Demand Response Implementation in New England and the Growing Need for Demand Flexibility

Consumer Liaison Group

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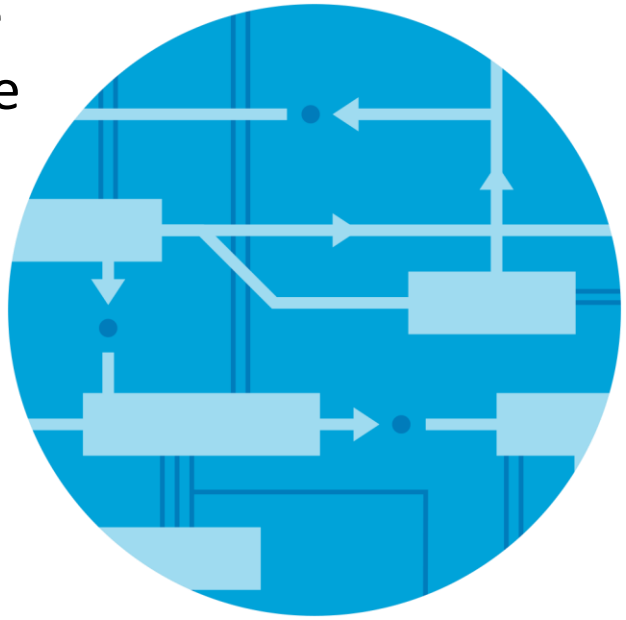
What Do We Mean by Demand Resources?

- Demand resources can be **passive** (e.g., energy efficiency) or **active** (e.g., demand response)
  - Passive resources, such as energy efficient light bulbs, **reduce electricity demand permanently** after they are installed (they do not need to be dispatched), whereas demand response requires **dispatch by a grid operator and a response by a customer or aggregator** to reduce demand
  - Both types participate in New England's wholesale electricity markets
    - Many state-sponsored EE programs participate in New England's capacity market and take on capacity supply obligations (treated as "supply" and paid for reducing demand)
    - State-regulated utilities may also administer demand response programs to reduce their peak demand, but these programs are not necessarily controlled by the ISO and we cannot count on these reductions in daily operations

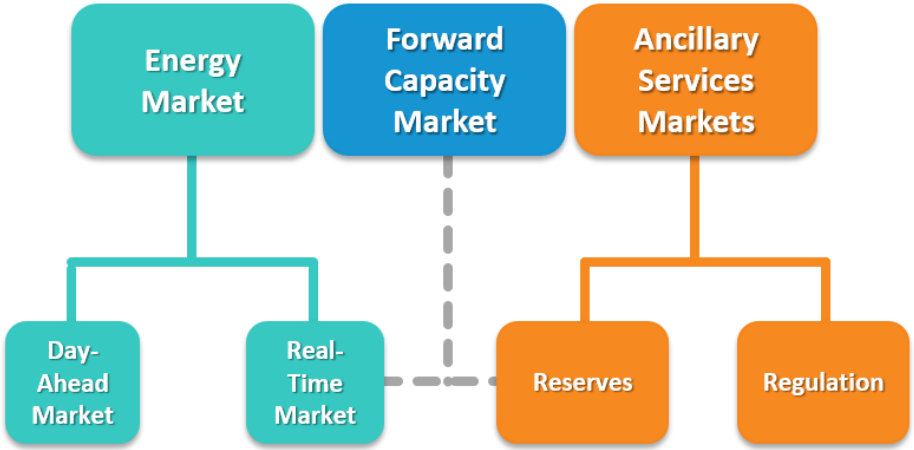
What Do We Mean by Demand Resources?

- Demand Response ("DR") capability is provided by customers that can respond in real time to a signal to curtail their electricity demand
- As required by FERC, New England shifted from DR *programs* (activated during reliability events) to a *market*-based system where DR customers participate directly in the wholesale market and are dispatched based on their offer prices



Demand Response Resources (DRRs) Are Integrated Into All Wholesale Markets in New England

- **Can follow** ISO-NE dispatch instructions
- **Consist** mostly of:
  - Load control (utility or customer action to control electricity demand)
  - Distributed generation (behind-the-meter)
  - Increasing interest in energy storage
- **Are dispatched to reduce** energy demand when their price offers are economic
- **Individual** customer facilities or homes can be aggregated into a single resource
  - Most DRRs are aggregations of customer facilities

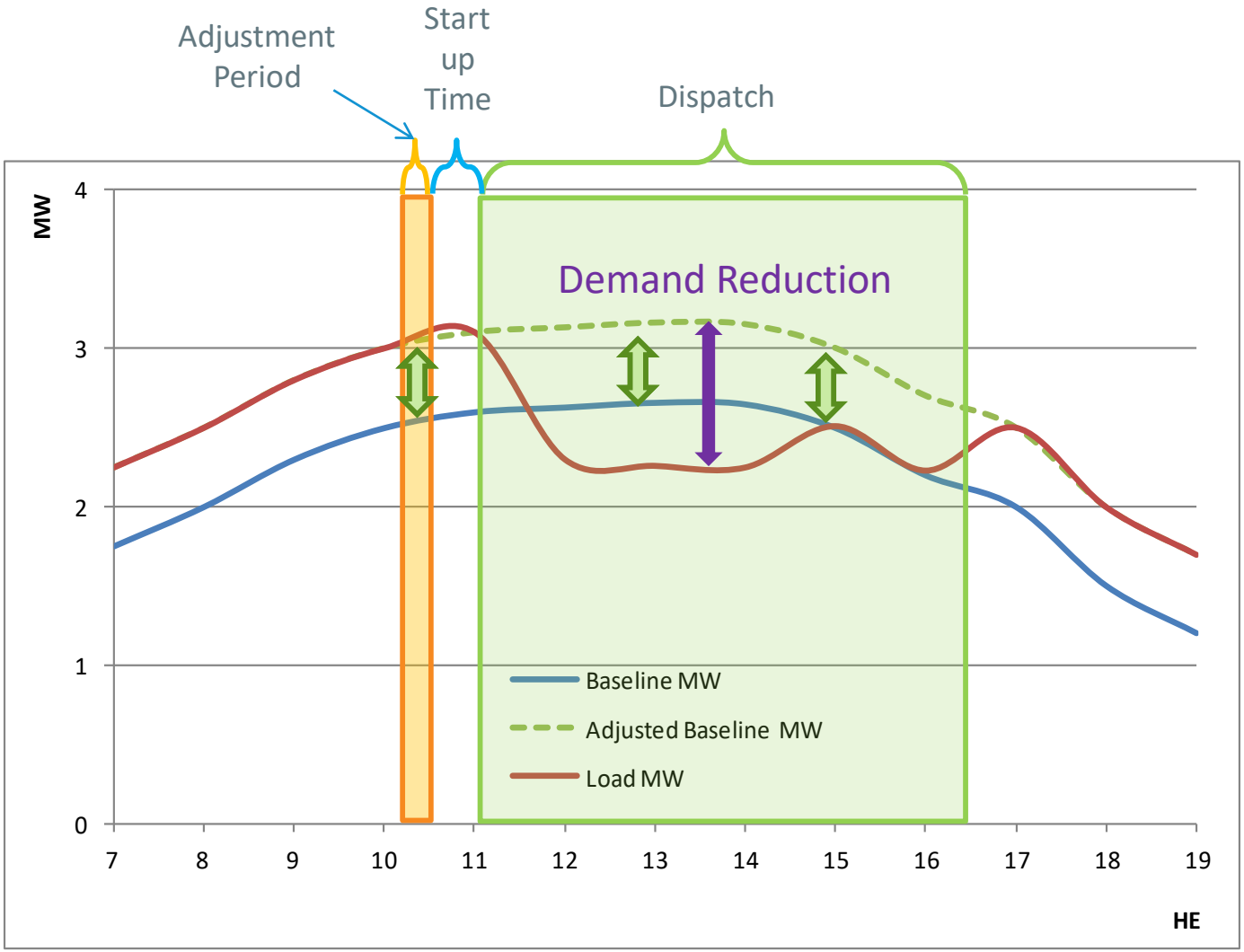


Demand Response Resources participate in energy, capacity, reserves, and regulation markets

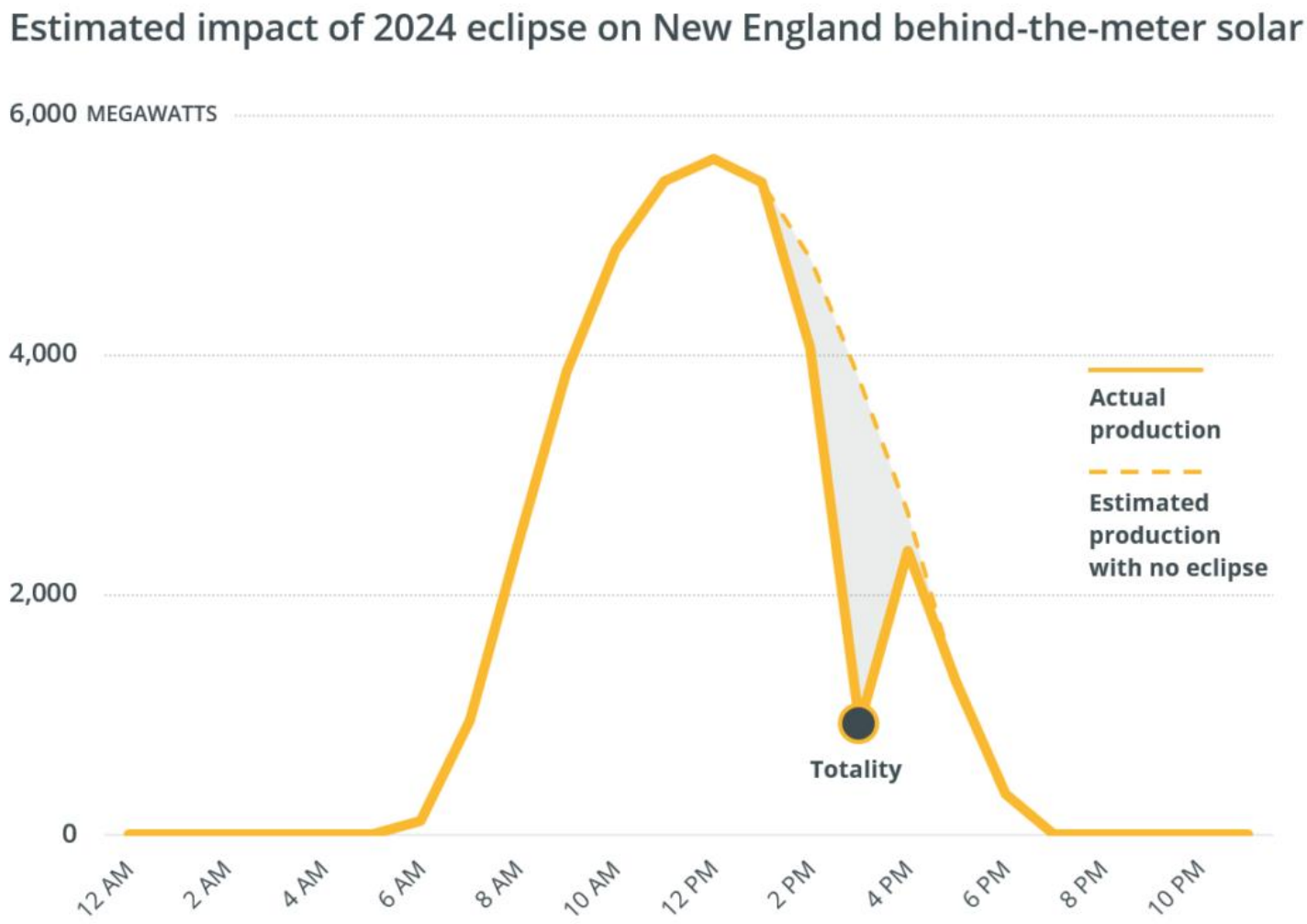
How Does Dispatching Demand Response Differ from Public Appeals to Reduce Electricity Use?

- One is paid to provide capacity, which can be dispatched to meet system energy needs based on price or can be used to provide reserves, while the other is generally called upon when the grid is operating under stressed conditions (i.e., we are short of capacity)
- The ISO would issue a **public appeal** for consumers to reduce electricity use if the grid is short of generating and demand response capacity needed to operate the grid reliably
  - This would occur if the ISO implements Operating Procedure No. 4 (OP 4), *Actions During a Capacity Deficiency*
  - Two OP 4 actions could trigger public appeals for voluntary conservation:
    - Power Watch (OP 4, action 4) or
    - Power Warning (OP 4, action 10)
  - If conditions warrant, the ISO also might issue a public appeal in anticipation of a potential capacity deficiency, such as prior to a heat wave

DRRs are Compensated for Reducing Demand Below Expected (Baseline) Demand

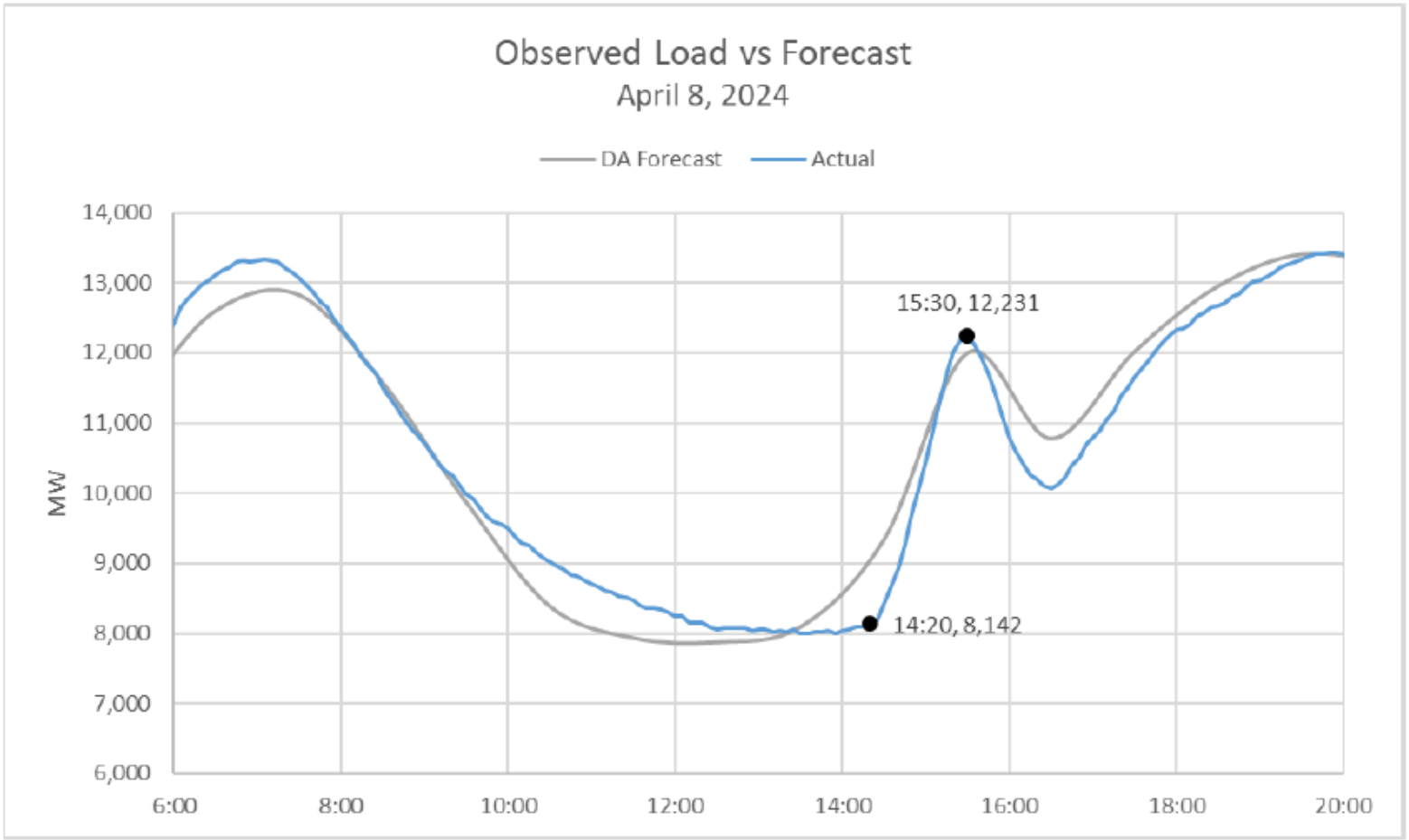


Solar Output Dropped Sharply During Eclipse

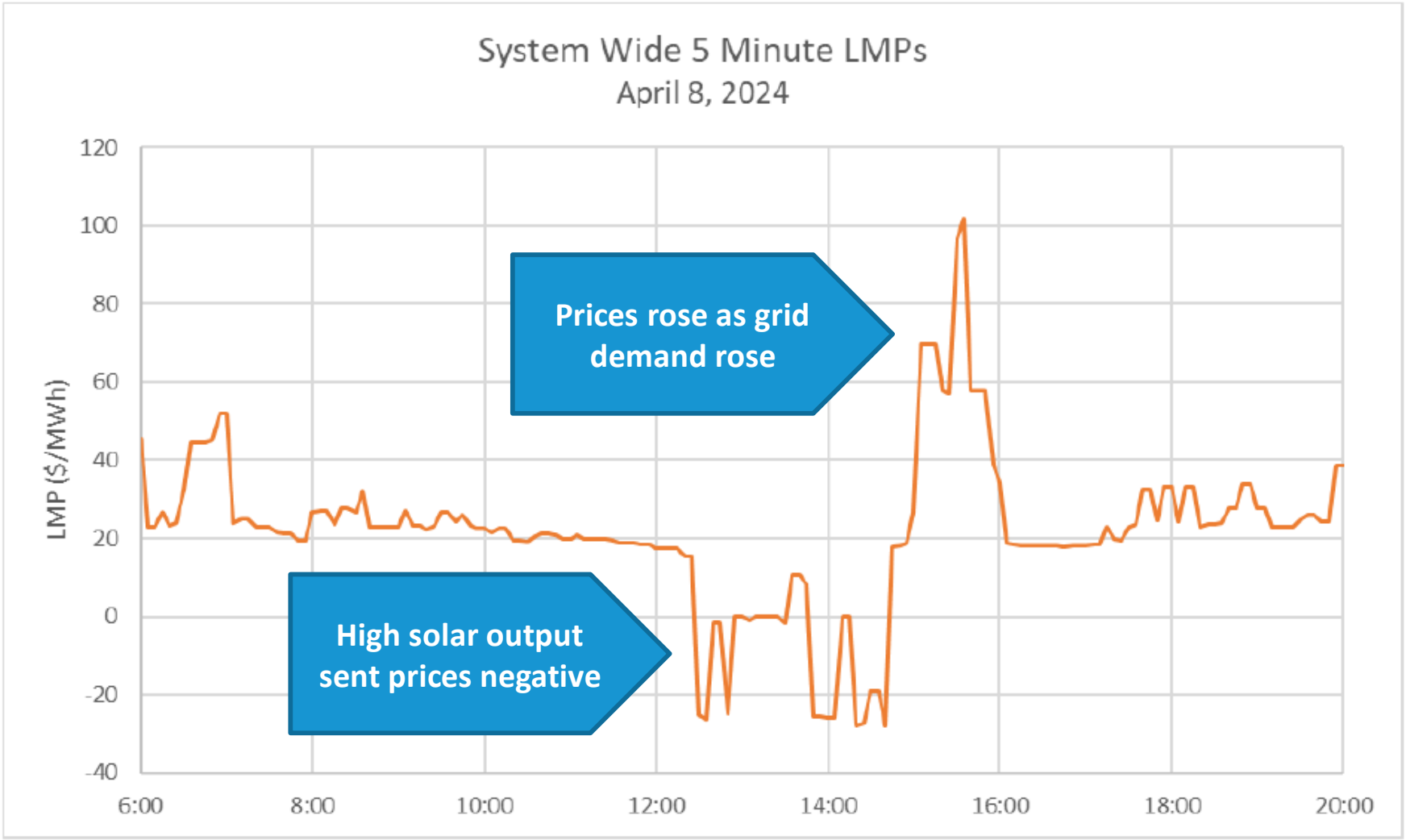


Demand Increased During the April Eclipse as Solar Output Dipped, then Ramped Down as Solar Production Resumed

The observed load increase of ~4,000 MW over a 60-minute period was approximately double the typical maximum observed load ramp

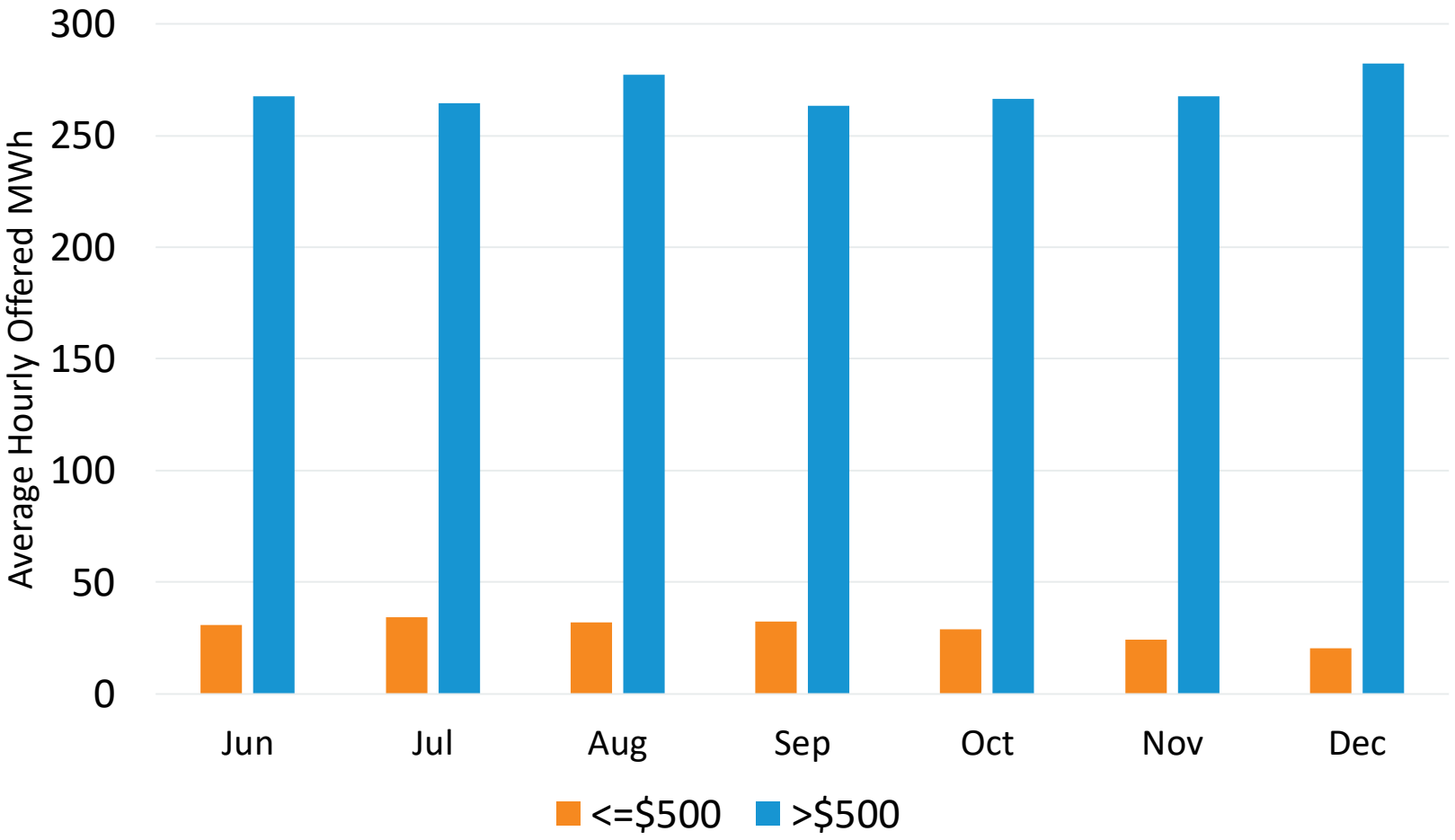


System Locational Marginal Prices (LMPs) Increased During the Periods of the Highest Load Ramps



Most DRRs are Offered at Very High Energy Prices

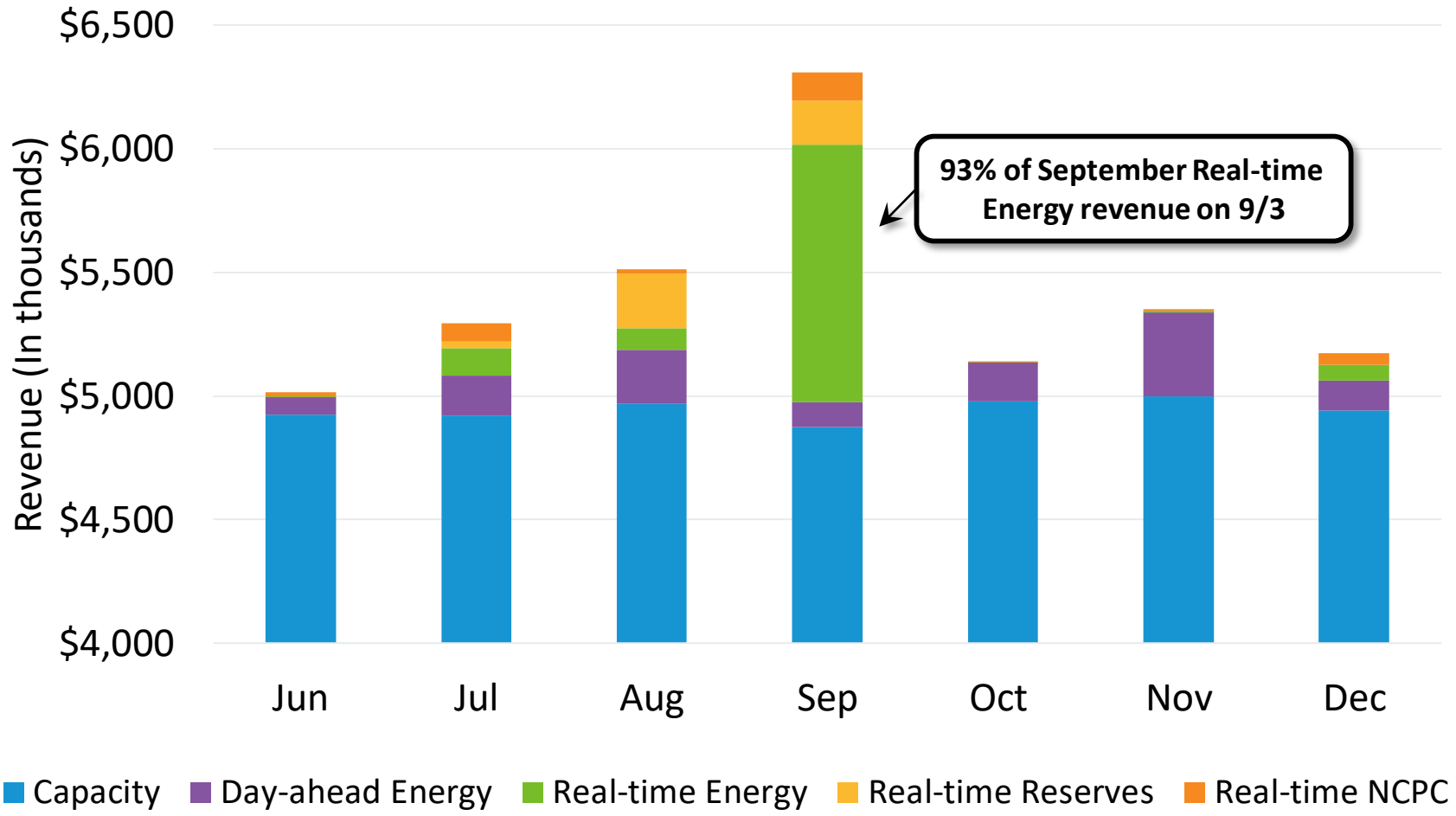
High DRR offer prices reflect the real-time value of reliable electricity



Note: Average hourly offered MWh was 301

Most DRR Revenue Comes from the Capacity Market

As a result, DRRs provide very little energy to balance supply and demand on most days



Challenges and Opportunities of the Clean Energy Transition

- Renewable supply resources do not respond to supply and demand conditions as reflected in market prices
  - Out of market revenues give resources incentive to submit negative bids, which could result in negative LMPs
  - Significant periods of over-generation with zero or negative prices, and under-generation with high prices are anticipated, leading to increased price volatility

- **Demand flexibility** could help address these conditions
  - Decrease demand during periods of under generation, and
  - *Increase demand during periods of over generation*
    - Energy storage and other flexible demand can help shift excess renewable generation to offset high emissions and high costs
    - Metering infrastructure and retail rates that enable and reward customers or their aggregators to respond to changing wholesale price signals are needed for demand flexibility to be successful

- **Demand response, historically, has only rewarded load reductions**
  - Increasingly, there will be opportunities for consumers to *reduce* demand when prices are high and to *increase* demand when prices are low

Flat Retail Rates Discourage Flexible Demand, High Retail Electricity Rates Discourage Electrification

- ***Buy low, sell high:*** greater price volatility creates opportunities for customers to benefit from *increasing load* when prices are low, and *decreasing load* when prices are high

- Flat retail rates eliminate potential customer savings from demand flexibility
- High $/kWh retail rates discourage electrification of heating and transportation, and adoption of behind-the-meter electrical storage

Opportunity for Future Retail Rate Design to Encourage Demand Flexibility

- $/kWh retail rate should reflect time-varying social marginal costs, with fixed costs being collected using more fixed charges (e.g., monthly customer charges, demand charges), which could be tiered to address any regressive properties

- While real-time pricing is most efficient, time-of-use and critical peak pricing have other desirable rate design properties – i.e., price predictability and bill stability
- Rate designs that encourage demand flexibility requires **advanced metering infrastructure** so that real-time hourly usage can be measured and used by customers or their aggregators to adjust load as renewable generation (and the associated retail rate) fluctuates

Conclusions

- DRRs are fully integrated into the ISO's capacity, energy, and ancillary service markets and receive market payments
- Most DRRs are aggregations of customer facilities
  - Market Participants (known as demand response providers or aggregators) recruit customers to form an aggregation – economics will dictate who is recruited
- DRRs are compensated for reducing demand below expected demand
- Most DRRs are offered at very high energy prices – energy prices that exceed generation costs
  - High offer prices from DRRs reflect the real-time value of reliable electricity supply
  - With little energy revenue, most DRR revenue comes from the capacity market
- As a result of offering at high prices, DRRs provide very little energy to balance supply and demand on most days
- As electricity supply is de-carbonized and becomes more intermittent, demand flexibility – increasing demand when prices are low, and reducing demand when prices are high – becomes more valuable
  - Demand flexibility requires advanced metering infrastructure and time-based retail rates