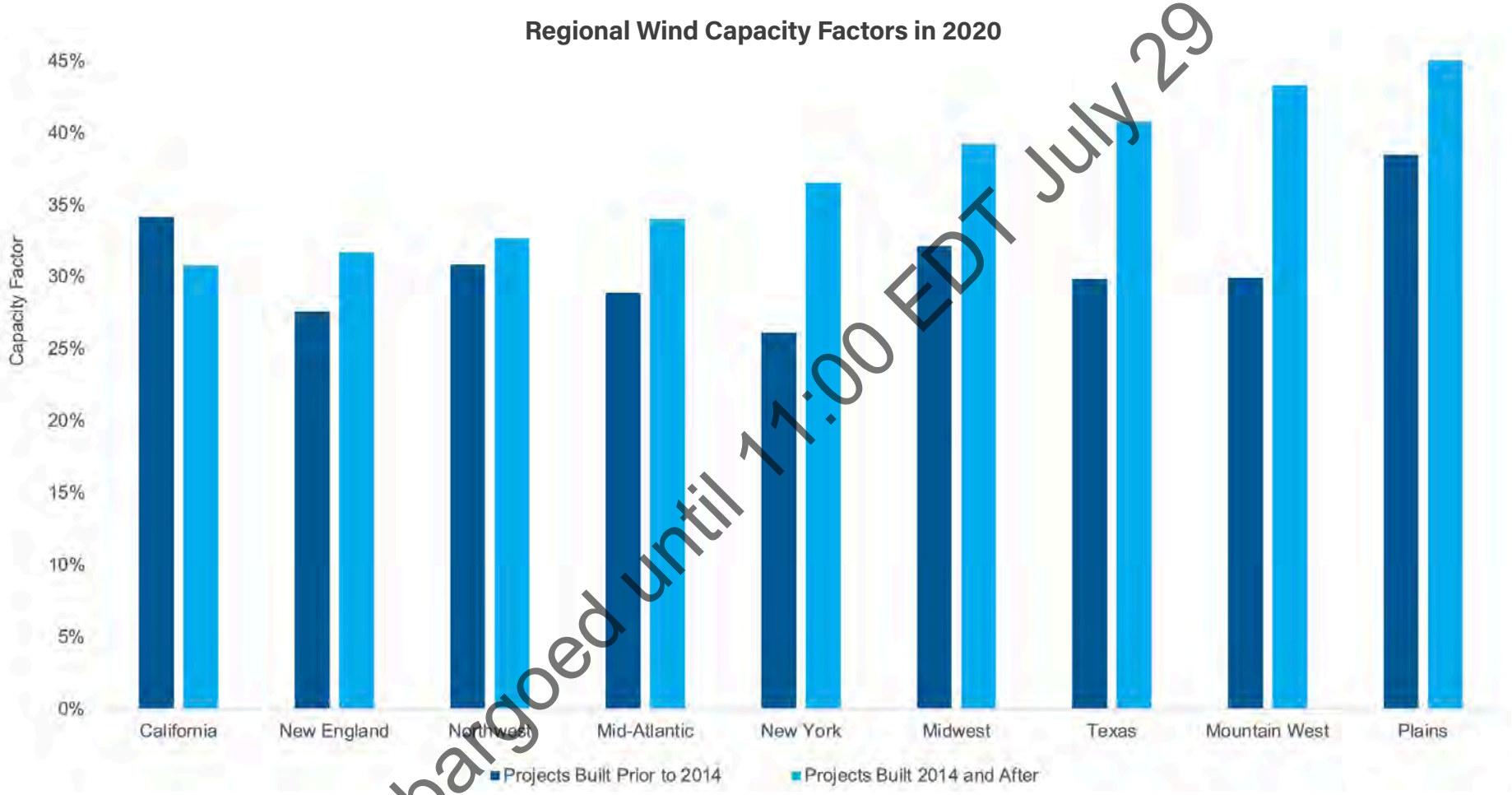
Over the last decade, the annual average capacity factor by vintage year has increased 13.5 percentage points from 27.7% for 2010 projects to 41.2% for 2019 projects, the latest year that data are available. Beginning with turbines installed in 2015, the average broke the 40% barrier and has remained above it ever since. The U.S. market hit its highest averages with 2017 and 2018 installations operating above 43%.

The slight downward movement in 2019 likely reflects that many of the best wind project sites with the highest wind speeds and near transmission access have already been developed and newer wind projects are moving into slightly less optimal locations.

A similar trend has been seen with solar projects as well with a flat-to-declining fleet-wide solar average capacity factor trend since 2013 reflecting the expansion of the solar market into less-sunny regions of the United States.

Regional Capacity Factors

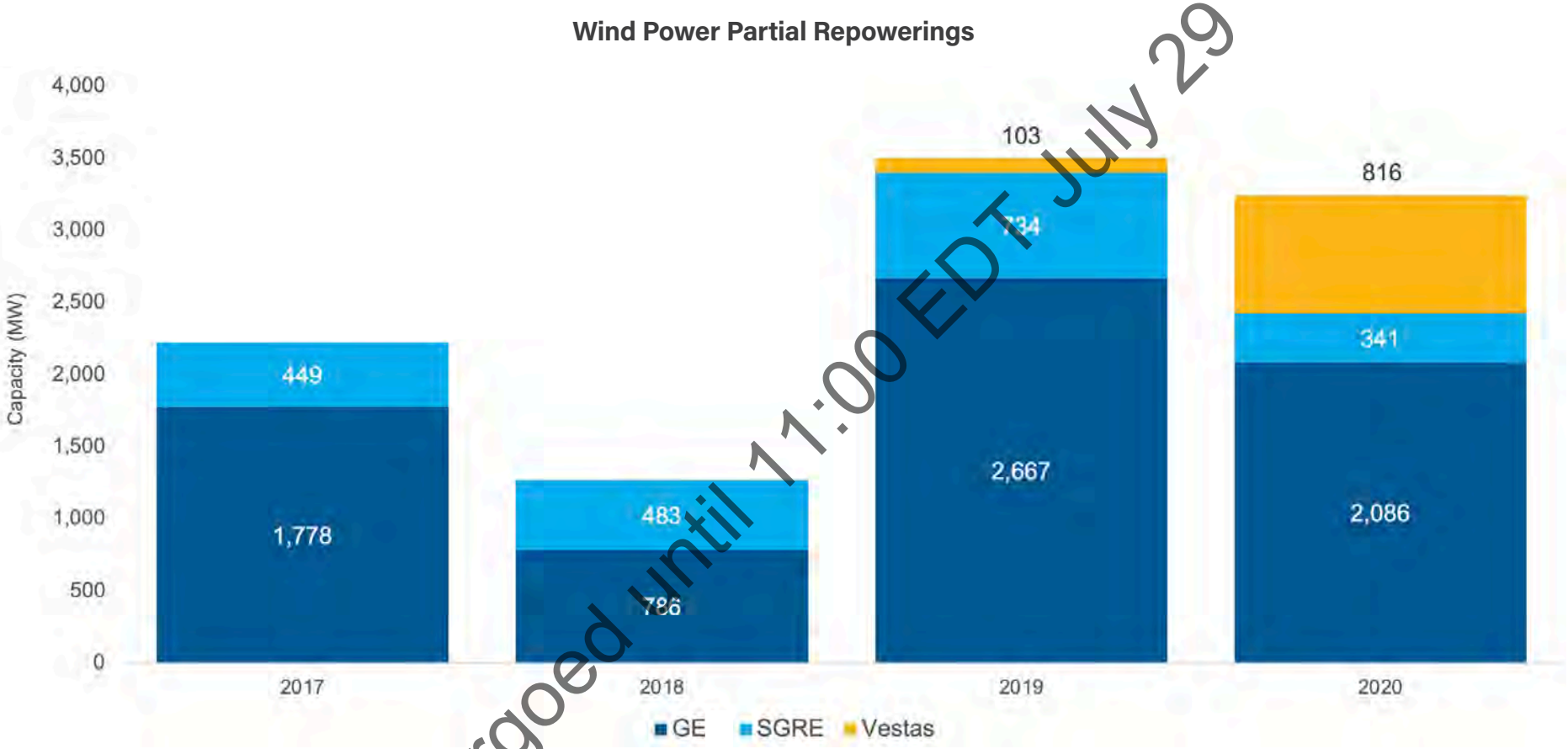
Strongest capacity factors found in Plains and Mountain West



Naturally, wind turbine capacity factors are heavily influenced by the relative strength or weakness of the wind resources in a project location. When assessing projects built after 2014—which is generally when new, more efficient turbine models entered the market—average capacity factors varied by region from a low of 31% in California and 32% in New England to highs between 41% and 45% in Texas, the Mountain West, and the Plains states.

Wind Partial Repowering

In 2020, GE repowered 2,086 MW, Vestas 816 MW, and Siemens Gamesa 341 MW



Major advancements in wind turbine technology and the opportunity to re-qualify for the PTC have spurred partial repowering activity in recent years—a trend that is expected to continue in the near-term.

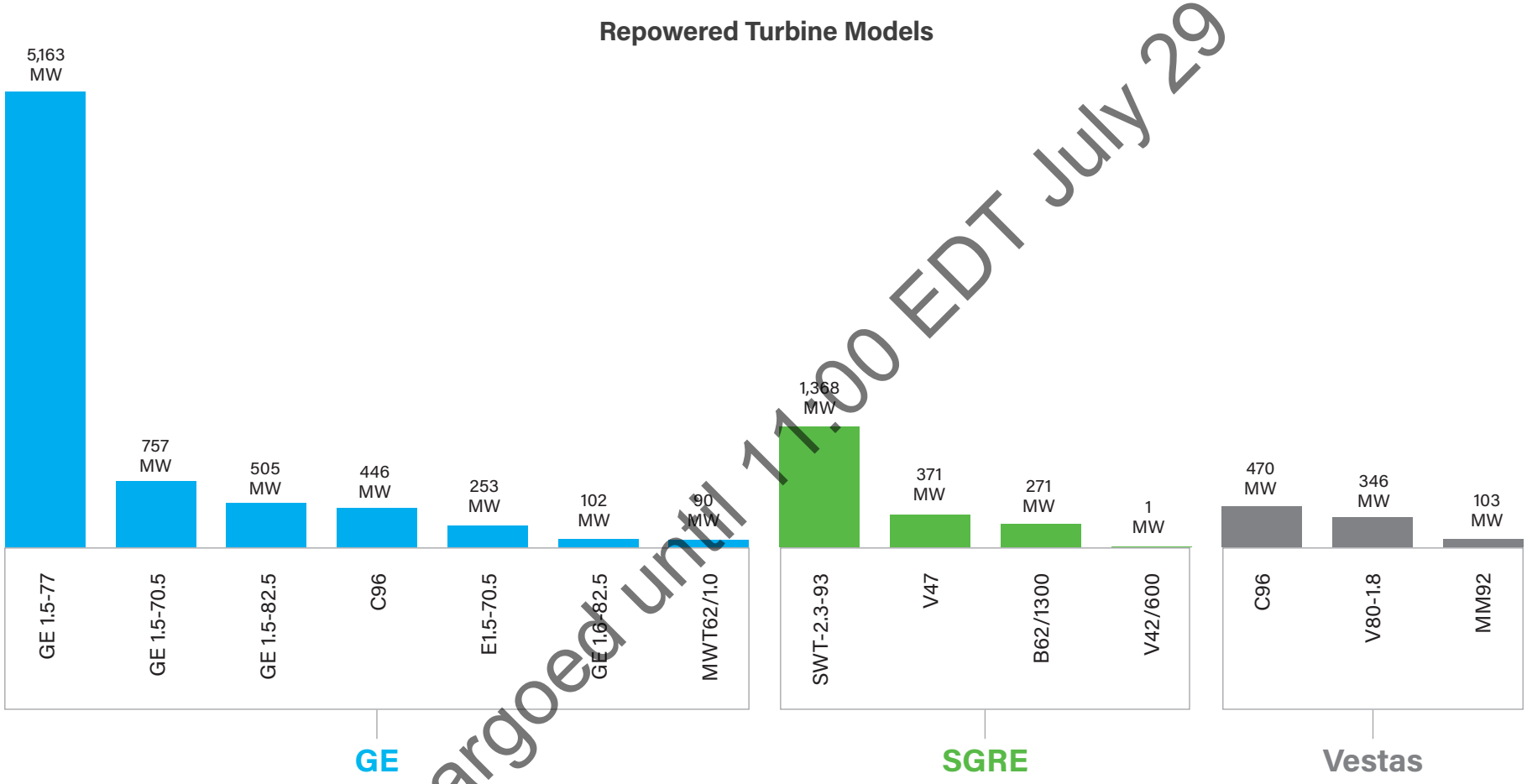
Partial repowering varies by turbine make and model and the extent of investment a wind plant owner is willing to commit. However, it generally involves extensive replacements and upgrades to a turbine's rotor and drivetrain. In most cases larger blades are added after an assessment of what can be operated safely within the original design envelope of the turbine, tower and foundation. New gearboxes, generators, power conversion, pitch/yaw drives are often component candidates for upgrades.

Through partial repowering, wind project owners can take advantage of new technologies, increase annual energy production, and extend the useful life of wind assets—without replacing the entire turbine, tower and foundation.

Full repowering, by contrast, involves an entire wind turbine be taken down and replaced with 100% new foundations and equipment. In 2020, GE Renewable Energy reported 2,086 MW of older wind turbines upgraded through partial repowering activity. Vestas follows with 816 MW and Siemens Gamesa with 341 MW.

Wind Partial Repowerings by OEM and Model

The largest legacy fleet results in the largest potential for repowering



GE Renewable Energy usually exhibits the most repowering in a given year because it has been the largest turbine OEM in the U.S. market for the longest time, so it has the most older operating turbines that are potential candidates for partial repowering.

Other turbines repowered in recent years include the C96 turbines from long-defunct Clipper Windpower. In many such repowerings, the units had their nacelles replaced by nacelles from GE and Vestas while keeping the same tower and foundation. There are other examples of repowerings between competing brands such as Siemens Gamesa securing contracts to repower Vestas V47 units—partly by drawing on the two companies' long-time shared use of hydraulic pitch and yaw systems versus electronic on GE units.

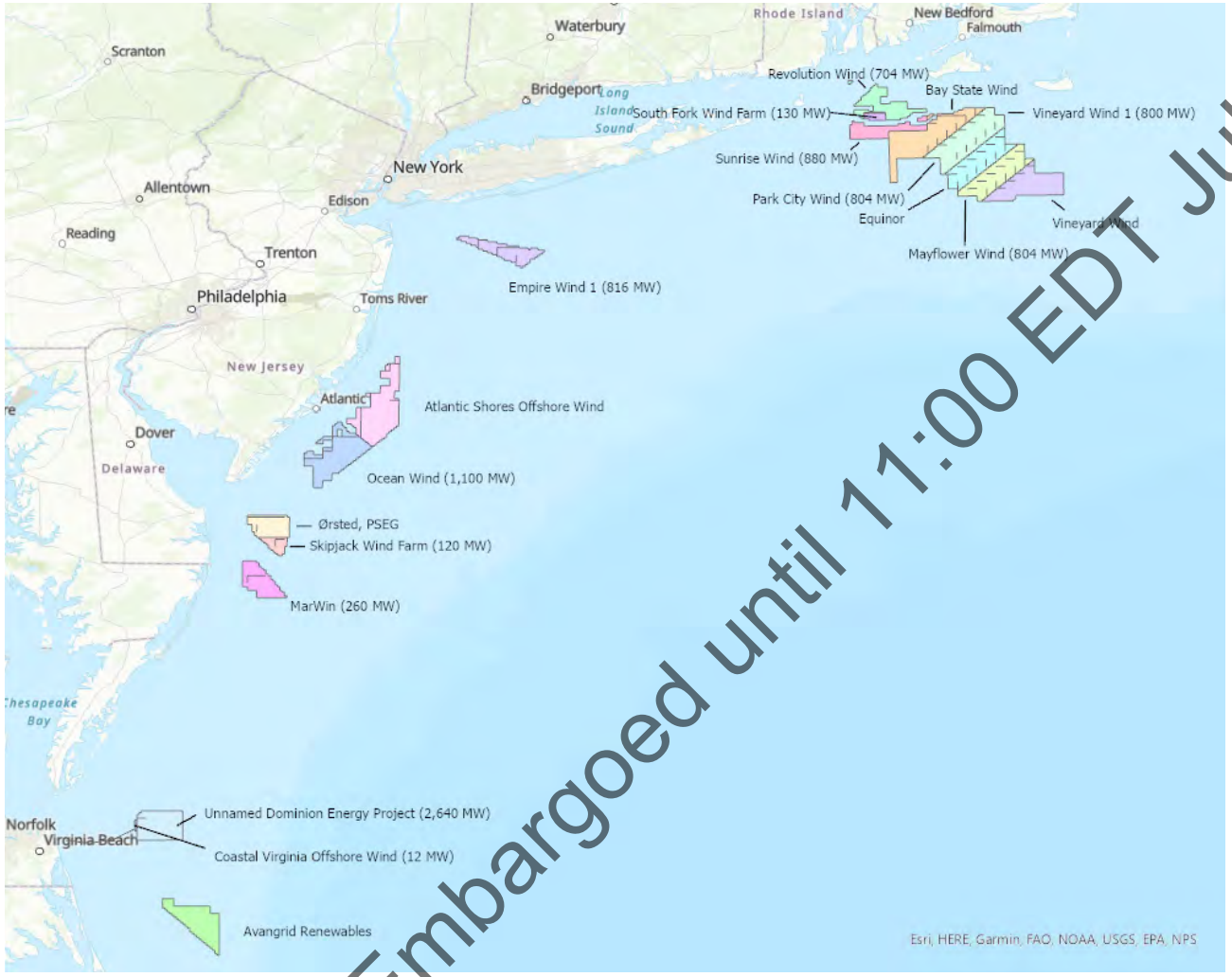
Offshore Wind Market

AMERICAN CLEAN POWER

CLEAN POWER ANNUAL **2020**

Offshore Wind Lease Areas

Offshore wind lease sites awarded to date could enable over 28.5 GW of capacity

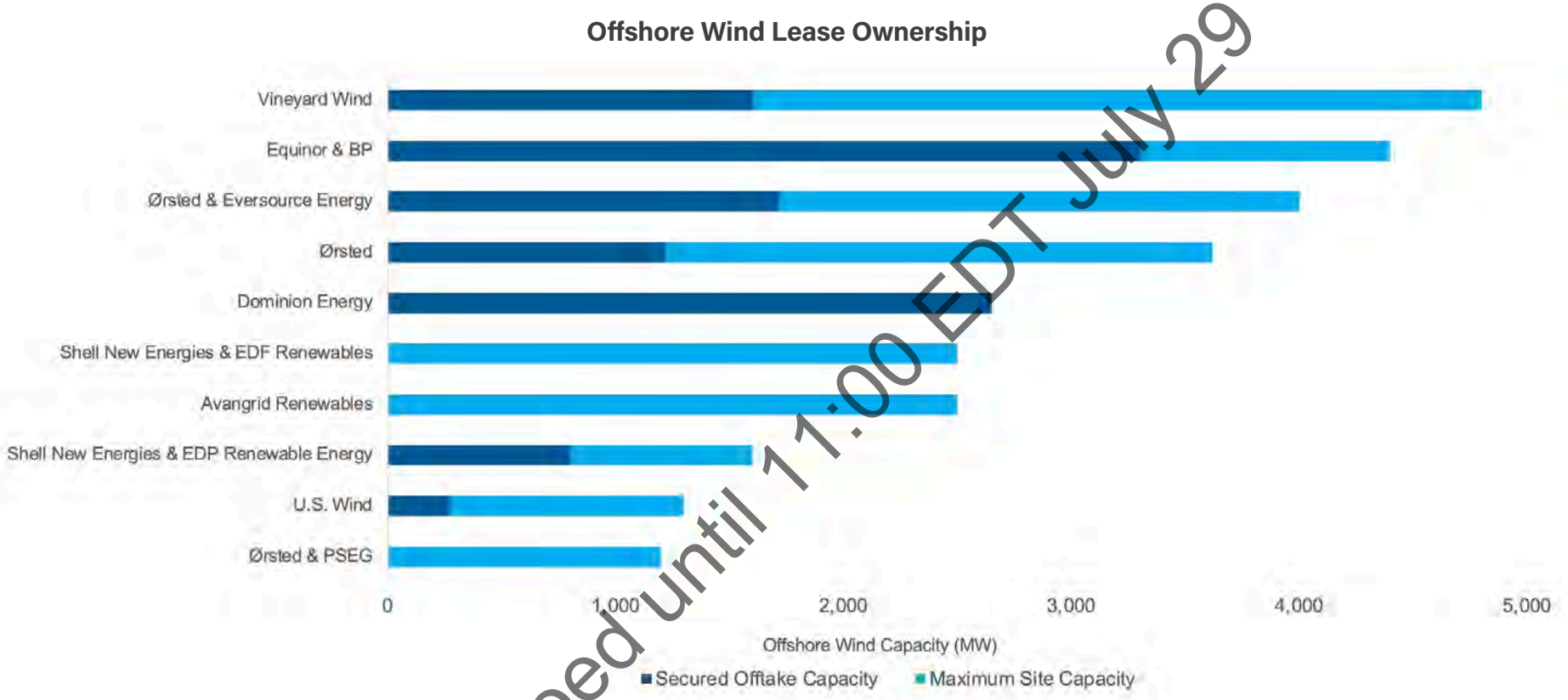


A mixture of market forces and policies at the state and federal level have enabled offshore wind to advance in the U.S., and a critical part of this momentum has been the offshore wind site lease program administered by the Bureau of Ocean Energy Management (BOEM). Its competitive auctions for offshore project site leases have so far yielded a total estimated site capacity of 28,560 MW from 19 lease sites covering 7,927 square kilometers. Actual future realized total MW capacity if all site areas are fully built out may even edge higher as larger capacity wind turbines continue to come to market.

Winning bid amounts over the years have escalated as a competitive rush ensued among developers to secure the best sites situated closest to high-cost electricity markets. For example, among the earliest leases signed in 2013 was site OCS-A 0483. Dominion Energy paid $1.6 million for the 456 km square site off the Virginia coast. Only a year later Statoil (now Equinor) paid $42.4 million for a 321 km square site—although that site located off New York is closest to some of the highest-priced electricity markets in the U.S. In 2018 the lease auction pricing wars peaked when three sites off Massachusetts each had winning bids of $135 million for similarly sized MW potential sites as the Dominion and Statoil/Equinor sites.

Offshore Wind Lease Ownership

Top five ranking ownership of offshore wind capacity with both a site lease and power contract offtake secured



Equinor and BP take the lead for total capacity under project site control and PPA offtake with 3,306 MW under offtake from Empire Wind 1 (816 MW), Empire Wind 2 (1,260 MW) and Beacon Wind 1 (1,230 MW).

Dominion Energy comes in second place with 2,650 MW of capacity from its Coastal Offshore Wind project off the Virginia coast. This is not a conventional offtake agreement because Dominion is building and owning the project to serve its own utility customers and investment is recouped by its ratepayer base, per review and contractual approval of state regulators.

Third place for offshore wind capacity with both a site lease and power contract offtake secured comes from the partnership between Ørsted U.S. Offshore Wind and Eversource Energy with 1,716 MW of capacity from three offshore wind projects: South Fork (132 MW), Revolution Wind (704 MW), and Sunrise Wind (804 MW).

In fourth place with 1,604 MW is Vineyard Wind, which is a joint venture between Avangrid Renewables and Copenhagen Infrastructure Partners. Vineyard Wind received full permitting approval for its 800 MW Vineyard Wind 1 project, so it has the distinction of being the first large project approved by Federal regulators. The developers also have a power offtake for their 804 MW Park City Wind project.

Ørsted takes fifth place with 1,220 MW with the combined PPAs of 1,100 MW for its Ocean Wind project and its smaller 120 MW Skipjack wind farm.

Offshore Wind Projects

18 named offshore wind projects totaling over 20 GW

STATE	LEASE AREA ID	PROJECT DEVELOPER/ OWNER	PROJECT NAME	WIND TURBINES	PROJECT SPECIFIC CAPACITY (MW)	TOTAL PIPELINE CAPACITY	OFFTAKER	OFFTAKE TYPE
North Carolina	OCS-A 0508	Avangrid Renewables	Kitty Hawk		800	2,500		
Massachusetts	OCS-A 0501	Vineyard Wind LLC	Park City Wind		804	2,400	Eversource Energy and United Illuminating Co (804 MW)	PPA
Massachusetts	OCS-A 0501	Vineyard Wind LLC	Vineyard Wind	GE Haliade X	800		Eversource Energy, National Grid, and Unitil Corp (800 MW)	PPA
Massachusetts	OCS-A 0522	Vineyard Wind LLC	OCS-A 0522 Development (unamed)		2400	2,400		
Virginia	OCS-A 0483	Dominion Energy	Unnamed Offshore Project	SWT-14-222	2,640	2,640	Dominion Energy	Direct Use
Massachusetts	OCS-A 0520	Equinor & BP	Beacon Wind 1		1230	2,400	NYSERDA	OREC Contract
New York	OCS-A 0512	Equinor & BP	Empire Wind 1		816	2,000	NYSERDA	OREC Contract
New York	OCS-A 0511	Equinor & BP	Empire Wind 2		1,260		NYSERDA	OREC Contract
Delaware	OCS-A 0519	Ørsted	Skipjack Wind Farm	15 x 8 MW (now 10 12-MW Haliade X turbines)	120	120	Maryland Public Service Commission	OREC Contract
Rhode Island	N/A	Ørsted	Block Island	GE Haliade 6.0-150	30		National Grid	
New Jersey	OCS-A 0498	Ørsted	Ocean Wind	92 Haliade-X 12 MW	1,100	3,500	New Jersey BPU	OREC Contract
Delaware	OCS-A 0482	Ørsted & PSEG	Garden State Offshore Energy		1200	1,200		
New York	OCS-A 0517	Ørsted; Eversource Energy	South Fork Wind Farm	15 SG 8.0-167 DD	132	2,000	Long Island Power Authority (130 MW)	PPA
Rhode Island / Connecticut	OCS-A 0486	Ørsted; Eversource Energy	Revolution Wind	88 SG 8.0-167 DD	704		National Grid (400 MW); Eversource Energy and United Illuminating Co (300 MW)	PPA
Rhode Island/ Massachusetts	OCS-A 0487	Ørsted; Eversource Energy	Sunrise Wind	110 SG 8.0-167 DD	880		NYSERDA	OREC Contract
Massachusetts	OCS-A 0500	Ørsted; Eversource Energy	Bay State Wind		2277	2,000		
New Jersey	OCS-A 0499	Shell New Energies and EDF Renewables	Atlantic Shore Offshore Wind		2300	2,500		
Massachusetts	OCS-A 0521	Shell New Energies and EDP Renewable Energy	Mayflower Wind		804	1,600	Eversource Energy, National Grid, and Unitil Corp (804 MW total)	PPA
Maryland	OCS-A 0490	U.S. Wind Inc	MarWin		269	1,300	Maryland Public Service Commission	OREC Contract

Offshore Wind Investment Announcements

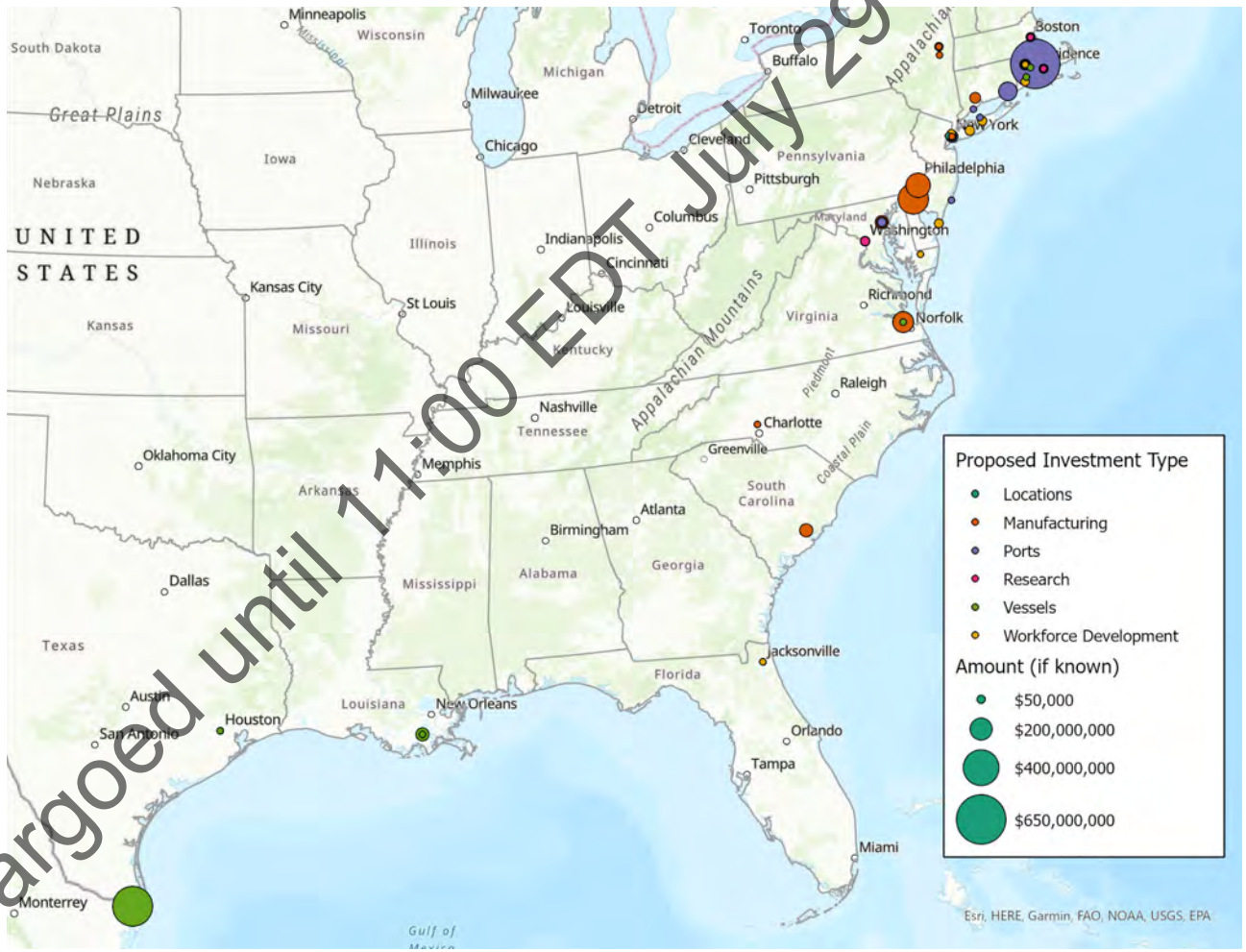
Early stage planned offshore wind investments top $2.9 billion – with much more on the way

ACP tracks announcements and news stories of planned or implemented investments in offshore wind. Proposed investments by the clean power industry includes at least $2.9 billion across manufacturing, ports, vessels, workforce development and research areas, with many more on the way.

Manufacturing and ports have seen the most investments planned with $1.47 billion, and $965 million, respectively. Vessel investments have topped $580 million followed by $57 million for workforce development and $50 million for a range of research activities.

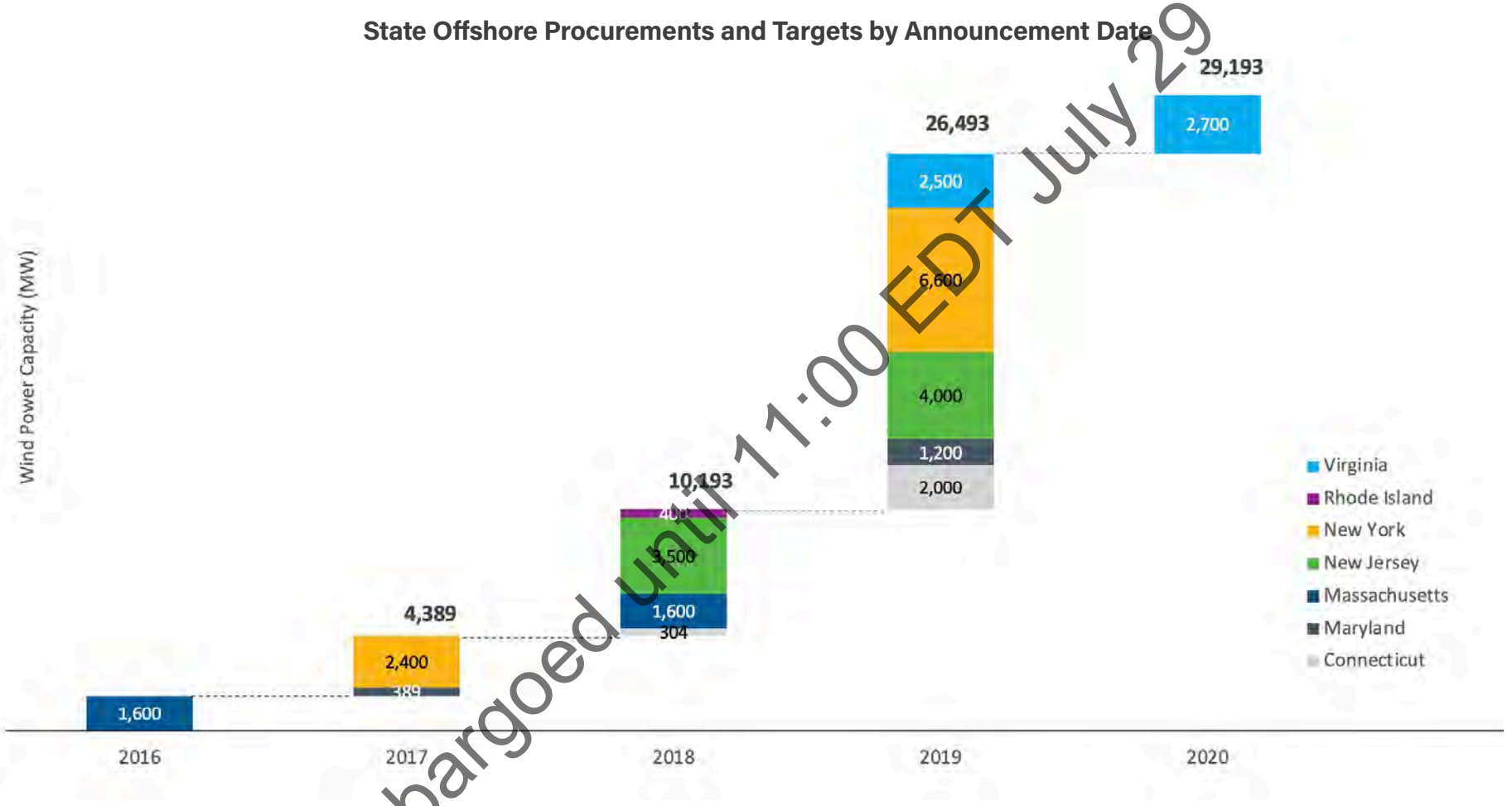
This is not an exhaustive list but rather based on data aggregated from public sources and may not reflect internal investment estimates. If your company's investments are missing or incomplete, please contact bcasey@cleanpower.org at ACP to have your information updated.

View all investment announcements



Offshore Wind State Targets

States have reached offshore wind targets of 29,193 – most with binding mechanisms



A mixture of market forces and policies at the state and federal levels has enabled offshore wind to advance in the U.S., and offshore wind procurement targets at the state level have played a crucial role.

East Coast states have steadily announced goals beginning with Massachusetts in 2016 calling for 1,600 MW, and followed by Maryland and New York the next year calling for 389 MW and 2,400 MW respectively.

Years 2018 and 2019 then saw a very large increase in these offshore targets with another 5,804 MW and 16,300 MW added. As of the end of 2020, states reached a cumulative target of 29,193 MW of offshore wind goals. The details of each state's targets differ with some as aspirational targets and some with contractually, legally binding mechanisms to direct large utilities serving those states to procure power from offshore wind projects through a PPA.

Offshore Wind and PPA Pricing

The average price of all PPAs secured so far in the U.S. for offshore wind is $98.01/MWh

Revenue in the form of power purchase price per MWh for an offshore wind plant is arguably the most critical factor in determining whether a project proceeds with a final investment decision and construction. The price discovery of what offshore wind plants require to be economically built and operated off U.S. waters has been mostly theoretical so far.

Offshore wind projects under advanced development in the U.S. will benefit from economies of scale both in the total number of turbines and the size of each turbine. Vessel capacity will not be as optimal as the established European sector, but it will be manageable.

Among the new projects underway, the various PPAs, Offshore Wind Renewable Energy Credits (ORECs) and other revenue streams show much more cost-effective pricing relative to the small first mover Block Island project.

Of the 11 wind projects with a secured PPA, the revenue ranges from $58/MWh for an 804 MW project to $160/MWh for a smaller 90 MW project. The average of all PPAs secured so far in the U.S. is $98.01/MWh. Over time the agreed-to contracts have trended significantly downward in price, largely as the economics of the next-generation 12+ MW wind turbines have been selected.

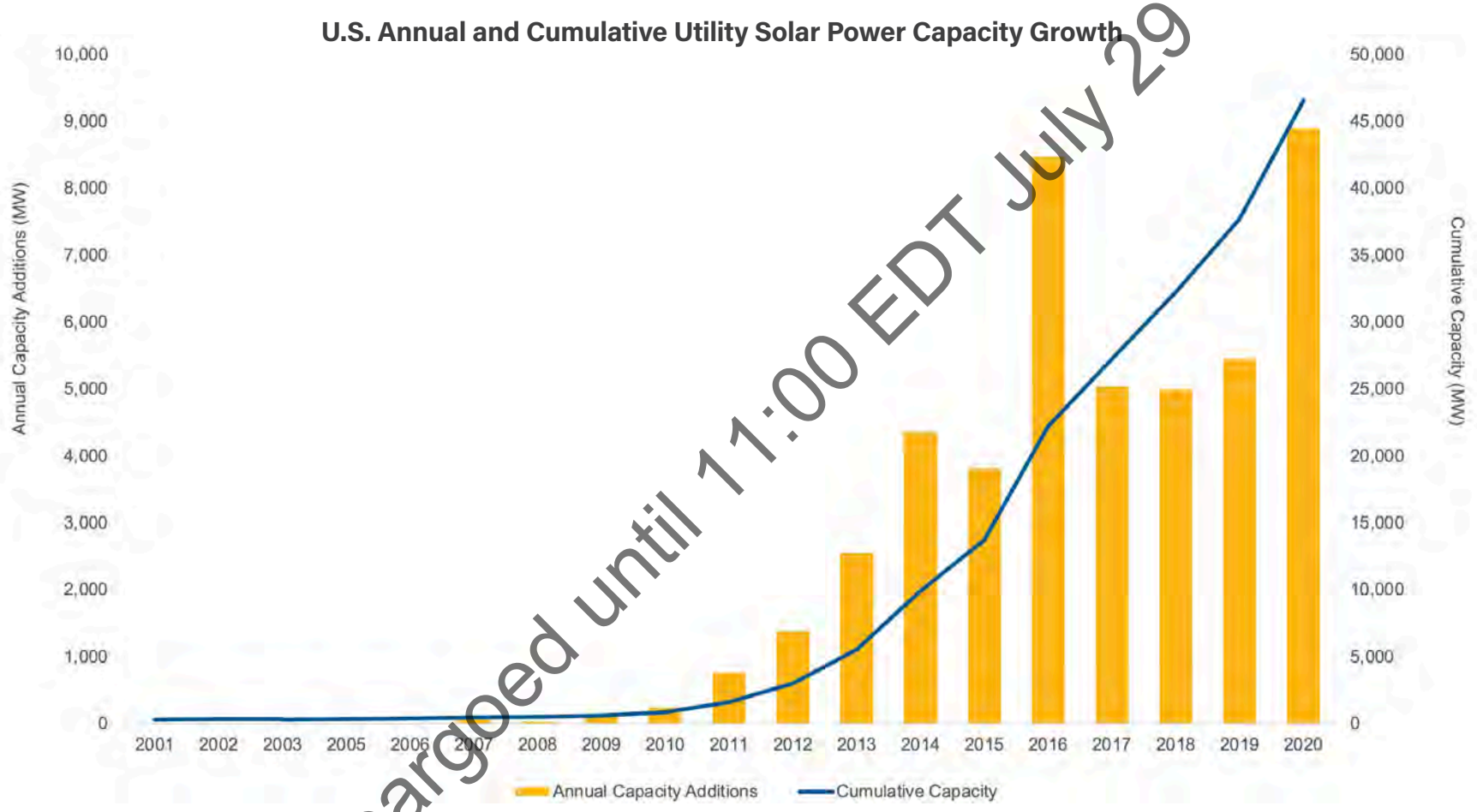
Solar Market

AMERICAN CLEAN POWER

CLEAN POWER ANNUAL **2020**

Annual and Cumulative Solar Power Capacity

Nearly 9,000 MW of new solar added to the grid



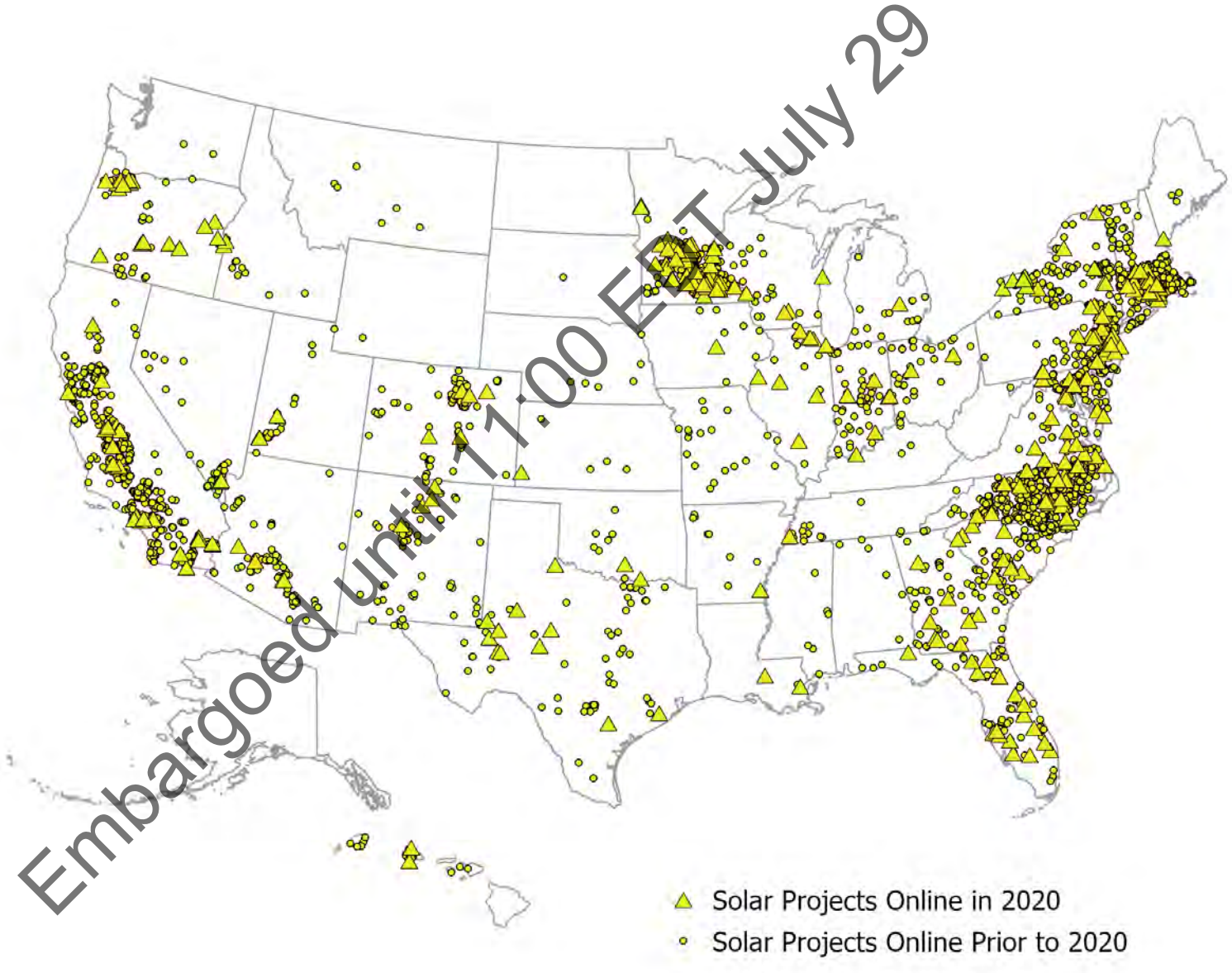
The U.S. solar industry installed 8,894 MW of utility scale capacity in 2020, up 63% from 5,450 MW installed the year before. This brings total cumulative operating capacity to 46,571 MW.

New Utility Solar Projects Built in 2020

Over 330 utility scale solar projects added to the grid

Solar power developers brought online 334 utility solar projects totaling 8,894 MW in 2020. These projects were spread across 35 states, including 14 states that added 100 MW or more. Texas led all states in new solar power, installing 2,044 MW. California placed second after adding 1,507 MW and Florida rounded out the podium with 1,267 MW.

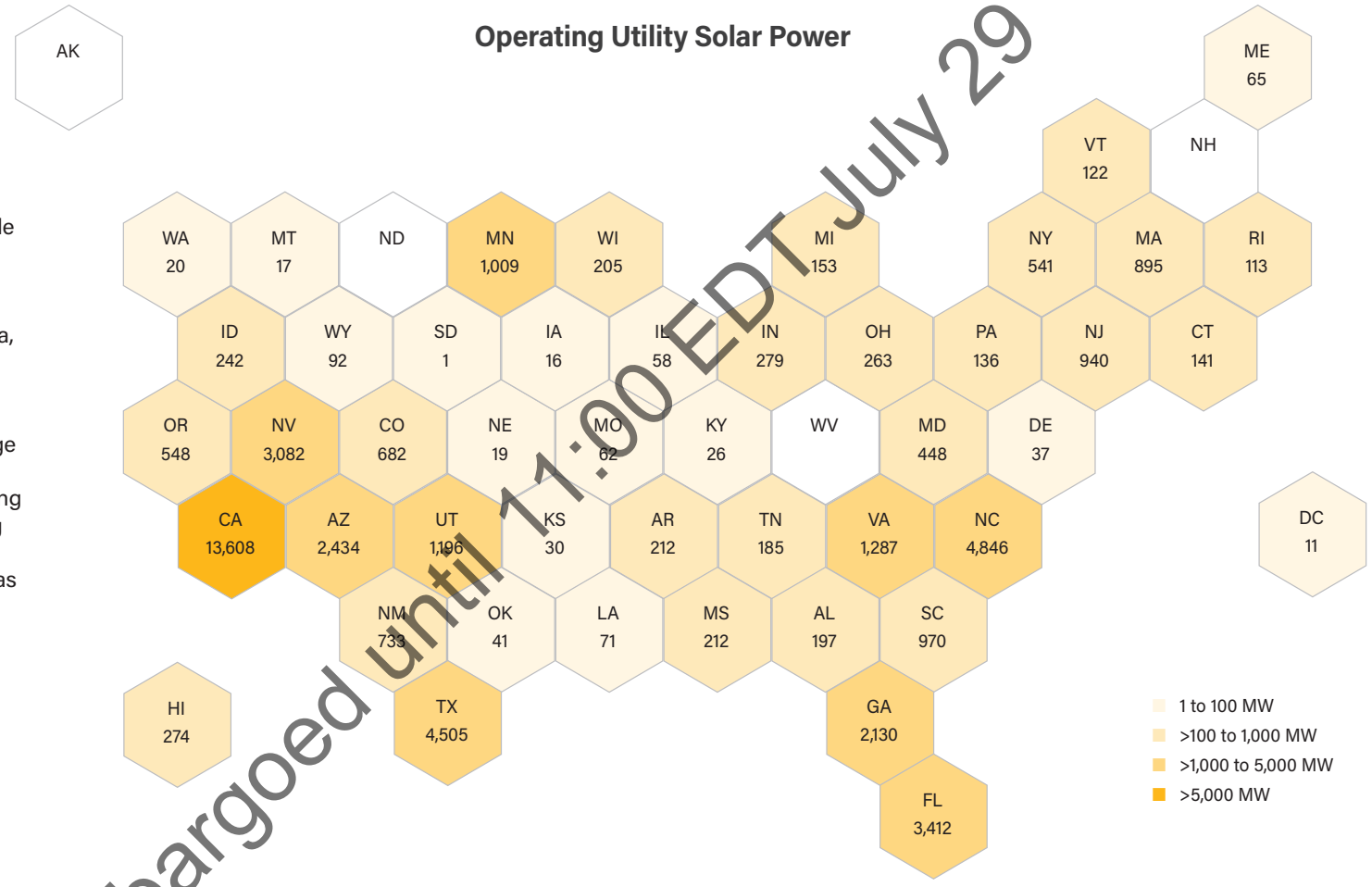
The three largest solar projects built in 2020 were all in Texas. The 400 MW Roadrunner project was the largest followed by the 300 MW Prospero plant and the 240 MW Misae Solar Park.



Operating Utility Solar Power

Nearly 47 GW of solar is operating across 45 states

Operating cumulative utility scale solar reached 46,571 MW by the end of 2020. This capacity is spread across 46 states and the District of Columbia. Only Alaska, New Hampshire, North Dakota, and West Virginia lack utility solar plants. California with its world-class solar resources, large population and supportive solar policies strongly leads the ranking with 13,608 MW. Next up among the top five are North Carolina with 4,846 MW, followed by Texas (4,505 MW), Florida (3,412 MW), and Nevada (3,082 MW).



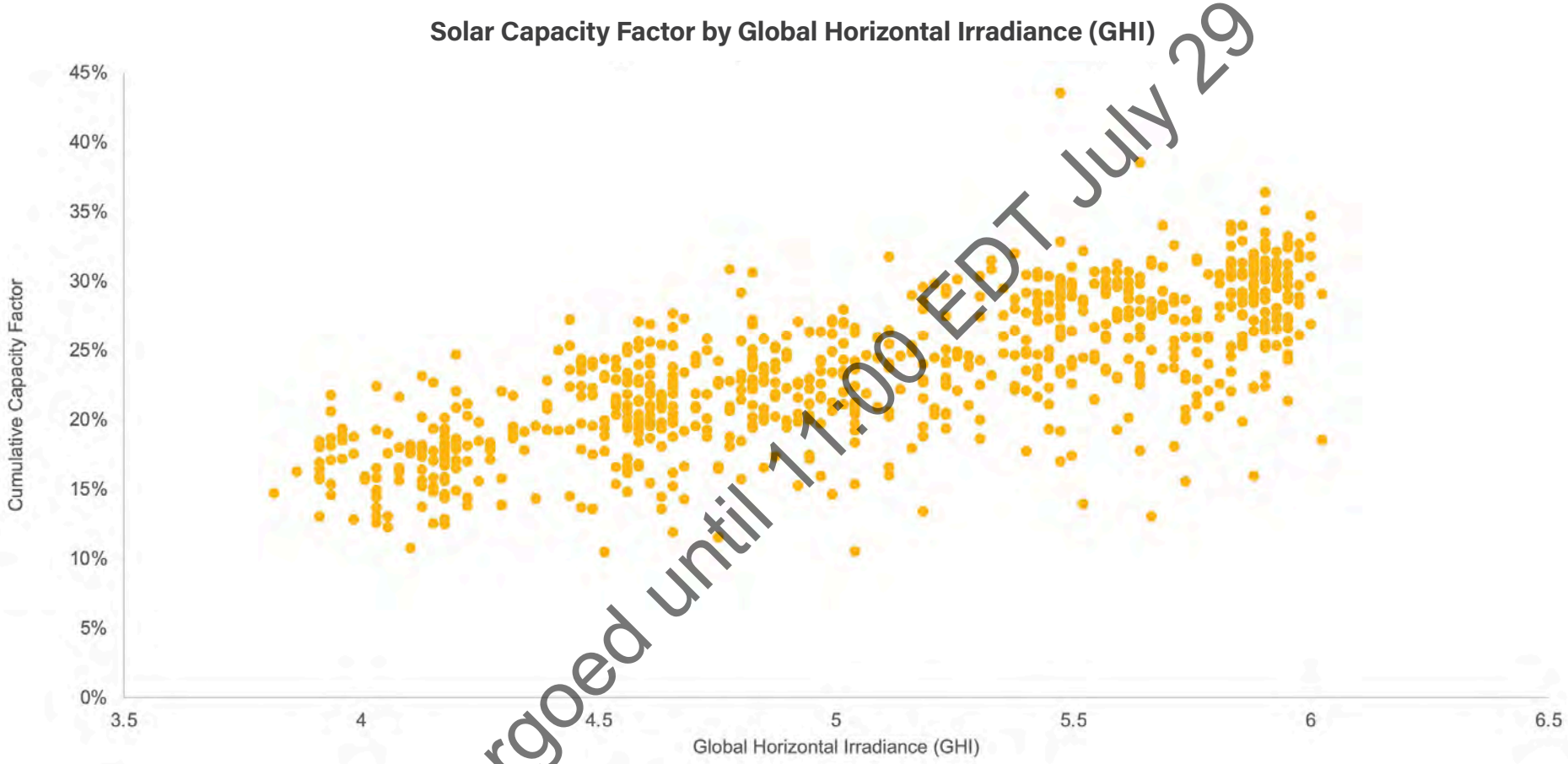
Operating Utility Solar Power by Region

California leads both state and regional rankings

California as a single state leads all regions in terms of operating utility solar power capacity, with 13,608 MW at the end of 2020. The Southeast is right behind with 12,268 MW of solar feeding the grid. In a distant third is the Mountain West with 8,218 MW. Texas, in fourth, is likely to gain similar status as California—a state surpassing regions in solar power capacity.

Solar Capacity Factors by GHI

Global Horizontal Irradiance and capacity factors are decreasing due to geographic dispersion of solar

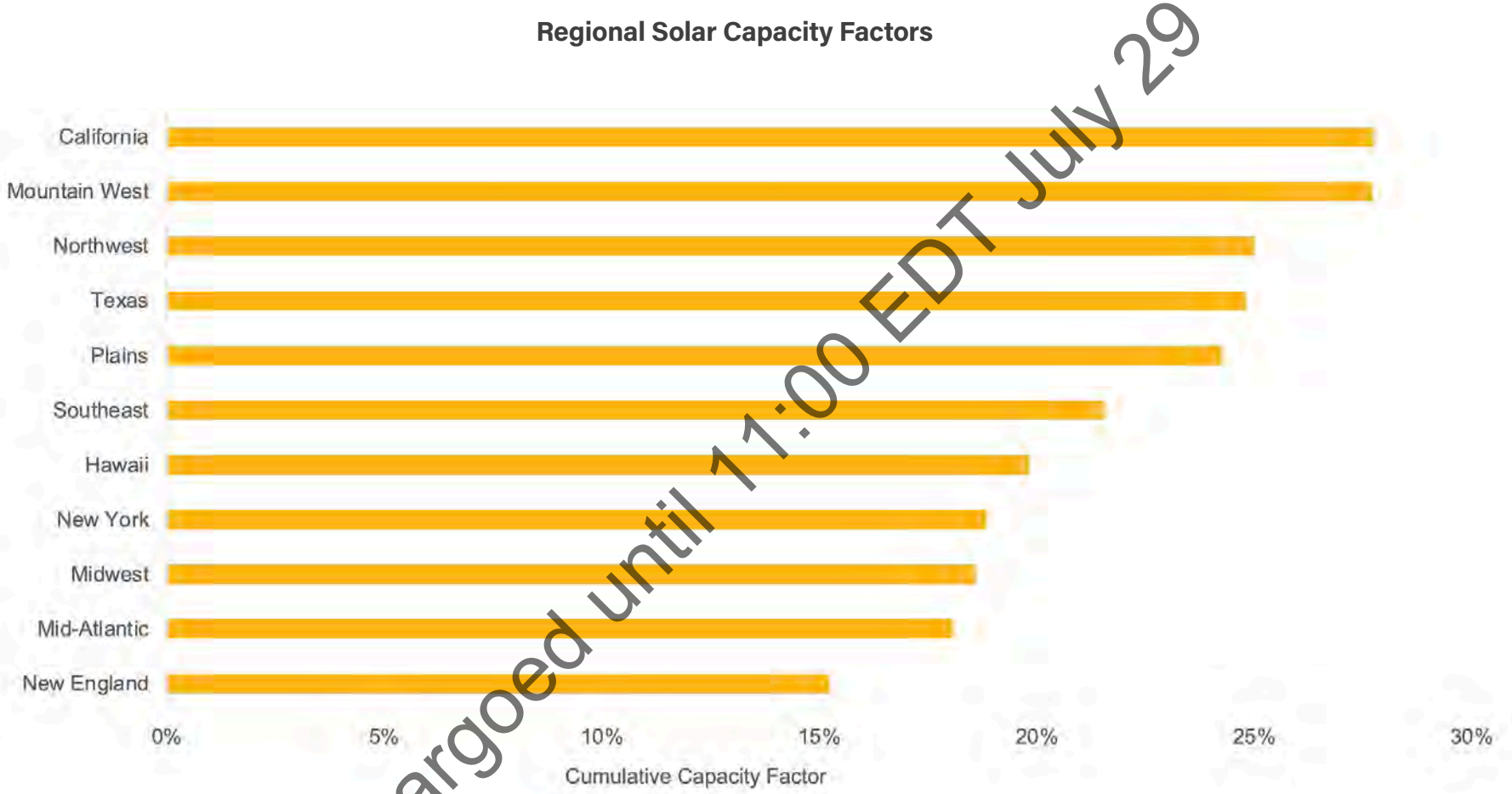


Global Horizontal Irradiance (GHI) is an important measure of total solar radiation – similar to average wind speeds in a given region for wind projects. The higher the GHI the more electricity can be produced. Historical data shows that solar projects were previously built in high GHI areas because that was in most cases the only cost-effective locations for developers to build projects and make a reasonable financial return.

Over time, developers have moved to areas with lower solar resources (in terms of GHI). This makes it seem like the capacity factor of solar panels is decreasing but it is a sign that lower capital costs are making solar projects in less sunny areas feasible. Likewise, solar modules have dropped in cost by around 90% in the last decade so these lower costs have also enabled solar projects to be profitably built in areas of less than ideal GHI.

Regional Capacity Factors

California and Mountain West home to strongest capacity factors

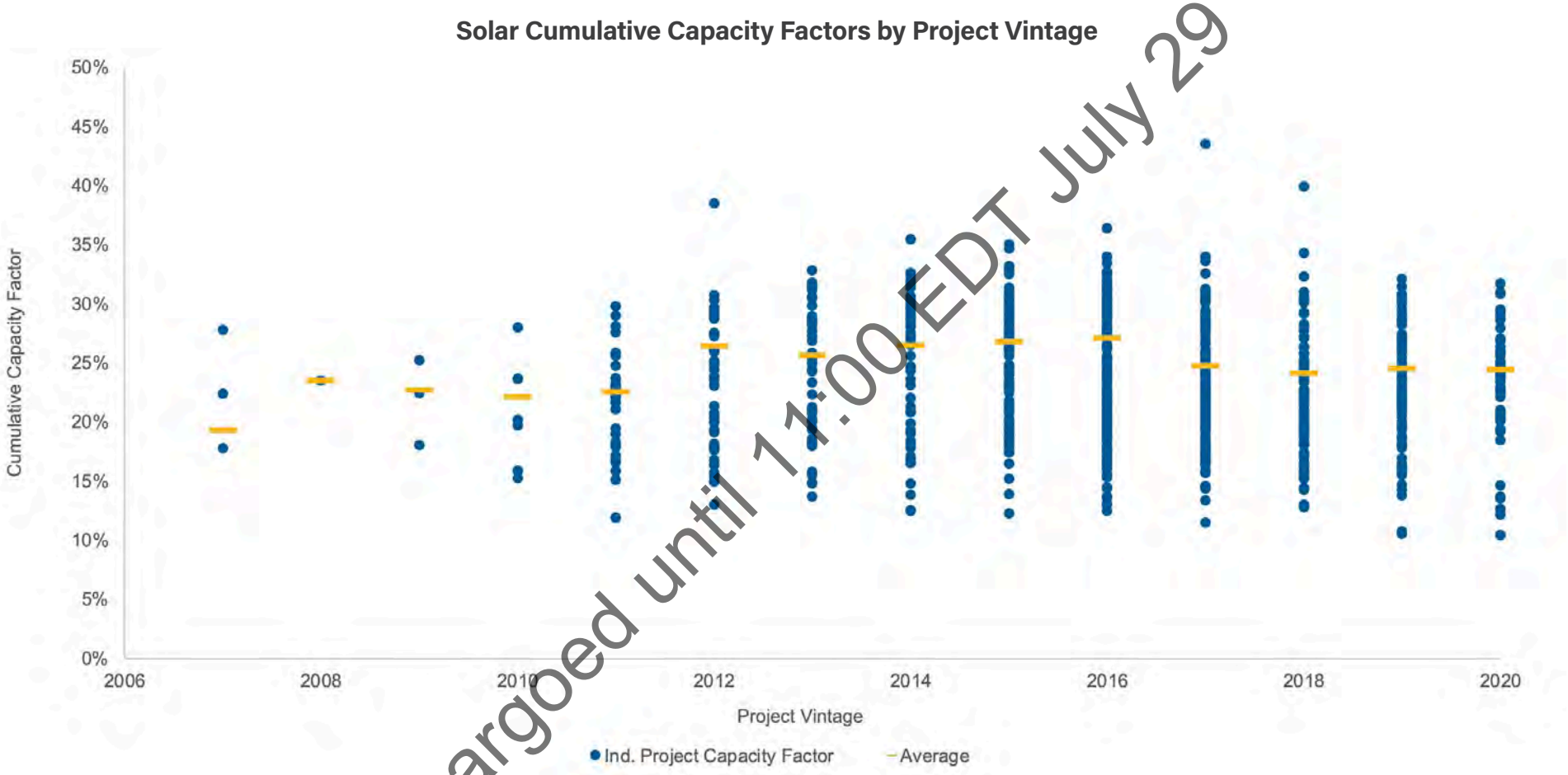


Naturally, capacity factors for solar are heavily impacted by the site-specific solar resources. Thus, solar technologies function most efficiently in the southwestern U.S., which receives the greatest amount of solar irradiance. California and the mountain west receive the most consistent sunlight so average capacity factors of utility scale solar plants are around 27.7%.

The lowest capacity factors are found in New England at 15.2% due toit being in the northernmost corner of the U.S. with longer winters and a higher incidence of cloudiness. The same phenomena explains the Mid-Atlantic and New York capacity factors averaging 18%..

Solar Capacity Factors in 2019, by Vintage

Flat-to-declining vintage capacity factors since 2013

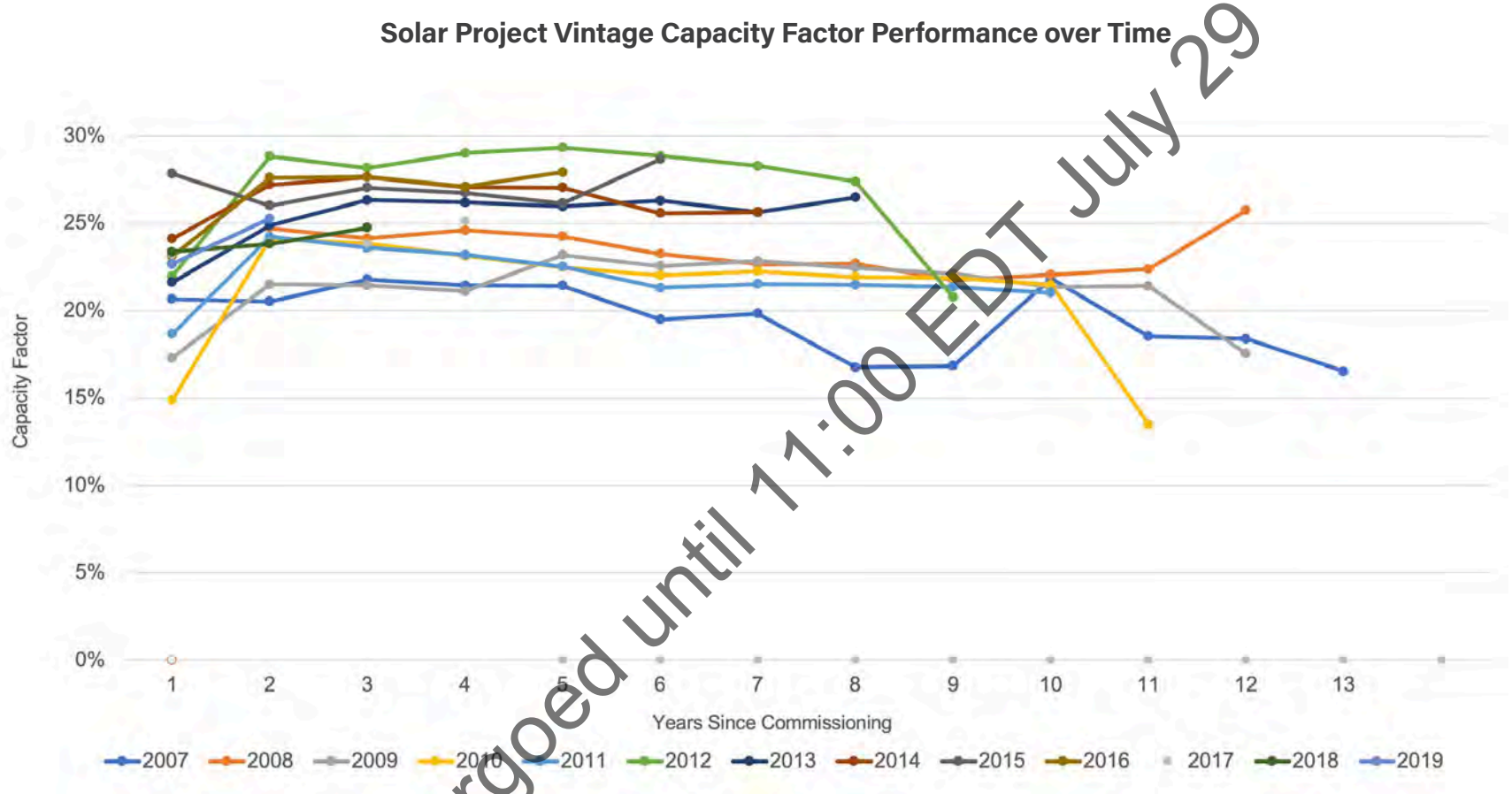


The U.S. solar market has seen gradual improvements in average solar plant capacity factors. This is the result of small but steady increases in solar PV module level capacity factors and other efficiencies and improvements with inverters and overall electrical balance of plant. Increasing use of single- and dual-axis trackers and bi-facial panels have also helped increase efficiencies.

Since 2007, average vintage capacity factors have increased five percentage points. Projects built in 2007 operate at an average capacity factor of 19.3%. Project performance steadily increased over the years and peaked between 2012 and 2016 ranging between 25%-27%. Projects built in 2017 and later saw a slight decline in overall performance with average capacity factors of ~24%. This is likely explained by the expansion of the solar market into less sunny regions of the United States.

Solar Capacity Factor Performance over Time

Solar performance declines modestly over time



Like most products there is some inevitable reduction in performance of an aging solar power plant. Although most solar panels are sold with 25- or 30-year lifespan guarantees, those panels will not perform as well 10 or 20 years after installation compared to the day they were installed. Performance declines as solar cells experience degradation due to unavoidable circumstances like UV exposure and weather cycles. Modules can fail because of unavoidable elements like thermal cycling, damp heat, humidity freeze and UV exposure. Thermal cycling can cause solder bond failures and cracks in solar cells. UV exposure also contributes to discoloration and backsheet degradation.

Studies evaluating solar degradation estimate the impact between 0.5% to 1.0% per year. Vintage capacity factors can shed some light. While some vintages of solar projects have seen sharp declines in capacity factors others have experienced flat or even increasing production. For instance, projects built in 2016 have annual capacity factors averaging between 27-28% throughout their, albeit short, life.

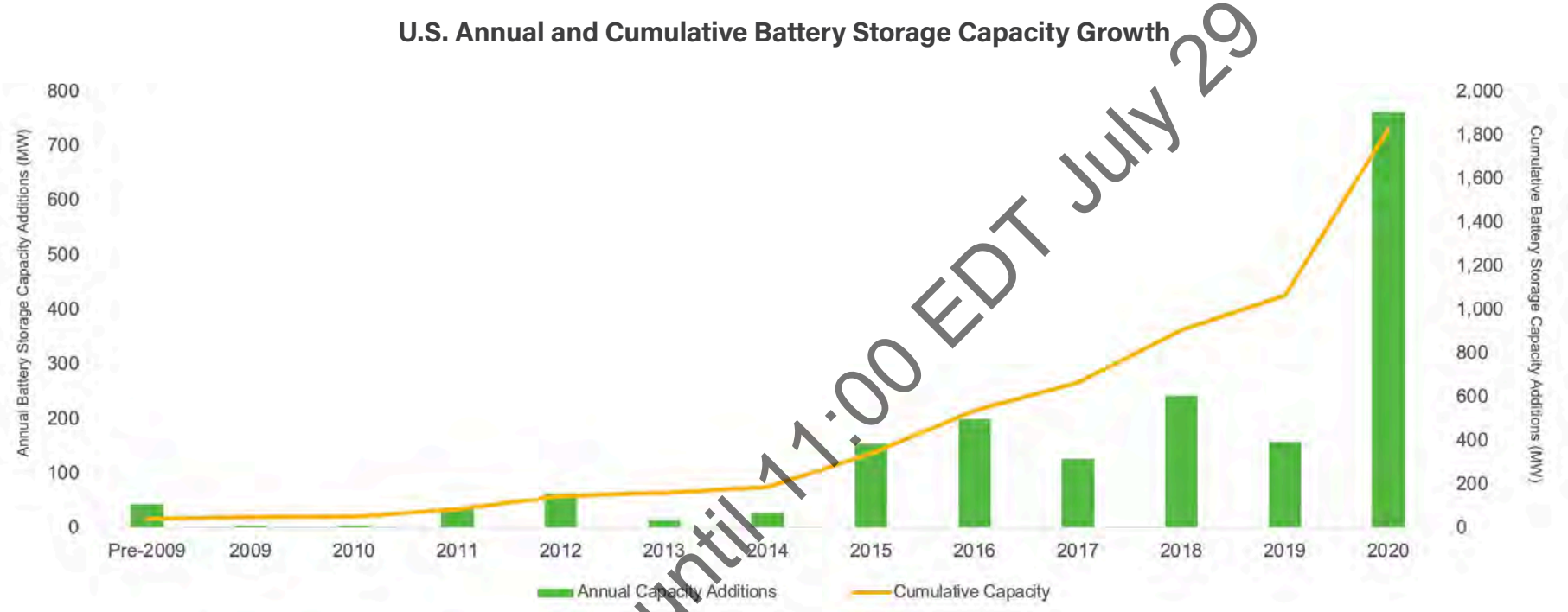
Battery Storage Market

AMERICAN CLEAN POWER

CLEAN POWER ANNUAL **2020**

Annual and Cumulative Energy Storage Power Capacity

Over 3.6 GW of battery storage is under construction across the U.S.



In 2020, a total of 760 MW of battery energy storage was added to the grid, up significantly from the year before when 157 MW was added. The new annual additions bring total cumulative capacity in the U.S. up to 1,822 MW. California with its energy storage procurement targets is the market leader with 824 MW online and goals to accelerate growth. Texas is in second place with 253 MW operating battery storage systems – mostly tethered to solar PV and wind plants.

Energy storage – almost entirely in the form of battery energy storage systems (BESS) – can allow the U.S. and other markets to incorporate more wind and solar into the grid by smoothing out the variable generation from these rapidly growing renewable energy sources and shift capacity into times of peak demand.

Solar and BESS are especially complementary since storage can shift a solar plant's peak daytime generation into the early evening when the grid is at peak demand. The most common battery systems installed recently are Lithium-ion batteries with 2-to-4-hour durations. As more wind and solar resources are added, storage is becoming more important for an efficient, reliable, and clean grid.

Like solar where rapidly falling prices are driving increased deployment, battery costs have also fallen steeply and enabled this fast-growing market. Lithium-ion battery pack prices have fallen 89% from above $1,100/kWh in 2010 to $137/kWh in 2020.

Over 3.6 GW of battery storage is under construction across the U.S. Much of this activity is concentrated in California (1,218 MW) and Texas (1,086 MW). Battery storage projects are under construction in 8 other states. Nevada (561 MW) and Florida (439) have significant amounts of battery storage capacity currently under construction.

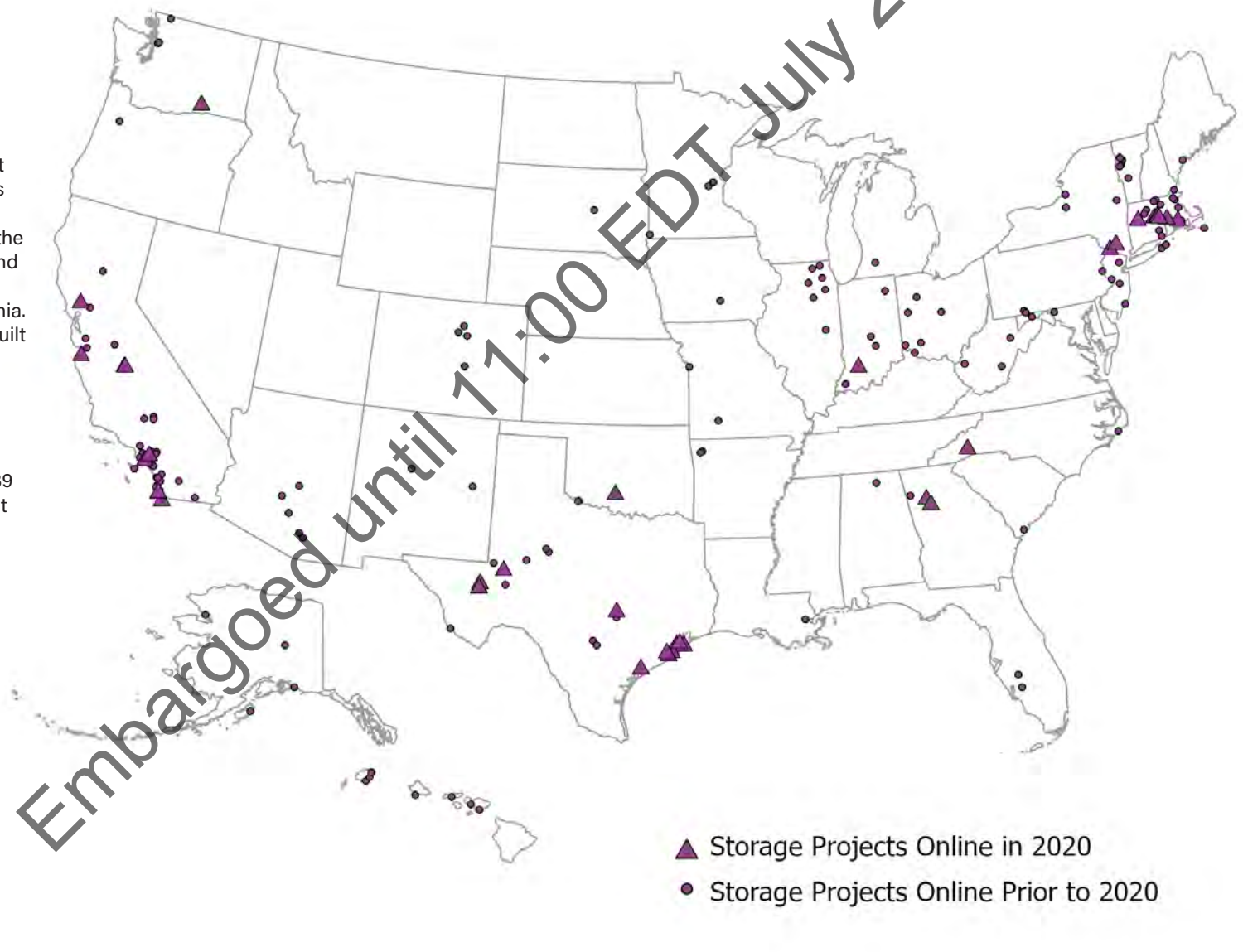
Beyond the 3.6 GW of BESS currently under construction, over 3.7 GW of battery storage is in advanced development across the U.S., including over 1.5 GW in California alone. There is 200 MW or more of battery storage capacity in development in 5 states (AZ, CO, NM, NV, OK), and four other states with projects in advanced development.

New Battery Storage Systems Built in 2020

Grid added 760 MW of battery storage in 2020

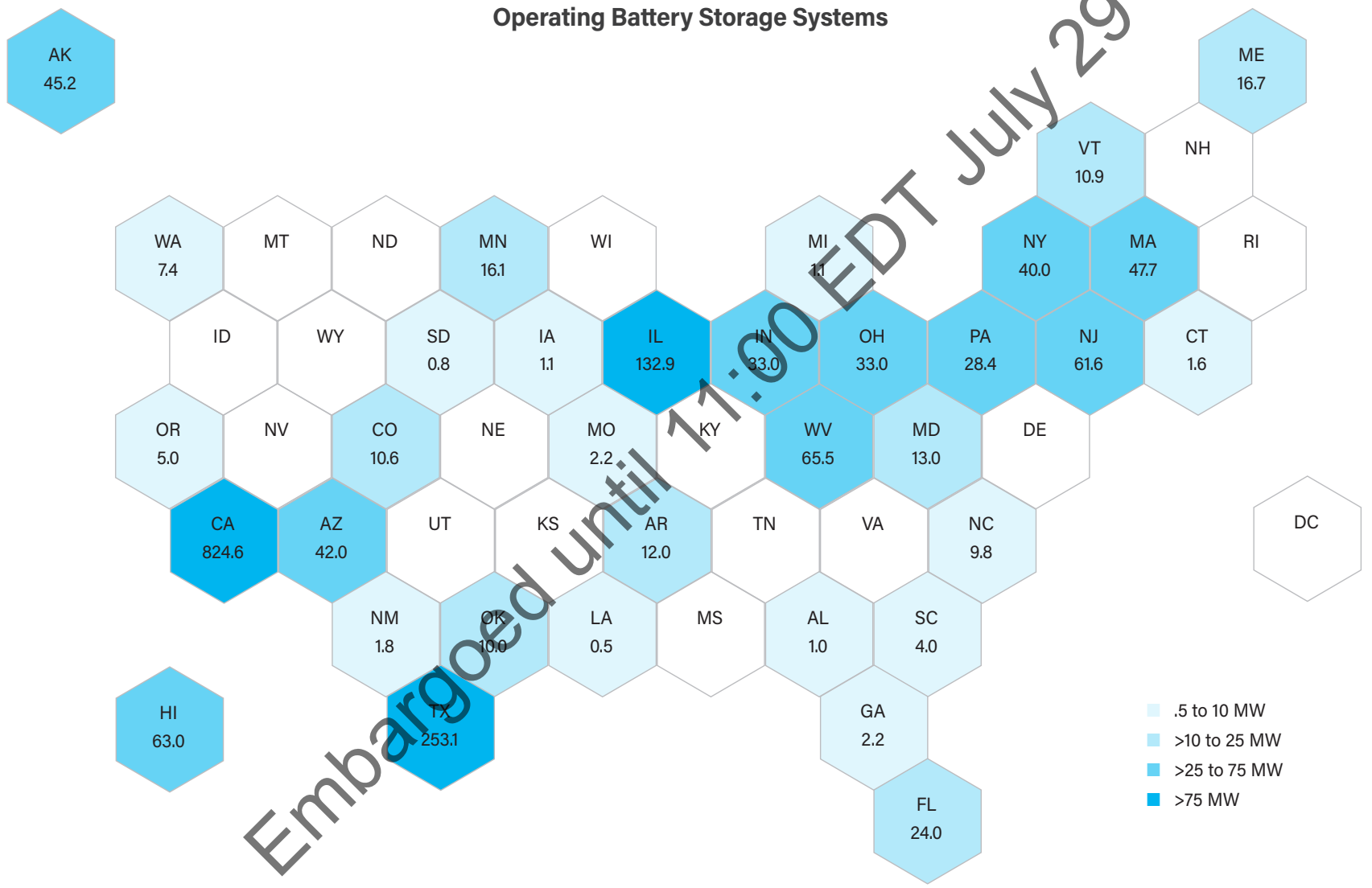
Industry built 37 new battery energy storage systems in eight states last year. These additions include the two largest energy storage systems in operation—the 300 MW Moss Landing plant and the 250 MW Gateway Energy Storage system, both in California. The rest of the storage plants built in 2020 were 20 MW or less in power capacity.

California led all states by installing 573 MW of battery energy storage systems. Texas followed in second, installing 139 MW. These two states represent 94% of all battery storage capacity added in 2020.



Operating Battery Storage Systems

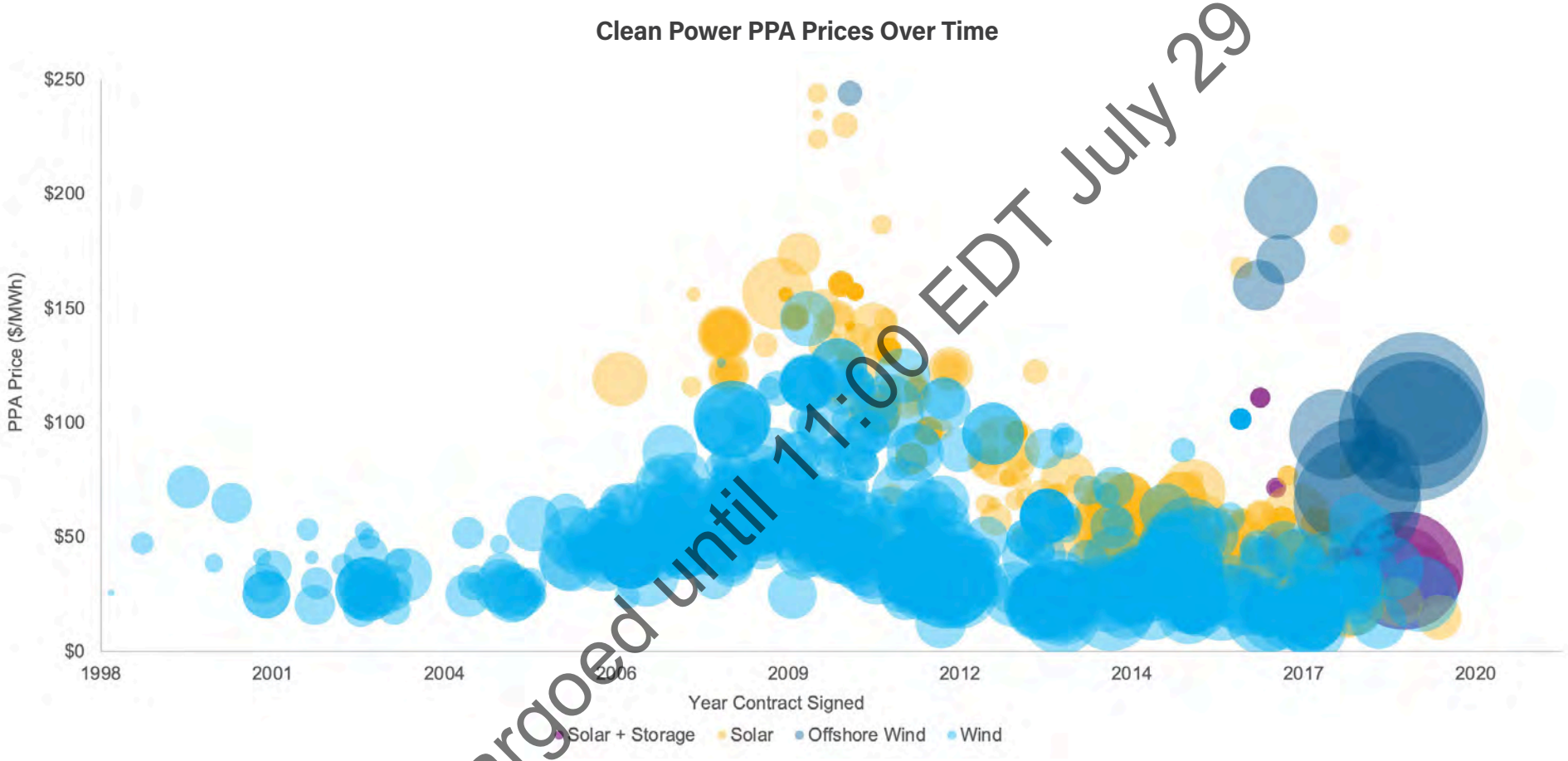
170 projects operating across 34 states



Pricing and Costs

Clean Power PPA Prices

Average wind and solar PPA prices low but starting to increase



PPA prices for utility solar prices continue to be competitive with increasing contracts for solar paired with storage. Recent solar PPAs average around $30/MWh with some projects offering in the $20s or below. Solar plus storage projects are increasing in popularity as the price declines. Recent transactions averaged $33/MWh down substantially from prices over $100/MWh as recently as 2017.

Average wind PPA prices remain flat in recent years and are starting to rise as the PTC phases-down. Projects in the center of the country continue to offer the lowest price thanks to strong wind resources. PPAs under $20/MWh are still available.

Considering offshore wind, of the 11 projects with a secured PPA, the price ranges from $58/MWh for an 804 MW project to $160/MWh for a smaller 90 MW project. The average of all PPAs secured so far in the U.S. is $98.01/MWh. Over time the agreed-to contracts have trended significantly downward in price, largely due to the economics of next-generation 12+ MW wind turbines.

Source: BNEF

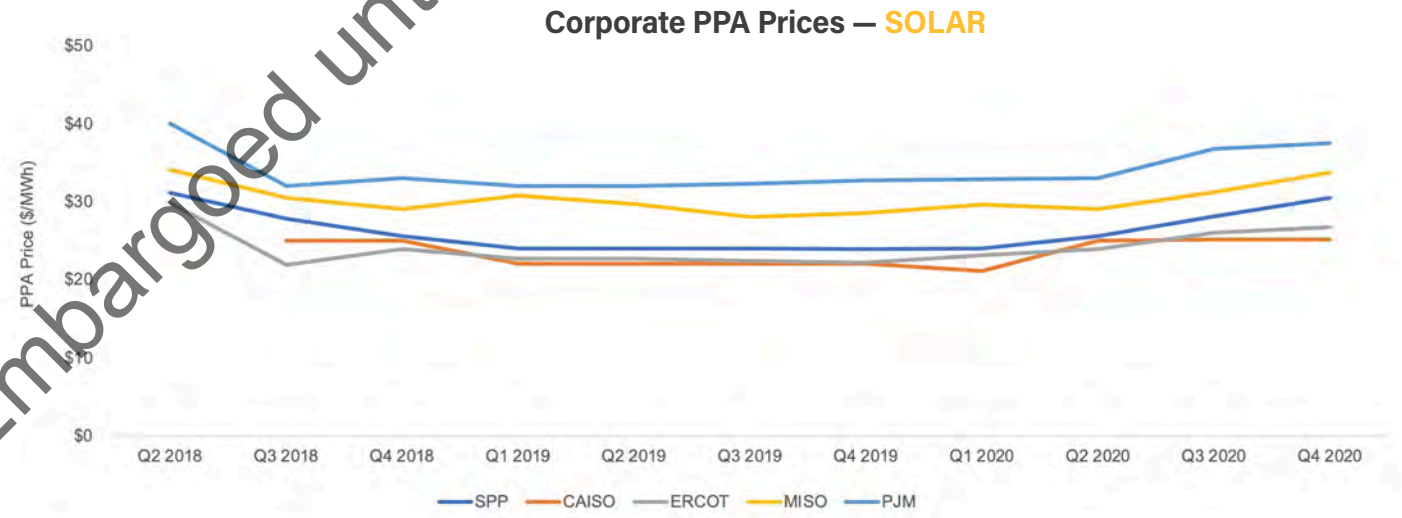
Levelized C&I PPA Prices by Technology Type

Race to the bottom C&I PPA pricing has leveled off

An important customer pool is corporate and industrial buyers. These companies seek renewables to cleanly power their business operations at a low cost. This customer class continues to grow as renewable costs decline and buying options expand.

Recent C&I PPA prices for wind and solar power reveal upward pricing pressure—though prices remain low compared to other technologies. Level10 Energy's fourth quarter 2020 data show wind pricing ranging from $19.70/MWh in SPP to $49/MWh in CAISO, while solar pricing ranged from $25.10/MWh in CAISO to $37.50/MWh in PJM.

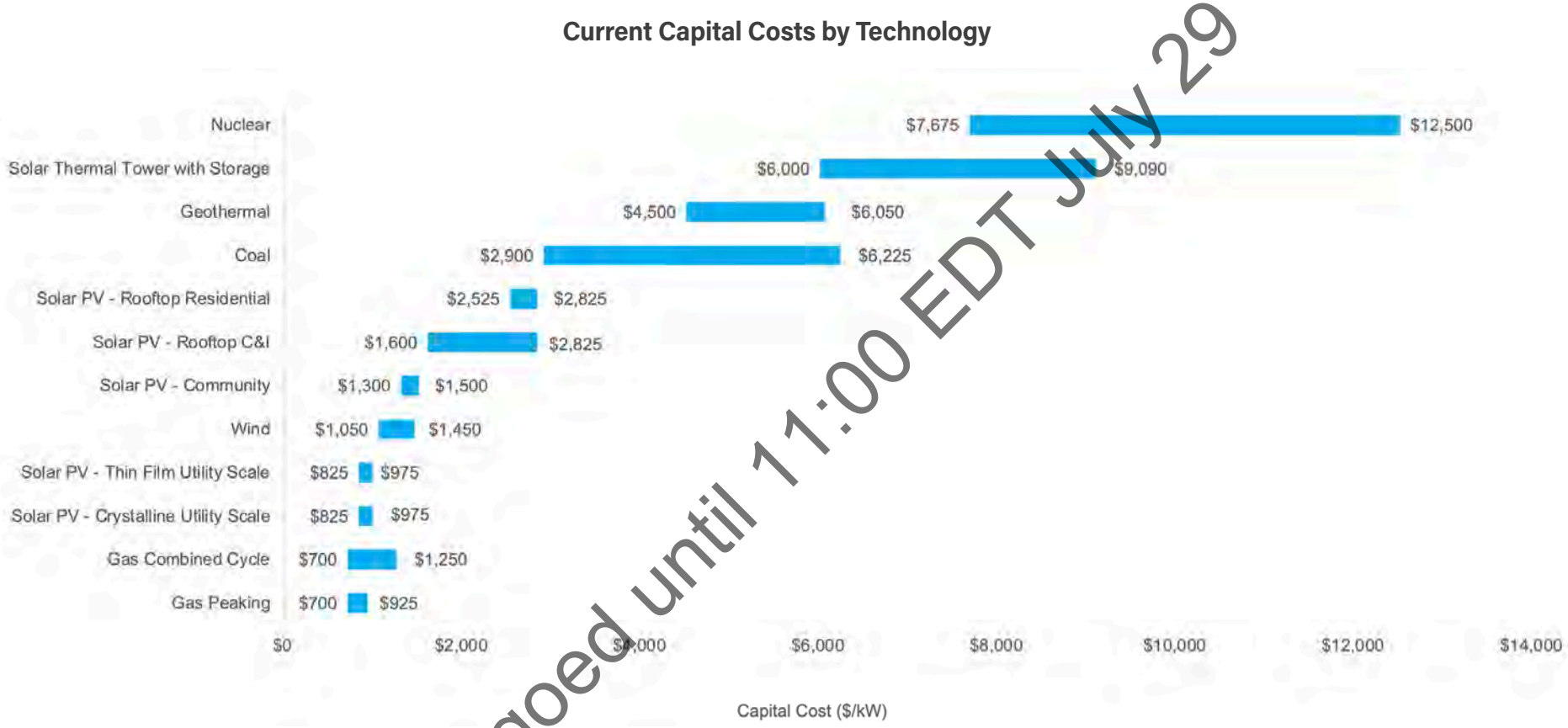
Notably for both technologies average pricing had been decreasing each year until between Q4 2019 and Q1 2020 when average pricing bottomed out and began to increase each subsequent quarter. This suggests the "race to the bottom" on pricing shifted course as tax credit levels ratcheted down and higher costs resulting from COVID, tariffs, and other barriers took hold.



Source: Level10 Energy
Prices shown represent the 10th percentile. Due to methodology changes, Q2 2018 prices represent the 50th percentile.

Capital Cost Comparison by Technology Type

CAPEX for wind and solar is within range of natural gas power plants



Renewable energy projects inherently require heavy capital cost investments up front to achieve a power generation source without ongoing fuel costs. These are hardware intensive power plants. In the case of wind, comprised of large volumes of valuable steel for towers and drivetrain parts, high tensile strength fiberglass- or carbon-fiber-reinforced polymers for oversized blades, miles of copper cabling and balance of plant, and hundreds, if not thousands of other material and component inputs.

Solar likewise has copper intensive cabling, balance of plant, and heavy expenditures on solar modules, inverters, and racking/tracking hardware. Both industries have managed to bring these CAPEX costs down to be competitive in many cases with traditional power generation projects.

Utility scale crystalline CAPEX per installed kW is between $825/kW-$975/kW. Wind ranges slightly above that between $1,050/kW-$1,450/kW (offshore wind is estimated at around $3,138/kW). This puts both technologies in competitive range with their biggest competitor, combined cycle natural gas plants, which range between $700/kW-$1,250/kW. Coal is vastly more expensive at $2,900/kW-$6,225/kW, underlying one reason why new coal plants are not being built anymore in the U.S.

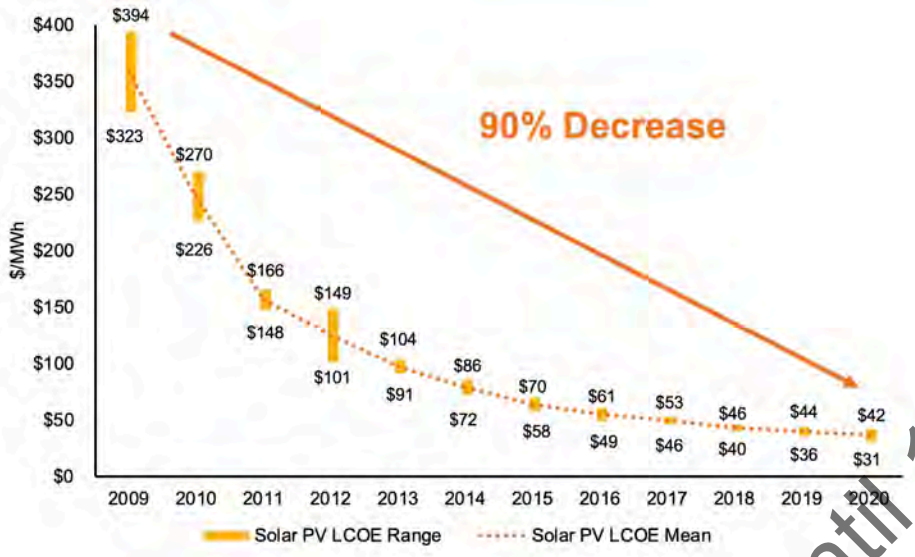
Low capital costs combined with operational efficiency and productivity advancements have enabled renewables to achieve a competitive LCOE.

Source: Lazard

LCOE by Technology Over Time

Cost of energy for solar and wind has decreased 90% and 71% since 2009, respectively

Unsubsidized Solar LCOE



Unsubsidized Wind LCOE

Levelized cost of energy (LCOE) is the lifetime price level that developers/owners of renewable energy projects need to secure to cover project and operational costs and receive a reasonable profit margin for their work bringing projects to fruition. As generation technologies that do not rely on fuel to produce electricity, technological advances that lead to falling turbine and solar module costs more easily translate to reductions in LCOE.

The unsubsidized (not considering tax credits) LCOE of wind power plants has dropped 71% from 2009 levels to just $40/MWh in 2020. Larger turbines and increasing capacity factors have contributed to an increase in the overall output of wind projects, bringing down the cost of incremental energy production. Additionally, as the wind industry continues to grow, project developers can lean on their significant experience to bring down costs and have begun to develop larger projects which benefit from economies of scale.

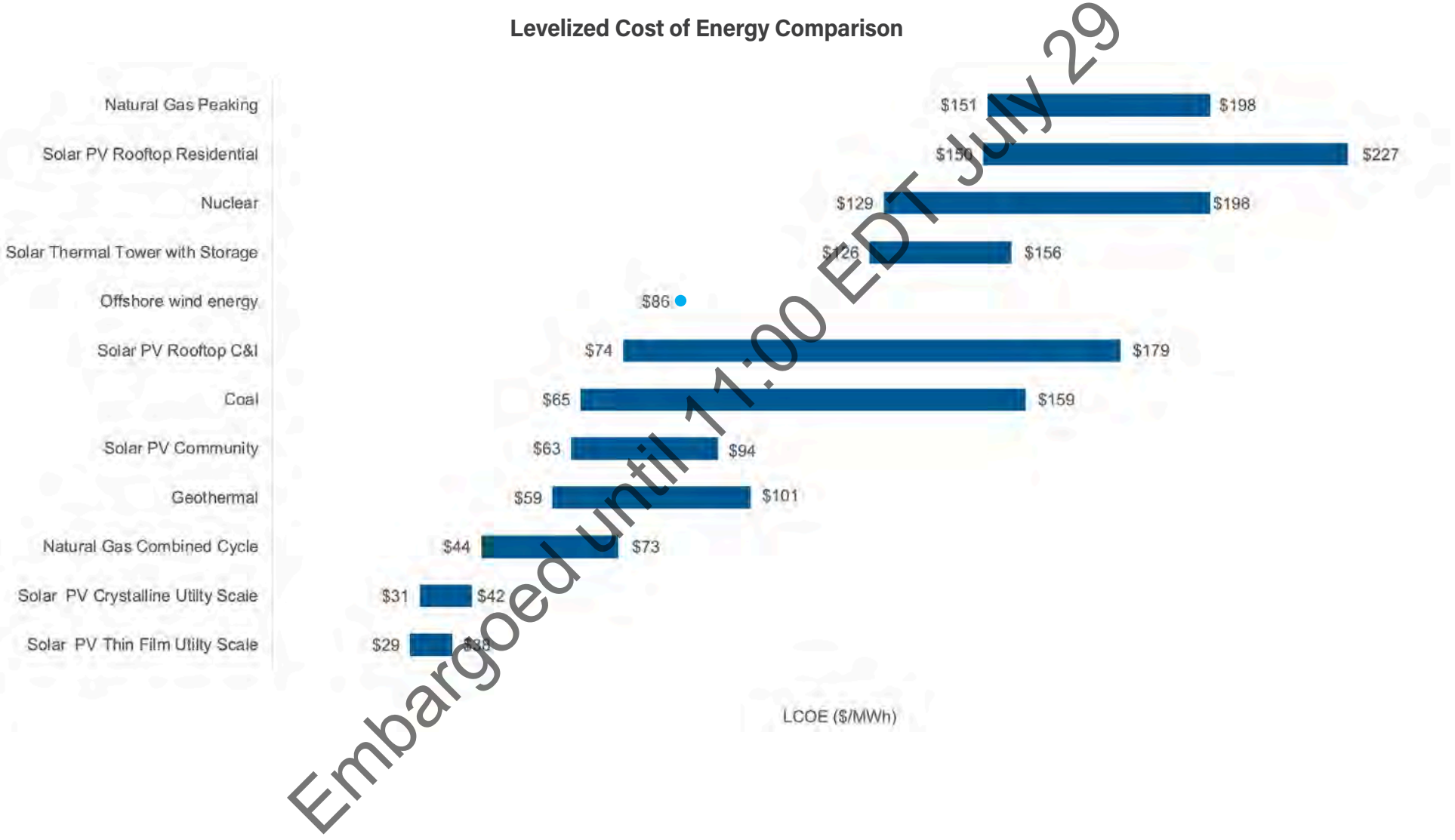
This "learning-by-doing" has had an even more drastic impact on solar project development. New manufacturing processes have led to stark declines in equipment costs as well as rapidly increasing module efficiency. Increasing project size and advances in operations and maintenance methods have also contributed to cost savings. As a result, the LCOE of solar power plants has dropped even more steeply than land-based wind, falling 90% from over $350 in 2009 to $37/MWh in 2020.

Offshore wind data points are not tracked earlier than 2013 but follow a similarly steep price drop of 43% from 2013 to 2020, from a mean of $155/MWh in 2013 to $87/MWh in 2020. These costs are expected to decline further as the nascent industry takes hold in the U.S., following a similar trend currently being witnessed in Europe.

Wind and solar offer the lowest LCOE of any generation type in most parts of the country, unsubsidized. These technologies, especially when incorporating available tax credits, are now competitive with the marginal cost of existing conventional generation.

Levelized Cost of Energy Comparison

Clean power offers lowest cost in most cases



Appendix

Offshore Wind Investment Announcements

PRIMARY INVESTMENT TYPE	SECONDARY INVESTMENT TYPE	AMOUNT	COMPANY	STATE	CITY	YEAR ANNOUNCED	DETAILS
Ports	Transmission and Energy Storage	$650,000,000	Anbaric	MA	Somerset	2019	Anbaric plans to spend $650 million to convert the former Brayton Point coal plant into an offshore wind facility. This includes building a 1,200 MW HVDC converter and 400 MW of onsite battery storage to convert and store electricity generated by offshore wind. The space will also house manufacturing and storage space for large turbine components.
Vessels	Wind Turbine Installation Vessel (WTIV)	$500,000,000	Dominion Energy, Keppel AmFELS	TX	Brownsville	2020	Keel laying began in mid-December for Dominion's "Charybdis" wind turbine installation vessel (WTIV), which could end up being first US Jones Act compliant WTIV. Keel laying customarily marks the start of full construction. The WTIV will be 472'x184'x38' and a main boom 426' tall with lifting capacity up to 2,200 tons for 12-15 MW turbines) and house a crew up to 119 persons.
Manufacturing	Blade and nacelle manufacturing	$350,000,000	State of New Jersey	NJ	Salem	2020	The state of NJ will develop a dedicated offshore wind energy port on the lower Delaware River. The wind port construction is planned in two phases, beginning in 2021 and first operations in 2023. Phase 1 calls for developing a 30-acre site to accommodate marshalling activities and a 25-acre component manufacturing site. As offshore activity grows with other projects, a Phase 2 would add more than 150 acres to accommodate expanded marshaling activities, plus manufacturing facilities for turbine components like blades and nacelles – a key long-range goal to build most components on U.S. soil.
Manufacturing	Foundations, Towers	$250,000,000	Ørsted, EEW	NJ	Paulsboro	2020	Ørsted & EEW will move forward with a factory for steel foundations for offshore wind in Paulsboro, New Jersey (announced July 2019 as part of Ørsted's winning project bid).
Manufacturing	Foundations, Towers	$250,000,000	Ocean Wind (Ørsted and PSEG), EEW	NJ	Paulsboro	2020	Ocean Wind, a joint venture between Ørsted and PSEG, and steel fabricator EEW broke ground in April 2021 on a new facility to build monopile towers in at the Port of Paulsboro Marine Terminal in Gloucester County, NJ. The facility will manufacture monopiles to supply the 1,100-MW Ocean Wind farm off the coast of southern New Jersey. EEW's facility will create as many as 260 jobs during the first phase of construction and manufacturing. Construction activities include clearing and grading of the 70-acre site, reinforcement to increase quayside bearing capacity to accommodate the 2,500-ton monopiles, and the construction of two large buildings that will support circumferential welding, sandblasting, and painting.
Manufacturing	Blades	$200,000,000	Siemens Gamesa	VA	Newport News	2020	Siemens Gamesa is actively considering a $200 million blade manufacturing facility in the Hampton Roads area. The new plant would employ 750 people and supply turbines for Dominion Energy's project.
Ports	Port upgrades	$157,000,000	Ørsted & Eversource, CT Port Authority	CT	New London	2019	A public-private investment of $157 million will upgrade State Pier's infrastructure and heavy-lift capabilities. The Connecticut Port Authority is responsible for oversight and execution of the project. More than 400 jobs will be created during the construction phase of the project. Construction is expected to begin in early 2021 and be completed by August 2022.

Offshore Wind Investment Announcements

PRIMARY INVESTMENT TYPE	SECONDARY INVESTMENT TYPE	AMOUNT	COMPANY	STATE	CITY	YEAR ANNOUNCED	DETAILS
Manufacturing	Export cables	$360,000,000	Nexans	SC	Goose Creek	2019	Nexans, Eversource, and Ørsted signed a framework agreement that gives Nexans the opportunity to provide up to 1,000 km of subsea high voltage export cables. Nexans plans to open a new U.S. facility.
Vessels	Service Operations Vessel (SOV)	$80,000,000	Edison Chouest Offshore (ECO), Ørsted, Eversource	LA	Cut Off	2020	ECO will engineer, build, operate under charter the Service Operations Vessel (SOV) for O&M for Ørsted offshore wind farms. The vessel planned will be 260 feet in length and house a crew of 60.
Manufacturing	Foundations, Towers	$76,000,000	US Wind, Ørsted	MD	Sparrows Point	2017	US Wind and Ørsted will jointly invest at least $76 million in a steel fabrication plant in Maryland as part of Maryland's Offshore Renewable Energy Credit (OREC) contract.
Ports	Port upgrades	$60,000,000	Equinor	NY	Brooklyn	2019	Equinor will invest over $60 million in port upgrades throughout New York for part of its Empire Wind project. Empire Wind was proposing to invest $60 million in port upgrades statewide, including the Port of Coeymans, Homeport Pier on Staten Island, and South Brooklyn Marine Terminal.
Manufacturing	Inter-array cables	$40,000,000	Marmon Utility	CT	Seymour	2019	Vineyard Wind will partner with Marmon Utility to establish manufacturing capabilities at its Connecticut facility to produce Kerite cables to supply some or all of the inter-array cable cores for the Park City Wind project. Marmon Utility will invest up to $4 million to hire personnel and make equipment upgrades in their Kerite power cable facility that will allow the company to manufacture inter-array cables for offshore. The supply contract would lead to nearly $40 million in direct expenditures in Connecticut.
Ports	Port upgrades	$40,000,000	Ørsted, Eversource	RI	Providence	2018	Ørsted commited to investing $40 million in improvements to the Port of Providence, port facilities in the Quonset Business Park in North Kingston, and potentially additional ports in the state for its Revolution Wind project.
Ports	Port upgrades	$26,400,000	US Wind	MD	Sparrows Point	2017	US Wind and Ørsted will invest $39.6 million for upgrades at Tradepoint Atlantic shipyard as part of Maryland's Offshore Renewable Energy Credit (OREC) program.
Research	Floating foundation R&D	$21,000,000	U.S. DOE	DC	Washington	2020	The U.S. Department of Energy (DOE) has awarded $21 million in funding for three projects: Atkins will develop a full-scale design of a floating offshore wind platform capable of supporting a 10+ MW turbine. It is planned for installation and grid connection at the Mayflower Wind lease area. The University of Maine will design, demonstrate, and validate a synthetic rope mooring for floating wind turbines at Aqua Ventus. Woods Hole Oceanographic Institution of Massachusetts will collect offshore wind resource data off the coasts of Massachusetts and Rhode Island and use it to improve atmosphere-ocean simulation tools and reduce uncertainty in offshore wind resource assessment and forecasting.

Offshore Wind Investment Announcements

PRIMARY INVESTMENT TYPE	SECONDARY INVESTMENT TYPE	AMOUNT	COMPANY	STATE	CITY	YEAR ANNOUNCED	DETAILS
Workforce Development	O&M training	$20,000,000	SUNY, NYSERDA	NY	Farmingdale	2021	The State University of New York (SUNY) and the New York State Energy Research and Development Authority (NYSERDA) have launched the Offshore Wind Training Institute (OWTI). OWTI will certify and train 2,500 New York workers beginning in 2021 to support both offshore and onshore renewable energy projects.
Workforce Development	Workforce development	$15,000,000	Ørsted	NJ	Cape May	2019	Ørsted will launch the Pro-NJ Trust Fund in Cape May and Atlantic Counties, which will invest up to $15 million in grants to support local infrastructure investments and to support small, women, and minority-owned business owners who wish to become part of offshore wind industry.
Research	Environmental	$14,500,000	U.S. DOE	DC	Washington	2021	US DOE Funding Opportunity Announcement will support regionally-focused, coordinated research efforts to increase understanding of the environmental impacts of offshore wind, as well as projects that advance and validate tools to monitor and minimize impacts.
Ports	Port upgrades	$13,200,000	Ørsted	MD	Sparrows Point	2019	A $13.2 million investment at Tradepoint Atlantic will create a 3,300-acre global logistics and staging center in Baltimore County, Maryland for laydown and assembly of components for Skipjack Wind offshore wind farm. Improvements will include strengthening ground bearing capacity at the port to allow heavy-lift cranes and specialized transporters to move wind turbine components, some weighing as much as 2,000 tons.
Ports	Port upgrades	$10,000,000	Ørsted, Eversource	NY	Brooklyn	2019	Sunrise Wind (50/50 JV between Ørsted and Eversource) will invest $10 million to establish a NY Ports Infrastructure Development Fund, which will invest the money in port facilities around the state to ensure that ports are capable of serving as staging areas for the manufacture, construction and transport of major windfarm components.
Research	Supply chain development	$10,000,000	Vineyard Wind	MA	Boston	2018	As part of the Vineyard Wind project, the Wind Accelerator Fund will accelerate development of an offshore wind supply chain, businesses, and infrastructure in Massachusetts.
Workforce Development	O&M training	$10,000,000	Ørsted, Eversource	NY	Selden	2019	Ørsted and Eversource are investing $10 million to create a National Workforce Training Center in partnership with Suffolk County Community College and leading labor unions as part of the Sunrise Wind project's economic development plans.
Ports	Port leasing	$9,000,000	Vineyard Wind	MA	New Bedford	2019	Vineyard Wind signed a $6 million annual lease to use the New Bedford Marine Commerce Terminal for 18 months (total $9M).
Workforce Development	Workforce development	$4,500,000	Equinor	NJ	New York	2019	Equinor will commit at least $4.5 million to community benefits and workforce development.
Research	Environmental	$3,000,000	Vineyard Wind	MA	Boston	2018	Vineyard Wind will contribute $3 million to a Marine Mammals and Wind Fund as part of the project's economic development package.

Offshore Wind Investment Announcements

PRIMARY INVESTMENT TYPE	SECONDARY INVESTMENT TYPE	AMOUNT	COMPANY	STATE	CITY	YEAR ANNOUNCED	DETAILS
Workforce Development	Workforce development	$3,000,000	Ørsted, Eversource	RI	South Kingstown	2019	Ørsted US Offshore Wind and Eversource pledged $4.5 million to support offshore wind education and supply chain development for the growing offshore wind industry in Rhode Island. Of this investment, $3 million will go toward higher education for offshore wind programs led by the University of Rhode Island, which will be working in partnership with other institutions of higher learning in the state.
Workforce Development	O&M training	$2,000,000	Vineyard Wind	MA	Boston	2018	The $2 million Windward Workforce program will recruit, mentor, and train residents of Massachusetts for careers in offshore wind (the effort is tied to the Vineyard Wind project).
Workforce Development	O&M training	$1,500,000	Ørsted, Eversource	RI	Providence	2019	$1.5 million will go toward the Rhode Island Commerce Corp. and the Rhode Island Department of Labor and Training to support the development of Rhode Island's offshore wind supply chain and workforce.
Workforce Development	O&M training	$1,000,000	Ørsted, Eversource	NY	Albany	2019	$1 million will fund an Upstate New York Workforce Development Fund to promote ongoing offshore wind job creation in upstate cities and ports.
Ports	Port upgrades	$50,000	Vineyard Wind	MA	New Bedford	2019	A $50,000 grant to the New Bedford Port Authority for purposes of developing publicly owned port facilities that can support offshore wind construction, O&M and other activities.
Locations	Meteorological	N/A	Dominion Energy, StormGeo	TX	Houston	2021	U.S. utility Dominion Energy has contracted StormGeo as its exclusive weather forecast provider for the 12 MW Coastal Virginia Offshore Wind project (CVOW), which went online in late 2020.
Locations	New U.S. Office	N/A	Ventolines, Mayflower Wind	MA	Boston	2020	Ventolines will be opening a headquarters in Boston for its EPC and transport and installation (T&I) business.
Locations	New U.S. Office	N/A	EnBW	MA	Boston	2019	Germany-based EnBW established a regional subsidiary EnBW North America Inc. and opened a second office in Boston in June 2019.
Locations	New U.S. Office	N/A	EnBW	NJ	Jersey City	2019	Germany-based EnBW established its U.S. regional subsidiary EnBW North America Inc. and opened first US office in Jersey City, NJ (May 2019).
Locations	New U.S. Office	N/A	Vineyard Wind	MA	Boston	2019	Vineyard Wind opened an office in Boston in June 2019 as its headquarters.
Locations	Transport and installation (T&I) consulting	N/A	Ventolines, Mayflower Wind	MA	Boston	2020	Ventolines won a contract with Mayflower Wind to provide transport and installation (T&I) expertise on the substation, foundations, array cables, and wind turbines of the 804 MW Mayflower wind project off the coast of Massachusetts. Mayflower Wind is a joint venture of Shell New Energies and Ocean Winds, the global offshore wind collaboration between EDP Renewables and ENGIE.
Manufacturing	Cable	N/A	Equinor, BP	NY	Brooklyn	2021	French power cable manufacturer Nexans has signed a preferred supplier agreement with Empire Offshore Wind LLC to connect the Empire Wind offshore projects to the New York State's onshore grid. The turnkey projects cover the full design and manufacturing, as well as the laying and protection of over 300 kilometres of export cables.

Offshore Wind Investment Announcements

PRIMARY INVESTMENT TYPE	SECONDARY INVESTMENT TYPE	AMOUNT	COMPANY	STATE	CITY	YEAR ANNOUNCED	DETAILS
Manufacturing	Cable	N/A	Vineyard Wind	NC	Huntersville	2021	Southwire's facility in Huntersville, N.C. will manufacture 32 miles of the high voltage cable for the onshore portion of Vineyard Wind 1.
Manufacturing	Foundations, Towers	N/A	Equinor	NY	Coeymans	2019	Empire Wind plans to manufacture gravity-based foundations at a facility at the Port of Coeymans. Upgrades to the Port of Coeymans are expected to begin in spring 2021.
Manufacturing	Foundations, Towers	N/A	Marmen & Welcon	NY	Albany	2021	Wind tower manufacturers Welcon and Marmen will open a manufacturing facility to build towers and fixed and floating foundations in a new factory in Albany, NY.
Manufacturing	Foundations, Towers	N/A	Ørsted, Eversource	RI	Provport	2021	Ørsted and Eversource are establishing a manufacturing facility for offshore wind foundation components at ProvPort in Rhode Island. The new 228-foot long facility will be used for advanced fabrication and assembly of foundation platforms for the companies' offshore wind projects in Rhode Island, Connecticut and New York.
Ports	O&M training	N/A	Vineyard Wind	CT	Bridgeport	2019	As part of the Park City Wind winning proposal, Vineyard Wind will make Bridgeport home to Park City Wind's O&M hub for the life of the project. This will bring many long-term jobs to Bridgeport and generate direct expenditures worth several hundreds of millions of dollars.
Ports	Port upgrades	N/A	Ørsted	NJ	Atlantic City	2019	Ørsted plans to locate its construction logistics base, foundation and transition-piece staging port, and operations and maintenance port in New Jersey for its Ocean Wind project.
Ports	Port upgrades	N/A	Ørsted, Eversource	NY	Port Jefferson	2019	Ørsted and Eversource plan to construct a new O&M Hub in the greater Port Jefferson area, which would include dockage for a 250-foot service operation vessel, with a warehouse and office facility to be located in the vicinity. Construction and operation of the O&M Hub is expected to create over 100 new fulltime jobs in the state.
Ports	Port upgrades	N/A	Vineyard Wind	CT	Bridgeport	2019	As part of the Park City Wind winning proposal, Vineyard Wind will partner with McAllister Towing and Transportation Co. to redevelop an 18.3-acre waterfront industrial property in Bridgeport that is currently underutilized and undeveloped. A renovated Barnum Landing property will host hundreds of local workers hired to do critical foundation transition piece steel fabrication and final outfitting. This labor-intensive work will create new union jobs and build valuable Connecticut-based offshore wind capabilities along with a trained workforce prepared for future offshore wind projects.

Offshore Wind Investment Announcements

PRIMARY INVESTMENT TYPE	SECONDARY INVESTMENT TYPE	AMOUNT	COMPANY	STATE	CITY	YEAR ANNOUNCED	DETAILS
Ports	Port leasing	N/A	Vineyard Wind	RI	Bridgeport	2021	Vineyard Wind has signed a lease at Barnum Landing in Bridgeport, Connecticut, to use the property as a construction and staging location for the 804 MW Park City Wind project. Barnum Landing, a 15-acre parcel located at 525 Seaview Avenue, will be used during the construction phase of the Park City Wind project, which will include storage and assembly of the transition pieces, the portion of the turbine that anchors the body of the machines to the steel foundation. Once construction is completed, Vineyard Wind intends to use three acres of the port site for an operations and maintenance hub that will support local jobs for the 20-plus year lifespan of the project. Vineyard Wind has also selected a location in downtown Bridgeport to serve as the Connecticut headquarters for the company's offshore wind project.
Research	Environmental	N/A	APEM, Vineyard Wind	MA	New Bedford	2020	Vineyard Wind has contracted APEM for the second year of surveys at its 800 MW offshore wind project off the coast of Massachusetts. The monthly surveys provide baseline information on the species that utilize the area and form part of the overall environmental assessment reports for the project.
Research	Floating foundation R&D	N/A	Chevron, Moreld Ocean Wind (MOW), Ocergy	CA	Oakland	2021	U.S. oil major Chevron, together with Norwegian company Moreld Ocean Wind, is set to invest in offshore wind technology at Ocergy, a U.S. company developing a low-cost floating wind foundation and a multi-disciplinary environmental monitoring buoy.
Research	Meteorological	N/A	Ørsted, NOAA	MA	Boston	2021	Ørsted has signed a Memorandum of Agreement (MOA) with the National Oceanic and Atmospheric Administration (NOAA) to share physical and biological information and data in Ørsted-leased waters offshore the United States.
Vessels	Crew Transfer Vessel (CTV)	N/A	Atlantic Wind Transfers, Dominion Energy	VA	Newport News	2020	Atlantic Wind Transfers will provide offshore marine support services for the Siemens Gamesa offshore wind turbines for Dominion Energy's first phase 12 MW offshore wind plant off the Virginia coast, which went online in late 2020.
Vessels	Crew Transfer Vessel (CTV)	N/A	Atlantic Wind Transfers, Blount Boats	RI	Warren	2019	U.S. offshore wind farm support company Atlantic Wind Transfers has signed a multi-million-dollar contract for two crew transfer vessels (CTVs), developed by Chartwell Marine. The vessels will be built by Blount Boats, with delivery scheduled for 2020.
Vessels	Crew Transfer Vessel (CTV)	N/A	Ørsted, Senesco Marine	RI	North Kingstown	2019	Vessel contract for Ørsted's and Eversource's Revolution Wind project. A second crew transfer vehicle (CTV) will be built by WindServe's affiliate shipyard, Senesco Marine, in North Kingstown, Rhode Island.

Offshore Wind Investment Announcements

PRIMARY INVESTMENT TYPE	SECONDARY INVESTMENT TYPE	AMOUNT	COMPANY	STATE	CITY	YEAR ANNOUNCED	DETAILS
Vessels	Crew Transfer Vessel (CTV)	N/A	Ørsted, WindServe Marine	RI	North Kingstown	2019	Ørsted awarded a crew transfer vessel contract to WindServe LLC in Rhode Island. It will be used for Northeast projects and Ørsted's Coastal Virginia Offshore Wind project. It is currently under construction with delivery anticipated for 2021.
Vessels	Fallpipe Vessel	N/A	Great Lakes Dredge & Dock (GLDD), Ulstein	TX	Houston	2021	Great Lakes Dredge & Dock (GLDD) has contracted Ulstein for the integration engineering for the first Jones Act compliant subsea rock installation vessel dedicated to the U.S. offshore wind market. The new contract follows the one for Basic Design, which GLDD awarded to Ulstein in December 2020. The scope of work includes the selection of vessel main equipment with integration engineering plus the start of detail design. The vessel will be built by a yet-to-be-selected U.S. shipyard.
Vessels	Service Operations Vessel (SOV)	N/A	Edison Chouest Offshore (ECO)	LA	Cut Off	2021	The American Bureau of Shipping (ABS) will class the first U.S.-flagged Jones Act service operation vessel (SOV). The SOV will be engineered, constructed, and operated by Edison Chouest Offshore (ECO) for long-term charter to service the Revolution Wind, South Fork Wind, and Sunrise Wind offshore wind farms in the northeast U.S.
Workforce Development	O&M training	N/A	AIS Training, Arcon	MD	Salisbury	2021	The ARCON Training Center in Maryland opened in January 2021 and is approved to offer basic safety training under standards of the Global Wind Organization (GWO).
Workforce Development	Research	N/A	Ørsted	RI	Providence	2019	Ørsted is establishing its Innovation Hub team in Rhode Island as part of its efforts to build an offshore wind industry supply chain in the U.S.
Workforce Development	Transport and Logistics	N/A	Crowley Shipping	FL	Jacksonville	2021	The Florida-headquartered Crowley Shipping has formed a new division focusing on the offshore wind sector. Solutions include transportation of turbines during construction, designs for industry-specific support vessels, shoreside terminal work, as well as supply chain services.

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