

Sixth Review of the PJM's RPM VRR Curve Parameters

MEETING #2: REFERENCE TECHNOLOGY INITIAL SCREENING
ANALYSIS

PREPARED BY

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PRESENTED TO

PJM Market Implementation
Committee

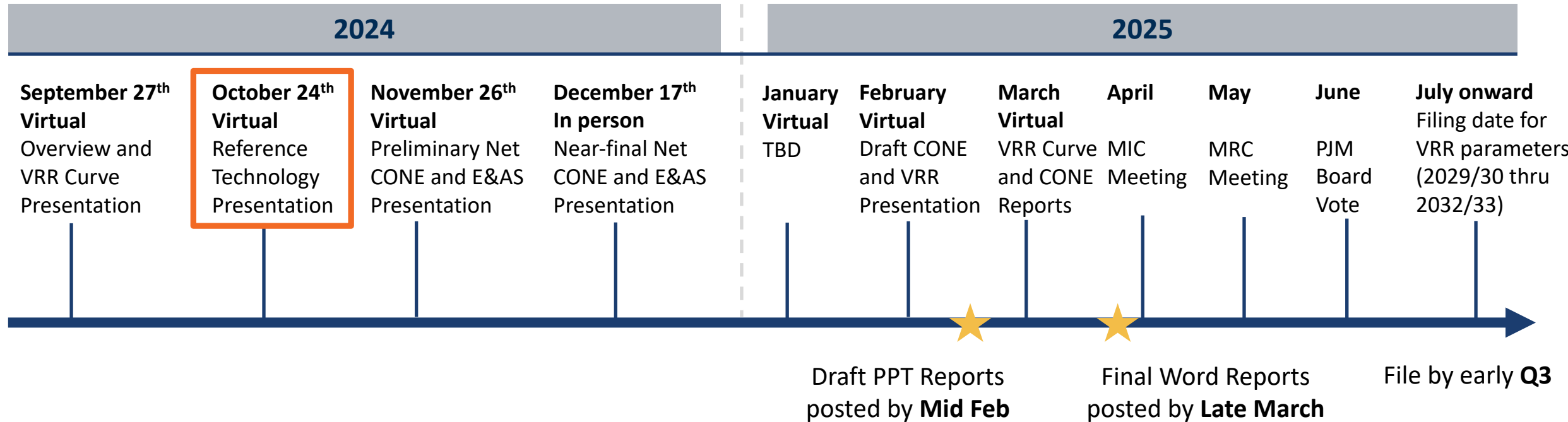
OCTOBER 24, 2024



Agenda

- 1. Quad Review Timeline**
- 2. Reference Technology High-Level Screening**

Timeline for Quadrennial Review



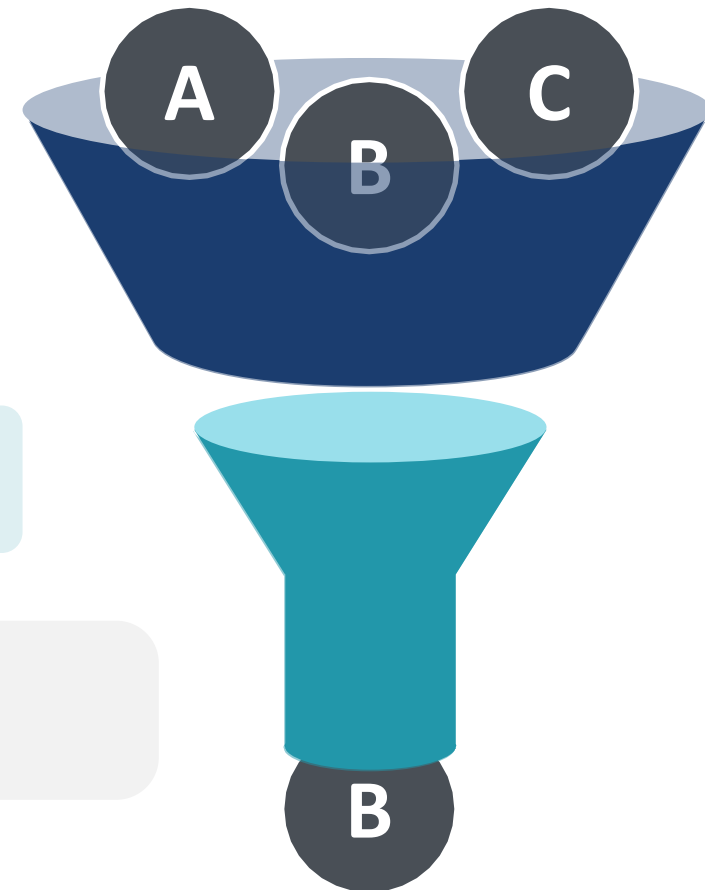
Workplan for Reference Technology Screening and Selection

1. Identify Candidate Technologies

2. Apply Evaluation Criteria in High-Level Screening
Criteria from PJM RFP: (see next slide)

3. Conduct detailed analysis on short-listed technologies and reapply evaluation criteria

4. Recommend Reference Technology
(or technologies if appropriate for different areas)



Criteria for Selecting Reference Technology



1. Economic viability

- Demonstrated by recent/planned merchant entry
- Not having a Net CONE much higher than other reasonable candidates



2. Feasibility to build at scale by delivery year



3. Compliance with all regulations and can operate as needed



4. Ability to accurately assess Net CONE

- Capital and operating costs demonstrated from commercial experience
- Costs are uniform when scaled, rather than increasing steeply as best sites are exhausted
- Long-term net revenues can be projected well enough to calculate a first-year revenue requirement (CONE), considering possible future technology/market/system/regulatory conditions
- Not largely dependent on revenues that are difficult to forecast (AS, energy arbitrage, RECs)
- Has high ELCC, else cost and EAS uncertainties (per kW ICAP) are amplified per kW UCAP



5. Stable reliability contribution for each/all of the 4 delivery years to limit unpredictability of Net CONE

Proposed Technologies to Consider

Proposed Candidates for Initial Screen

- **Gas-Fired Frame Combustion Turbine (CT)**
- **Gas-Fired Combined-Cycle (CC)**
- **4-hour Battery Energy Storage System (BESS)**
- **6, 8, and 10-Hour BESS**
- **PV + BESS 4hr**

We excluded several technologies

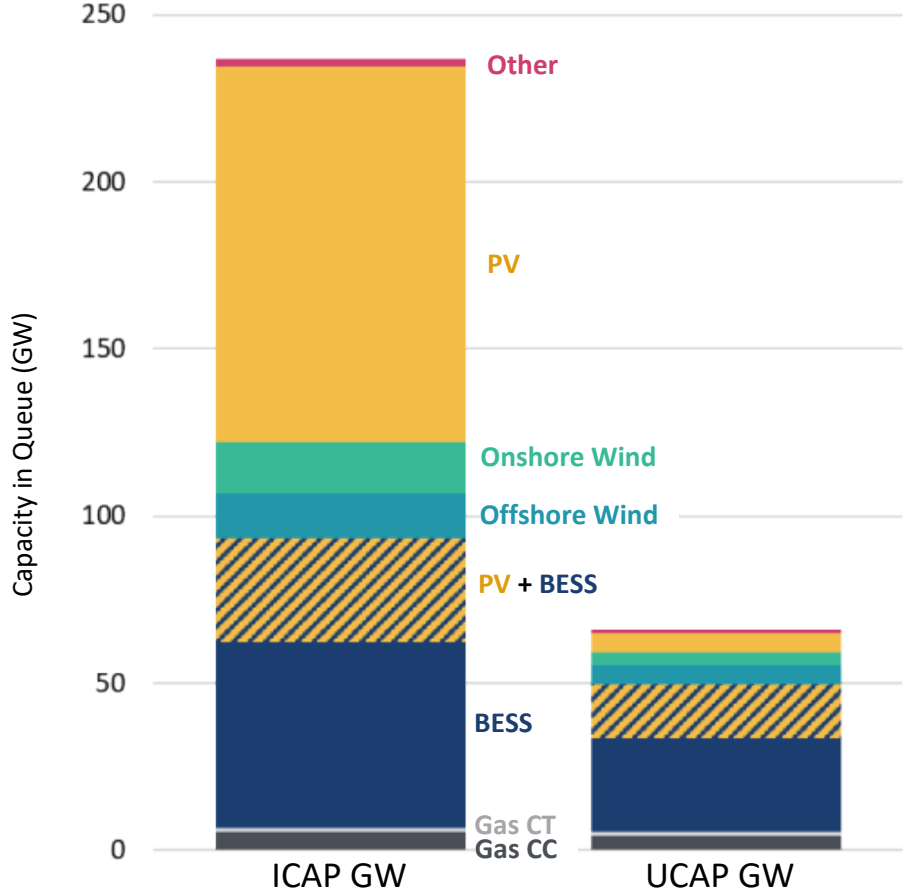
- ⌘ **Onshore Wind:** unclear REC value; uncertainties amplified by low expected reliability contribution
- ⌘ **Solar PV:** unclear REC value; uncertainties amplified by very low expected reliability contribution
- ⌘ **Demand Response:** difficult to accurately estimate CONE because likely idiosyncratic and does not scale
- ⌘ **Upgrades/Conversions:** inability to accurately estimate CONE because idiosyncratic and not scalable
- ⌘ **Emerging Technologies:** Not feasible to build by Delivery Year; difficult to assess Net CONE

Queue as an Indicator of Development Activity and Implied Economic Viability

Interconnection Queue (2029/30 DY)

Technology	ICAP (GW)	ELCC (%)	UCAP (GW)
	[A]	[B]	[C]: [A] × [B]
Gas CC	5	83%	4
Gas CT	1	68%	1
Solar	113	5%	6
Storage	55	51%	28
PV+BESS	31	TBD	TBD
Onshore Wind	15	25%	4
Offshore Wind	14	44%	6
Other	2	Varies	1

Interconnection Queue (2029/30 DY)



Sources and Notes: [A]: Project ICAP values from PJM, [Serial Service Request Status](#), October 2024; [B]: Projected 2029/30 ELCC values from PJM, [Supplementary Information about ELCC Class Ratings calculated for DY 2027/28 – DY 20234/35](#), August 6, 2024, p. 3. Summarized data includes all projects active in the queue with a Commercial Online Date (COD) prior to June 1, 2029.

Gas-Fired Plants in Development

Project Name	Target COD	State	Queue Status	LDA	Ownership	ICAP (MW)
New Build Gas-Fired Total						6,010
Gas CC Total						4,740
Glen Falls 138kV	03/31/2028	WV	Engineering and Procurement	APS	IPP (GE subsidiary)	550
Sullivan 345kV #1	06/01/2025	IN	Engineering and Procurement	AEP	IPP (Invenergy)	575
Sullivan 345kV #2	06/01/2025	IN	Engineering and Procurement	AEP	IPP (Invenergy)	575
Highland-Hanna 345kV	08/12/2025	OH	Under Construction	ATSI	IPP (Clean Energy Future)	940
Belmont-Flint Run 500 kV	07/01/2026	WV	Active	APS	IPP (Competitive Power Ventures)	2,100
Gas CT Total						1,138
Chesterfield 230 kV	06/01/2023	VA	Active	Dominion	Regulated Utility (Dominion)	569
Chesterfield 230 kV	12/31/2029	VA	Engineering and Procurement	Dominion	Regulated Utility (Dominion)	569
Gas Other Total						132
Coal to Gas Conversion Total						750
Osage 138 kV	04/01/2022	WV	Active	APS	IPP (Vicinity Energy)	50
Rockport 765 kV	05/31/2026	IN	Active	AEP	Regulated Utility (AEP)	700
Existing Facility Uprates Total						1,437
Gas CC						725
Gas CT						703
Gas Other						9
Total Gas-Fired Capacity in Queue						8,197

Sources and Notes: Project ICAP values retrieved from PJM, [Serial Service Request Status](#), October 2024. The full 1,138 MW of the Chesterfield 230 kV CT facility included here, but the 569 MW portion with target COD of 12/31/2029 is excluded from totals on prior slide due to a projected COD after the June 1 start of the 2029/30 DY.

Indicative Net CONE Ranges, Starting Wide

Technology	Overnight Capital Cost	Capital Charge Rate	Year-1 Capital Recovery	Levelized FOM	E&AS Offset	Net CONE ICAP	ELCC	Net CONE UCAP
All \$2024	(\$/kW)	(%/year)	(\$/MW-day)	(\$/MW-day)	(\$/MW-day)	(\$/MW-day)	(%)	(\$/MW-day UCAP)
	[A]	[B]	[C]: [A] × [B]	[D]	[E]	[F]: [C]+[D]-[E]	[G]	[H]: [F] × [G]
Gas CC	\$1,178-\$1,505	13.3%-20.2%	\$429-\$832	\$109-\$148	\$118-\$573	-\$35-\$862	83%	-\$42-\$1,038

Sources and Notes: All costs in ICAP terms and 2024 \$s unless otherwise noted.

[A],[D]: Capital Cost and FOM from NREL, [2024 ATB](#); CT adjusts -15% from F to H class; BESS costs include 30% reduction for the ITC; CapEx range is -10 to 15%; FOM -15% to +15%.

[B]: CCR for nominal levelization with 9.5% ATWACC; no bonus depreciation; 20-year life for gas and 15 for BESS; 20-year MACRS for CC, 15 for CT, and 7 for BESS; and IDC. Range expresses +/- 1% ATWACC, possibility of 10-year economic life for CC, and 2% steeper real revenue decline for BESS. In “stringent state,” assume effective economic life ranges from 8 year to 15 years.

[E]: E&AS offset provided by PJM staff; for CCs, assume only 70% of EAS retained with 111(b) rules. Range for CC/CT reflects 10-year historical low and possibility of +25% (and possibility of regaining half the EAS lost to 111). “Stringent States” are NJ, IL, and MD with EAS baseline chosen from IL (middle value). For BESS, range of possibility as +/-30%.

[G]: 2029/30 ELCC values from PJM, [Supplementary Information about ELCC Class Ratings calculated for DY 2027/28 – DY 20234/35](#).

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Gas CT	\$880-\$1,125	13.0%-14.0%	\$314-\$432	\$48-\$65	\$71-\$295	\$67-\$427	80%	\$84-\$533

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Gas CC (Stringent State)	\$1,178-\$1,505	16.2%-23.3%	\$524-\$961	\$109-\$148	\$74-\$310	\$323-\$1,034	83%	\$389-\$1,246

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BESS 4-hr	\$933-\$1,192 net of 30%ITC	11.9%-15.0%	\$303-\$490	\$86-\$117	\$198-\$367	\$23-\$410	41%-61%	\$37-\$999

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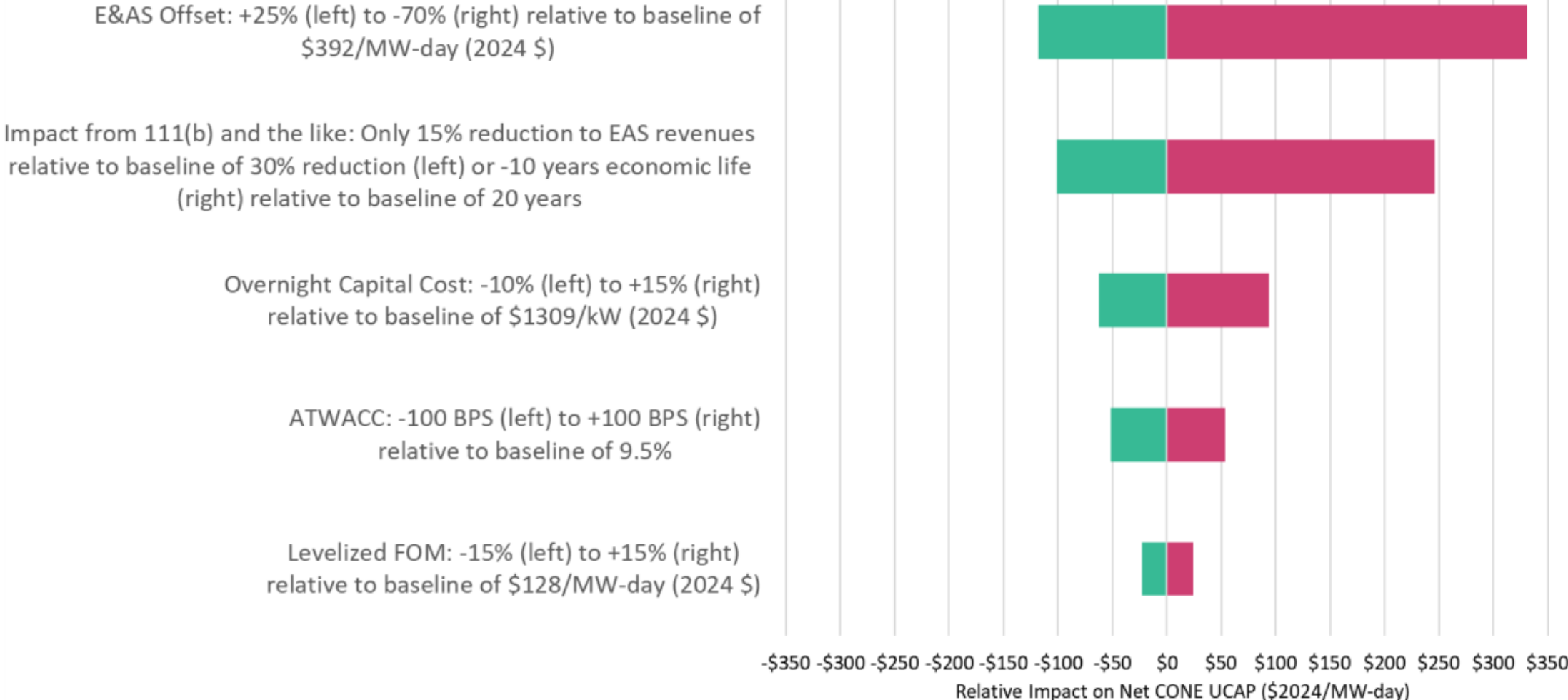
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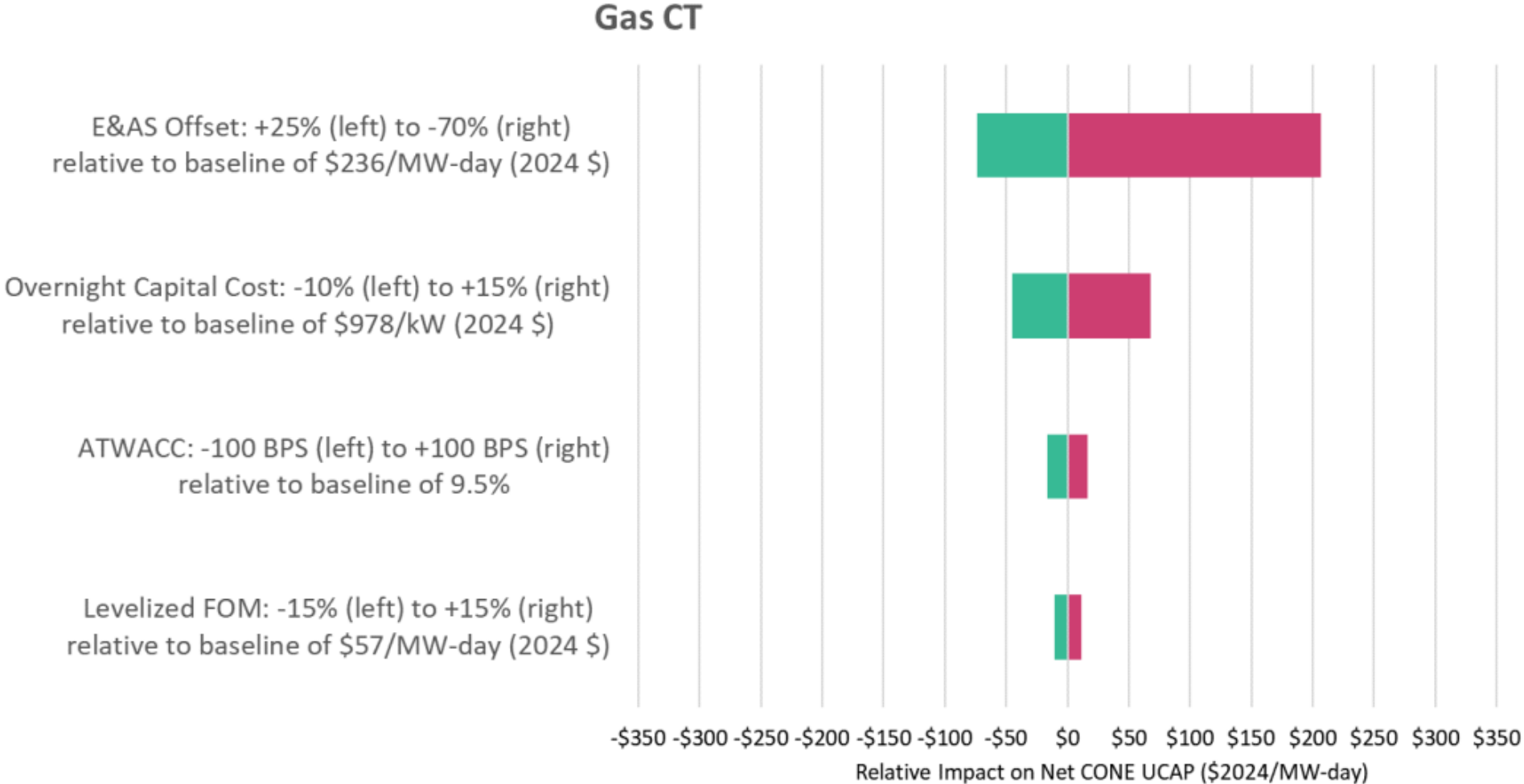
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Indicative Net CONE Sensitivities

Gas CC

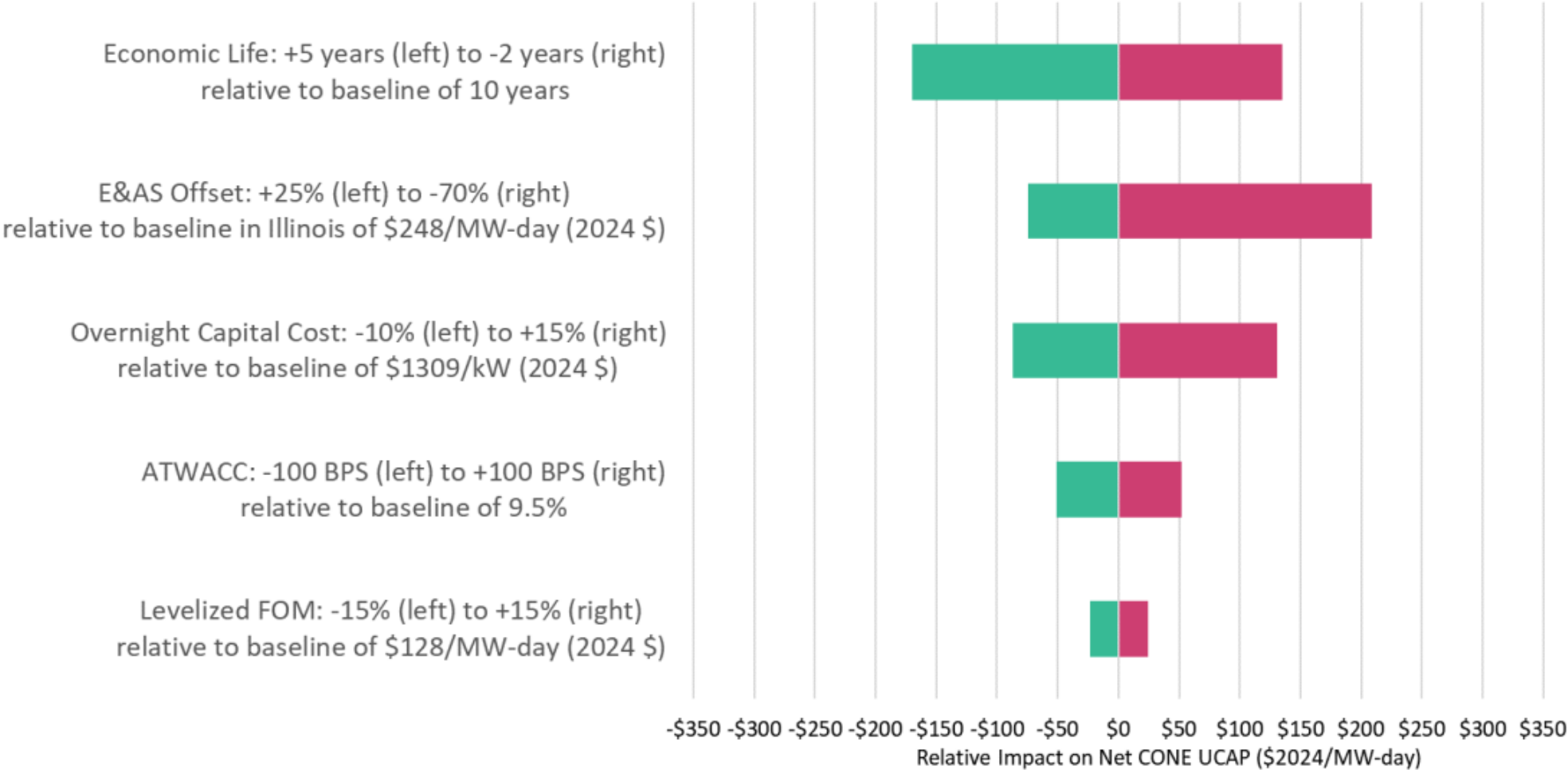


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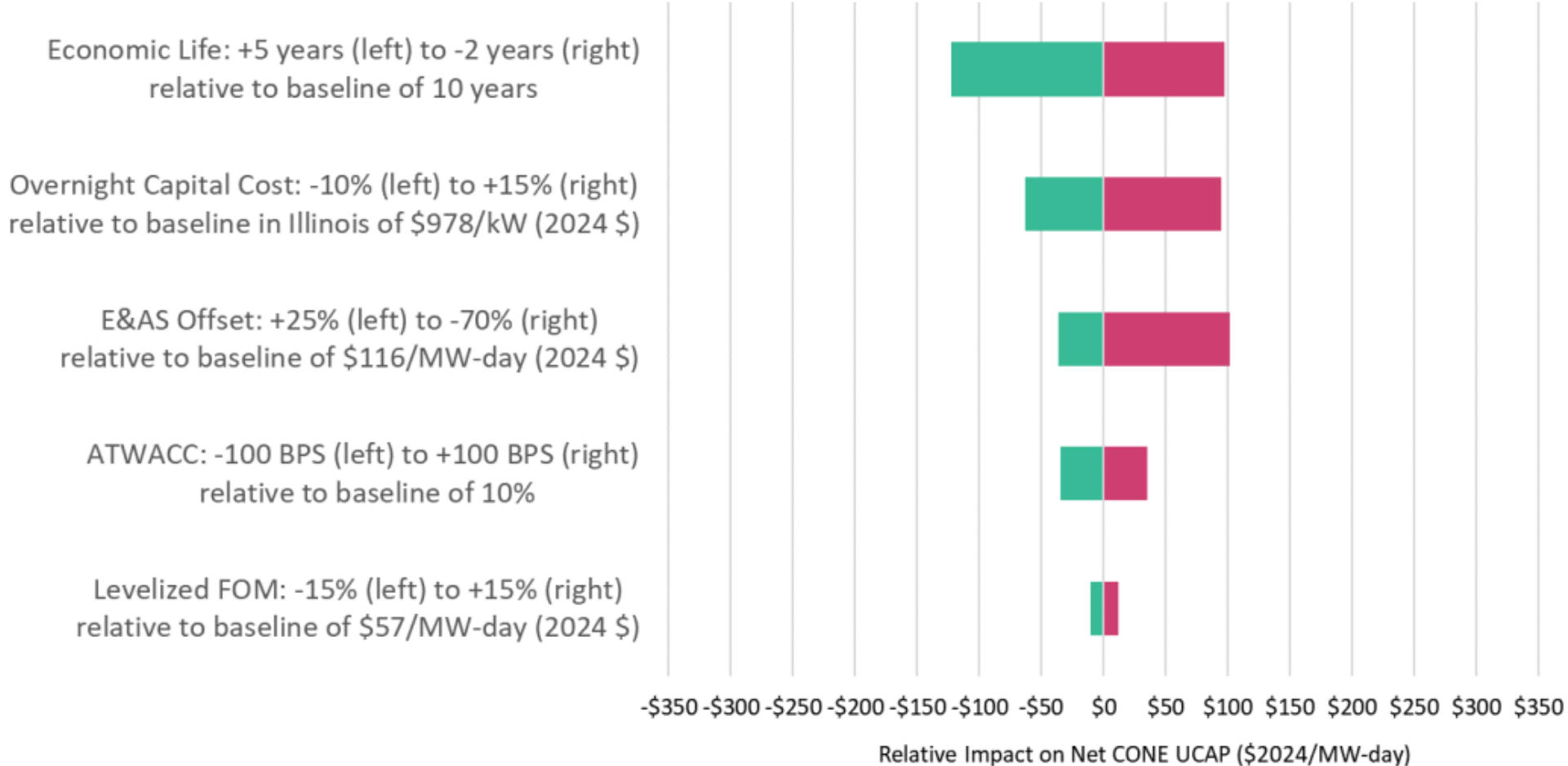
Indicative Net CONE Sensitivities

Gas CC (Stringent States)



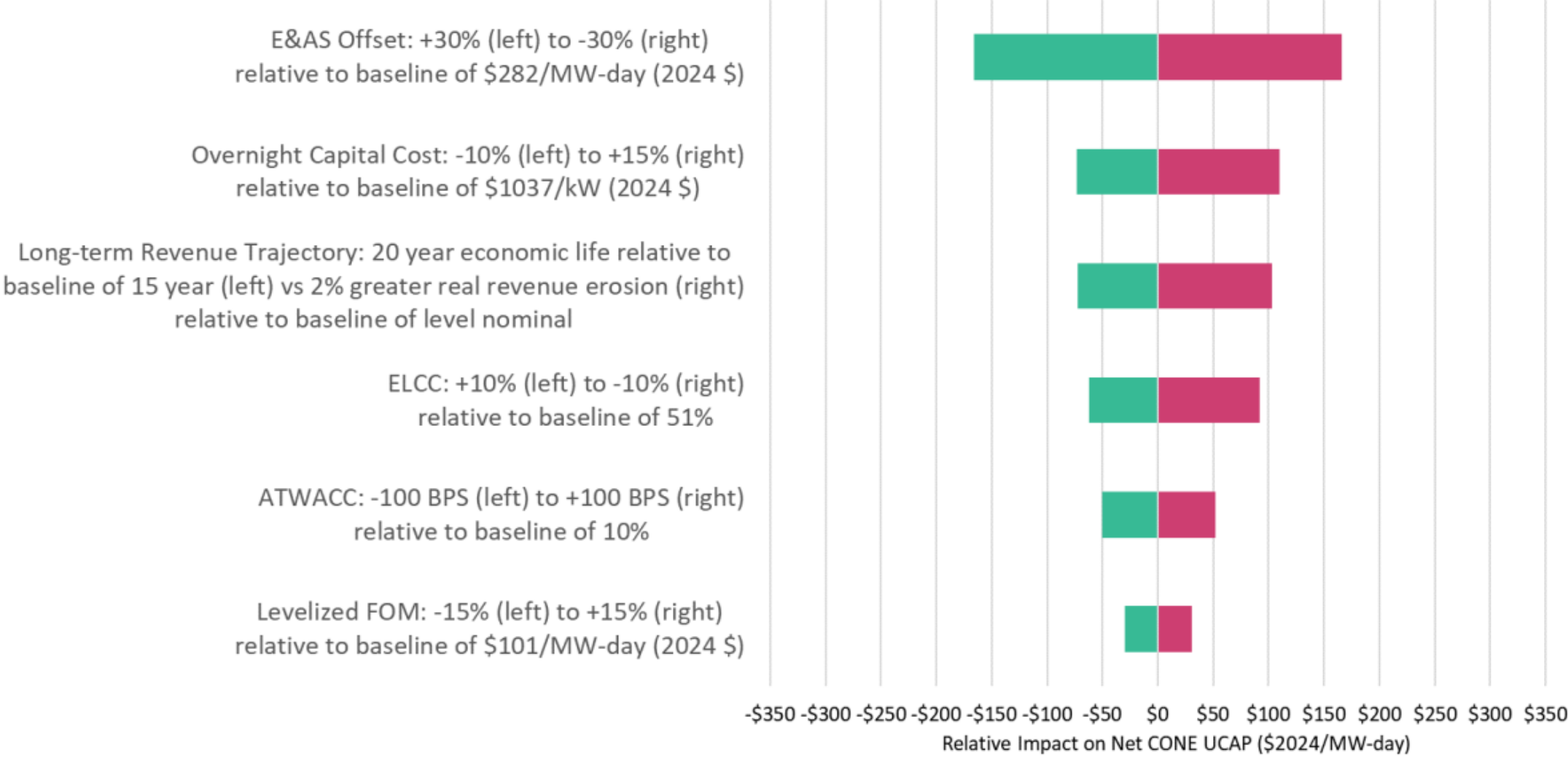
Indicative Net CONE Sensitivities

Gas CT (Stringent States)






























Indicative Net CONE Sensitivities

BESS 4hr



Initial Screening Analysis: Nothing Perfect

Low      High

Tech	Feasible to Build for Delivery Year	Economic Source of Capacity	Accuracy of Net CONE Estimates	Complies w/Local Regulations	Stable ELCC 29/30 – 32/33
Gas CC	 Some development for '29; equipment backlogs?	 Recent entry and queue but doubts with 111(b) rules	 CONE: increased policy risks EAS: good forward indicators even if varies over time	  Varies by state	
Gas CT	 Little development for 2029/30	 No merchant entry in queue, but some anecdotal interest and favorable indicative Net CONE	 CONE: less policy risk EAS: almost as good as CCs	  Varies by state	
BESS 4 hr	 Much development; short construction	 Much development, indicative Net CONE worth pursuing further	 CONE: uncertain future LRMC EAS: sensitive to AS, dispatch		
BESS 6 hr 8 hr 10 hr	 None in development; short construction	 None in development; doubtful near-term fundamentals	 CONE: uncertain future LRMC EAS: sensitive to AS, dispatch		
PV+ BESS	 Much development; short construction	 Much development; unclear Net CONE frustrates econ analysis	 CONE: uncertain future LRMC EAS: unclear REC value		

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