

# **Electric Reliability Council of Texas Market Price Forecast E3 Core Case**

Fall 2023 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.*



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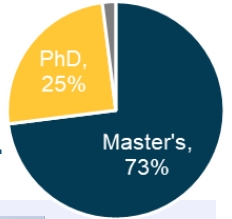
# Executive Summary



# 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

350+ 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 | ~\$5B)

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)

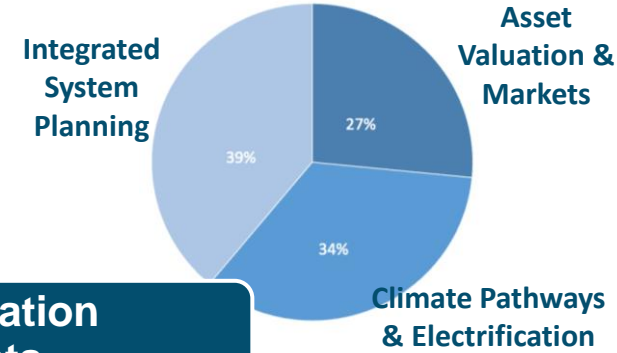
Buy-side diligence support to acquire several **residential and C&I solar portfolios** (~1+ GW | 200,000+ customers)

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



# E3's 3 Practice Areas

+ E3 has organized itself across three main practice areas to maximize its impact through the diversity of clients, project work, and technical innovation to support the energy transition across North America in a holistic, transparent, and intellectually honest manner



## Climate Pathways & Electrification

- Climate pathways studies
- Future of gas
- Low carbon fuels
- Building electrification
- Transportation electrification
- Load forecasting



## Integrated System Planning

- Integrated system planning for electricity: G, T, & D & non-wires alternatives
- Utility procurement
- Rate design
- Grid modernization
- Avoided costs
- Distributed resource planning



## Asset Valuation & Markets

- Asset valuation and due diligence
- Strategic advisory for commercial clients
- Energy market price forecasting
- Market design & analysis
- DER dispatch & asset optimization

Policy

Integrated Energy Planning

Commercial Interests



# E3 Work in Texas

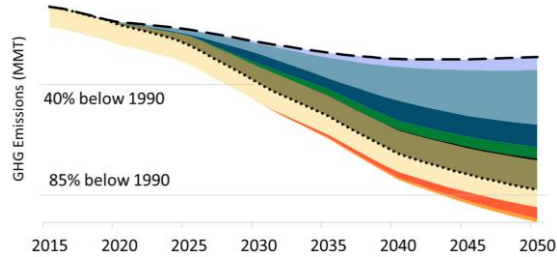
- + E3's experience with such a broad range of industry participants in Texas gives us an unparalleled understanding of policies, regulations, stakeholder interests, market dynamics, contract structures, and the competitive landscape**
- + E3's work in ERCOT has covered a wide range of topics and clients such that we not only understand the current market but have thought extensively how the market may change over the short-, medium-, and long-term from a holistic, transparent, and intellectually honest perspective**
- + Previous versions of this forecast has been used by a wide range of market participants and stakeholders to support market strategy, project development, and major capital investment decisions valued in the many tens of billions of dollars across a diverse set of energy asset classes and mandates**
- + E3 has also worked directly with ERCOT and the Texas regulators**
  - Public Utility Commission of Texas (2022): evaluated six potential market reforms to the ERCOT electricity market
  - Reform market proposal (2021) in the aftermath of the Texas electricity crisis of February 2021
  - Currently supporting ERCOT to examine its approach on cost-benefit and congestion analysis with regards to new transmission builds which may impact the underlying future economics of electricity supply
- + E3 has actively supported dozens of developers, investors (infrastructure funds, private equity, lenders, and tax equity), and technology companies on storage, renewables, hydrogen production, and transmission**
- + Lastly, we have worked with several utilities in Texas most prominently and consistently with El Paso Electric, focused on integrated resource planning and renewable energy procurement**



# E3's comprehensive and best-in-class modeling toolkit positions E3 well to study future energy system dynamics

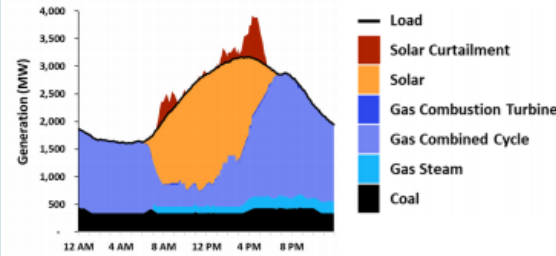
## PATHWAYS

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



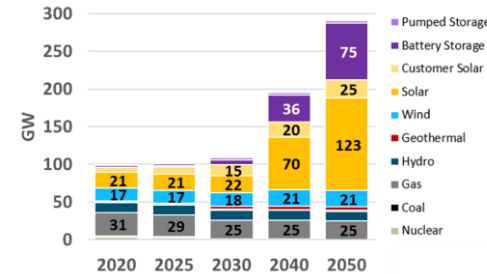
## Production Simulation (PLEXOS)

Detailed operational simulations of system dispatch and flexibility needs



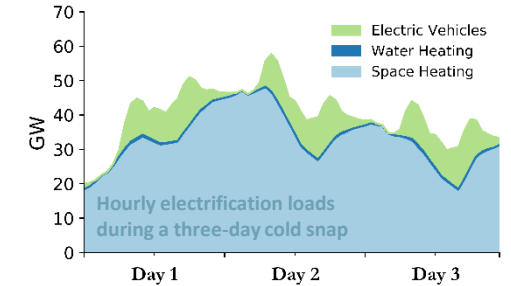
## RESOLVE

Optimal capacity expansion model for electric systems



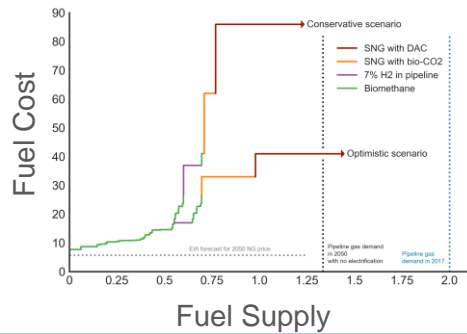
## RESHAPE & EVGrid

Hourly simulations of electric loads for specific end uses



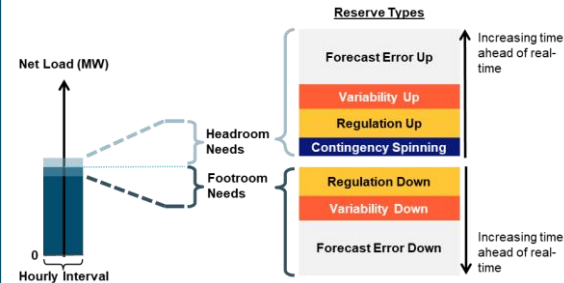
## Low-Carbon Fuels and Future of Gas

Role of fuels in deep decarbonization



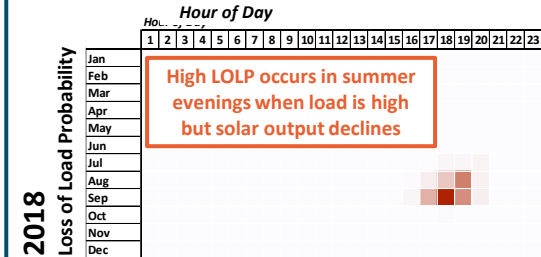
## RESERVE

Dynamic operating reserves for renewable integration



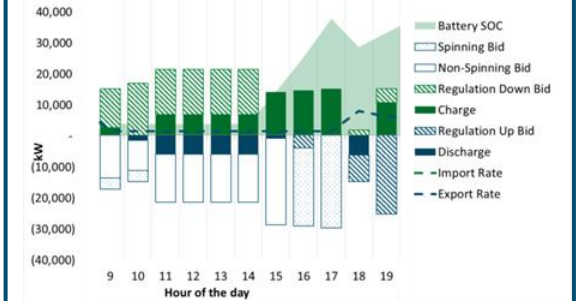
## RECAP

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





# 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

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



# 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 2025? 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
- 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

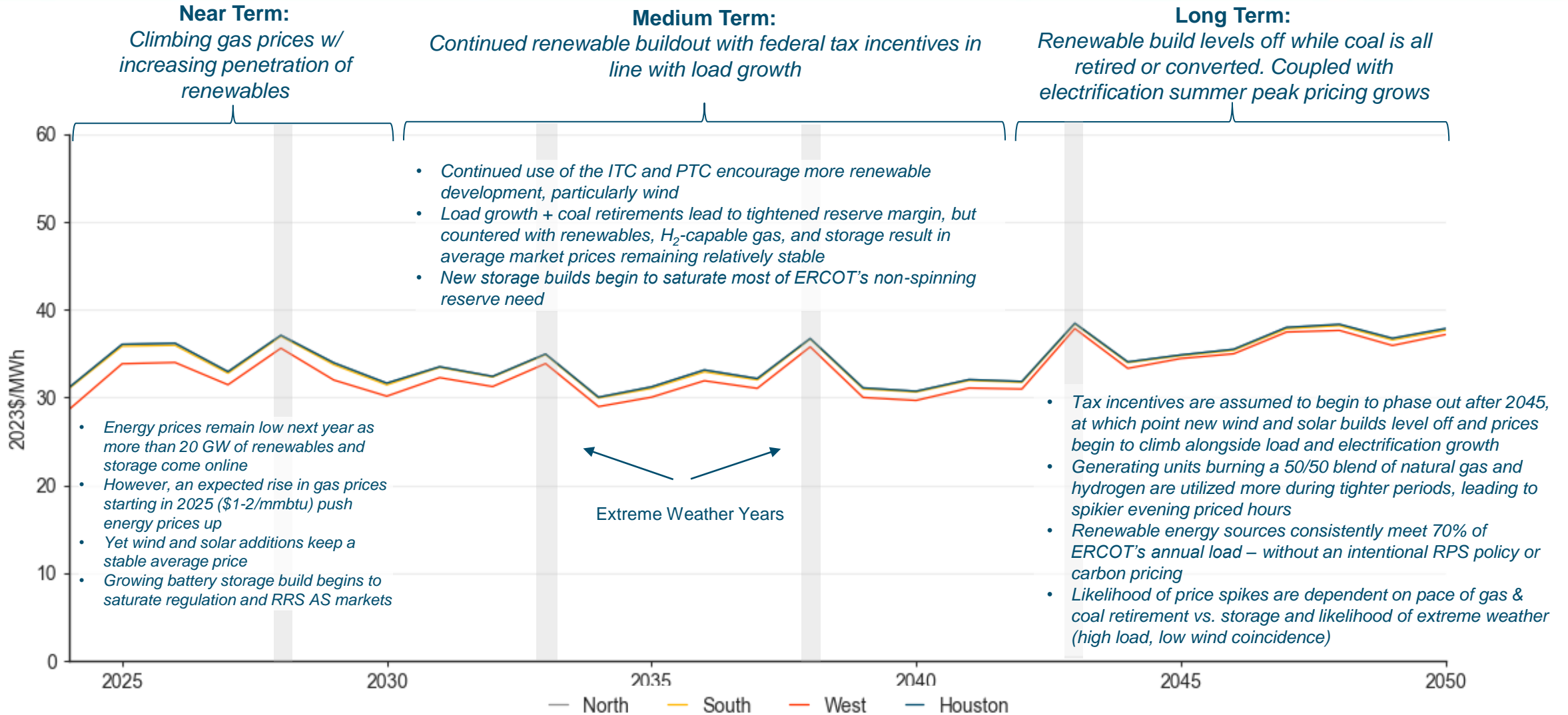


## Asset Valuation / Strategy

- 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



# Annual Average Energy Price



On an average level, ERCOT's competitive hubs are relatively identical. This does not capture nodal level differences, nor truly illustrate the volatility of the west whose lower load, high penetration of renewables, and constrained transmission leads to more volatile prices but ultimately balances out on average.



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# ERCOT Market Overview



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# E3 Forecasting Approach



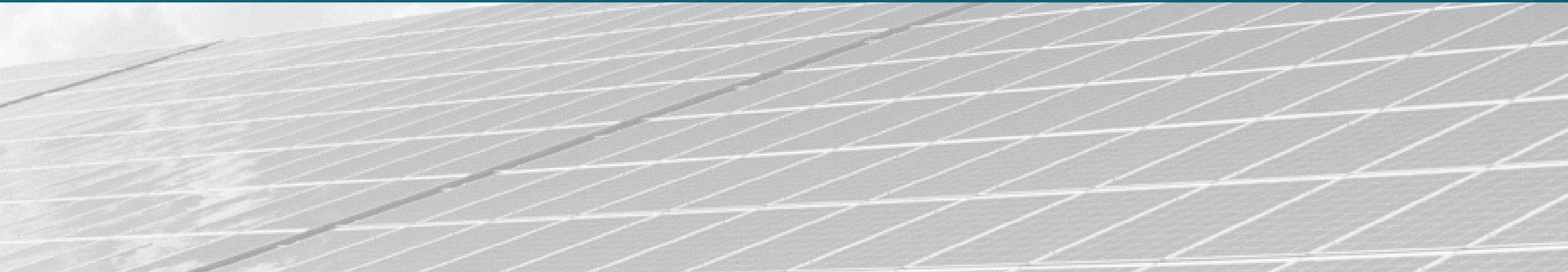
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# E3 Modeling Assumptions



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# **E3 Forecast Results: 2024-2050**





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# Appendix





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# Inflation Reduction Act (IRA)



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# ERCOT Market and Bidding Rules





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# ERCOT West Texas Export Assumptions



# E3 Electrification Modeling

