Fuel Security Senior Task Force
Summary and Poll Questions

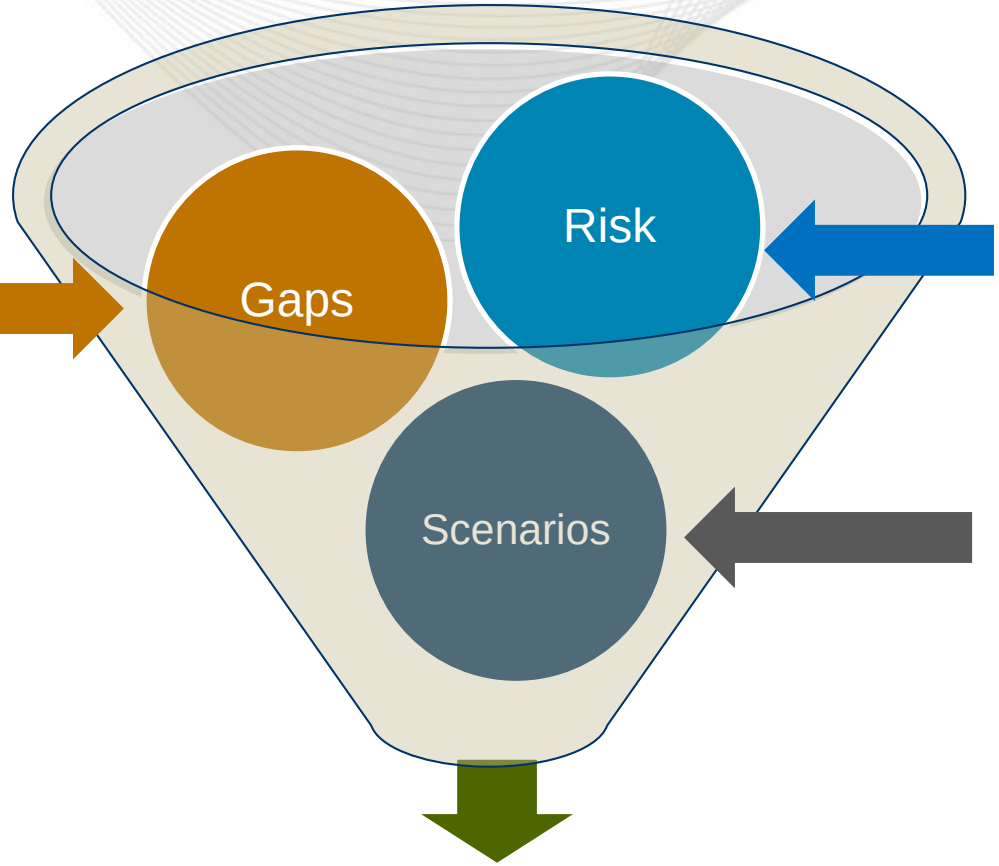
FSSTF

November 22, 2019

FSSTF Phase 2 Status

Gaps in Existing Mechanisms

- ✓ Modeling of uncertainties
- ✓ Compensation



Relevant period & credible risks informed by historical data and stakeholder feedback ✓

Relevant risks determine focused scenarios ✓

- Supplement Phase 1

What scenarios result in loss of load and what is threshold?

What is cost and incentive?

Inform stakeholder recommendation

(Are changes necessary?)

→

- Poll (November)
- MRC Recommendation (December)

FSSTF Timeline

	Oct. 25 (9-4)	Nov. 22 (9-4)	Dec. 16 (1-4)
Scenarios	Present early results	Present final results and Summary	Final summary and draft recommendations
Gaps	Summary, Conclusions	-	
Poll	Review 1st Draft	Review Final	

Vote at December 19th MRC

- Recommendation to the MRC on whether market, operational, or planning changes are needed to ensure current or future fuel/energy/resource security

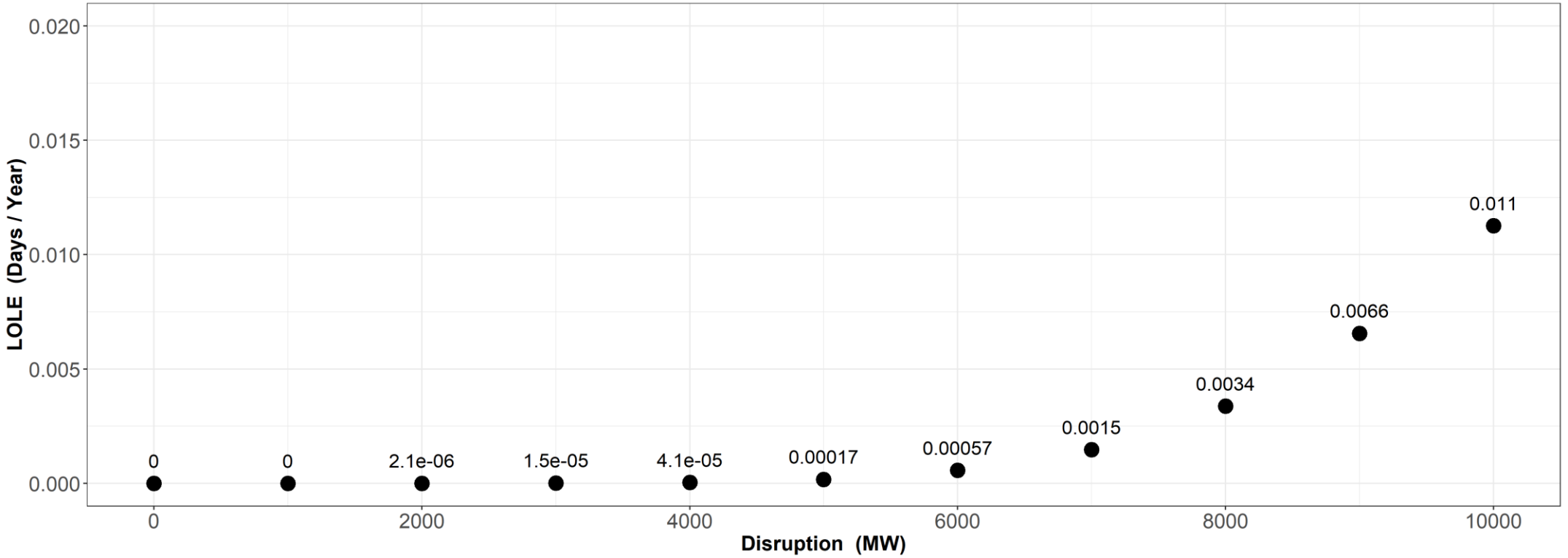
Scenario Analysis Summary:
Deterministic Dispatch Simulations

324 “Phase 1” Scenarios + 56 Sensitivities based on stakeholder feedback

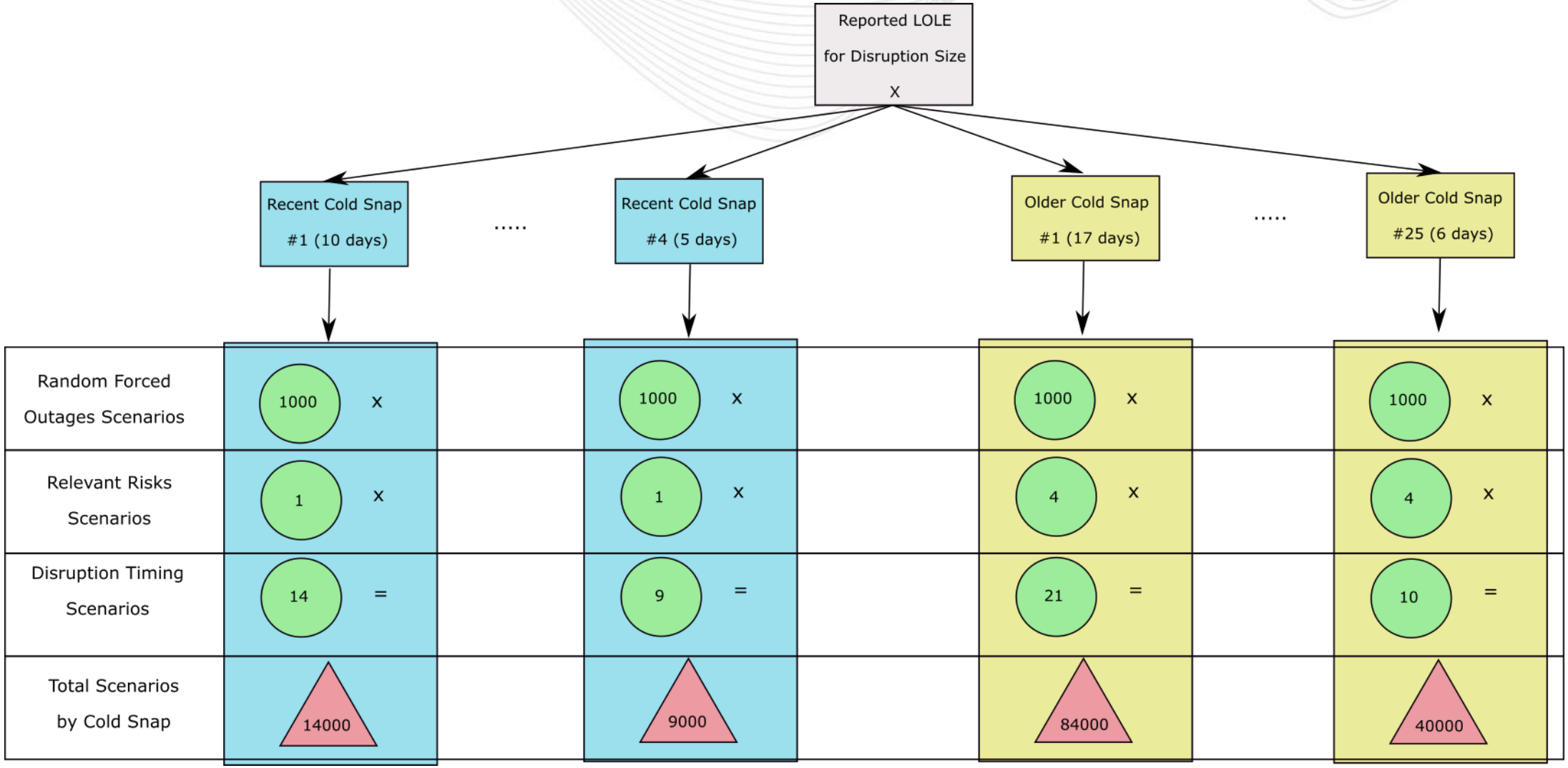
- Inclusion of assumptions reflective of typical conditions and more extreme assumptions **intended to stress the system**.
- Focus was on **event impact** and **contributions of fuel delivery infrastructure interdependencies** like firm/non-firm gas availability, onsite fuel replenishment, and pipeline disruptions. *Focus was not on event probability*.
- Based on assessment of a 2023 portfolio at expected reserve margin (“Announced” portfolio, 28.5%), there is no immediate threat to the reliability of the PJM RTO due to risks associated with fuel delivery infrastructure interdependencies, even in scenarios with the most conservative assumptions.
- Some scenarios with *stressed* portfolios at the IRM (“Escalated 1, 2, 3” 15.8%) and conservative fuel delivery infrastructure risk assumptions resulted a need for emergency procedures, including Voltage Reduction and Manual Load Shed.
- Simulation of PJM operational procedure to manage resource limitations like onsite fuel inventory (Maximum Emergency, Manual 13) showed reduction in need for escalating emergency procedures.

Scenario Analysis Summary:
Relevant Risk Assessment & Probabilistic Scenarios

Arriving at the LOLE shown in each of the points in the graph below involved analyzing a large number of scenarios



Scenario Analysis Summary:
Relevant Risk Assessment & Probabilistic Scenarios



Scenario Analysis Summary:
Relevant Risk Assessment & Probabilistic Scenarios

Cold Snap #	Type	Duration (days)	Random Forced Outages Scenarios	Relevant Risk Scenarios	Disruption Timing Scenarios	Total Scenarios by Cold Snap
1	Recent	10	1000	1	14	14000
2	Recent	13	1000	1	17	17000
3	Recent	8	1000	1	12	12000
4	Recent	5	1000	1	9	9000
1	Older	17	1000	4	21	84000
2	Older	11	1000	4	15	60000
3	Older	5	1000	4	9	36000
4	Older	8	1000	4	12	48000
5	Older	14	1000	4	18	72000
6	Older	8	1000	4	12	48000
7	Older	5	1000	4	9	36000
8	Older	7	1000	4	11	44000
9	Older	6	1000	4	10	40000
10	Older	7	1000	4	11	44000
11	Older	7	1000	4	11	44000
12	Older	5	1000	4	9	36000
13	Older	6	1000	4	10	40000
14	Older	7	1000	4	11	44000
15	Older	5	1000	4	9	36000
16	Older	10	1000	4	14	56000
17	Older	6	1000	4	10	40000
18	Older	7	1000	4	11	44000
19	Older	6	1000	4	10	40000
20	Older	9	1000	4	13	52000
21	Older	5	1000	4	9	36000
22	Older	5	1000	4	9	36000
23	Older	5	1000	4	9	36000
24	Older	5	1000	4	9	36000
25	Older	6	1000	4	10	40000
				Total Scenarios		**1180000**

Each of the LOLE points in the graph shown in Slide 5 summarizes the result of analyzing 1,180,000 scenarios

Gaps in Existing Mechanisms Compensation

- Currently, there may not be sufficient incentive under the existing mechanisms for a resource to increase its fuel / energy / resource security.

- The only mechanism available for a resource that guarantees it cost-recovery of fuel availability expenses is its capacity market avoidable cost rate (ACR) and the vast majority of resources are not submitting unit specific cost data so there is no specific information on fuel availability costs.

Key Takeaways from Gap Analysis

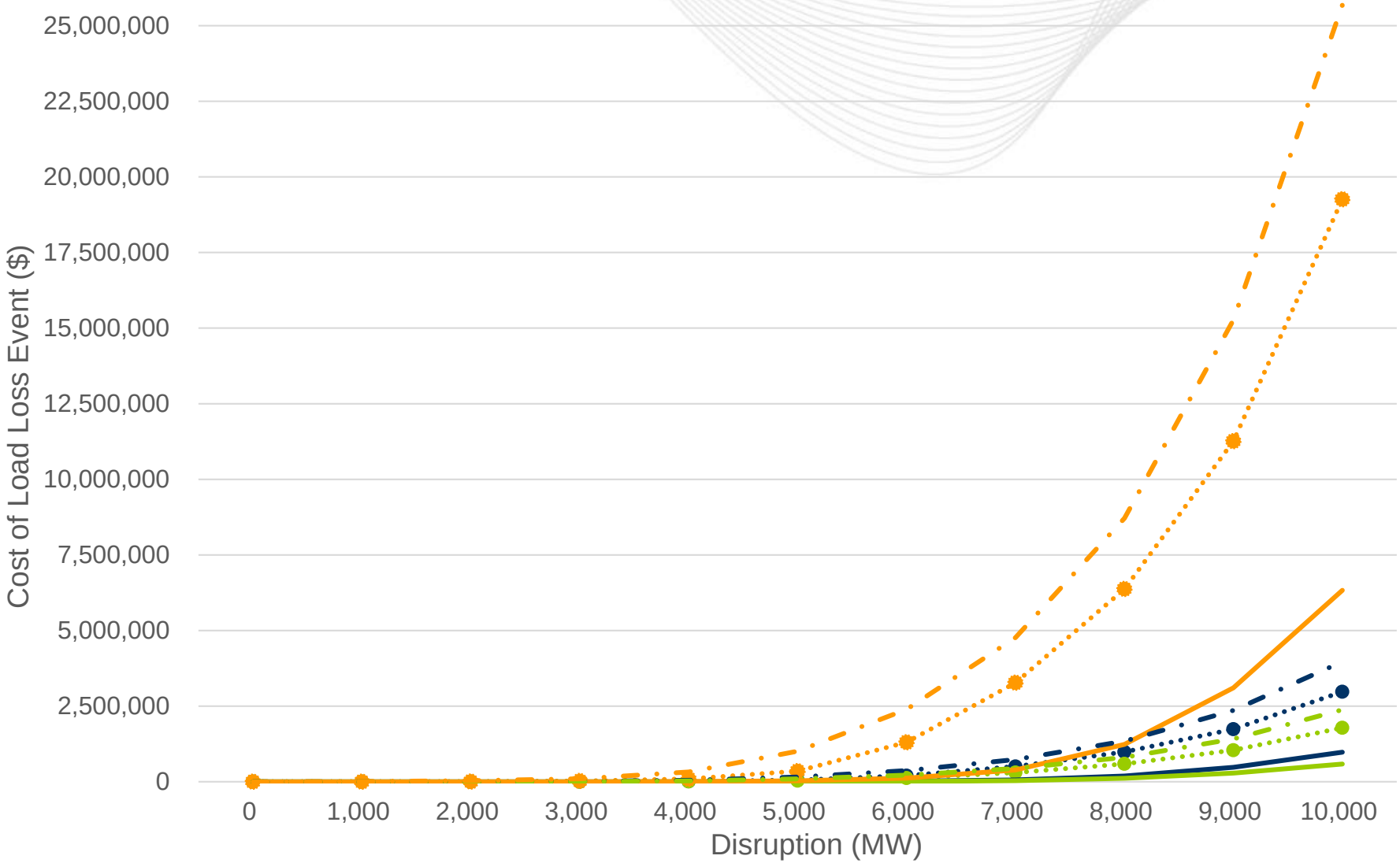
As a result of the gaps identified:

1) It is important to study the reliability of the system under extended periods of severe weather conditions

2) Refrain from making assumptions about the potential availability improvements of certain resources under stressed system conditions

3) Consider whether any changes to the existing mechanisms are needed to incentivize desired behavior.

Potential Event Costs Derived from Historical Sources

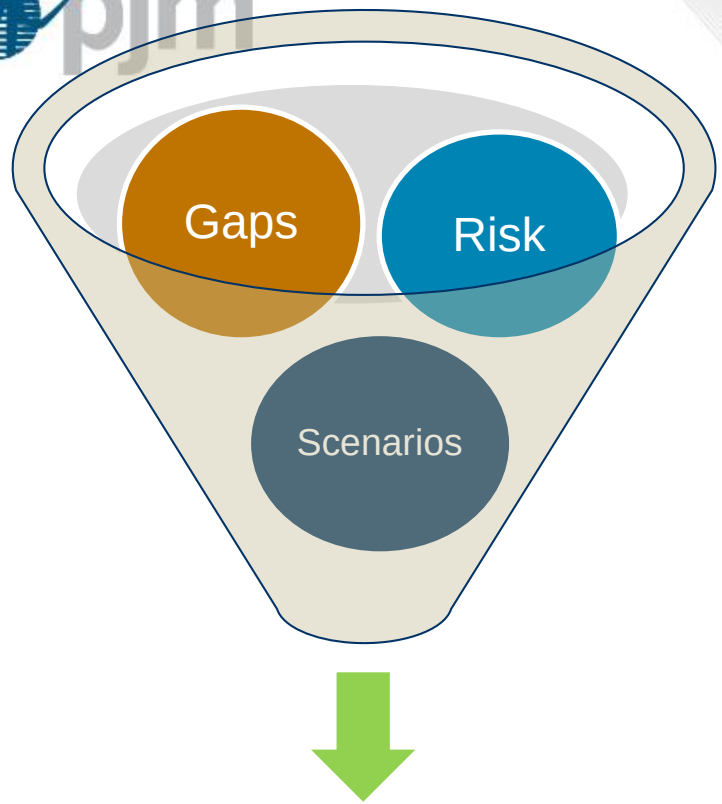


Estimates $/MWh costs used in graph from the following sources:

- **$9,000/MWh** - The Brattle Group for ERCOT. Estimating the Economically Optimal Reserve Margin in ERCOT.
- **$15,000/MWh** - Astrape Consulting for EISPC & NARUC. "The Economic Ramifications of Resource Adequacy"
- **$97,087/MWh** - Electricity Consumers Resource Council. The Economic Impacts of the August 2003 Blackout

Cost values ($) in graph from multiplying $/MWh cost values above by conditional value at risk (CVaR) in MWh for each portfolio, see appendix

FSSTF Phase 2 Summary



Multiple Potential Paths Forward

1,180,380 Scenarios

- Phase 1 (324)
- Phase 2 (1,180,056)

Analysis demonstrated there may be gaps in existing mechanisms in compensation and incentives

Cost impacts can be derived from expectations of scenarios and perceived value of loss load.

- Provided potential costs derived from historical independent sources

Potential Paths Forward

Path 2: Pre-defined Criteria

PJM and stakeholders develop criteria, but do not develop solution until criteria is met

- *Criteria to be developed in 2020*

Path 1: Status Quo

PJM continue to monitor and re-visit with stakeholders if risk increases.

Path 3: Complete solution

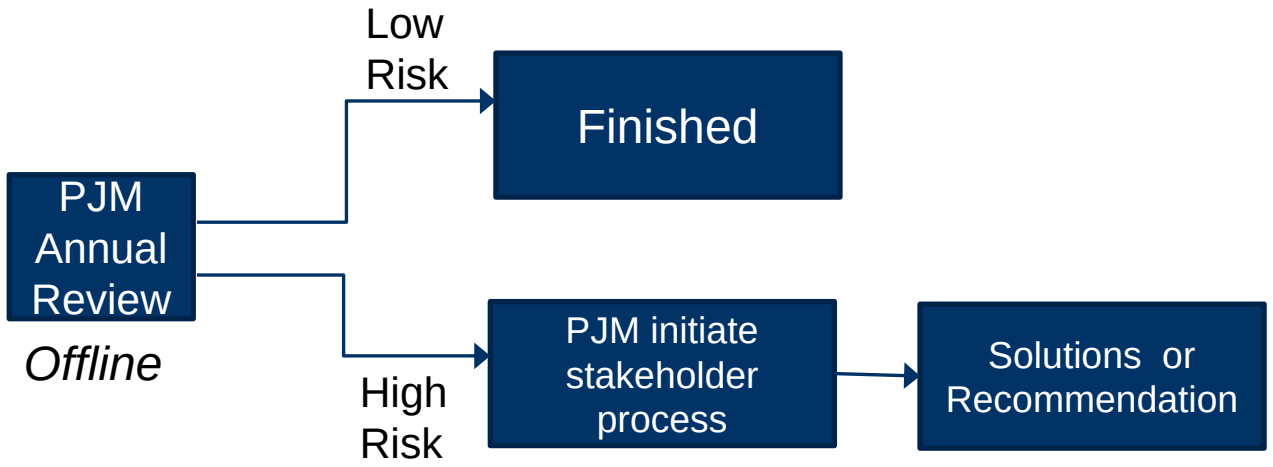
Stakeholders develop a solution mechanism to automatically be triggered based on an embedded criteria

- *Criteria and solution mechanism to be developed in 2020*

*All Paths include incorporation of potential NERC guidelines/standards or FERC orders if applicable

Path 1: Status Quo

PJM continue to monitor and re-visit with stakeholders if risk increases



Advantages

- Risk of event already low- No action until review indicates concerns
- Monitoring allows for additional initiatives at NERC/FERC to complete
- Includes additional stakeholder input if risk increases

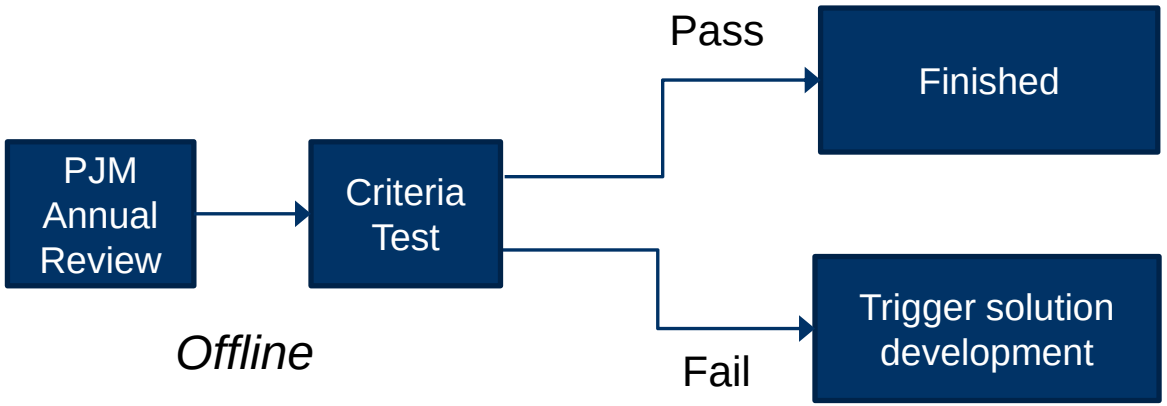
Disadvantages

- Risk that a solution mechanism may not be in place before event
- Market does not drive when solution is triggered

Path 2: Pre-defined Criteria

PJM and stakeholders develop criteria, but do not develop solution until criteria is met

- Criteria to be developed in 2020



Advantages

- Risk of event already low
- Monitoring allows for additional initiatives at NERC/FERC to complete
- Criteria pre-defined to trigger solution development
- Solution to be determined once trigger is met

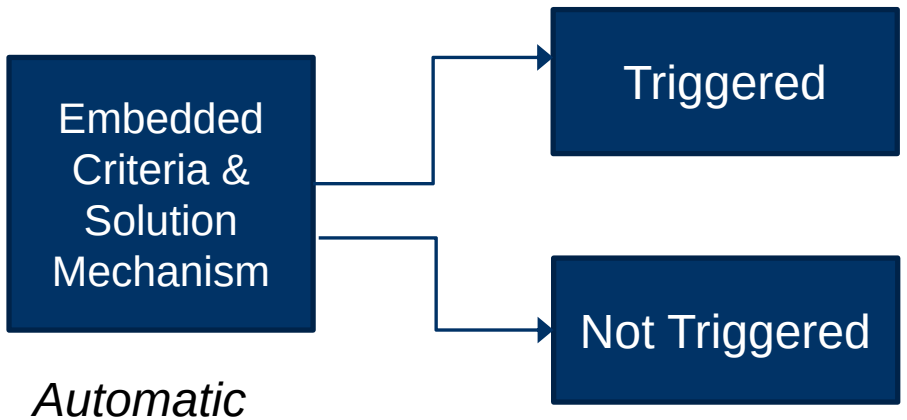
Disadvantages

- Risk that a solution mechanism may not be in place before event
- Market does not drive when solution is triggered

Path 3: Complete Solution

Stakeholders develop a solution mechanism to automatically be triggered based on an embedded criteria

- Criteria and solution mechanism to be developed in 2020



Automatic

Advantages

- Risk of event already low and impact should be minimal
- Solution already in place removes risks of timing to develop solution and implement
- Markets, Operations, or Planning pre-defined criteria can determine when solution is triggered

Disadvantages

- Potential for the solution to be triggered prematurely

Potential Paths Forward

	PJM continues to monitor risks internally	Development of criteria to trigger further action and related solution mechanism(s) in future stakeholder process when risk increases	Development of criteria to trigger further action in 2020 stakeholder process	Development of solution mechanism(s) in future stakeholder process when criteria established by PJM & stakeholder is met	Development of solution mechanism(s) to be triggered based on criteria in 2020 stakeholder process
Path 1	X	X			
Path 2	X		X	X	
Path 3	X		X		X

FSSTF Draft Poll Questions

1. Do you think it is important for PJM to monitor fuel/energy/resource security needs? (Y, N, Maybe)
2. Do you think that existing PJM market, operational, or planning mechanisms provide sufficient incentives to ensure fuel/energy/resource security? (Y, N, Maybe)
3. Do you think market, operational, or planning changes are needed to ensure fuel/energy/resource security under existing conditions? (Y, N, Maybe)
4. Do you think market, operational, or planning changes are needed to ensure fuel/energy/resource security under expected future conditions? (Y, N, Maybe)
5. Do you think market, operational, or planning changes are needed to ensure fuel/energy/resource security under future conditions AND these changes should only be triggered if a PJM-determined criteria is met? (Y, N, Maybe)

FSSTF Draft Poll Questions

6. Do you think market, operational, or planning changes are needed to ensure fuel/energy/resource security under future conditions AND these changes should only be triggered if a pre-determined stakeholder approved criteria is met? (Y, N, Maybe)
7. Do you think PJM should only implement changes for fuel/energy/resource security if NERC or FERC provides orders, guidelines, or standards? (Y, N, Maybe)
8. Do you think there needs to be an operational change (non-market mechanism) in place to ensure fuel/energy/resource security? (Y, N, Maybe)
9. Do you think there needs to be a change to the PJM planning criteria to ensure fuel/energy/resource security? (Y, N, Maybe)
10. Do you think there needs to be a change to market mechanism(s) in place to ensure fuel/energy/resource security? (Y, N, Maybe)

FSSTF Draft Poll Questions

11. Do you support Path 1 as follows? (Y, N, Maybe)

    Status Quo: *PJM continue to monitor and re-visit with stakeholders if risk increases.*

12. Do you support Path 2 as follows? (Y, N, Maybe)

    Pre-defined Criteria: PJM and stakeholders develop criteria, but do not develop solution until criteria is met

13. Do you support Path 3 as follows? (Y, N, Maybe)

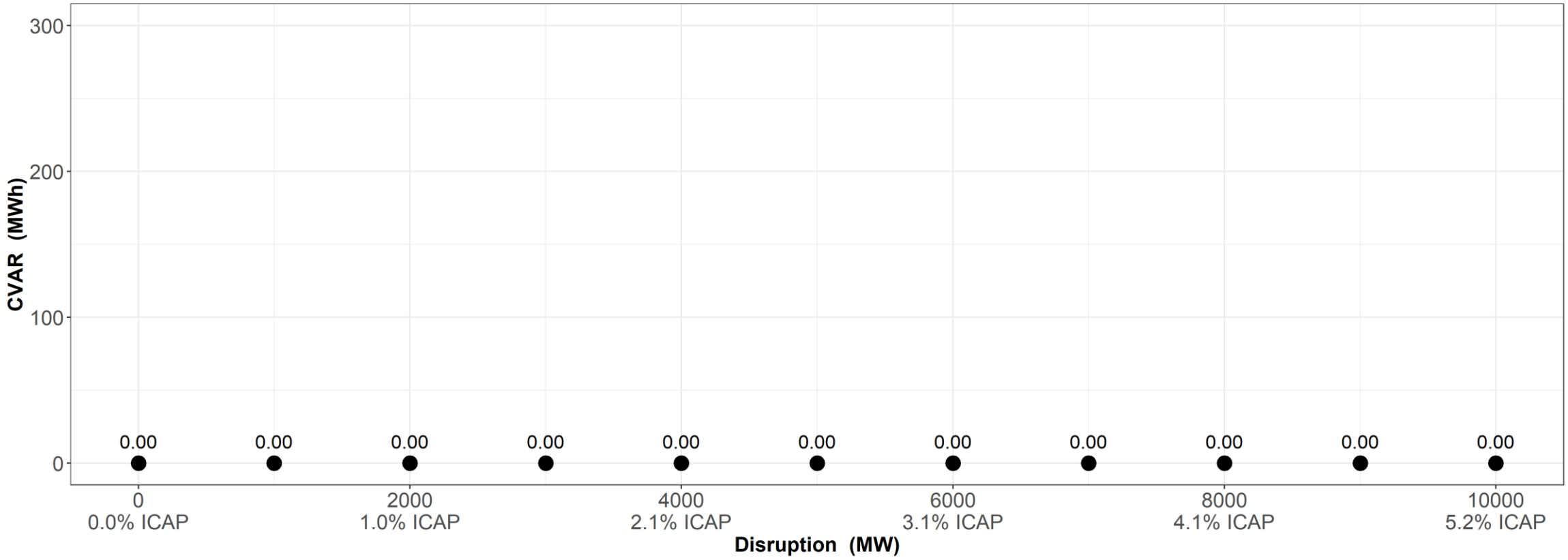
    Complete Solution: Stakeholders develop a solution mechanism to automatically be triggered based on an embedded criteria

14. What is your preferred path forward? (Path 1, Path 2, Path 3, Other)

Appendix

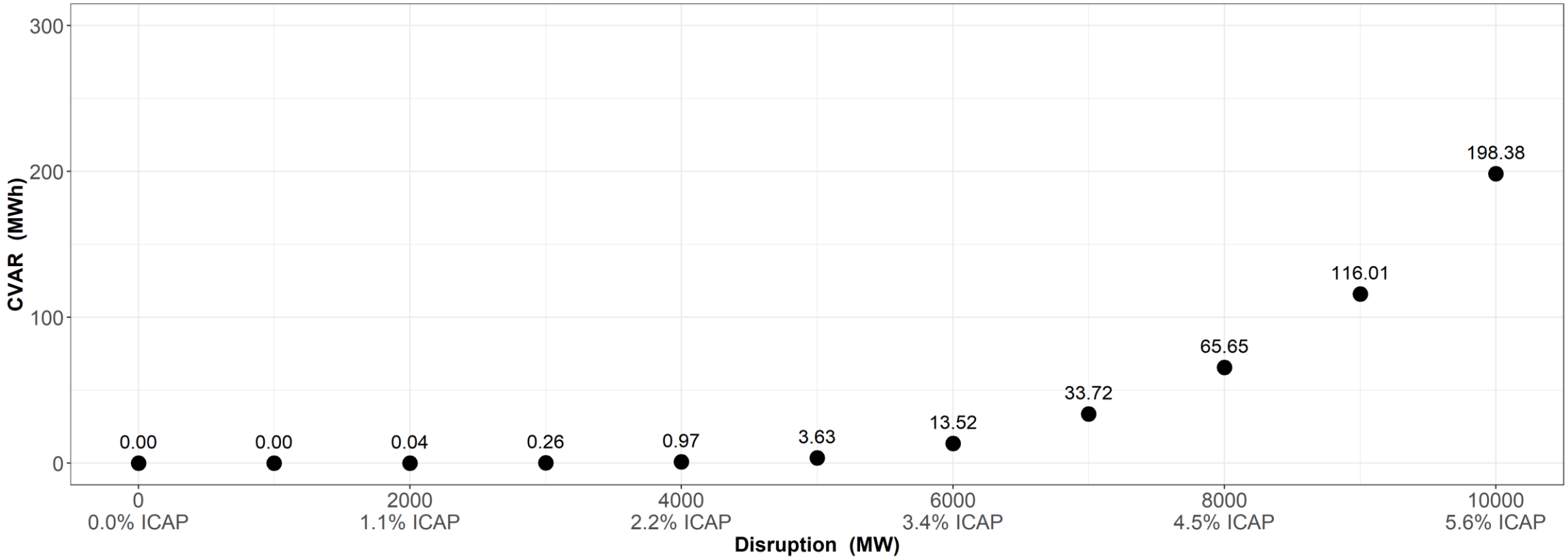
CVaR vs Disruption - Announced Retirements

(28.5% ICAP Reserves)



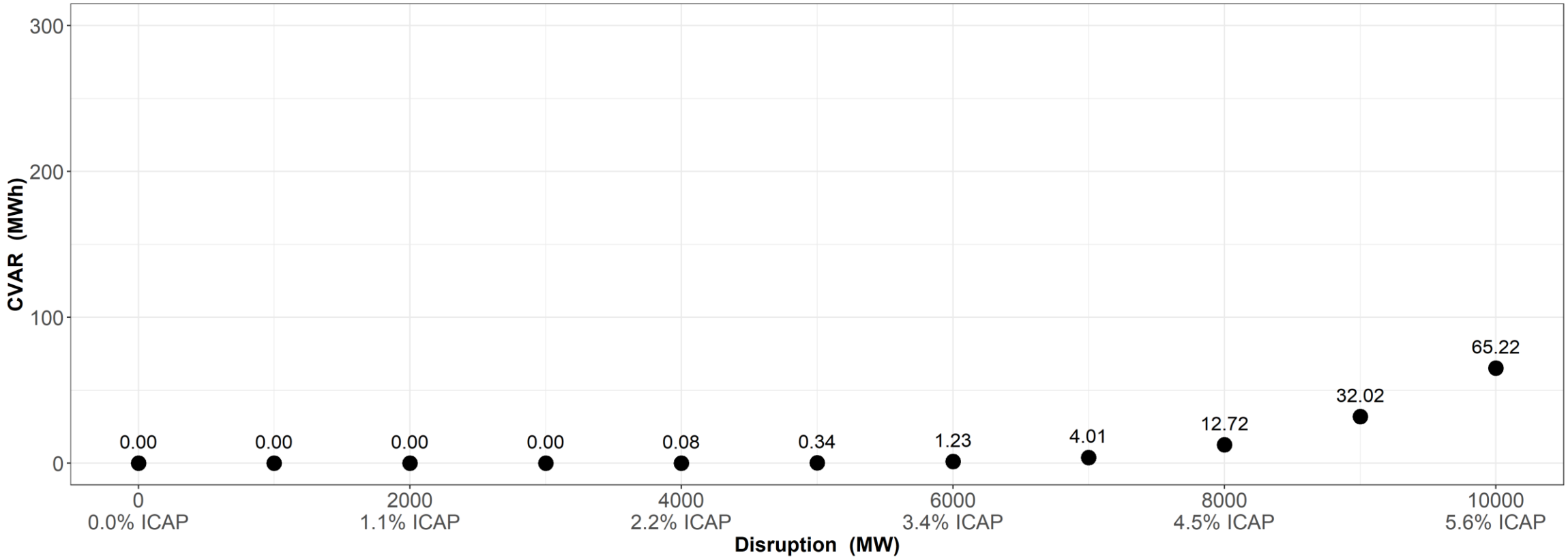
CVaR vs Disruption – Escalated 1 Retirements

(15.8% ICAP Reserves)



CVaR vs Disruption – Escalated 2 Retirements

(15.8% ICAP Reserves)



CVaR vs Disruption – Escalated 2 Retirements

(15.8% ICAP Reserves)