SAMPLE REPORT: PJM Market Price Forecast E3 Core Case

2022 edition

Energy+Environmental Economics

marketprices@ethree.com

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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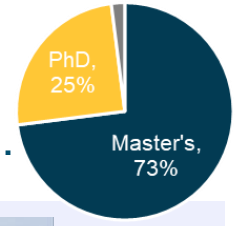
Executive Summary Selected Slides

Who is E3?

Thought Leadership, Fact Based, Trusted.

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




San Francisco

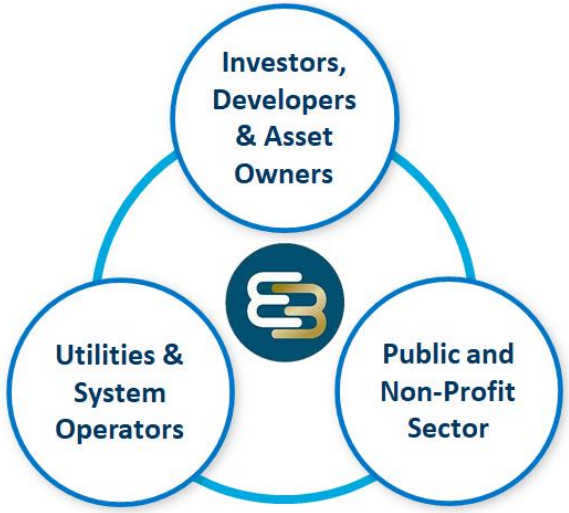

New York


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? (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 the clean energy transition topics
+ E3 has four major practice areas covering energy systems from bulk grid to behind the meter

Climate Pathways / Policy Analysis

- Climate and energy policy analysis
- Long-term energy & climate scenarios
- Electrification and low-carbon fuels
- Future of gas

Asset Valuation / Strategy

- Asset valuation and due diligence
- Strategic advisory
- Energy market price forecasting
- Market design
- Transmission planning

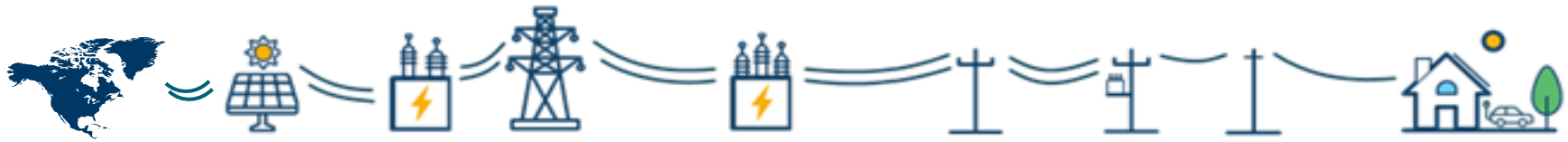
Resource Planning

- Integrated resource planning for electric systems: reliability and resource mix
- Planning for utility and state RPS + GHG targets
- Utility planning and procurement decisions

DER / Electrification / Rates

- Valuation of DERs
- DER dispatch and asset optimization
- Rate design
- Grid modernization
- Building electrification
- Vehicle electrification

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?
+ **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**

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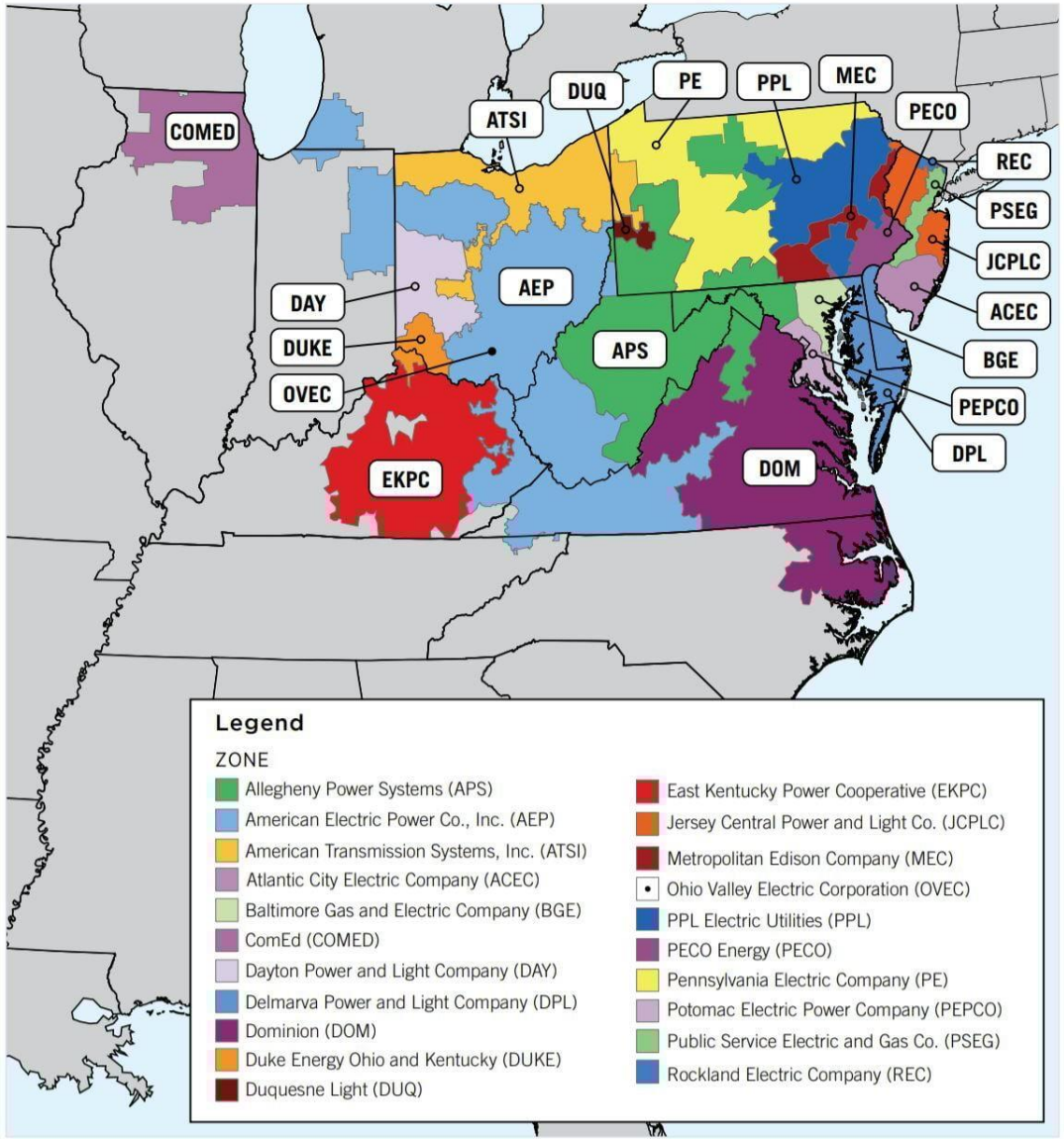
PJM Market Overview
Selected Slides

PJM Fact Sheet

- PJM Interconnection serves 65 million people in all or parts of 13 states and the District of Columbia.
- About 171 GW of committed generating capacity in 2021
- Peak load of 149 GW in 2021 and max peak of 158 GW in summer 2011
- 84,236 miles of transmission lines
- In 2020, total PJM billing was about $33.6 billion



PJM Relays Clean Policy Decisions to Each State or District

+ RPS – Renewable Portfolio Standard

- All regions have renewable energy standards or goals
- Some RPS policies are short-term focused (no view beyond 2030)
- DC and VA committed to 100% RPS by 2032 and 2045, respectively

+ GHG Emission Reduction Goals

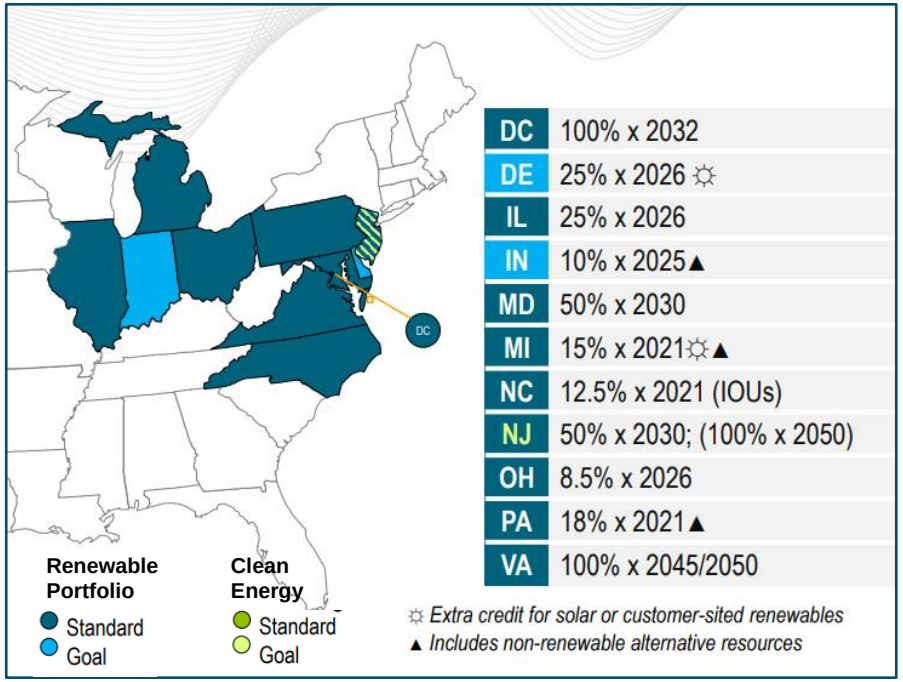
- On top of the RPS, some regions have a GHG emission reduction goal
- Varies greatly by region, with most aggressive targets of 80% CO_2 emissions reduction by 2050

+ Regional Greenhouse Gas Initiative (RGGI)

- Several northeastern states participate in RGGI, a regional cap-and-trade program for carbon emissions
- MD, NJ, VA and DE currently participate, while PA is in process to join

+ Offshore Wind Targets

- In addition, MD, NJ, and VA have instituted policies to take advantage of offshore wind potential



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E3 Forecasting Approach
Selected Slides

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)**

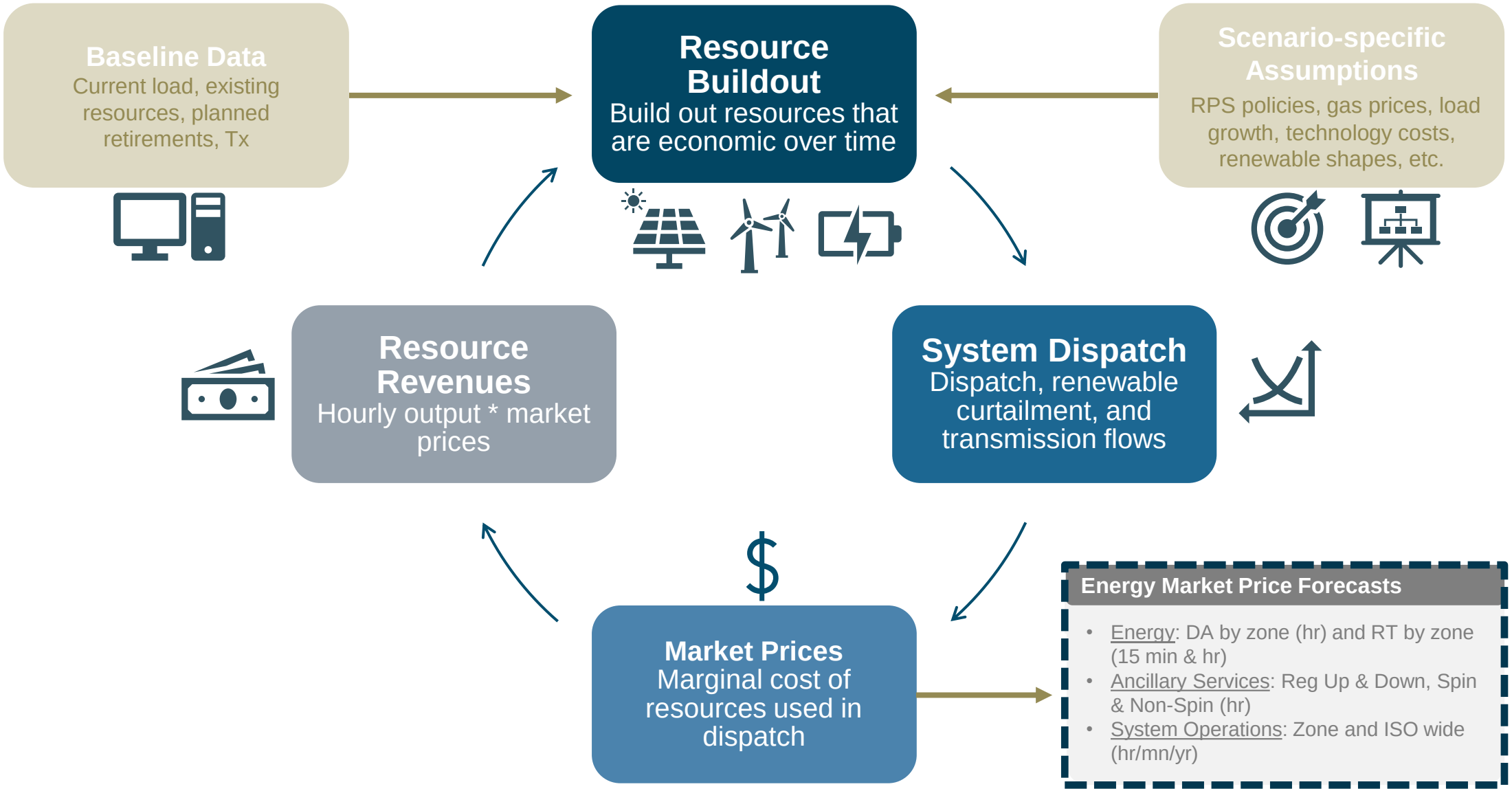
Energy Market Forecasts
- Hourly day-ahead energy prices by zone
- Dispatch, renewable curtailment, and transmission flows

E3 Forecasts

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

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

Modeling Approach for Long-Run Resource Builds



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E3 Modeling Assumptions
Selected Slides

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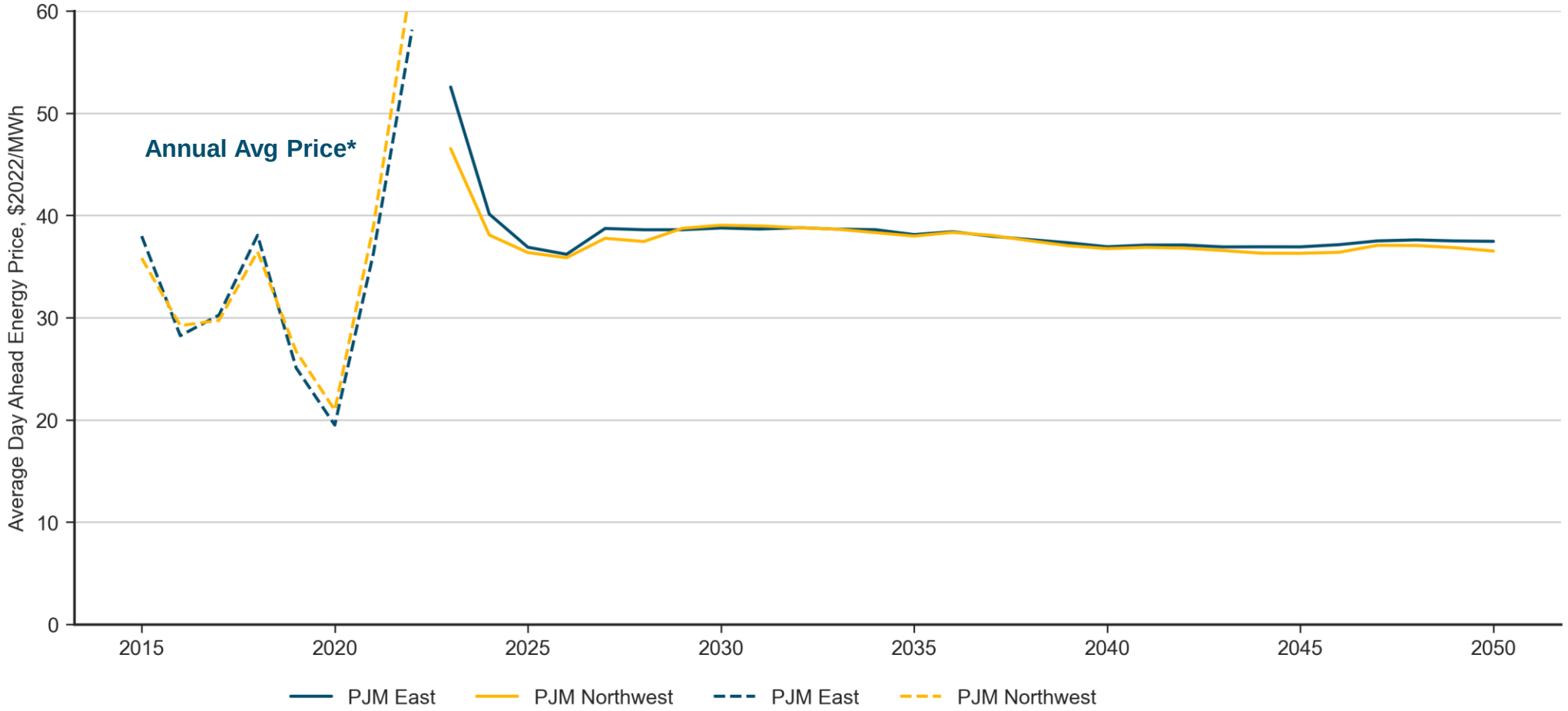
E3 Forecast Results: 2023-2050
Selected Slides

PJM East and PJM Northwest Annual Average Prices

- Annual average prices are expected to decrease in the near term as gas prices decline from current highs
- Prices stabilize as wind and solar builds meet load growth and retiring thermal capacity



* Average annual prices for the historical years are pulled from ABB's Velocity Suite through end of May 2022, and are shown in nominal unadjusted numbers

Annual Average Ancillary Service Prices