



Special OC/MIC: Fuel Requirements for Black Start Resources

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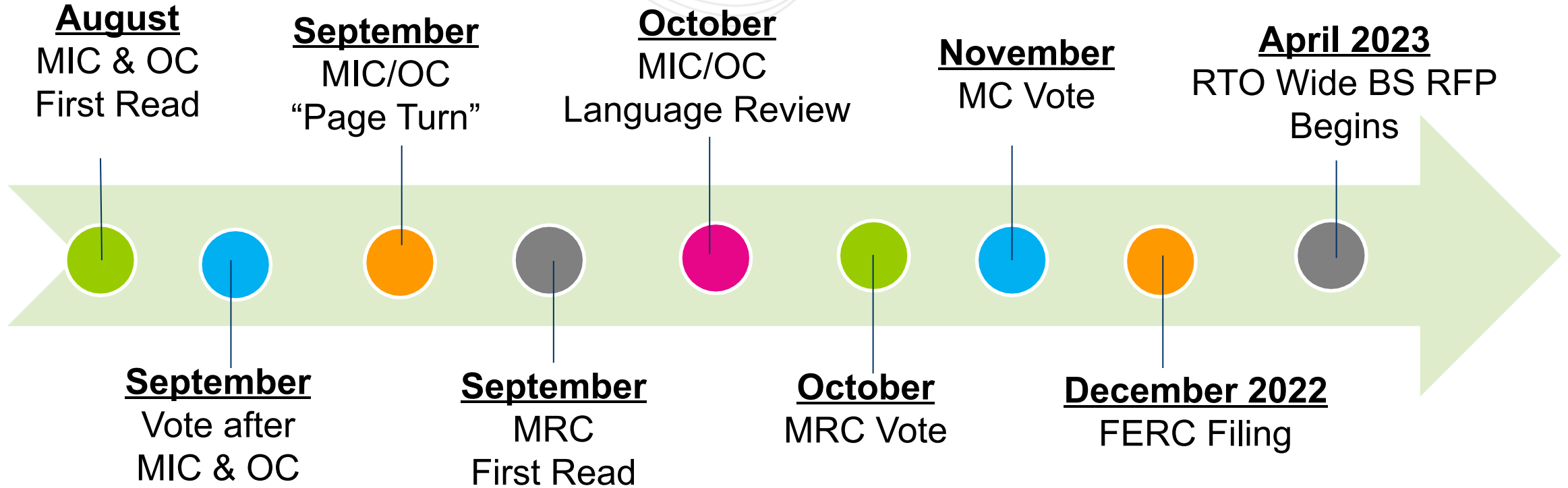
Markets & Reliability Committee
October 24, 2022

Purpose:

- Develop fuel assurance business rules to mitigate the impact of non-fuel assured Black Start resources being unavailable during a restoration event due to fuel unavailability.

Timeline:

- FRBSR started in 2019 and continued through early 2020. The effort was put on hiatus in March 2020, and resumed in Feb 2022.
- The stakeholder process produced two packages for consideration.
- New fuel assurance business rules would be included in next RTO wide RFP





Consolidated Offline MIC/OC Vote Results

Question	Yes Count	No Count	Abstentions	Tally	Pass/Fail
Can you support Package B (IMM)?	19	187	0	9%	FAIL
Can you support Package H (PJM/Brookfield/DCOPC)?	126	39	41	76%	PASS
Do you prefer Package B over Status Quo?	20	164	22	11%	FAIL
Do you prefer Package H over Status Quo?	126	80	0	61%	PASS

Level of Fuel Assurance - Each transmission owner zone is required to be fuel assured in accordance with the following:

- **Minimum criteria:** One fuel-assured black start site per zone
- **Additional black start solutions beyond minimum fuel-assurance criteria:** Based on reliability criteria that identifies high-impact black start sites

Key Benefit

Ensures a zonal minimum level of fuel-assured black start resources while using a reliability-focused approach to address only the more extreme cases of potential restoration time increases

Key Fuel Assurance Enhancements:

- 16 hour run hour requirement
- Fuel assurance requirements by primary fuel type
- Testing and verification requirements
- Implementation through RTO wide RFP process / reliability backstop
- Compensation for black start resources on Base Formula Rate:
 - For fuel assured resources selected via RFP Z factor = 20%
 - For all other resources, Z factor = 10% (Status Quo)
- BS monthly revenues foregone where onsite fuel, water level, stored energy, etc. is not maintained for run hour requirement

	Thermal, Pumped Storage Hydro, Energy Storage, and DER / DR Resources		Run of River Hydro, Intermittent Resources, and Hybrid Resources	
	Non-Fuel Assured (Status Quo)	Fuel Assured	Non-Fuel Assured (Status Quo)	Fuel Assured
Revenue Black Start MW	ICAP	ICAP	ICAP	Monthly MW amount based on 90% confidence level (calculated by PJM every five years)
Restoration Plan MW	ICAP	ICAP	ICAP * % of year unit can provide ICAP for the 16 hours	Annual MW amount based on 90% confidence level (calculated by PJM every five years)
Run Hour Requirement	Thermal: 16 Hours PSH / ESR: Determined by TO Restoration Plan	16 Hours at ICAP	Determined by TO Restoration Plan	16 Hours at 90% Confidence MW
X Factor	Thermal: 0.02 PSH / ESR: 0.01	0.02	0.01	0.02 (Same as CT)
Z Factor	10%	20% ¹	10%	20% ¹
Fuel Assurance Penalties	None	Monthly revenues forgone in months where onsite fuel, water level, stored energy, etc. is not maintained for run hour requirements	None	No penalties because Revenue Calculation MW is determined by PJM calculation of confidence level

Minimum One Fuel-Assured Black Start Site Per Zone

The majority of TO zones currently meet the minimum criteria and there is no current projected capital cost impact to meet this minimum.

Additional Black Start Z Factor Incentive ¹	20% Z Factor (Single Site Per Zone Cost Range)	20% Z Factor (All Sites)
Total Cost	\$174,000 - \$272,000	\$436,000
Cost Per MWh	\$0.0002 - \$0.0003 / MWh	\$0.0006 / MWh

Additional Black Start Solutions Beyond Minimum Criteria

Mitigation of 8 high-impact BS sites in 5 TO zones is estimated to increase the RTO BS Annual Revenue Requirement by \$28,175,000 per year (\$0.036 per MWh based on RTO load); see Appendix for projected zonal cost increases on \$ / MWh basis). ^{2, 3}

Note 1: Z Factor increase only impacts Black Start units on the Base Formula Rate and that currently meet fuel assurance requirements
 Note 2: For reference, the 2021 RTO BS Annual Revenue Requirement is \$68,230,718 per year (\$0.087 / MWh)
 Note 3: See Appendix slides for cost estimate assumptions and for projected cost increases on \$ / MWh basis

- **Open Access Transmission Tariff**
 - Schedule 6A
- **Manual 12: Balancing Operations**
 - Section 4.6: Black Start Service
- **Manual 14D: Generator Operational Requirements**
 - Section 7.1.6: Dispatching of Generation – Black Start
 - Section 10.1: Black Start Selection Process
 - Section 10.2: Black Start Incremental RFP Process
 - Section 10.3: Black Start Reliability Backstop Process
- **Manual 27: Open Access Transmission Tariff Accounting**
 - Section 7.3: Black Start Service Charges
- **Manual 36: System Restoration**
 - Attachment A: Minimum Critical Black Start Requirement

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Fuel Requirements for Black Start Resources



Member Hotline

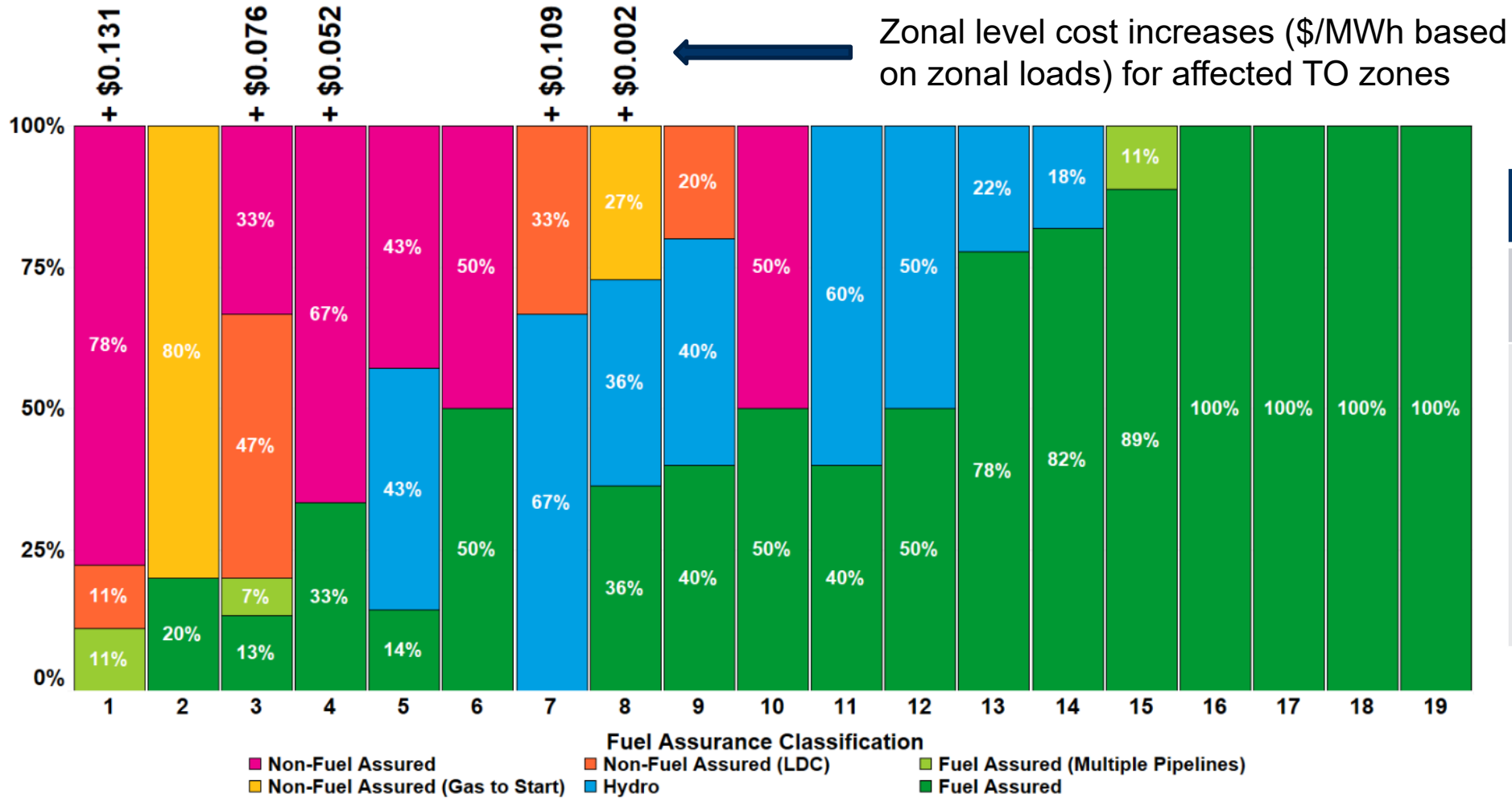
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Appendix

Projected Zonal Cost Increase (\$/MWh) for High-Impact Black Start Sites



Notes

Percentages based on a black start unit count basis

Costs represent the projected incremental zonal increase in black start annual revenue requirement on a cost per MWh basis for fuel-assurance conversions

Cost Projection Assumptions/ Clarifications

- It is currently unknown which hydro resources would choose to be fuel assured.
- High impact black start sites agree to convert to become fuel assured (at black start resource owner discretion).
- Costs estimates based on dual fuel conversions, other fuel assurance solutions (e.g., LNG, CNG) could result in higher costs.

A minimum of one black start site per zone meeting the following fuel-assurance criteria, in order of preference:

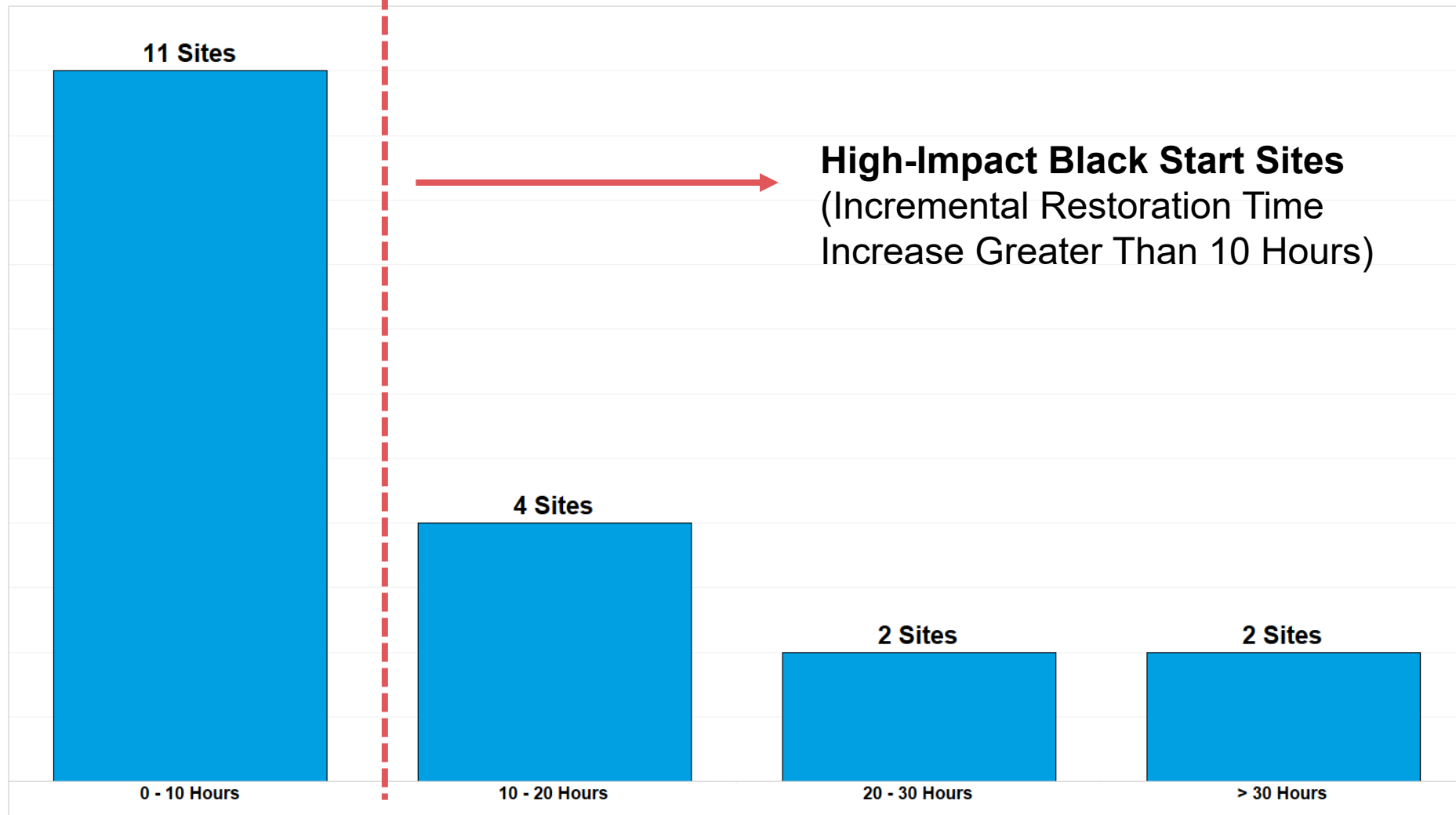
1. On-site fuel storage (e.g., dual fuel)
2. Connected to multiple pipelines
3. Gas-only black start site connected to a single source fed directly from a gas supply basin/gathering system ahead of interstate pipeline
4. Fuel-assured hydro black start site in accordance with the new hydro proposal
5. Fuel-assured intermittent or hybrid black start site in accordance with methodology that aligns with the new hydro proposal and also meets all other black start technical requirements
6. Minimum of 2 separate gas-only black start sites in a TO zone connected to 2 separate interstate gas pipelines (excludes connections to LDCs) would also be acceptable to meet min. fuel assurance requirement if 1–5 are not currently available

- Additional black start solutions (fuel-assurance conversions or additional fuel-assured or non-fuel-assured black start generation) beyond minimum fuel-assurance criteria to be based on reliability criteria that identifies high-impact black start sites.
 - Reliability criteria is incremental increase in restoration time greater than 10 hours upon the loss of a non-fuel-assured black start site.

- Hydro units (run of river or pumped storage) to align with new hydro proposal
 - Fuel-assurance criteria for future intermittent black start resources to follow similar methodology as in new hydro proposal.
- Includes all the other key fuel assurance enhancements:
 - 16 hr. run-hour requirement, fuel-assurance requirements by primary fuel type, testing and verification requirements, compensation
- Implementation through RTO-wide RFP or future incremental RFP

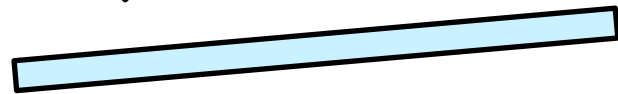
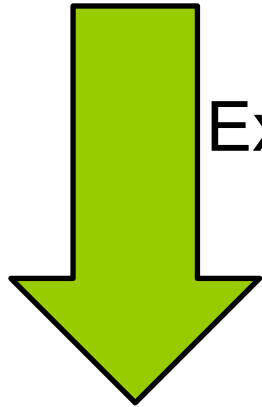
- Reliability Backstop
 - Existing Reliability Backstop Process (in PJM Manual 14D, Section 10.3 and OATT Schedule 6A, Section 6A) to be implemented in the event of insufficient response to RTO-wide RFP or future incremental RFP (2 failed RFP processes), to meet minimum of one black start site per zone meeting fuel-assurance criteria **and** reliability (PLUS) criteria beyond minimum criteria for high-impact black start sites.
 - For Reliability Backstop RFP, TO required to submit RFP proposal.

PJM Non-Fuel Assured Black Start Site Incremental Restoration Time Increase Results



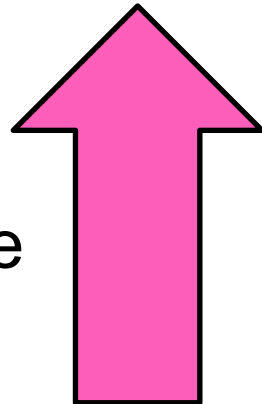
Benefit

Mitigated Increase
in Blackout
Expected Cost



Cost

Fuel Assurance
Conversion



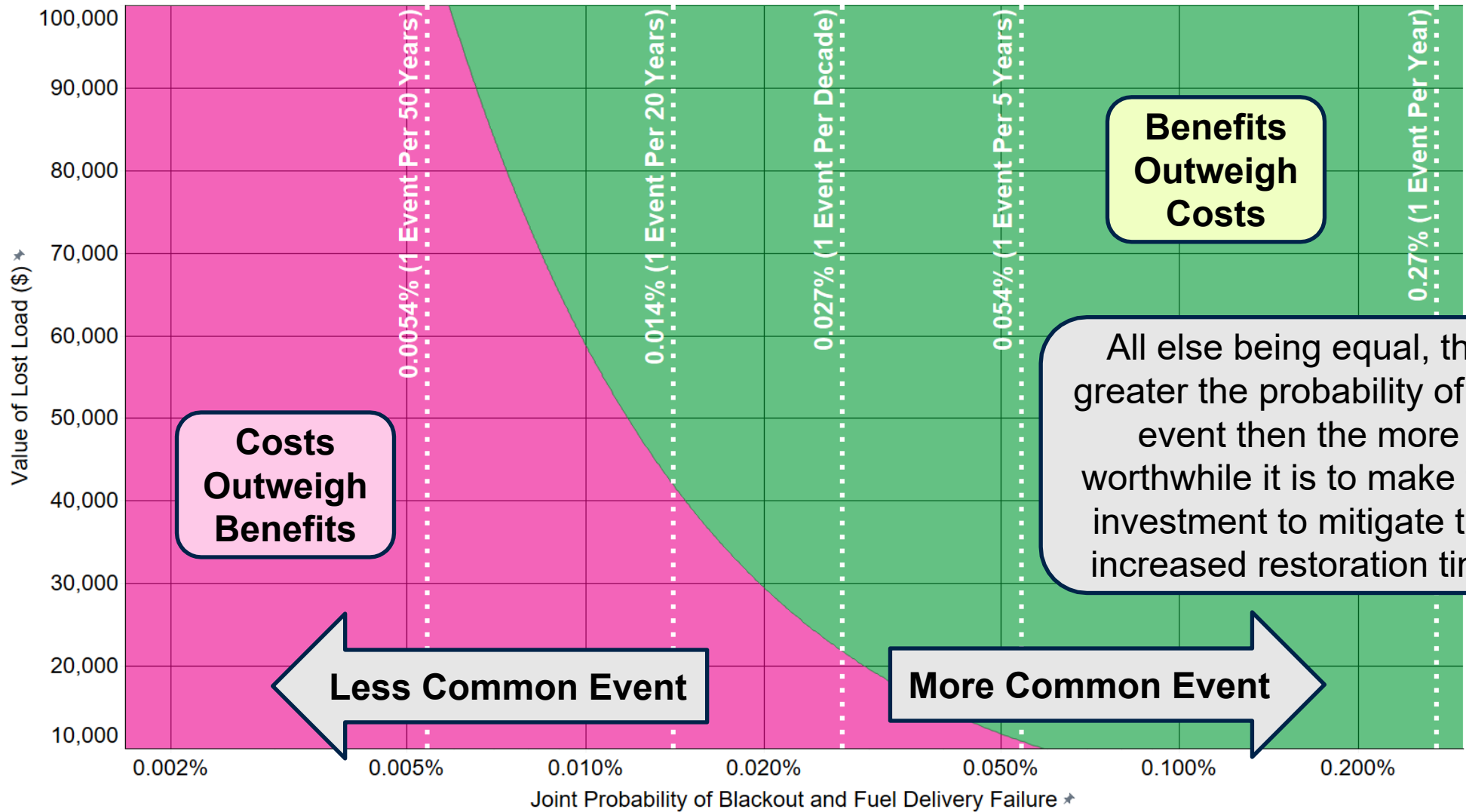
Using a range of probabilities of a coincident black out and fuel delivery failure and a range of VoLLs, PJM has calculated the increase in the blackout expected cost that would be incurred if a Black Start site were unavailable due to a fuel failure during a restoration event.

The benefit of avoiding this additional expected cost can be weighed against the fuel conversion cost to provide supplemental financial input into fuel conversion decision.

This cost vs. benefit assessment can be displayed visually for each black start site so that all probability and VoLL combinations can be evaluated.

Inputs to Model Include:

- Incremental Restoration Time Increase
- Site Conversion Cost
- Zonal Load



Package	Sponsor	Status	Package Support: Poll #1 (May 2022)	Package Support: Poll #2 (June 2022)
A	PJM	Original from 2019; Removed Jan 2022	N/A	N/A
B	IMM	Current ; Updated in 2022	Yes: 30% No: 70%	Yes: 23% No: 77%
C	Calpine	Removed in 2019	N/A	N/A
D	DC OPC / Exelon	Removed April 2022	N/A	N/A
E	Consumer Advocates	Removed in July 2022	Yes: 29% No: 71%	Yes: 33% No: 67%
F	PJM	New in 2022; Removed & consolidated with Package G after Poll #2	Yes: 54% No: 46%	Yes: 73% No: 27%
G	Brookfield / DCOPC	New in 2022; Removed & consolidated with Package F after Poll #2	N/A	Yes: 37% No: 63%
H	PJM / Brookfield / DCOPC	Current ; New in June 2022	N/A	N/A

Note: When two packages remained at end of 7/14/2022 special session, stakeholders decided not to proceed with Poll #3.

Gaps between Consolidated PJM / Brookfield / DCOPC package and IMM package:

1. Intermittent resources (and DER/DR resources) eligibility to provide Black Start Service or be considered fuel assured in accordance with the 90% confidence level
2. Increase in Z-factor from 10% to 20% and X-factor from .01 to .02
3. RTO wide cost allocation vs. current zonal cost allocation
4. Reliability Backstop

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