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California Energy Resource and Reliability Outlook 2026

Moderator, Dhruv Bhatnagar, Supervisor – Supply Planning Unit, EAD

June 9, 2026

Housekeeping

- Workshop is being conducted remotely via Zoom
- Workshop is being recorded
- Attendees may participate in the workshop by:
  - Asking questions during public Q&A periods: questions can be entered in the Q&A section of the Zoom application or by using the raise hand feature
  - Making comments during public comment period, and
  - Submitting written comments by 5 pm on June 23rd, 2026

CERRO Workshop Overview

Opening Remarks	**9:00 – 9:05**
Comments from the Commissioner(s)	**9:05 – 9:15**
Introduction – CERRO Overview	**9:15 – 9:25**
Session 1	**9:25 – 10:55**
Mid-Term Resource Adequacy Analysis	
Long-Term Reliability and System Planning	
Session 2	**10:55 – 12:15**
Wildfire Risk Analysis	
Weak Grid Analysis	
Public Comments	**12:15 – 12:35**
Closing Remarks & Adjourn	**12:35 – 12:40**

Commissioner's Opening Comments

California Energy Resource and Reliability Outlook 2026

Aleecia Gutierrez

CERRO Workshop
June 9, 2026

California Energy Resource and Reliability Outlook

Statewide assessment of electric, fossil gas, and petroleum resource planning and reliability

- A **comprehensive picture of planning and reliability** throughout California. Topics include:
  - 2026 Summer Conditions
  - Summer 2026 Electric Reliability Analysis
  - Emerging Loads and Demand Flexibility
  - **Electric Resource Planning (Mid-term and Long-term)**
  - Maintaining Reliability Through Extreme Events
  - Western Interconnection and Coordination
  - Gas System Reliability
  - Petroleum Market and Short-Term Outlook
  - Fossil Gas Plant Performance Updates

Report Highlights

Clean Energy Highlights

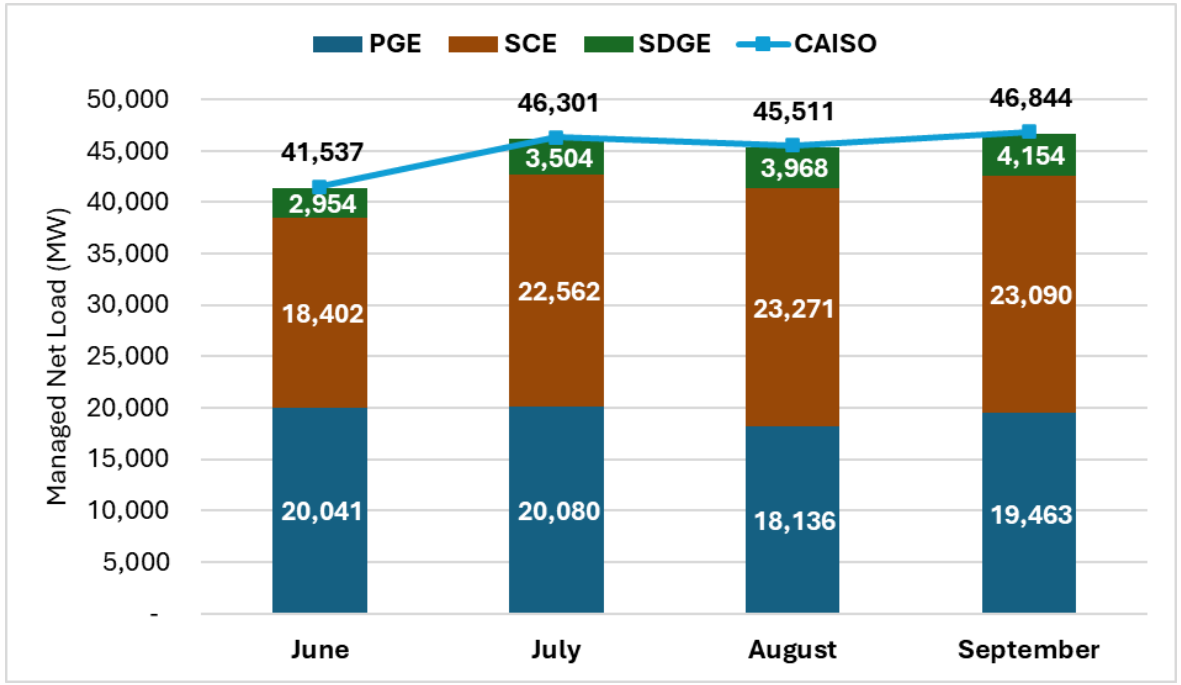
- The entire state has run on **100% clean energy** for some part of the day **almost every day this year.**
- As of November 2025, the state has more than **16,900 MW of battery energy storage capacity,** up from 770 MW in 2019.
- In June 2025, the CEC approved **the world's largest battery energy storage project** under its Opt-In consolidated permitting authority.
- As of September 2025, there are more than **201,000 public/shared EV chargers** in the state, 68% more than the number of gasoline nozzles.

Darden Clean Energy Solar + Storage Project

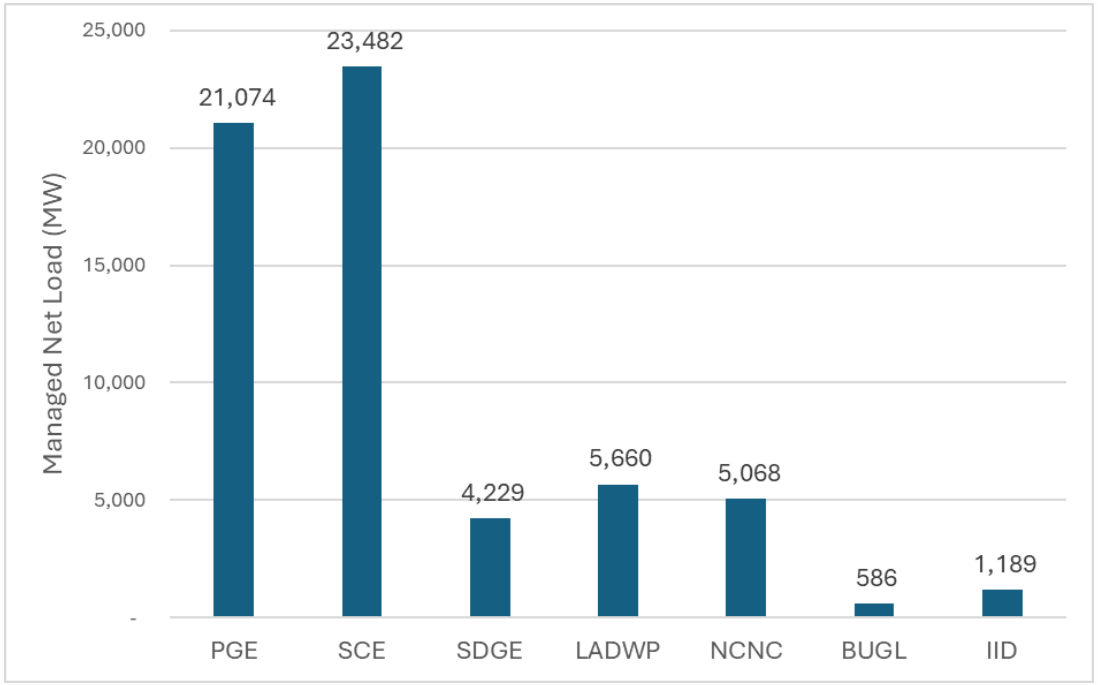
2026 Summer Conditions: Demand

Electricity demand continues to increase and peak in the summer months

California ISO Coincident Monthly Peaks for Summer 2026



Noncoincident Annual Peaks for 2026

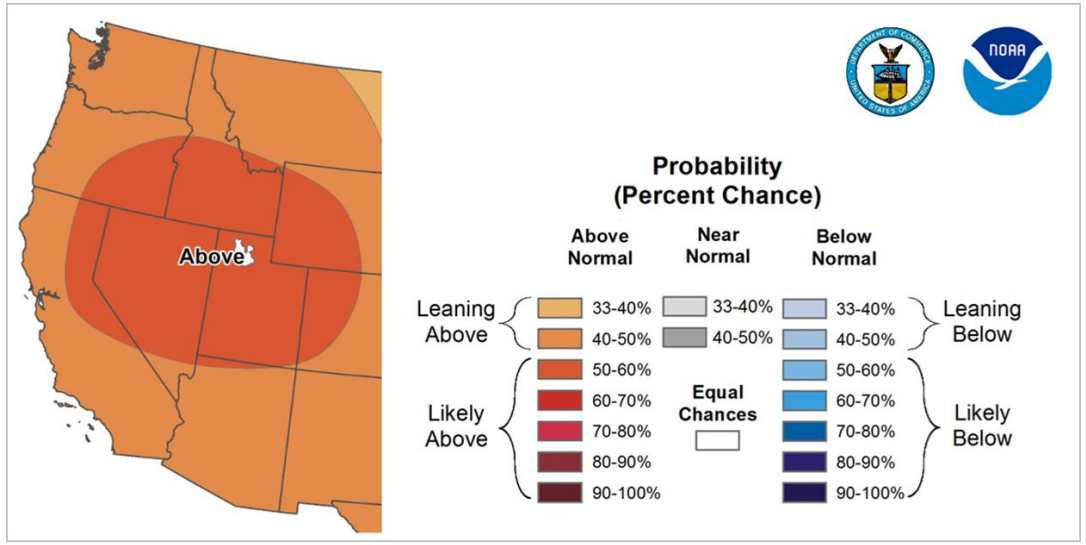


Source: CEC 2025 IEPR Planning Forecast

2026 Summer Conditions: Weather

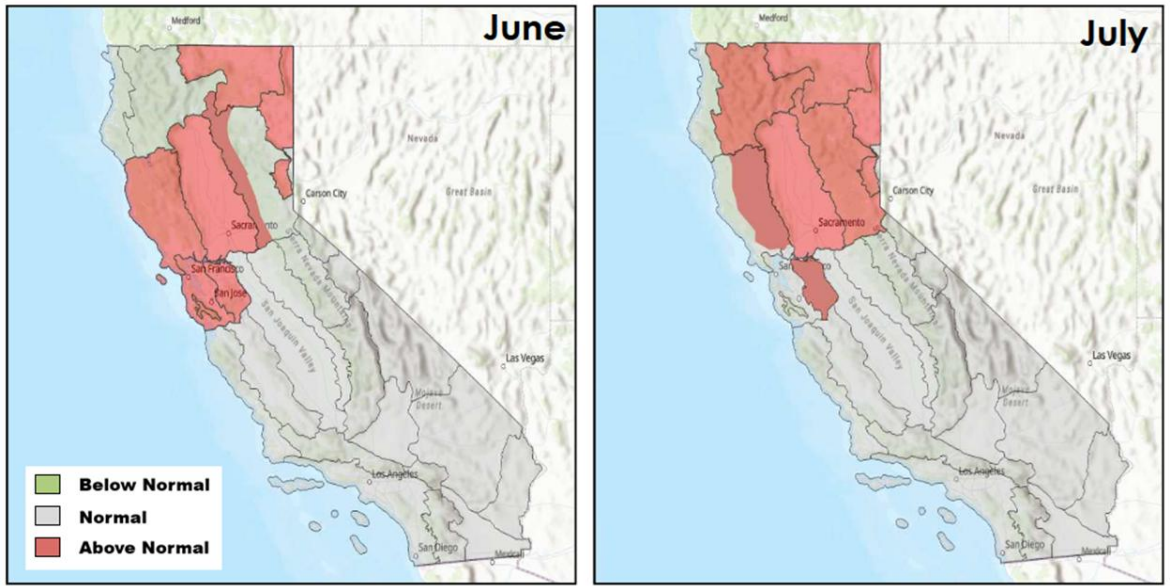
Climate forecasting predicts above normal temperatures; early fire forecasts indicate above normal fire potential in June/July

Seasonal Temperature Outlook for July–September



Source: CPC Seasonal Temperature Outlook for July–September 2026, valid March 19, 2026

Significant Fire Potential Outlook for June – July 2026



Source: WFTIIC Significant Fire Potential Outlook, valid April 2, 2026

Summer Electric Reliability Outlook

California meets the reliability standard in 2026, with surplus available in most cases

Cautiously optimistic summer outlook: No shortfalls expected under average conditions and extreme events, Tight conditions may occur if there is a coincident fire impacting transmission assets

Loss of Load Expectation Analysis

Scenario	2026 LOLE (days/year)	Effective Statewide Margins	Effective CAISO Margins
2025 IEPR Planning	0	7-8	5-6
2025 IEPR Pln. w/ Known Loads	0	6-7	6-6.5
2024 IEPR Planning	0	7-8	5-6
2025 IEPR Local Reliability with Known Loads	0	6-7	6-6.5

**Surplus is defined by adding firm load. Deficit by adding perfect generation*

Stack Analysis

	2026 2nd Quarterly Report
Surplus/Shortfalls (MW)	
Average Conditions	6,600
2020 Equivalent Event	4,500
2022 Equivalent Event	2,900

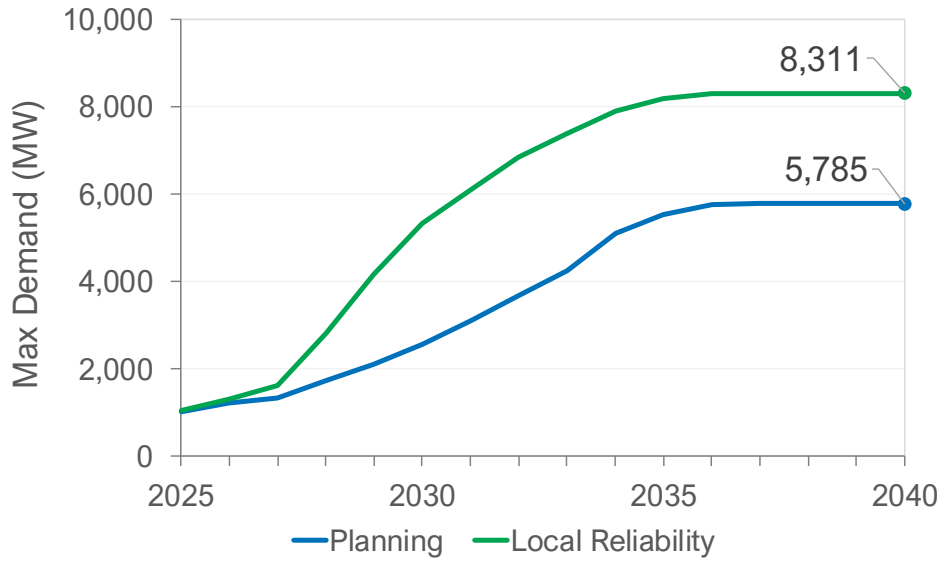
Coincident Fire Risk

System conditions	Surplus/Shortfalls
Average Conditions	**2,600 MW**
2020 Equivalent Event	**500 MW**
2022 Equivalent Event	**-1,100 MW**

Emerging Loads and Demand Flexibility

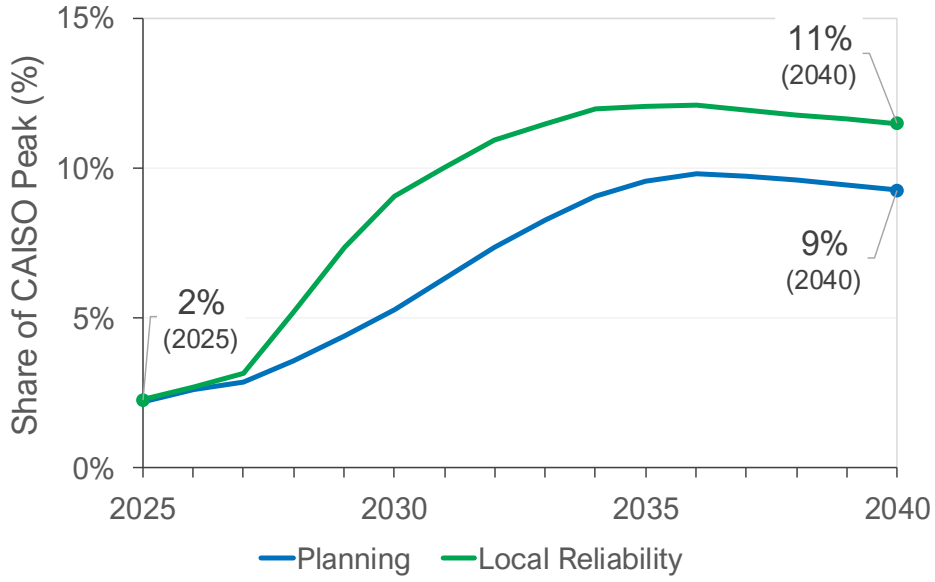
2025 IEPR Forecast results show continued peak demand growth

Statewide Data Center Maximum Demand Forecast, including Existing Load



Source: CEC staff based on utility data as of December 2025

Data Center Share of California ISO Peak Demand

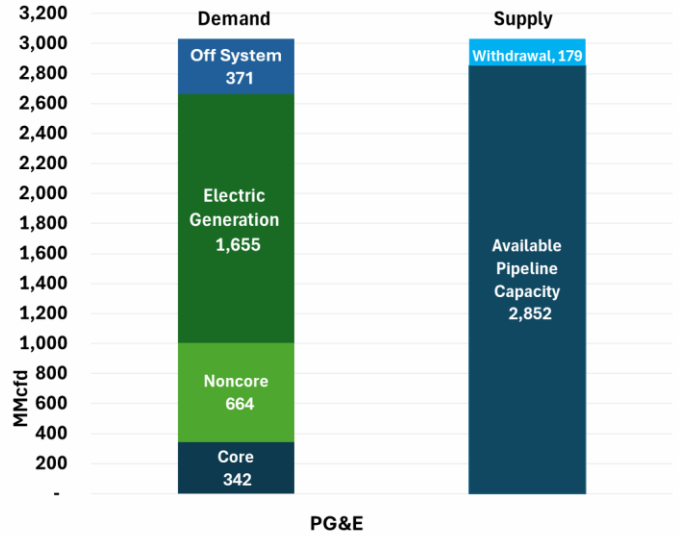


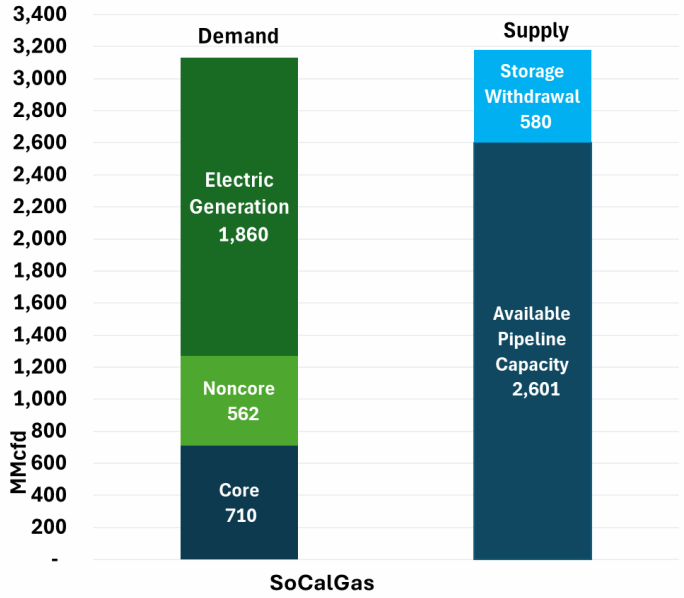
Source: CEC staff based on utility data as of December 2025

Gas System Reliability: Peak Day Gas Balance & Storage Inventory

The gas system is anticipated to meet Summer 2026 forecasted peak gas demand

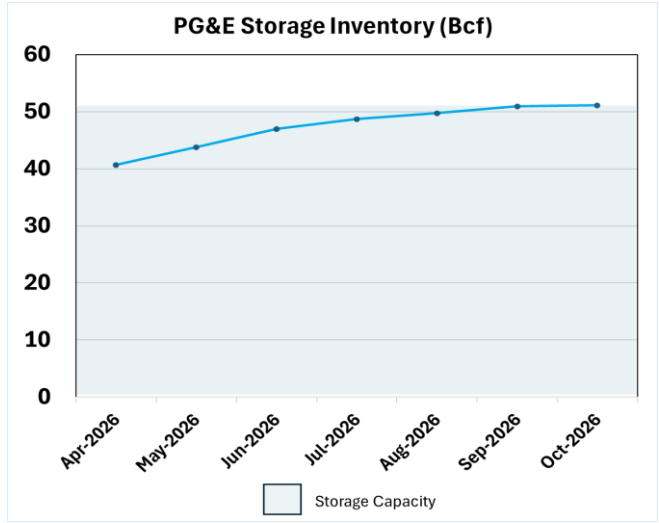
Summer peak day gas balance for PG&E and SoCalGas

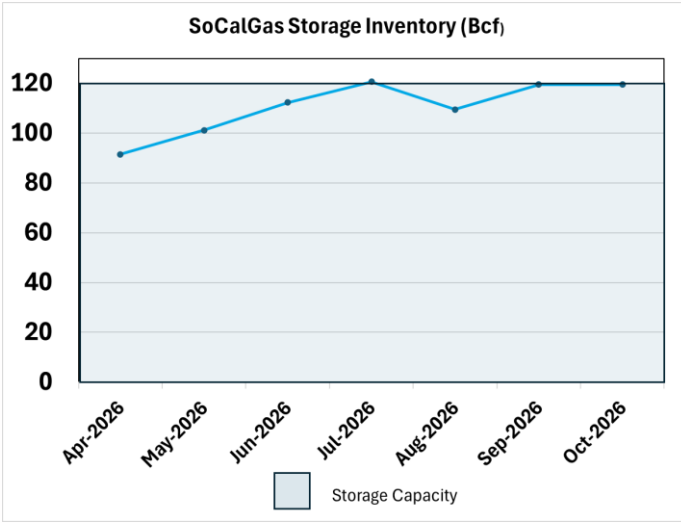




Source: CEC staff based on utility data

Projected storage inventory levels for PG&E and SoCalGas and over the summer injection season





Electric Resource Planning Issues – Mid-Term System Reliability

Alyssa Tavares

California Energy Resource and Reliability Outlook Workshop
June 9, 2026

Overview: Mid-term (5-10 year) Probabilistic Assessment

- Objective: Assess system reliability under ordered procurement – is existing and ordered procurement sufficient to meet the reliability criterion in future years, and by how much

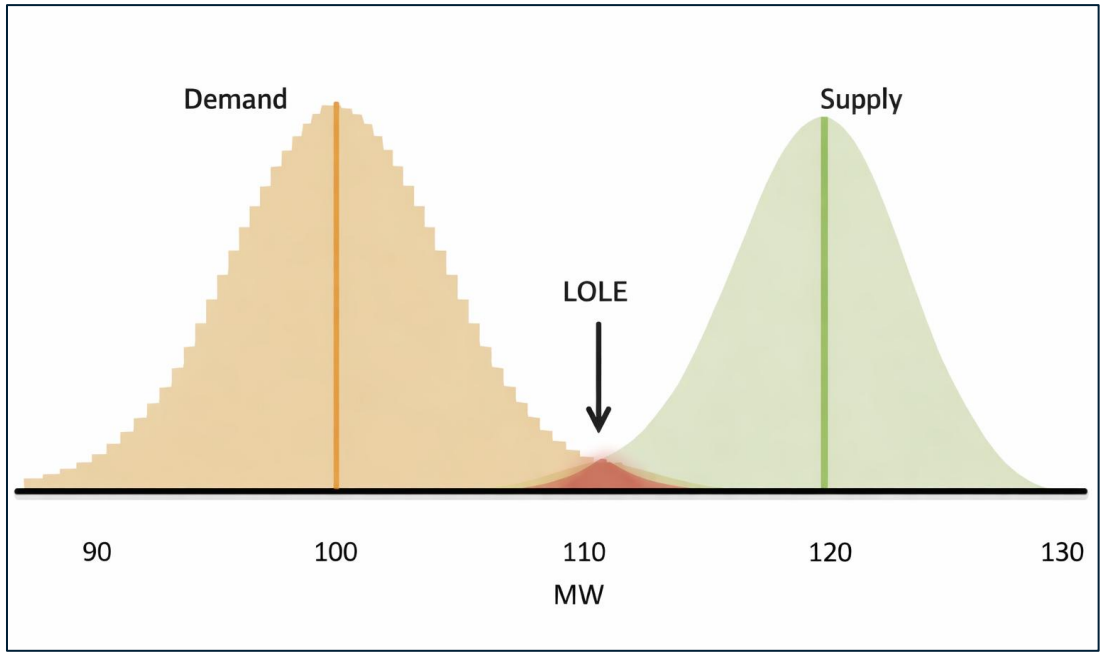
- Evaluates California statewide system including Investor-Owned Utilities (IOUs) and Publicly-Owned Utilities (POUs)

- Multiple load scenarios
  - Base forecast
  - Base forecast + Known Loads
  - Prior-year forecast comparison
  - Local reliability

Probabilistic Loss of Load Expectation (LOLE)

- Reliability standard: less than 0.1 days/year LOLE (1-in-10)
- Captures key risks:
  - Resource availability uncertainty
  - Demand variability (hourly/weather-driven)
  - Outage events
  - Import limitations

Illustrative Example of LOLE



Source: 2023 SPP Loss of Load Expectation Report

Resource Adequacy

Overall Approach

Demand Forecast

- 17 weather year dependent loads
- Includes extreme (tail-risk) conditions
- Annual forecast with load modifiers

Supply Inputs

- Energy Information Administration (EIA)
- Quarterly Fuel and Energy Report (QFER)
- CAISO Master Capability Generating List
- CPUC procurement requirements (NQC)

Supply includes both fully deliverable (CAISO NQC list) and energy only resources

Model Topology

- 7 California BAs – PG&E, SCE, SDG&E, LADWP, BANC, IID, TIDC
- Imports/exports constrained to CAISO transfer limits

RA Model

- Simulation Design: 17 weather years x 24 outage draws
- Co-optimizes energy + reserves under system conditions

Results

- LOLE
- Surplus/Deficit

Resource Adequacy

Demand

Stochastic Loads

- Chronological; 17 weather year patterns.

Scenarios

- Base Case, 2025 IEPR Planning Forecast
- 2025 IEPR Planning Forecast with Known Loads
- 2024 IEPR Planning Forecast
- 2025 IEPR Local Reliability Forecast

Load Modifiers

- Additional Achievable Modifiers:
  - Additional Achievable Energy Efficiency (AAEE)
  - Additional Achievable Fuel Substitution (AAFS)
  - Additional Achievable Transportation Electrification Light-Duty Vehicle (AATE LDV)
  - Additional Achievable Transportation Electrification Medium- and Heavy-Duty Vehicle (AATE MDHD)
- Other Modifiers:
  - Climate Change, Data Centers, Storage, Electric Vehicles

Resource Adequacy

Supply

Category	CAISO (MW)	Non-CAISO (MW)	CPUC Procurement (MW)		
			2026	2027	2028
Natural Gas	25,385	9,949	0	0	0
Utility Scale PV	22,273	1,957	2,700	2,700	2,700
Distributed PV	16,712	1,825	0	0	0
Batteries	16,701	556	2,364	2,364	0
Pumped Storage Hydro	2,658	1,682	0	0	0
Land Based Wind	6,612	135	0	0	0
Geothermal	2,020	950	0	0	0
Demand Response	2,466	302	0	0	0
Nuclear	2,393	0	0	0	0
LDES	0	0	0	0	1,110
Other	366	88	0	0	0

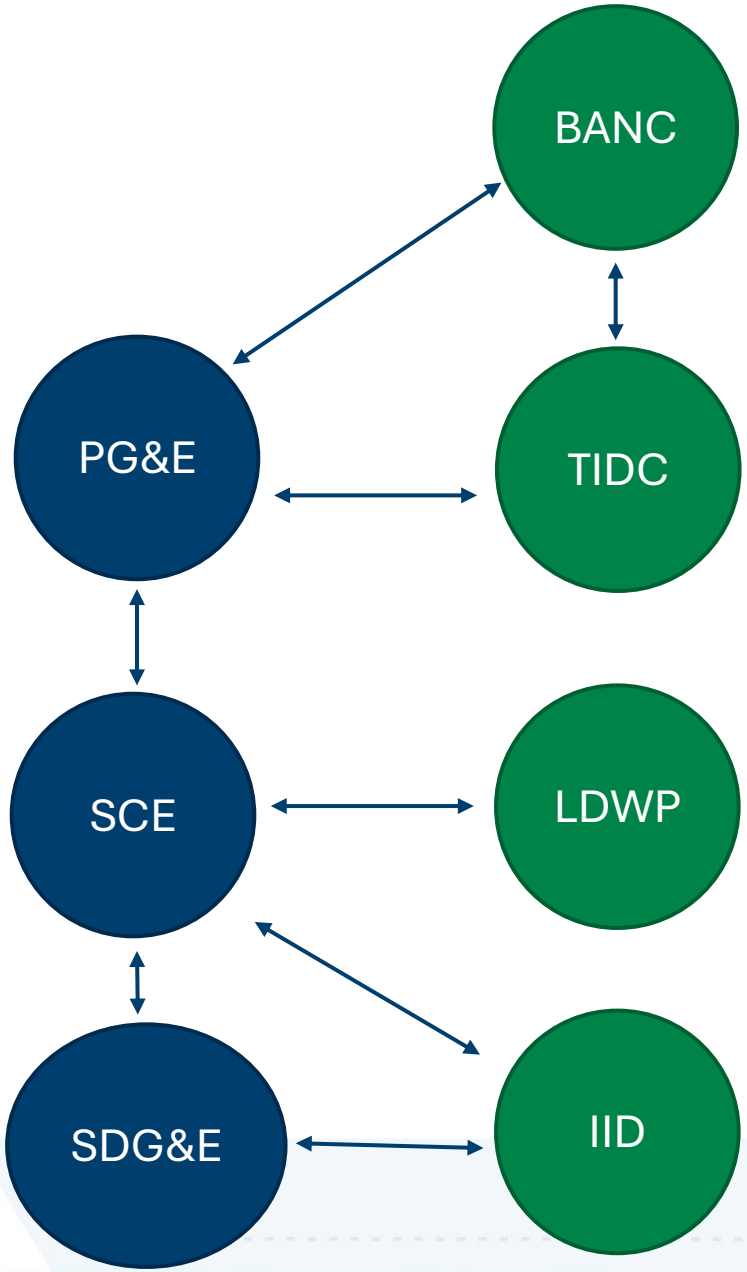
Includes CPUC Procurement Orders as of December 2025

- CPUC Procurement Order D.23-02-040 (MTR)
  - 2,000 MW NQC in 2026 and 2,000 MW NQC in 2027
- CPUC Procurement Order D.21-06-036 (MTR) ordered 11,500 MW NQC from 2023-2028
  - 2,000 MW NQC in 2028
- ***Does Not*** include Feb 2026 CPUC IRP Decision (R.25-06-019)
  - Procurement of 6,000 MW NQC by June 2032

Resource Adequacy

California Transmission System

- California-centric
  - Out of state – modeled as generic imports
- 7 Regions
  - Investor-owned utilities (IOUs)
    - PG&E, SCE, SDG&E
  - Publicly-owned utilities (POUs)
    - BANC, TIDC, LADWP, IID
- Import Limits
  - Total CAISO Import Limit: 11,665 MW
  - Resource Adequacy Import Limit: 5,500 MW
    - Morning and Afternoon peaks (H6-9, H17-23)
    - Across entire year



Resource Adequacy

LOLE - Results

LOLE Scenarios (days/year)	2031	2036
Base Scenario, 2025 IEPR Planning	0.005	1.64
2025 IEPR Planning with Known Loads	0.15	9.89
2024 IEPR Planning	0.38	> 10
2025 IEPR Local Reliability with Known Loads	0.64	> 10

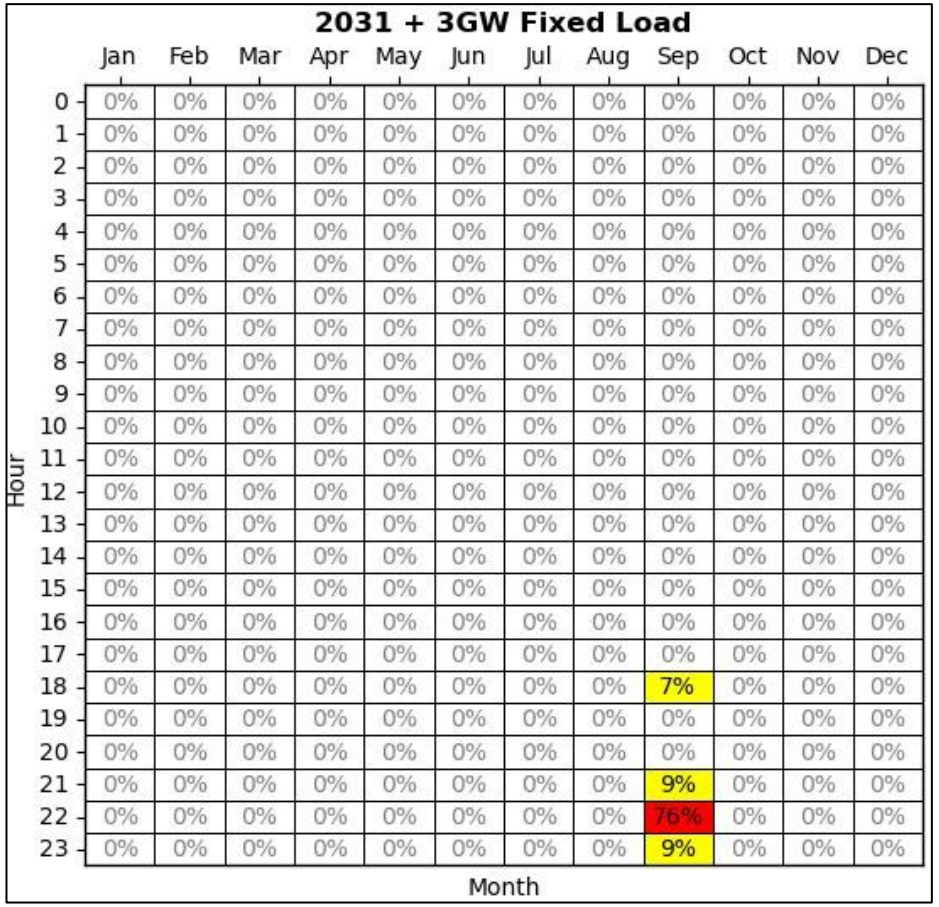
Scenarios – Effective Surplus/Deficit (GW) *	2031	2036
Base Scenario, 2025 IEPR Planning	3 – 4 Surplus	6 – 7 Deficit
2025 IEPR Local Reliability with Known Loads	4 – 5 Deficit	> 10 Deficit

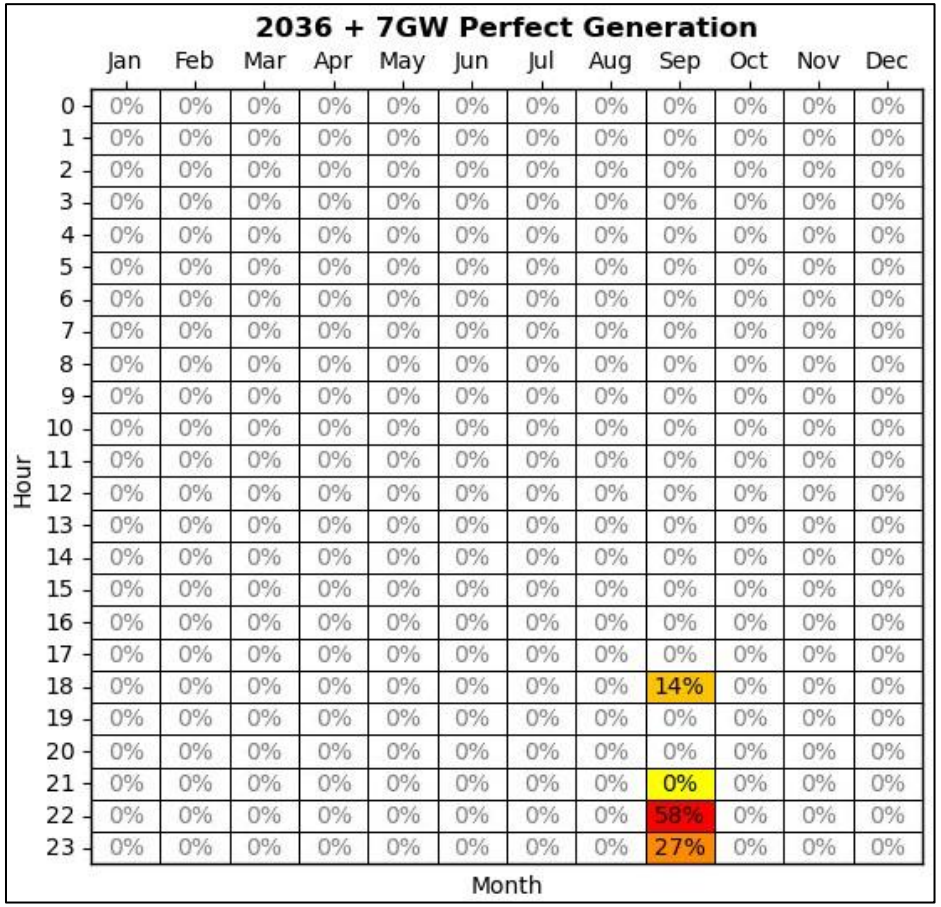
- In 2026, all scenarios meet 0.1 days/year LOLE reliability criterion
- By 2031, higher load scenarios no longer meet the 0.1 days/year reliability criterion under ordered procurement through 2028
  - 2031: Base scenario continues to meet the reliability criterion. The inclusion of known loads leads to the exceedance of the criterion. Including the 6 GW procurement, all scenarios should meet the criterion.
  - 2036: As expected, no scenarios meet the criterion.
  - CPUC procurement decision D.25-06-019 ordered an additional 6,000 MW NQC procurement by June 2032 (not included in this analysis). This analysis confirms the prudency of that decision.

*Amount of surplus or deficit capacity to achieve 0.1 days/year LOLE criterions for each study year.

Resource Adequacy

Results – Distribution of Unserved Energy



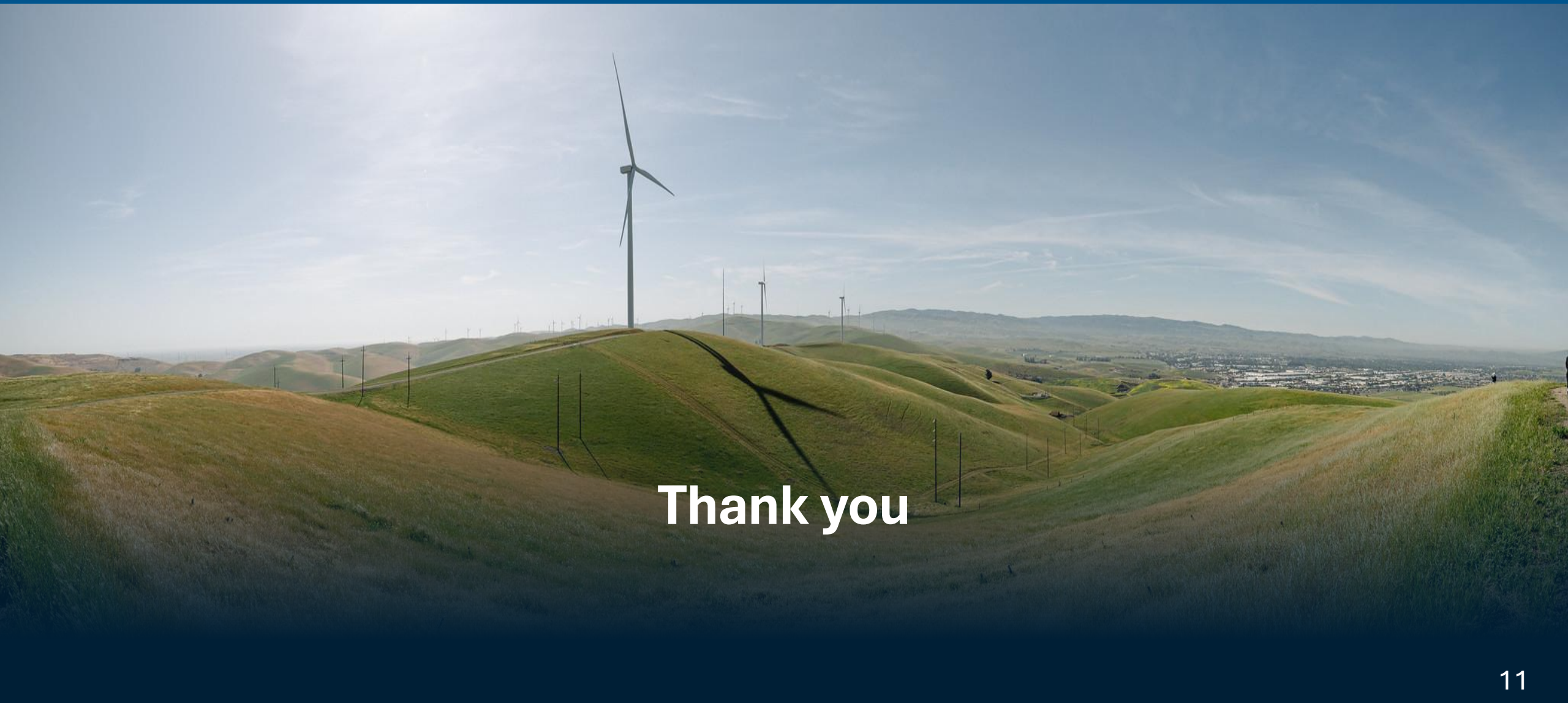


Source: CEC Staff

Resource Adequacy

Future Considerations

- Summer remains greatest risk season, which is a change from prior demand forecasts moving risk to winter periods
- Need for continued resource development in the state.
  - Findings consistent with the February 2026 CPUC IRP decision (R.25-06-019) ordering procurement of 6,000 MW NQC by June 2032.
  - Need to continue to monitor demand forecast uncertainty- highest demand scenarios may results in a need for additional procurement
- Future Analysis
  - Wildfire Risks to Power System
  - Weak Grid Analysis
  - Winter Reliability Risks


Thank you

Long-Term Reliability and System Planning – Resource Availability and California's Future Electric System

Hannah Craig

California Energy Resource and Reliability Outlook Workshop

June 9, 2026

CERRO Modeling Goals

- Support the state's effort to meet climate goals, which requires reliability analysis of different scenarios of clean energy development:
  - Evaluate the risks and uncertainties that could shape how the clean energy transition unfolds.
  - Estimate the types of resources most impactful to that transition, the volume of resources required, and the risk associated with each type of resource.
  - Understand how different assumptions could impact California's electric system reliability through 2045:
    - Resource costs and availability
    - Policy and tax incentives enabling resource development
    - Land use constraints limiting resource availability

Long-term System Scenarios

Feasibility Scenarios

- **Base:** Allowed to build all emerging resources at their default prices.
- **No CCS**: Removes the availability of Carbon Capture & Storage (CCS) retrofits from the portfolio.
- **No Emerging Resources:** Removes the availability of emerging resources from the portfolio.

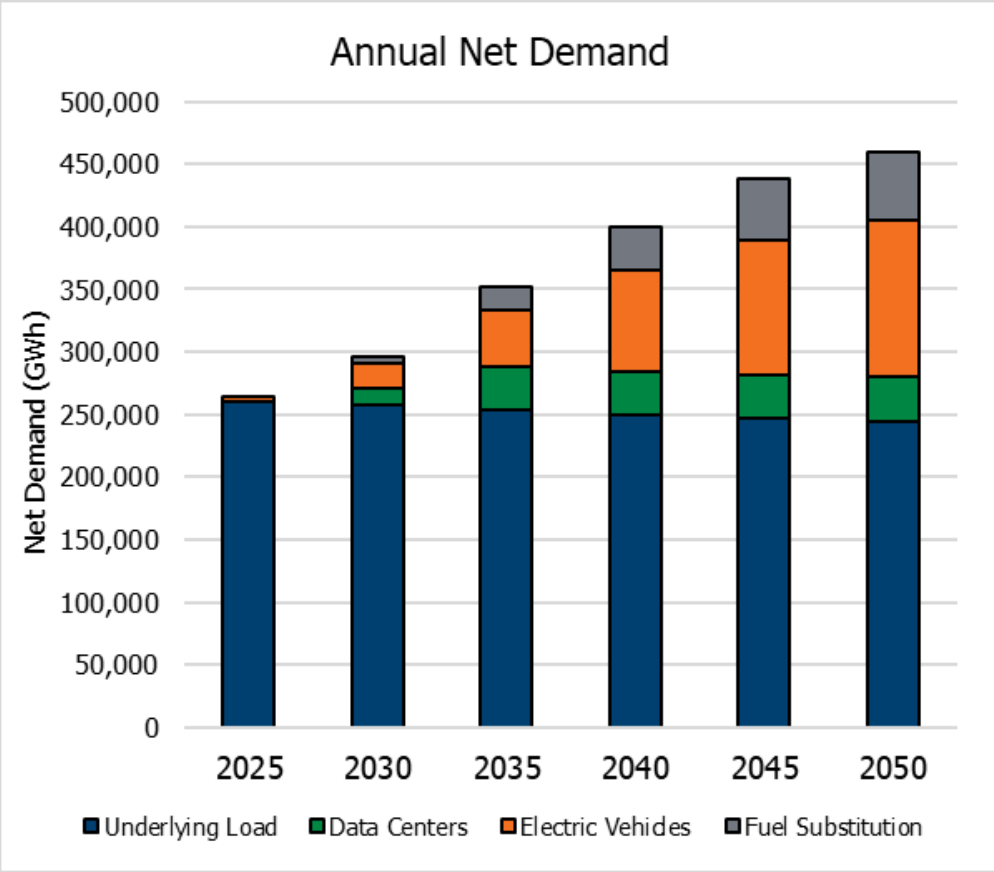
Cost Reduction Scenarios

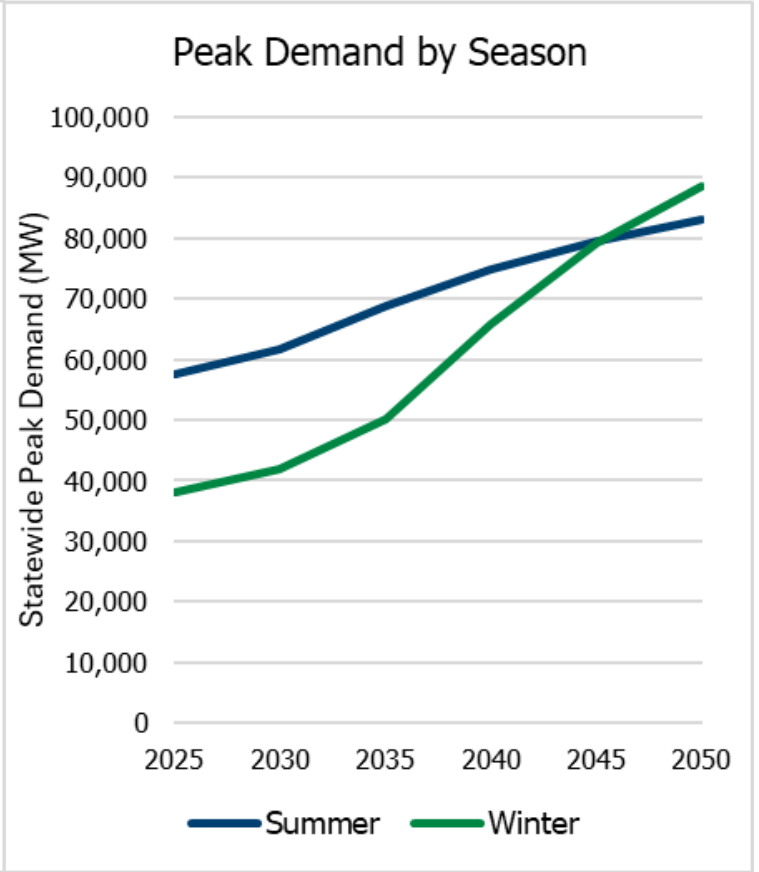
- **Tax Credits Extension:** Maintains the tax credit regime from Inflation Reduction Act.
- **Low-Cost LDES**: Models 70% cost reduction for Long Duration Energy Storage (LDES).
- **No CCS – Low-Cost OSW:** Models the Advanced cost for Offshore Wind (OSW) from NLR's ATB.

Land Use Scenarios

- **No Emerging – High Wind Potential**: Adds 35 GW of low-quality in-state wind as a candidate resource.
- **No Emerging – TCR Land Use Screen**: Reduced wind and solar potentials due to Terrestrial Climate Resilience (TCR) higher conservation land use screen.

Demand Assumptions

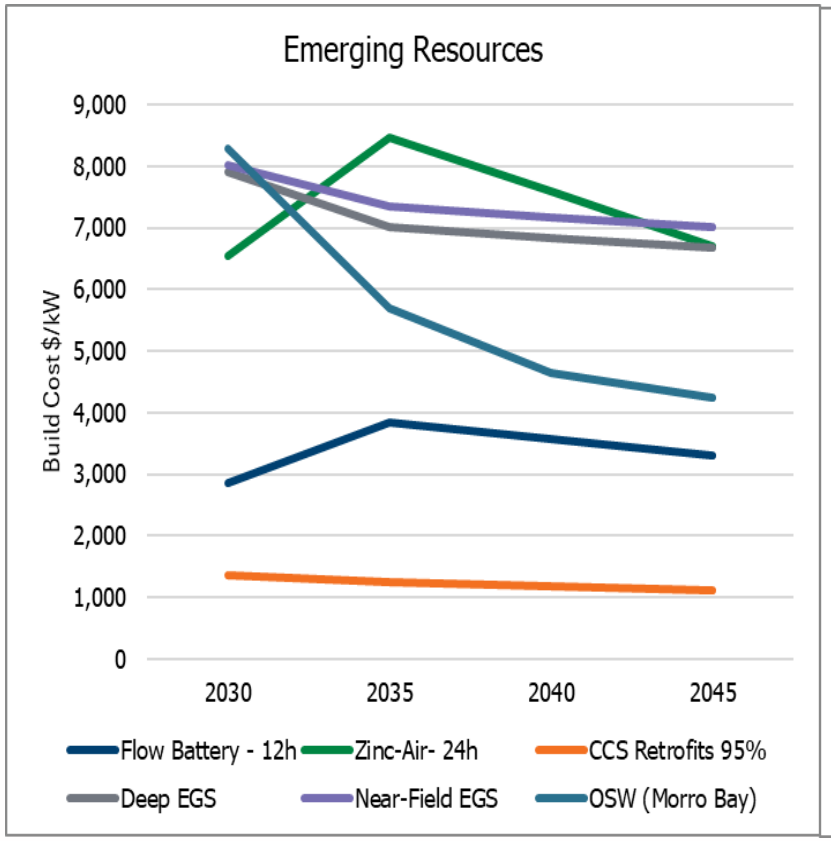


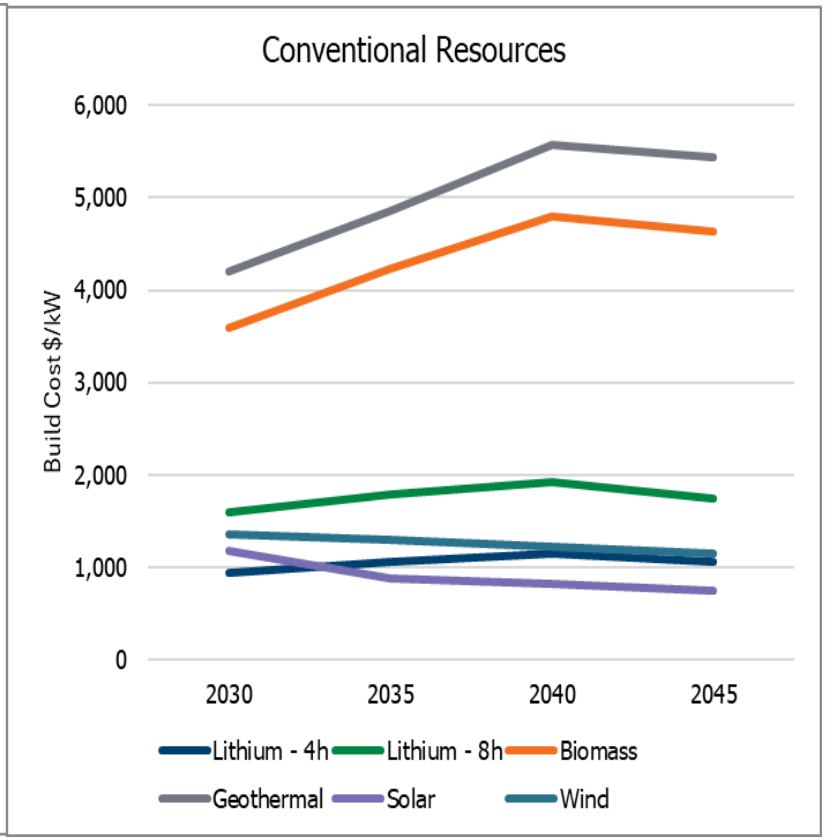


- 2025 IEPR Demand Forecast – Planning
- Lower electrification assumptions than SB100 or 2024 IEPR Forecast, due to slower adoption following federal actions in 2025.
- 70% increase in total demand by 2045.
- Winter peaking by 2045.

Source: CEC Staff

Build Costs for Candidate Resources





Source: CEC Staff, based on data from NLR ATB 2024

CEC is seeking stakeholder feedback on build costs and resource availability

- Costs sourced from National Laboratory of the Rockies Advanced Technology Baseline (ATB) 2024 (most recent).
- Wind, solar, lithium batteries, and CCS retrofits are the lowest-cost resources.
- OSW costs vary by CA region depending on transmission.
- CCS costs include estimates for cost of carbon transport and storage.*
- Investment Tax Credit expires in 2035 for energy storage, geothermal, and biomass.

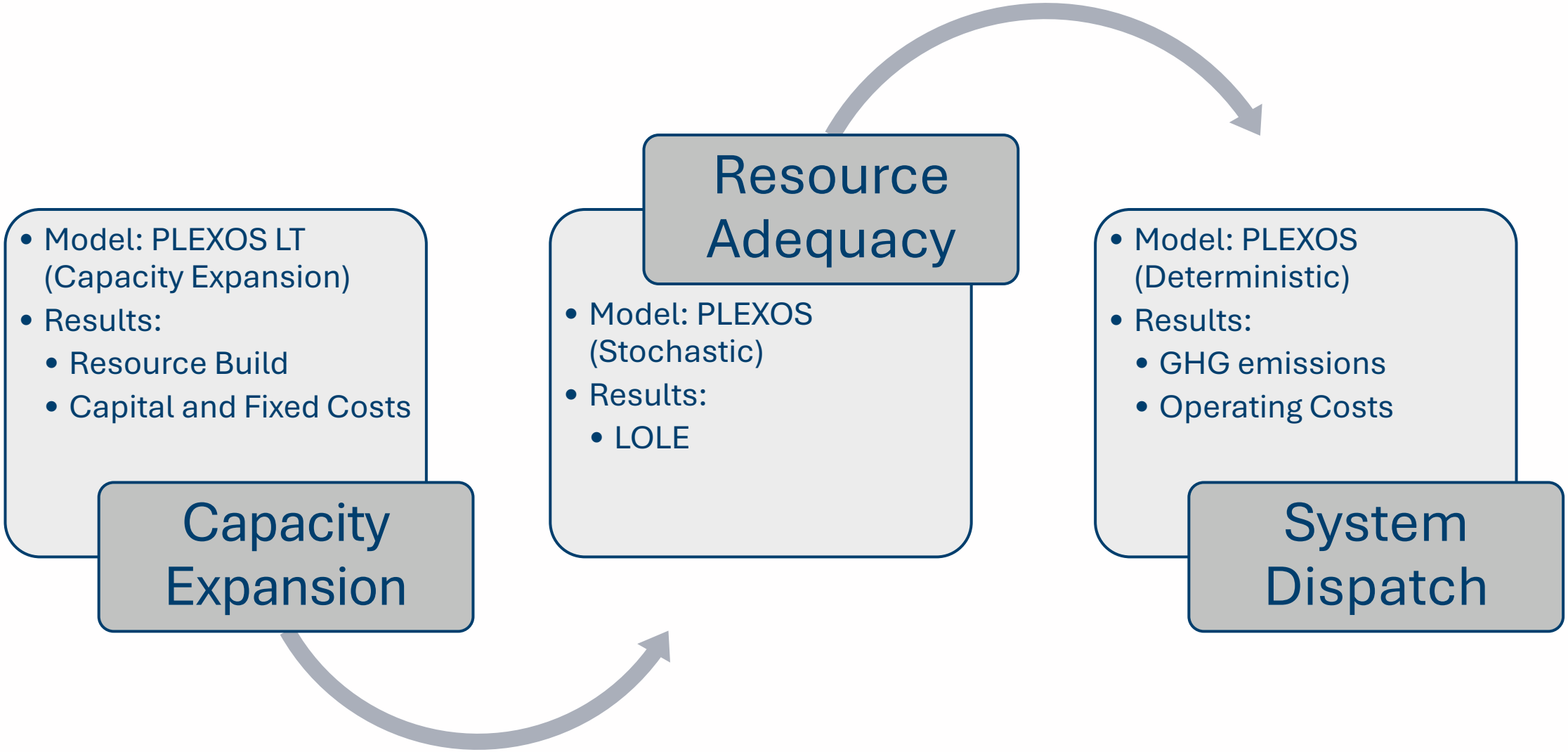
*Sourced from "Geospatial Modeling of Geologic Carbon Dioxide Storage Potential" by Electric Power Research Institute

Resource Portfolio Targets

- **State Goals**
  - SB 100/SB 1020: Percent of retail sales must be from renewable and zero-carbon resources.
  - AB 1279: 85% statewide anthropogenic GHG emissions reductions and carbon neutrality by 2045
  - 2045 electric sector GHG emissions from CA 2022 Scoping Plan
- **Reliability Requirements**
  - 22.5% statewide planning Reserve Margin (PRM) in the capacity expansion model
  - 0.1 loss of load expectation (LOLE) target in the reliability model
  - No unserved load in the dispatch model

Year	SB100 Retail Sales Target	GHG Emissions	Planning Reserve Margin
2030	[60% RPS]	30 MMT	22.5%
2035	90%	25 MMT	22.5%
2040	95%	16.9 MMT	22.5%
2045	100%	6.9 MMT	22.5%

Modeling Process

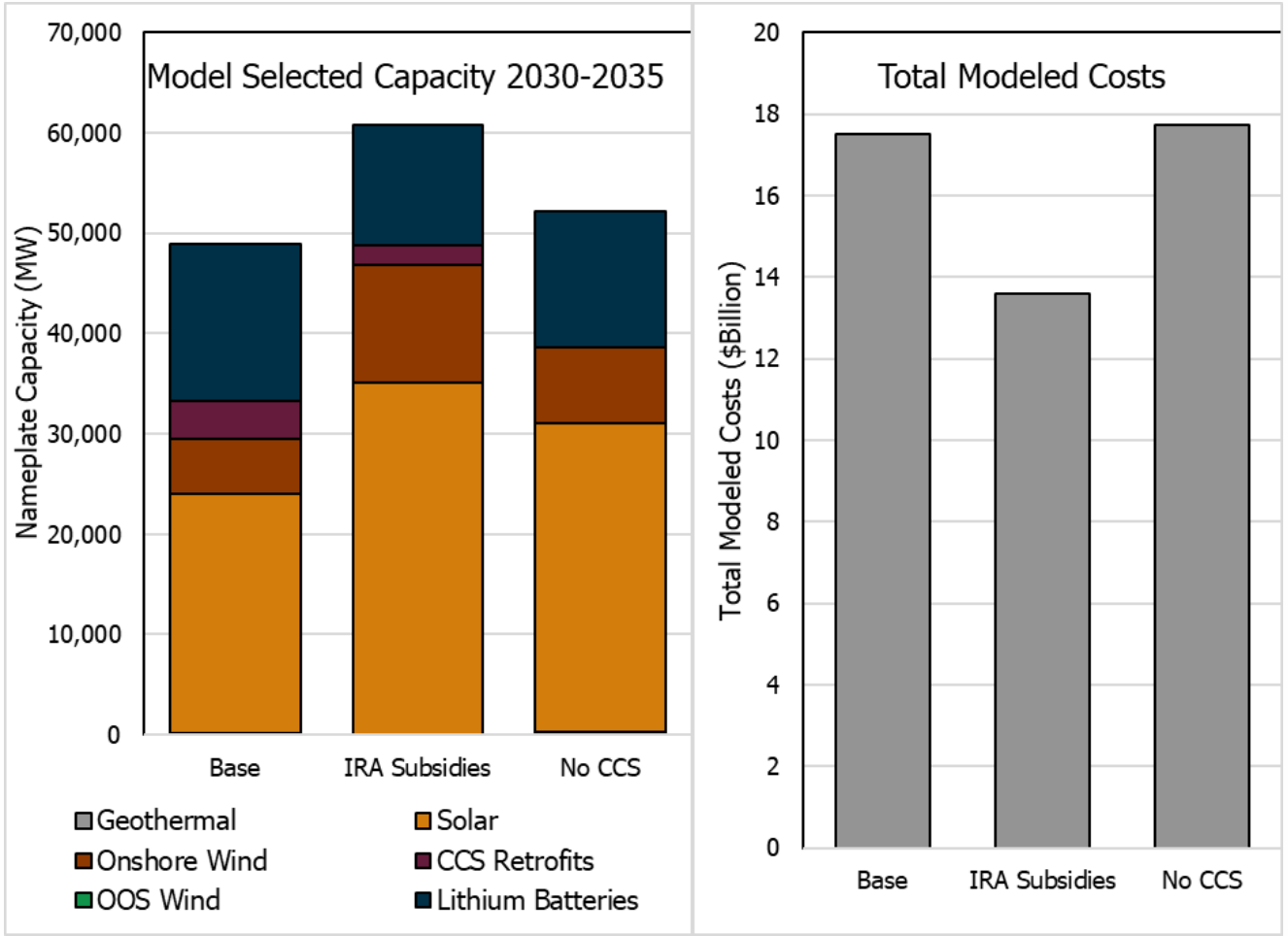


Modeling Results for 2035

2035 Results Across Scenarios

Mid-term Resource Buildout: All Scenarios Follow Current Trends

- 10-year outlook shows high loads and high buildout to reliably meet interim GHG targets:
  - Load increases by 40%.
  - Gas generation reduced by 50%.
  - 10 GW of buildout per year, mostly solar and storage.
- Cost trajectory impacted more by federal action than emerging resources:
  - IRA Subsidies scenario has more renewables, more buildout, but 20% lower modeled costs.
  - CCS is only emerging resource deployed.
  - Minimal cost impact without CCS.
  - Other scenarios look similar to Base and No CCS.

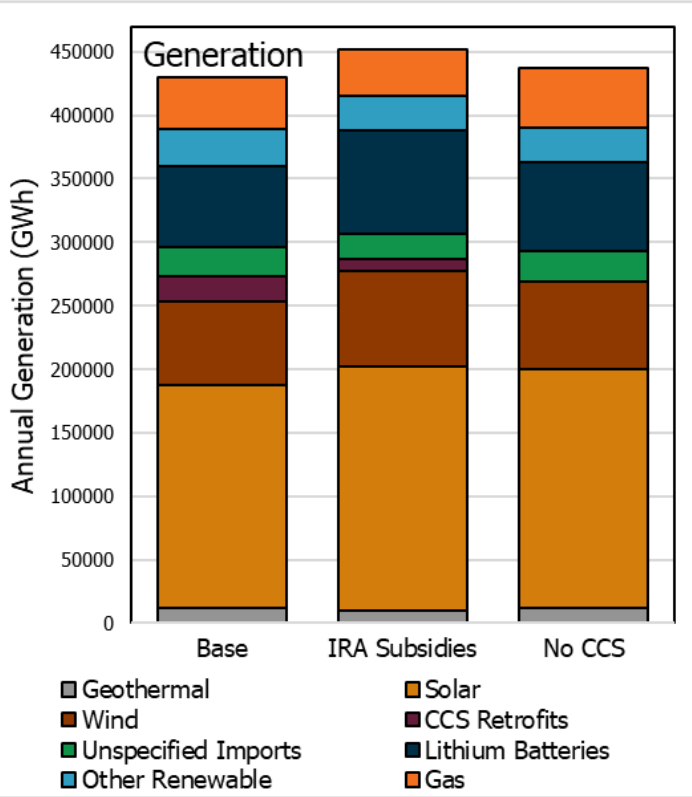


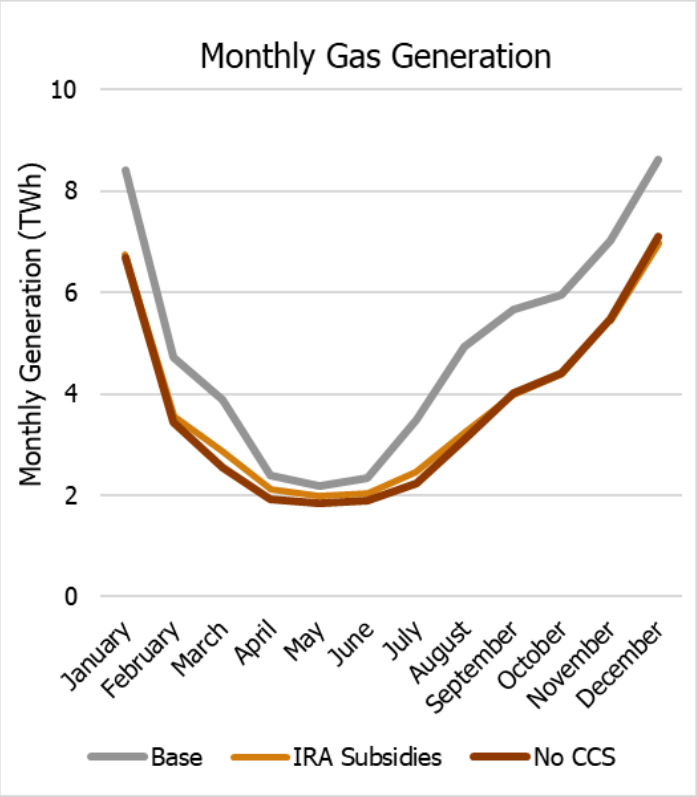
Source: CEC Staff

2035 Results Across Scenarios

Annual Generation by Fuel and Monthly Gas Generation

- Annual Generation Mix:
  - Similar across scenarios
  - Solar/wind provide 67% of energy
  - CCS Retrofits provide only 5% of generation in Base scenario
- Monthly Gas Patterns:
  - Some gas generation remains in all hours.
  - Gas use in winter is similar to today.
  - Gas use in spring/summer is much lower.
  - Solar/wind + storage most effective at reducing summer gas use.



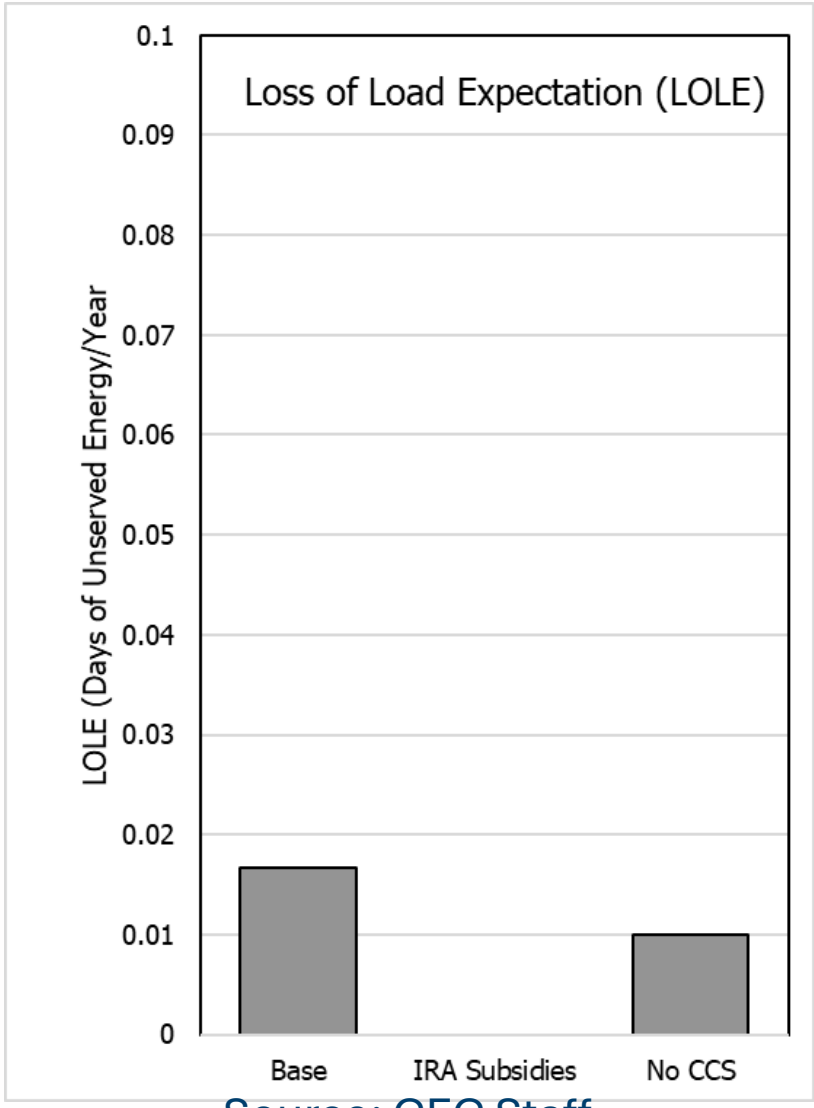


Source: CEC Staff

2035 Reliability Implications

Reliability Met Through Continued Solar and Storage Buildout

- Unserved energy is limited and all scenarios meet 0.1 days of unserved energy per year target.
- Risk occurs during September monsoonal event:
  - High loads (~1 in 5 event)
  - Clouds reduce solar generation
  - Batteries deplete
  - Unserved energy appears at night
- No unserved energy in winter or during peak load/net load hours
- This assumes high buildout of resources to meet GHG goals.



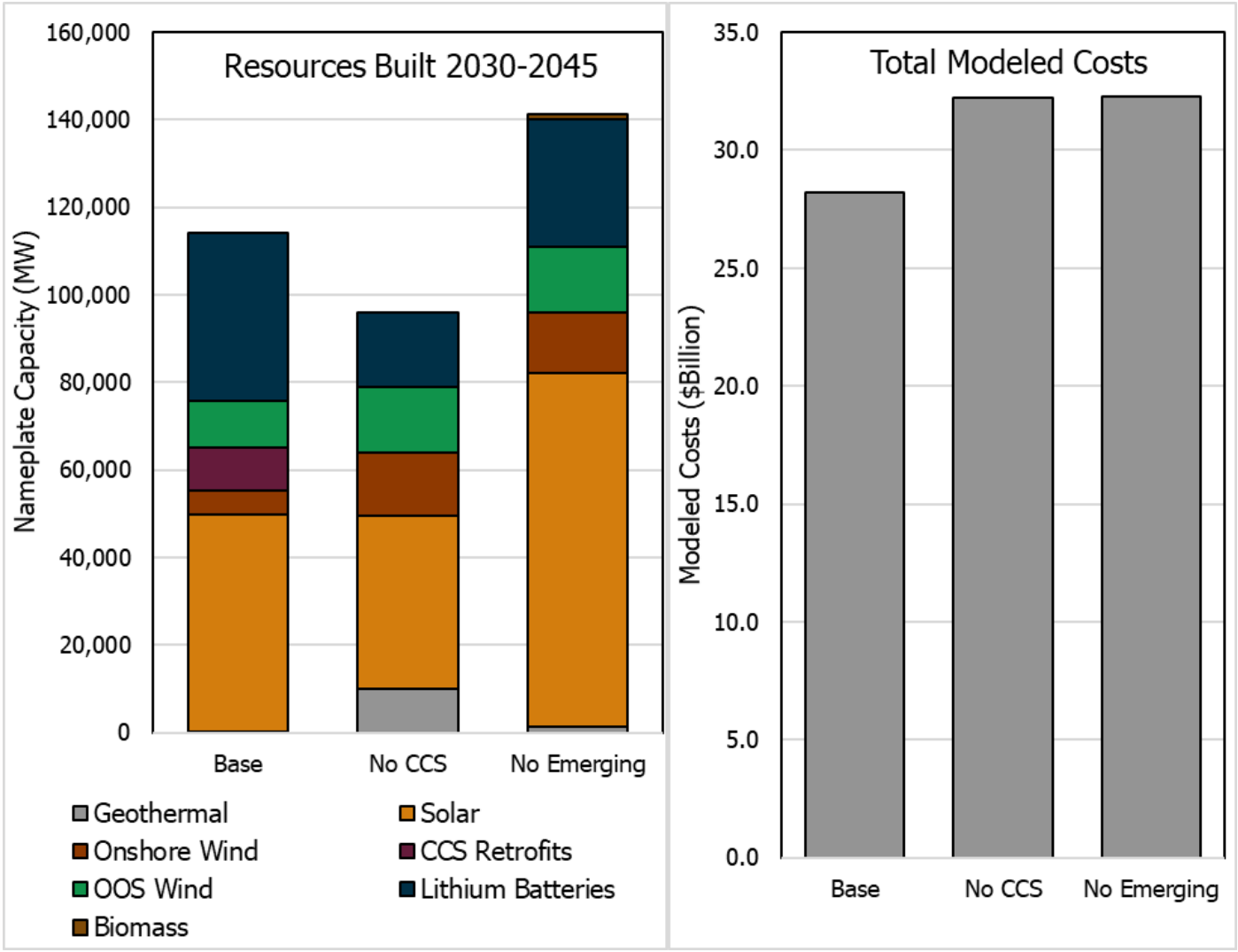
Source: CEC Staff

Modeling Results 2045

Feasibility Scenarios

Meeting Demand Long-term Reliant on Clean Firm Resources

- Low-GHG firm resources selected in all scenarios, demonstrating need and cost-competitiveness even at high costs per kW:
  - 10 GW of CCS in Base
  - 10 GW of EGS in No CCS
  - 3 GW of geothermal and biomass in No Emerging
- Removing CCS raises modeled costs by 15% with current CCS assumptions.
- Removing other emerging resources raises costs by 1%
- EGS costs 10x solar per kW but generates power in winter when it is most needed.

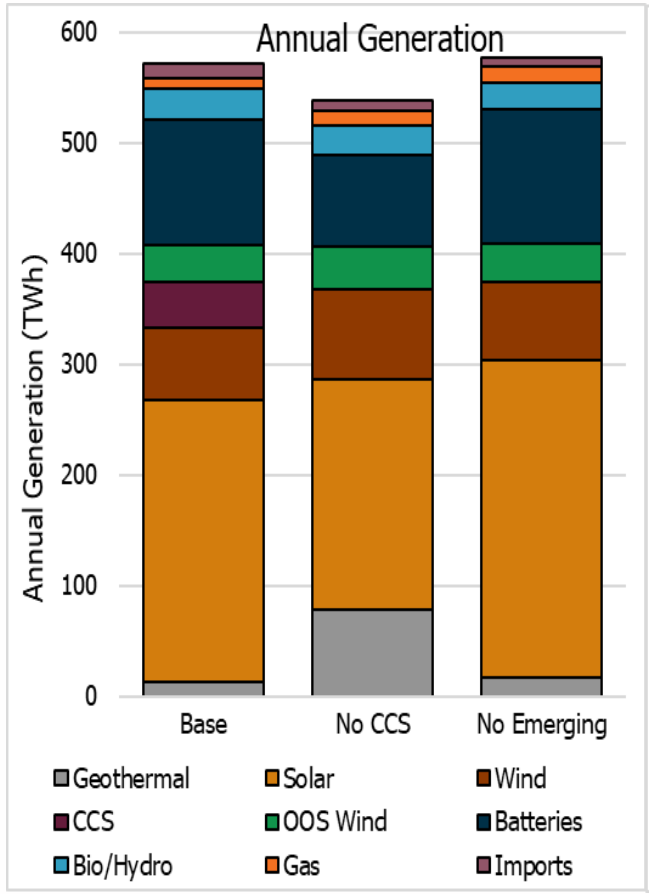


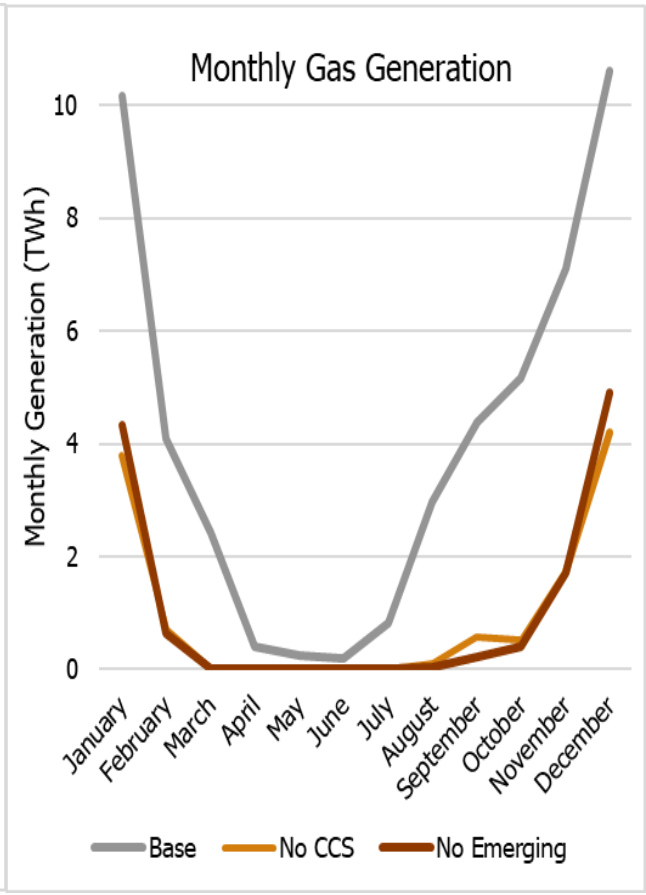
Source: CEC Staff

Feasibility Scenarios

Gas Generation Maintained in Winter to Meet Demand

- Emerging resources contribute significantly to overall generation mix:
  - 11% from CCS in Base Scenario
  - 15% from Geothermal in No CCS Scenario
- Fossil gas from unretrofitted plants must decline from levels seen today:
  - Less than 3% of total generation
  - Down from 34% today
  - Highly concentrated in specific winter days
- Seasonal variations:
  - Most gas use in winter
  - Little to no gas use in spring/summer without CCS
  - Need to evaluate implications, feasibility and requirements of no gas generation for multiple months



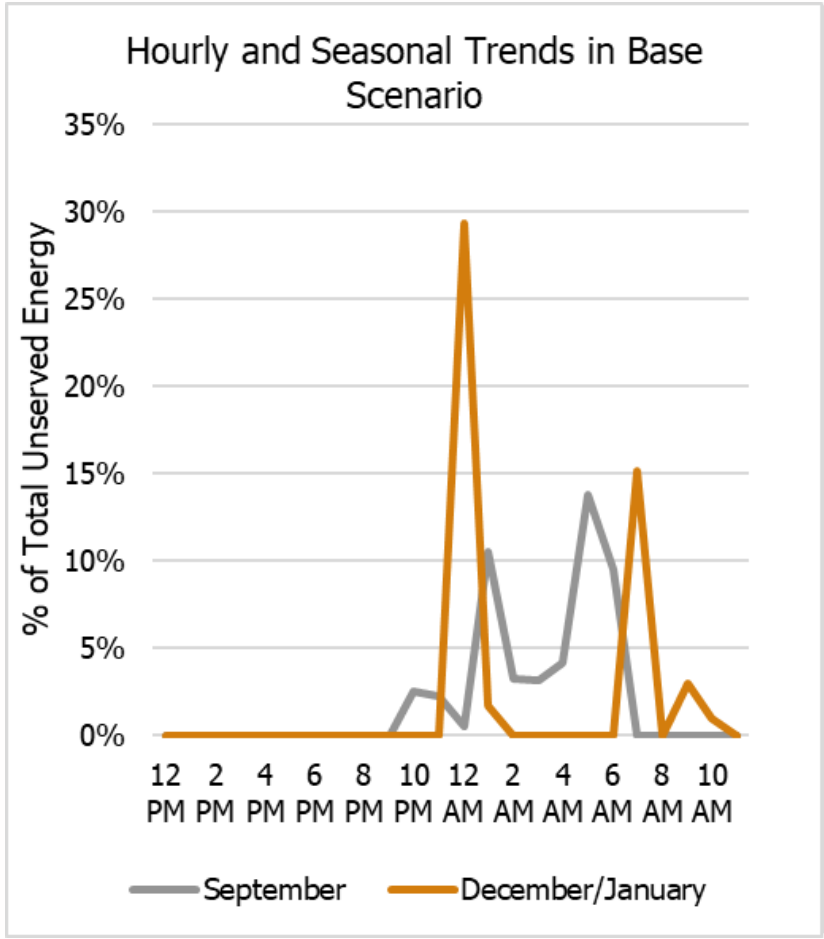


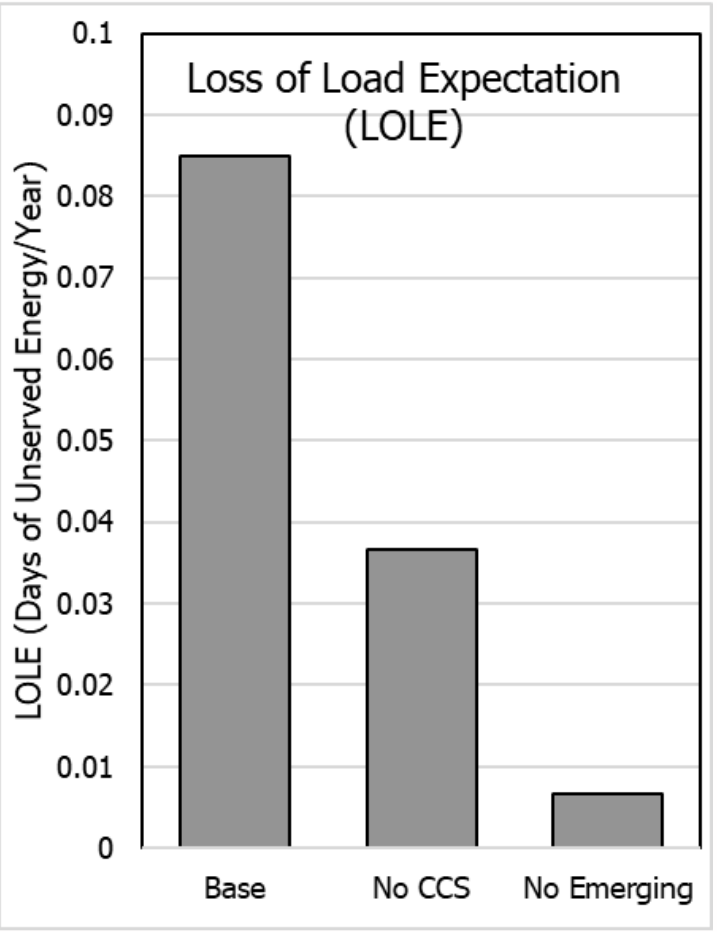
Source: CEC Staff

Feasibility Scenarios

Reliability Requirements add Summer Peak and Winter Resource Needs

- CCS Retrofits add low GHG energy but not new capacity.
- Reliability constraints lead to adding ~30GW of solar + storage to Base scenario.
- Load growth to 2045 will require 150+ GW of new generation capacity to meet reliability targets, not just clean energy targets.
- In 2045, unserved energy occurs at night during energy-constrained events in summer and winter.



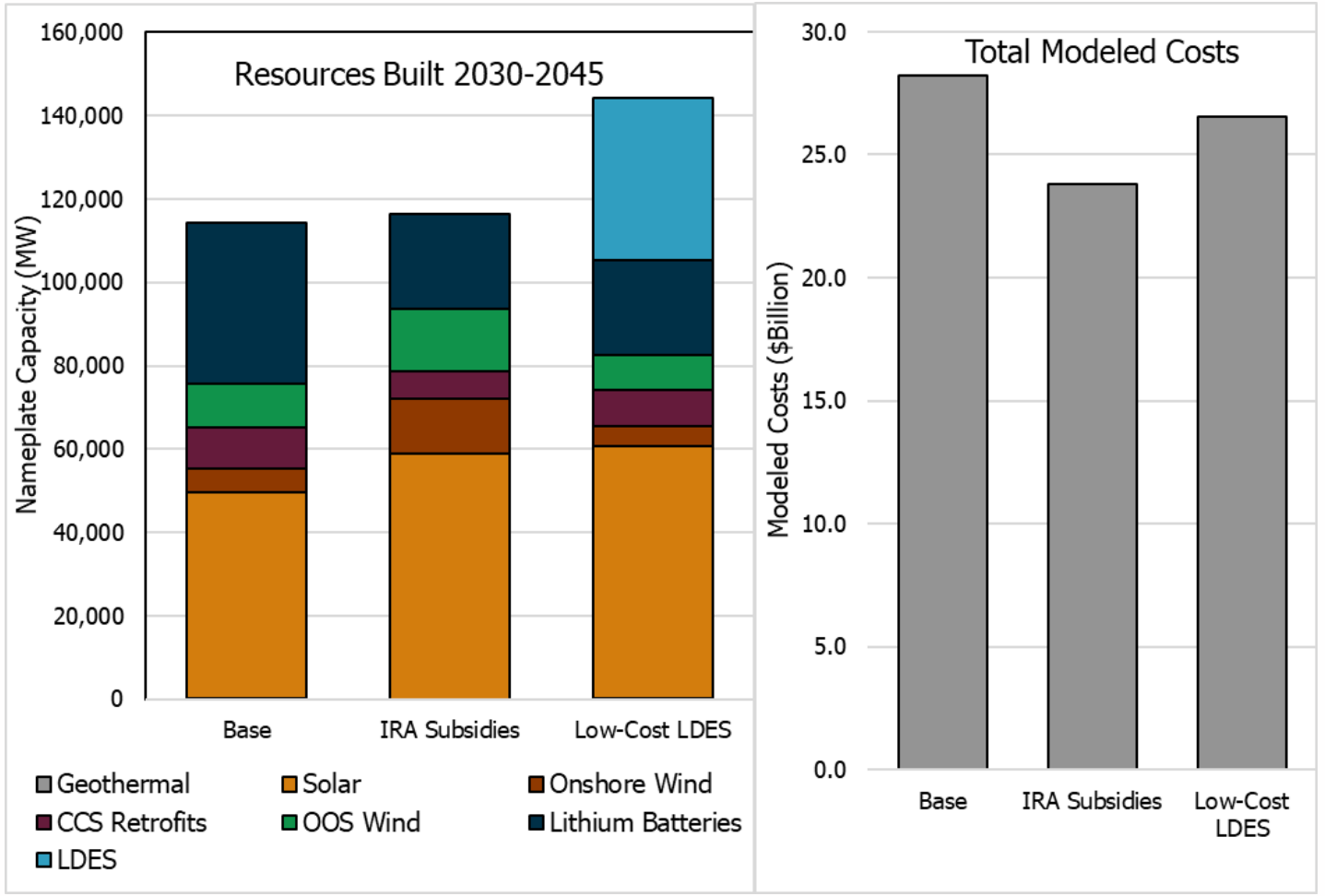


Source: CEC Staff

Cost Reduction Scenarios – Subsidies & LDES

Cost Reductions Alter Portfolios, but Long-Term Capacity Needs Remain

- Effect of IRA Tax Credits:
  - Modeled costs 15% lower
  - Renewables more attractive
  - Less CCS and geothermal
- Low-Cost LDES:
  - 70% lower capex costs
  - Builds 30 GW of 12-hour batteries
  - 0 GW of 24-hour batteries
  - Higher solar build
  - Similar CCS build
  - Modeled costs 5% lower

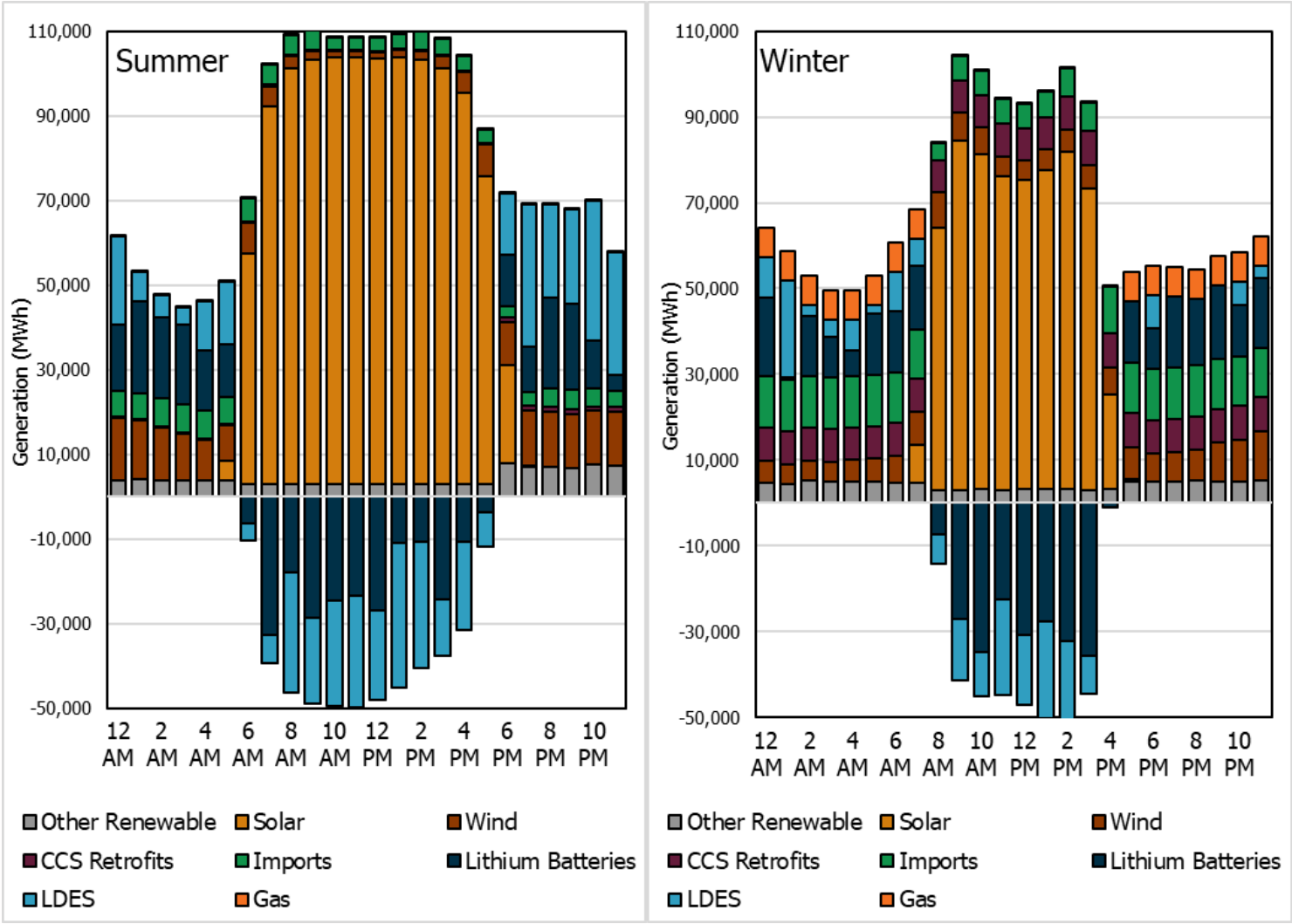


Source: CEC Staff

Cost Reduction Scenarios – LDES

LDES can Deliver Summer, but not Winter, Clean Firm Capacity

- LDES in Summer:
  - Sun shines 12-16 hours
  - LDES is 70% efficient
  - LDES fleet can get to 70-100% charged
- LDES in Winter:
  - Sun shines 6-8 hours
  - Efficient lithium batteries charge first.
  - Large LDES fleet 0-25% charged most of winter
  - Adding hours of battery energy capacity does not solve energy limitations
  - Natural gas plants provide winter energy.

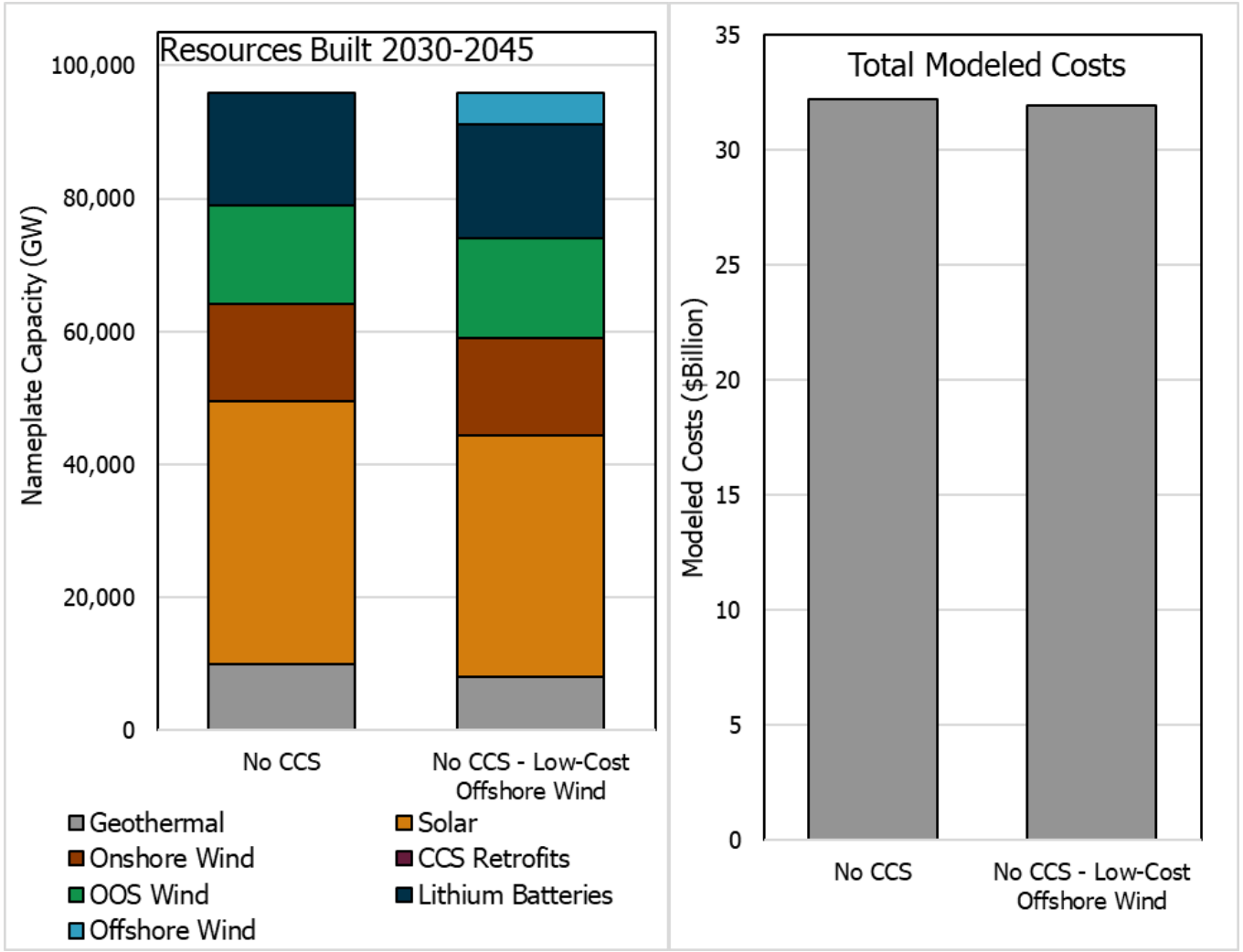


Source: CEC Staff

Cost Reduction Scenarios – OSW

Offshore Wind Alters the Portfolio, but Delivers Limited Firm Capacity

- 5 GW of OSW are deployed under the ATB Advanced Cost projection, which is 25% below the Moderate projection used in other scenarios.
- Capex costs include the costs of construction and transmission, but not the cost of port upgrades or other infrastructure.
- "Breakeven" price point – deployed but minimal impact on portfolio costs.
- Capital cost comparison:
  - $3,700/kW for OSW (Advanced Cost)
  - $1,100/kW for onshore wind
  - $7,000/kW for EGS

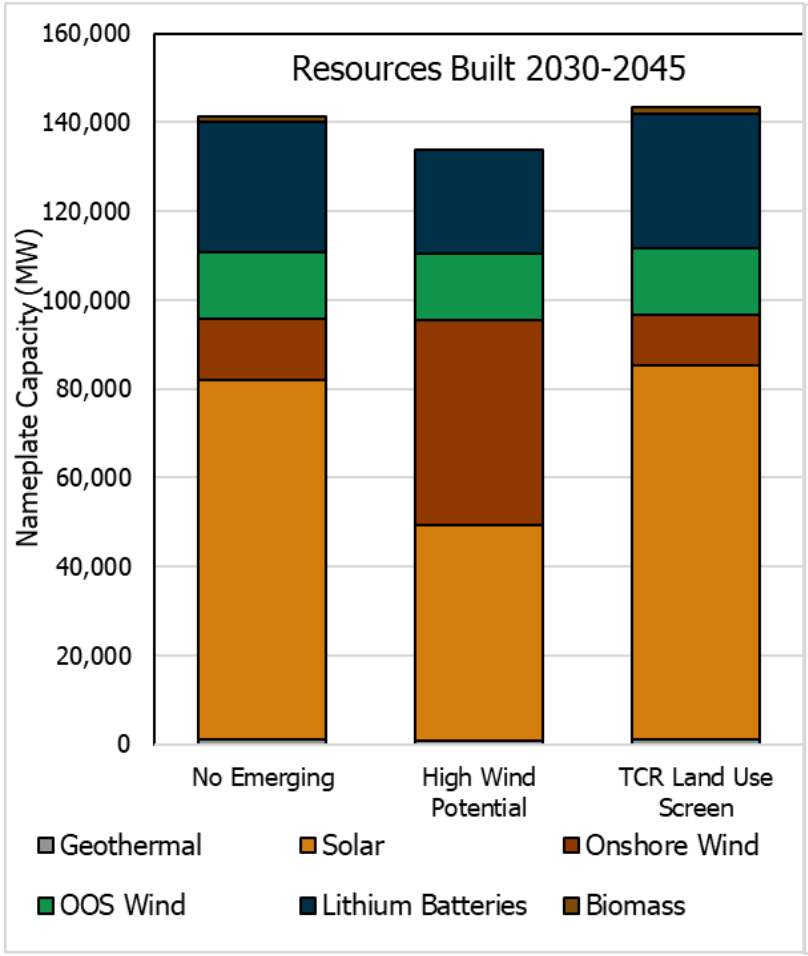


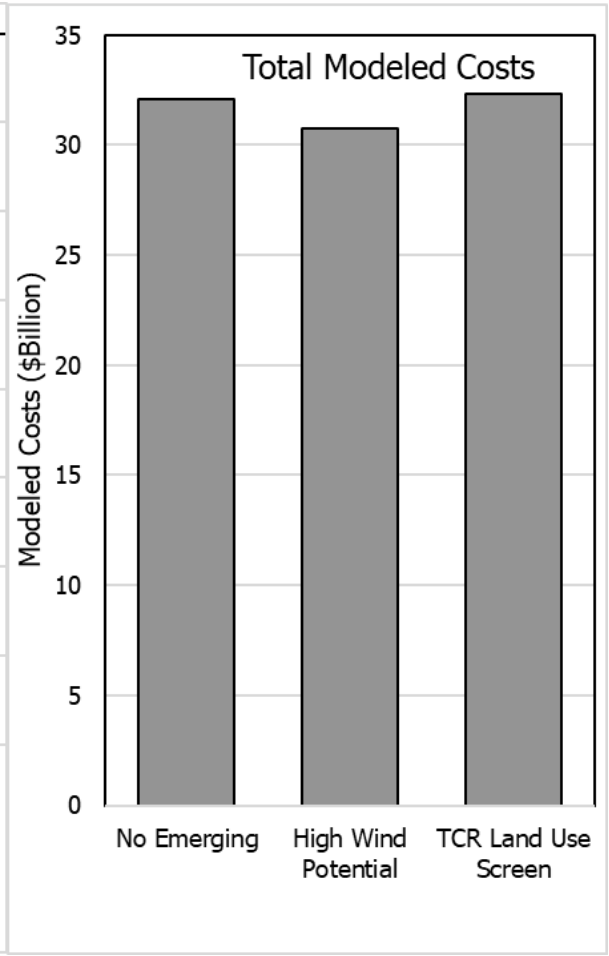
Source: CEC Staff

Wind and Land Use Scenarios

Low Quality Wind Provides a Complementary Resource; Land Screen Pushes Solar

- Low-quality wind provides much less energy per kW than solar, but complementary profile results in significant deployment.
  - 32 of 35 GW available deployed
  - Modeled costs reduced by 6%
- TCR screen reduces total land available for development by about 40%.
  - 2 GW less wind available
  - 3 GW more solar built
  - 1% increase in costs



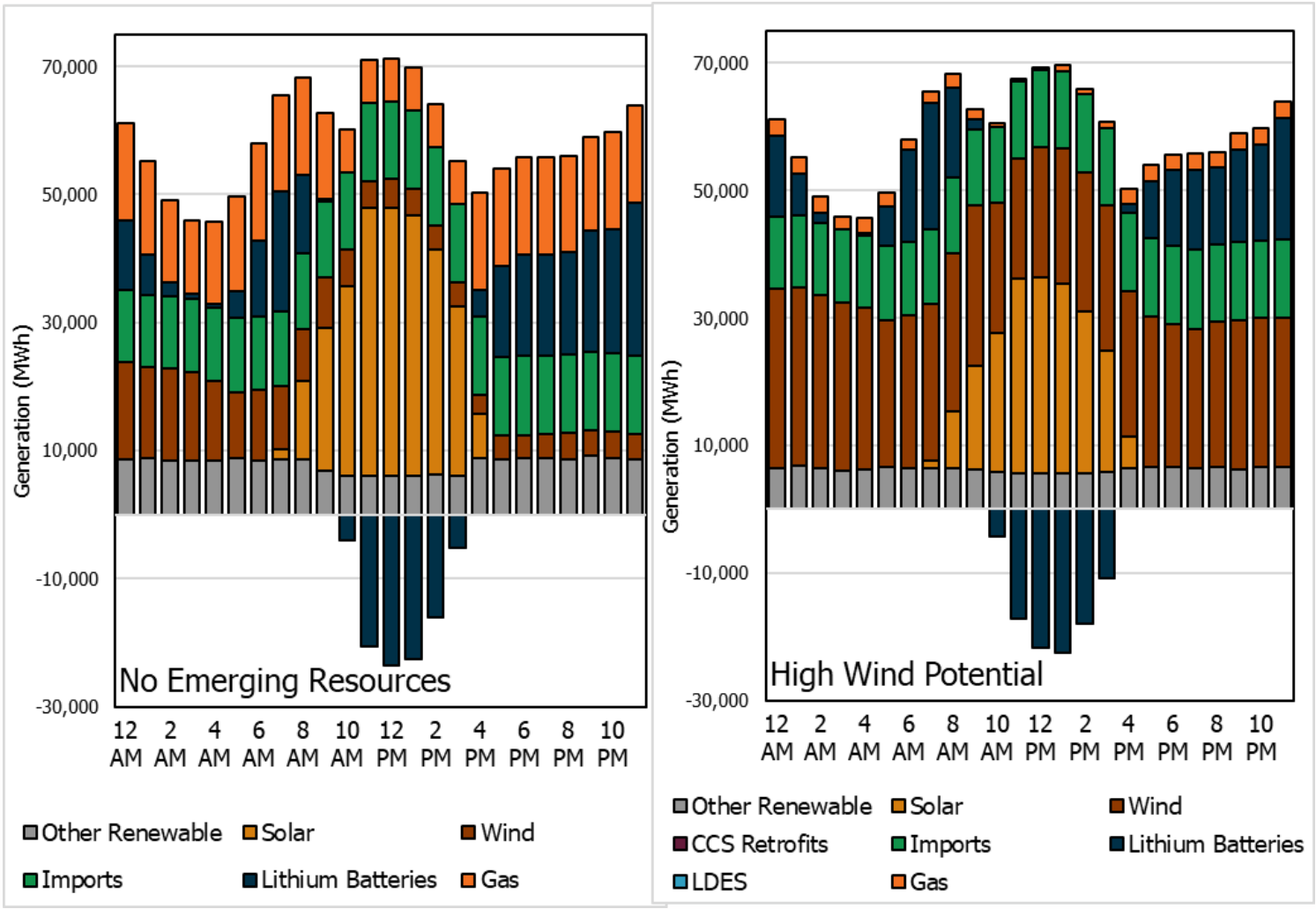


Source: CEC Staff

Wind and Land Use Scenarios

Wind Delivers Generation on Low-Solar Days

- Low-solar days see high gas burn.
- Low-solar days tend to be cloudy, stormy, windy days
- Complementary wind profile reduces need to overbuild solar and curtail it all in summer.
- Resource diversity is very impactful for winter loads, even from intermittent sources like wind.



Source: CEC Staff

Conclusions

Conclusions

Maintaining Reliability While Meeting Climate Goals Under Future Uncertainty

- Meeting GHG goals will require significant increase in electric demand and consequent deployment of clean energy resources.
  - Build rates of 7-10 GW/year every year until 2045
  - Critical summer peak and winter night capacity needs
- High demands and low renewable output in winter means firm technologies/resource diversity is strongly valued to meet reliability even at current cost projections.
  - EGS built at $7,000/kW
  - CCS reduces portfolio costs by 15%
  - 32 GW of marginal wind deployed without clean firm resource available
  - OOS Wind selected in all scenarios
- IRA repeal will raise overall costs, making clean firm technologies more cost-competitive relative to large renewable and storage builds to meet reliability.
  - Modeled cost increases of 15-20%
  - Higher CCS uptake in base scenario.

Questions for Stakeholders

- Do you have any feedback or additional data you can share on reasonable assumptions on resource availability and costs, particularly for emerging resources?

- Do you have any inputs or data you can share on resource performance assumptions, particularly for emerging resources?

- What long-term concerns about reliability and achieving the state's electric sector goals keep you up at night? What issues/topics might benefit from CEC analysis in the future?