

# **SPP**

# **Market Price Forecast**

# **E3 Core Case**

2023 edition



Energy+Environmental Economics

[marketprices@ethree.com](mailto:marketprices@ethree.com)

# Disclaimer

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*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.*

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# Introduction to E3

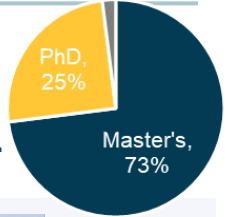


Energy+Environmental Economics

# Who is E3?

Thought Leadership, Fact Based, Trusted.

110+ 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

Assessment of **offshore wind opportunities** in New York and other jurisdictions for other market players

Developed **hydrogen roadmap** for the State of Colorado; H<sub>2</sub> market study: **Mitsubishi Americas**

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**)

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

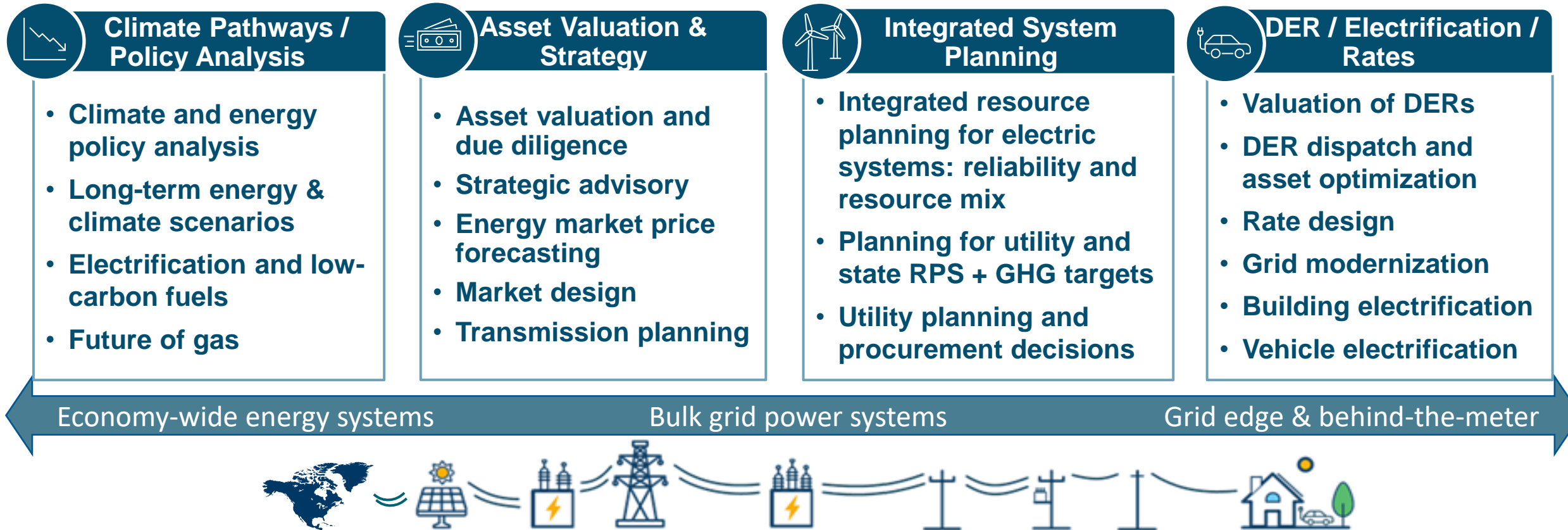
Supporting **NYSERDA** across multiple facets of the **Climate Leadership and Community Protection Act**

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

Currently supporting several **electric vehicle infrastructure and automakers with strategy**

# Who is E3? (cont'd)

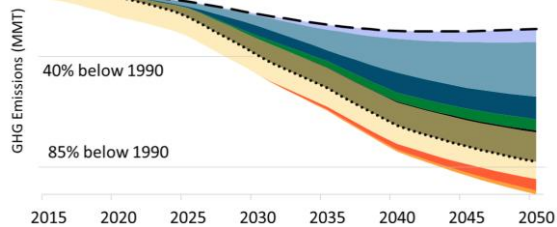
- + E3 is the **largest consulting group** focused on the clean energy transition in North America
- + E3 is a recognized **thought leader** on decarbonization and clean energy transition topics
- + E3 has **four major practice areas** covering energy systems from bulk grid to behind the meter



# E3's Comprehensive and Best-in-Class Modeling Toolkit

## PATHWAYS

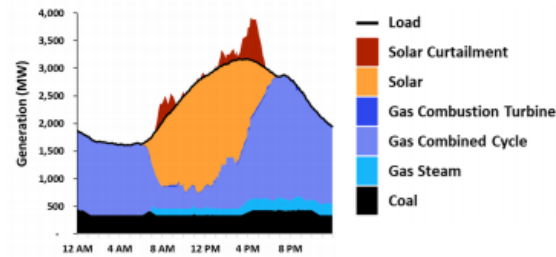
Economy-wide accounting of energy supplies and demands under deep decarbonization scenarios



## Production Simulation

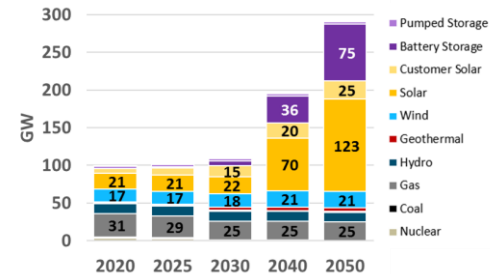
(AuroraXMP and PLEXOS)

Detailed operational simulations of system dispatch and flexibility needs



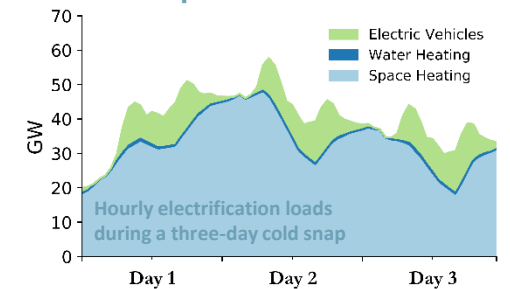
## RESOLVE

Optimal capacity expansion model for electric systems



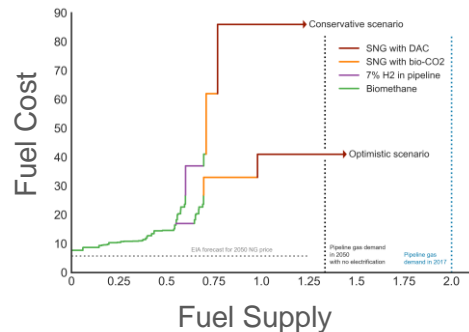
## RESHAPE & EVGrid

Hourly simulations of electric loads for specific end uses



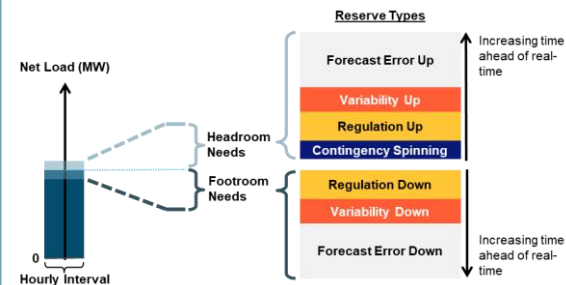
## Low-Carbon Fuels and Future of Gas

Role of fuels in deep decarbonization



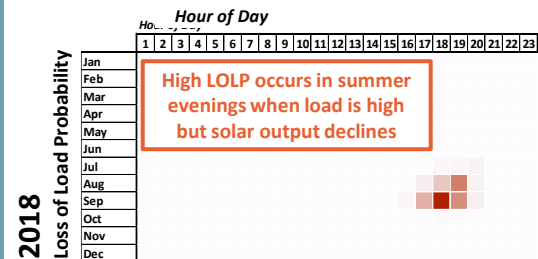
## RESERVE

Dynamic operating reserves for renewable integration



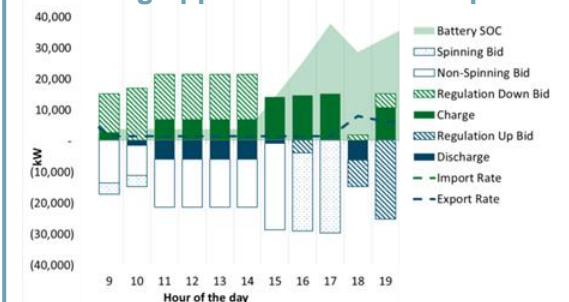
## RECAP

Loss of load probability simulation to measure resource adequacy



## RESTORE & IDSM

DER Toolkit for optimizing DER value stacking opportunities and adoption



Economy-wide energy systems

Bulk grid power systems

Grid edge & 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?



## Asset Valuation / Strategy

Determines asset values and strategies from multiple perspectives

Uses proprietary in-house models and in-depth knowledge of public policy, regulation and market institution

- + 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
- 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 Forecasting Approach



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# 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 (Day-Ahead and Real-Time)</b>	Zonal	Hourly
<b>Capacity (low, medium, high forecasts)</b>	System / Local	Annual
<b>Ancillary Services (Reg, Spin, Non-Spin)</b>	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

# E3 Modeling Assumptions



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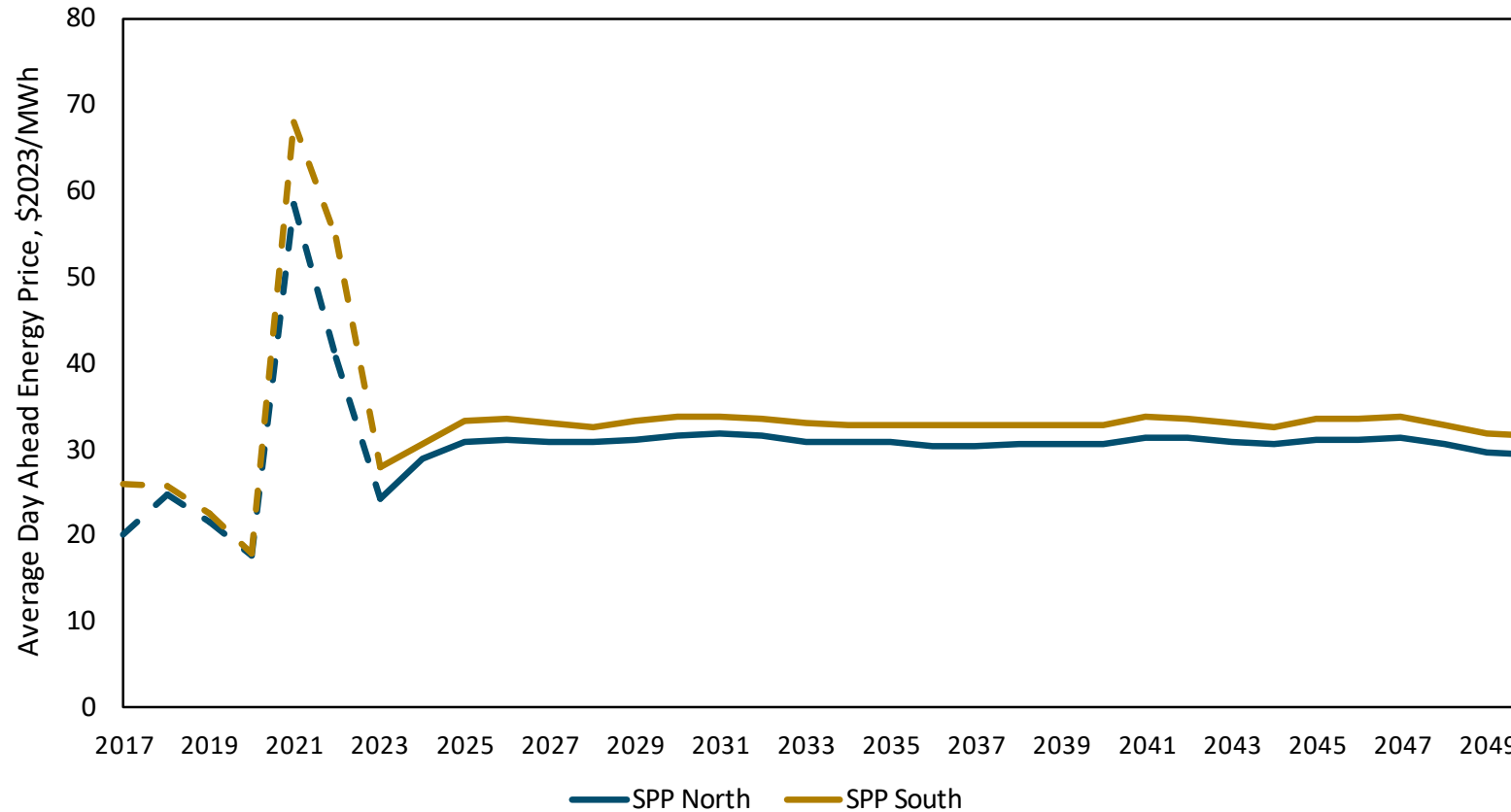
# E3 Forecast Results



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# SPP North and SPP South Annual Average Prices

- + Annual average prices expected to stabilize after recent volatility led by changes in natural gas prices
- + Longer term, prices remain stable as wind builds primarily meet load growth and overall thermal capacity is maintained



\* Average annual prices for the historical years are pulled from ABB's Velocity Suite through November 2023, and are shown in nominal unadjusted numbers