Gap Analysis - Summary

FSSTF

October 25, 2019

Schedule

- **June Meeting:**
  - Assessed what current mechanisms exist today that contribute toward fuel/energy/resource security and what uncertainties/risks are currently accounted for by these mechanisms
- **July Meeting:**
  - Given the credible risks to fuel/energy/resource security that were identified, determine which uncertainties are not accounted for in the requirements for the current mechanisms that exist today
- **August Meeting:**
  - Given the credible risks to fuel/energy/resource security that were identified, determine if any gaps exist in the compensation in the form of cost-recovery available for the current mechanisms to mitigate those risks
- **September Meeting:**
  - Given the credible risks to fuel/energy/resource security that were identified, determine if any gaps exist in the incentives provided by the compensation available for the current mechanisms to mitigate those risks
- **Today**:
  - Summarize key findings from the gap analysis and draw any inferences from the results

Relevant Risks Identified at June FSSTF Meeting

Relevant Risks	
Long Duration Cold Snap	
Short Duration Cold Snap	
Natural Gas Pipeline Disruptions	
Solar Intermittency	Renewable Intermittency - Related
Wind Intermittency	
Coal Refueling (Bridge Failure)	Forced Outages - Related
Coal Refueling (Lock and Dam Failure)	
Coal Refueling (Rail Failure)	
Coal Refueling (River Freezing)	
Coal Unavailability (Coal Quality)	
Natural Gas Unavailability Non-Firm Units	
Oil Refueling (Oil Terminal)	
Oil Refueling (Truck Restrictions)	
Nuclear Regulatory Shutdown (Fuel Related)	
Nuclear Regulatory Shutdown (Non-Fuel Related)	
Nuclear Unavailability (High Winds)	
Hydro Unavailability (Freezing Rivers)	
River Freezing (Cooling Water Impacts)	
Ice Storm (Transportation Impacts)	

For ease of exposition, some of the Relevant Risks are grouped in two categories: Renewable Intermittency and Forced Outages.

Survey of Existing Mechanisms

- Capacity Performance (CP)
- Energy Market (DA and RT)
- Contingency Reserves – Current and Proposed
- Regulation
- Maximum Generation Emergency Procedure
- “Resource Limited” Unit Dispatch
- Voltage Reduction
- Gas Contingency Procedures
- Gas/Electric Coordination
- Transmission Planning Solution
- Restoration Plan (Black Start Services)
- Emergency Operating Procedures

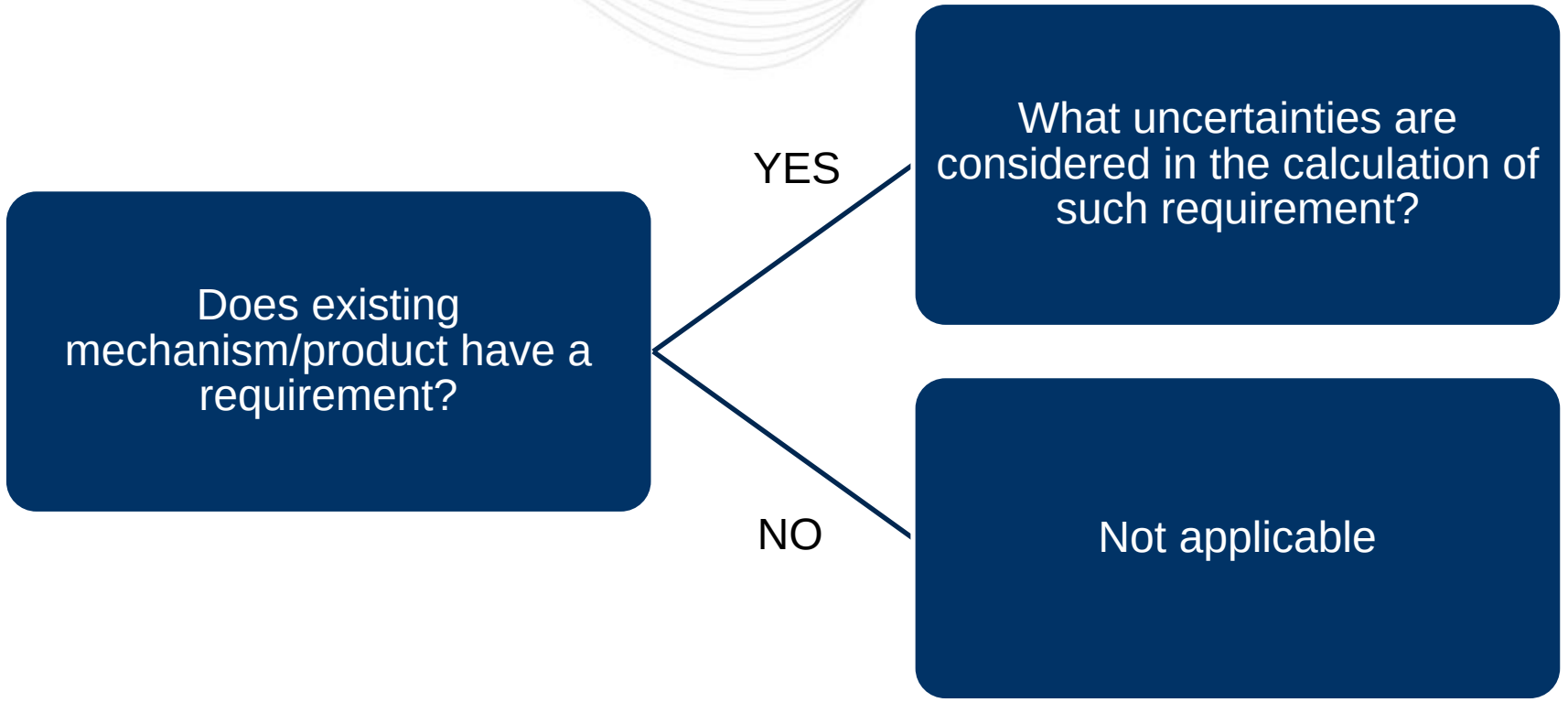
Existing Mechanisms Matrix

- A matrix of the existing mechanisms and products with their associated details is located on the FSSTF webpage:
  - https://www.pjm.com/committees-and-groups/task-forces/fsstf.aspx

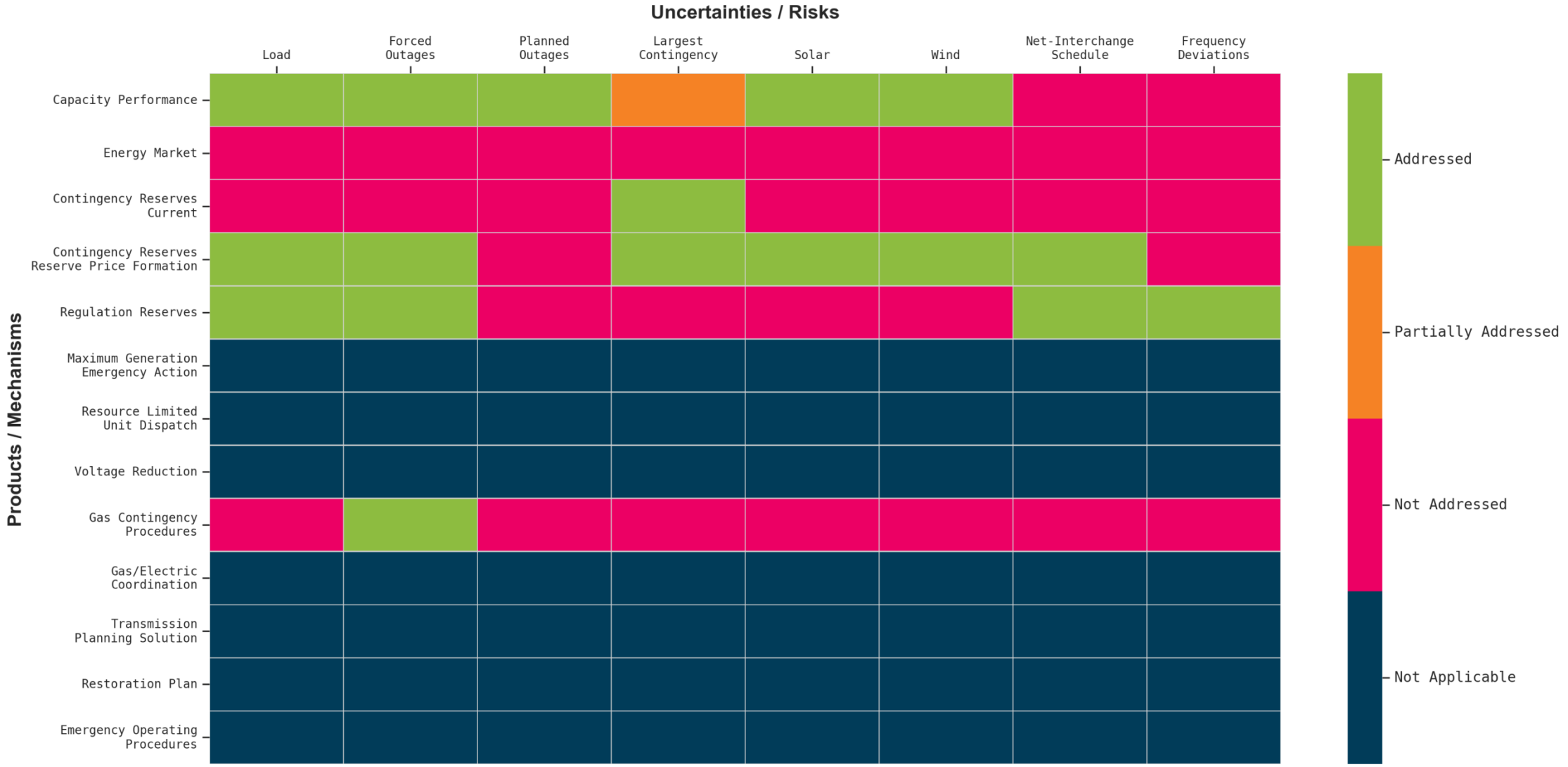
Comparison of Existing Mechanisms and Products

- Uncertainties/Risks included in Requirements
- Procurement Time Period
- Compensation

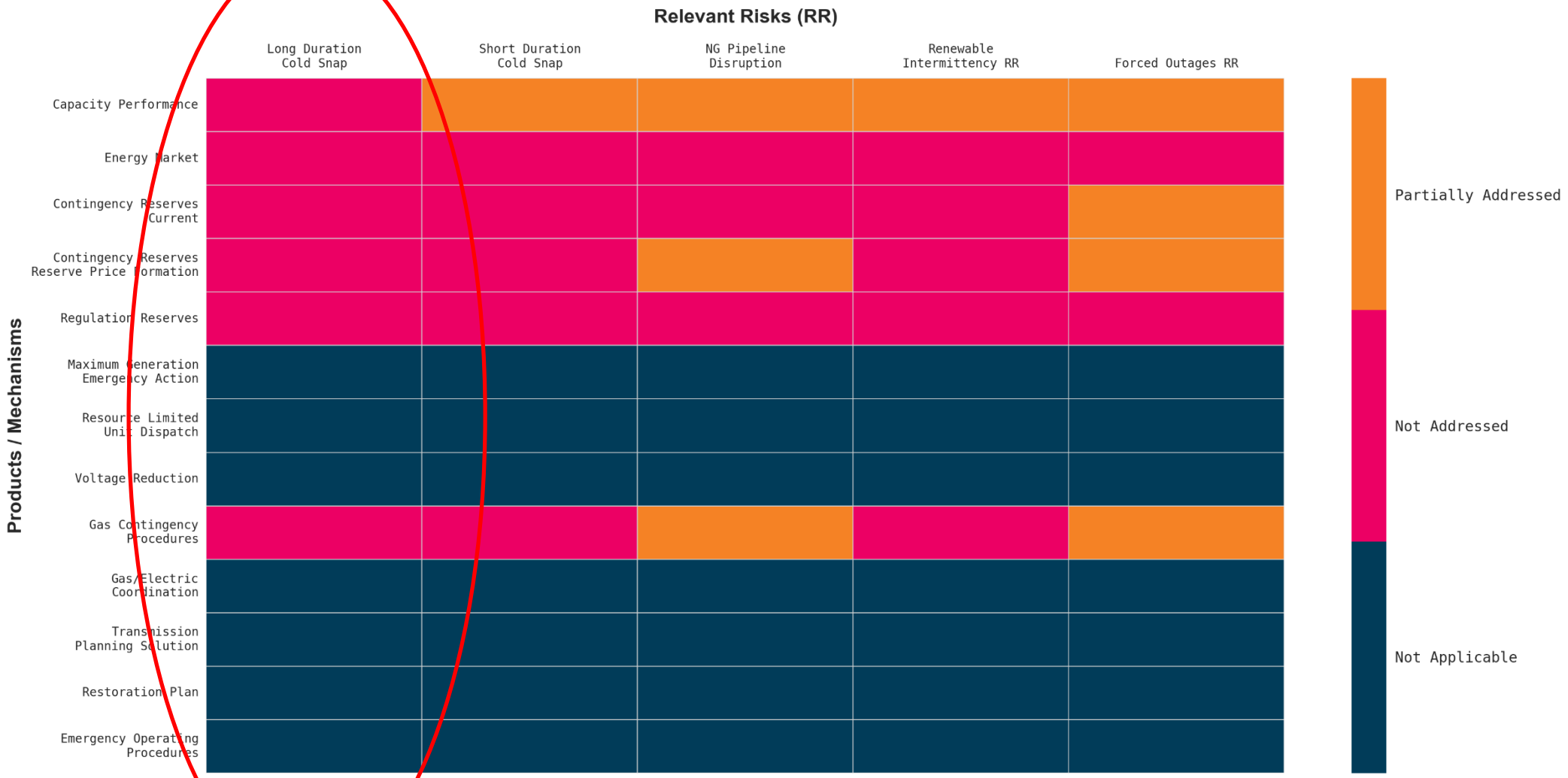
Uncertainties/Risks in Requirements of Existing Mechanisms



Uncertainties/Risks in Requirements of Existing Mechanisms



Relevant Risks (RR) in Requirements of Existing Mechanisms

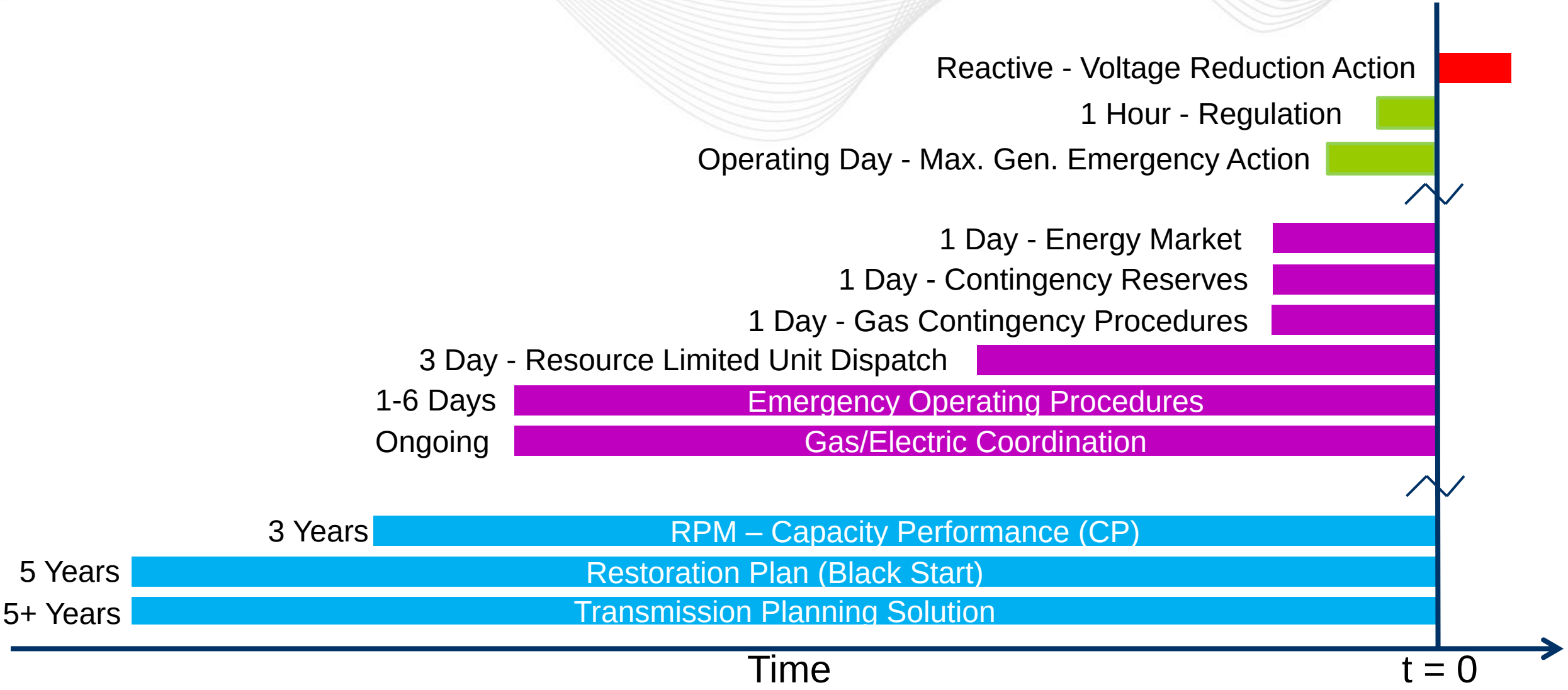


Gaps in the Existing Mechanisms Requirements

- The risks from a long duration cold snap are not addressed in the requirements of any of the existing mechanisms.

- For example, the CP requirement (the FPR) is calculated via the Reserve Requirement Study (RRS).
  - The study does not consider all hours of the year, only the peak hour of each weekday. When dealing with a cold snap, it is important to consider the loss of load risk at all hours, not just the peak hour.
  - The RRS considers an average relationship between the peaks of two contiguous weeks. In a long duration cold snap encompassing two weeks or more, the relationship between the weekly peaks is likely to be much different from what has occurred on average historically.

Procurement Time Period – Existing Mechanisms



Gaps in the Procurement Time Period of Existing Mechanisms

- No Gaps Identified

Compensation - Existing Mechanisms

Mechanism	Compensation	Compensation Structure
Capacity Performance	RPM Auction Clearing Prices (+) PAI Bonus Performance Credits (-) PAI Non-Performance Charges	Auction (3-year Forward); PAIs (RT)
Energy Market	Locational Marginal Prices	Auction (DA/RT)
Contingency Reserves	Reserve Market Clearing Prices	Auction (DA/RT)
Regulation Reserves	Regulation Market Clearing Prices	Auction (RT)
Transmission Planning Solution	Cost Recovery Rates	RFP - Cost/Benefit Analysis (5-year Forward+)
Gas Contingency Procedures	Reserve Clearing Price / Switching Cost Recovery (under discussion)	Auction (DA/RT) / Administrative
Restoration Plan (Black Start)	Cost Recovery Rates	RFP (5-year Forward or as needed)
Gas/Electric Coordination	No specific compensation	-
Maximum Generation Emergency Procedure	No specific compensation	-
"Resource Limited" Unit Dispatch	No specific compensation	-
Voltage Reduction	No specific compensation	-
Other Emergency Operating Procedures	No specific compensation	-

Cost-Recovery – Capacity Performance

Long Duration Cold Snap	Short Duration Cold Snap	NG Pipeline Disruption	Renewable Intermittency RR	Forced Outage RR
Allowable costs included in Avoidable Cost Rate (ACR): Fuel Availability Expenses, Carrying Charges, Capacity Performance Quantifiable Risk, and Project Investment Recovery.				
				Ability to recover capital costs to reduce forced outage rates.

Cost-Recovery – Capacity Performance

- Majority of generation resources are not offering in unit specific ACRs – thus no specific information on fuel availability expenses
- From the SOM report, for the 21/22 BRA:
  - 84.2% of Generation Resources used the default offer cap
  - 11.4% of Generation Resources offered in as price takers
  - <1% submitted a unit specific ACR

Incentives Provided by Current Mechanisms

- Incentives provided by the current mechanisms fall into two categories:

  1) Penalties for Not Performing

  2) Lost Revenue from Not Performing (or deviation charges for units with a day-ahead market obligation)

Expectations of Future Costs

- Given that each scenario in Phase I has a probability of occurring, generator incentives to perform can be measured based on expectations of future costs, not on the costs themselves
- Note: Expected costs are only one measure of risk that can be used for decision making.

- A generator may want to minimize expected cost:

$$\text{Expected Cost} = \sum_{for\ all\ Scenarios\ i} (Cost_{Scenario\ i} \times Probability_{Scenario\ i})$$

- Question 1: How to determine the cost of each scenario occurring?
- Question 2: How to determine the probability of each scenario occurring?

Maximum Expected Cost

- To calculate a Maximum Expected Cost (upper bound), we can assume a probability for the highest cost scenario that is equal to the sum of the probabilities of all the non-zero cost scenarios occurring.

- For example, let:

$$Probability_{Highest\ Cost\ Scenario} = \sum_{for\ all\ Scenarios\ j\ with\ non-zero\ cost} Probability_{Scenario\ j}$$

- Then:

$$\text{Max. Expected Cost} = Cost_{Highest\ Cost\ Scenario} \times Probability_{Highest\ Cost\ Scenario}$$

$$\geq Expected\ Cost = \sum_{for\ all\ Scenarios\ i} (Cost_{Scenario\ i} \times Probability_{Scenario\ i})$$

Probability of a Non-zero Cost Scenario

- Based on emergency procedures triggered during the last few years, the probability of a non-zero cost scenario occurring in any hour is in the range of 0.1%.

- For example, in 2018, below are the number of hours with the following emergency procedures triggered:
  - Demand Response Deployment Hours: 0
  - Synchronized Reserve Shortage Hours: 2
  - Voltage Reduction Hours: 0
  - Manual Load Shed Hours: 3

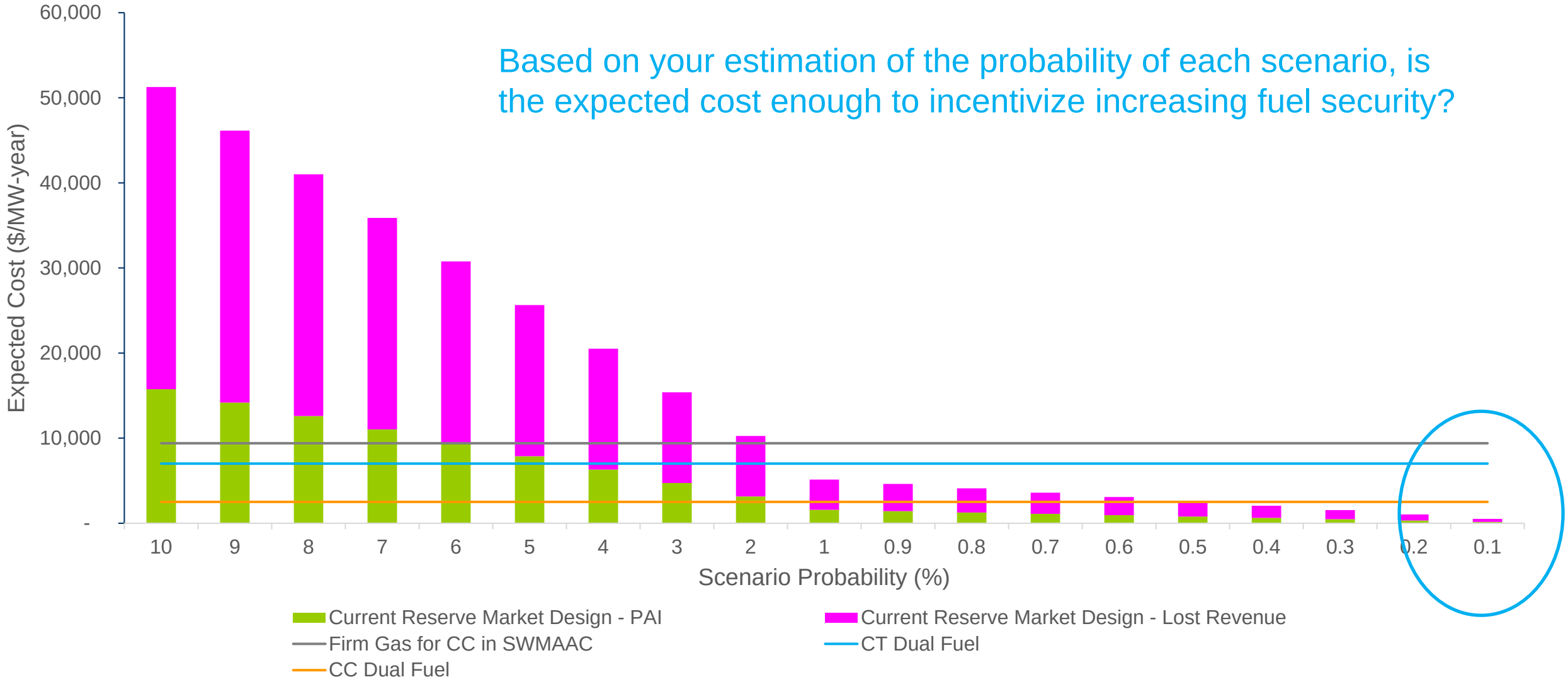
Example Costs to Increase Fuel Security

- The following are some example costs for generator investments that may allow a resource to increase fuel security (these are provided for illustrative purposes only, actual costs may differ).
  - Cost for Firm Gas in SWMAAC for a CC = $9,400/MW-year
  - Cost to add dual fuel capability:
    - CT = $7,000/MW-year
    - CC = $2,500/MW-year

Costs are from the Brattle Report

Phase I Highest Cost Scenario Expected Costs

Based on your estimation of the probability of each scenario, is the expected cost enough to incentivize increasing fuel security?



Incentive to Become Fuel Secure

- Under the current reserve market design, assuming the probability of all scenarios with a non-zero cost is approximately 0.1%, a maximum expected cost of $510/MW-year does not appear to be enough to incentivize a generator to increase its fuel security.

Gaps in Existing Mechanisms Compensation

- Currently, there does not appear to be an incentive under the existing mechanisms for a resource to increase its fuel 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

- 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 additional compensation mechanisms or modifications to the compensation of the existing mechanisms are needed to incentivize desired behavior