

# California ISO Market Price Forecast E3 Core Case

2022 edition



Energy+Environmental Economics

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# Disclaimer

*E3 created the following forecasts and analyses using the best available public information and our expertise and knowledge of the relevant markets, along with commercially available 3rd party software models and proprietary in-house energy market price forecasting tools. However, the future is uncertain, and these forecasts (along with underlying market expectations) may change due to many factors, including unforeseen events, new technology adoption or inventions, new market structures, regulatory actions, and changes in both state and federal government policies. E3 makes no guarantees related to these forecasts or the information presented herein and should not be held liable for any economic damages associated with independent investment decisions.*



## + Executive Summary

## + Market Overview

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- Historical AS Prices
- Resource Adequacy
- Future Market Changes

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## + E3 Forecast Results: 2023-2050

## + Appendices

- Inflation Reduction Act (IRA)
- Recent Reliability Events in CA
- Load Inputs - Additional Details



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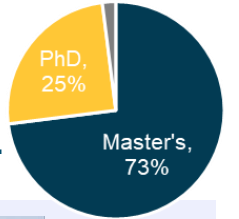
# Executive Summary



# Who is E3?

Thought Leadership, Fact Based, Trusted.

100+ full-time consultants | 30 years of deep expertise | Engineering, Economics, Mathematics, Public Policy...



San Francisco



New York



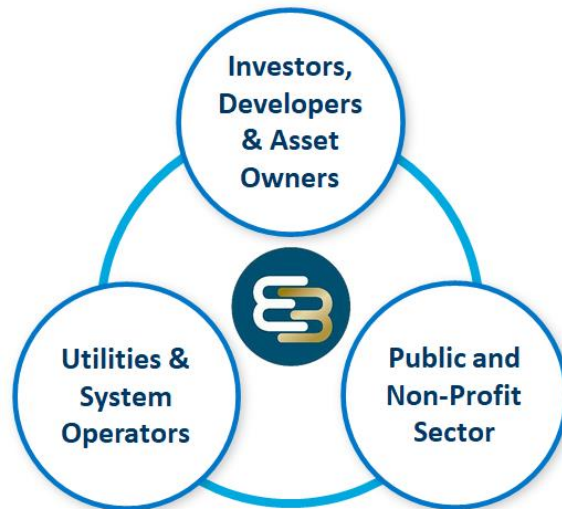
Boston



Calgary

## E3 Clients

300+ projects per year across our diverse client base



## Recent Examples of Relevant E3 Projects

Buy-side diligence support on several successful investments in **electric utilities** (~\$15B in total)

Supporting investment in several **stand-alone energy storage** platforms and individual assets across North America (15+ GW | ~\$5B)

Acquisition support for several portfolios and individual **gas-fired and renewable generation assets** (20+ GW | ~\$4B)

Acquisition support of several **electric vehicle infrastructure companies** (~\$500M)

Strategic advisory support for a SPAC offering of a **distributed energy resource aggregation software company** (~\$1.3B)

Supporting an investment into an **electric vehicle V2G software company** (~\$750M)

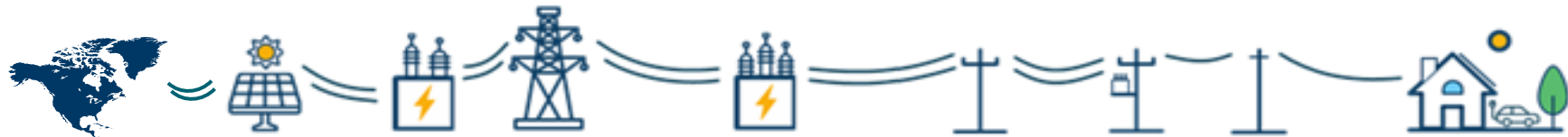
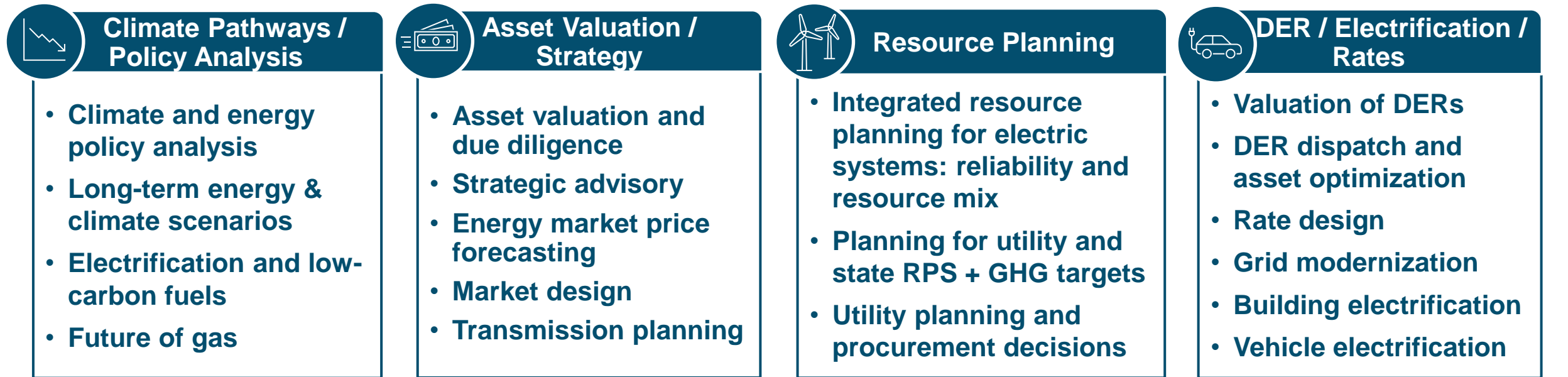
Buy-side diligence support to acquire several **residential solar portfolios** (~1+ GW | 200,000+ customers)

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



# Who is E3?

- + E3 is the **largest consulting group** focused on the clean energy transition in North America
- + E3 is a **recognized thought leader** on decarbonization and clean energy transition topics
- + E3 has **four major practice areas** covering energy systems from bulk grid to behind the meter







# Asset Valuation and Strategy Practice Area

- + The Asset Valuation and Strategy practice area works primarily with project developers, asset owners, and investors
- + Insights informed by work being done across the firm that provides a unique 360-degree perspective of rapidly evolving markets
  - Clean Energy Policy → how will policy change the playing field for different resources?
  - Planning → what resources will power the grid in 2020? 2030? 2050?
  - Market Analysis → how will market prices evolve in the grid of the future?
- + The E3 Asset Valuation and Strategy team provides a variety of analytical support tailored to client needs.
- + Typical services include:
  - Transaction support and due diligence on both the buy side and sell side
  - Strategy formulation and market entry
  - Board-level reports on market outlook and asset performance
  - Customized forward-market price projections incorporating impacts of policy and technology changes
  - Revenue stream/benefits analysis, either on an individual asset or portfolio basis



## Asset Valuation / Strategy

- Analyze asset value from multiple perspectives in vertical, bilateral, and wholesale markets
- Strategic support for project development, acquisition, and operation, including market entry
- Proprietary in-house models and in-depth knowledge of public policy, regulation and markets

- Production simulation cost modeling using in-house proprietary tools or customized commercial software
- Project site evaluation
- Off-taker assessments
- Basis spread assessment
- Wholesale market rules and bidding strategies



# E3 Model Ecosystem for Market Price Forecasts: Built on Decades of Experience and 360° Analysis

## E3 Model Toolkit

### Input Models

#### E3 PATHWAYS

Least-cost decarbonization pathways across sectors to meet GHG targets

#### E3 RESHAPE

Load simulation for building electrification & EVs

#### E3 Pro Forma Model

Levelized costs of new resources including financing and tax incentives

#### E3 RECAP

Stochastic reliability modeling for ELCCs of renewables and storage

### Output Models

#### E3 RESTORE

Optimized battery operations and revenues

#### E3 Scarcity + RT Price Model

Forecasts scarcity and real-time energy prices with regression analysis

#### E3 Nodal Price Model

Node-zone basis forecast for nodal prices

#### E3 Ancillary Services Model

Forecasts AS prices with regression analysis and market saturation

#### E3 Capacity Market Models

Capacity price formation by market, aligned with unique market dynamics

#### E3 REC Market Models

Renewable Energy Credit prices aligned with unique market dynamics

## Market Price Forecasting Approach

### Key Scenario Variables

- 1 **Load Forecasts**  
Regional load growth, energy efficiency, building electrification, and EVs
- 2 **Policies**  
RPS, CES, GHG, other mandates
- 3 **Regional Coordination**  
Transmission, Trading, and policy alignment
- 4 **Costs:**
  - New resource costs
  - Gas prices
  - Carbon prices

### AURORA Model Outputs

- 5 **Long-Term Capacity Expansion (Annual)**  
**New Resource Additions**
  - Economics
  - Policies and mandates (RPS, CES, GHGs)
  - System reliability needs
  - Retirements
- 6 **Production Cost Simulation (Hourly)**  
**Energy Market Forecasts**
  - Hourly day-ahead energy prices by zone
  - Dispatch, renewable curtailment, and transmission flows

### E3 Forecasts

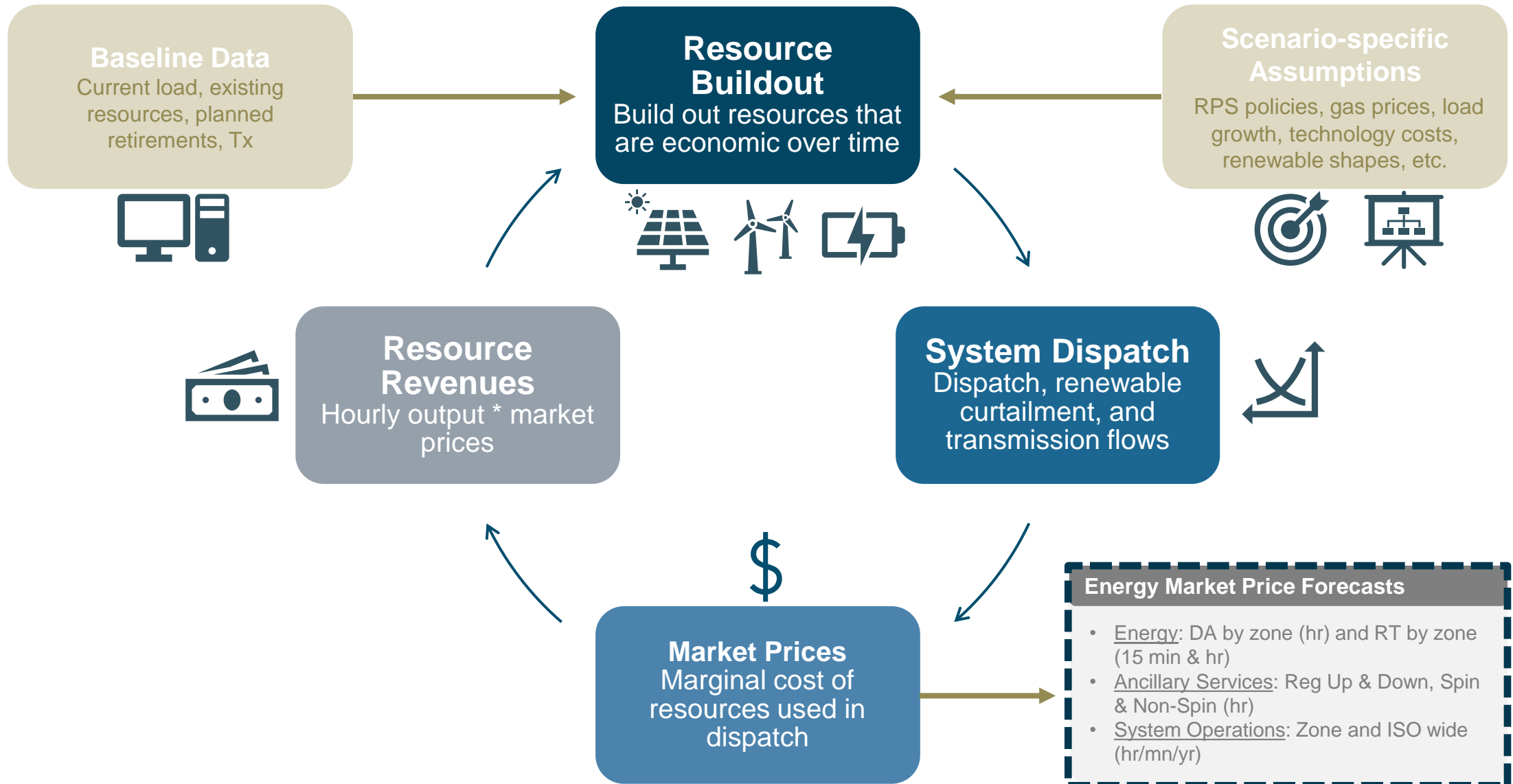
| Market Product                                     | Geographic Granularity | Temporal Granularity |
|--|------------------------|----------------------|
| <b>Energy</b><br>(Day-Ahead and Real-Time)         | Zonal                  | Hourly               |
| <b>Capacity</b><br>(low, medium, high forecasts)   | System / Local         | Annual               |
| <b>Ancillary Services</b><br>(Reg, Spin, Non-Spin) | ISO                    | Hourly               |
| <b>ELCC Curves</b>                                 | Regional               | Annual               |
| <b>RECs</b>  | State / ISO            | Annual               |
| <b>System Operations</b>                           | System / Local         | Hourly / Monthly     |

Fundamentals-based market modeling built on day-ahead energy prices



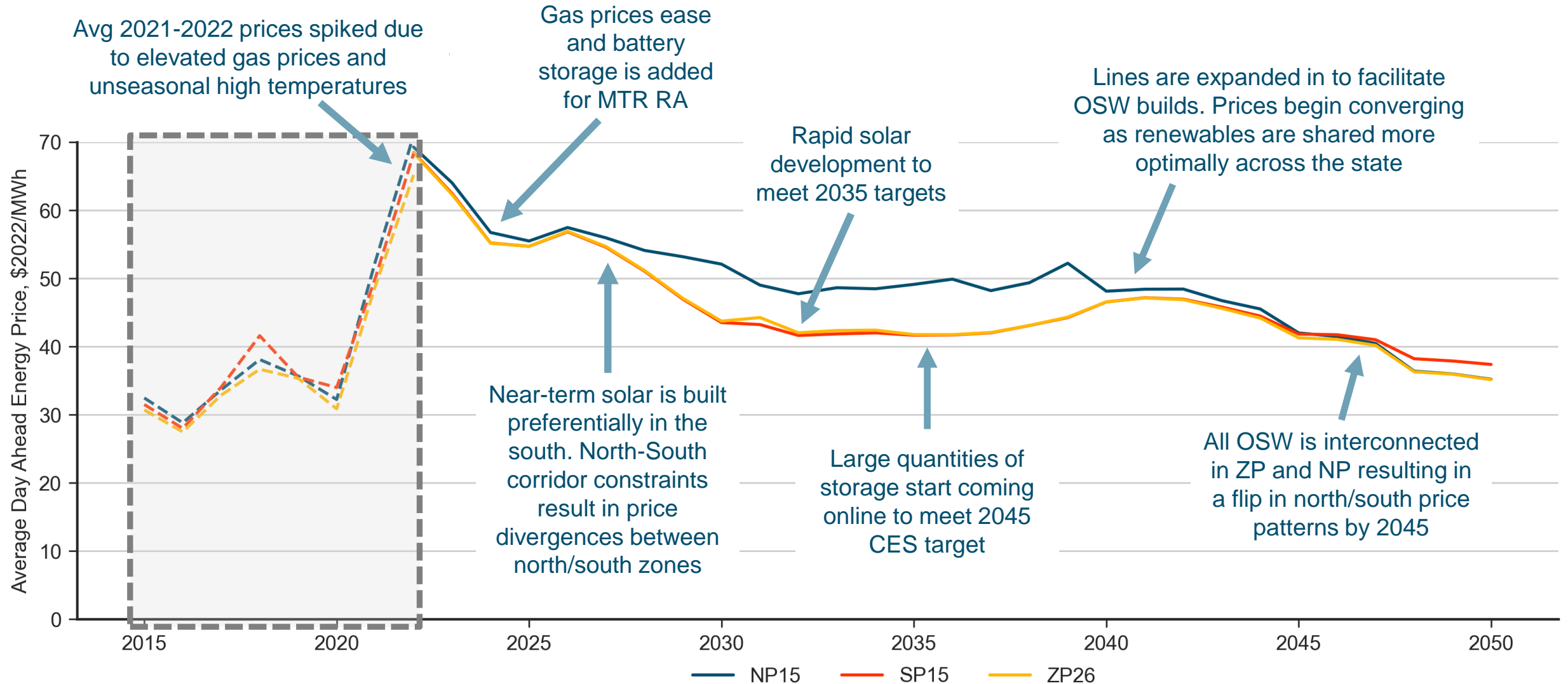


# Modeling Approach for Long-Run Resource Builds





# Avg. Annual Historical and Forecast Prices (\$2022/MWh)



\*Average annual prices for the historical years are pulled from ABB's Velocity Suite, and are shown in nominal unadjusted numbers



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# CAISO Market Overview



# Historical AS Prices





# Resource Adequacy







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# Market Changes in the Future





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# E3 Forecasting Approach



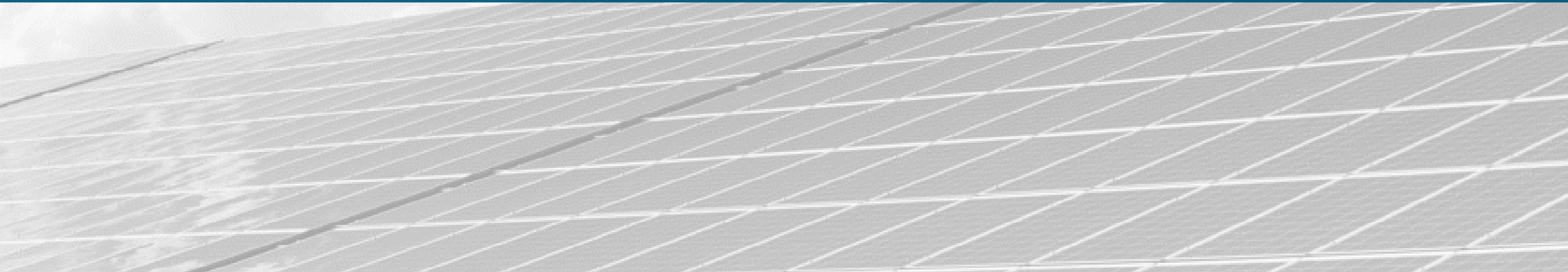
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# E3 Modeling Assumptions



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# **E3 Forecast Results: 2023-2050**





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# Appendices





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# Inflation Reduction Act (IRA)



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# Recent Reliability Events in CA





# Load Inputs – Additional Details

