

## Summary of ISO New England Board and Committee Meetings

### October 7, 2021 Participants Committee Meeting

Since the last update, the Compensation and Human Resources Committee, the Markets Committee, the System Planning and Reliability Committee, and the Information Technology and Cyber Security Committee met on September 22. On September 23, the Nominating and Governance Committee, and the Board of Directors met. All of the meetings were held by videoconference.

**The Compensation and Human Resources Committee** reviewed details regarding the employee health and benefit plan renewals for 2022. The Committee also examined national compensation survey data regarding projected merit and promotional increase budgets. After reviewing information specific to the utility industry, all-industry data, and data from other system operators, the Committee approved a 3.0% merit increase and a 0.5% promotional/equity increase for inclusion in the proposed 2022 operating budget. Next, the Committee reviewed proposed conforming edits to its charter regarding previously approved changes in the Company's retirement and welfare plan investment fiduciary; the Committee agreed to recommend a revised charter for the Board's approval in November. Management updated the Committee on the Company's return to campus plans. During executive session, the Committee discussed director compensation trends with the Company's compensation consultant.

**The Markets Committee** received an update on various market issues, including the initiative to eliminate the Minimum Offer Price Rule, and the investment environment for renewable resources in New England. The Committee also conducted its annual discussion of the External Market Monitor's (EMM's) business continuity and succession plans and held an executive session with the EMM. Following the executive session, the System Planning and Reliability Committee joined the meeting to consider the key risks within the scope of both Committees' oversight. The Committees discussed the risks that are a function of market activity, technological change, and regulatory changes that are relevant to both Committees. The Committees agreed that significant risks exist for the foreseeable future, driven by the inherent complexity of wholesale electricity markets, the inter-relationship between planning, markets and operations, the increasing urgency from stakeholders to pursue various topics simultaneously, state and federal priorities, and regulatory uncertainty.

**The System Planning and Reliability Committee** reviewed the schedule for the 2021 Regional System Plan public meeting and discussed comments received from stakeholders on the Plan. The Committee was provided with a status update of Regional System Plan projects. The Committee discussed the states' transmission planning recommendations in NESCOE's June 2021 Report to the Governors, and noted the Company's progress in this area. The Committee then reviewed a summary of the FERC Advance Notice of Proposed Rulemaking on transmission and interconnection reforms and potential responses from the Company. Following a brief executive session, the Committee joined the Markets Committee meeting to consider the key risks within the scope of both Committees' oversight (see above).

**The Information Technology and Cyber Security Committee** convened with the full Board for the Committee's annual "deep dive" on cyber security issues and received a presentation from an expert on ransomware attacks, proactive exercises to minimize the risk of an attack, and the process for data recovery in the event of an attack. The Committee also discussed the Company's communications plan in the event of a cyber security event and progress related to the cyber security work plan.

**The Nominating and Governance Committee** adopted resolutions recommending that the Board elect the proposed slate of directors. The Committee discussed the launch of the Joint Nominating Committee process for 2022, and also discussed Board needs and requisite skills in connection with the Company's annual board succession process. Next, the Committee conducted its annual assessment of the risks within the Committee's purview. The Committee also received an update on the political environment, including related state and federal topics, and discussed significant energy legislation and policies considered by federal and state policymakers this year. The Committee then conducted its biennial consideration of its charter. The Committee reviewed its charter, confirmed its compliance, and agreed to revise it to emphasize the Committee's focus on diversity on the Board.

**The Board of Directors** held its annual meeting on September 23. Acting as the members of the Corporation, the Board elected Ms. Anders and Messrs. Corneli and Curran as Directors for three-year terms, and Ms. Flax as Director for a four-year term. The Board also approved changes to the Company's Articles of Incorporation, waived the provisions of the Bylaws, and approved a Waiver Agreement regarding the Participants Agreement, all in order to elect an eleventh director and a single director with a four-year term.

The Board also elected Ms. LaFleur as Chair of the Board of Directors, and adopted the committee assignments recommended by the Nominating and Governance Committee, as follows:

- Ms. Flax and Messrs. Curran and Corneli shall serve on the **Audit and Finance Committee**, with Mr. Curran to serve as Chair;
- Mses. Anders, LaFleur, and VanZandt and Mr. Denis shall serve on the **Compensation and Human Resources Committee**, with Mr. Denis to serve as Chair;
- Ms. VanZandt and Messrs. Colangelo, Curran, and Vannoy shall serve on the **Information Technology and Cyber Security** Committee, with Mr. Vannoy to serve as Chair;
- Mses. Anders and VanZandt and Messrs. Colangelo, Corneli, Curran, Denis, and Vannoy shall serve on the **Joint Nominating Committee**, with Mr. Colangelo to serve as Chair;
- Ms. Flax and Messrs. Corneli, Curran, Rush, and Vannoy shall serve on the **Markets Committee**, with Mr. Rush to serve as Chair;
- Ms. LaFleur and Messrs. Colangelo, Rush, and Vannoy shall serve on the **Nominating and Governance Committee**, with Mr. Colangelo to serve as Chair; and
- Mses. Anders and VanZandt and Messrs. Colangelo and Denis shall serve on the **System Planning and Reliability Committee**, with Ms. VanZandt to serve as Chair.

The Board also elected the Company's officers for the upcoming year, reviewed assignments of directors as liaisons to individual states, and recognized retiring directors Kathleen Abernathy and Phil Shapiro, thanking them for their service on the Board.

The Board received a report from the CEO, including an update on corporate goal achievement and a discussion of plans to return to the office. Next, the Board discussed the 2022 budgets. The Board reviewed the states' comments on the budgets and discussed the remaining stakeholder process, noting that the Board's vote on the budgets will take place after the Board is notified of feedback from and the vote of the NEPOOL Participants Committee.

The Board then prepared for its upcoming meeting with NESCOE, received reports from the standing committees, and considered potential topics for the meetings scheduled in November with NEPOOL and NECPUC. The Board met with NESCOE and reviewed slides that have been posted at [https://www.iso-ne.com/static-assets/documents/2021/09/iso-ne-response\\_to\\_states-vision\\_sept\\_23\\_2021.pdf](https://www.iso-ne.com/static-assets/documents/2021/09/iso-ne-response_to_states-vision_sept_23_2021.pdf).

# Response to the New England States' Vision Statement and Advancing the Vision Report

---



*Meeting with New England States*

ISO New England Board of Directors



# Introduction

- The ISO Board of Directors has directed management to prioritize transmission planning studies and market pathways analysis in support of the states' clean energy vision
- The board is also pursuing targeted governance and communications enhancements, consistent with its independence and oversight role and with the need to focus on transmission and market priorities
- The board remains committed to working with the states and NEPOOL to achieve the region's goals for a clean energy system that is reliable and efficient



# Our Commitment to the Clean Energy Transition Is Explicitly Included in Our Vision Statement

## Mission: *What we do*

Through collaboration and innovation, ISO New England plans the transmission system, administers the region's wholesale markets, and operates the power system to ensure reliable and competitively priced wholesale electricity

## Vision: *Where we're going*

To harness the power of competition and advanced technologies to reliably plan and operate the grid as the region transitions to clean energy



*The ISO's **Vision** for the future represents our long-term intent and guides the formulation of our Strategic Goals.*

# ISO Plays a Unique Role in the Region

## Independence

- The independent role of the ISO was central to the creation of competitive wholesale electricity markets and planning the bulk electric transmission system in New England

## Filing Market Rules with FERC

- Granting the ISO primary responsibility to file market rules with FERC was central to the Commission's vision for the ISO becoming a Regional Transmission Organization, and remains a key aspect of the ISO's independence



# ISO Plays a Unique Role in the Region, cont.

## Transmission for Reliability

- The ISO has primary responsibility for identifying reliability needs and approving the projects in the transmission plan for the region
  - The board votes on the Transmission Project List in the Regional System Plan, following input from stakeholders and the states through the Planning Advisory Committee

## Transmission for Public Policy

- The ISO tariff has provisions to enable transmission planning for public policy
  - The *states play a key role* in determining whether studies are needed, but to date, have not exercised the need for such studies
- The states' Vision foresees large-scale transmission investment to enable clean energy
  - This will require *increasing levels of input and decision-making from state regulators and policymakers* with the ISO playing a technical role to support the states





# States and ISO Have Overlapping Objectives

- The states have **clean-energy mandates** – and we are supportive of the states in those efforts
- The ISO has a **reliability mandate** and a **mandate to administer competitive wholesale markets** for the resources needed for a reliable system – and we know that the states recognize the importance of reliability and have continued to express support for competitive markets
- There is an overarching need to ensure a reliable power system throughout the clean energy transition



## ACTIVITIES TO FURTHER THE STATES' VISION

*ISO Board and Management are committed to working with the states to achieve a reliable and efficient clean energy future for New England*



# ISO New England Is Aligned with the States on the Clean Energy Transition

## Transmission Planning

- 2050 Transmission Study
- Cluster Studies to Interconnect Offshore Wind on Cape Cod
- Transition Planning for the Clean Energy Transition – Pilot Study
- Future Grid Reliability Study
- Storage as a Transmission Solution

## Wholesale Market Design

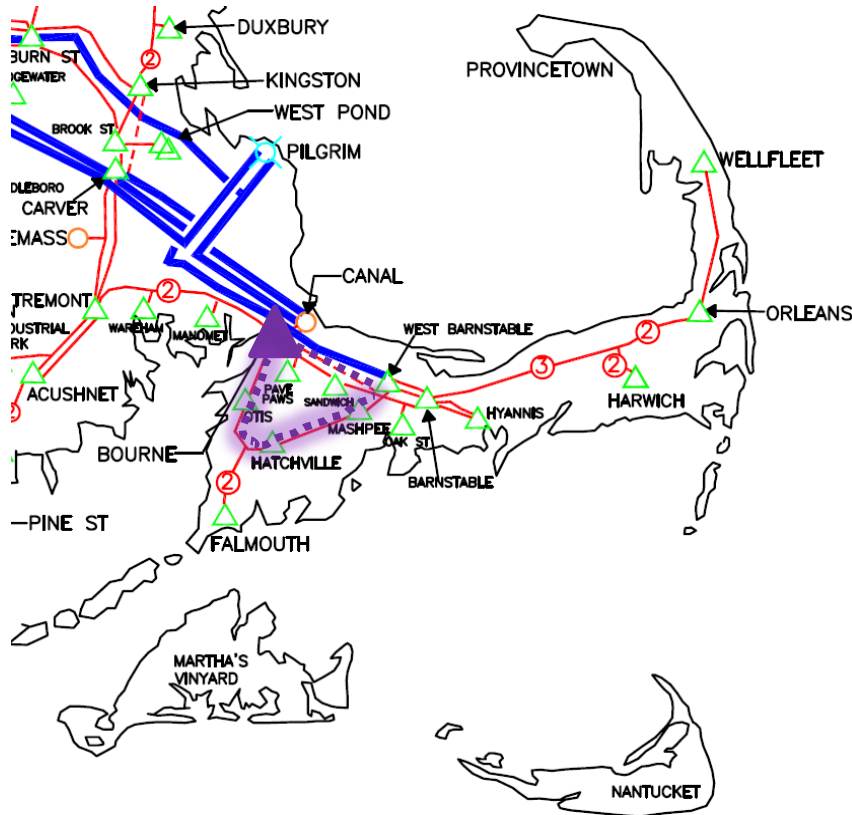
- Pathways analysis of a forward clean energy market and net carbon pricing, and a hybrid of the two concepts
- Elimination of the Minimum Offer Price Rule (MOPR)
- Revisit ancillary service design
- Enable distributed energy resource aggregations to participate in the wholesale market (Order 2222)



# 2050 Transmission Study Is a Direct Response to the States' 2020 Vision Statement

- At the states' request, the ISO is leading a high-level transmission study to look at scenarios to **reliably and cost-effectively incorporate clean energy and distributed energy resources by 2050**
  - This is referred to as the “2050 Transmission Study”
    - Primary focus is the year 2050, but also looking at 2035 and 2040
  - Study is intended to look beyond the current, 10-year planning horizon
  - The ISO is working with NESCOE to develop study assumptions and the study scope; further discussions with stakeholders will take place at the Planning Advisory Committee
  - Study will include high-level cost estimates to help the states evaluate different transmission scenarios
  - The ISO is working with NESCOE to draft corresponding changes to the ISO tariff to enable this type of transmission study on a recurring basis

# The ISO Initiated the Cape Cod Resource Integration Study to Increase Integration of Offshore Wind



- 1,600 MW of offshore wind on Cape Cod have completed System Impact Studies and can interconnect immediately
- 3,260 MW of additional generation are seeking to interconnect on the Cape
  - Previous studies by the ISO have identified that without transmission upgrades the ability to interconnect offshore wind is limited
- The ISO initiated the Cape Cod Resource Integration Study (CCRIS) to identify infrastructure upgrades to enable the interconnection of approximately 1,200 MW of additional offshore wind
  - The ISO has initiated a second CCRIS to support the interconnection of additional wind

# Other Planning Initiatives

- **Transmission Planning for the Clean Energy Transition**
  - The ISO is conducting a pilot study to proactively plan for growing levels of Distributed Energy Resources (DERs), renewable resources, including offshore wind, imports via HVDC transmission interconnections, and energy storage
    - Study will aid in developing assumptions for use in future Needs Assessments, and will explore reliability concerns that may arise
    - Focus is the current, 10-year planning horizon for reliability needs
    - The ISO presented initial results in summer 2021; further results are coming this fall
- **Future Grid Reliability Study**
  - The ISO is conducting a study of how the power system could operate in **2040** under current energy and environmental policies
    - NEPOOL requested the study; stakeholders, including NESCOE, developed the scenarios
    - The ISO presented initial results in June; further results are coming this fall
    - Using 2040 aligns with interim years in the 2050 Transmission Study
- **Storage as a Transmission Solution**
  - Beginning in Q1 2022, the ISO will initiate discussions of proposed tariff changes to consider storage as a transmission asset for the purposes of implementing solutions to Needs Assessments or Public Policy Transmission Studies

# Market Design for the Clean Energy Future

- **Analysis of Pathways to a Future Grid**

- The ISO is working with regional stakeholders to evaluate potential wholesale market frameworks that reflect states' policies
  - Analysis includes a regional net carbon price, a Forward Clean Energy Market, and a hybrid of the two concepts
- Study results are expected in Q2 2022

- **Elimination of the MOPR**

- The ISO is developing a proposal with input from stakeholders to address the dual objectives of allowing sponsored resources to clear and maintaining competitive capacity pricing that can attract merchant entry when needed to maintain resource adequacy

- **Ancillary Service Markets**

- With the evolving power system, it will be necessary to enhance ancillary services to ensure the markets produce a reliable next-day operating plan
- In 2022, the ISO will be refocusing efforts on proposals to co-optimize reserves in the day-ahead energy markets



# Market Design for the Clean Energy Future, cont.

- **Integration of Distributed Energy Resource Aggregations (DERAs)**
  - The ISO plans to file its proposal with FERC in February 2022 to integrate DERAs into the wholesale markets, pursuant to Order 2222
- **Enhancements to Resource Capacity Accreditation (RCA)**
  - To assist with ensuring a reliable and clean energy future, the ISO is working with the states and NEPOOL to improve the methodology for determining resource capacity ratings in order to reflect the evolving resource mix





# ISO-NE Board Review of Governance Practices

- The states' review of ISO/RTO governance practices reflects that ISO-NE is comparable to peer organizations
- The Nominating & Governance Committee and the board of directors have reviewed current practices in light of the states' recommendations, have met with the states, and are making changes that are consistent with the ISO's core requirement for *independence* and its role as an *oversight board*, and that can be achieved without impeding the organization's focus on the states' markets and transmission goals

## Governance Structure and Practices in the FERC-Jurisdictional ISOs/RTOs

February 2021

Prepared for:

**NESCAE**  
New England States Committee on Electricity

Prepared by:

Christopher A. Parent  
Katherine S. Fisher  
William R. Cotton  
Cali C. Clark

**EXETER**  
ASSOCIATES, INC.

# Annual Open Meeting of the Board

- The board of directors will hold an annual open meeting:
  - The meeting will be focused on the wholesale electricity markets, in even-numbered years beginning in 2022
  - The meeting will be focused on system planning, in odd-numbered years beginning in 2023
    - Potentially linked to the biennial Regional System Plan public meeting
  - *This would be in addition to meetings the board holds with the states and NEPOOL sectors throughout the year*



# Board Committee Charter Revisions

- The Board Markets Committee and System Planning and Reliability Committee have updated their charters to ensure that the committees' work is conducted consistent with the ISO's Vision, which emphasizes the company's role in utilizing competitive markets and planning processes, and advanced technologies, to facilitate a reliable transition to clean energy (*Committee charters are posted on the ISO web*)
- The board of directors and committees do evaluate costs and consumer impact in discussions on ISO proposals and, as the next section explains, the board looks forward to having further conversations with the states on this topic

# Enhancements to Board Communications

- Distribute the CEO's monthly board reports directly to the states
  - ISO staff can look for areas to enhance summaries
  - States also have opportunities to ask questions of the CEO about board activities at monthly NEPOOL Participants Committee meetings
- Additional board discussions with the states
  - The board proposes to add plenary or liaison meetings where necessary to discuss consumer implications of an ISO proposal
  - If the states have a majority position on an ISO proposal, the board is willing to meet with the states to discuss their position, and management will include consideration of a state majority position in filings to FERC

# Leadership Role for the New England States on a Regional Clean Energy Market Design

- The ISO's analysis of Pathways to a Future Grid is targeted for completion in April 2022
- Should the Pathways results lead to consensus from the states on a viable option, we will look to state regulators and policymakers to provide increasing levels of input and decision-making to establish a clean energy market



# Enhancing Communication of Technical Information to Non-Technical Audiences

- Existing communications seek to deliver technical information to technical as well as non-technical audiences, such as:
  - Regional Electricity Outlook (the “REO”)
  - ISO Newswire
  - ISO-to-Go mobile app
  - ISO Express data portal
  - State and regional profiles
  - Regional System Plan: executive summary and public meeting
  - Consumer Liaison Group: presentations, summaries, annual report
  - ISO101 Online and special session for public officials
- Management can also meet with the states to review existing documents to identify additional reasonable needs for enhanced communications with non-technical audiences

# Equity and Environmental Justice

- The board and management understand this is an important issue and offer to be a resource to the states on matters related to the regional power system as they evaluate equity and environmental justice issues
- External Affairs is available to be the initial point of contact



# Conclusion

- ISO New England, the New England states and regional stakeholders have a **long history of collaboration** to ensure the region has a reliable transmission system, a comprehensive system planning process, and wholesale electricity markets that are consumer-focused, competitive and deliver the electricity the region needs today and in the future
- The board's role is to **provide advice to and oversight of** management, including to ensure they have the right talent and resources needed to fulfill the organization's mission and vision
- We believe the ISO is **well positioned to support the clean energy transition** and we look forward to continuing to work with the states, NEPOOL and other stakeholders on this endeavor





# NEPOOL Participants Committee Report

---

*October 2021*



Vamsi Chadalavada

EXECUTIVE VICE PRESIDENT AND CHIEF OPERATING OFFICER



# Table of Contents

• Highlights	Page	3
• System Operations	Page	13
• Market Operations	Page	26
• Back-Up Detail	Page	43
– Demand Response	Page	44
– New Generation	Page	46
– Forward Capacity Market	Page	53
– Reliability Costs - Net Commitment Period Compensation (NCPC) Operating Costs	Page	59
– Regional System Plan (RSP)	Page	88
– Operable Capacity Analysis – Fall 2021 Analysis	Page	116
– Operable Capacity Analysis – Preliminary Winter 2021/2022 Analysis	Page	123
– Operable Capacity Analysis – Appendix	Page	130

# Regular Operations Report - Highlights

---



# Highlights

- Day-Ahead (DA), Real-Time (RT) Prices and Transactions
  - Update: August 2021 Energy Market value totaled \$685M
  - September 2021 Energy market value was \$497M, down \$188M from August 2021 and up \$290M from September 2020
  - September 2021 natural gas prices over the period were 12% higher than for August
    - Average RT Hub Locational Marginal Prices (\$46.48/MWh) over the period were 5% lower than August averages
      - DA Hub: \$48.01/MWh
    - Average September 2021 natural gas prices and RT Hub LMPs over the period were up 206% and up 134%, respectively, from September 2020 averages
  - Average DA cleared physical energy during the peak hours as percent of forecasted load was 99.9% during September, down from 100.5% during August\*
    - The minimum value for the month was 92.7% on Wednesday, September 1st

All data through September 29<sup>th</sup>

\*DA Cleared Physical Energy is the sum of Generation and Net Imports cleared in the DA Energy Market

Underlying natural gas data furnished by:



# Highlights, cont.

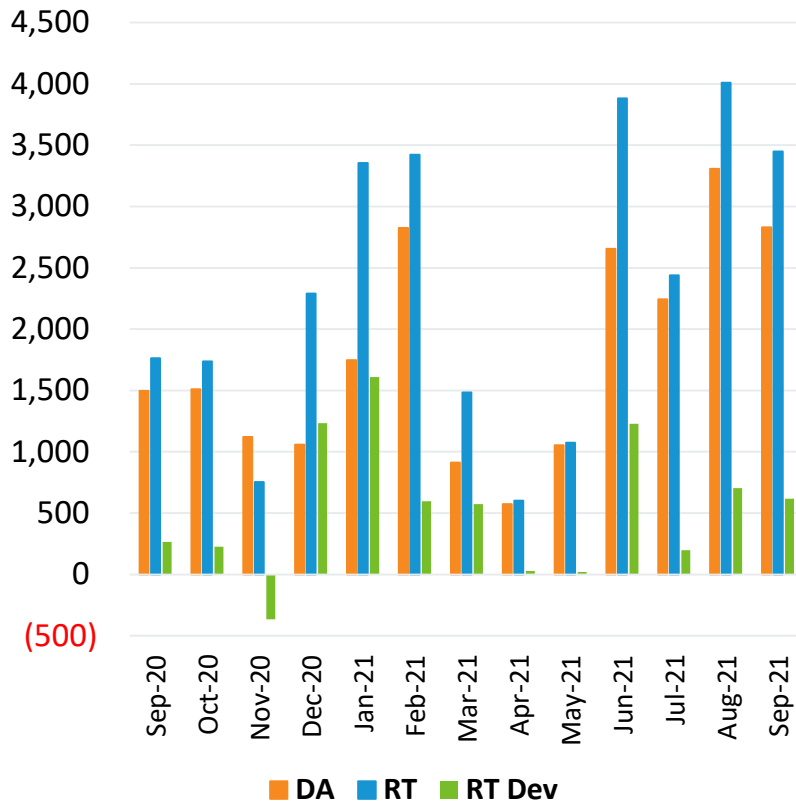
- Daily Net Commitment Period Compensation (NCPC)
  - September 2021 NCPC payments totaled \$1.3M over the period, down \$2M from August 2021 and down \$1.1M from September 2020
    - First Contingency payments totaled \$1.3M, down \$1.5M from August
      - \$1.3M paid to internal resources, down \$1.5M from August
        - » \$350K charged to DALO, \$491K to RT Deviations, \$445K to RTLO\*
      - \$42K paid to resources at external locations, down \$1K from August
        - » \$38K charged to DALO at external locations, \$1K to RT Deviations
    - Second Contingency payments totaled \$5K, down \$93K from August
    - Voltage and Distribution payments were negligible (\$3K combined)
  - NCPC payments over the period as percent of Energy Market value were 0.3%

\* NCPC types reflected in the First Contingency Amount: Dispatch Lost Opportunity Cost (DLOC) - \$263K; Rapid Response Pricing (RRP) Opportunity Cost - \$170K; Posturing - \$12K; Generator Performance Auditing (GPA) - \$0K

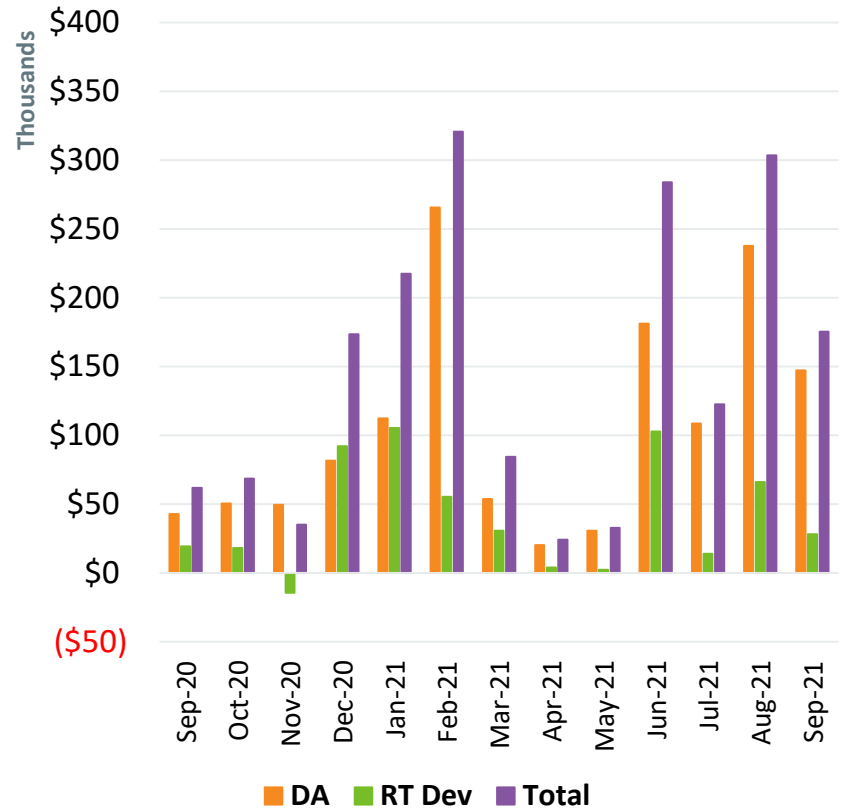


# Price Responsive Demand (PRD) Energy Market Activity by Month

## DA, RT, and RT Dev MWh



## Market Value



Note: DA and RT (deviation) MWh are settlement obligations and reflect appropriate gross-ups for distribution losses.



# Highlights

- Production cost preliminary results for the 2021 Economic Study (Future Grid Reliability Study) were discussed at a special September 17 PAC meeting and joint MC/RC meetings
  - The ISO is working on refining the scenario matrix and will present to the MC/RC for approval before completing the final runs
- RC voted in favor of the FCA 16 ICR and Related Values at their September 21 meeting; FERC filing to be made by November 9
- 2022 ARA assumption discussions continue at the PSPC
- Regional System Plan Public Meeting will be held virtually on October 6
- Four Attachment K revisions are in various stages of development



# Forward Capacity Market (FCM) Highlights

- CCP 12 (2021-2022)
  - Third and final annual reconfiguration auction (ARA3) was held on March 1-3, and results were posted on March 29
- CCP 13 (2022-2023)
  - Second annual reconfiguration auction (ARA2) was held on August 2-4, and results were posted on August 31
  - Development of ICR-Related Values continues with discussions at the PSPC; FERC filing to be made by November 30
- CCP 14 (2023-2024)
  - First annual reconfiguration auction (ARA1) was held on June 1-3, and results were posted June 30
  - Development of ICR-Related Values continues with discussions at the PSPC; FERC filing to be made by November 30
- CCP 15 (2024-2025)
  - Auction results were filed with FERC on February 26 and FERC approved on June 24
  - Development of ICR-Related Values continues with discussions at the PSPC; FERC filing to be made by November 30

CCP – Capacity Commitment Period

ISO-NE PUBLIC



# FCM Highlights, cont.

- CCP 16 (2025-2026)
  - FCA 16 will model the same zones as FCA 15
    - Export-constrained zones: Northern New England, and Maine nested inside Northern New England
    - Import-constrained zones: Southeast New England
  - A summary of permanent and retirement de-list bids was posted on March 17, and a summary of substitution auction demand bids was posted on April 30
    - These summaries were reposted on June 11 to reflect de-list bid withdrawals made after the Internal Market Monitor reissued its determinations based on the FERC-accepted CONE, Net CONE and Capacity Performance Payment Rate for FCA 16
      - The bid withdrawal Tariff provision that FERC accepted was for FCA 16 only
    - New Capacity Qualification is ongoing
  - ICR and Related Values to be filed no later than November 9, 2021

# Load Forecast

- Efforts continue to enhance load forecast models and tools to improve day-ahead and long-term load forecast performance
- Efforts to expand/improve the transportation electrification forecast for CELT 2022 have commenced
  - Initial discussion related to these efforts was at the September 24 Load Forecast Committee meeting



# FERC Order 1000

- Qualified Transmission Project Sponsor (QTPS)
  - 25 companies have achieved QTPS status
- Competitive Solution Process: Order 1000/Boston 2028 Request for Proposal Lessons Learned
  - The ISO held discussions on the associated Tariff changes at the 7/14/21, 8/24/21, and 9/28/21 TC meetings
  - The first discussion at the RC occurred on 9/21/21; next discussion is scheduled for 10/19/21

# Highlights

- The lowest 50/50 and 90/10 Fall Operable Capacity Margins are projected for week beginning October 16, 2021.
- The lowest 50/50 and 90/10 Preliminary Winter Operable Capacity Margins are projected for week beginning January 8, 2022.



# SYSTEM OPERATIONS



# System Operations

<u>Weather Patterns</u>	Boston	Temperature: Above Normal (4.0°F) Max: 86°F, Min: 52°F Precipitation: 7.47" – Above Normal Normal: 3.56"	Hartford	Temperature: Above Normal (1.3°F) Max: 86°F, Min: 44°F Precipitation: 6.81" - Above Normal Normal: 4.39"
-------------------------	--------	-------------------------------------------------------------------------------------------------------------------	----------	-------------------------------------------------------------------------------------------------------------------

<u>Peak Load:</u>	19,707 MW	September 15, 2021	18:00 (ending)
-------------------	-----------	--------------------	----------------

## Emergency Procedure Events (OP-4, M/LCC 2, Minimum Generation Emergency)

Procedure	Declared	Cancelled	Note
None in September, 2021			



# System Operations

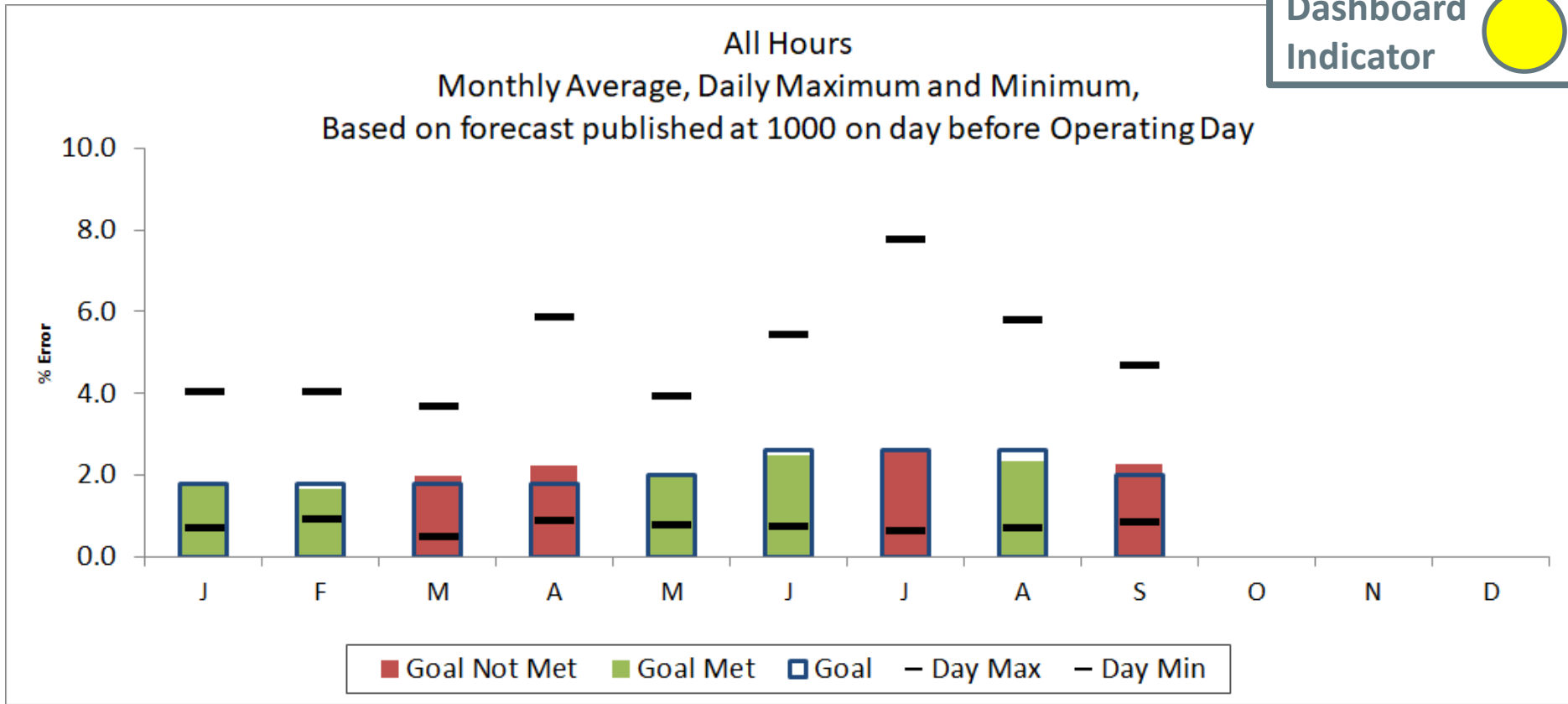
## NPCC Simultaneous Activation of Reserve Events

Date	Area	MW Lost
9/27/2021	PJM	750
9/30/2021	IESO	530



# 2021 System Operations - Load Forecast Accuracy

Dashboard Indicator 

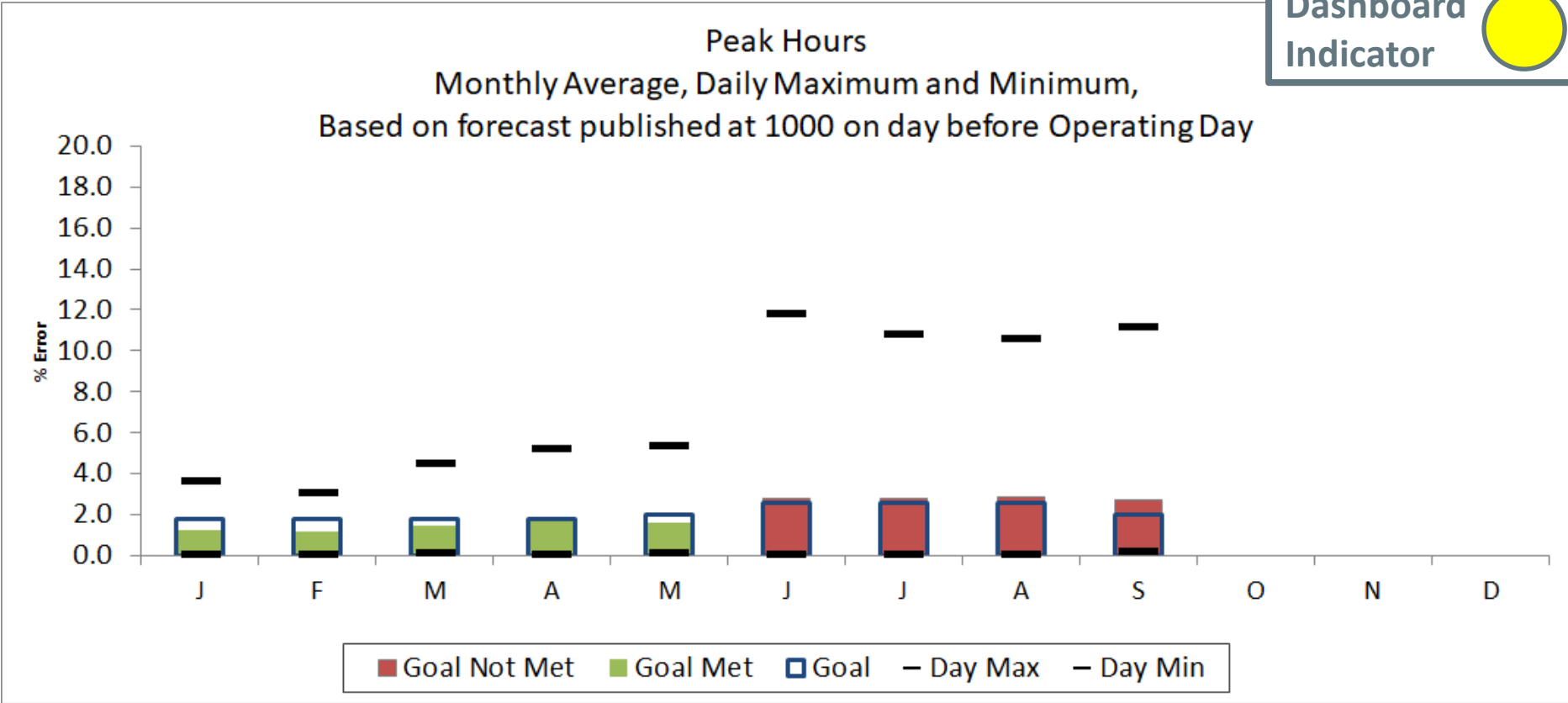


Month	J	F	M	A	M	J	J	A	S	O	N	D	
Day Max	4.04	4.03	3.67	5.85	3.92	5.41	7.75	5.77	4.68				7.75
Day Min	0.70	0.92	0.49	0.88	0.77	0.73	0.63	0.71	0.86				0.49
MAPE	1.72	1.66	1.97	2.24	1.95	2.50	2.61	2.33	2.28				2.14
Goal	1.80	1.80	1.80	1.80	2.00	2.60	2.60	2.60	2.00				



# 2021 System Operations - Load Forecast Accuracy cont.

Dashboard Indicator 

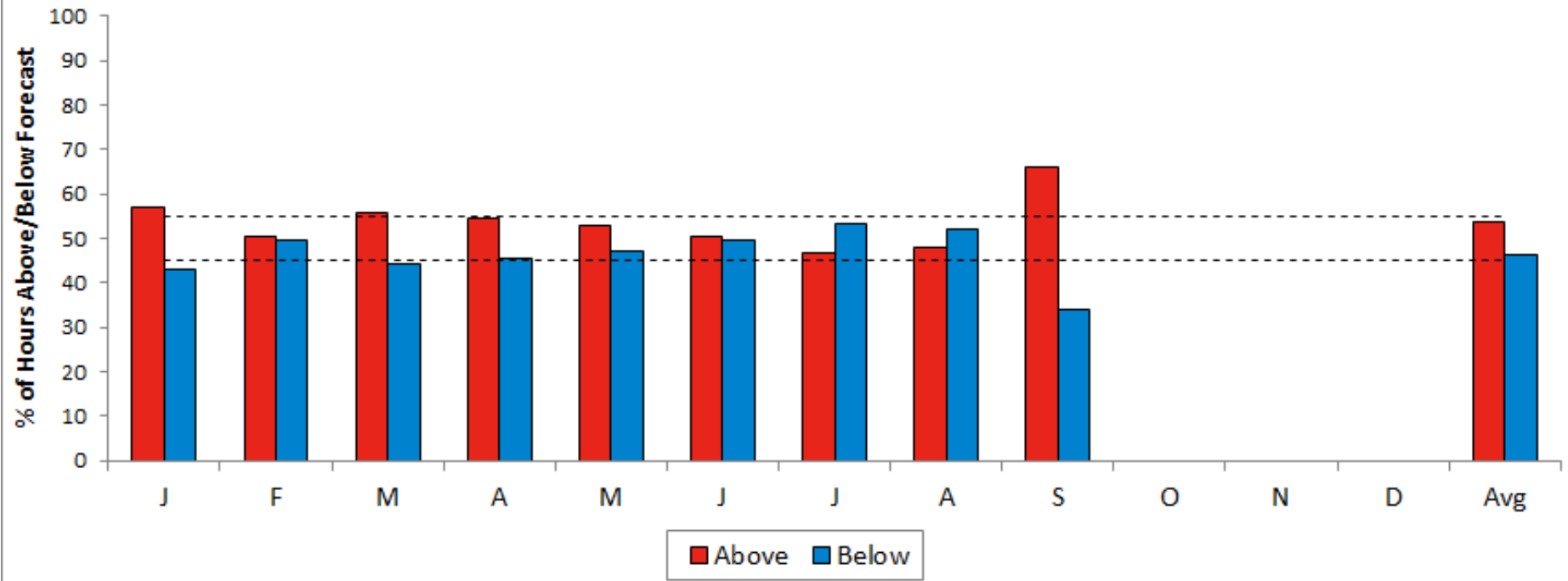


Month	J	F	M	A	M	J	J	A	S	O	N	D	
Day Max	3.61	3.03	4.47	5.19	5.31	11.76	10.75	10.54	11.13				11.76
Day Min	0.02	0.06	0.08	0.03	0.11	0.04	0.05	0.01	0.17				0.01
MAPE	1.26	1.18	1.48	1.66	1.60	2.79	2.78	2.86	2.73				2.04
Goal	1.80	1.80	1.80	1.80	2.00	2.60	2.60	2.60	2.00				

# 2021 System Operations - Load Forecast Accuracy cont.

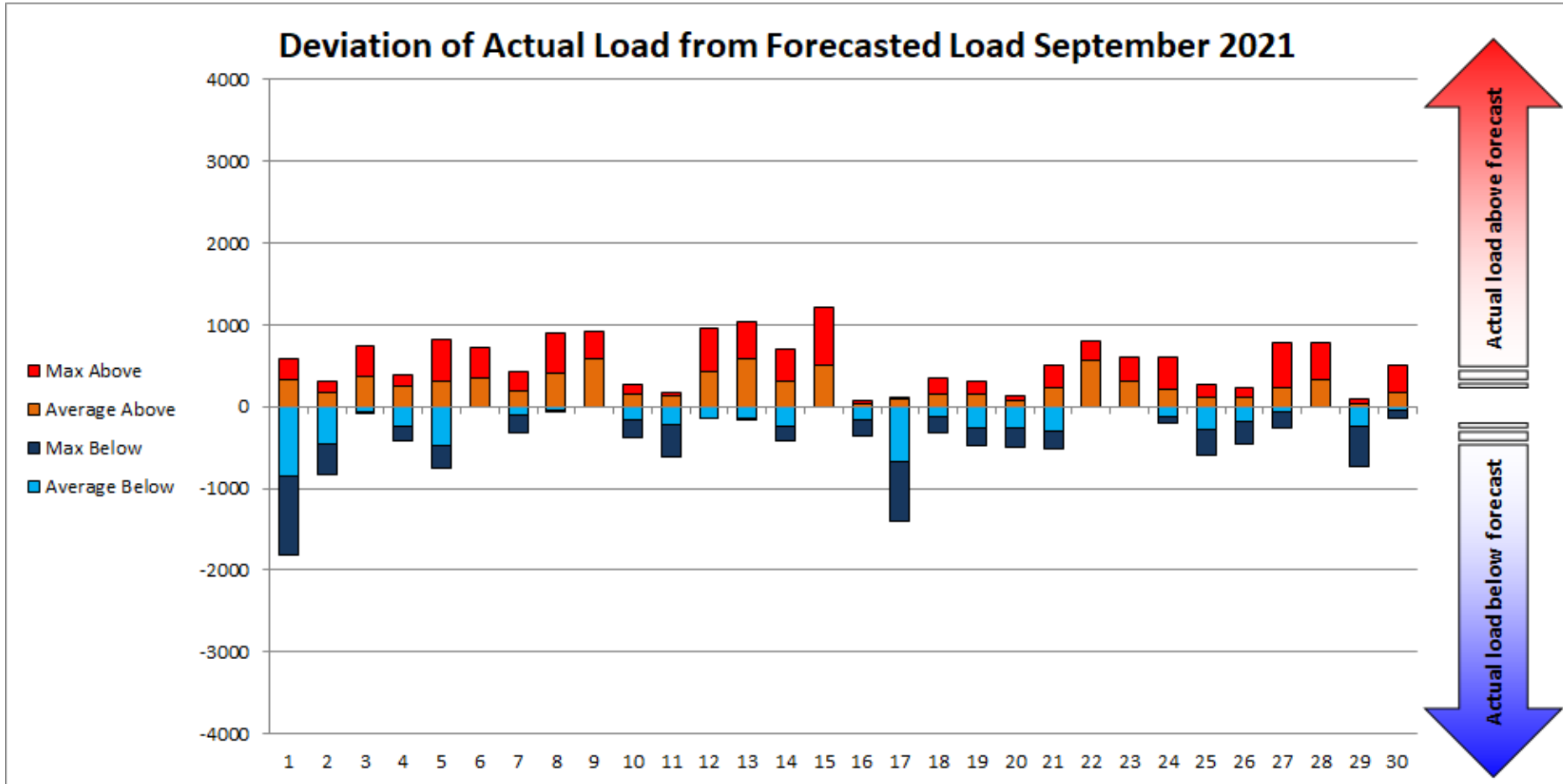
Percent of Hours Actual Load  
 Above vs. Below Forecast  
 Based on LF published by 1000, day before Operating Day

Target = 50%  
 Plus/Minus = 5%



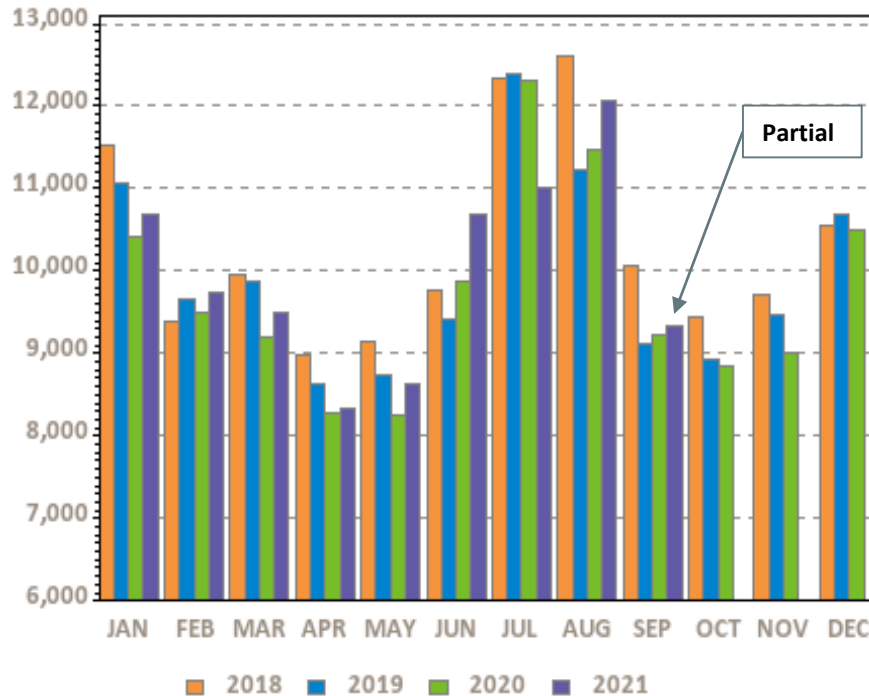
	J	F	M	A	M	J	J	A	S	O	N	D	Avg
Above %	57.1	50.4	55.6	54.4	52.8	50.3	46.9	47.8	66.2				53
Below %	42.9	49.6	44.4	45.6	47.2	49.7	53.1	52.2	33.8				47
Avg Above	209.5	166.7	185.4	206.1	227.4	233.1	214.5	227	263.1				263
Avg Below	-147.6	-216.4	-188.0	-167.9	-146.8	-309.1	-348.1	-307.5	-195.6				-348
Avg All	60	-25	30	40	61	-48	-122	-79	105				3

# 2021 System Operations - Load Forecast Accuracy cont.



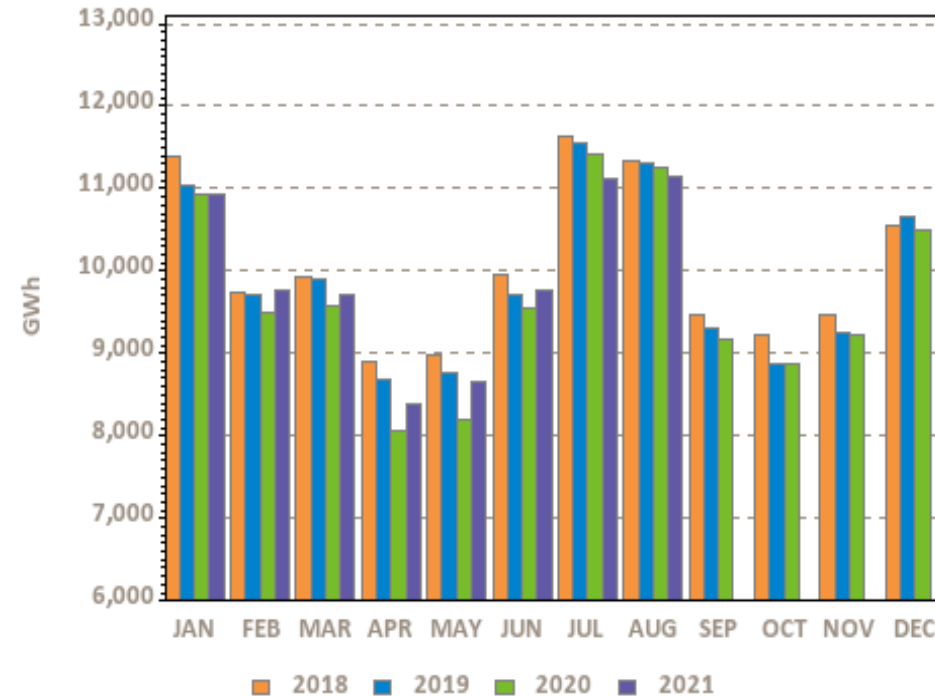
# Monthly Recorded Net Energy for Load (NEL) and Weather Normalized NEL

Net Energy for Load (NEL)



Ann Tot (TWh): 123.5 119.2 116.9 90.0

Weather Normalized NEL

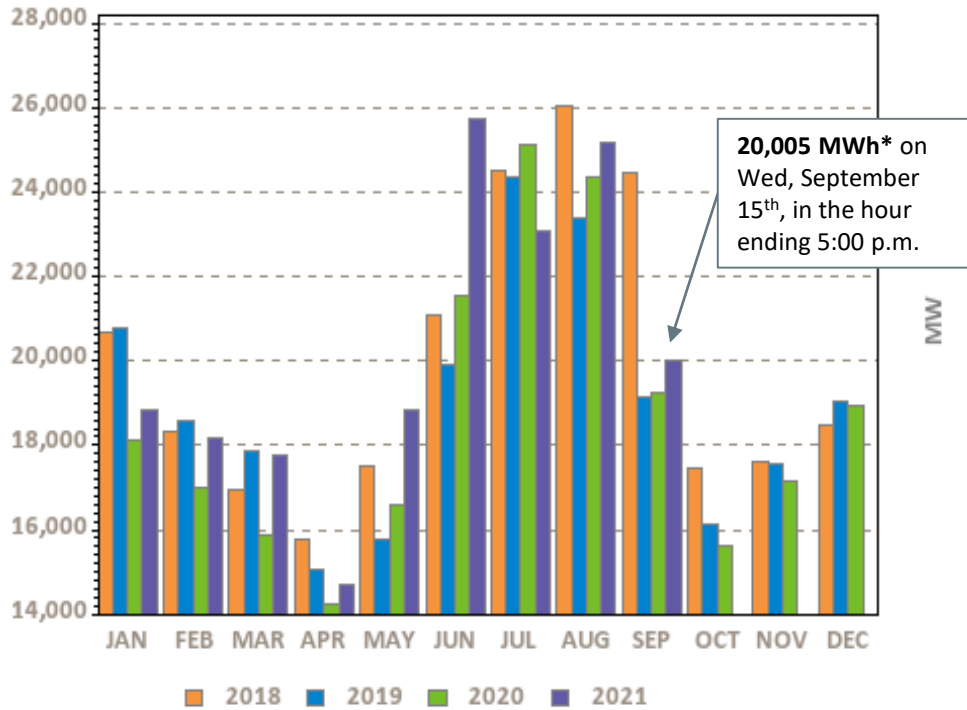


Ann Tot (TWh): 120.6 118.8 116.3 79.5

NEPOOL NEL is the total net revenue quality metered energy required to serve load and is analogous to 'RT system load.' NEL is calculated as: Generation – pumping load + net interchange where imports are positively signed. Current month's data may be preliminary. Weather normalized NEL is typically reported on a one-month lag.

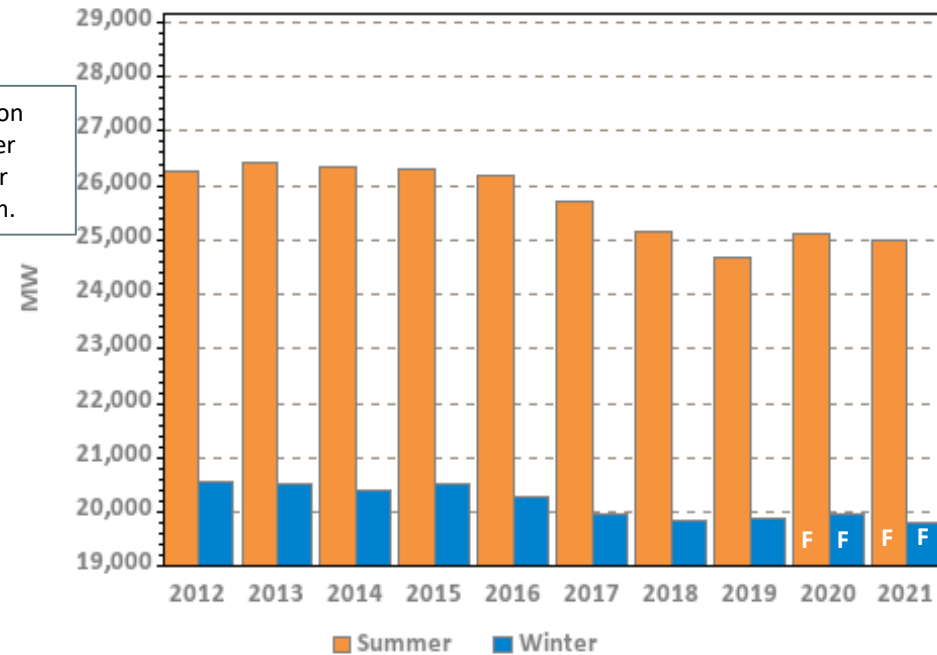
# Monthly Peak Loads and Weather Normalized Seasonal Peak History

System Peak Load



\*Revenue quality metered value

Weather Normalized Seasonal Peaks



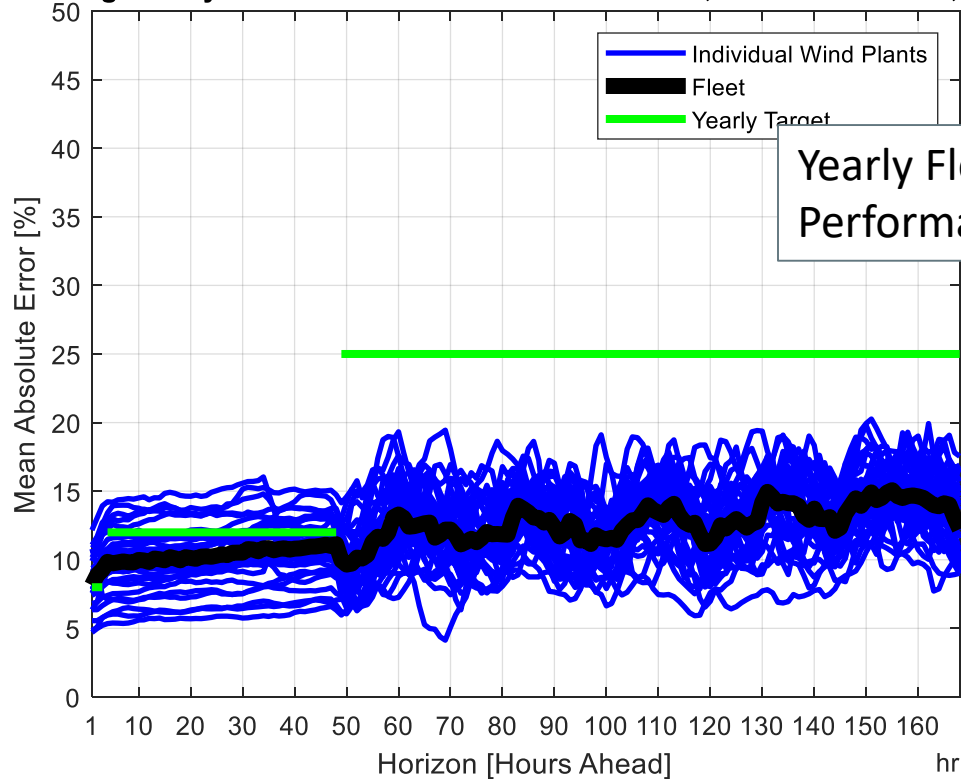
Winter beginning in year displayed

F – designates forecasted values, which are typically updated in April/May of the following year; represents “net forecast” (i.e., the gross forecast net of passive demand response and behind-the-meter solar demand)



# Wind Power Forecast Error Statistics: Medium and Long Term Forecasts MAE

Rolling 30-day MAE for ISO Wind Power Forecast, as of October 01, 2021

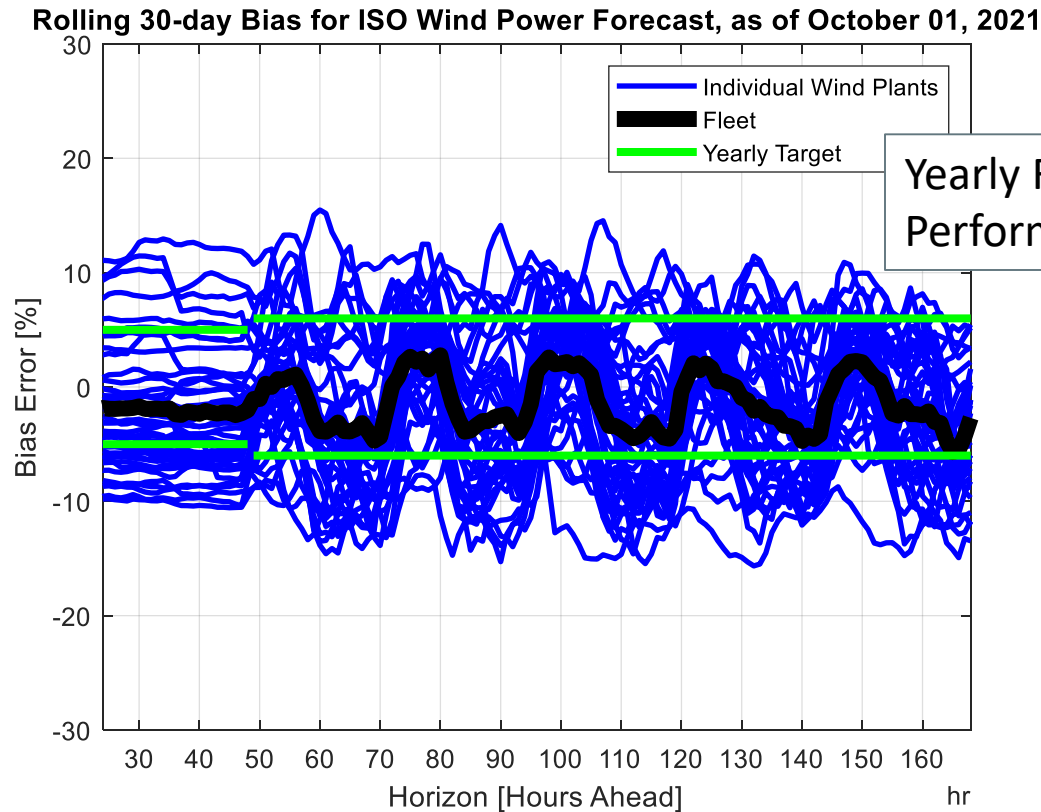


Dashboard Indicator ●

Yearly Fleet Performance targets —

Ideally, MAE and Bias would be both equal to zero. As is typical, MAE increases with the forecast horizon. MAE and Bias for the fleet of wind power resources are less due to offsetting errors. Across all time frames, the ISO-NE/DNV forecast is very good compared to industry standards, and monthly MAE is within the yearly performance targets.

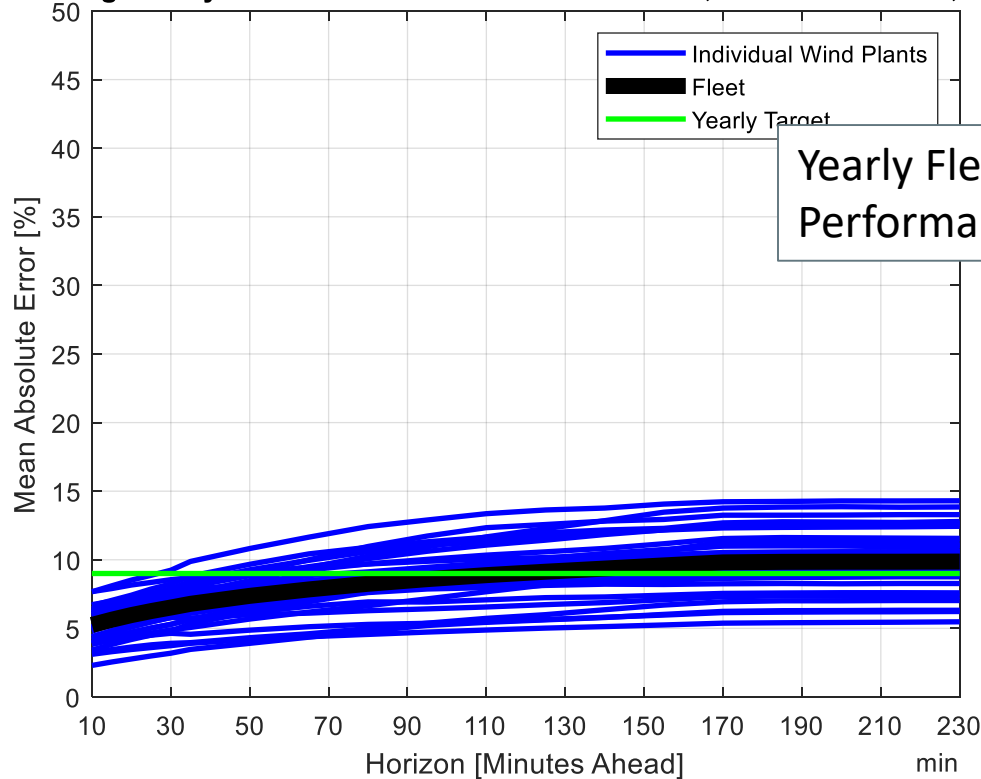
# Wind Power Forecast Error Statistics: Medium and Long Term Forecasts Bias




Ideally, MAE and Bias would be both equal to zero. Positive bias means less windpower was actually available compared to forecast. Negative bias means more windpower was actually available compared to forecast. Across all time frames, the ISO-NE/DNV forecast compares well with industry standards, and monthly Bias is within yearly performance targets.

# Wind Power Forecast Error Statistics: Short Term Forecast MAE

Rolling 30-day MAE for ISO Wind Power Forecast, as of October 01, 2021



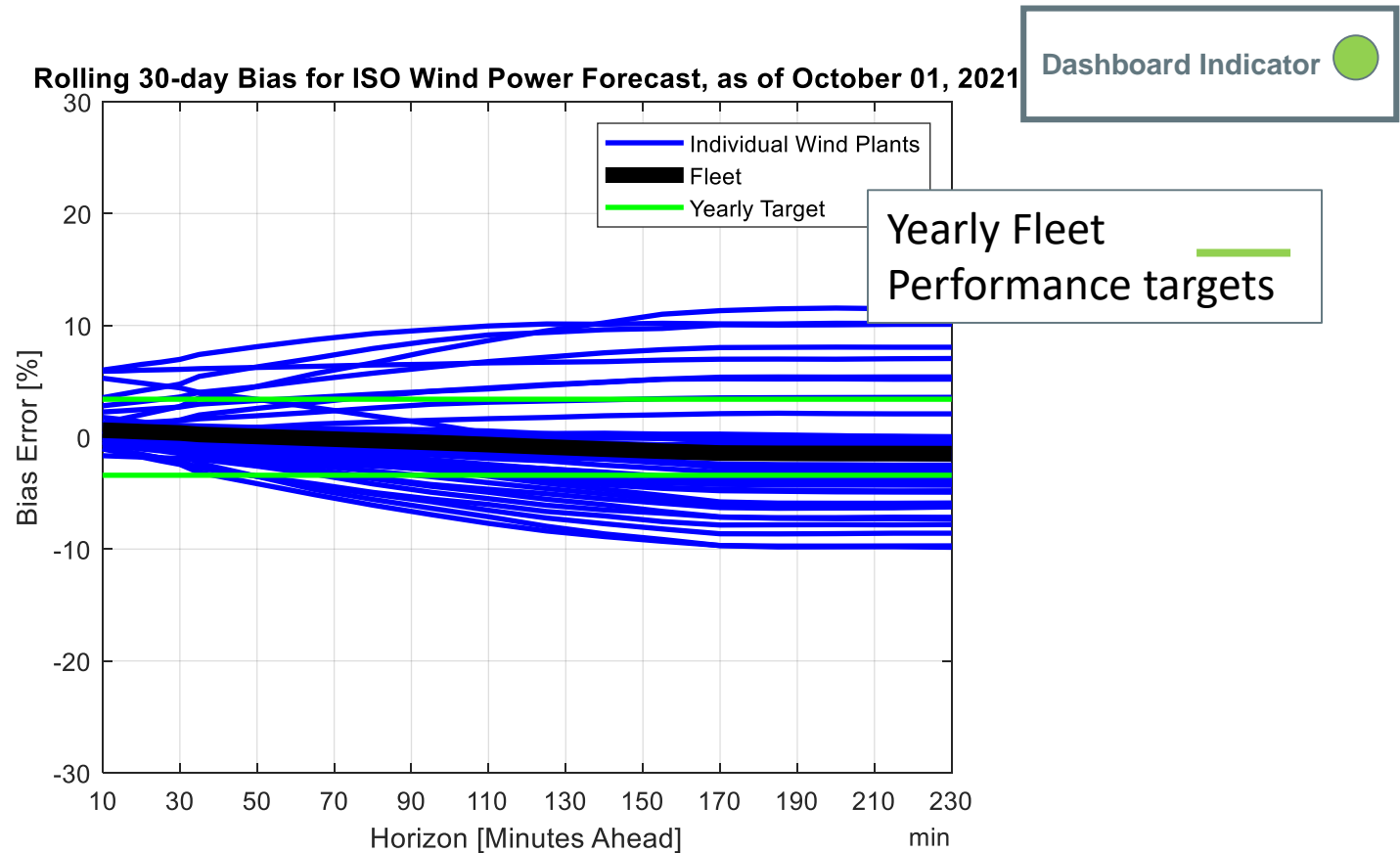
Dashboard Indicator 

Yearly Fleet Performance targets 

Ideally, MAE and Bias would be both equal to zero. As is typical, MAE increases with the forecast horizon. MAE and Bias for the fleet of wind power resources are less due to offsetting errors. Across all time frames, the ISO-NE/DNV forecast is very good compared to industry standards, and monthly MAE is within the yearly performance targets up to 130 minutes ahead.



# Wind Power Forecast Error Statistics: Short Term Forecast Bias

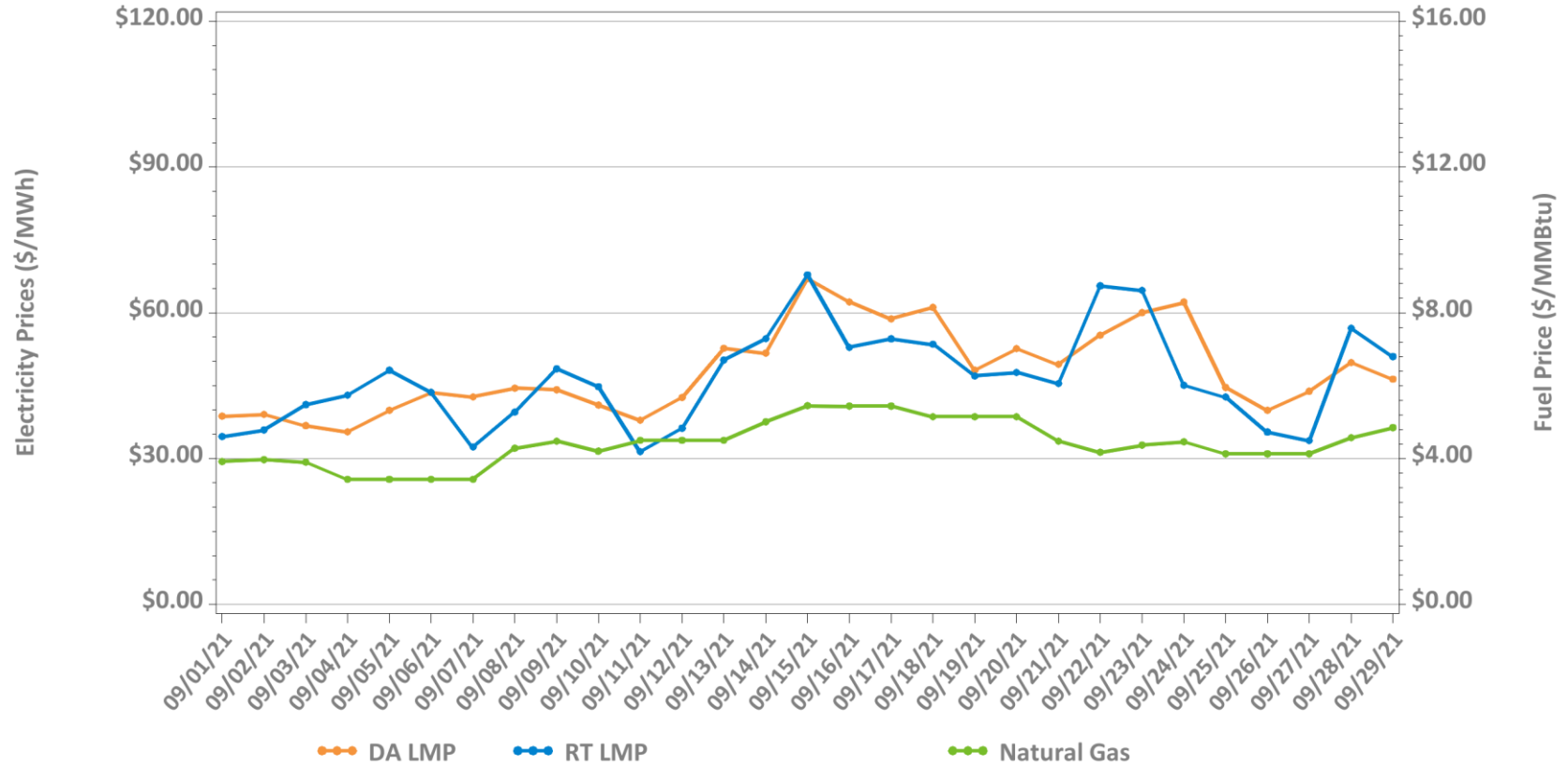


Ideally, MAE and Bias would be both equal to zero. Positive bias means less windpower was actually available compared to forecast. Negative bias means more windpower was actually available compared to forecast. Across all time frames, the ISO-NE/DNV forecast compares well with industry standards, and monthly Bias is within yearly performance.

# MARKET OPERATIONS



# Daily Average DA and RT ISO-NE Hub Prices and Input Fuel Prices: September 1-29, 2021

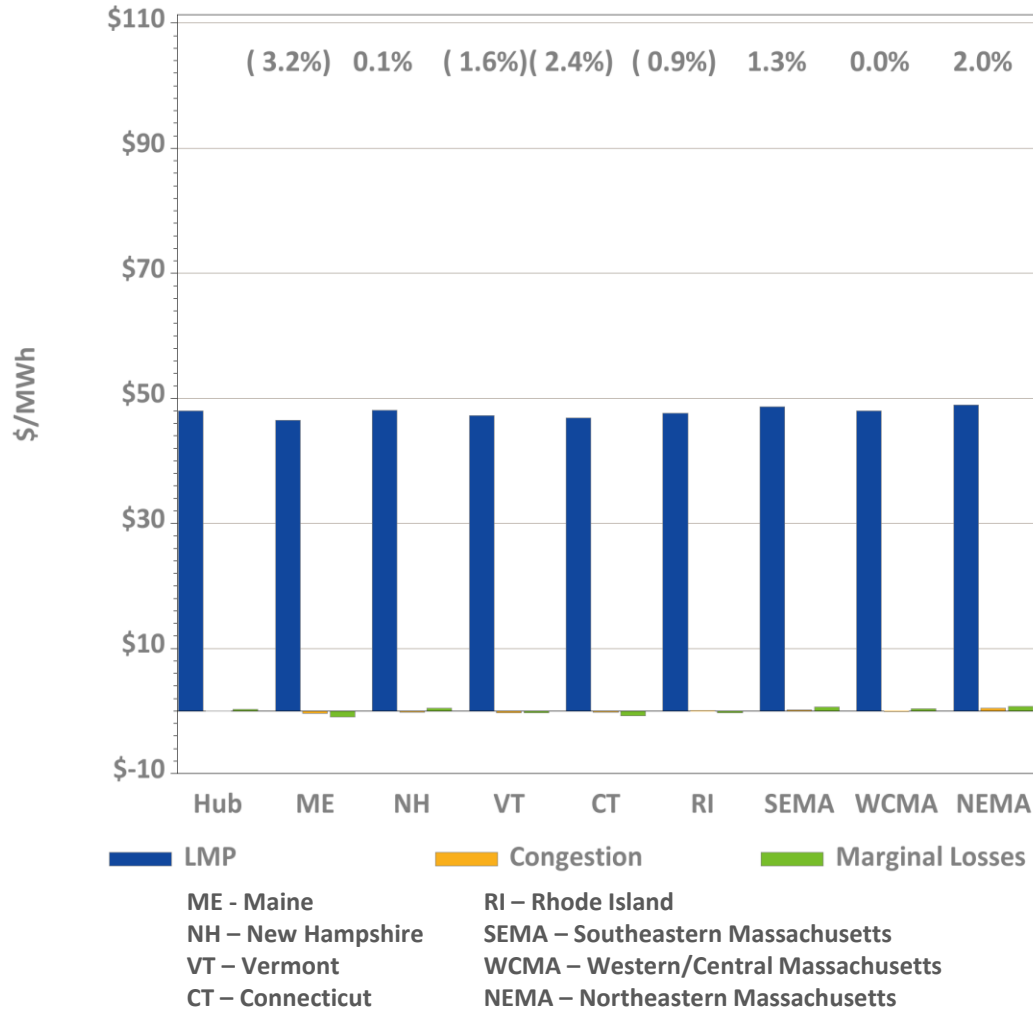


Underlying natural gas data furnished by:

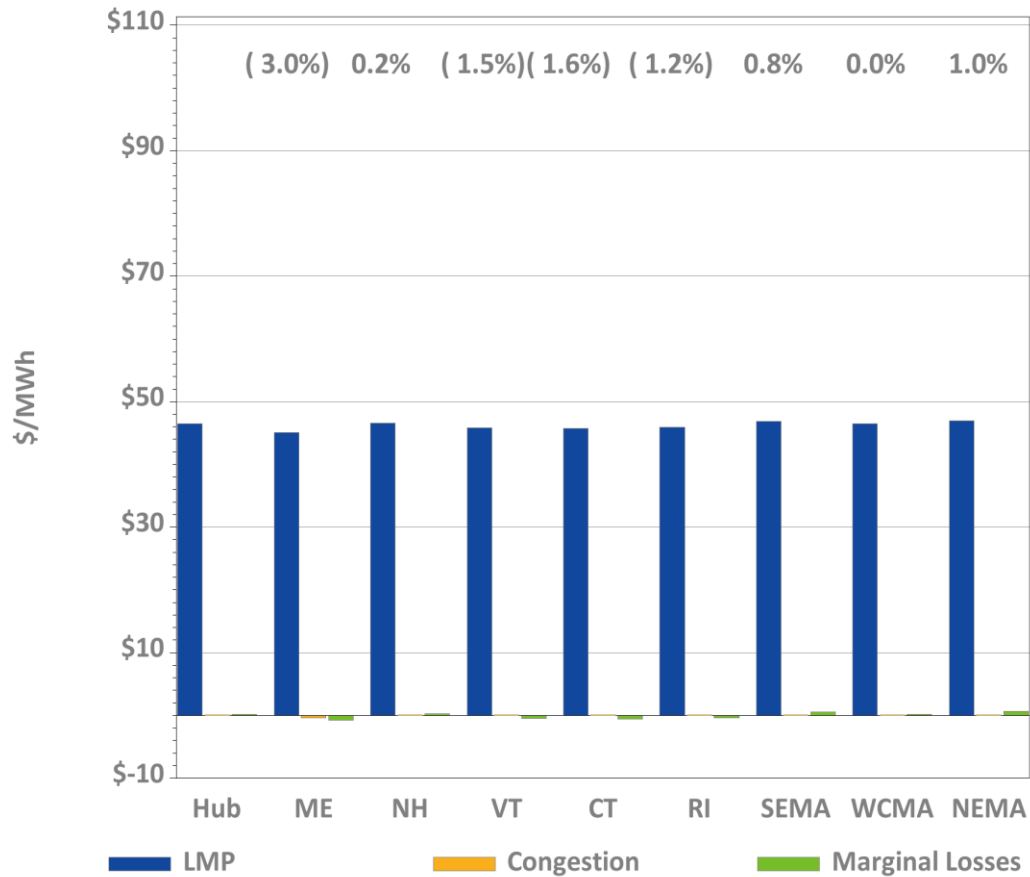


Average price difference over this period (DA-RT): \$1.53  
 Average price difference over this period ABS(DA-RT): \$5.55  
 Average percentage difference over this period ABS(DA-RT)/RT Average LMP: 12%  
 Gas price is average of Massachusetts delivery points

# DA LMPs Average by Zone & Hub, September 2021



# RT LMPs Average by Zone & Hub, September 2021



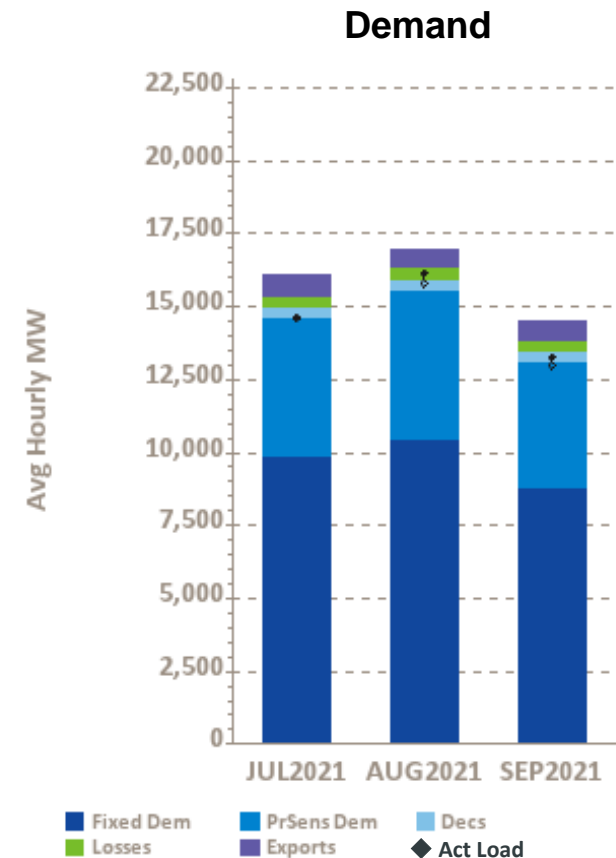
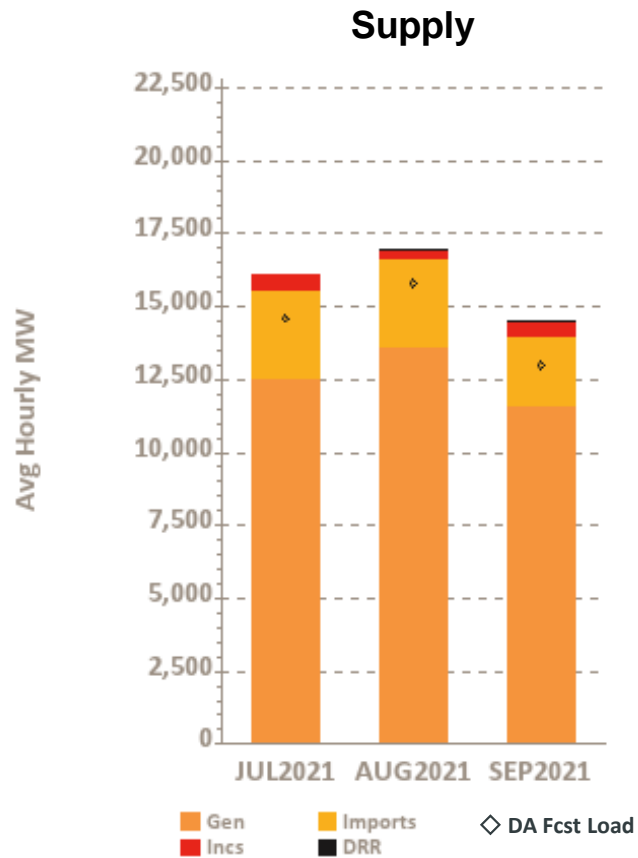
# Definitions

Day-Ahead Concept	Definition
Day-Ahead Load Obligation ( <b>DALO</b> )	The sum of day-ahead cleared load (including asset load, pump load, exports, and virtual purchases and excluding modeled transmission losses)
Day-Ahead Cleared Physical Energy	The sum of day-ahead cleared generation and cleared net imports



# Components of Cleared DA Supply and Demand

## – Last Three Months

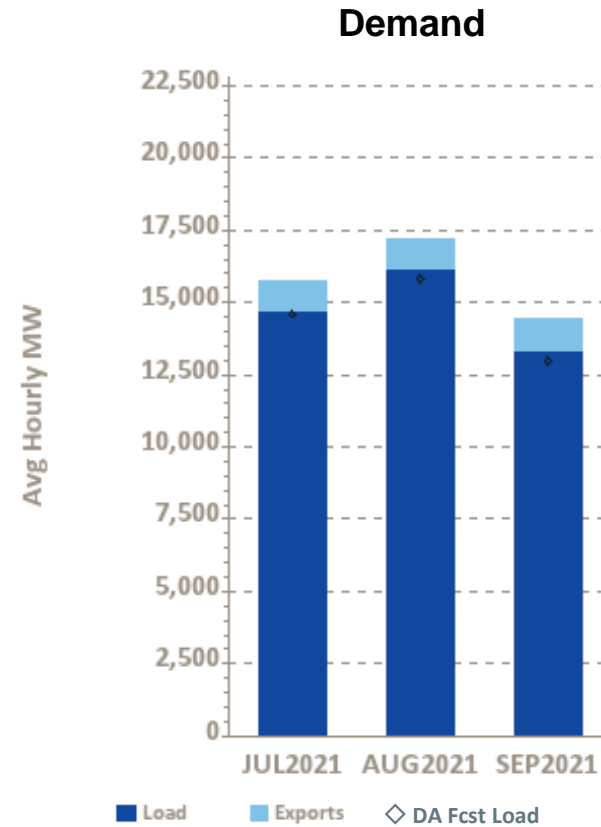
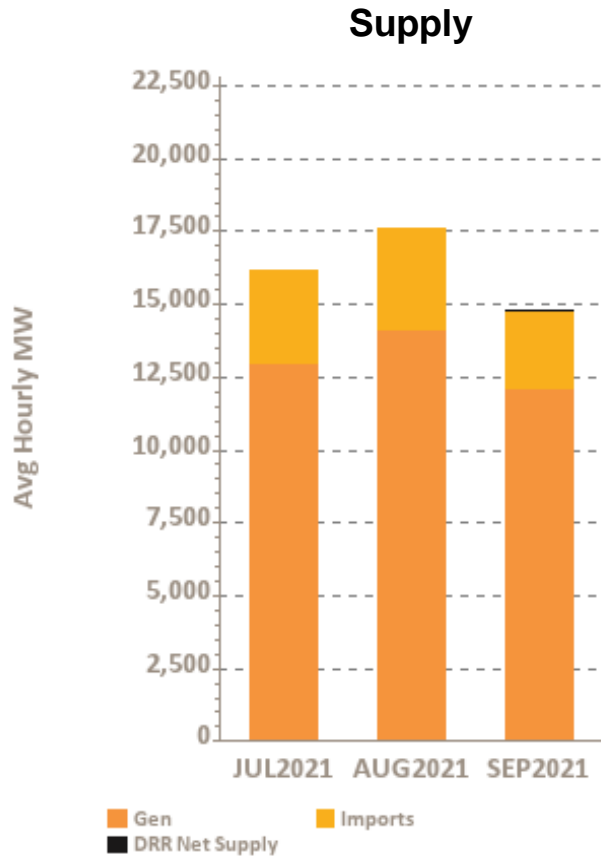


Gen – Generation  
 Incs – Increment Offers  
 DA Fcst Load – Day-Ahead Forecast Load  
 DRR – Demand Response Resource

Fixed Dem – Fixed Demand  
 PrSens Dem – Price Sensitive Demand  
 Decs – Decrement Bids  
 Act Load – Actual Load

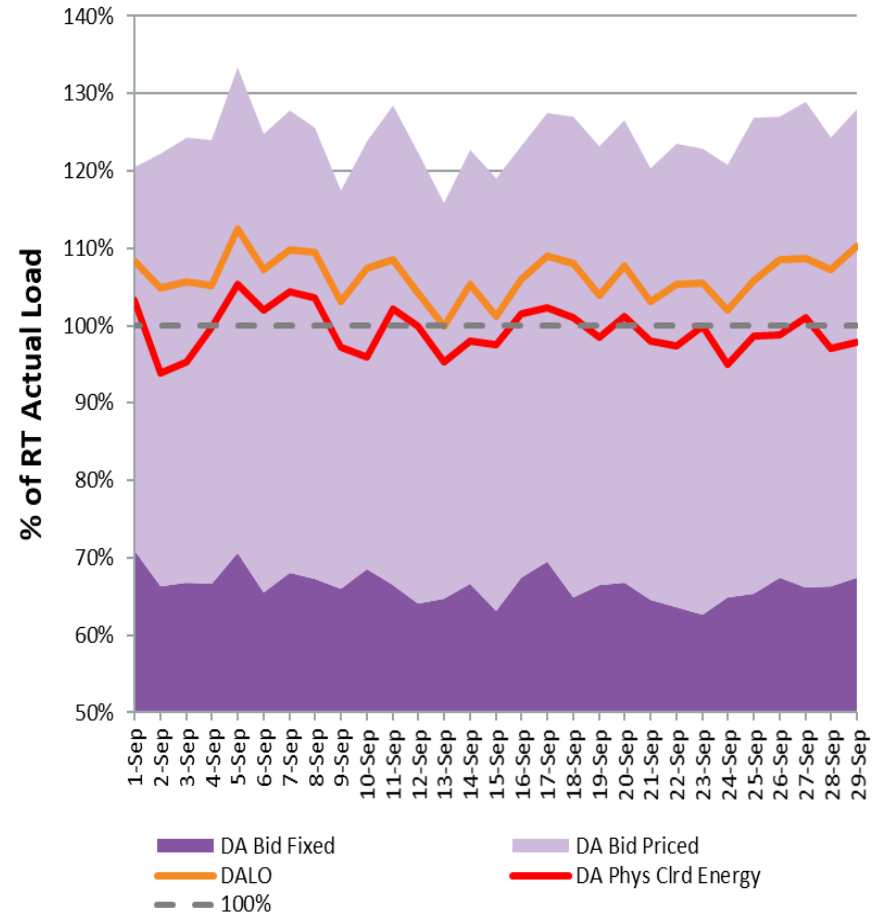
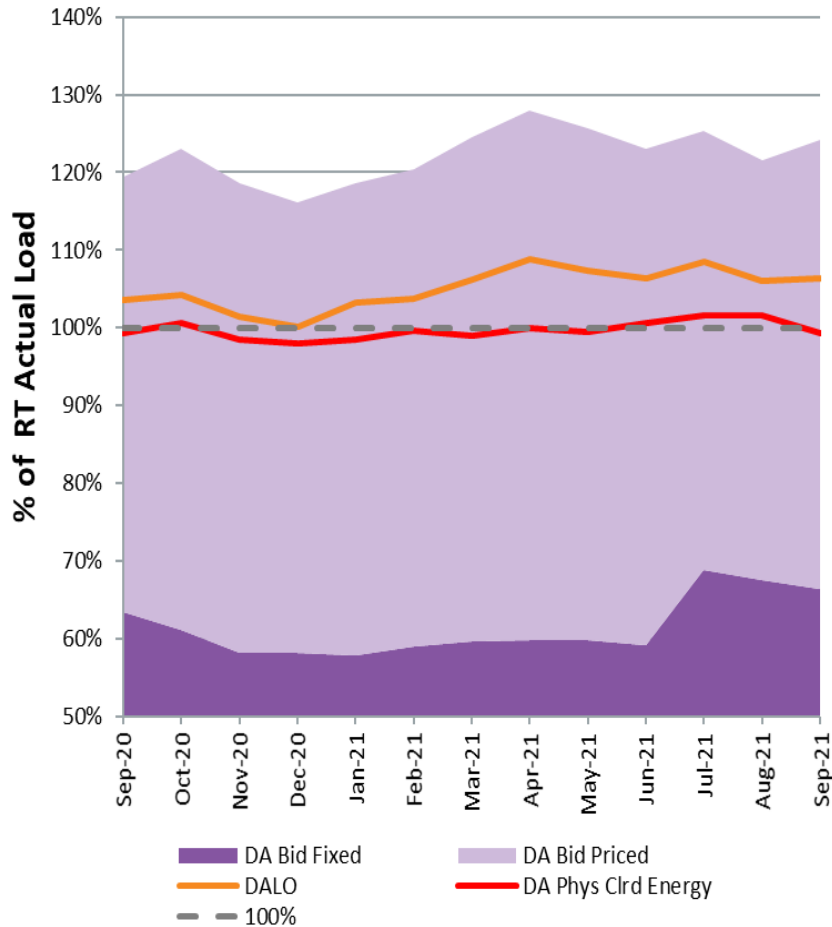


# Components of RT Supply and Demand – Last Three Months





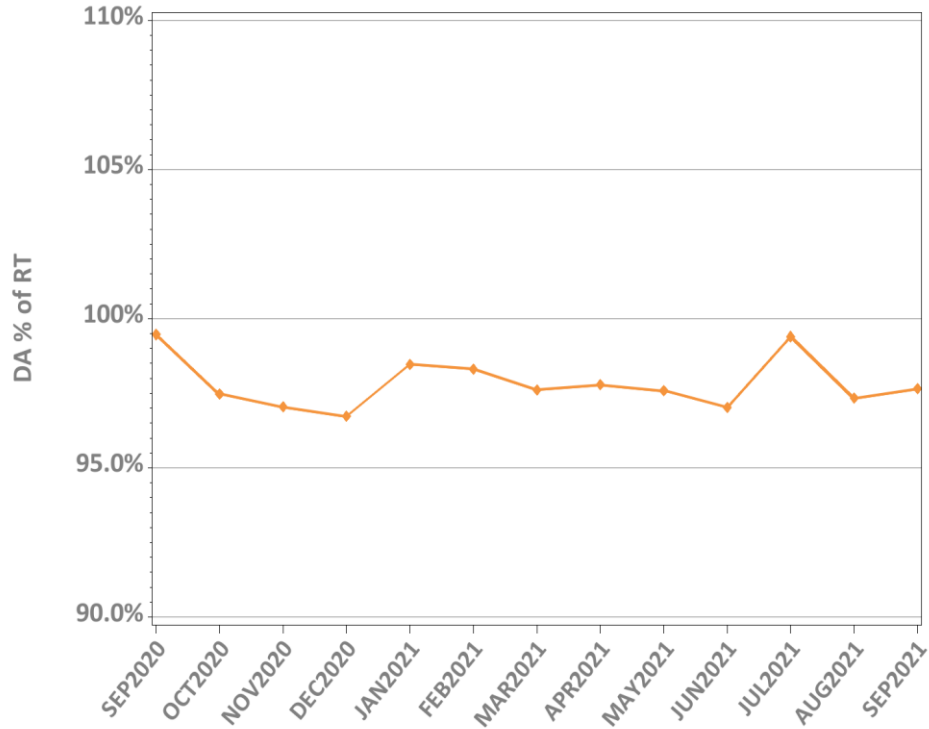
# DAM Volumes as % of RT Actual Load (Forecasted Peak Hour)



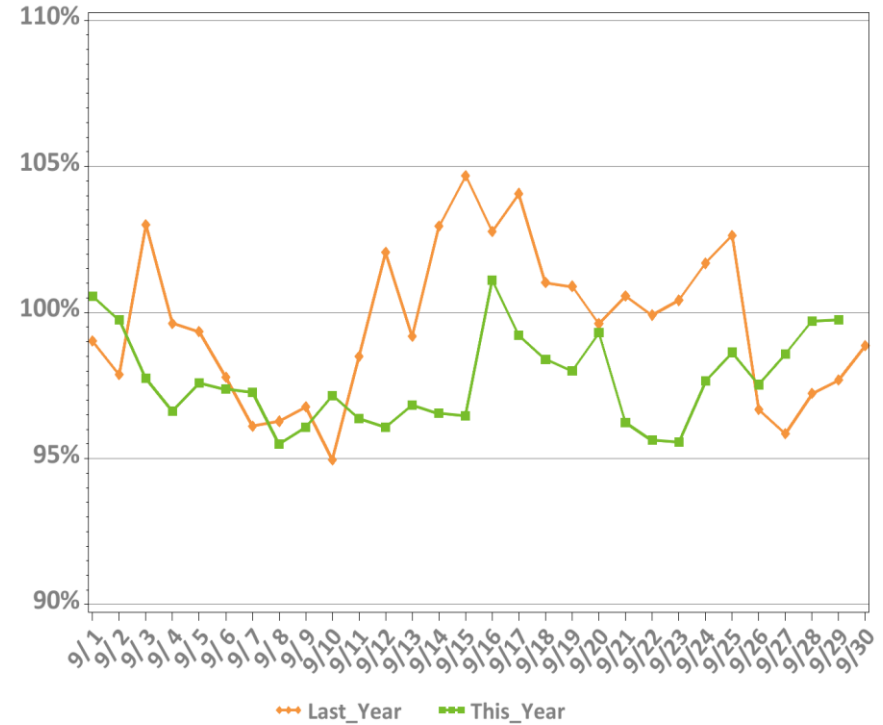
Note: Forecasted peak hour for each day is reflected in the above values. Shown for each day (chart on right) and then averaged for each month (chart on left). 'DA Bid' categories reflect load assets only (Virtual and export bids not reflected.)

# DA vs. RT Load Obligation: September, This Year vs. Last Year

Monthly, Last 13 Months



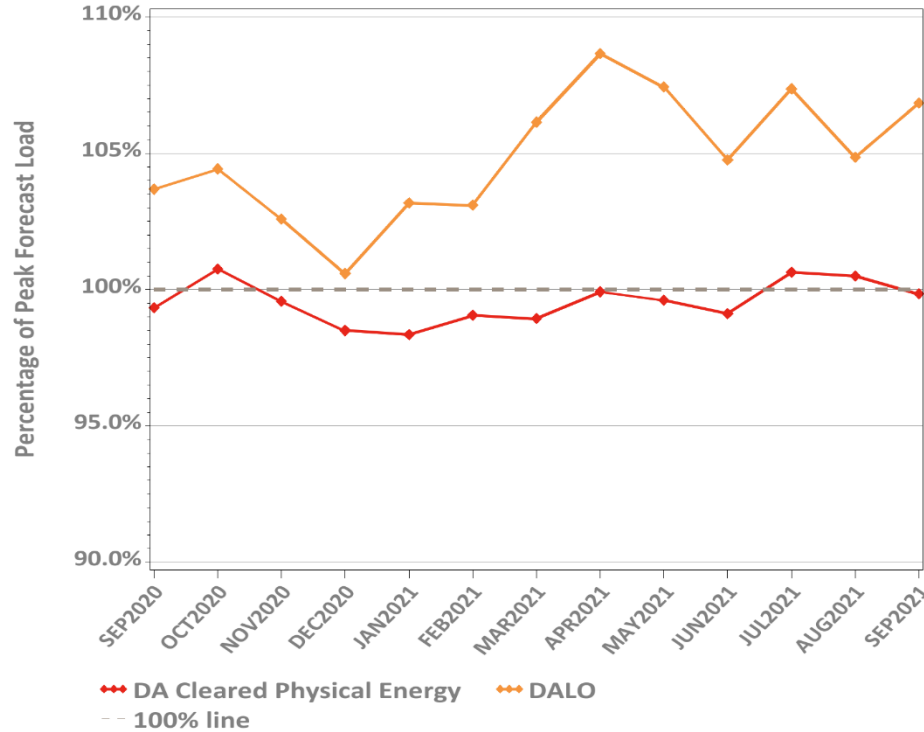
Daily, This Year vs. Last Year



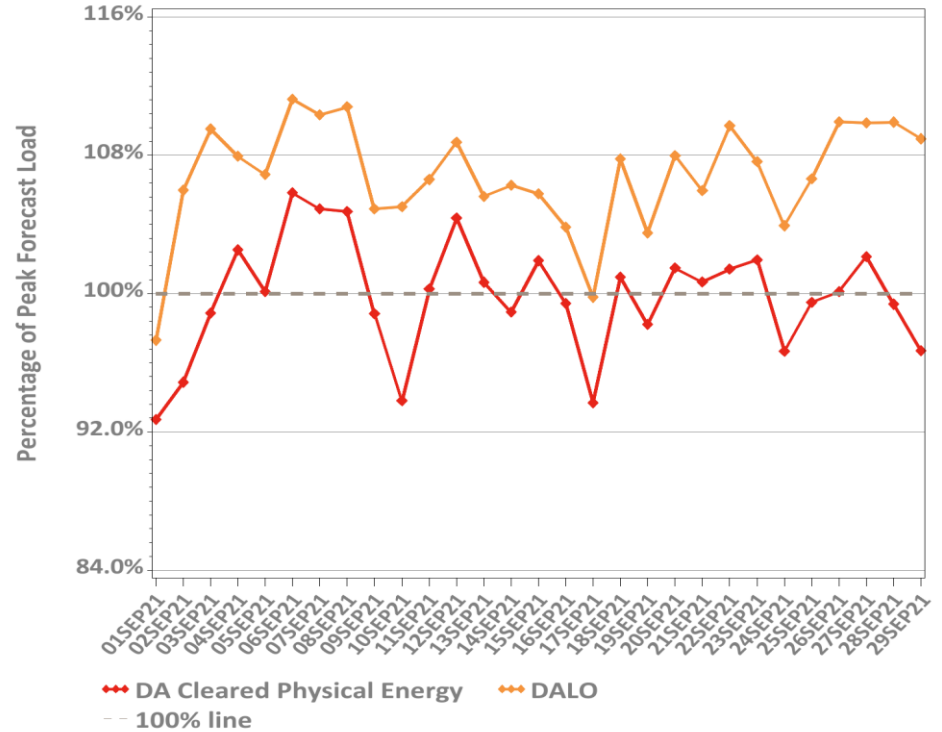
\*Hourly average values

# DA Volumes as % of Forecast in Peak Hour

Monthly, Last 13 Months

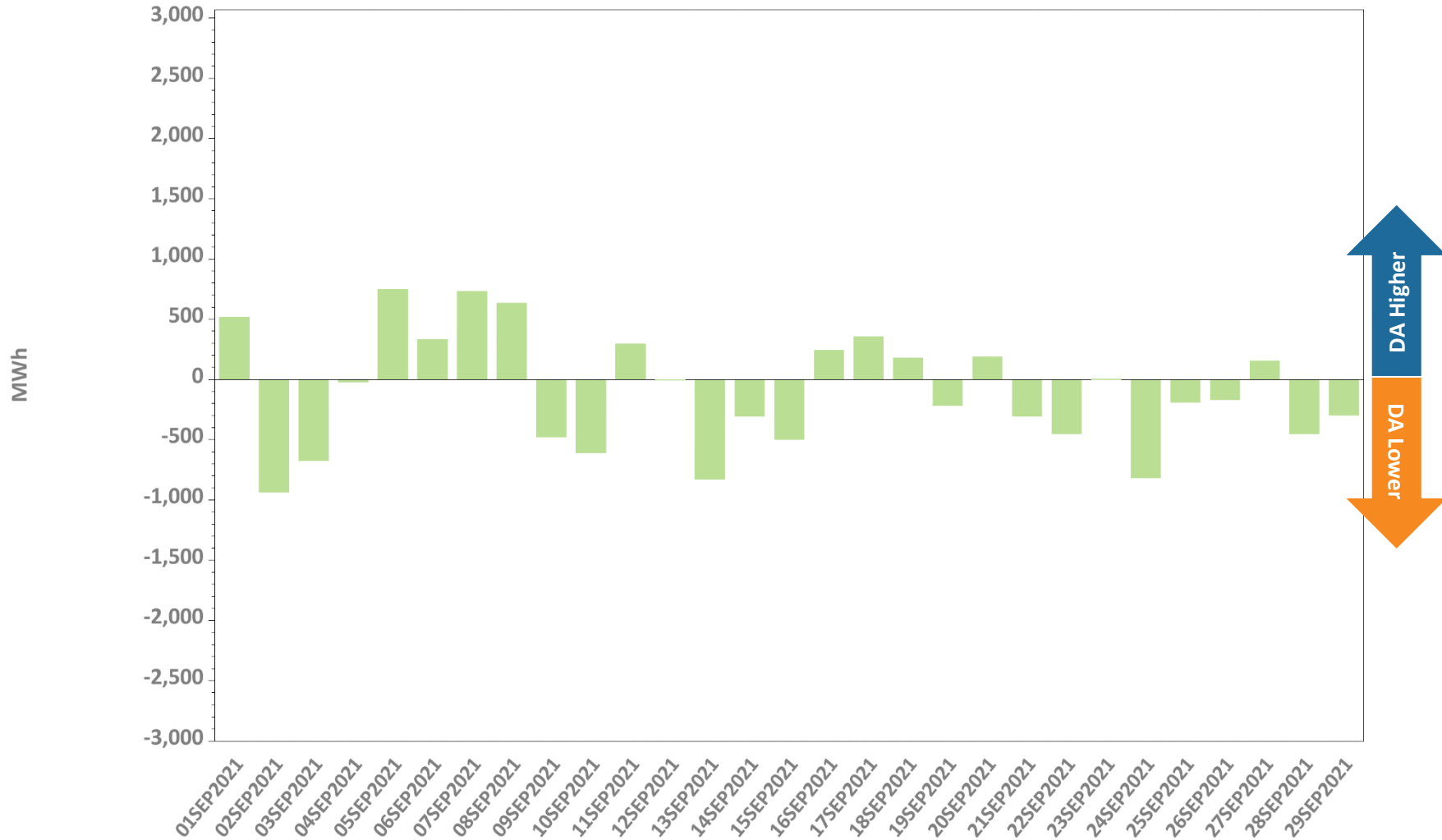


Daily: This Month



Note: There were **no** instances of system-level manual supplemental commitments for capacity required during the Reserve Adequacy Assessment (RAA) during the month.

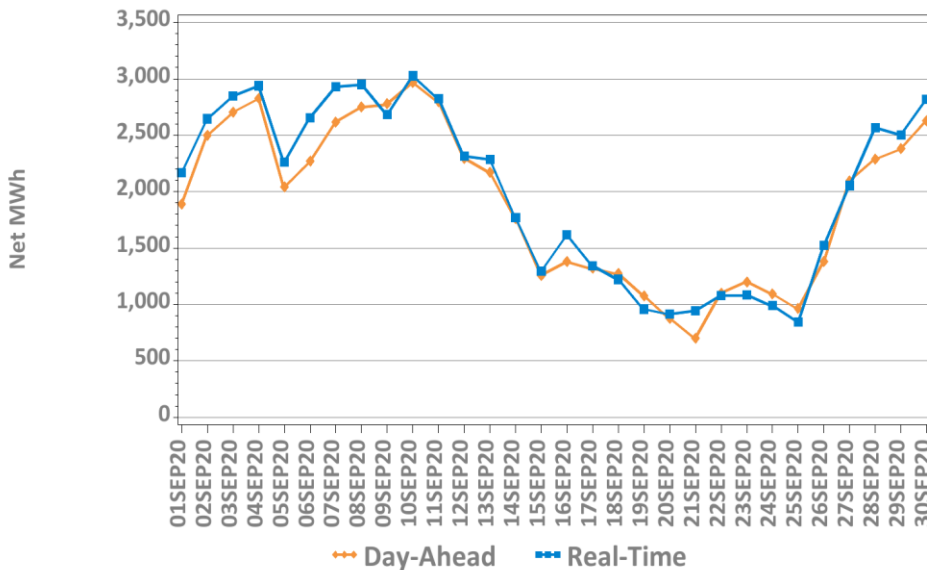
# DA Cleared Physical Energy Difference from RT System Load at Forecasted Peak Hour\*



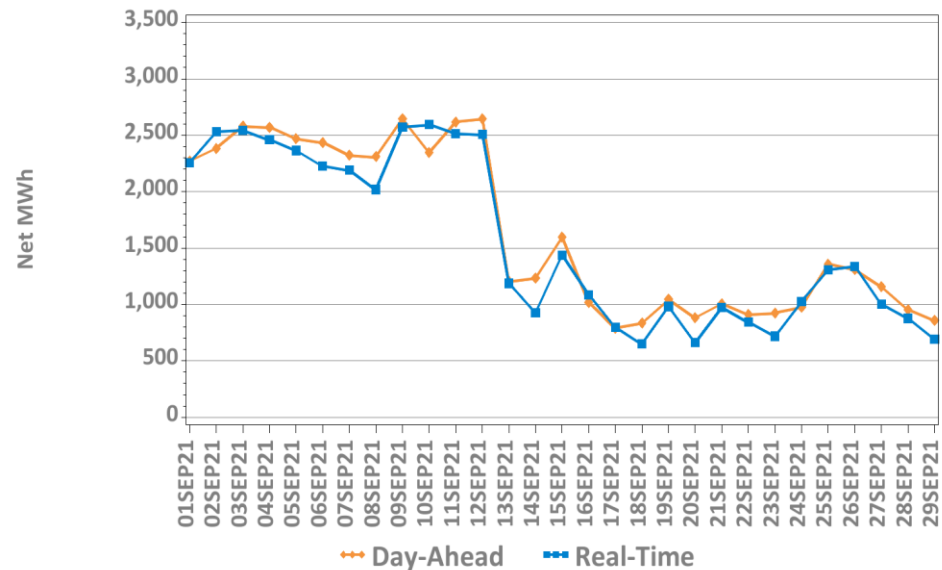
\*Negative values indicate DA Cleared Physical Energy value below its RT counterpart. Forecast peak hour reflected.

# DA vs. RT Net Interchange September 2020 vs. September 2021

Hourly Average by Day, Last Year



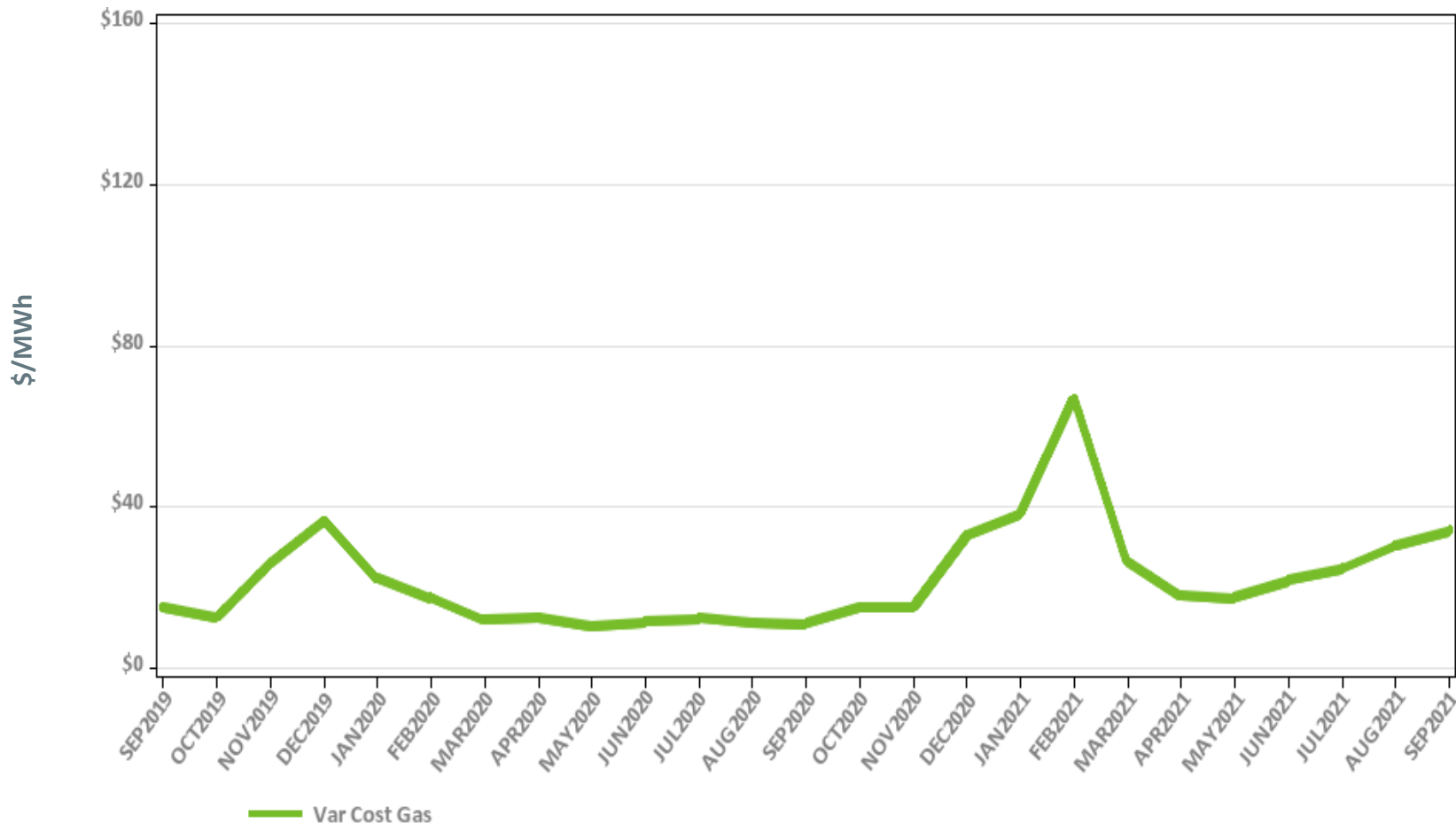
Hourly Average by Day, This Year



Net Interchange is the sum of daily imports minus the sum of daily exports  
 Positive values are net imports



# Variable Production Cost of Natural Gas: Monthly

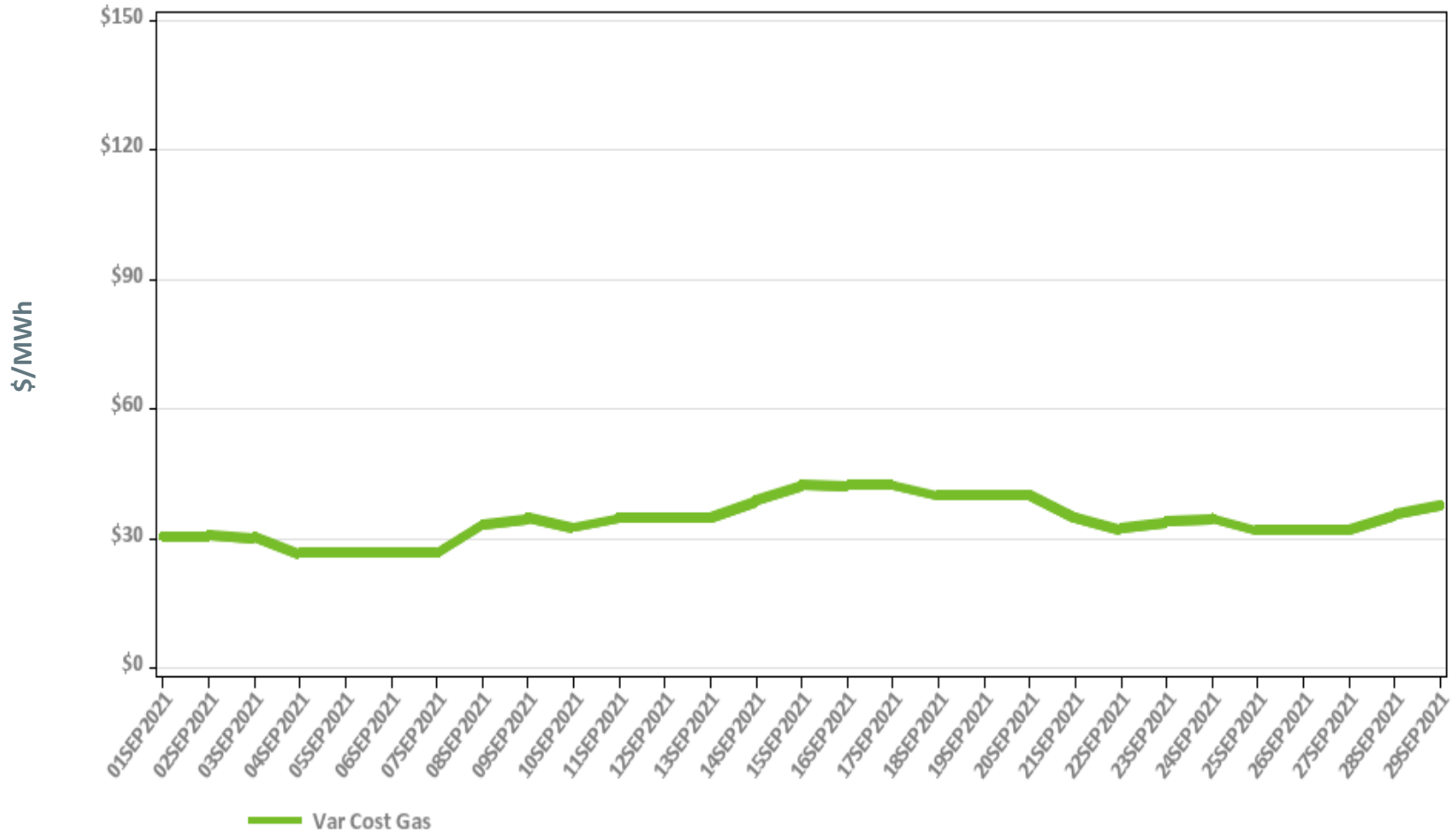


Note: Assumes proxy heat rate of 7,800,000 Btu/MWh for natural gas units.

Underlying natural gas data furnished by:



# Variable Production Cost of Natural Gas: Daily



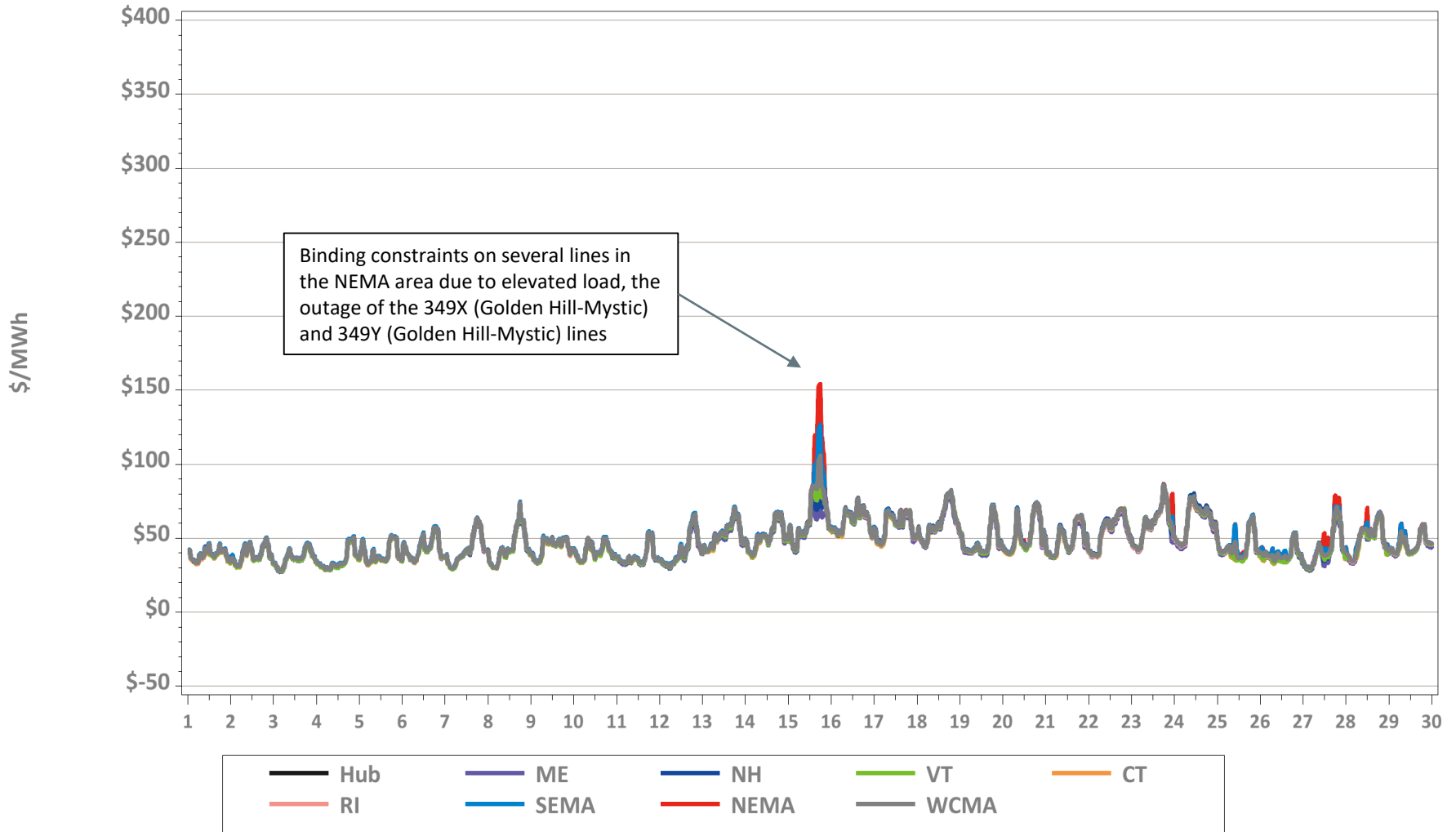
Note: Assumes proxy heat rate of 7,800,000 Btu/MWh for natural gas units.

Underlying natural gas data furnished by:



# Hourly DA LMPs, September 1-29, 2021

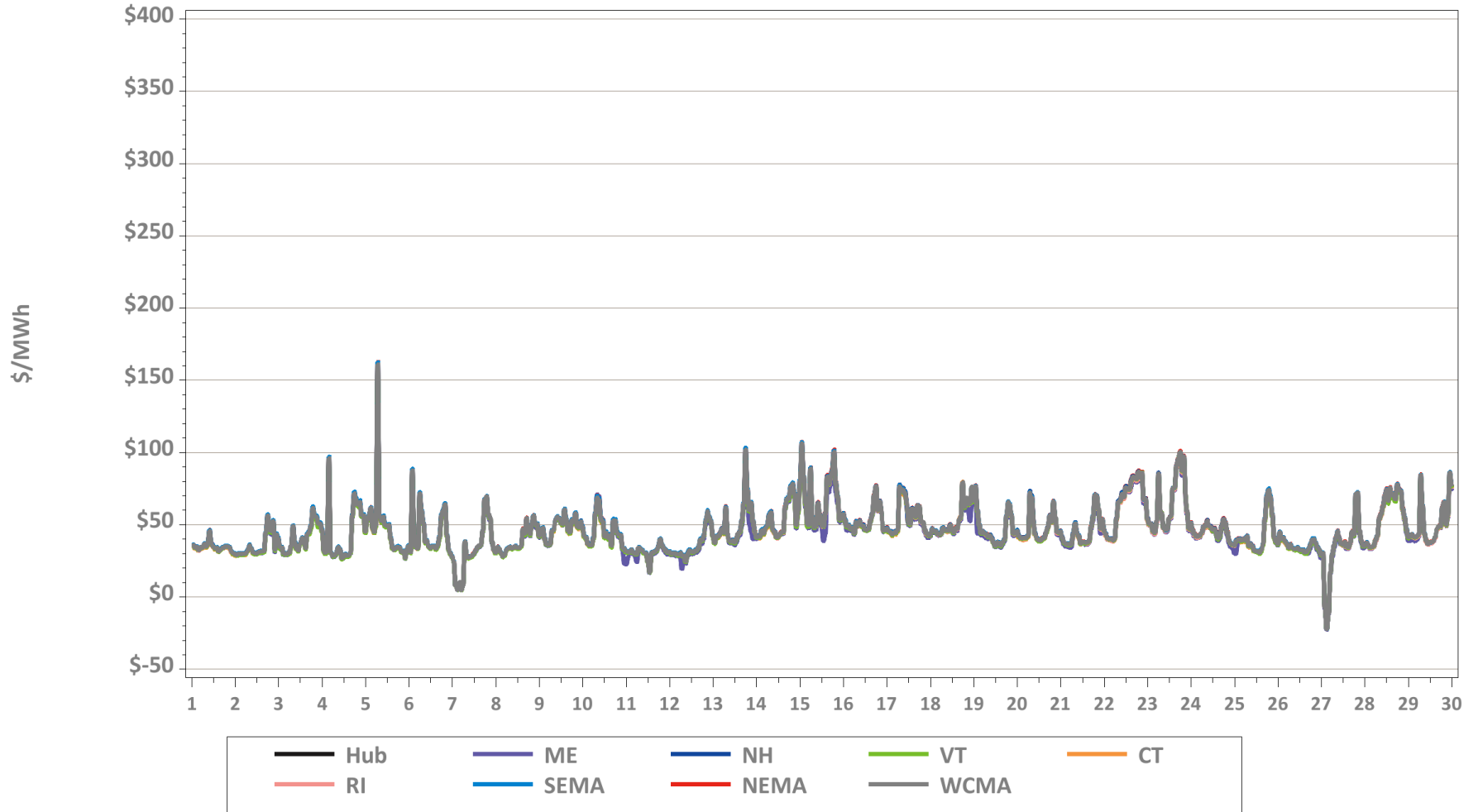
## Hourly Day-Ahead LMPs



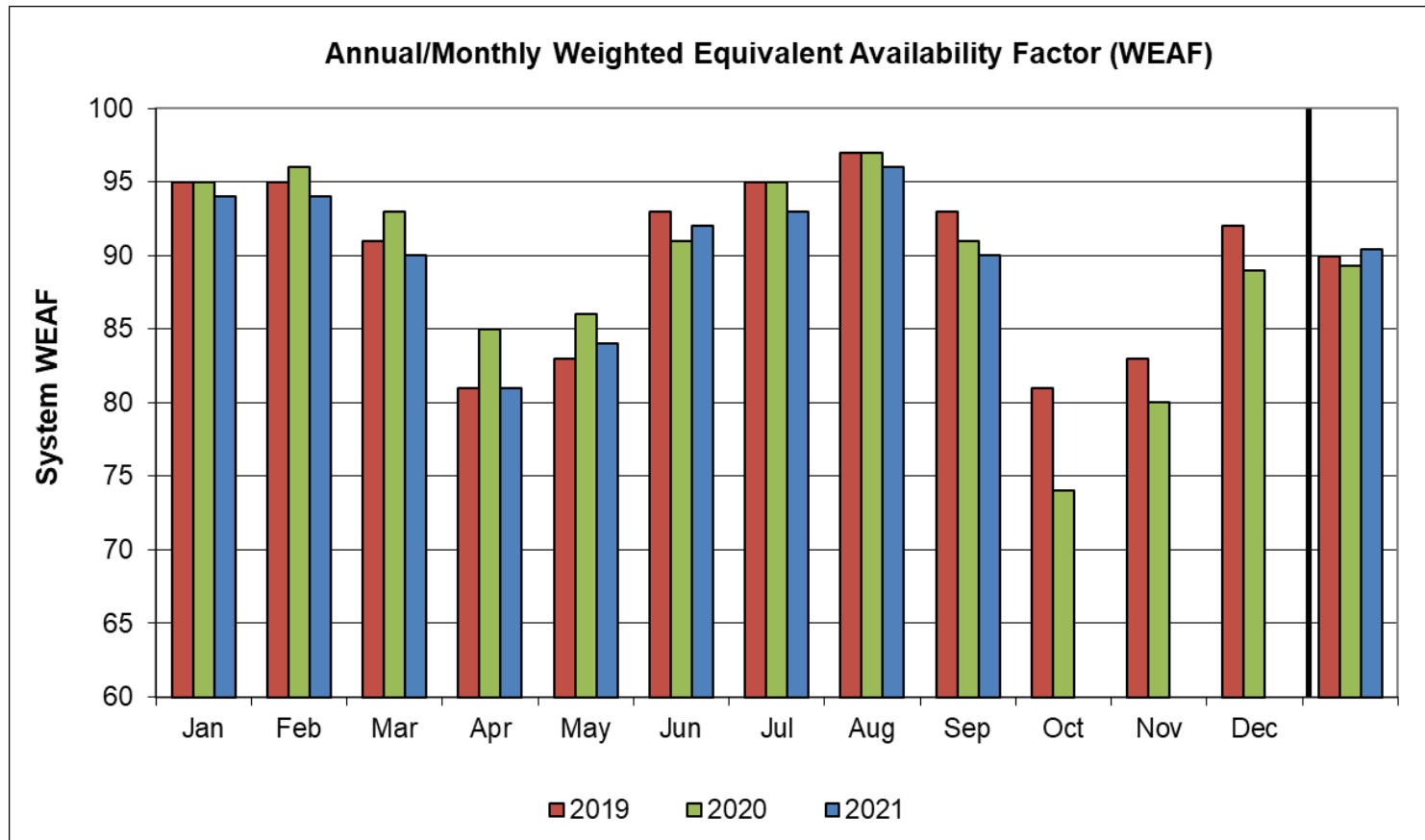


# Hourly RT LMPs, September 1-29, 2021

Hourly Real-Time LMPs



# System Unit Availability



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	YTD
<b>2021</b>	94	94	90	81	84	92	93	96	90				90
<b>2020</b>	95	96	93	85	86	91	95	97	91	74	80	89	89
<b>2019</b>	95	95	91	81	83	93	95	97	93	81	83	92	90

Data as of 9/28/2021

# Operational Impact of Extreme Weather Events

---



Vamsi Chadalavada

EXECUTIVE VICE PRESIDENT AND CHIEF OPERATING OFFICER



# Operational Impact of Extreme Weather Events

## – Introduction

- Recent experiences in Texas and California with extreme weather events have emphasized the importance of a comprehensive energy/resource adequacy assessment that covers a wide range of operating conditions
- The objective of this project is to conduct a probabilistic energy security study for the New England region in the operational time frame under extreme weather events



# Operational Impact of Extreme Weather Events

## – Introduction

- The ISO will work with EPRI on this project
- The ISO effort will leverage the ongoing “Resource Adequacy for a Decarbonized Future” project by EPRI
- There are three major steps to this effort
  - Step 1: Extreme Weather Modeling (performed by EPRI)
  - Step 2: Risk Model Development and Scenario Generation (performed by EPRI)
  - Step 3: Energy security/adequacy assessments (performed by the ISO)
- Each of these major steps will be discussed with stakeholders
- This project is expected to take 15-18 months and will continue through the end of 2022/early 2023



# Scope of Work – Step 1: Extreme Weather Modeling

- The objective of this step is to identify extreme weather events of interest, summer and winter, using probabilistic modeling
- This analysis begins with the acquisition and interpretation of locationally-specific climate data, both historical and projections
  - EPRI has developed and is expanding a repository of historical and projection climate data that includes multiple models and sources
  - This data repository will be used to characterize and visualize trends, including uncertainty, in the mean and extremes for different climate variables of interest

# Scope of Work – Step 1: Extreme Weather Modeling, continued

- EPRI will incorporate future changes in weather variables
  - Future changes will be based on calculated trends for the near-term (next 20 years) and integrated with localized CMIP6 climate change projections (~2050 timeframe) to provide an appropriate margin or range of outcomes for the next 4 decades
- As part of this analysis, EPRI will summarize a number of possible extreme weather events in the New England region
  - For example, this could be for single day, 3-day or 5-day events by mean temperature, at an aggregate or city level
- Final deliverable for this task will include extreme weather events to model, and associated probabilistic distributions



# Scope of Work – Step 2: Scenario Generation

- The objective of this step is to identify power system scenarios of interest using probabilistic techniques
- Key inputs for this phase include the following:
  - Agreement on macro assumptions about future energy mix, demand composition and other high-level factors
  - Identification of risk factors associated with each resource type (e.g., wind speed, temperature and age for wind power, streamflow for hydro, outages for synchronous machines, availability of natural gas etc.)
- For each of these risk factors, a model will be developed that suitably characterizes the risk associated with that risk factor (e.g., wind power conversion curve, forced outage failure rates)





# Scope of Work – Step 2: Scenario Generation, continued

- Data from weather modeling, together with additional power system data, will be translated to various power system variables – wind/solar output, load, generator availability
  - This will include impact of extreme weather on output of resources
- The various power system variables, along with the risk models will be used to develop scenarios of interest, using Monte Carlo simulation
- These scenarios will be developed via a ‘scenario engine’ tool that will be built by EPRI



# Scope of Work – Step 3: Assessing Energy Security/Adequacy

- Initially as part of this project, the ISO will use its 21 day Energy Security Analysis tool to assess operational impacts
- By limiting the analysis to 21 days, and furthermore, applying the probabilistic scenarios developed in the prior step, the ISO expects to quantify the operational impact of extreme weather events using probabilistic risk metrics, reducing the use of engineering judgement
- As a longer term effort (beyond 18 months), to provide a comprehensive assessment of energy adequacy for different time frames and weather conditions, new adequacy study methodologies are required
- These changes are a key focus of EPRI’s “Resource Adequacy for a Decarbonized Future” supplemental project, which plans to develop methods to better account for tail risk in adequacy studies
  - For example, this may include methods to run Monte Carlo simulations and make appropriate draws to ensure such events are included in chronological adequacy studies using production cost modeling approaches



# Draft Timeline

- This is a draft timeline, and subject to other priorities over the course of the next year
  - Feedback may add to the scope of work, which will likely extend the timeline into early 2023
- Q4 2021 – Initiate project
- Q1 2022 – Initiate stakeholder process on Extreme Weather Modeling
- Q2 2022 – Finalize Weather Modeling scenarios
- Q2 2022 – Initiate stakeholder process on Study Scenarios
- Q4 2022 – Finalize Scenarios for operational assessment
- Q4 2022 – Preliminary results of operational assessment