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

Connecticut Department of Energy and Environmental Protection

2022 Comprehensive Energy Strategy Technical Session #5 Active Demand Response

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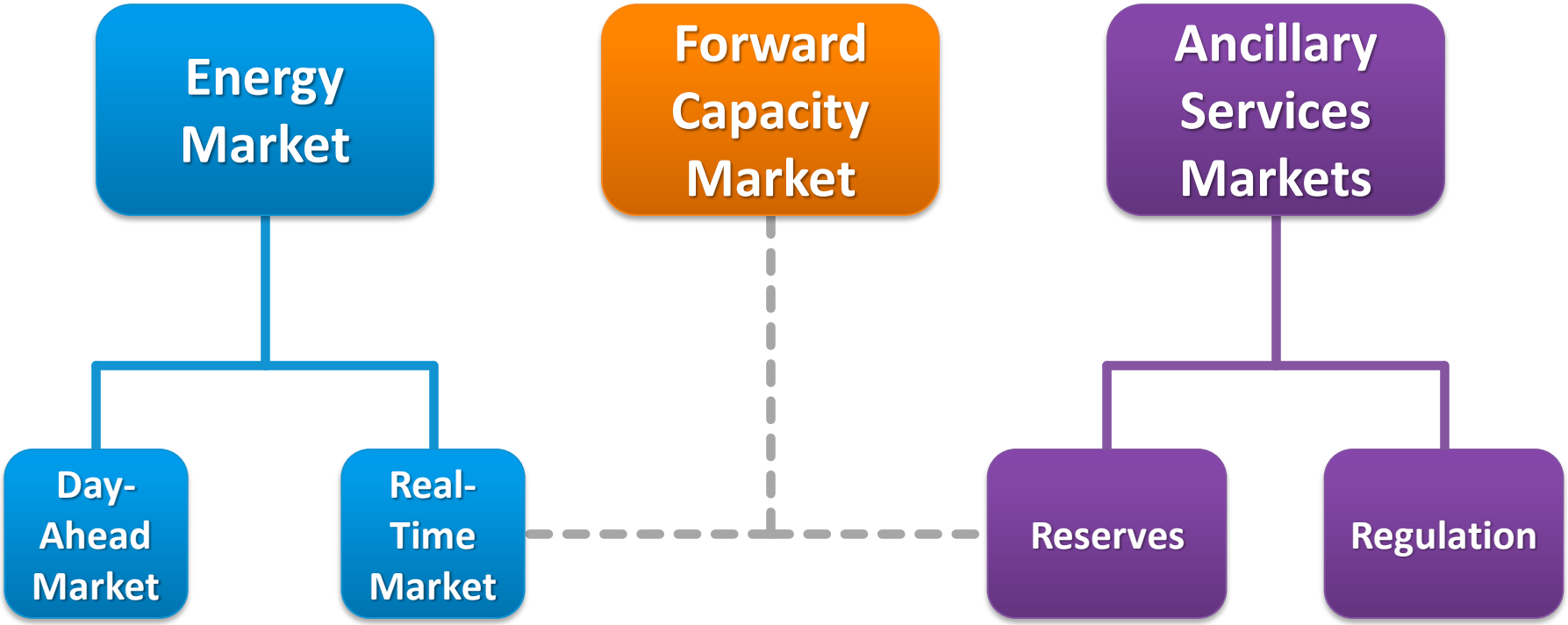
DEMAND RESPONSE IN NEW ENGLAND: DEMAND RESPONSE ASSETS (DRAs) AND DEMAND RESPONSE RESOURCES (DRRs)

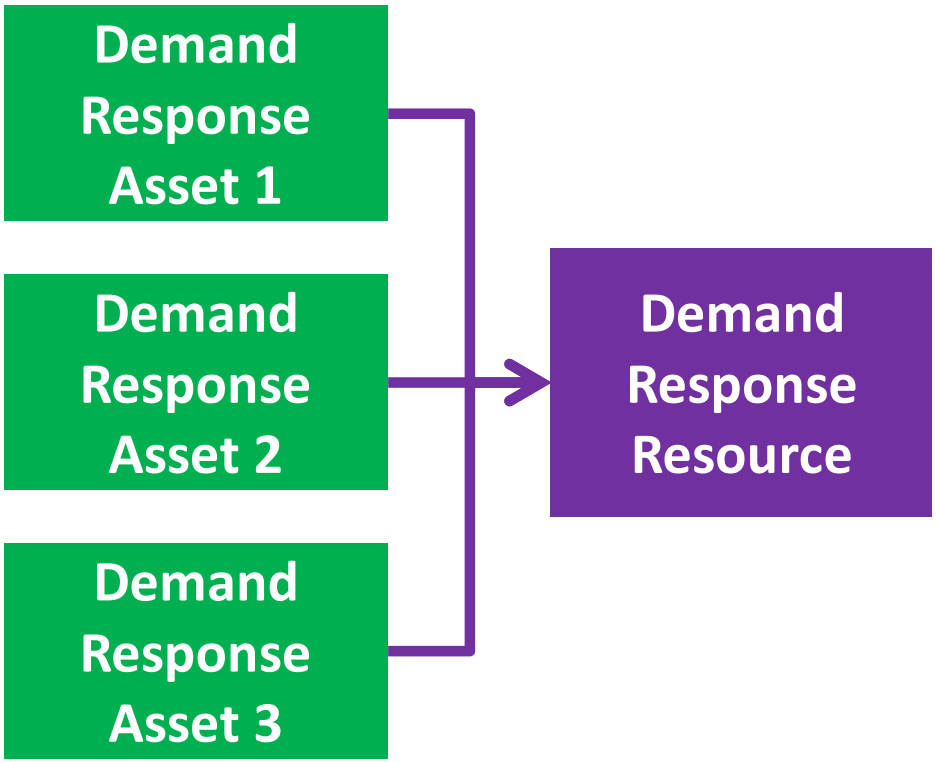
New England Wholesale Markets



Demand Response Resources participate in energy, capacity, and ancillary services markets

What are Demand Response Assets (DRAs) and Demand Response Resources (DRRs)?

- A DRA is an individual end-use customer facility, which may be aggregated and mapped to a DRR
- DRR can consist of multiple DRAs located in the same zone
  - A DRA with a capability of 5 MW or greater must be mapped to its own DRR
- DRRs participate in energy and reserve markets
  - Supply offers are associated with DRRs, not with specific DRAs
- DRRs can be further aggregated into capacity resources (Active Demand Capacity Resources)



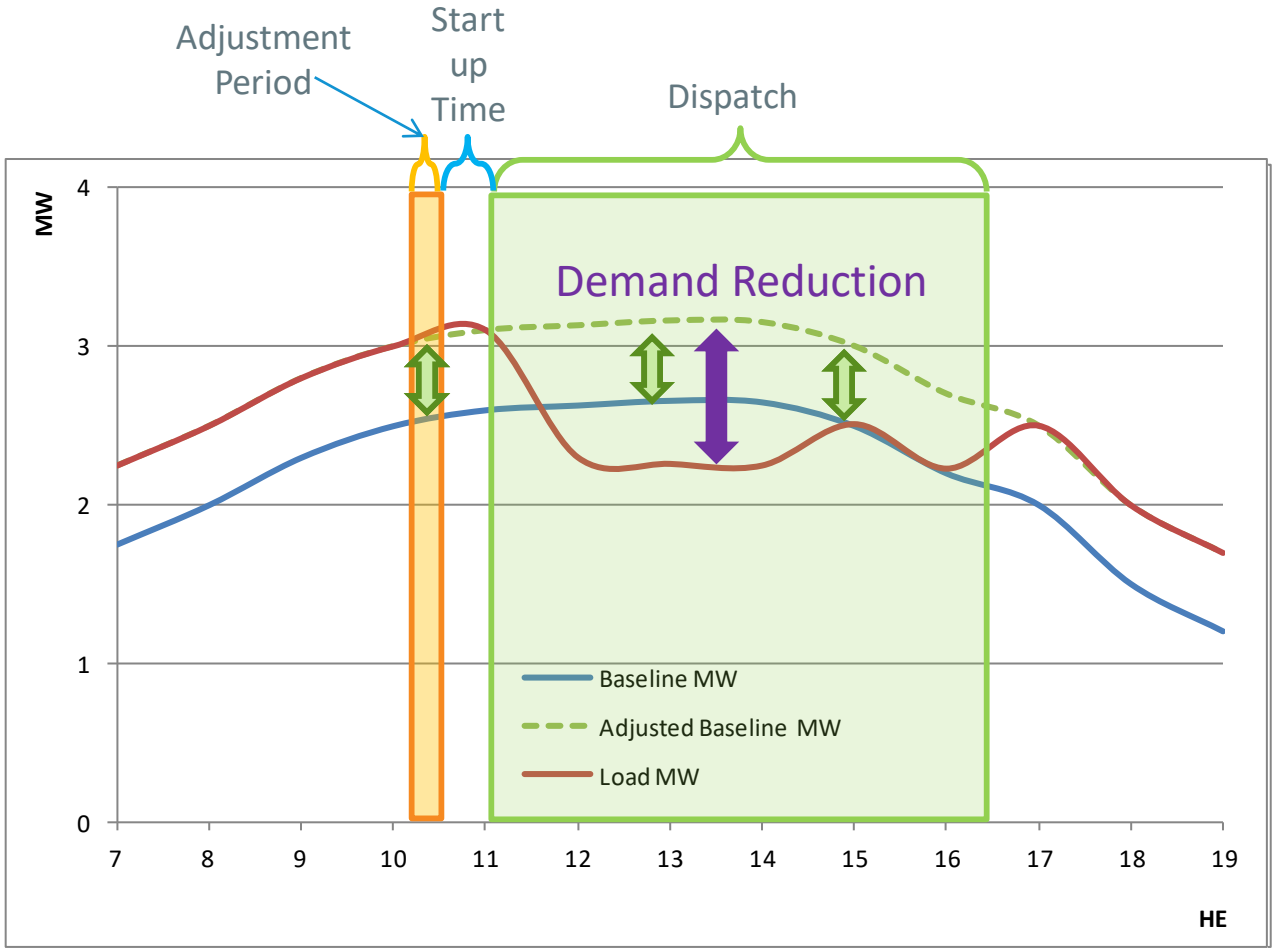
Performance Measurement Example

Dispatch instruction received at 10:29 with a 0 minute notification and 30 minute startup time

Adjustment period 10:10 to 10:25

Actual load is much higher than the baseline during the adjustment period

Baseline adjustment will increase the baseline to accurately calculate the demand reduction MW



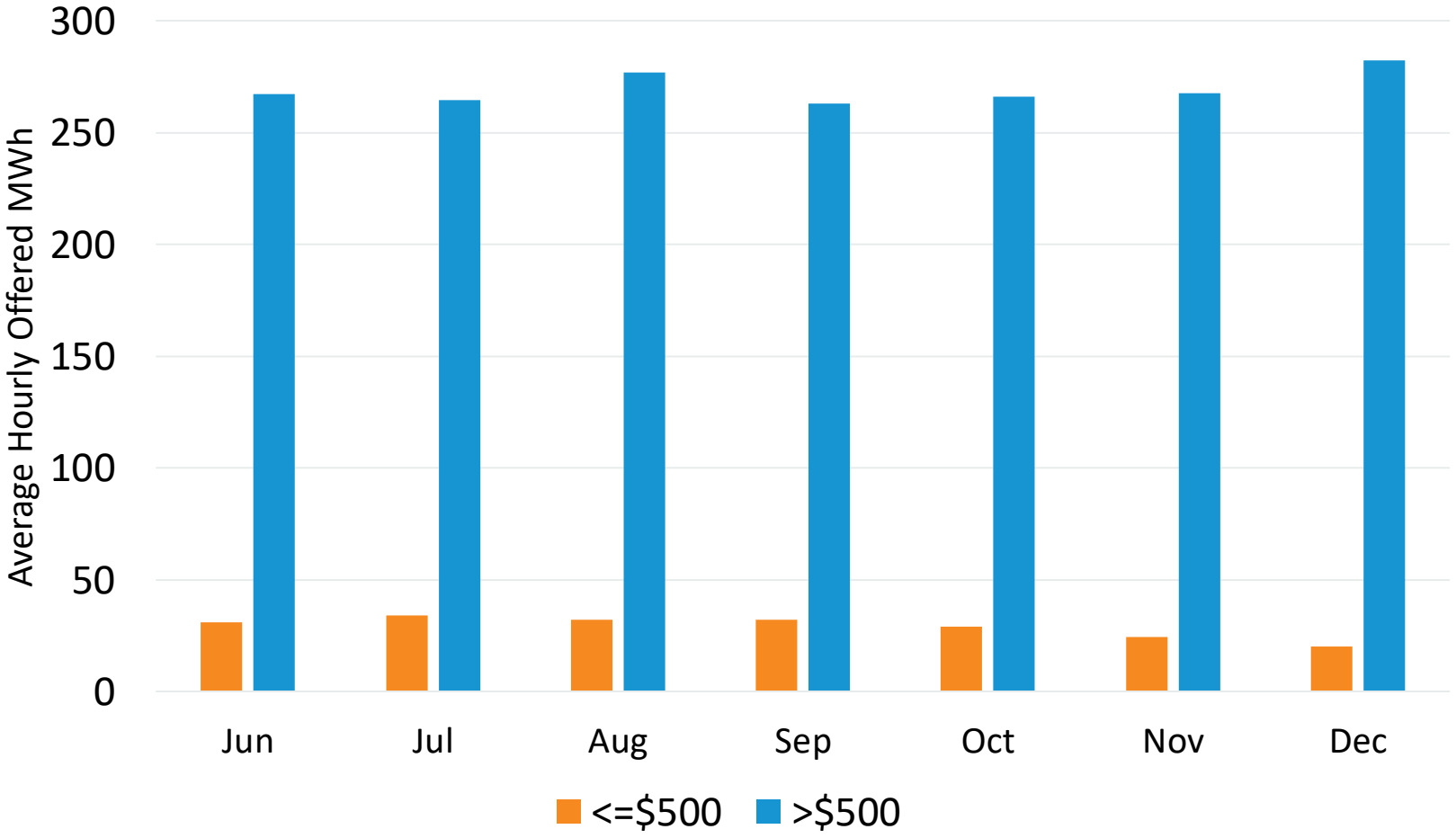
Note that at the 30 minute point in this example (10:59), the load = the adjusted baseline, so based on this dispatch, this asset was not capable of providing 30 minute reserves.

Capacity Supply Obligation (CSO) MW by Demand Resource Type for November 2022

Load Zone	ADCR*	On Peak	Seasonal Peak	Total
ME	90.9	214.1	0.0	305.0
NH	40.5	169.4	0.0	209.9
VT	37.4	132.5	0.0	169.8
CT	147.5	227.2	614.4	989.0
RI	37.6	345.8	0.0	383.4
SEMA	41.4	531.8	0.0	573.2
WCMA	81.3	566.7	35.2	683.2
NEMA	68.6	880.2	0.0	948.8
Total	**545.2**	**3,067.7**	**649.5**	**4,262.4**

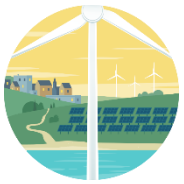
* Active Demand Capacity Resources
NOTE: CSO values include T&D loss factor (8%).

90% of DRR MWh have been offered above $500/MWh



Note: Average hourly offered MWh was 301; see: https://www.iso-ne.com/static-assets/documents/2019/01/a6_presentation_review_of_prd_implementation.pptx

Observations



- DRRs are aggregations of DRAs (i.e., end-use customer facilities)
- DRRs are fully integrated into the ISO's capacity, energy, and ancillary service markets and receive market payments
- DRRs are compensated for reducing demand below expected (baseline) demand
- Most DRRs are offered extra-marginally in the energy market – i.e., they offer at a very high energy price
- DRR inclusion in economic dispatch has improved price formation
  - DRR integration improves the accuracy of economic dispatch
- Most DRR revenue is derived from the capacity market, and DRRs provide mostly Operating Reserves rather than energy in real-time

See Appendix slides for more detail

GENERATION AND PRICING DYNAMICS OF THE FUTURE GRID

Electricity Pricing Dynamics in a De-carbonized Economy

- To de-carbonize the economy, electricity will be generated by renewable resources (e.g., solar, wind), and end-uses (e.g., transportation and space-heating) will be electrified
- Renewable resources like solar and wind do not respond to supply/demand conditions as reflected in market prices, leading to periods of over- and under-generation and increased price volatility
  - Periods of zero or negative Locational Marginal Prices (LMPs) resulting from renewable resource over-generation, and periods of high LMPs resulting from renewable resource under-generation
    - Out-of-market revenues give resources the incentive to submit negative bids into the market, which could result in negative LMPs
- Price volatility provides an opportunity for energy storage and "demand flexibility"
  - *Increase demand* during periods of renewable resource over generation with low prices
  - Decrease demand during periods of renewable resource under generation with high prices
  - Such demand flexibility reduces overall system costs and carbon emissions, and addresses system reliability from renewable generation intermittency

Can Demand Response Encourage Demand Flexibility?

- Demand response resources are given incentives to reduce load, which addresses only half of the problem
  - "Demand response means *a reduction in the consumption of electric energy* by customers from their expected consumption in response to an increase in the price of electric energy or to incentive payments designed to induce lower consumption of electric energy" [18 CFR 35.28(b)(4) (emphasis added)]
  - Demand response is treated like a supply resource in the markets – like a generator increasing output, demand response is paid for decreasing consumption
- Demand response does not consider the positive implications of *increasing demand* at the right times

States Have An Opportunity to Leverage Demand Flexibility if Consumers are Given the Tools to Act

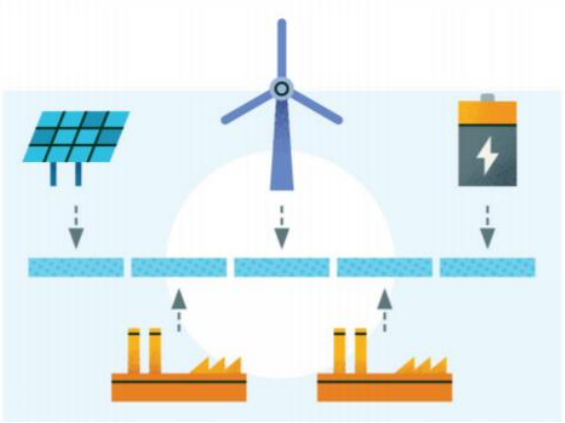
- Retail rates that reflect time-varying costs can enable demand flexibility
  - Prices will be high when marginal costs are high
  - Prices will be low when marginal prices are low
  - Embedding fixed costs in the rate – which increases the rate – would be a disincentive for electrification
- While **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 require **advanced metering functionality** 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

FERC ORDER NO. 2222: ISO NEW ENGLAND'S COMPLIANCE APPROACH

ISO's Proposal Builds Upon Region's History of DER Market Participation

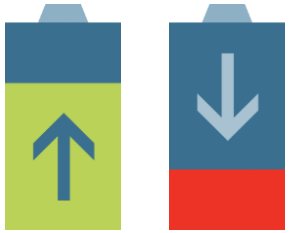
- The ISO's Order No. 2222 proposal creates opportunities for Distributed Energy Resources (DERs), bundled together through DER Aggregation (DERA) to respond to market prices.
  - The ISO's proposal allows DERA's to provide flexibility by reducing demand, injecting energy, withdrawing energy, and providing regulation in response to market prices.
- The ISO's proposal creates two new market participation models and amends several existing models in order to allow the participation of DERAs in the region's energy and ancillary services markets as well allow DERAs to participate as capacity resources in the Forward Capacity Market (FCM).
- In addition, to comply with the order, the proposal:
  - sets a minimum size of 100 kilowatts (kW) for DERAs;
  - includes an opt-in provision for small electric distribution companies;
  - creates a registration process to allow electric distribution companies to determine whether DERA participation in wholesale markets may pose risks to the safe and reliable operation of the distribution system; and
  - creates a framework to coordinate the real-time operation of DERAs and DERs with electric distribution companies and aggregators.
- Timeline:
  - The ISO has proposed that FCM-related changes go into effect in the fourth quarter of 2022, in order to allow the ISO to complete changes necessary for DERAs to participate in Forward Capacity Auction (FCA) #18.
  - The energy and ancillary services market changes would be effective in the fourth quarter of 2026, such that resources can be commercial and integrated ahead of the FCA #18 Capacity Commitment Period that begins on June 1, 2027.

Customers and the Environment will Benefit from Greater Demand Flexibility



- To encourage demand flexibility, DER Aggregators and their customers must have better access to wholesale market LMPs so the supply and demand of the DERA is priced at the LMP
  - When LMPs are negative, a DERA withdrawing energy from the system should be paid for the amount withdrawn – *increasing consumption yields higher payment*
  - When LMPs are positive, a DERA reducing its withdrawal of energy should avoid paying high prices – and should receive payment if it injects energy into the system
- Customers that are part of a DERA with flexible demand priced at the LMP pay a lower average rate

Customers and the Environment will Benefit from Greater Demand Flexibility *(Cont.)*

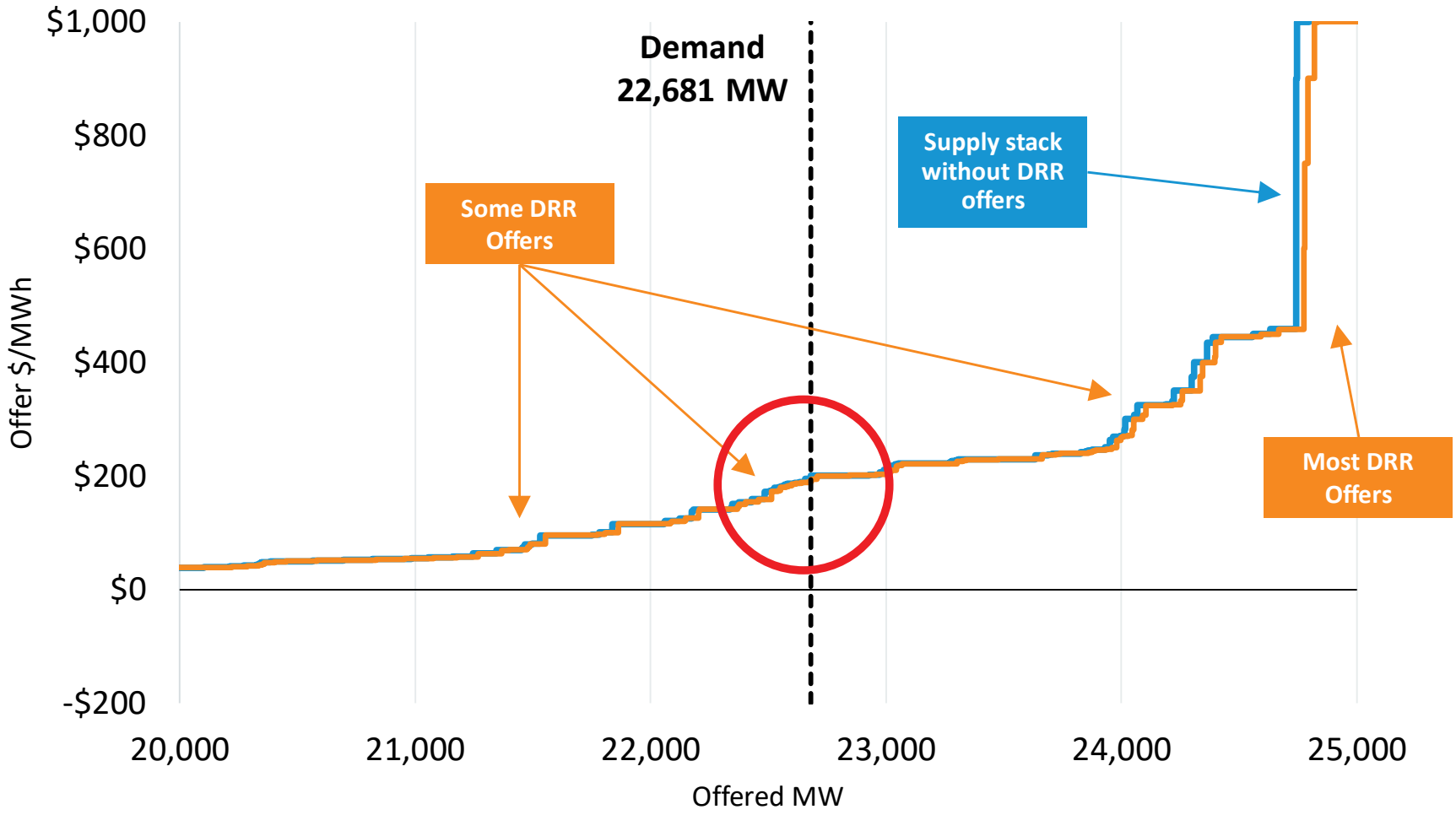


- This approach encourages DER Aggregators to serve customer energy needs by installing, aggregating, and/or operating any set of devices – e.g., heating/cooling systems, electrical or thermal storage, water heating, distributed generation, electric vehicle charging – at customer facilities and lower customer costs by taking advantage of price volatility
- Shifting load from high-priced periods to zero- (or negative) priced periods utilizes renewable resource over-generation, and reduces the use of fossil-fuel resources, which reduces carbon emissions

Questions

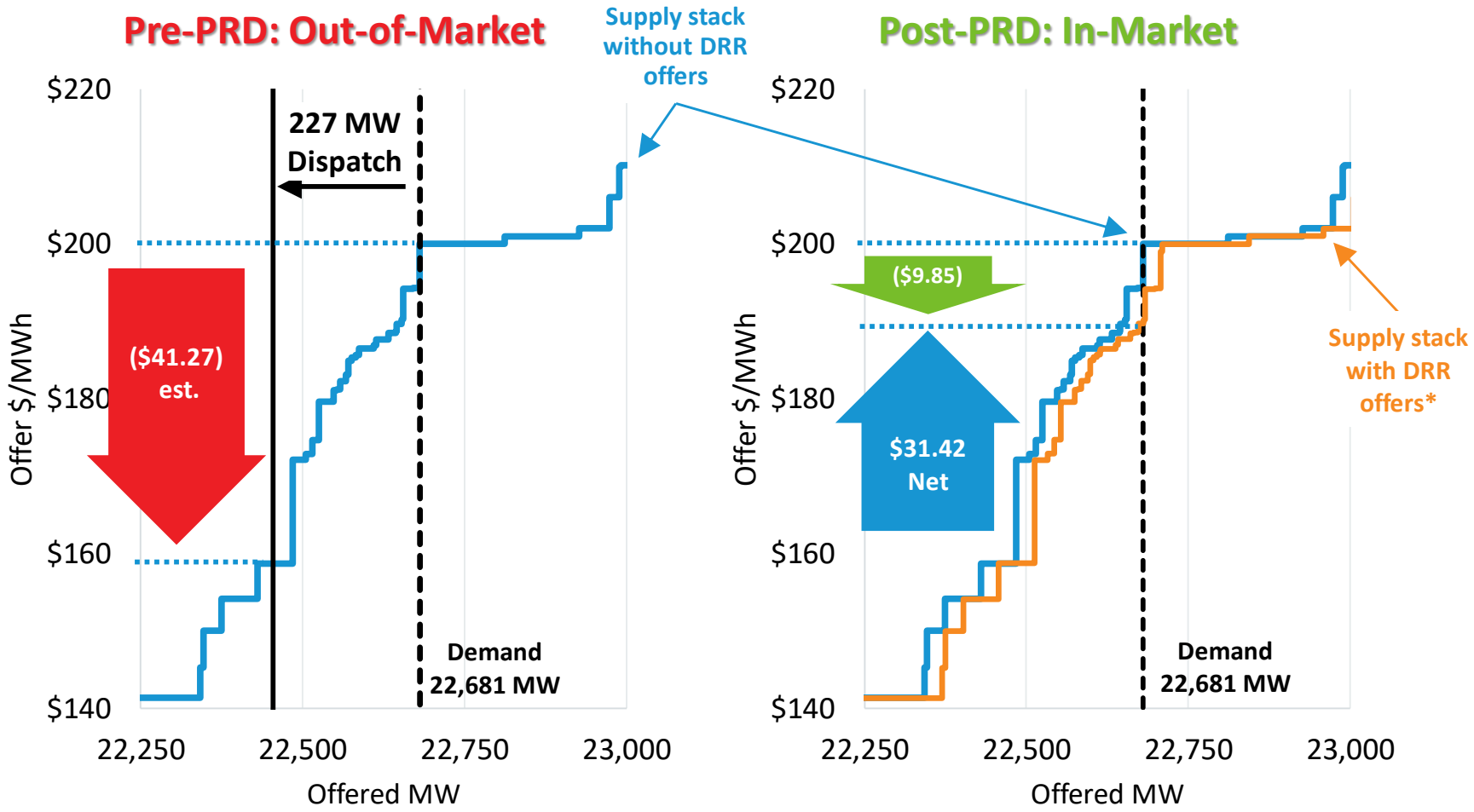
APPENDIX

DRR offers affect the supply stack



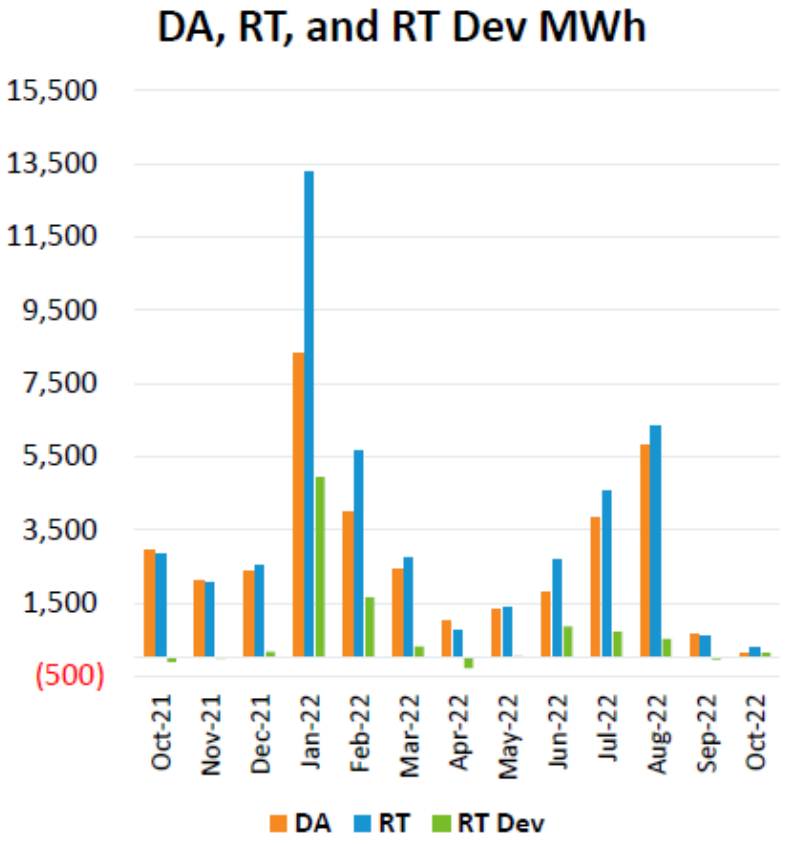
** Observed real-time (RT) supply stack with DRR offers on 9/3/2018, hour ending 7:00 pm*

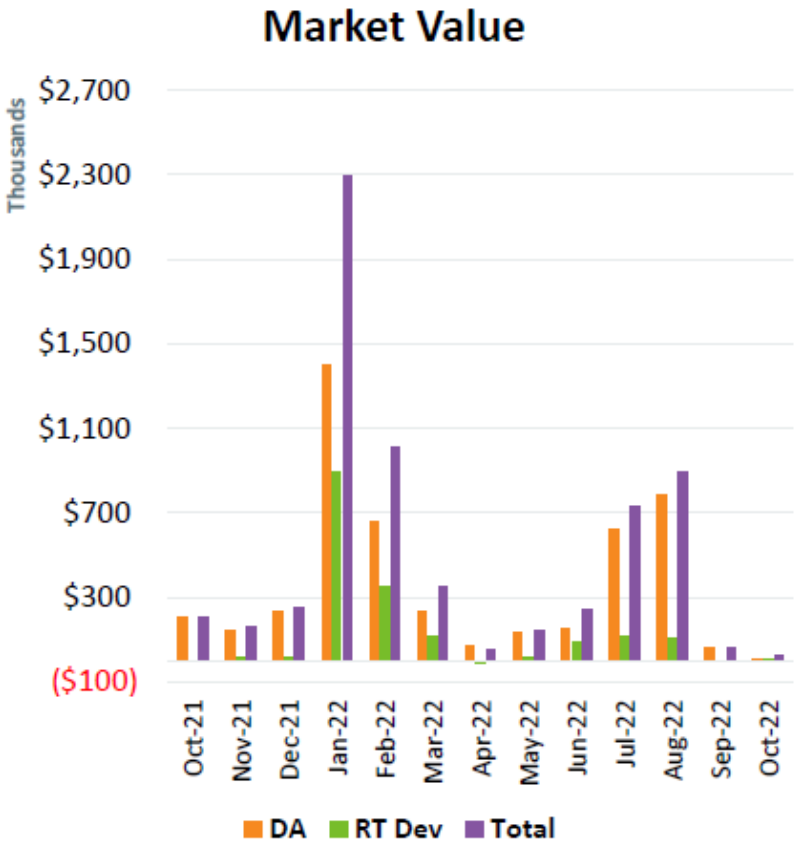
DRR offers in supply stack improve accuracy of economic dispatch compared to pre-DRR



** Observed RT supply stack with DRR offers on 9/3/2018, hour ending 7:00 pm*

Price Responsive Demand (PRD) Energy Market Activity by Month

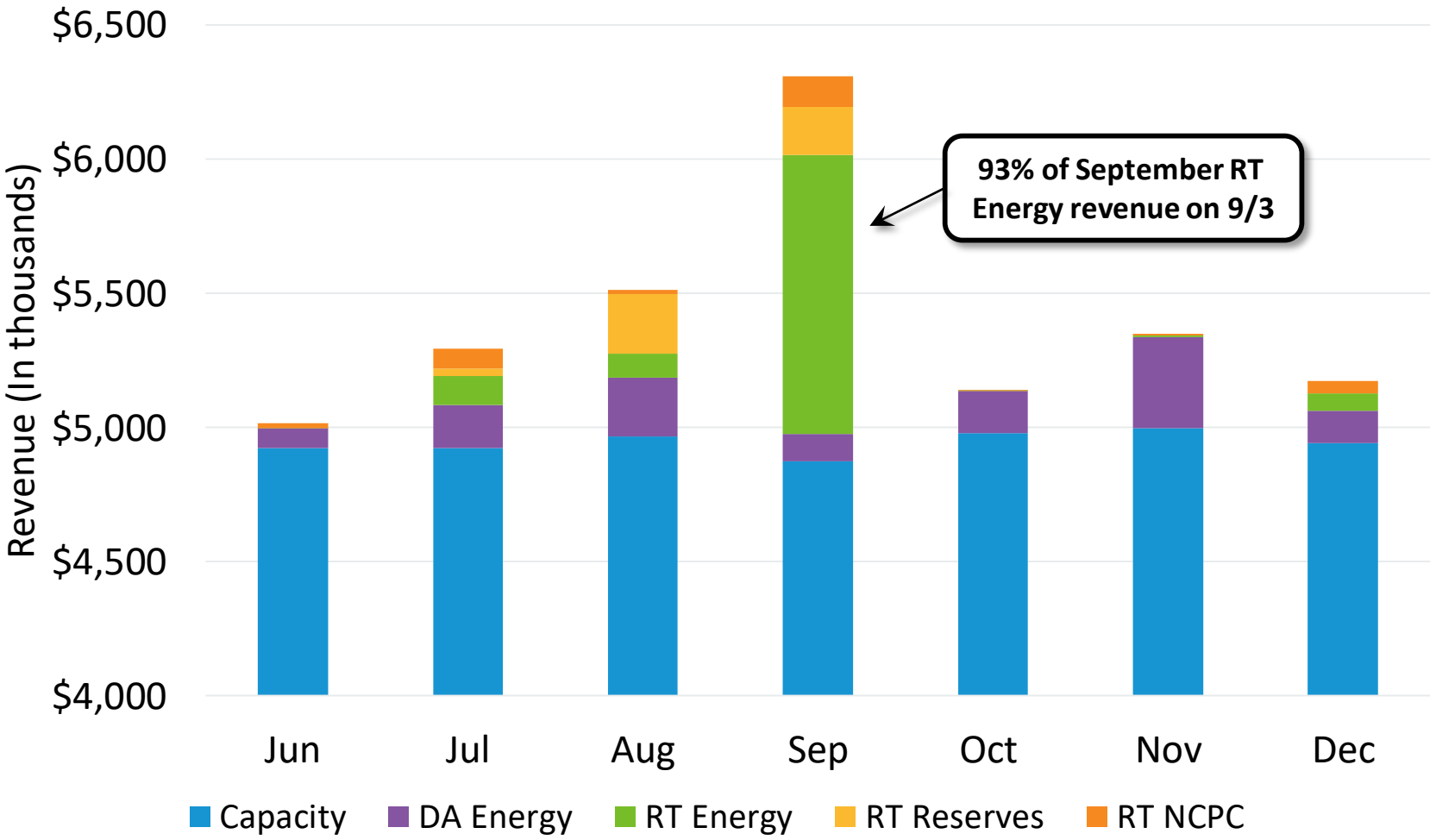




Note: DA and RT (deviation) MWh are settlement obligations and reflect appropriate gross-ups for distribution losses.

DRRs produced about 13,500 MWh in January 2022. The January COO report showed that DRRs had a CSO of 529.5 MW. So 13,500 MWh ÷ (529.5 MW x 744 hours in January) = 0.03, i.e., a 3% monthly capacity factor.

92% of DRR revenues derived from capacity



DRRs comprised 3% of system 30-minute reserve capability, and have supplied 9% of designated TMOR