North American ESS Market Outlook

NaatBatt 2023

Chris Seiple, February 2023

Wood Mackenzie
A Verisk Business

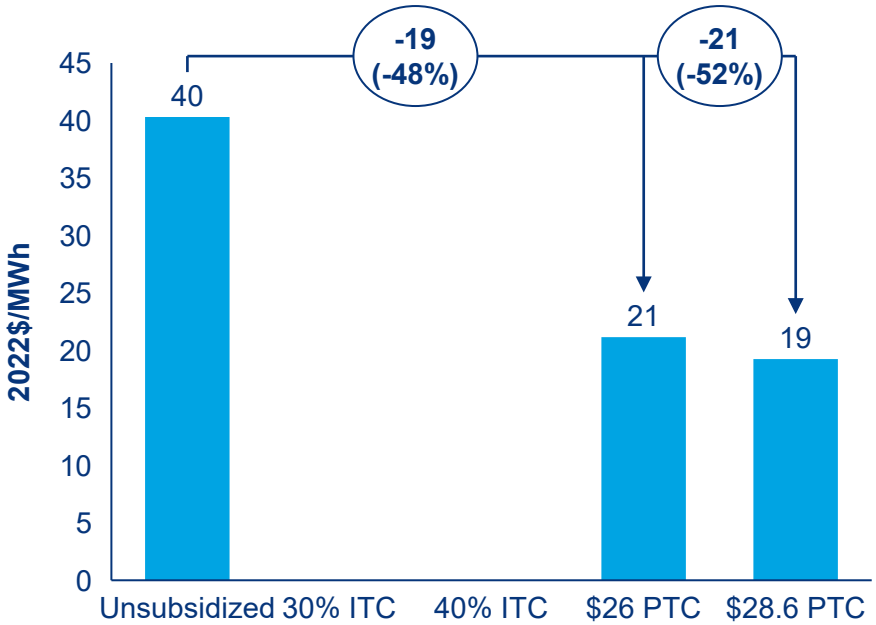
2022: A Global Reset for Electricity Markets

- Established substantial, long-term public policy support for renewables and electrification in Europe and the US
- Extreme weather is challenging the reliability of our electric power systems
- The relationship between gas prices and gas demand has changed, introducing new volatility into power prices and raising future reliability concerns
- Re-globalization taking hold, reshaping trading patterns between allies, with the power sector implications being a reshaping of the supply chain for renewables and return of US manufacturing
- Witnessing an acceleration in the changing composition of demand – more distributed generation and coming different demand patterns

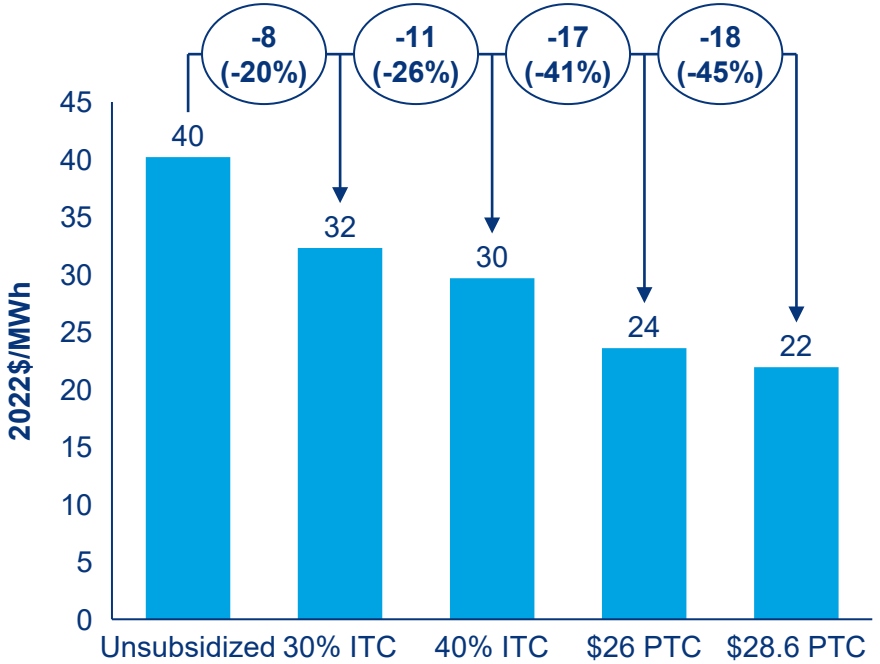
The IRA provides significant cost relief for zero-carbon technologies

Projects can take advantage of various bonuses for higher value subsidies

Onshore wind 2025 LCOE



Utility-scale solar 2025 LCOE



Note: representative of TX projects (solar: $1222/kW, wind: $1766/kW)
Source: Wood Mackenzie

The PTC option is generally more attractive than ITC for utility-scale solar

PTC will only grow in attractiveness over time as capital costs fall and production increases

Difference in LCOE ($2022/MWh) between ITC and PTC single-axis tracker solar

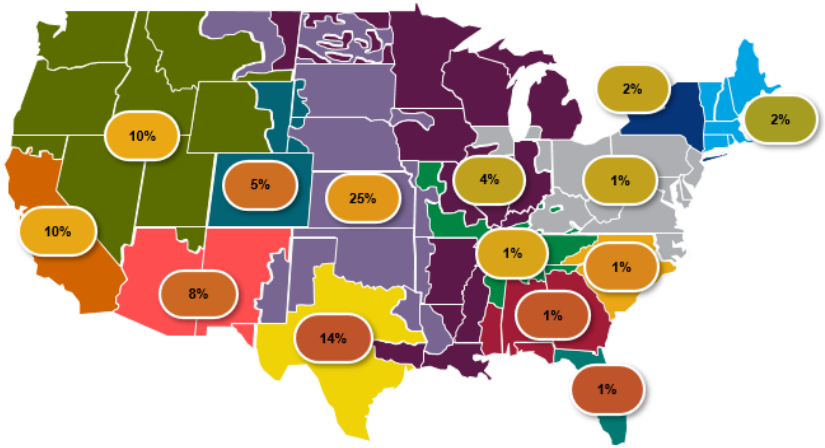
Capital Costs (2022 $/kWac) \ Capacity Factor	21%	23%	25%	27%	29%	31%	33%	35%
800	9.9	10.4	10.6	11.0	10.9	11.3	11.6	11.7
900	9.0	9.7	10.1	10.4	10.7	10.9	11.6	11.6
1000	8.0	8.7	9.4	9.6	10.0	10.3	10.9	10.9
1100	6.8	7.7	8.5	8.6	9.4	9.7	10.4	N/A
1200	6.0	6.7	7.5	7.9	8.6	9.2	9.6	N/A
1300	5.1	5.8	6.4	7.2	7.5	8.5	8.9	N/A
1400	4.2	5.0	5.8	7.2	6.7	N/A	N/A	N/A
1500	2.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A

- On an LCOE basis, the PTC will offer a lower overall cost for most projects, and a materially lower cost for high capacity factor and low capital cost projects
- We project average capital costs are around $1,200 to $1,300 per kW. Capacity factors vary widely, with the highest quality irradiance states having capacity factors between 25% and 30% but often a wide dispersion for individual projects within a state.
- With significantly higher capital costs, distributed solar is largely expected to continue electing the ITC over the PTC

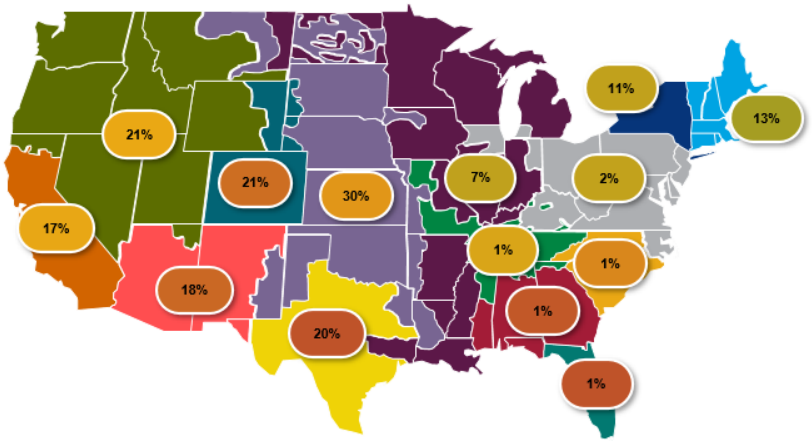
Source: Wood Mackenzie

Increasing shares of generation receiving production-based subsidies forecast to drive more negative power prices, especially in central and western US

Percentage of negative-prices hours in 2030



Percentage of negative-priced hours in 2040



Source: Wood Mackenzie

Inflation Reduction Act: Opportunity for up to 50% tax credit is the foundation for sector growth in our base/bull case

Section 48 ITC opportunity for standalone energy storage systems

	2023	2024	2025	2026	2027	2028	2029	2030	2031	203X	PO Yr1	PO Yr2	PO Yr3
Section 38/48E – base	**6%**		**6%**								**4.5%**	**3.0%**	**1.5%**
+ Wage/apprentice	+24%		+24%								18.0%	12.0%	6.0%
+ Domestic content	+10%		+10%								7.5%	5.0%	2.5%
+ Energy community	+10%		+10%								7.5%	5.0%	2.5%
Total grid scale potential	**50%**		**50%**								**37.5%**	**25.0%**	**12.5%**
+ Low income	+20%		+20%								15.0%	10.0%	5.0%
Total residential potential	**70%**		**70%**								**52.5%**	**35.0%**	**17.5%**

- Potential ITC runway extends well beyond 15 years, more than enough time for manufacturers to recoup their investments in US production facilities
- Energy community credit places a priority on the redevelopment of retired coal plants, which also offer ready access to high voltage transmission resource
- Massive opportunity for small-scale deployments in low-income communities, though annual capacity limits exist at 1.8GW per annum

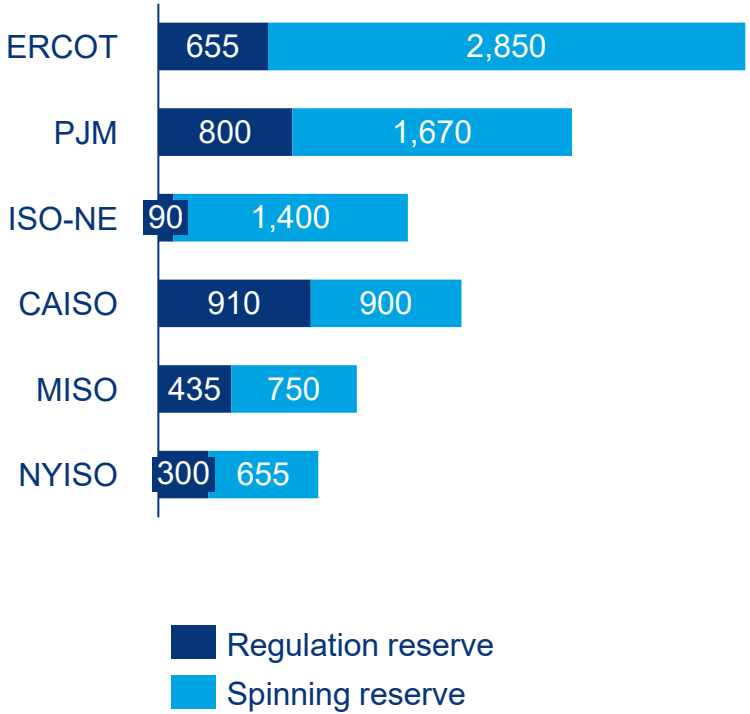
Phase out (PO) not likely to begin until 2040 given extensive emissions reductions required

Source: Wood Mackenzie

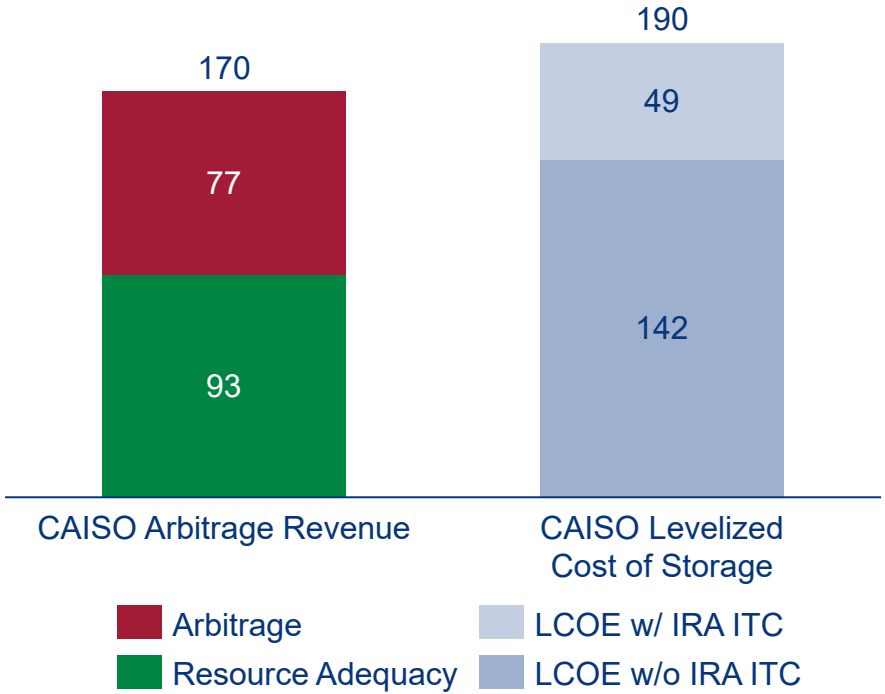
The storage ITC within the IRA significantly improves storage profitability

The ITC enables arbitrage to be cashflow positive as ancillary services markets become oversubscribed

Ancillary services market sizes by ISO (MW)



CAISO arbitrage revenue versus levelized cost of electricity (US$/kw-year)

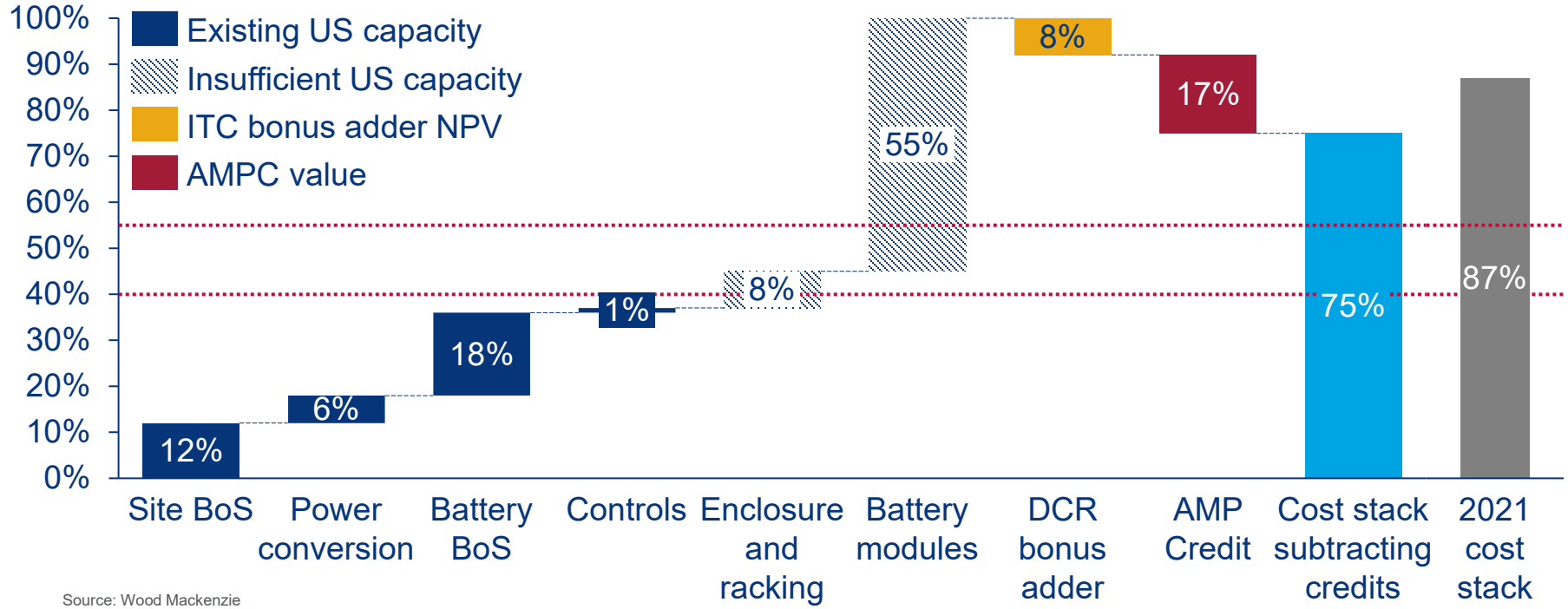


Source: Wood Mackenzie, ISOs

DCR thresholds may be achievable without US-made battery modules

US manufacturers may need to share some value of the AMPC to incentivise domestic uptake should supply/demand constraints largely resolve

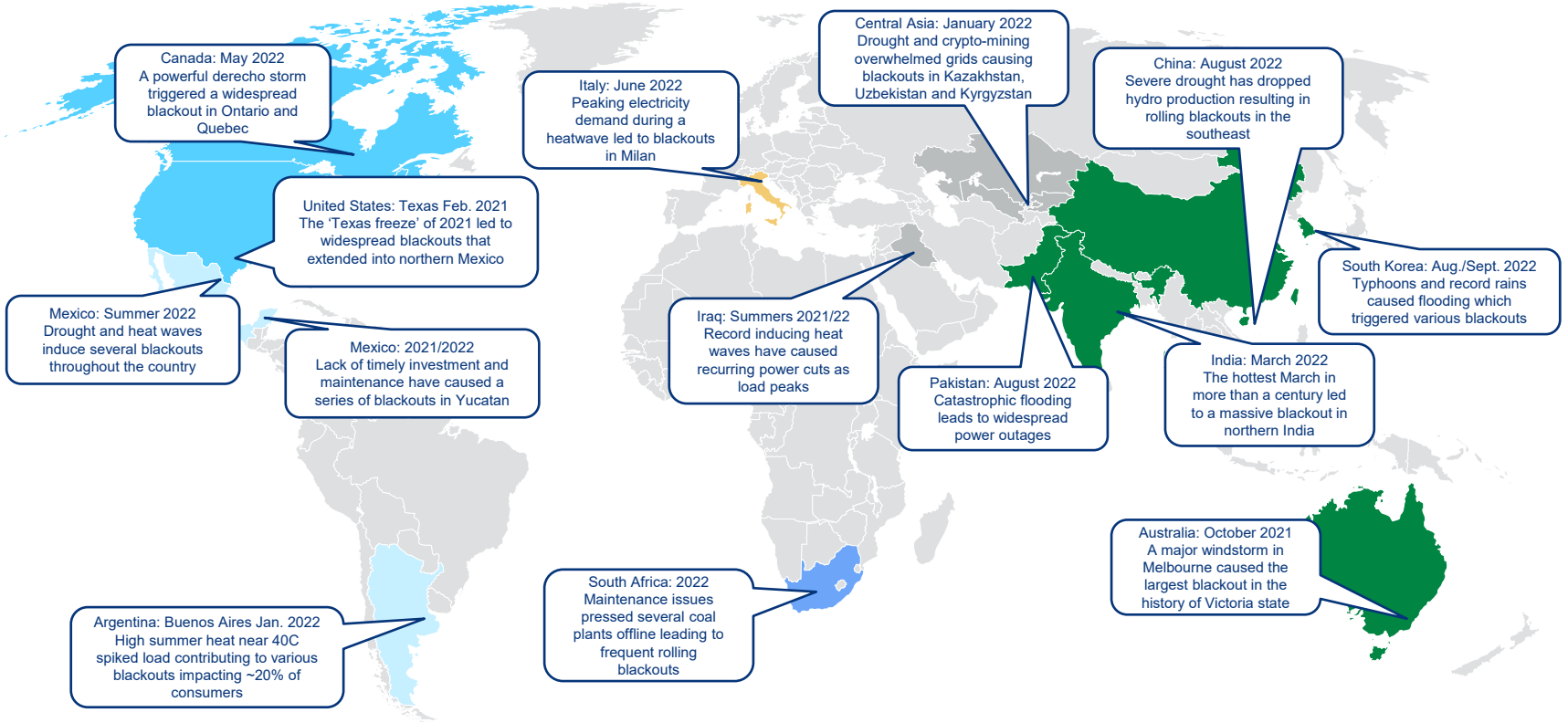
Energy storage hardware cost stack using US manufacturing



Source: Wood Mackenzie

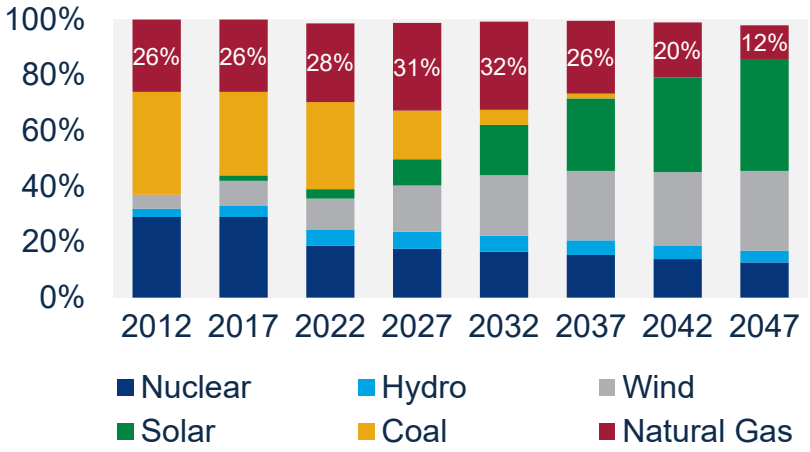
Increasingly extreme weather events are overwhelming grids across the globe

Power outages have been triggered more frequently by unprecedented weather which will likely become more volatile as climate risks increase

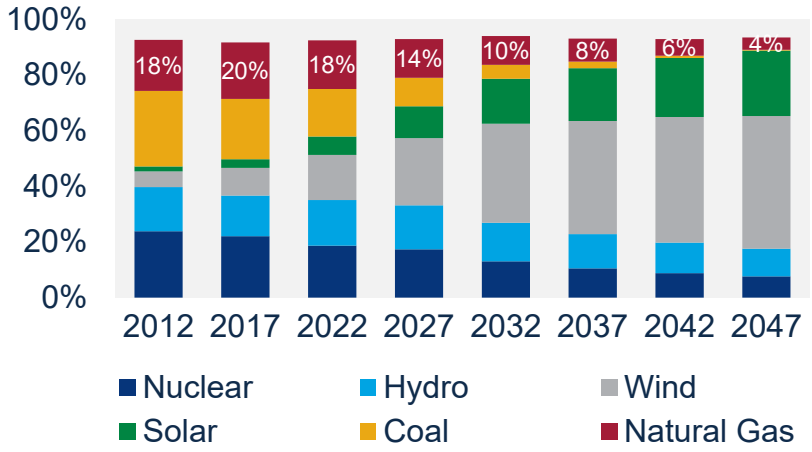


All major power markets facing an increased reliance on natural gas as the main source of dispatchable supply

US Power Supply by Fuel Type



European Power Supply by Fuel Type



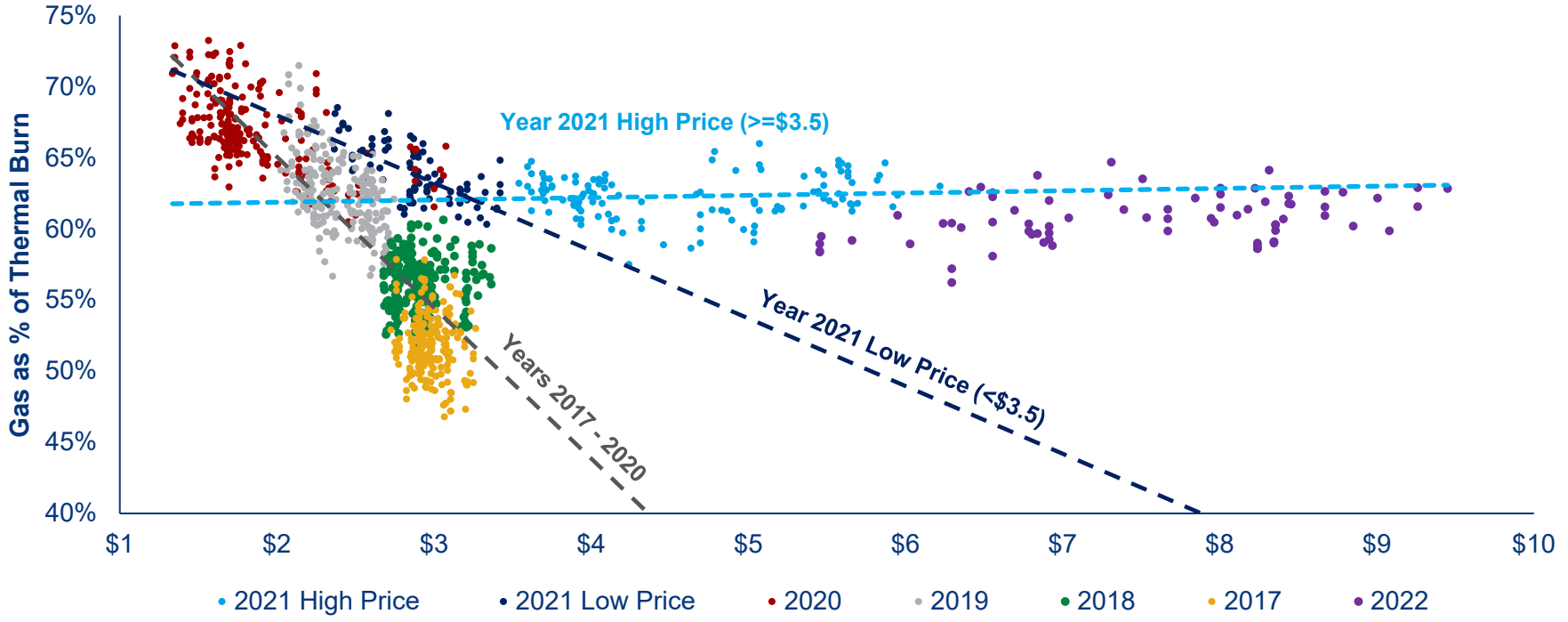
- Increased reliance on natural gas in combination with increased variable generation from renewables and increased weather volatility is likely to strain power systems going forward

Source: Wood Mackenzie, EIA

Price elasticity of gas power burns disappear at higher gas prices

Traditional market balancing mechanism of economic gas-to-coal switching reduced due to coal generation retirements, but low thermal coal stockpiles are key short-term constraint

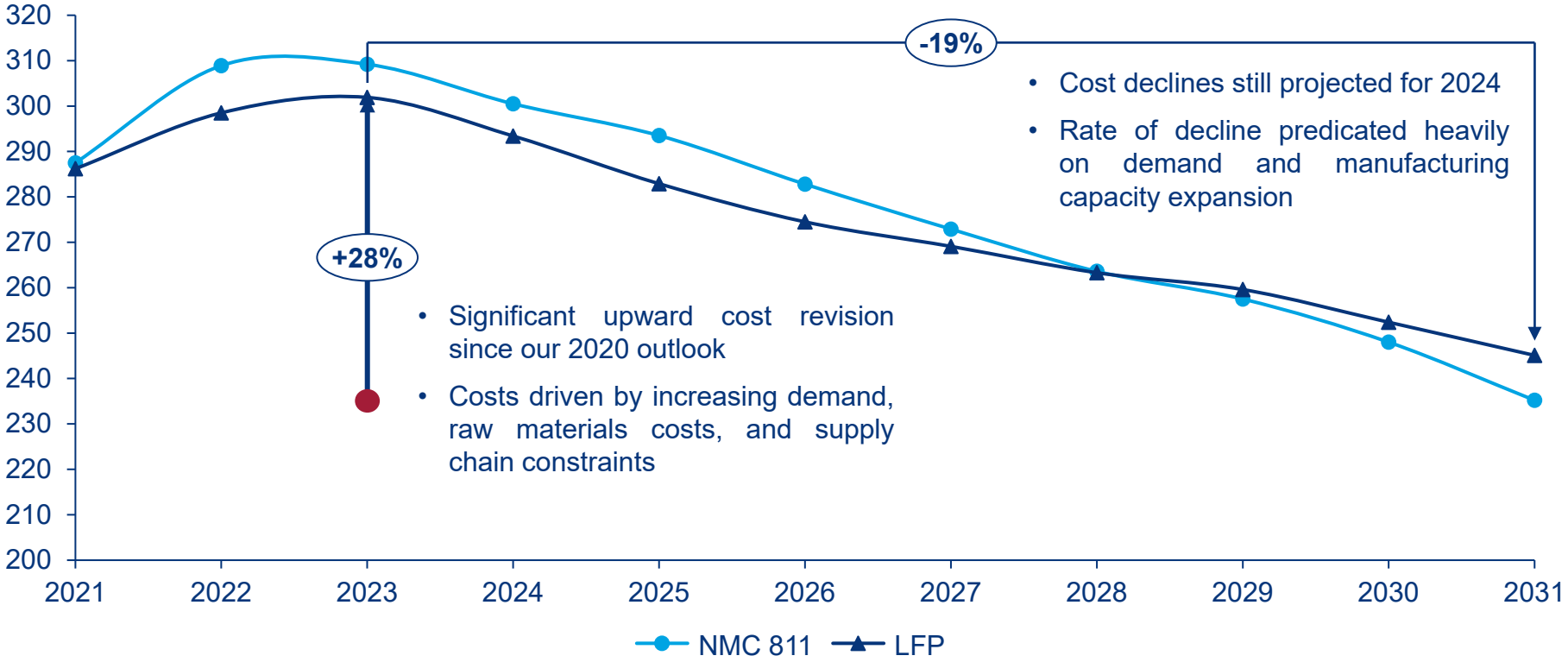
Gas percentage of summer thermal generation versus Henry Hub gas price



Source: Wood Mackenzie Shrinking coal stockpiles and gas storage are a growing quandary for utilities, NatGas Analyst, Argus Media Group

COVID and commodity spikes have prompted a recalibration of long-term price reduction trends

U.S. grid-scale storage system cost outlook by chemistry, 2021-2031E (US$/kWh)



Source: Wood Mackenzie; Note: cell costs are landed costs and include impacts of import tariffs

Despite supply chain and solar coaster negatively impacting short-term demand, US capacity additions are expected to more than double in 2023

An additional 1 GW of grid-scale projects were delayed in Q3 2022, often pushed to 2023 COD

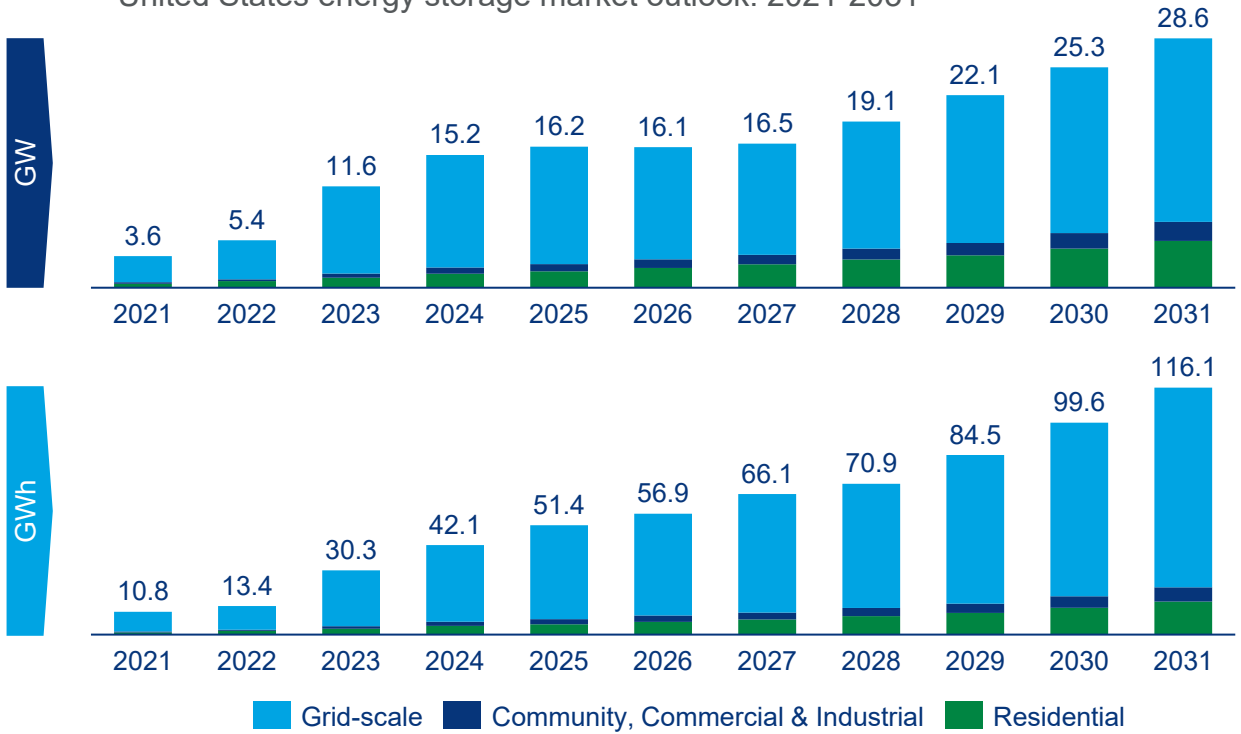
Grid-Scale Segment:

- Cumulative volumes from 2022-2031 increase to 138GW, largely driven by additional announcements in ’22-’25.
- Procurement delays, other supply chain challenges, solar volatility, and increased pricing drive project delays in ’23-’26.
- Developers, utilities, and IPPs are awaiting IRS guidance on the Inflation Reduction Act to plan for achieving bonus adders.

CCI and Residential Segments:

- Both CCI and residential forecasts were positively affected by policy changes in California with a new community solar program and the NEM 3.0 decision, respectively.
- The updated NEM 3.0 incentivizes solar+storage systems versus standalone solar due to higher peak hour export rates.

United States energy storage market outlook: 2021-2031

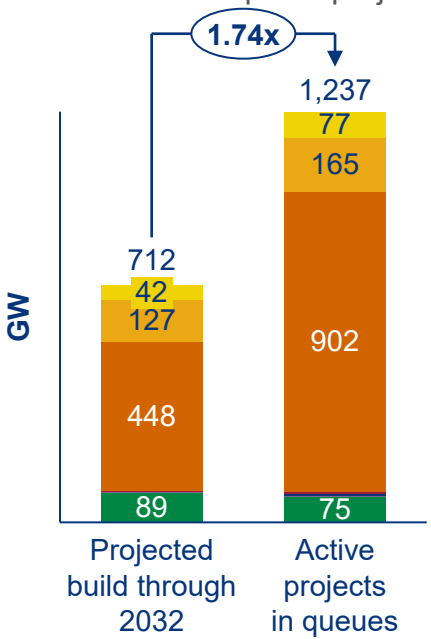


Source: Wood Mackenzie

Interconnection queues are bloated compared to projected builds through 2032

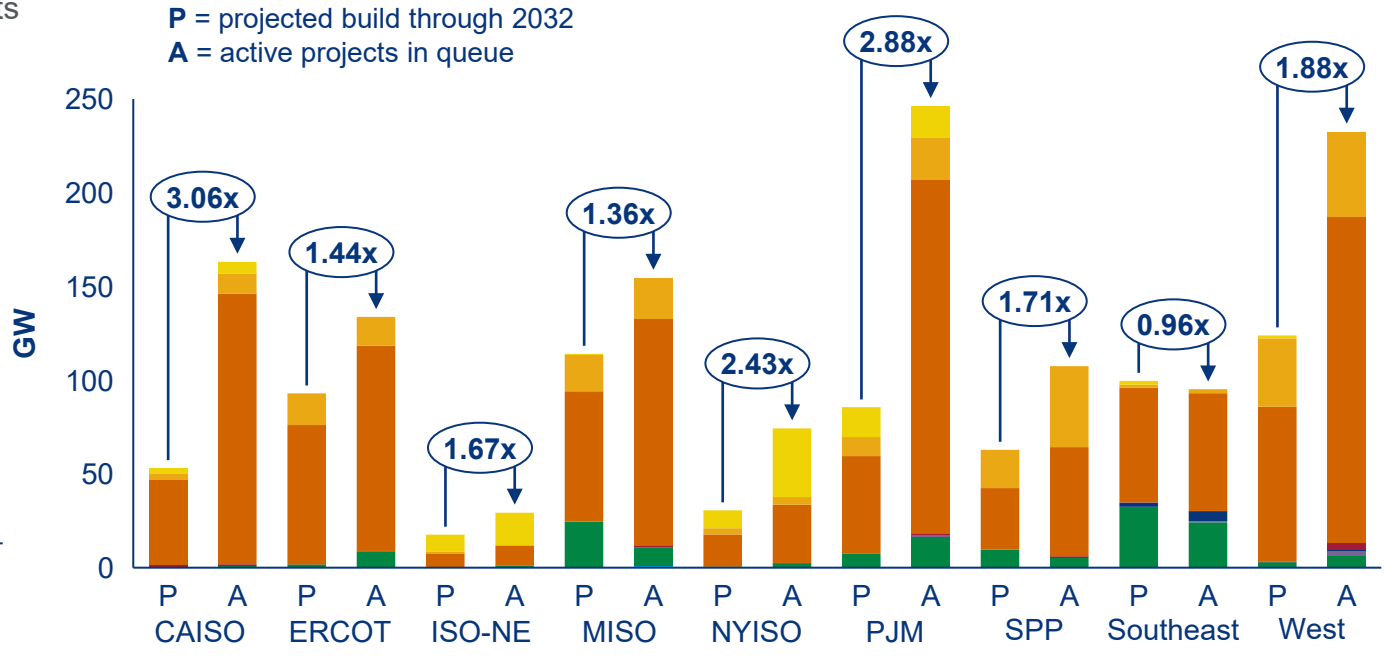
Some regions – such as CAISO – have more excess queue capacity than others

US projected build through 2032 versus active queue projects



Regional projected build through 2032 versus active queue projects

P = projected build through 2032
A = active projects in queue



Coal | Hydro | Other | Wind Onshore (Standalone + Hybrid)
Gas | Nuclear | Solar and Storage (Standalones + Hybrids) | Wind Offshore

Source: Wood Mackenzie, LBNL

About Wood Mackenzie

We provide commercial insight and access to our experts leveraging our integrated proprietary metals, energy and renewables research platform.

Wood Mackenzie is ideally positioned to support consumers, producers and financers of the new energy economy.

- Acquired Genscape, MAKE and Greentech Media (GTM)
- Leaders in the energy transition and cross-commodities
- Over 600 sector-dedicated analysts and consultants globally
- Located close to customers and industry contacts

License

Ownership Rights

All reports are owned by Wood Mackenzie, protected by United States Copyright and international copyright/intellectual property laws under applicable treaties and/or conventions. User agrees not to export any report into a country that does not have copyright/intellectual property laws that will protect Wood Mackenzie's rights therein.

Grant of License Rights

Wood Mackenzie, hereby grants user a personal, non-exclusive, non-refundable, non-transferable license to use the report for research purposes only pursuant to the terms and conditions of this agreement. Wood Mackenzie retains exclusive and sole ownership of each report disseminated under this agreement. User agrees not to permit any unauthorized use, reproduction, distribution, publication or electronic transmission of any report or the information/forecasts therein without the express written permission of Wood Mackenzie. Users purchasing this report may make a report available to other persons from their organization at the specific physical site covered by the agreement, but are prohibited from distributing the report to people outside the organization, or to other sites within the organization.

Disclaimer of Warranty and Liability

Wood Mackenzie has used its best efforts in collecting and preparing each report.
Wood Mackenzie its employees, affiliates, agents, and licensors do not warrant the accuracy, completeness, correctness, non-infringement, merchantability, or fitness for a particular purpose of any reports covered by this agreement. Wood Mackenzie, its employees, affiliates, agents, or licensors shall not be liable to user or any third party for losses or injury caused in whole or part by our negligence or contingencies beyond Wood Mackenzie's control in compiling, preparing or disseminating any report or for any decision made or action taken by user or any third party in reliance on such information or for any consequential, special, indirect or similar damages, even if Wood Mackenzie was advised of the possibility of the same. User agrees that the liability of Wood Mackenzie, its employees, affiliates, agents and licensors, if any, arising out of any kind of legal claim (whether in contract, tort or otherwise) in connection with its goods/services under this agreement shall not exceed the amount you paid to Wood Mackenzie for use of the report in question.