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Impact Assessment of ORDC Changes

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The Brattle Group

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PUCT requested an assessment of alternative ORDCs

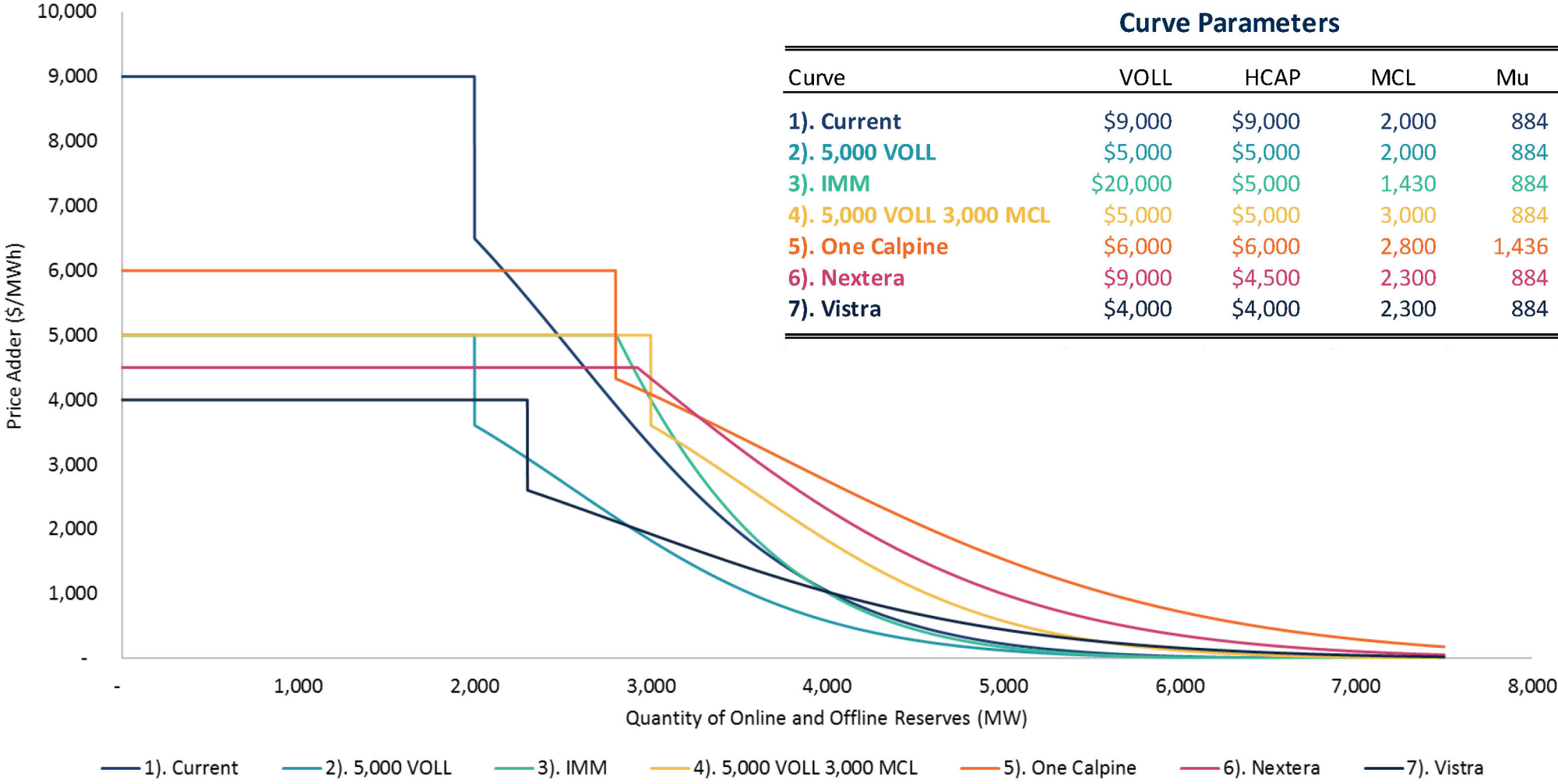
A wider ORDC can support several objectives

- Limit exposure to the very highest prices (lower HCAP) but without taking money out of the market, by allocating modest scarcity pricing to a greater number of hours.
- Send the strongest possible price signal (i.e., prices at HCAP) before ERCOT declares a Control Room Advisory (<3,000 MW reserves) or issues a Conservation Alert.
- Increase demand for reserves in real-time, consistent with ERCOT's day-ahead procurement of more AS; otherwise, the procured AS would cannibalize self-commitment unless ERCOT RUCs units to achieve the desired reserves.

This presentation assesses a several candidate wider curves, selected from stakeholders and ERCOT proposals to show a range of possibilities. We show:

- Each curve's parameters and shape
- Whether each curve reaches HCAP before PRC < 3000
- Impacts on prices and CC revenues *assuming* dynamic self-commitment but static investment
- Impacts on reserve margins and reliability *assuming* dynamic self-commitment and investment (such that prices equilibrate to long-run marginal cost) and no additional measures to support resource adequacy
  - This analysis does not account for extreme supply shortages as observed in February 2021 and thus overstates reliability absent other measures to prevent such shortages; modest changes to the ORDC cannot be viewed as a solution to such risks

ORDC Curves Evaluated



Curve Parameters

Curve	VOLL	HCAP	MCL	Mu	Sigma
1). Current	$9,000	$9,000	2,000	884	1,275
2). 5,000 VOLL	$5,000	$5,000	2,000	884	1,275
3). IMM	$20,000	$5,000	1,430	884	1,275
4). 5,000 VOLL 3,000 MCL	$5,000	$5,000	3,000	884	1,275
5). One Calpine	$6,000	$6,000	2,800	1,436	2,072
6). Nextera	$9,000	$4,500	2,300	884	1,939
7). Vistra	$4,000	$4,000	2,300	884	1,939

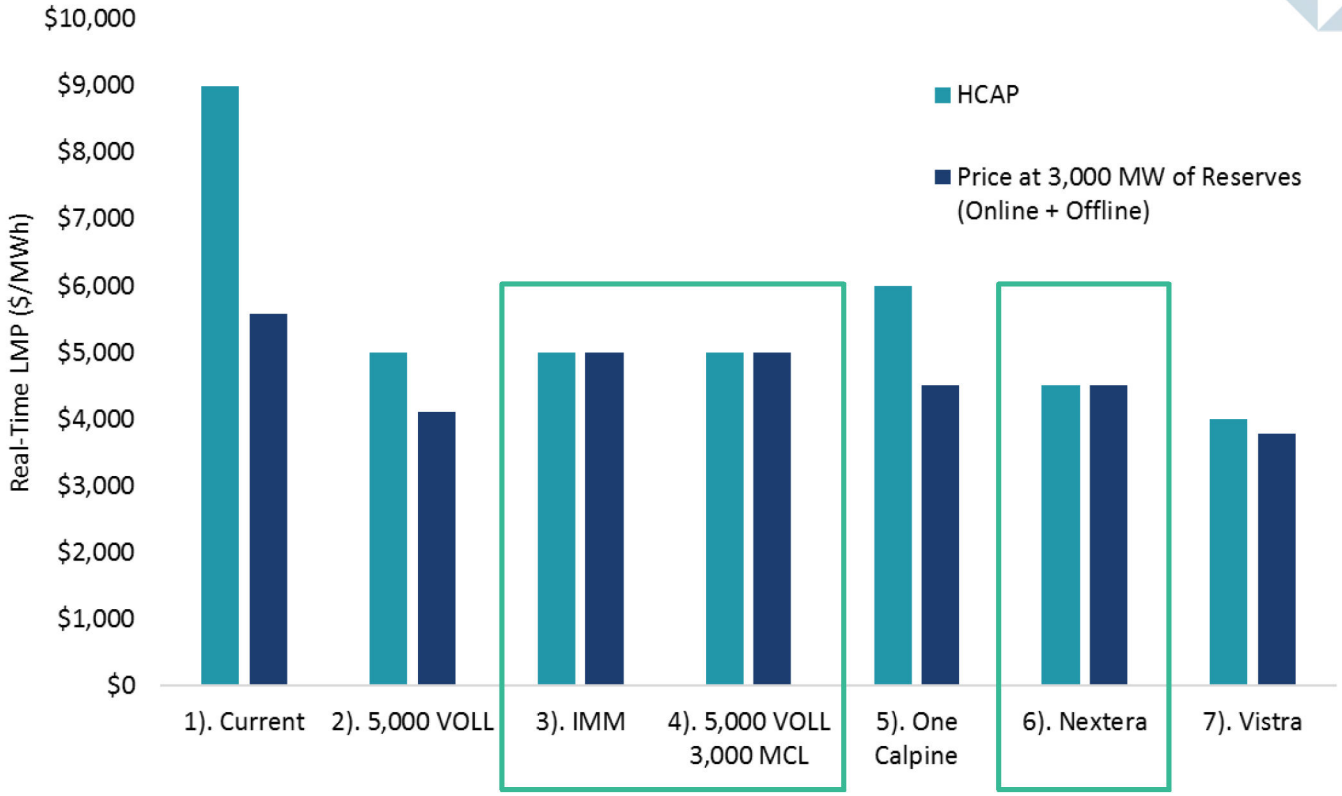
Note: These simplified curves are based solely on On-Line Reserves, assuming 0 MW of Off-Line Reserves, and system lambda of $0.

Which curves achieve their price cap *before* ERCOT advisory?

Of the curves evaluated, only the "**5,000 VOLL 3,000 MCL**" curve will always necessarily yield an energy price at HCAP at 3,000 MW of reserves, **before ERCOT has declared a Control Room Advisory**.

Depending on system lambda, several other curves may at times also yield energy prices at HCAP at 3,000 MW of reserves.

Using proxy values ERCOT provided, the "**IMM**" and "**Nextera**" curves resulted in energy prices at HCAP at 3,000 MW of reserves.



Which curves will alleviate the need for frequent RUCs?

ERCOT estimates that a **$10/MWh adder** is sufficient to cover the start-up costs of a marginal combustion turbine, assuming 4 hours of operation.

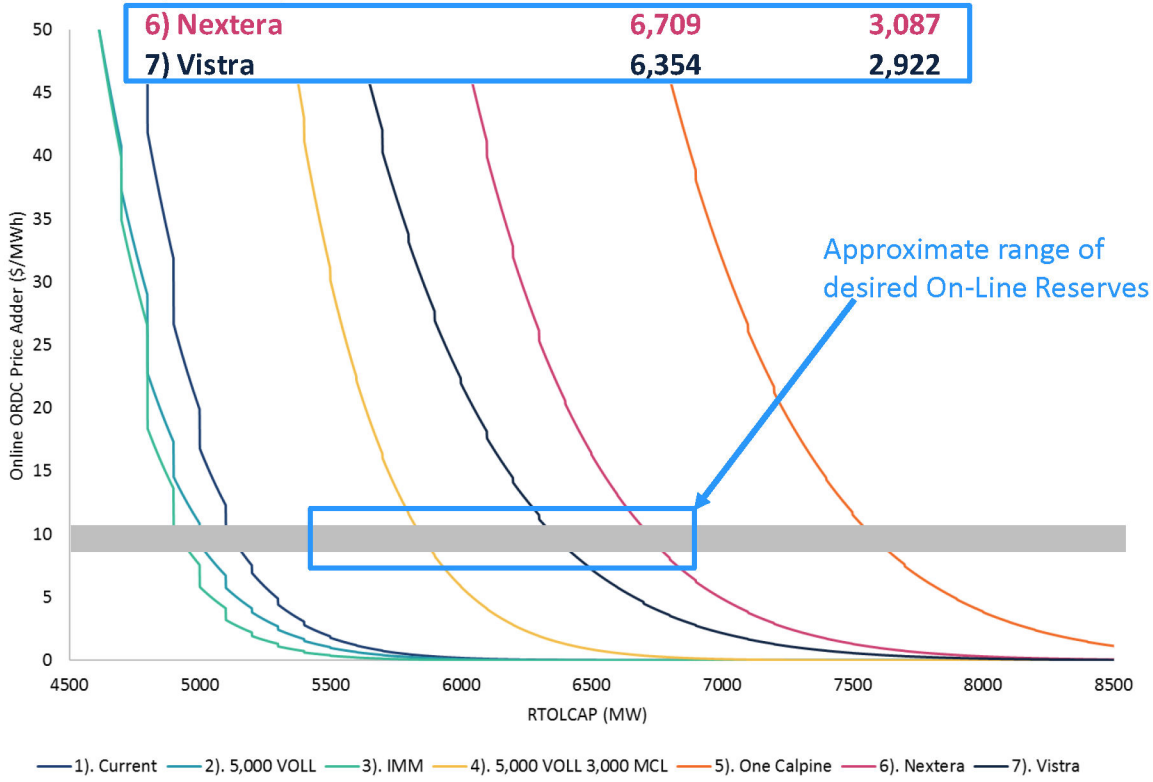
This level of adder should incent these units to **self-commit when they would otherwise remain offline** (leaving ERCOT to RUC them when needed).

Since summer 2021, ERCOT has utilized the RUC process to commit units as needed to maintain between **5,500 to 5,800 MW of on-line reserves.**

The ORDC should achieve a comparable operational result by imposing a **$10/MWh price adder at around 5,500 – 5,800 MW of on-line reserves.**

Level of Reserves Yielding a $10/MWh Adder (MW)

Curve	RTOLCAP	RTOFFCAP
1) Current	5,114	1,820
2) 5,000 VOLL	4,999	1,508
3) IMM	4,913	1,508
4) 5,000 VOLL 3,000 MCL	5,845	2,534
5) One Calpine	7,572	3,450
6) Nextera	6,709	3,087
7) Vistra	6,354	2,922



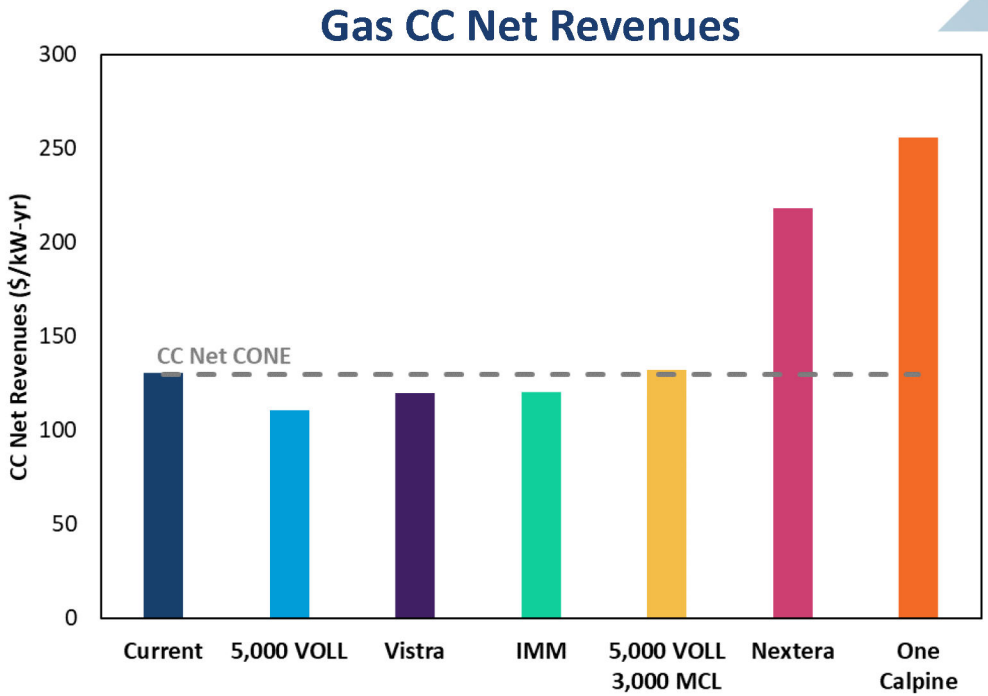
Energy prices with static investment & dynamic commitment

Modeled using **2019 weather** and 12% reserve margin

With **static investment**, the fleet is constant across ORDC scenarios.

Dynamic commitment allows economic commitment depending on prices. This moderates price impacts of wider ORDCs.

The gold curve's width just compensates for its decreased cap's impact on revenues & prices.



Average Energy Price ($)

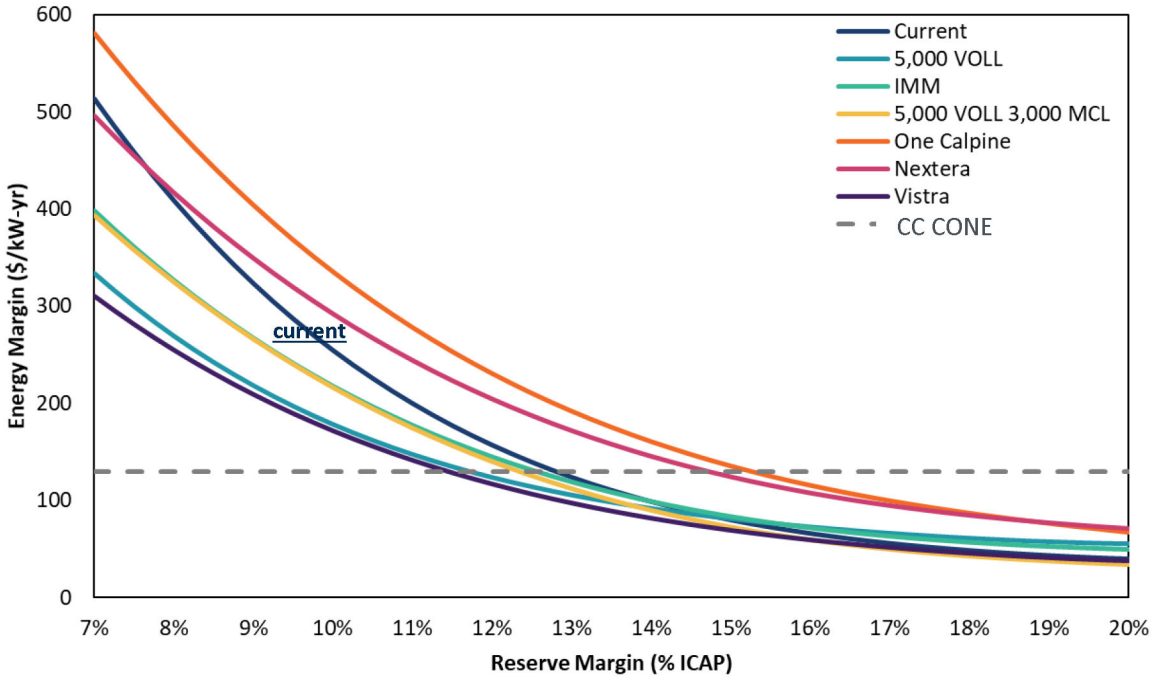
Curve	Month												Annual Average	Annual Load Weighted Average
	1	2	3	4	5	6	7	8	9	10	11	12		
Current	31	28	21	28	30	31	46	143	44	28	26	27	40.4	48.3
5,000 VOLL	37	31	22	29	31	31	37	102	35	29	29	31	37.0	41.9
IMM	35	30	22	29	29	30	35	115	41	28	28	29	37.7	43.5
5,000 VOLL 3,000 MCL	31	27	24	27	33	31	48	129	42	25	27	28	39.5	46.6
One Calpine	39	31	41	41	68	42	73	186	64	30	45	41	58.9	70.0
Nextera	41	34	39	37	56	44	79	161	46	28	37	42	54.0	63.6
Vistra	29	23	26	24	36	33	47	105	37	24	29	31	37.0	42.8

Impacts on equilibrium reserve margins and reliability

Dynamic investment is modeled based on economics: if the net revenues earned by a typical CC exceed the levelized cost of new entry (CONE), **new generation will be built** until **equilibrium is reached** (see right, assuming many years of weather conditions; equilibrium RM is at intersection)

Several ORDCs incent about as much investment as current, in spite of lower caps, marginally affecting reserve margins.

The widest two would increase reserve margins, but likely not solve the deeper Uri problems (not modeled here) absent other measures and might force on more capacity than needed operationally.



Equilibrium Reserve Margin and Reliability Metrics

Curve	Equilibrium Reserve Margin (%)	LOLE (events/year)	EUE (MWh)	EUE (ppm of load)	LOLH (hours/year)
Current	12.8%	0.36	1480	3.55	1.11
5,000 VOLL	11.8%	0.59	2660	6.39	1.76
IMM	12.6%	0.37	1729	4.15	1.14
5,000 VOLL 3,000 MCL	12.3%	0.49	2194	5.27	1.51
One Calpine	15.3%	0.10	316	0.76	0.27
Nextera	14.7%	0.13	449	1.08	0.38
Vistra	11.5%	0.71	3350	8.04	2.23