State of the California Market and Insights for CCAs

E3 Webinar

June 17, 2025

Energy+Environmental Economics

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Who is E3?

Thought Leadership, Fact Based, Trusted.

130+ full-time consultants

30+ years of deep expertise

Engineering, Economics, Mathematics, and Public Policy Degrees


San Francisco


New York

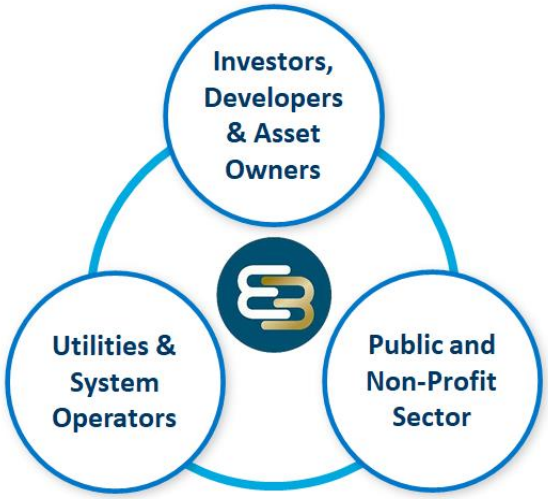

Boston


Calgary


Denver

E3 Clients

300+ projects per year across our diverse client base



Recent Examples of E3 Projects

Market price forecasts for every U.S. market (wholesale and retail), supporting billions of dollars of capital deployment;

Supporting CCAs with bid evaluation, procurement, load forecasting, program evaluation;

Supporting the CPUC in developing the CA Integrated Resource Plan;

Supporting investment in multiple hybrid and standalone battery energy storage platforms and assets across North America (15+ GW | ~$5B);

Supporting investment in 5+ GW of community solar and distributed energy resource projects;

Evaluation of electric vehicle and V2G value and markets in North America for several large automakers.

Relevant E3 Services

Market Outlook

- E3 has built a detailed market outlook for CAISO and WECC
- Forecasts include wholesale market prices (day ahead, real time, ancillary services, capacity, RECs)
- Informs strategy

Bid Evaluation

- E3 has supported CCAs with procurement and bid evaluation
- Including asset-specific cost and revenue forecasts, operations modeling, and risk assessment (i.e. curtailment, development)

PPA Support

- PPA structuring, negotiation, and review support

Storage and Renewables

- Storage and renewable project evaluation including:
  - Nodal revenue forecasting
  - Operations forecasting
  - Onsite load, hybridization

Rates and Programs

- Rate design
- Program design and evaluation

Much More…

- Electric vehicle adoption and value
- Distributed generation adoption forecasts
- Data centers and large loads

State of the California Market

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Load

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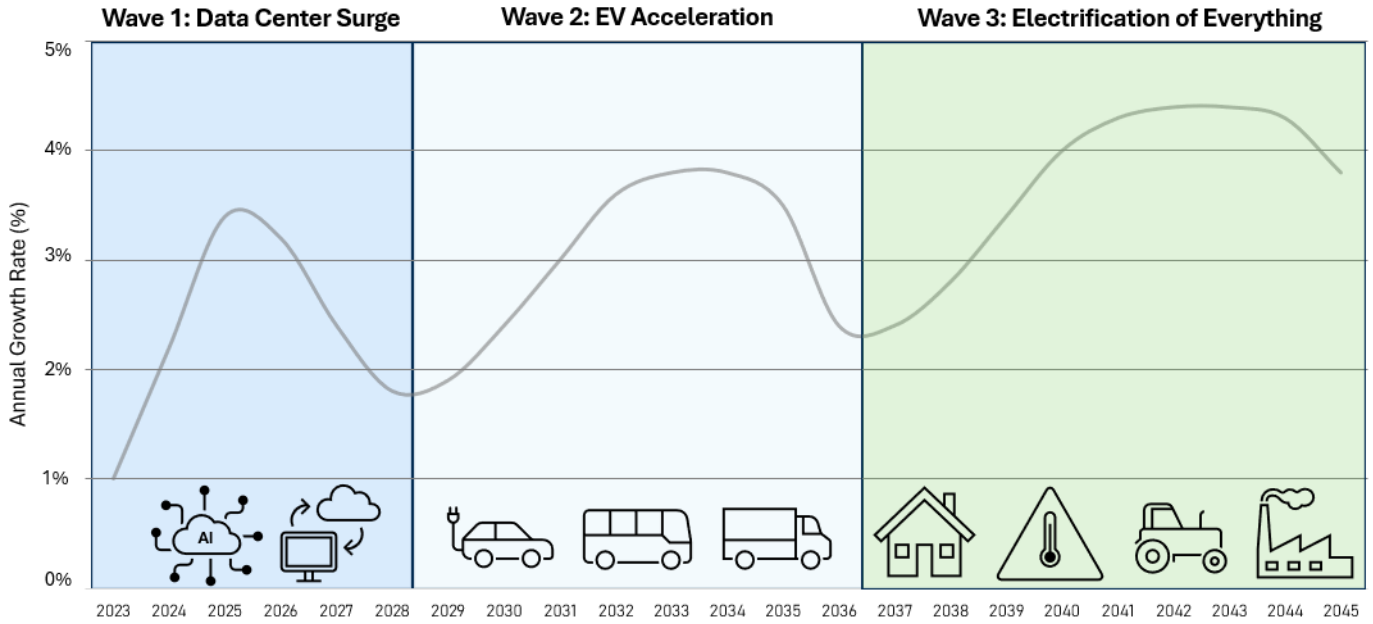
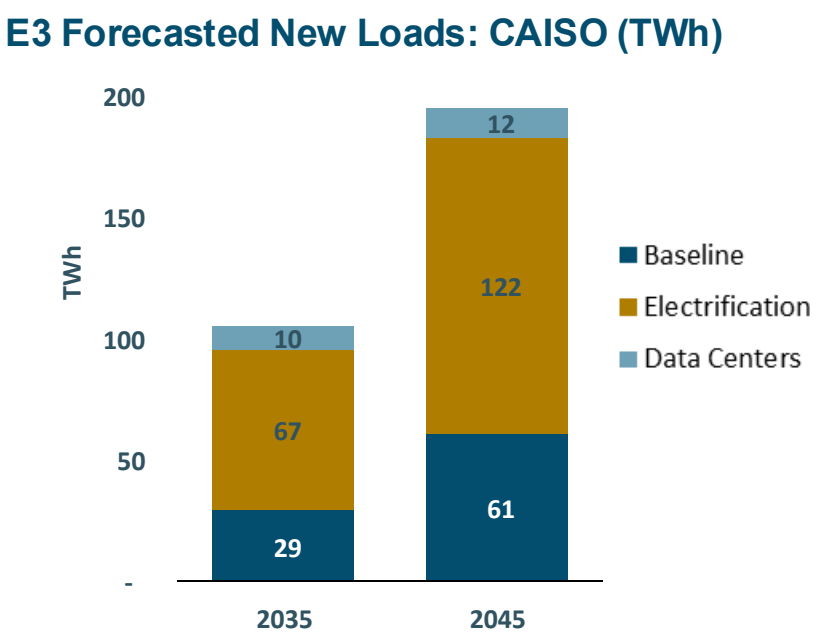
Significant Uncertainty in a New Age of Load Growth…

- Population & Economic Growth
- Data Centers
- Manufacturing Loads
- Electric Vehicles
- Building Electrification
- Extreme Weather

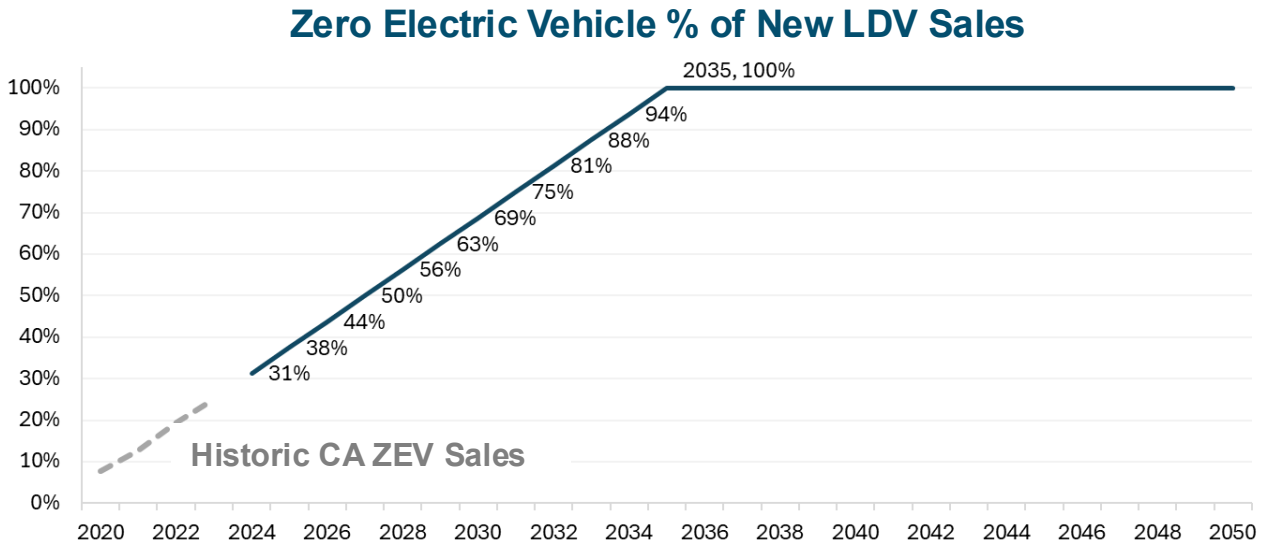
Data Centers are the 1st of 3 Waves of New Load Growth

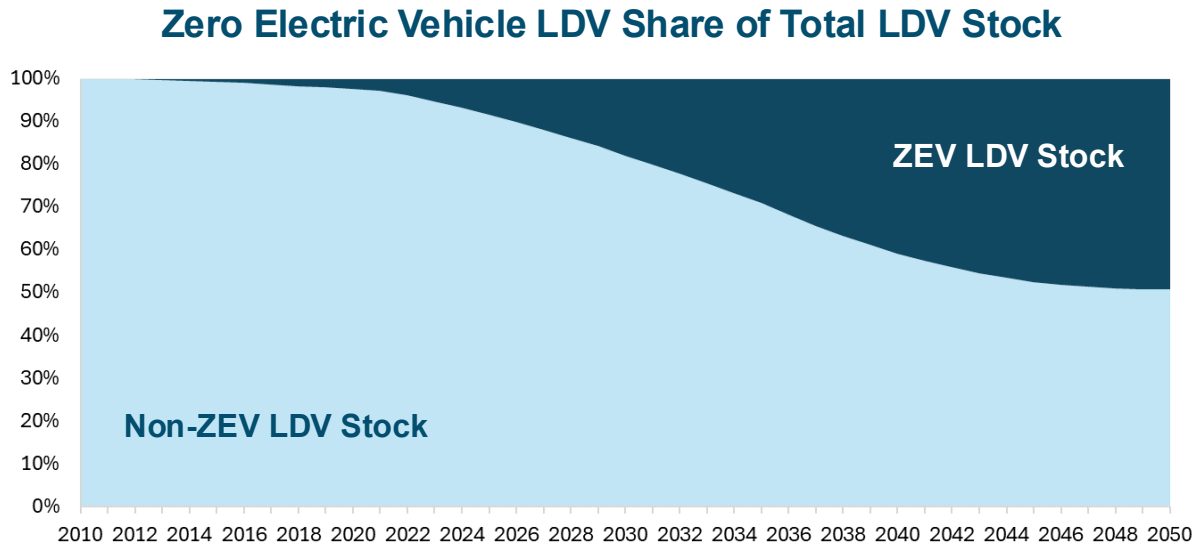
- Data center demand forecasts may be overly optimistic, but general computing load is likely to grow even if AI-driven growth slows or stops
- Beyond data centers, U.S. industrial policies are supporting 'on-shoring' of domestic manufacturing loads (Southwest and Southeast regions in particular)
- Electric vehicles and the 'electrification of everything' will drive sustained electric demand over the long-term





Electric Vehicles Could Create Significant New Load





- E3 estimates light-duty vehicle adoption consistent with recent trends and CA Advanced Clean Cars II standard → phasing out new gasoline vehicle sales by 2035
- Achieving CA's clean vehicle standards could add ~78 TWh of new load (and 19% of total state load) by 2035!
- By 2050, EVs could reach 144 TWh (~27% of CA load) even if EVs are only 50% of on-road vehicles!

Supply

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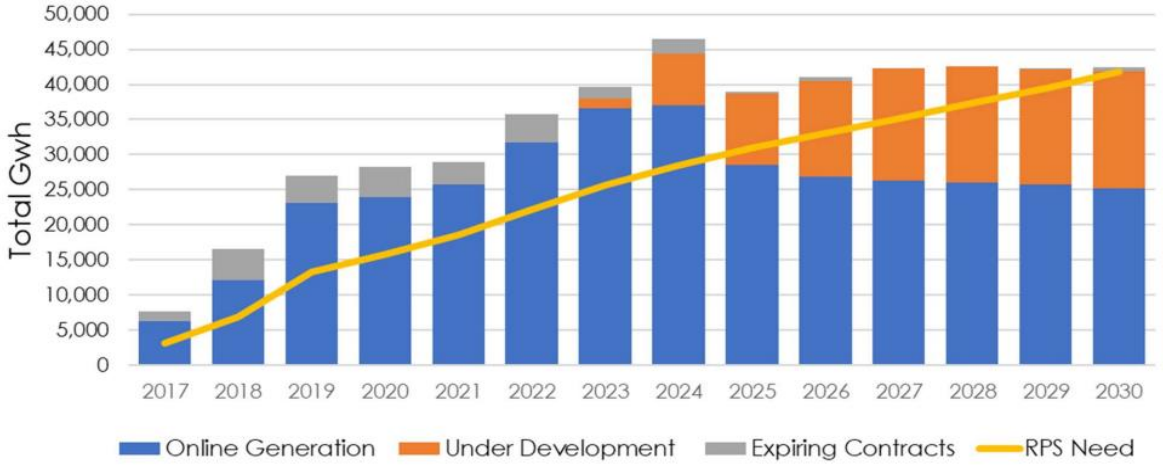
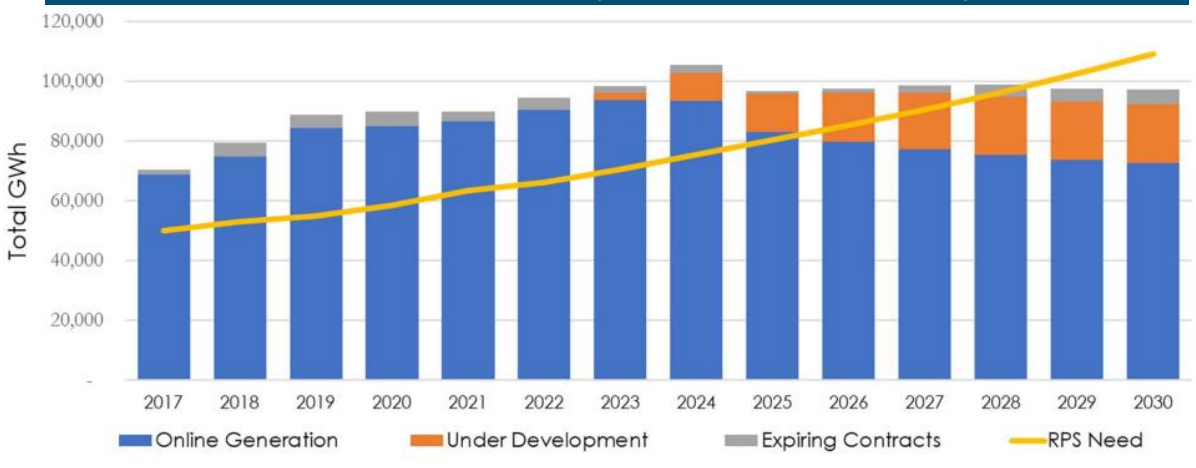
CCAs are helping California exceed its clean energy targets

CCAs



All Retail Providers (IOUs + CCAs + ESPs)

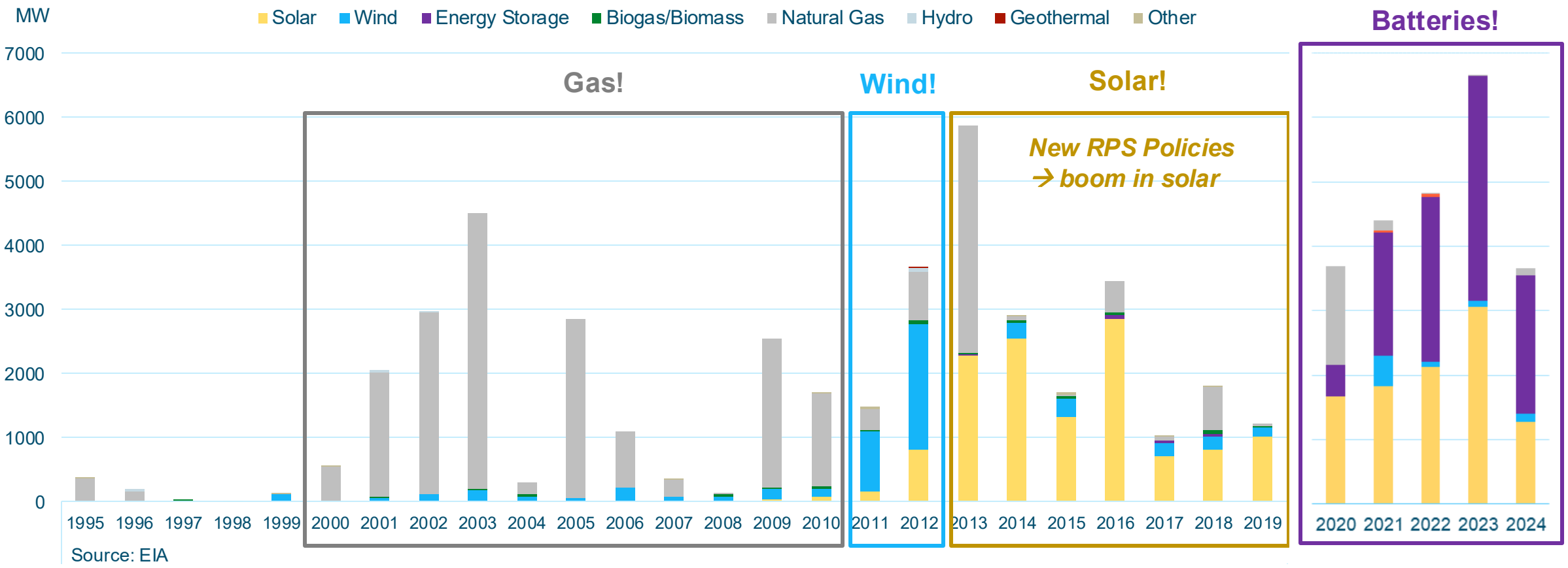


+ CCAs already have enough resources under development to meet California's 60% RPS target by 2030

+ California market as a whole is close to meeting 2030 target

Source: CPUC 2023 Annual REC Report

CA's Evolving Grid: Resource Additions 1995-2024



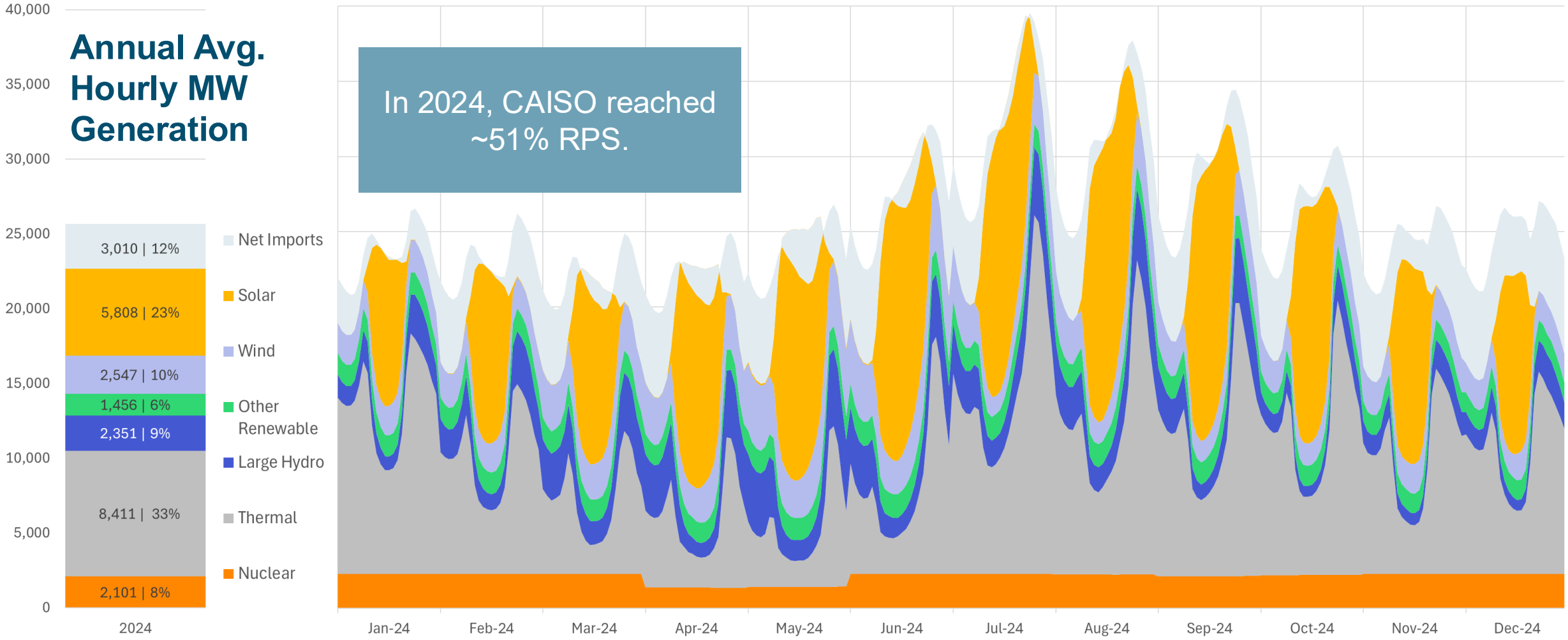
CA energy crisis
→ boom in gas generation
→ RA surplus + birth of RA program

New RPS Policies
→ boom in solar PV

RA Procurement Orders
→ boom in batteries

2024 Average Hourly Generation by Type

Average Daily Generation (24-hr) by Month and Resource Type (MW)

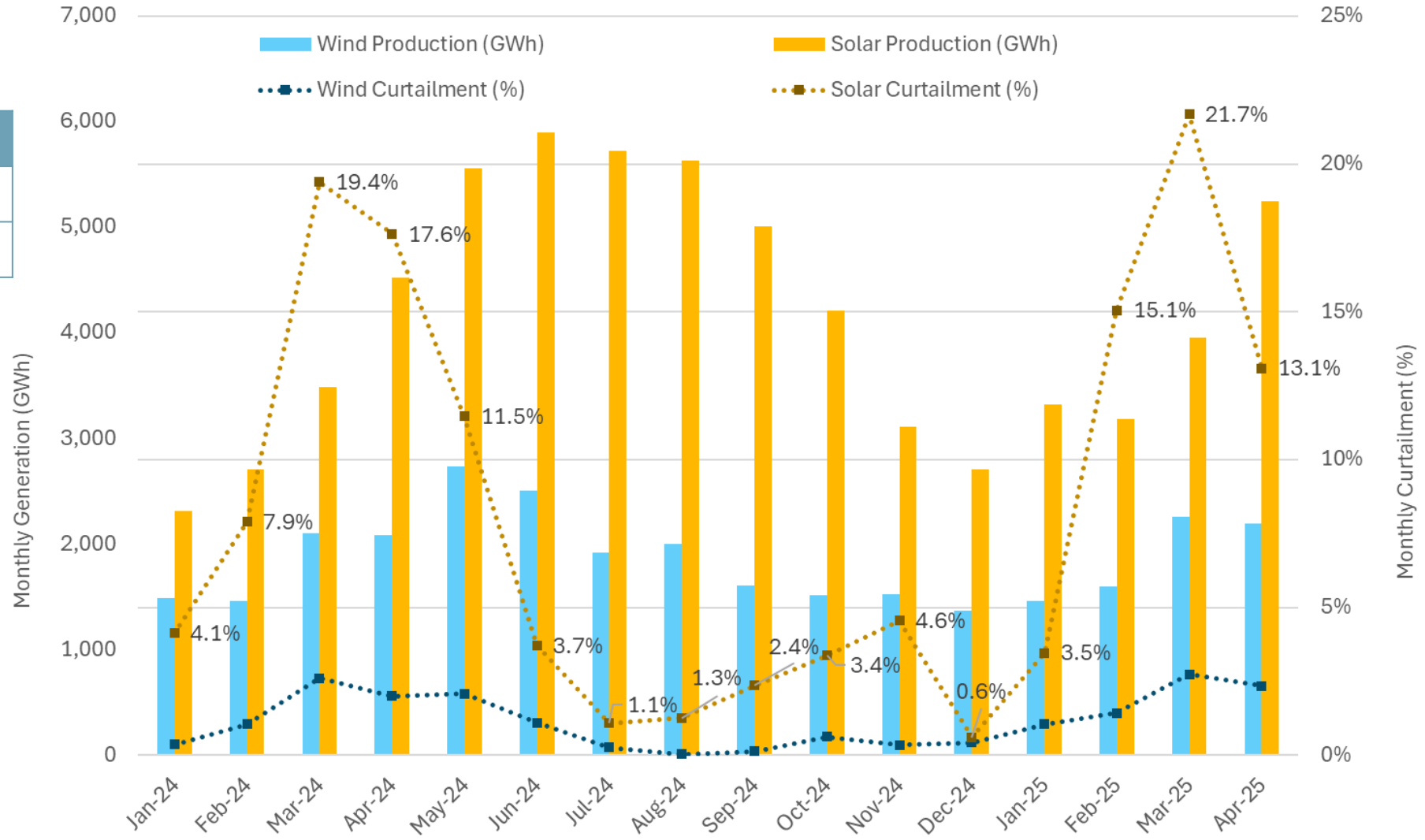


CAISO. Production and Curtailment Data. Curtailed generation is not counted in totals.

CA Wind & Solar Curtailment: 2024-Apr 2025

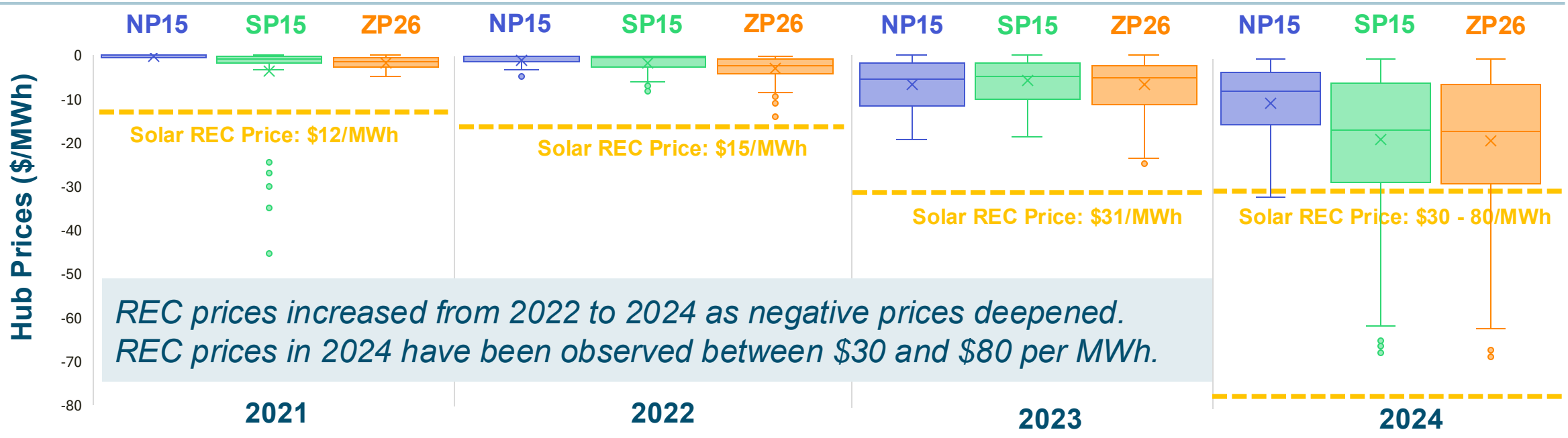
Solar Curtailment

	Jan-Apr	Jan-Dec
2024	13.7%	6.3%
2025	13.6%	TBD

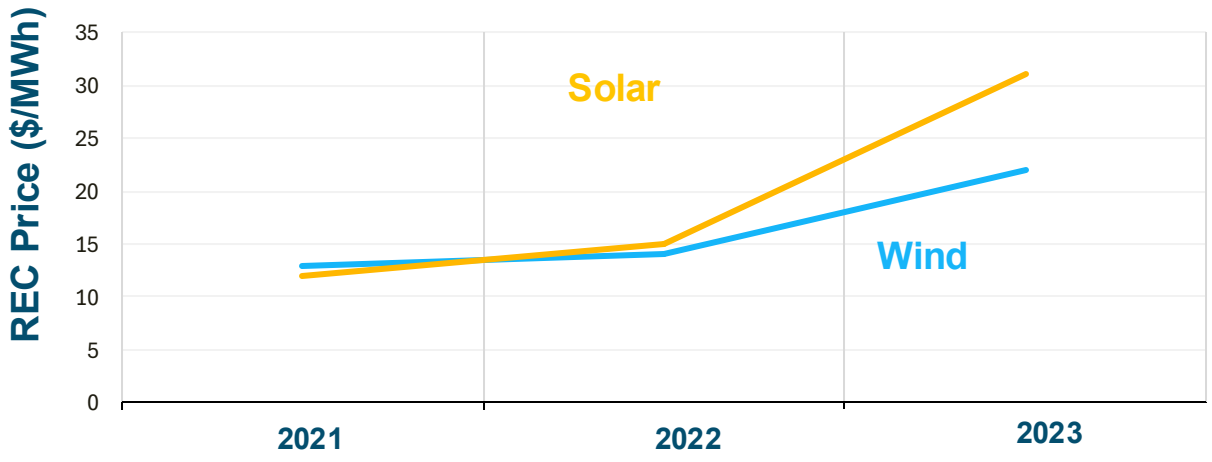


CAISO. Production and Curtailment Data.

Deeper Negative Energy Prices Reflect Tight REC Supply



REC prices increased from 2022 to 2024 as negative prices deepened.
REC prices in 2024 have been observed between $30 and $80 per MWh.

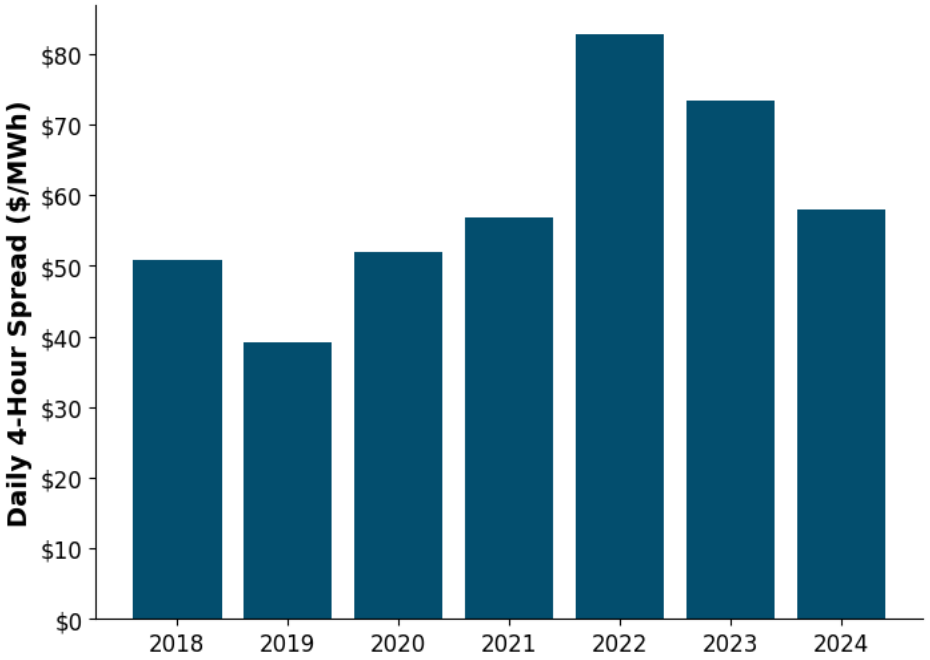


Year	Avg. Wind REC Price	Avg. Solar REC Price
2021	$13/MWh	$12/MWh
2022	$14/MWh	$15/MWh
2023	$22/MWh	$31/MWh

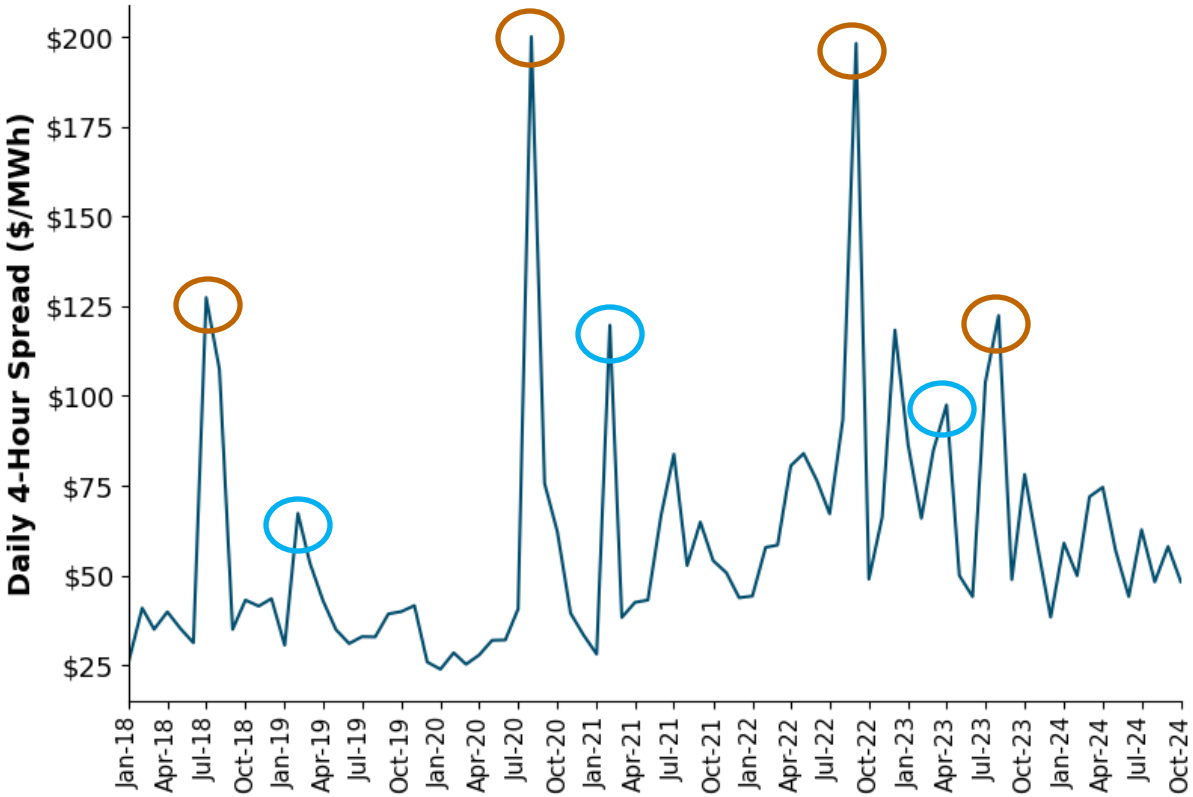
Sources: CA Padilla Reports

Daily 4-hour Spread of Day-Ahead Energy Prices Represents Arbitrage Opportunities for 4-hour Battery Storage

Annual Average of Daily 4-hour Spread



Monthly Averages of CAISO SP15 Daily 4-hour Spread



The 4-hour spread is highest in summer months but also peaks in winter months.

Procurement

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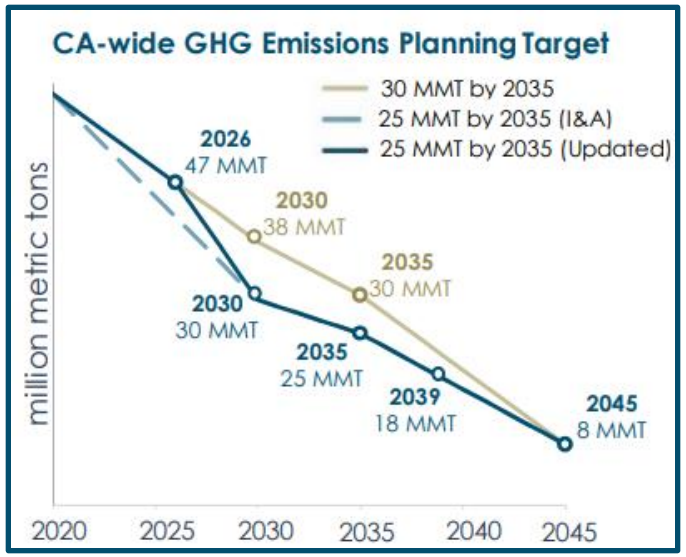
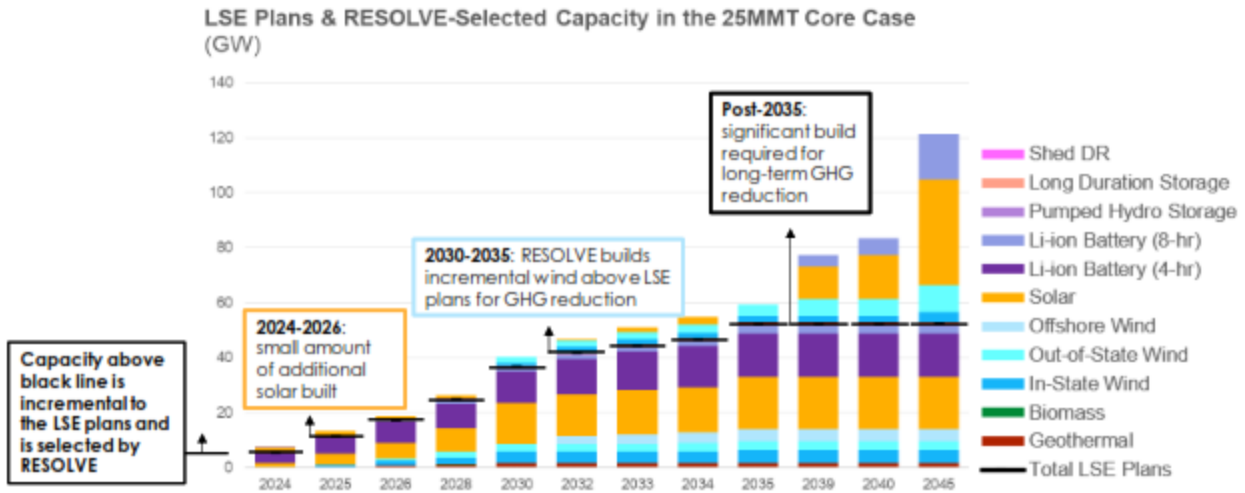
More resources are needed to meet California's goals



2023 Preferred System Plan



+ The CPUC adopted a carbon emissions target of 25 MMT by 2035

+ Requires an additional 50 GW of clean resources by 2035 and 110 GW by 2045

What is the job of a CCA today?

Apple Valley Choice Energy
Ava Community Energy
Central Coast Community Energy
Clean Energy Alliance
CPA Clean Power Alliance
CleanPowerSF
Desert Community Energy
EPIC Energy for Palmdale's Independent Choice
Lancaster Energy
MCE
Orange County Power Authority The Power of Community
Peninsula Clean Energy
Prime Pico Rivera Innovative Municipal Energy
Pioneer Community Energy
Pomona Choice Energy The Power to Choose
Rancho Mirage Energy Authority Power to Choose
Redwood Coast Energy Authority
San Diego Community Power
San Jacinto Power The Power to Choose
San Jose Clean Energy
Santa Barbara Clean Energy Choosing Renewable Electricity
Silicon Valley Clean Energy
Sonoma Clean Power
Valley Clean Energy

=

Friendly Hometown Service Deliverer

+

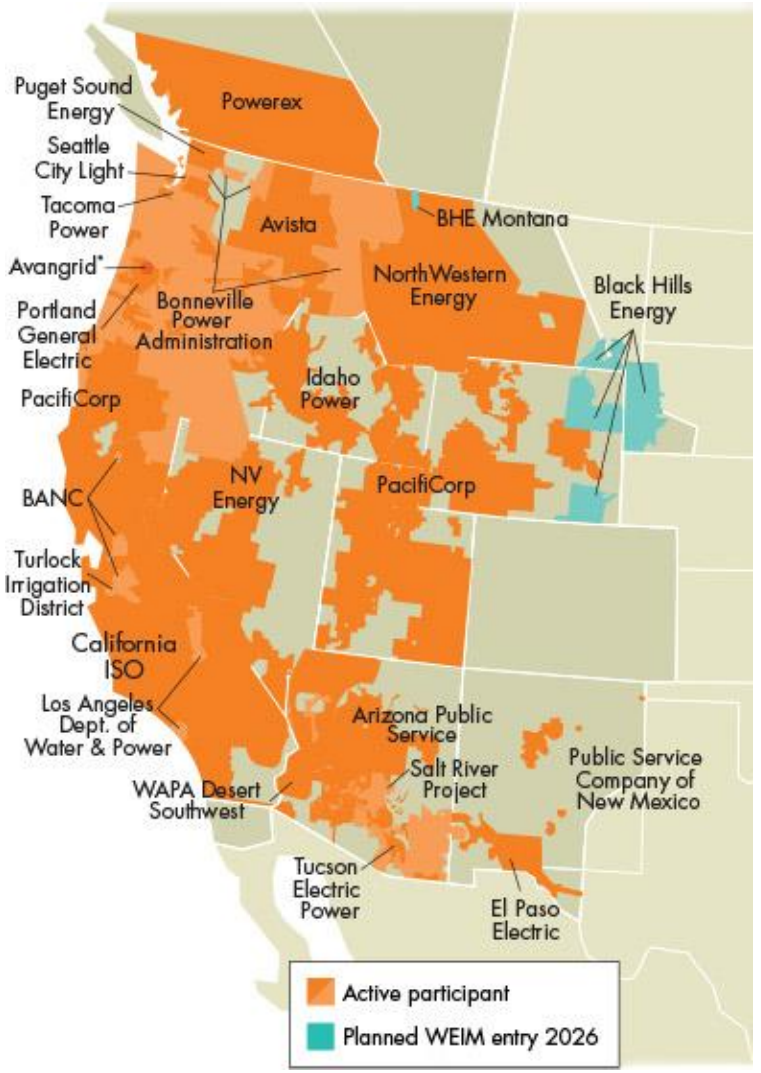
Cold-Blooded Commodities Trader

The ability to exchange clean energy surpluses and shortfalls through the CAISO market is very beneficial

+ Balancing on a market-wide basis creates efficiencies that benefit all market participants

+ CAISO and WEIM have facilitated low-cost integration of large quantities of clean energy resources

+ Studies show larger markets will yield more benefits for California



CPUC reliability orders since 2019 have kept or added 21 GW of incremental capacity

+ 2019: Delay retirement of 3.8 GW of gas plants PLUS 2.5 GW of new procurement by 2023

+ Mid-term Reliability (MTR) Orders: 2021, 11.5 GW of "effective capacity" by 2028, +4 GW ordered in 2023

+ Has led to development of over 13 GW of battery storage and no energy alerts during 2024!

Need Type	2023	2024	2025	2026	2027	2028
General D.21-06-035 requirements[7]	2,000	6,000	1,500			
LLT resources, as defined in D.21-06-035						2,000
New in this decision				2,000	2,000	
Total	**2,000**	**6,000**	**1,500**	**2,000**	**2,000**	**2,000**
Total (cumulative)	**2,000**	**8,000**	**9,500**	**11,500**	**13,500**	**15,500**

CPUC's role continues to evolve

+ **Set "market rules" for 40+ Load-Serving Entities (IOUs, CCAs, ESPs)**

+ **RCPPP will establish stable ground rules to guide long-term CCA procurement to avoid market "externalities"**
  - Resource adequacy
  - Clean energy procurement

+ **Order procurement of large and long lead-time resources**

Reliable and Clean Power Procurement Program (RCPPP)

Navigating Future Uncertainty

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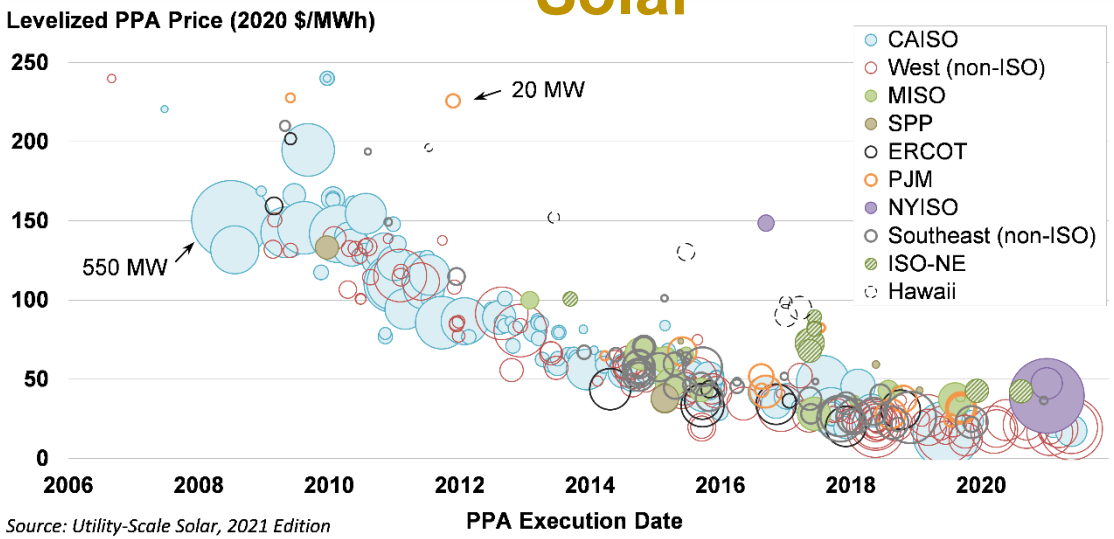
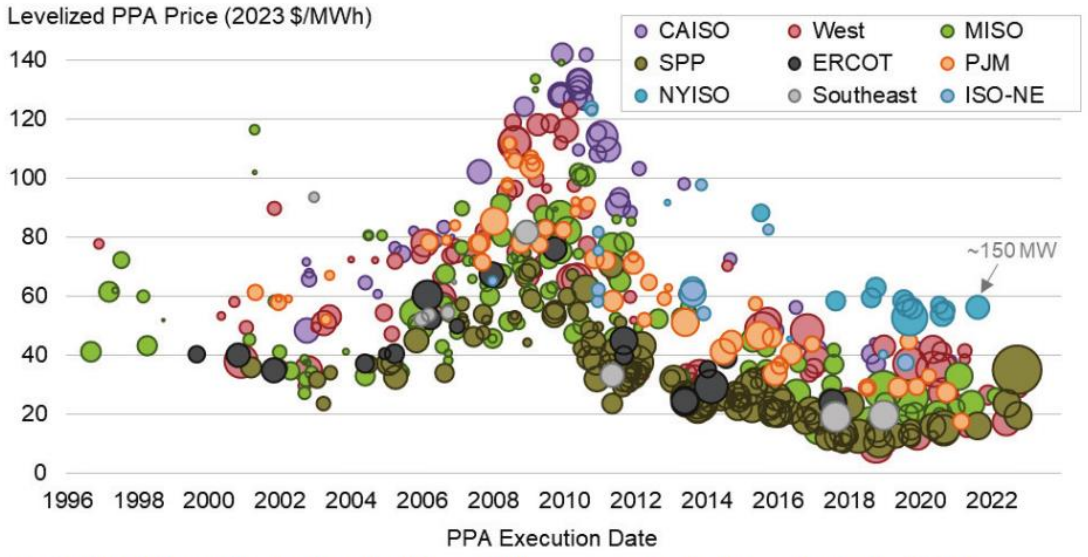
CCAs came of age in the 2010s in an era of capacity surpluses and declining resource costs

Solar



Source: Utility-Scale Solar, 2021 Edition

Wind



Note: Smallest bubble sizes reflect smallest-volume PPAs (<5 MW), whereas largest reflect largest-volume PPAs (>500 MW)

Source: Berkeley Lab, FERC

Batteries

Figure 1: Volume-weighted average lithium-ion battery pack and cell price split, 2013-2023

Source: BloombergNEF. Historical prices have been updated to reflect real 2023 dollars. Weighted average survey value includes 303 data points from passenger cars, buses, commercial vehicles, and stationary storage.

Key drivers included:

+ Technology "learning" and maturation
+ Low interest rates
+ Supportive federal tax and trade policy

Future of California Electricity Market Be Like…

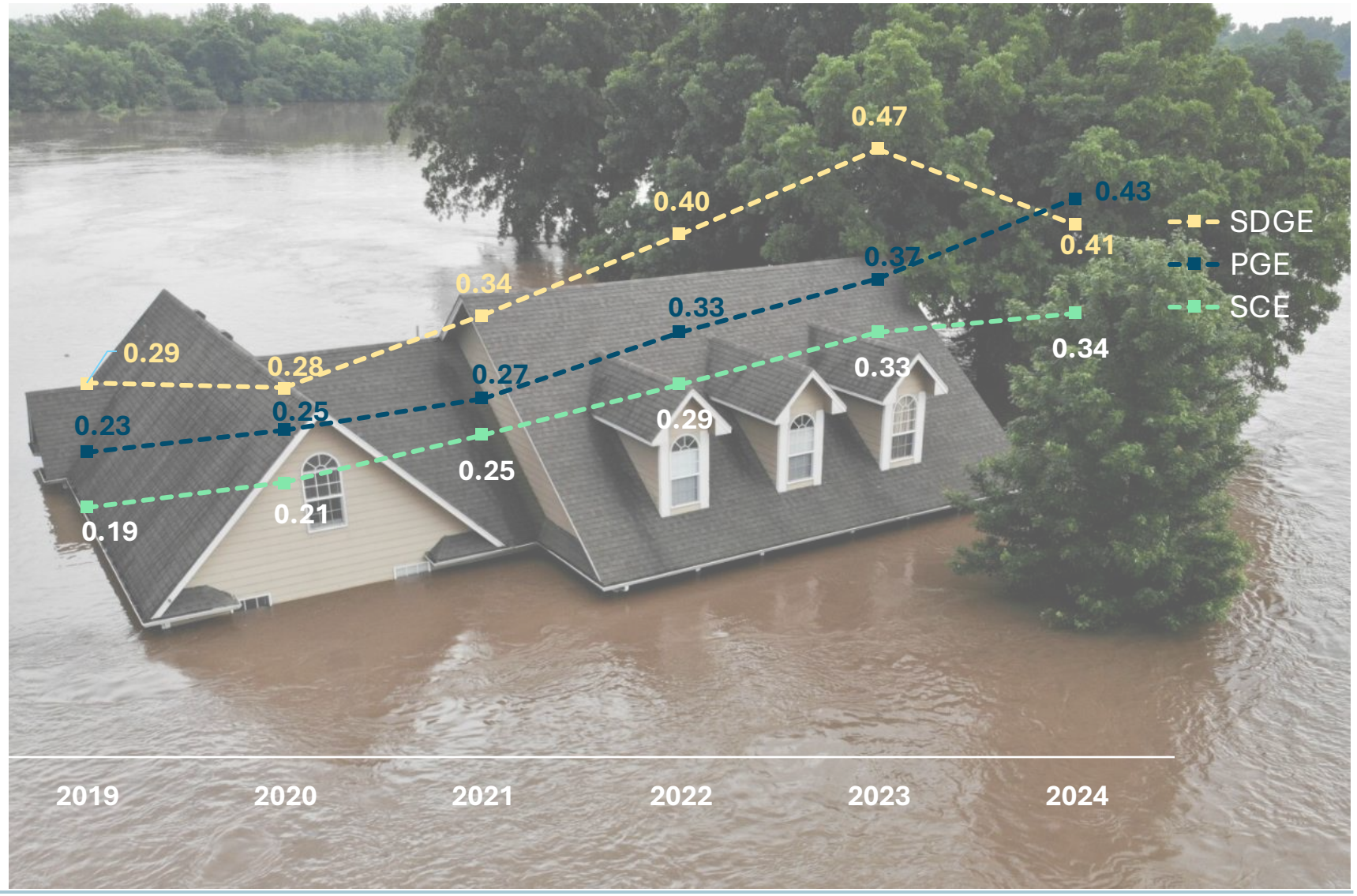
California has an Affordability crisis

Since 2019, residential rates have increased significantly:

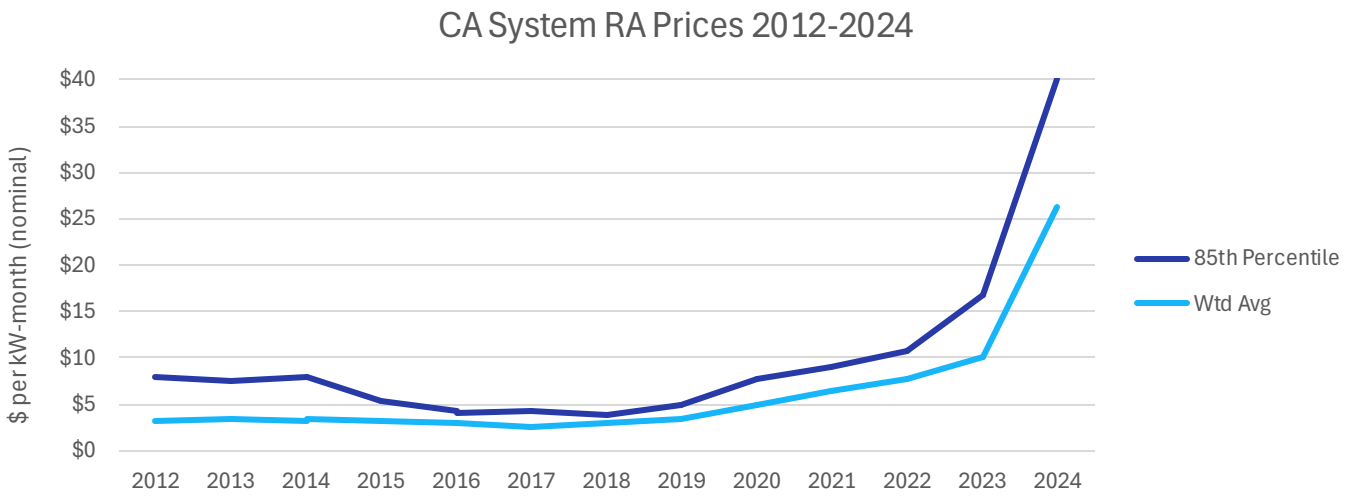
+ PG&E: +87% (~11%/yr)
+ SCE: + 79% (~10%/yr)
+ SDG&E: + 41% (~6%/yr)

Customers are being flooded with higher costs…

+ Wildfire mitigation and damages
+ Cost of capital and other inflationary pressures
+ Net energy metering cost-shift



Capacity market prices are peaking under stress



+ CA RA prices have risen dramatically since 2022

DIVE BRIEF

PJM capacity prices hit record highs, sending build signal to generators

Consumers across the PJM Interconnection footprint will pay $14.7 billion for capacity in the 2025-26 delivery year, up from $2.2 billion in the last auction.

Published July 31, 2024

DIVE BRIEF

MISO capacity prices triple for next summer, spring, partly on power plant retirements

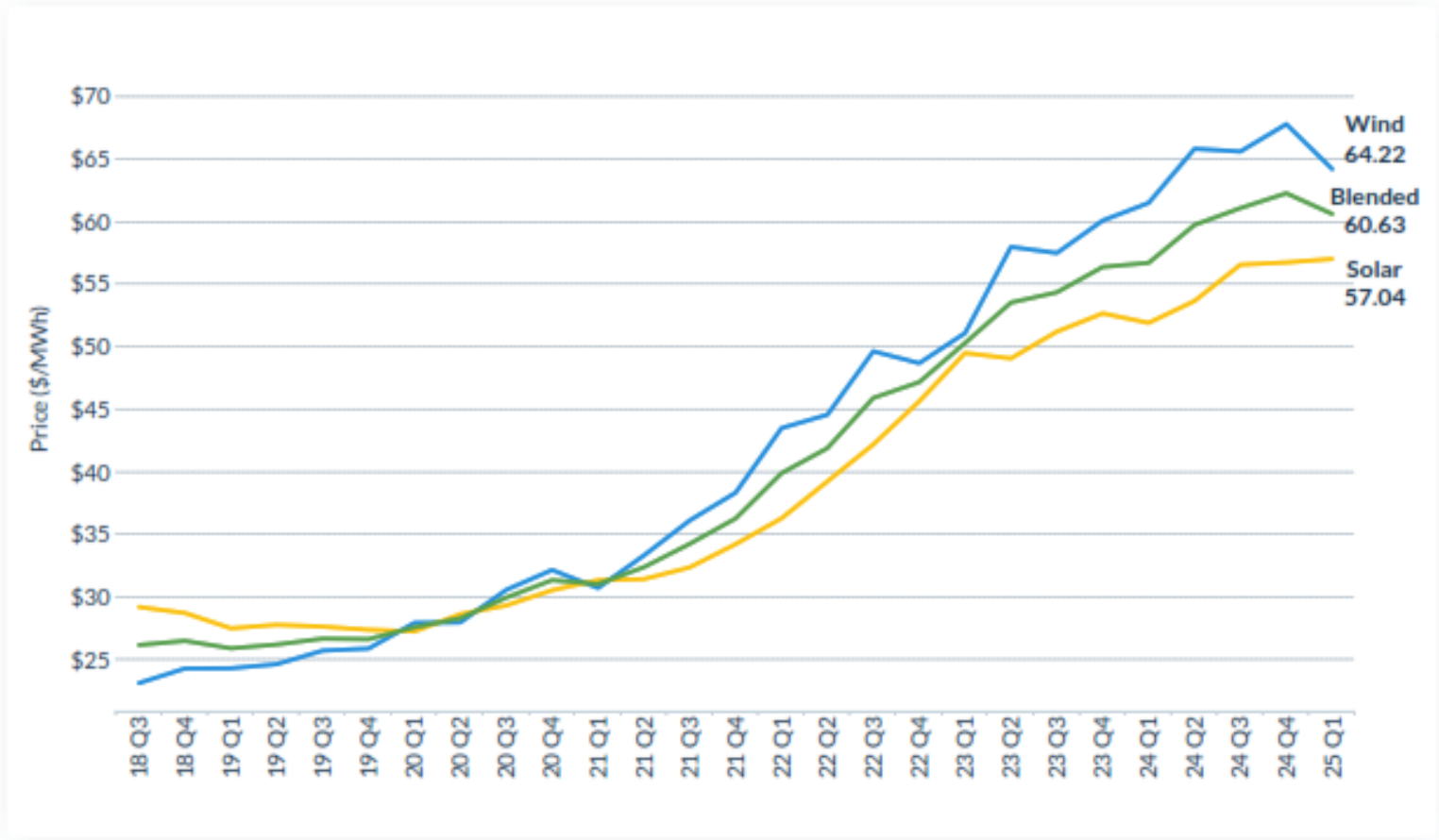
Prices for Ameren Missouri and Columbia, Missouri's municipal utility jumped to nearly $720/MW-day for the upcoming fall and spring seasons due to expected power supply shortages.

Published April 26, 2024

Costs are sky-high right now for all new resources

- **Solar and wind PPAs are now $50-60/MWh**
  - More than double pre-pandemic levels
- **Price pressures will continue due to:**
  - Competition from tech industry
  - Land, labor, equipment, interconnection, tariffs
- **Gas CT costs at or above $2000/kW**

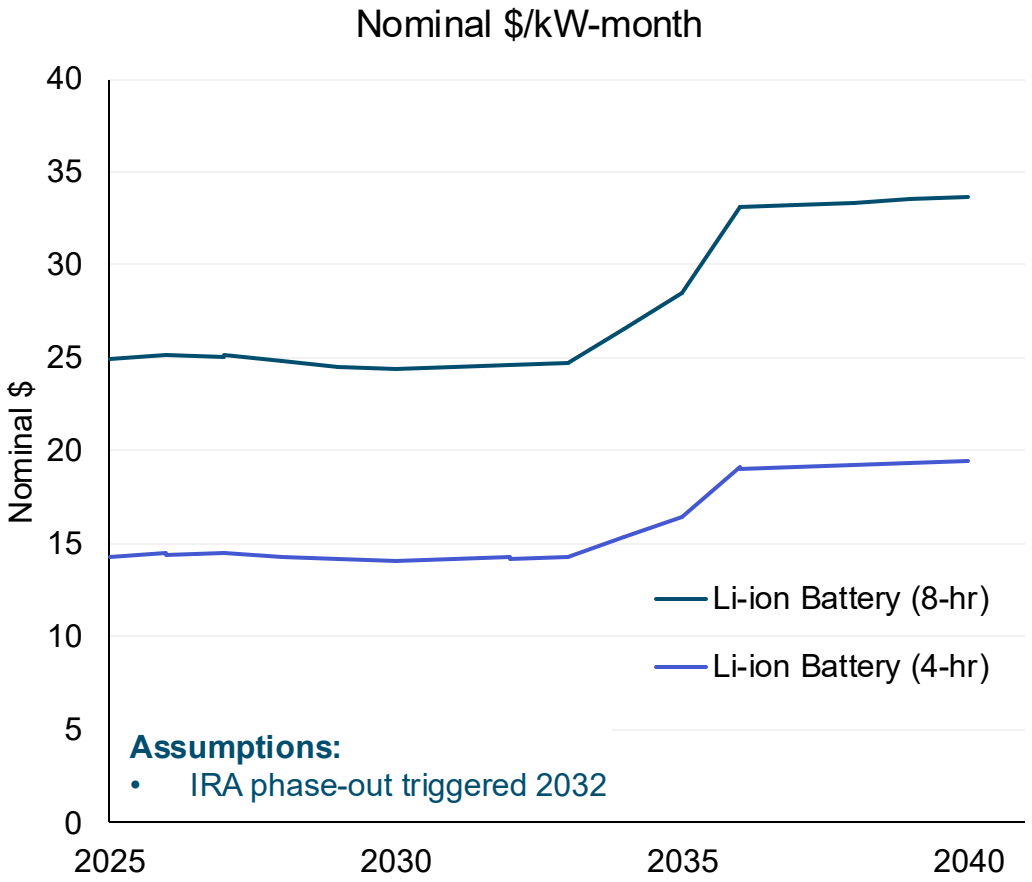
Solar and Wind PPA Price Index: North America (LevelTen)



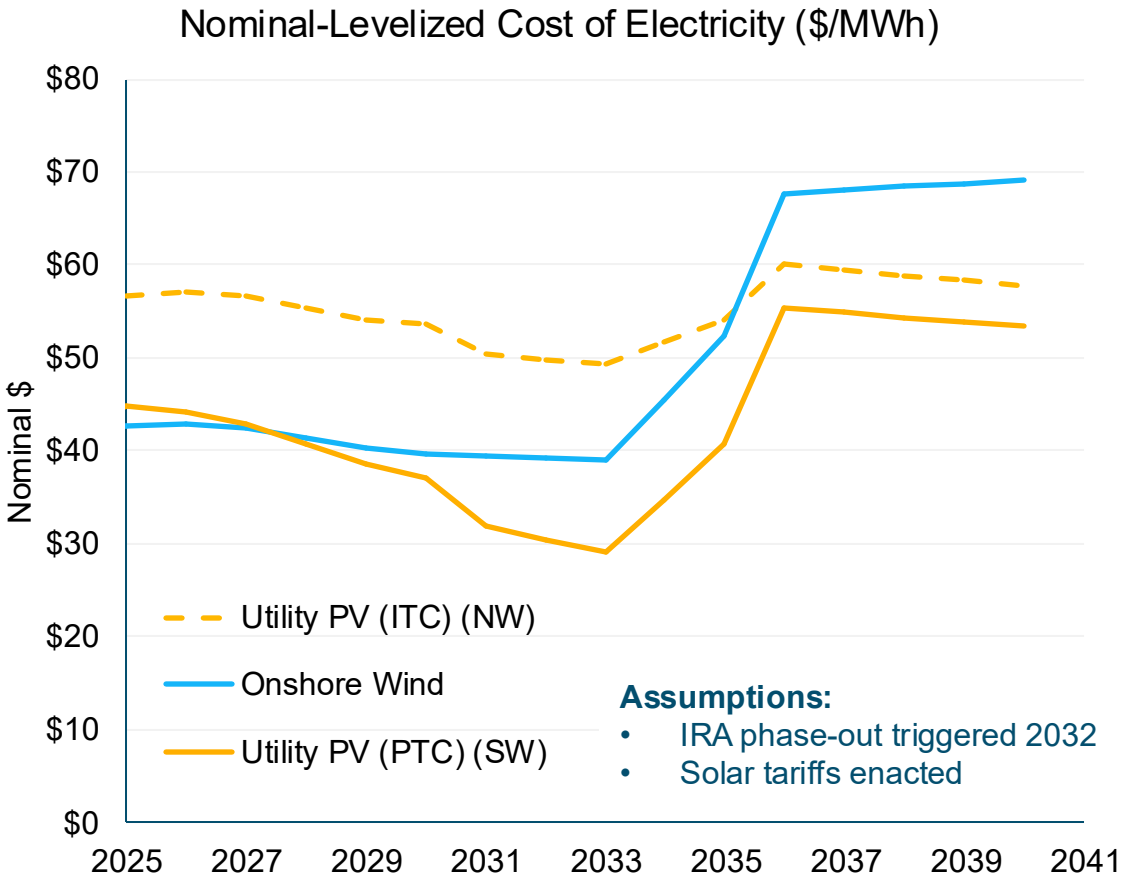
Source: LevelTen Energy (www.leveltenenergy.com/ppa)

E3 New Resource Cost Estimates for Q1 2025

RECOST Levelized Fixed Costs for Selected Resources
Q2 2025, Mid Cost Trajectory, Generic U.S. Location



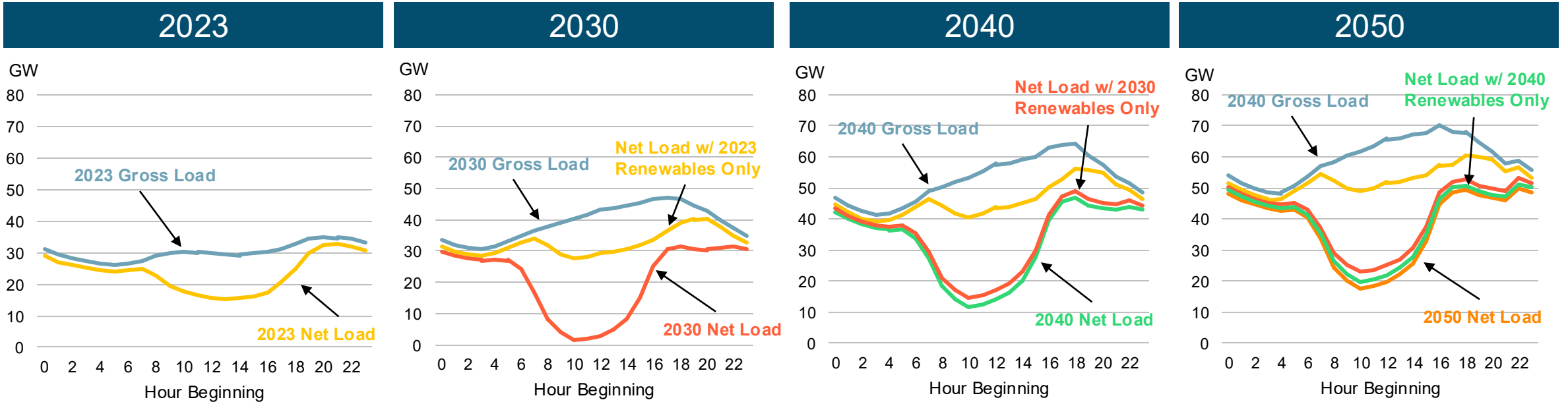
RECOST LCOE Estimates for Selected Resources
Q2 2025, Mid Cost Trajectory, Generic U.S. Location



Note: Resource Costs include a generic interconnection cost but no specific costs for transmission upgrades or wheeling service.

CA's Evolving Net Load Shape

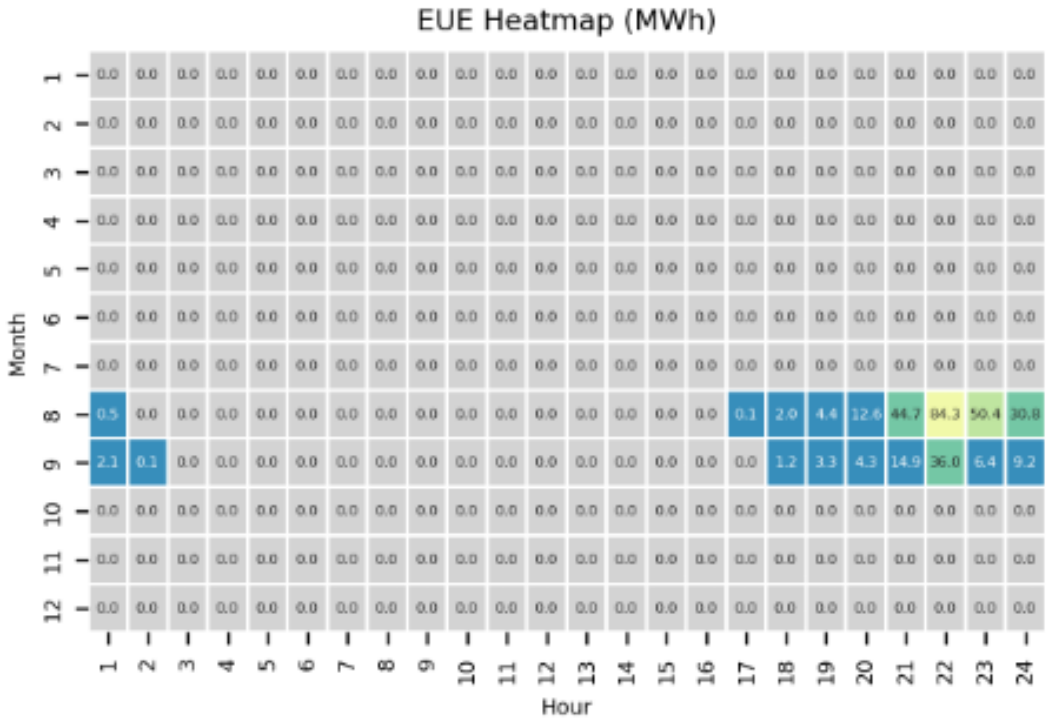
- **Load expected to grow steadily through 2050 → average 2050 peak demand > 70 GW**
- **Solar penetration serves gross peak and depresses midday net load**
  - Expected "baseload" remains between 10-20 GW through 2050
  - Generation for morning and evening hours is most valuable and critical for reliability



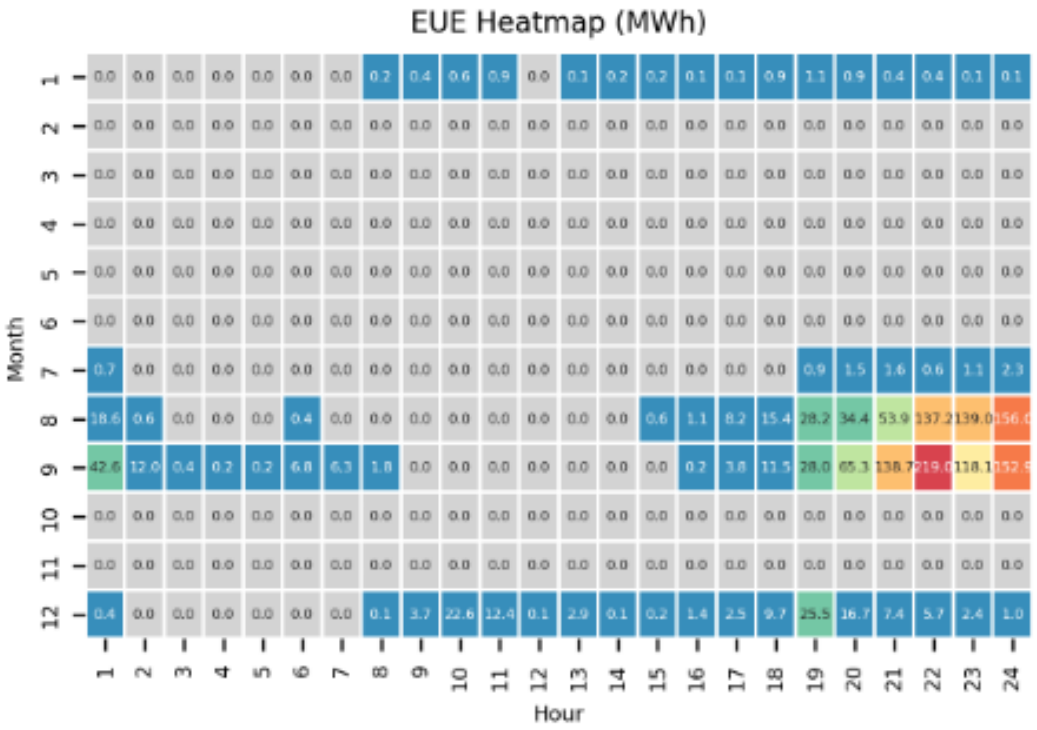
Forecasts for 2030, 2040, and 2050 sourced from E3's Market Price Forecast.
2023 Data accessed from EIA: https://www.eia.gov/electricity/gridmonitor/dashboard/electric_overview/regional/REG-CAL.

Reliability need is evolving to longer durations due to saturation of solar and short-duration storage

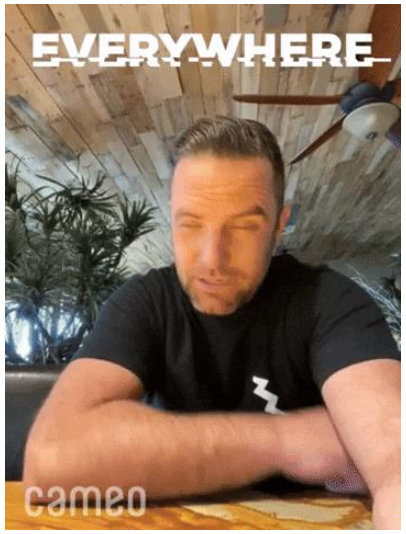
2035: Modeling shows summertime Loss-of-Load events lasting 8-10 hours



2039: Modeling shows summertime and wintertime loss-of-load events lasting 16-20 hours



Federal Policy Be Like...



Closing Thoughts

+ **California needs more generation resources and future procurement decisions will be more challenging and higher risk**
  - Solar and storage will continue to be built at rapid pace
  - Need for future clean firm dispatchable resource is certain but technology is still to be determined
  - Expecting additional procurement mandates
+ **Affordability concerns and uncertainty will leave less room for CCAs to maneuver**
  - High retail rates driven by wildfire costs and NEM pose challenges for new costs
  - Wholesale market prices are higher
+ **CCAs are well-positioned to rise to the challenge**
  - Understanding fundamental market outlook will be critical to making smart procurement and program choices

Image Source

Thank you!

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Q&A

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