

The Value of Distributed Electrical Energy Storage in Texas

Proposed Policy for Enabling Grid-Integrated Storage Investments

PRESENTED TO
Energy Storage Policy Forum 2015
Washington, DC

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January 29, 2015

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Agenda

Summary

Three Perspectives of Storage Benefits

Aggregate Value of Storage

- Merchant Value
- Societal or System-Wide Benefits
- Consumer Benefits

Proposed Regulatory Framework

Impact on Wholesale Market and Generators

Summary

Deploying grid-integrated electricity storage on distribution systems across Texas could provide substantial net benefits to the state

- Up to 5,000 MW of distributed energy storage cost effective in ERCOT from a system-wide perspective at storage cost \$350/kWh
- Total customer benefits (lower bills and improved reliability) would exceed costs
- Assumes storage deployment reduces but does not eliminate need for new generation

Current market and regulatory mechanisms will not enable cost-effective deployment of this innovative technology

- Wholesale market participants cannot capture T&D value (avoided outages, deferred T&D costs)
- Wires companies cannot justify large-scale storage deployment solely based on T&D savings (i.e. without also capturing and passing on to customers the wholesale market value)

Capturing the full value of storage to enable cost-effective investments requires new policy frameworks. For example:

- Allow TDSPs to deploy storage that is optimized to capture T&D and reliability benefits
- Auction off the rights to dispatch that storage into the wholesale market to third parties
- Use the auction revenues to offset storage costs to retail customers
- Ensure expected reliability and T&D benefits of deployment plan exceed net customer costs

Estimating Economic Benefits of Storage from Three Perspectives

Merchant Benefits

- Profits that a private investor could capture in the ERCOT wholesale market
- Driven by energy arbitrage value and ancillary service prices
- **Importance:** determines (a) whether wholesale market incentives by themselves are sufficient to attract investment in storage; and (b) the offset to storage costs if deployed by wires company for T&D/reliability benefits

"Societal" or "System-Wide" Benefits

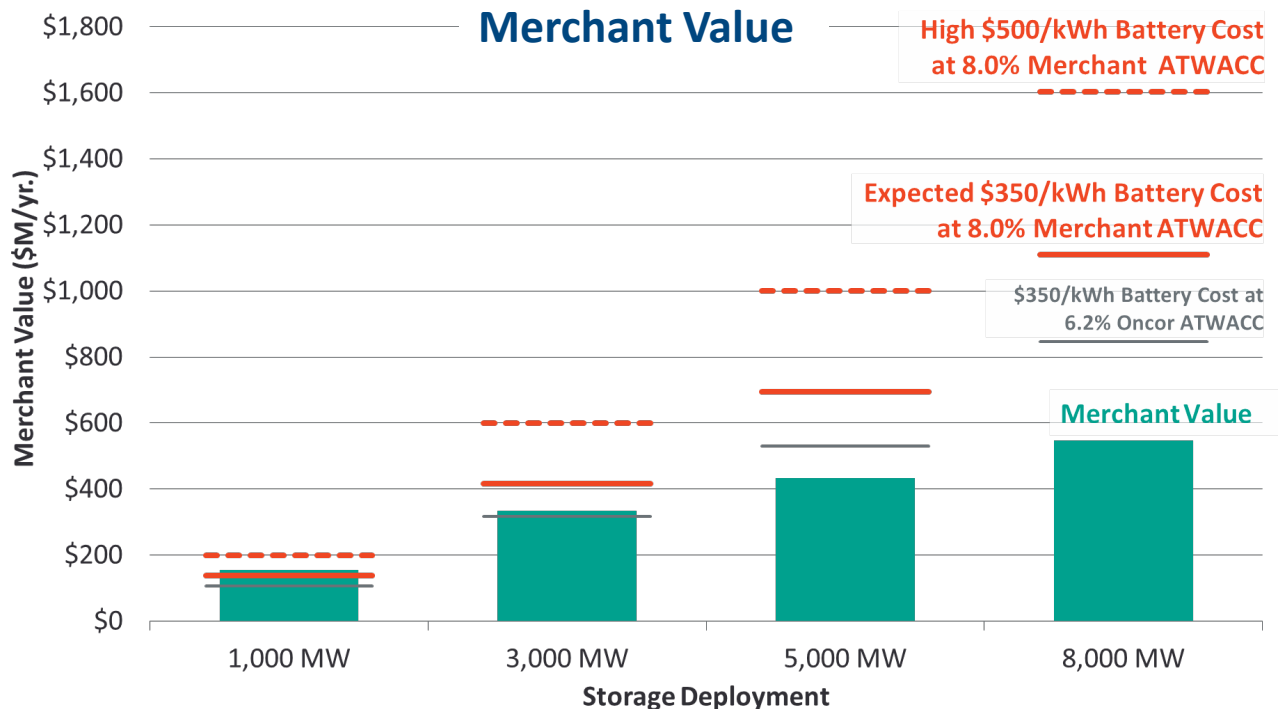
- Economy-wide benefits, including reduction in production, investment, and outage costs (regardless of whether suppliers or customers benefit)
- Also known as “total resource cost” benefits
- **Importance:** PUCT transmission policy order requires analysis of net “societal” or “system” benefits

Customer Benefits

- Customer bill savings from reduced wholesale prices, deferred transmission and distribution costs, and rebated merchant value
- Increase in realized distribution system reliability (reduced outages)
- **Importance:** customer advocates' and distribution utilities' primary interest, also a key metric from a public policy perspective

Merchant Value of Storage in Wholesale Market

- Even at the low projected battery costs, the wholesale market value of storage (without capturing T&D and reliability benefits) is too limited to support merchant investments at a meaningful scale
- Particularly true if investment risks were to exceed the 8% ATWACC assumed for merchant generators

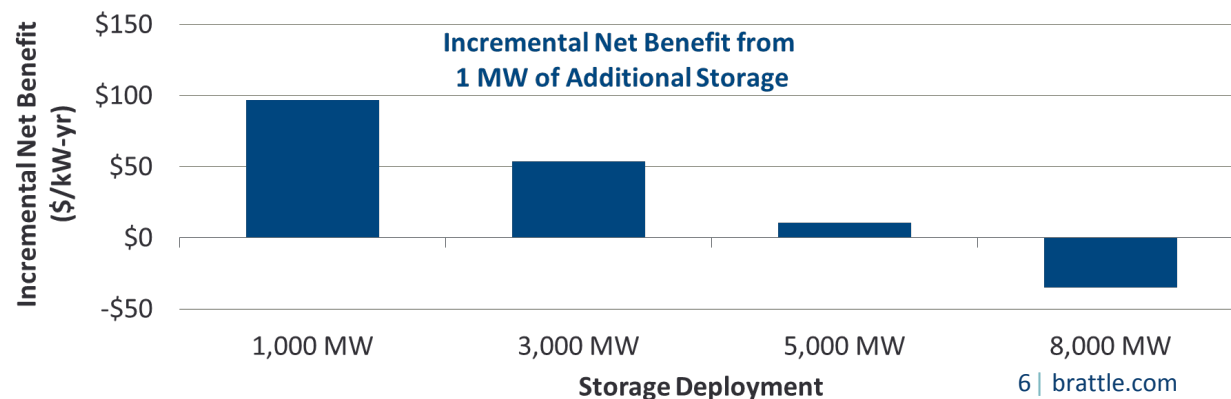
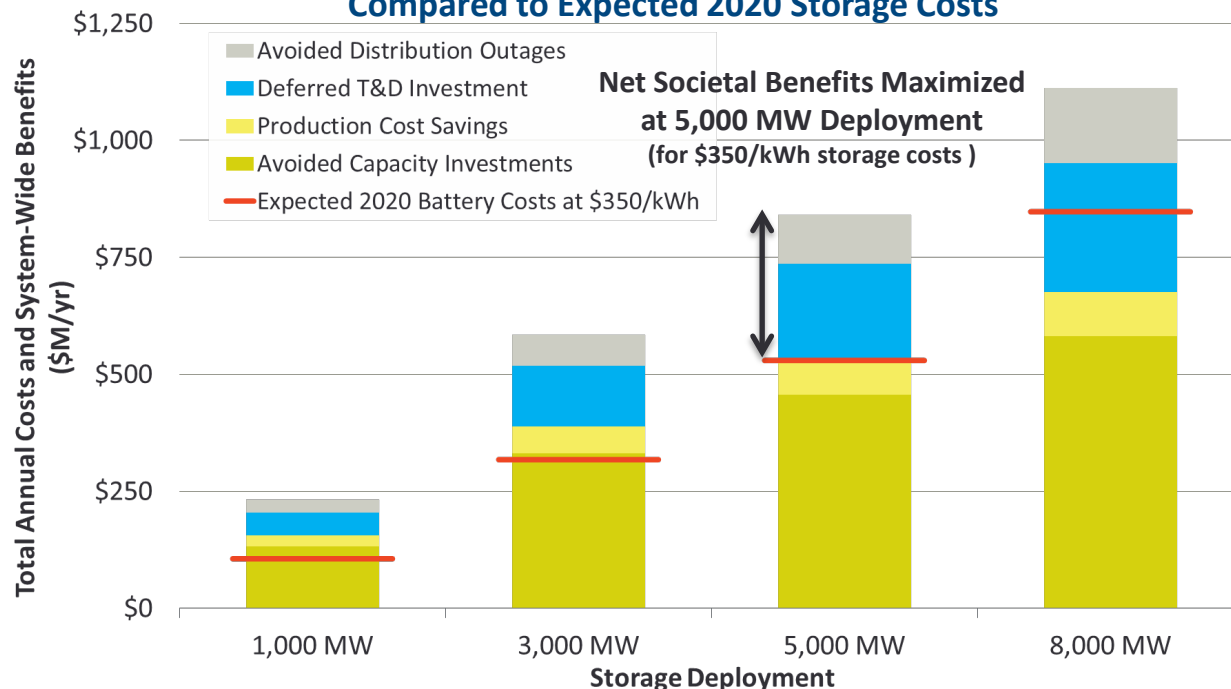


Notes: Merchant value represents the margins that a merchant investor would receive by participating in ERCOT's energy and ancillary services markets; assuming storage with a 3-hour discharge capability, 85% round-trip efficiency, and no other variable operations and maintenance (VOM) costs. Storage costs of \$350/kW-y are based on battery vendors' estimates of \$200/kWh as quoted to Oncor, plus an Oncor-estimated installation cost of \$150/kWh, plus fixed operations and maintenance costs equal to 1% and 2% of investment costs for the "expected" and "high" cost levels.

Societal / System-Wide Benefits

- Incremental value of storage exceeds its cost up to approx. 5,000 MW
- Beyond that point, incremental investment is not beneficial unless the cost of storage drops below \$350/kWh

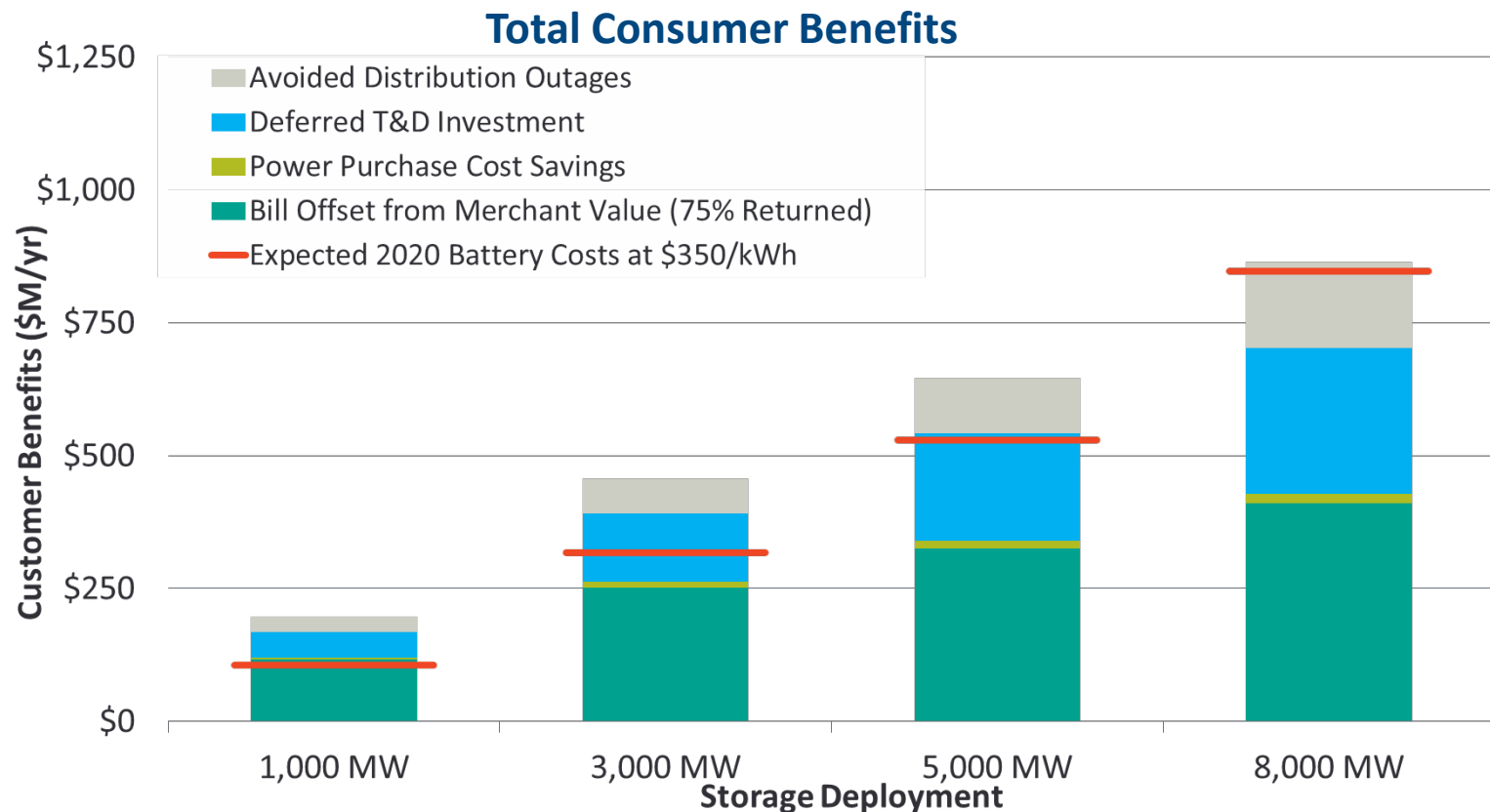
**System-Wide Annual Benefits
Compared to Expected 2020 Storage Costs**



Notes: The expected 2020 battery costs are annualized based on Oncor's 6.3% ATWACC, with 15- and 30-year assumed lifetime for the battery and balance of plant respectively.

Consumer Benefits

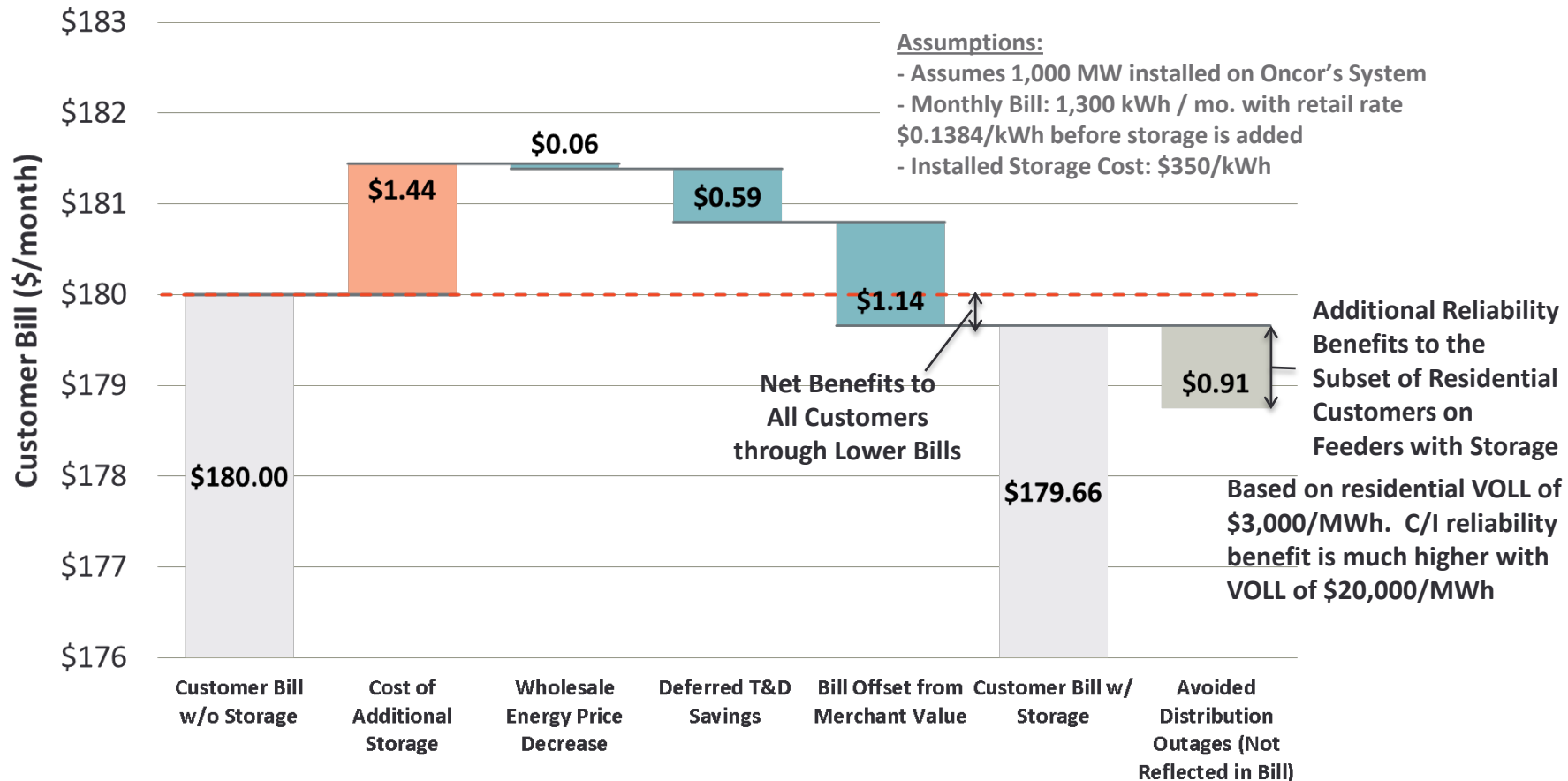
- Customers experience overall benefits through lower bills and improved reliability
- With the proposed policy framework, customer costs are offset by the merchant value a third-party market operator obtains in the ERCOT wholesale markets



Notes: The expected 2020 battery costs are annualized based on Oncor's 6.3% ATWACC, with 15- and 30-year assumed lifetime for the battery and balance of plant respectively.

Consumer Benefits – Bill Impact

Impact on Typical Residential Bill in 2020 for 3,000 MW of Storage ERCOT-wide



Notes: We assume that Oncor installs 1,000 MW out of 3,000 MW of storage deployed on an ERCOT-wide basis, with storage costs and wholesale-market proceeds reflecting the same proportion of installations. Oncor customers realize deferred transmission and distribution investment benefits based on the 1,000 MW installed on Oncor's system. The avoided distribution outage value shown is for a typical residential customer on a feeder with storage. Customers not located on a feeder with storage would not realize these reliability benefits.

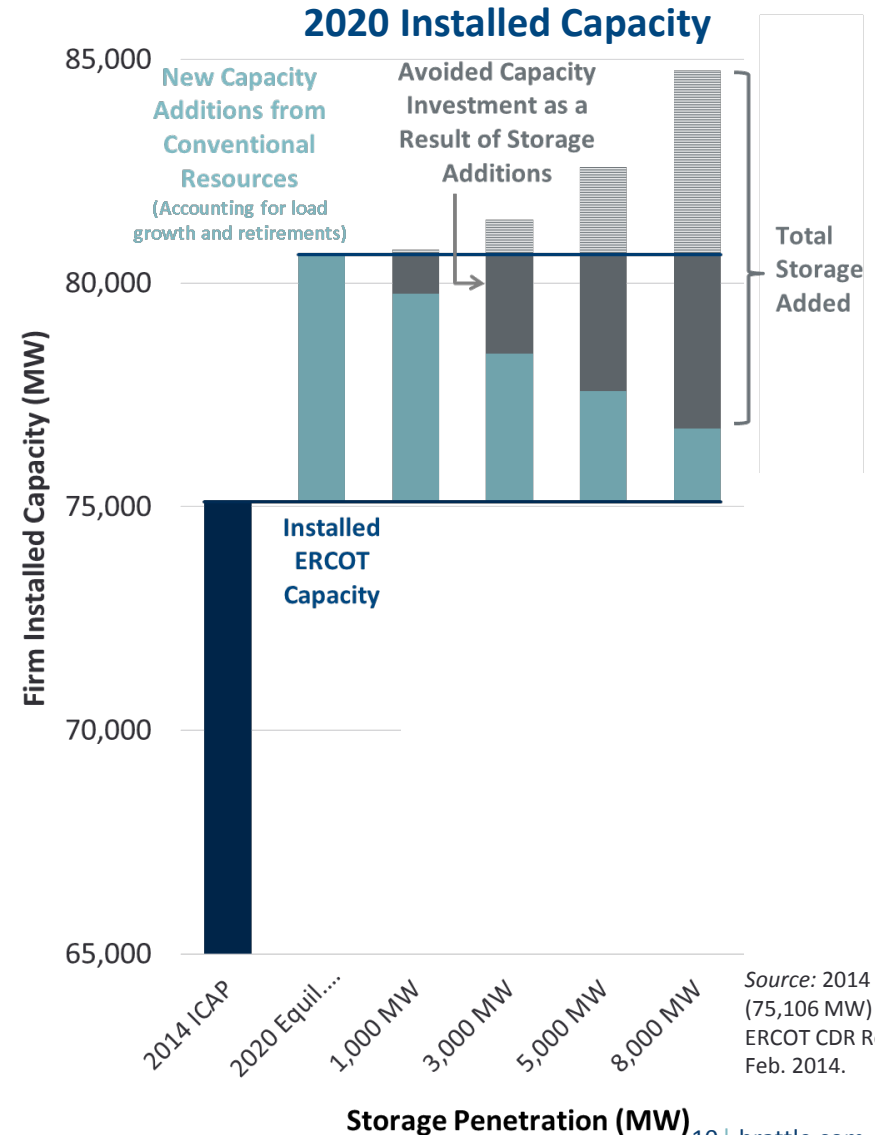
Proposed Regulatory Framework

- Targeted distribution-level deployment and operations needed to allow the utility to realize reliability, T&D, and wholesale market benefits
- Utility-based deployment can simultaneously capture these benefits without regulated utilities transacting in competitive wholesale markets
 - Wires companies would auction off wholesale market participation to unregulated entities who would then bid the storage assets into the markets
 - Auction proceeds used to offset regulated storage costs, thereby reducing customer costs
 - Commission would evaluate and approve storage deployment plan only if beneficial from a net customer cost perspective (e.g., based on experience from limited initial deployment)
- Framework allows wires companies to make investments in electricity storage and recover investment costs through regulated rates as long as:
 - A significant fraction of the value of these storage assets is associated with reliability and T&D benefits that are not captured through wholesale market participation
 - The incremental reliability and T&D benefits are expected to exceed net customer costs by a sufficient margin
- Approach solves the barriers created by fragmented value streams that will otherwise lead to under-investment in electric energy storage

Impact on Wholesale Market and Generators

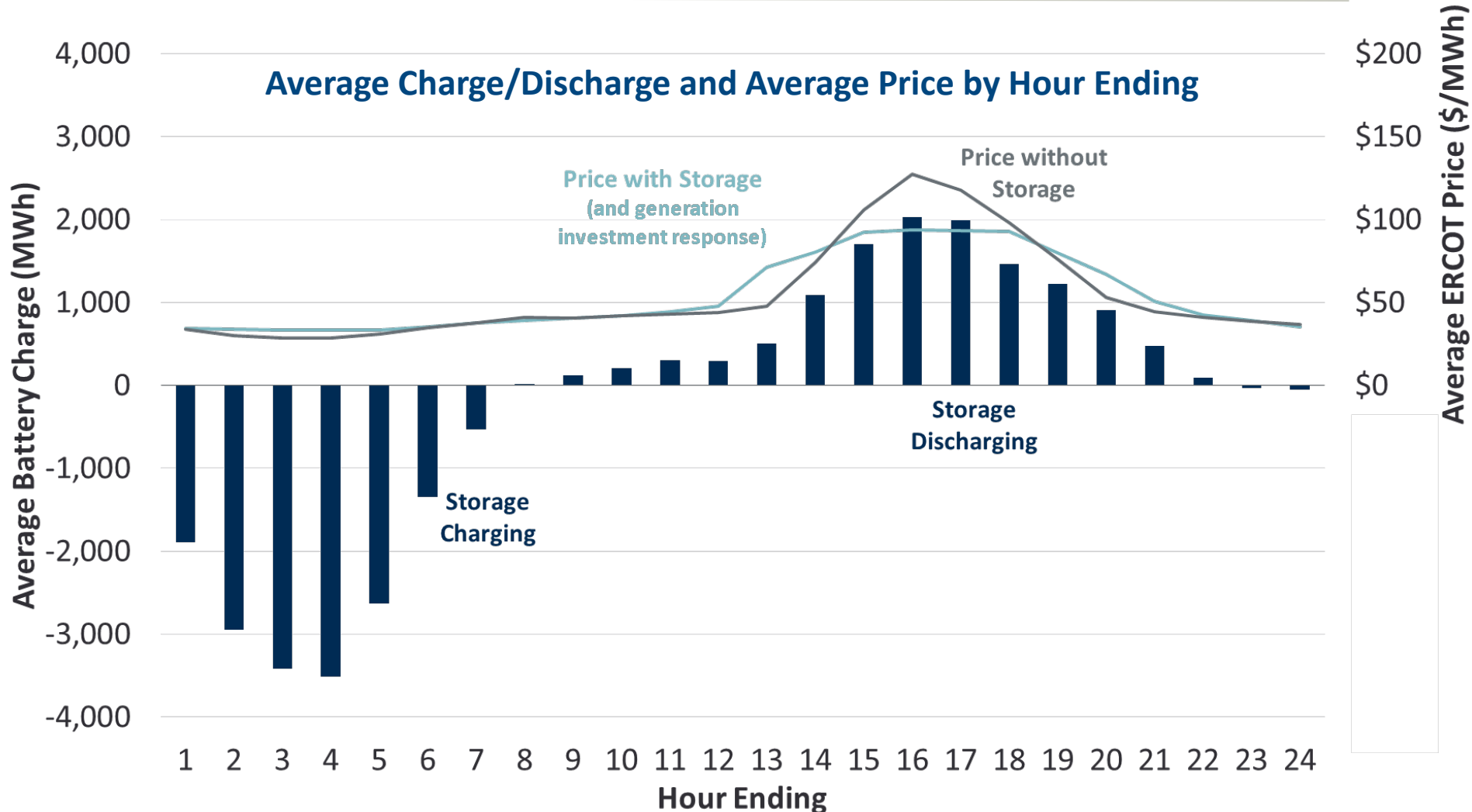
Simulating Generation Investment Response

- Simulated ERCOT's energy-only market in 2020:
 - With full ORDC curve
 - With 2011 and 2012 weather years to arrive at realistic distribution of CC margins
- Evaluated the likely investment response by conventional generation if storage is added to the ERCOT system
- Yields reserve margin consistent with a market outcome at the CONE of combined cycle (CC) unit (estimated at \$149/kW-yr in 2020)
 - 5,000 MW of storage results in 3,100 MW of reduced generation investment (or increased retirements)



Impact on Wholesale Market and Generators

Charging/Discharging Impact on Price

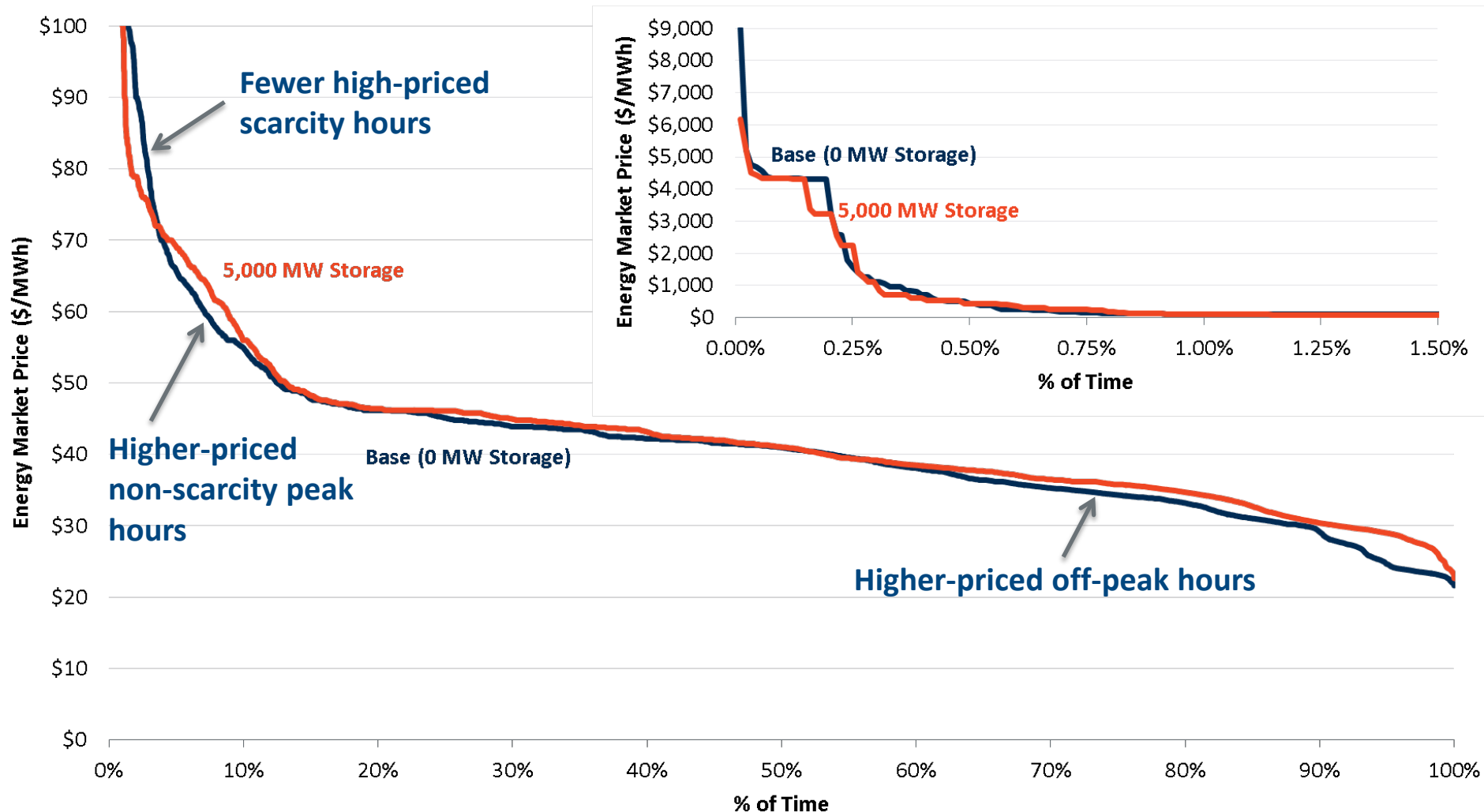


Notes:

Price with storage reflects 3,068 MW of less generation investment compared to the price without storage
Results represent the weighted average of the 2011 and 2012 weather year results

Impact on Wholesale Market and Generators

Price Duration Curve with/without Storage

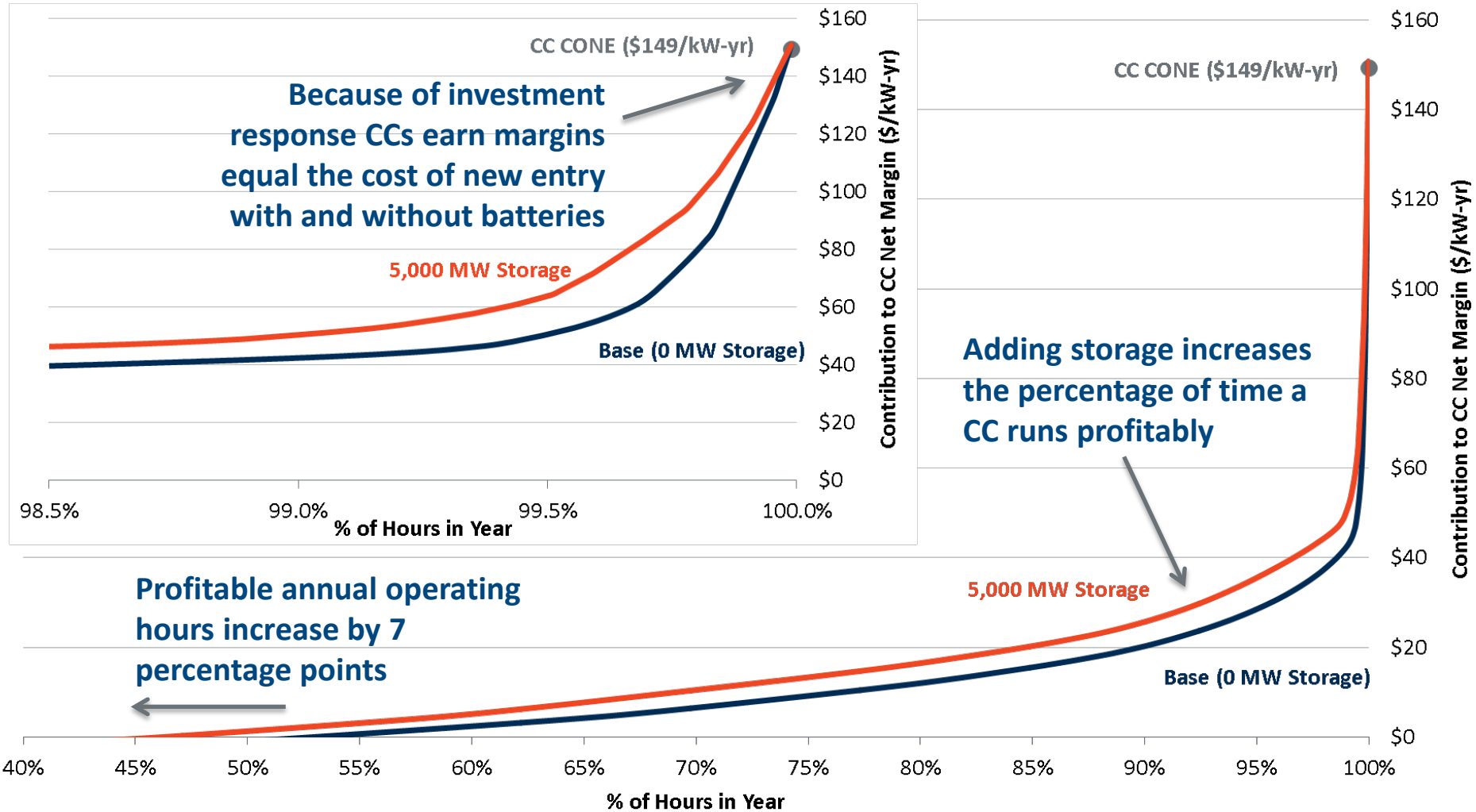


Notes:

Price with storage reflects 3,068 MW of less generation investment compared to the price without storage
Results represent the weighted average of the 2011 and 2012 weather year results

Impact on Wholesale Market and Generators

CC Energy Margins with/without Storage



Notes:
 Margins calculated based on the representative CC unit (Jack County) used for determining the equilibrium reserve margin.
 Results represent the weighted average of the 2011 and 2012 weather year results

Contact Information



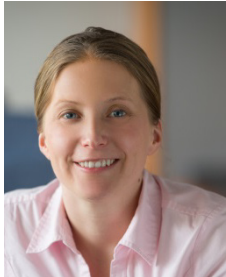
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