Estimation of the Market Equilibrium and Economically Optimal Reserve Margins

FOR THE ERCOT REGION, 2018 UPDATE

PRESENTED TO

ercot SAWG

PRESENTED BY

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THE Brattle GROUP

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Agenda

Problem Statement and Approach

Analytical Results

- Market Equilibrium Reserve Margin
- Economically Optimal Reserve Margin
- Physical Reliability Metrics
- Comparison to 2014 Study Results

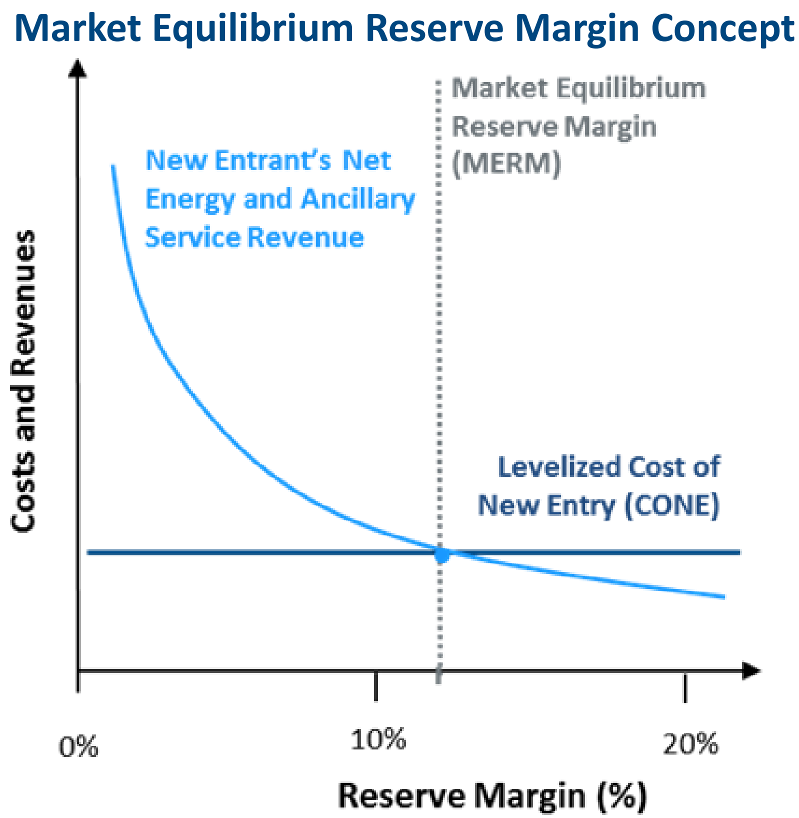
Sensitivities

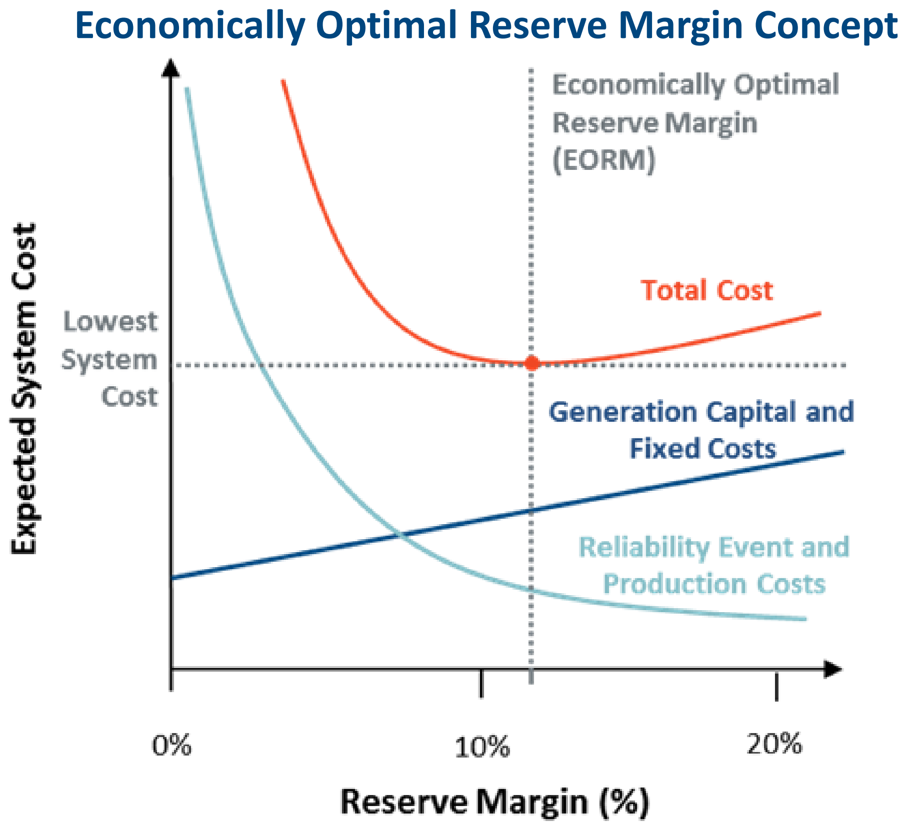
Appendix

- Model Validation
- Key Assumptions

Problem Statement

What are the MERM and EORM in ERCOT?





Estimating the MERM and EORM inform whether ERCOT's market will support sufficient reserve margins from an economic perspective (the modeling also informs reliability implications)

Modeling Approach

Simulation Period: 2022 (8760 hours)

Simulations per Reserve Margin: 9,500

- 50 outage draws
- 38 weather years
- 5 non-weather load forecast errors

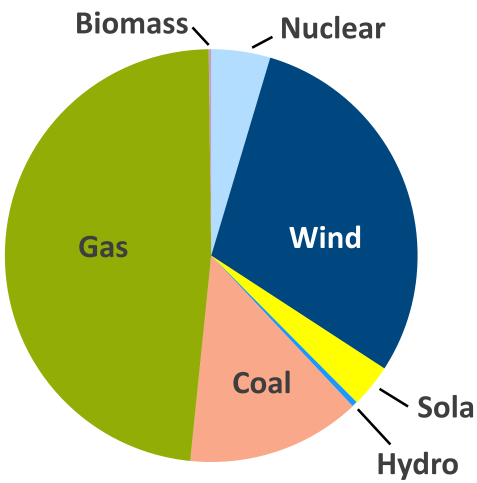
Topology

- ERCOT, Mexico, SPP, and Entergy footprints
- Connected through existing DC-Ties

Installed Capacity

- Baseline capacity consistent with ERCOT's 2018 LTRA submissions
- *Higher and Lower Reserve Margins modeled by adding and subtracting generic CC/CT capacity from baseline*

Baseline ERCOT Installed Capacity by Resource Type



Source: 2018 Report, Figure 2

Note: "2018 Report" references Newell et. al., *Estimation of the Market Equilibrium and Economically Optimal Reserve Margins for the ERCOT Region—2018 Update, Final Draft*. See http://www.ercot.com/content/wcm/lists/143980/10.12.2018_ERCOT_MERM_Report_Final_Draft.pdf

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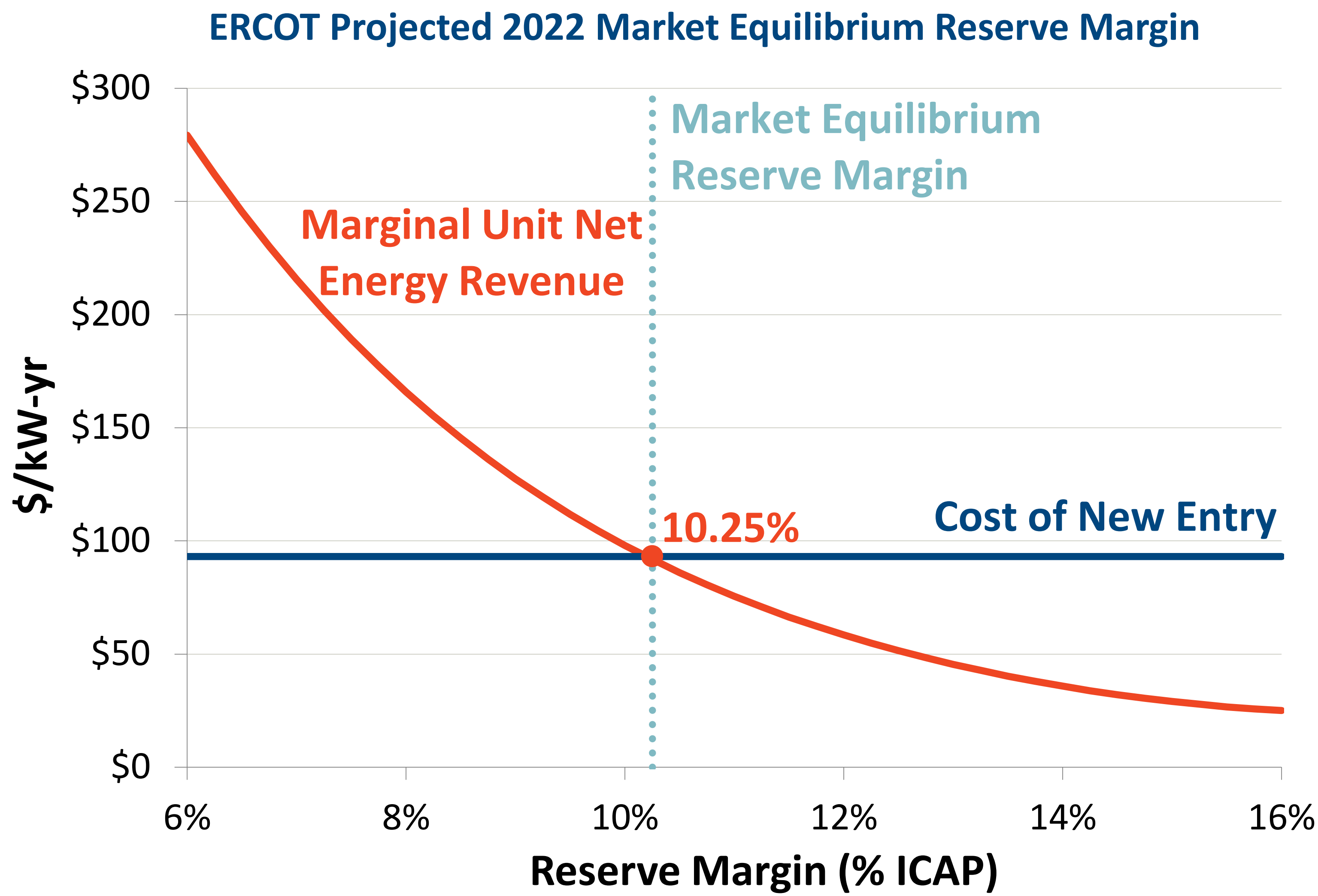
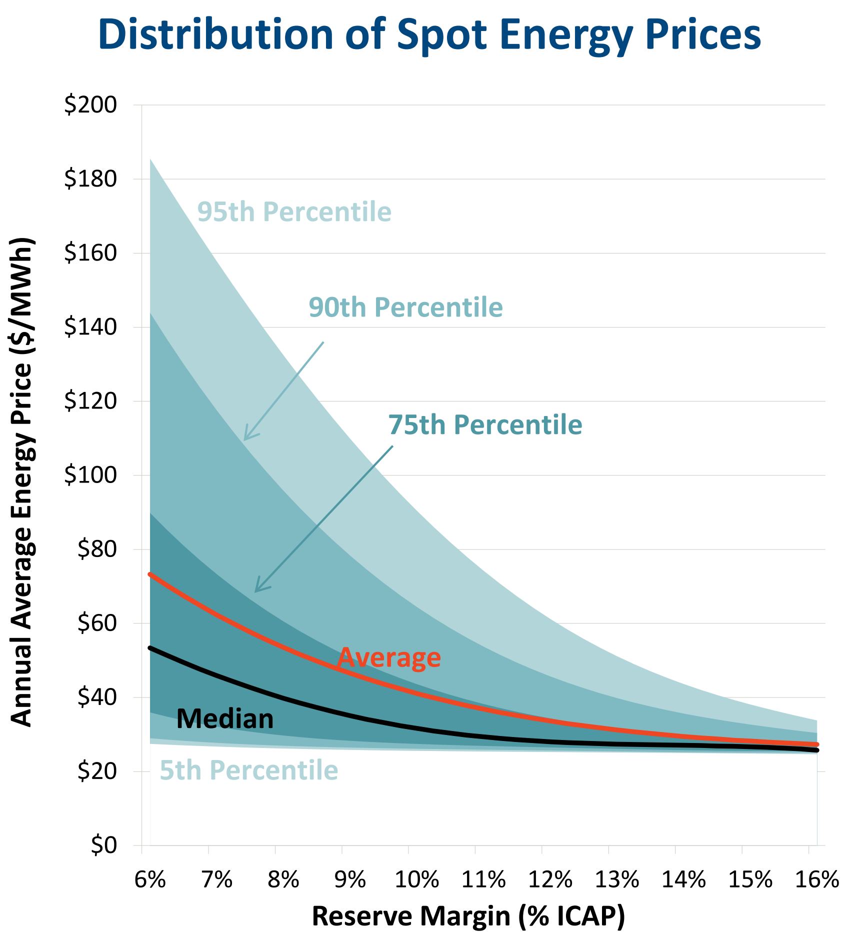
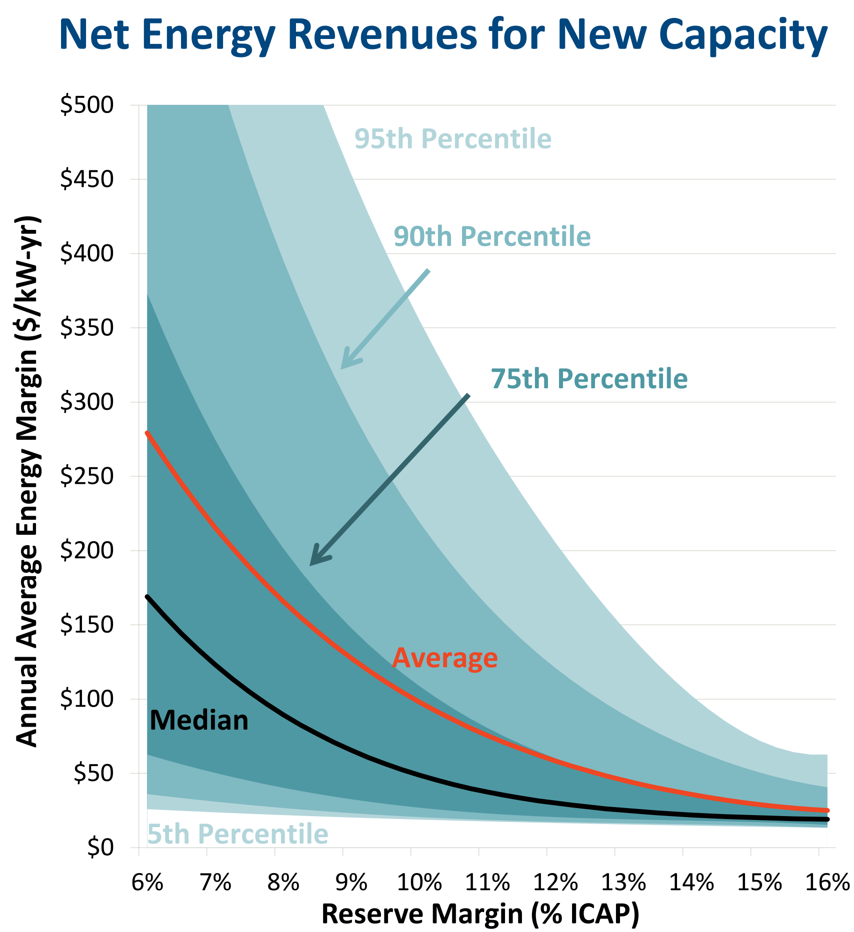
Market Equilibrium Reserve Margin



Source: 2018 Report, Figure ES-1 and Figure 5

Year-to-Year Volatility in Annual Average Price and Revenue



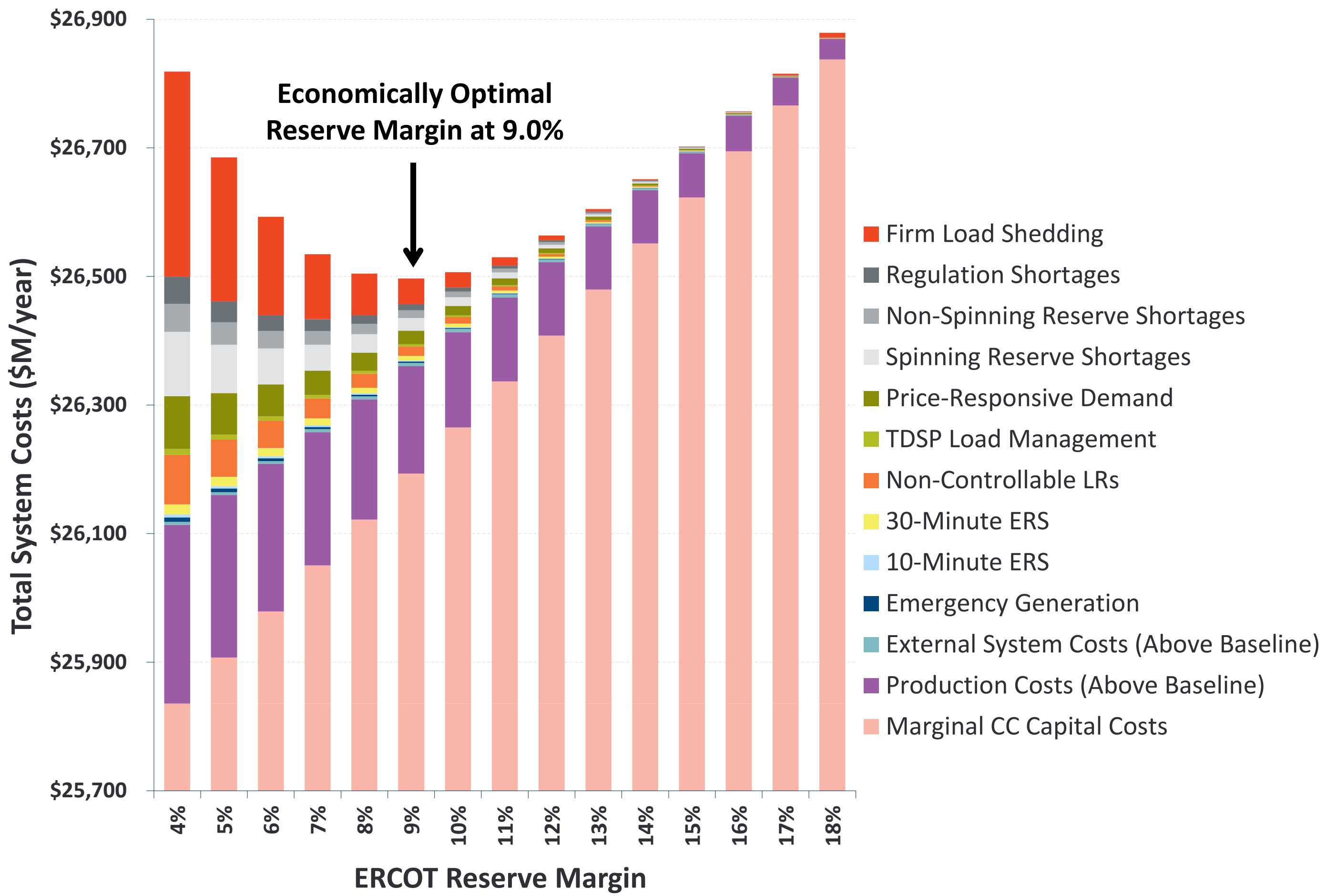


Source: 2018 Report, Figure 6

Note: Marginal Unit Net Energy Revenue represents the net revenue from a mix of added CCs and CTs (77:23 ratio)

Economically Optimal Reserve Margin

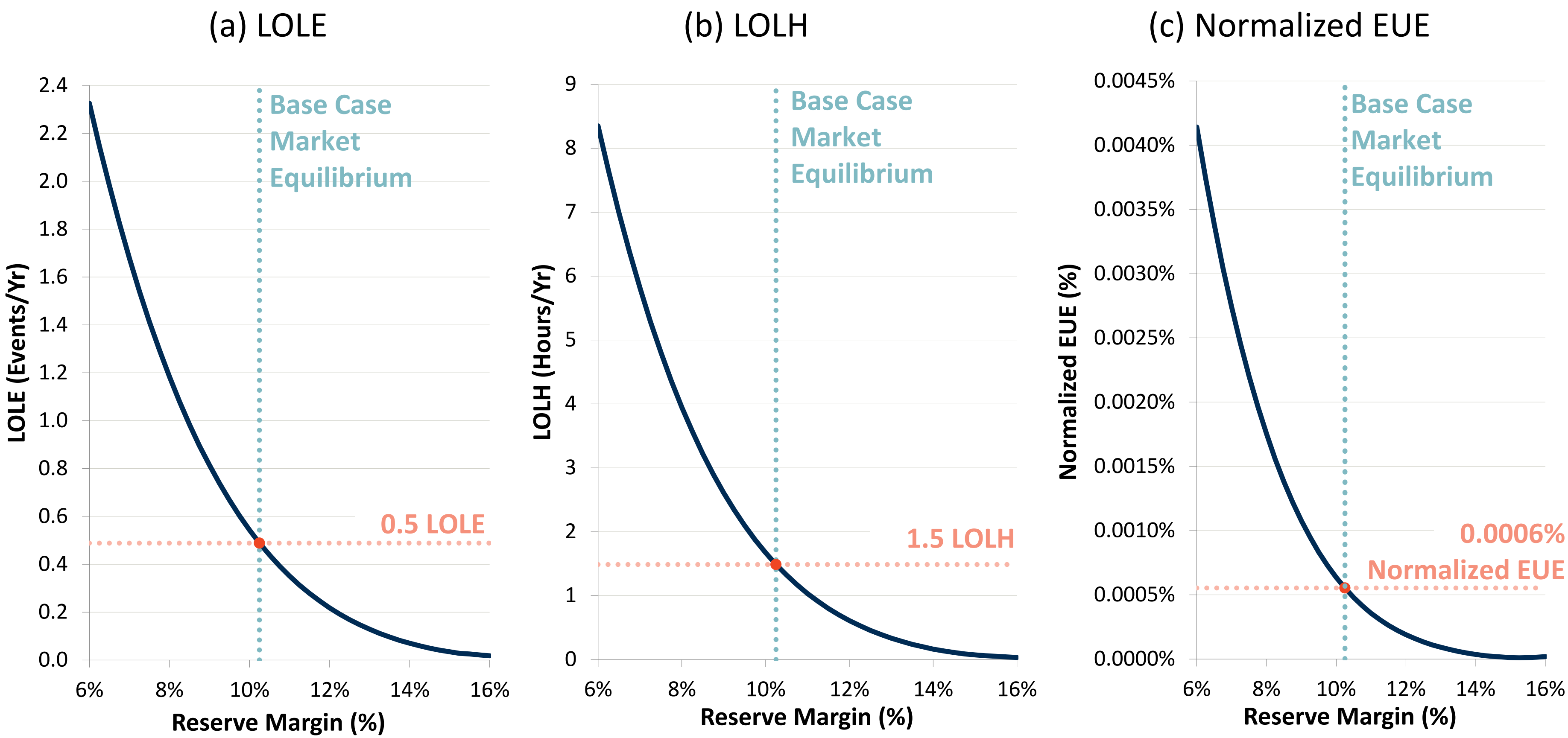
Total System Costs across Planning Reserve Margins



Source: 2018 Report, Figure 8

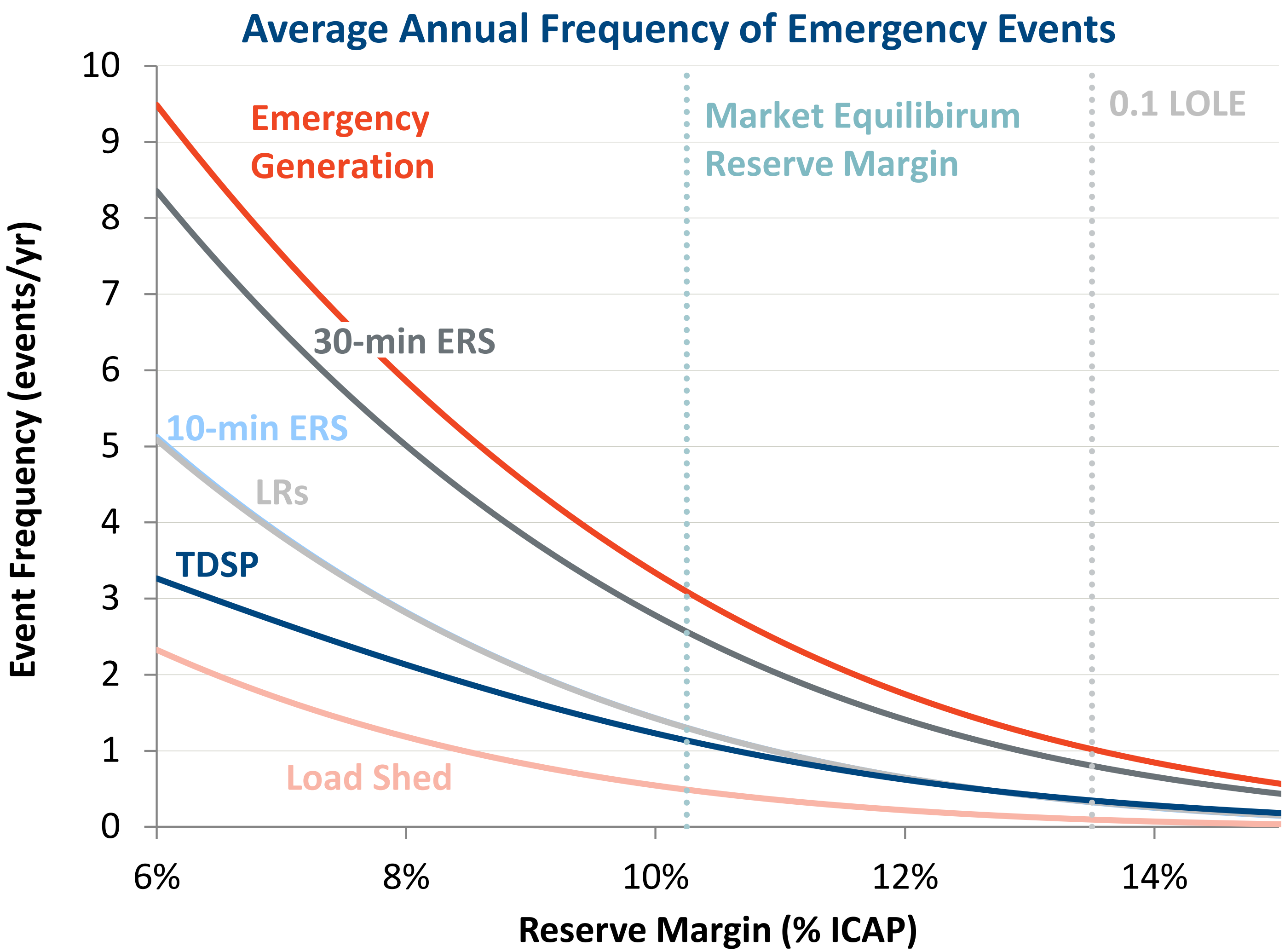
Physical Reliability Metrics

Reliability Metrics that Vary with Reserve Margins



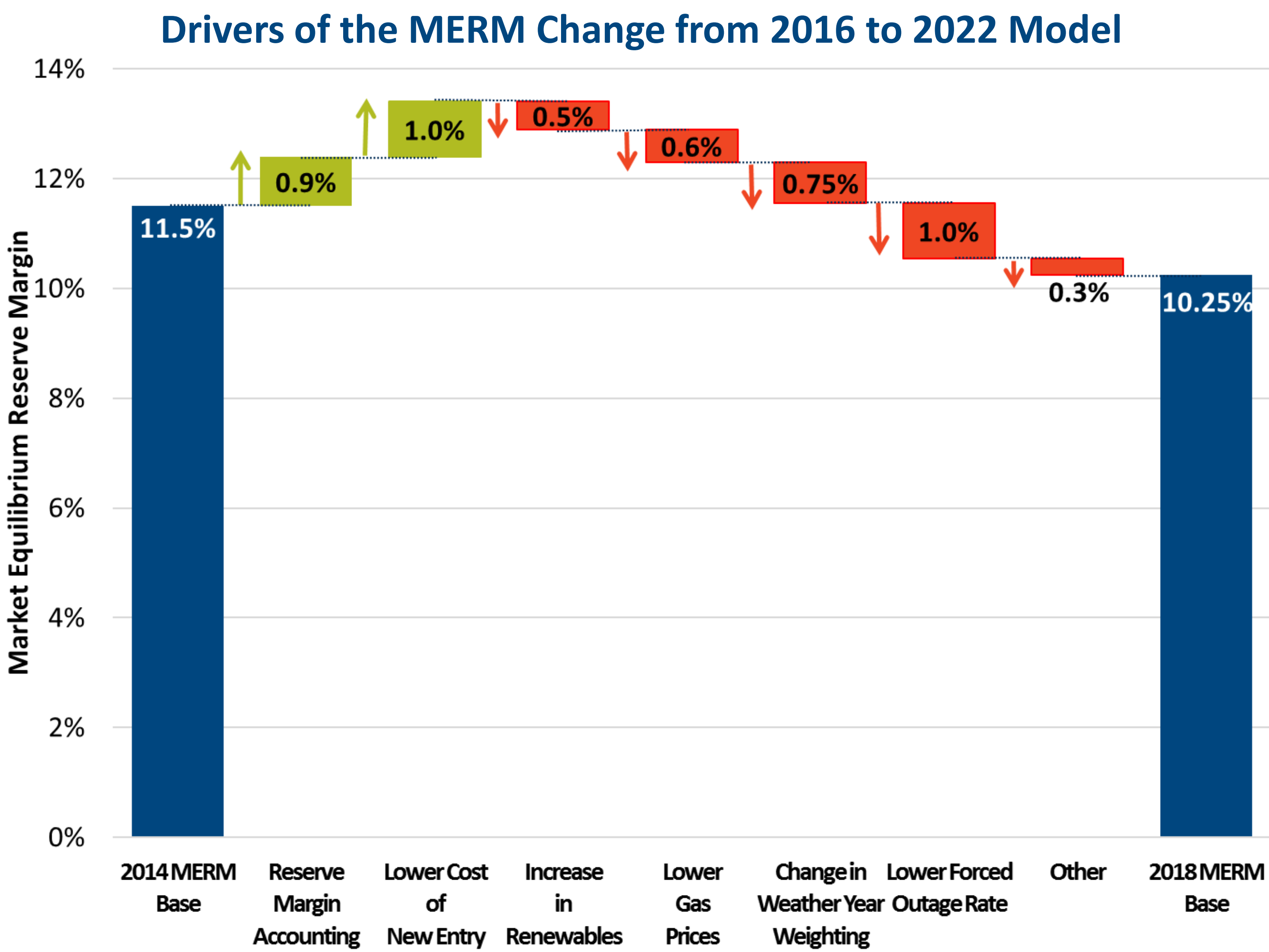
Source: 2018 Report, Figure 10

Emergency Event Frequencies



Source: 2018 Report, Figure 12

Comparison to 2014 EORM Study Results



Source: 2018 Report, Figure 7

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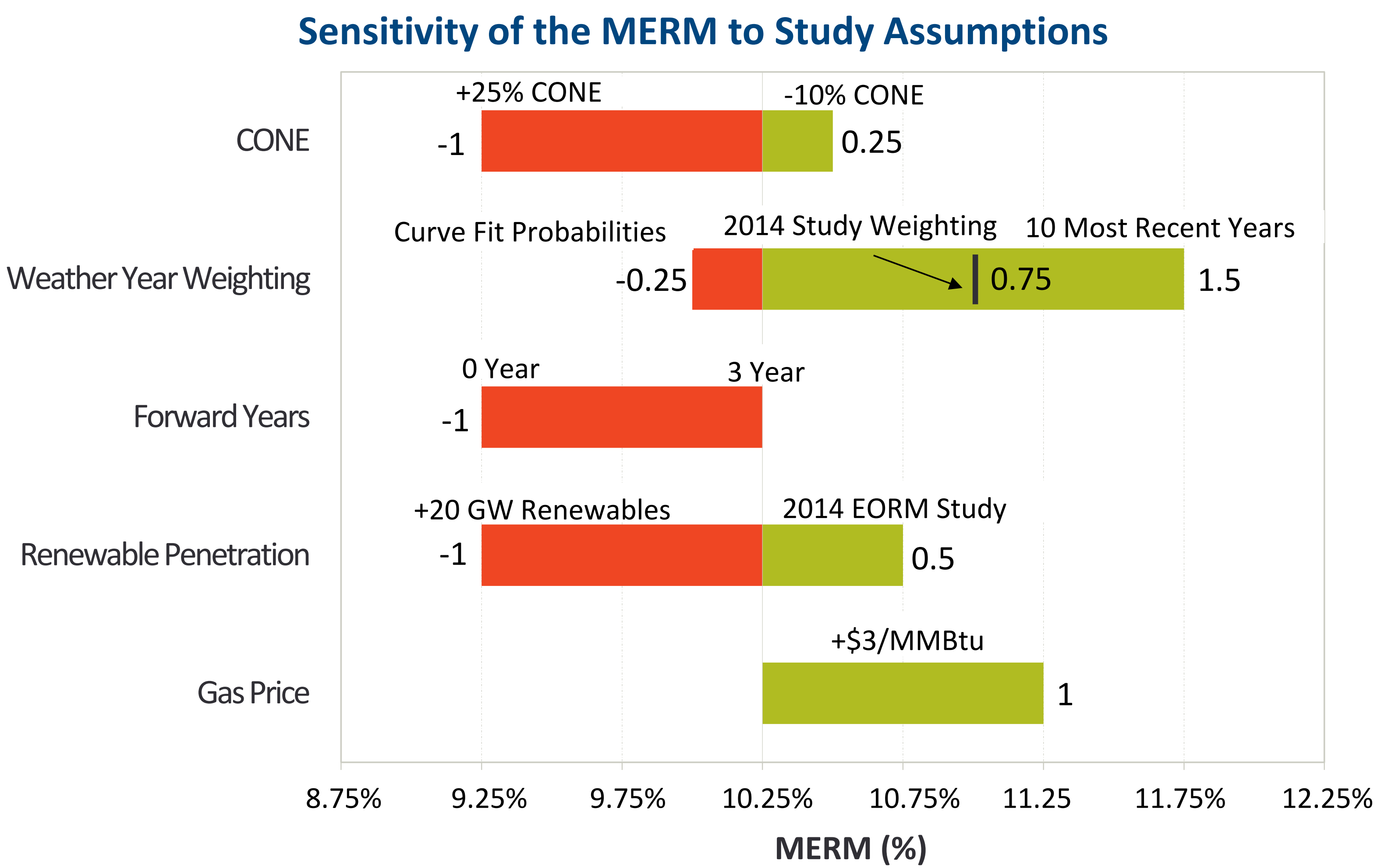
Sensitivity to Key Uncertainties

Variable	Base Case Assumption	Sensitivity Range
Renewables Penetration	9.6 GW new renewables	-10.7 GW/+29.6 GW of renewables*
High Gas Price	Henry Hub: $3.26	Henry Hub: $6.25
Gross CONE	CT: $89/kW-year CC: $95/kW-year	-10% / +25%
VOLL	$9,000/MWh	$5,000 to $30,000/MWh
Weighting of Historical Weather Years	Equal probability (2.6%) on last 38 years	(1) 10% on each of the last 10 years (2) Probabilities based on Pareto distribution fit to weather years based on number of consecutive days with weather over 100 degrees (3) Probabilities equal to 2014 EORM base case
Forward Period and Load Forecast Uncertainty	3 years	0 years to 2 years

Source: 2018 Report, Table 4 & Table 5
Note: * -20.3 GW/ + 20 GW from the Base Case assumption

Summary of Sensitivity Results



Source: 2018 Report, Figure 15

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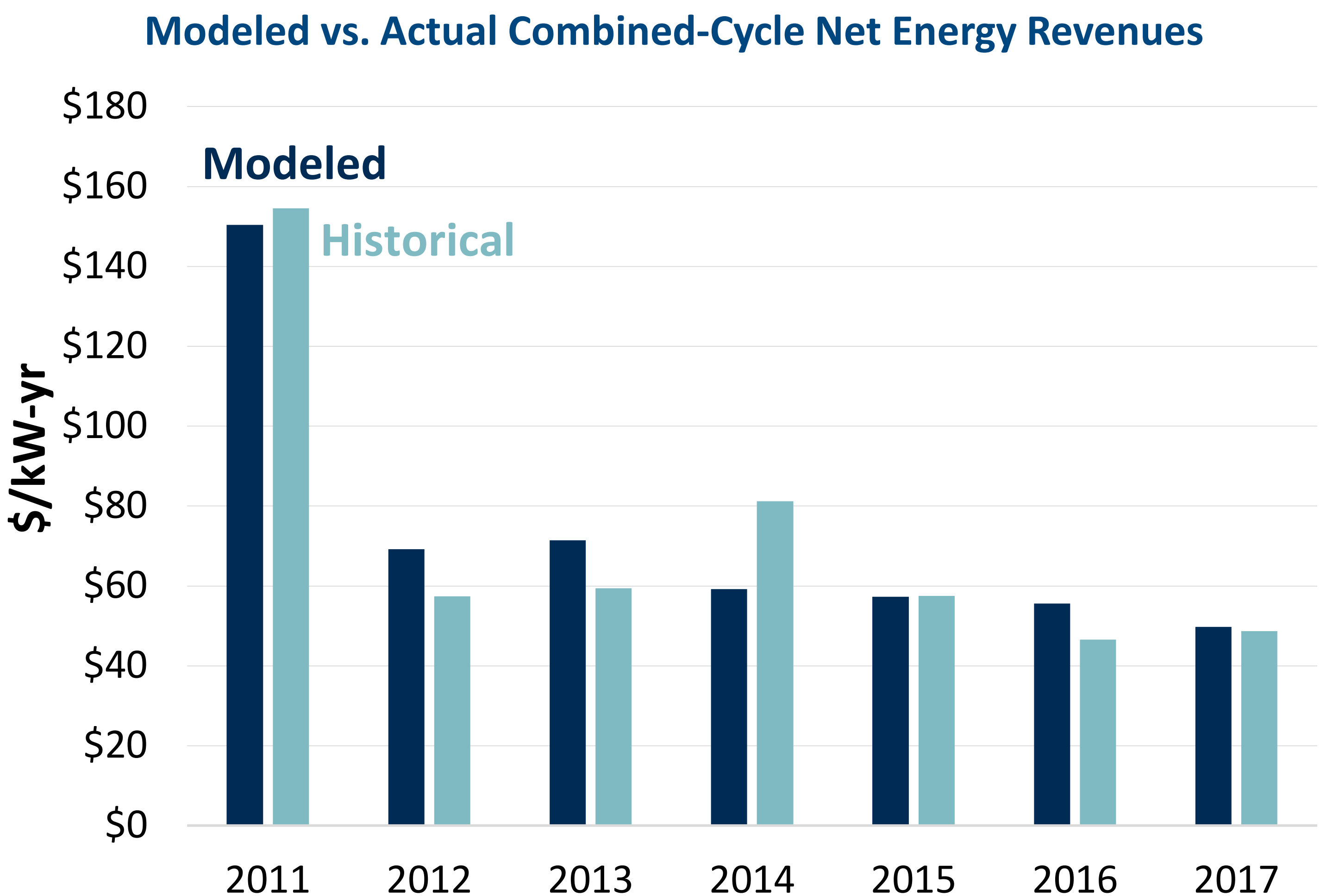
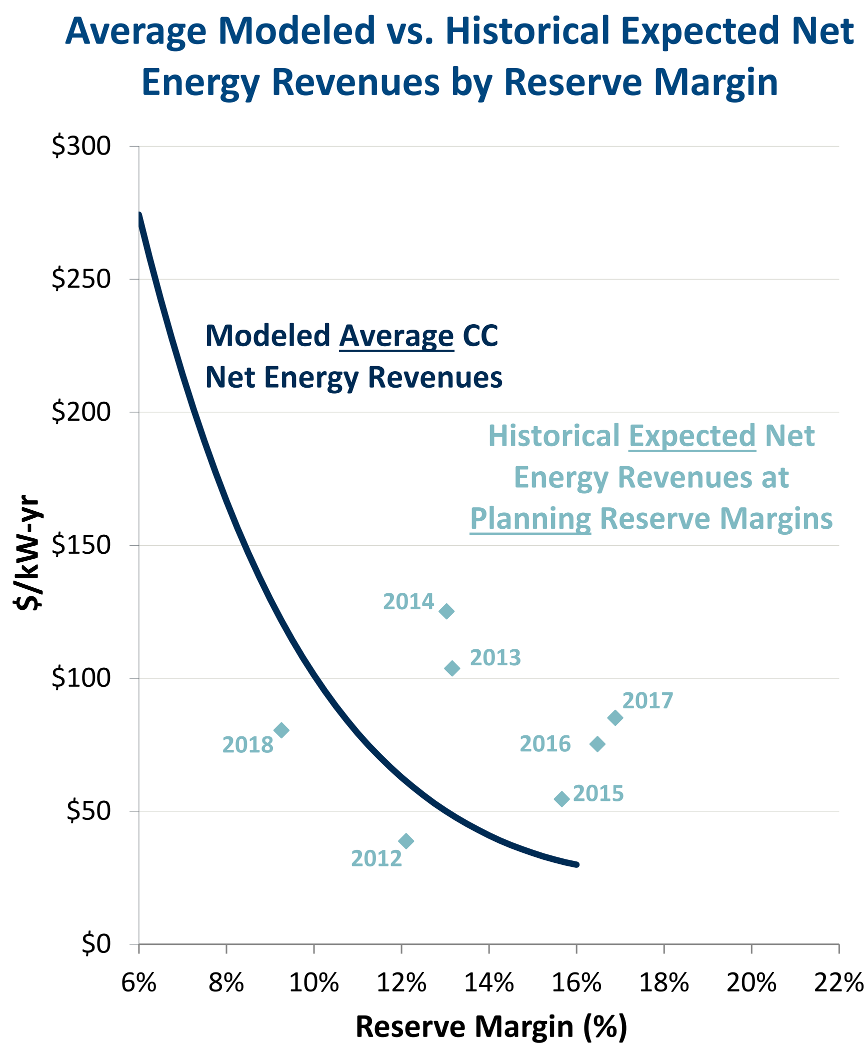
Model Validation (1 of 2)



Source: 2018 Report, Figure 3

Model Validation (2 of 2)



Source: 2018 Report, Figure 4

Reference Technology Assumptions

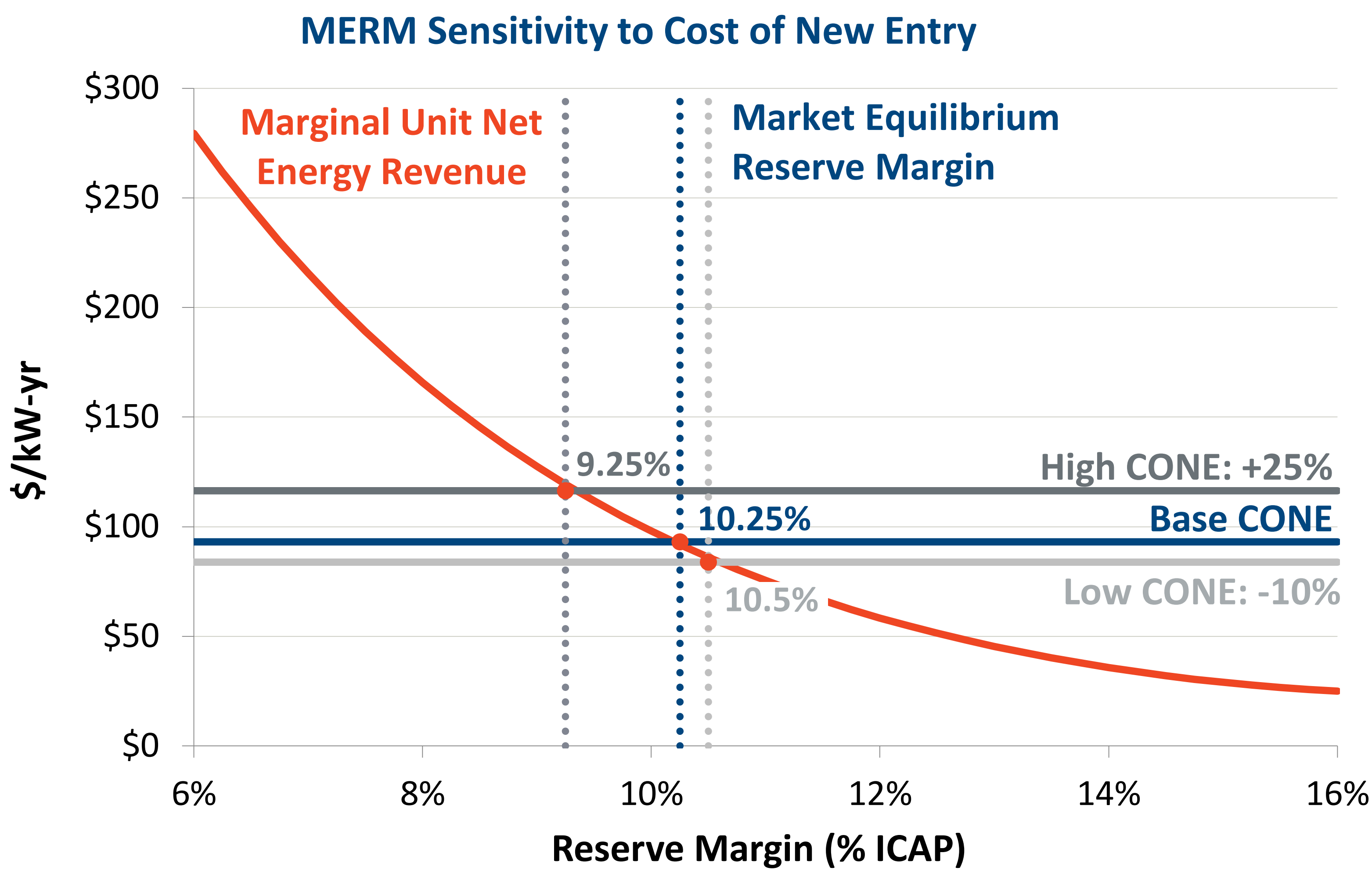
Higher reserve margin cases add reference technology that represents a mix of H-Class combined cycles and combustion turbines consistent with recent additions and announced new builds (77:23)

Reference Technology Cost and Summer Performance Characteristics

		Simple Cycle	Combined Cycle
Plant Configuration			
Turbine		GE 7HA.02	GE 7HA.02
Configuration		1 x 0	2 x 1
Heat Rate (HHV)			
Base Load	*(Btu/kWh)*	9,274	6,312
Max Load w/ Duct Firing	*(Btu/kWh)*	n/a	6,553
Installed Capacity			
Base Load	*(MW)*	352	1,023
Max Load	*(MW)*	n/a	1,152
Gross CONE	*($/kW-yr)*	**$89**	**$95**

Source: 2018 Report, Table 2

CONE Sensitivity Results



Source: 2018 Report, Figure 14

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Dr. Newell is the co-leader of the firm's electricity practice, with 20 years of experience in electricity wholesale markets, the transmission system, and RTO/ISO rules. He supports clients throughout North America in matters involving wholesale market design, generation asset valuation, transmission development, integrated resource planning, and demand response programs.

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Rebecca Carroll has nearly ten years of experience in energy economics and electricity market modeling. She has supported a broad range of clients on system planning, market rules development, retail gas and electric choice, power plant and transmission line valuations, regulatory hearings, and arbitration proceedings.

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Mr. Carden has over 18 years of experience in production cost simulations for risk analysis and reliability planning for power supply options, coupled with diverse utility management experience. Under Kevin's leadership, Astrapé Consulting has provided consulting services to utilities nationwide.

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