Phase 1 Analysis Education

Fuel Security Senior Task Force

April 5, 2019

Context for Fuel Security Study

Approach & Assumptions

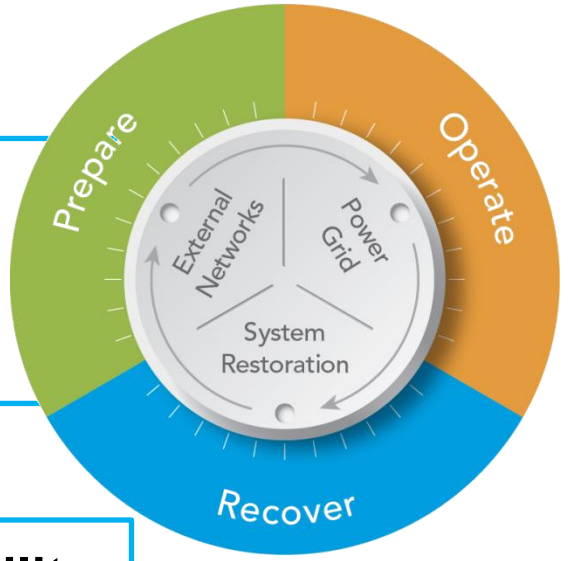
Results & Conclusions

A Common Understanding of Resilience

FERC's Proposed Definition: The ability to withstand and reduce the magnitude and/or duration of disruptive events, which includes the capability to anticipate, absorb, adapt to, and/or rapidly recover from such an event.

PJM's Working Definition: The ability to withstand or quickly recover from events that pose operational risks.

Prepare + Operate + Recover



Reliability: Delivering electricity consistently and uninterrupted

Resilience: Grid survivability during extreme events, even if that means outages

Fuel Security Summary

FOCUS

1. Define fuel security **considering risks in fuel delivery** to critical generators
2. Reaffirm the **value of markets to** achieving a cost-effective, fuel-secure fleet of resources
3. **Identify fuel security risks** with a primary focus on resilience
4. Establish **criteria to value fuel security** in PJM markets

APPROACH

1. **Phase 1: Analysis**
   Identify potential system vulnerabilities and develop criteria to address them
2. **Phase 2: Modeling**
   Model incorporation of vulnerabilities into PJM's markets or operations construct
3. **Phase 3: Ongoing Coordination**
   Address specific security concerns identified by federal and state agencies

TIMING

May–November 2018
Phase 1 Analysis

2019/2020
Phase 2: Completion of key work activities #1-4 and expected deliverable #1 by end of 3Q19

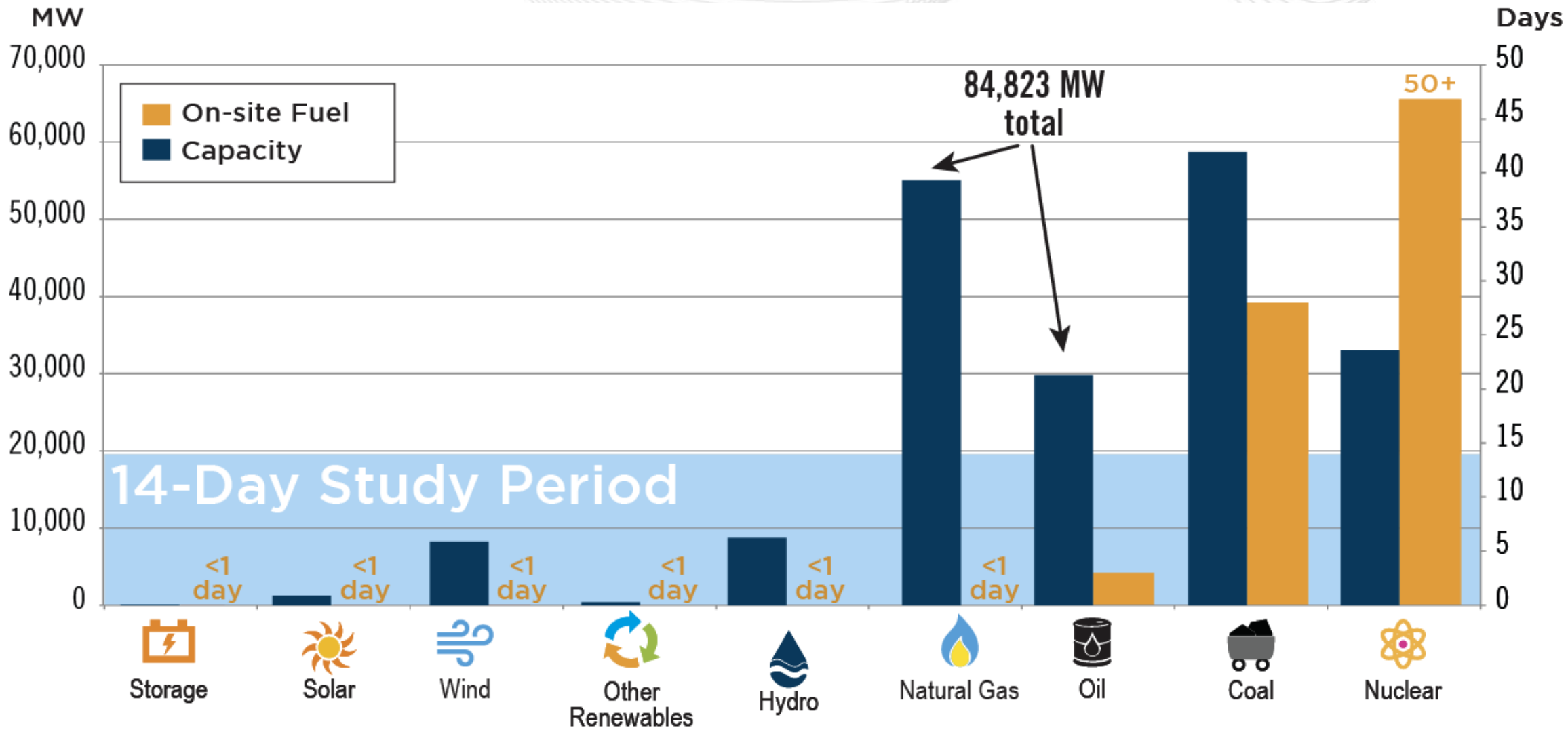
May 2018–December 2019
Phase 3 ongoing coordination

Context for Fuel Security Study

Approach & Assumptions

Results & Conclusions

Understanding the Study



Approach Overview

Study Cases

Retirements

Announced

Escalated

Weather Scenarios

Typical 50/50 Winter

Extreme (95/5) Winter

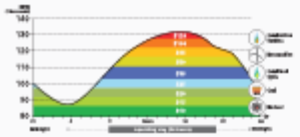
Disruptions

Fuel delivery infrastructure disruption sensitivities

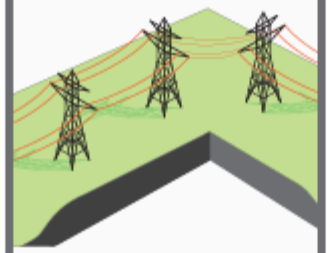
E F

Deterministic Analysis

Dispatch simulation for study case duration



Detailed transmission analysis for selected peak hours



Outcomes

Evaluation of current capabilities of resources to mitigate fuel delivery infrastructure risk

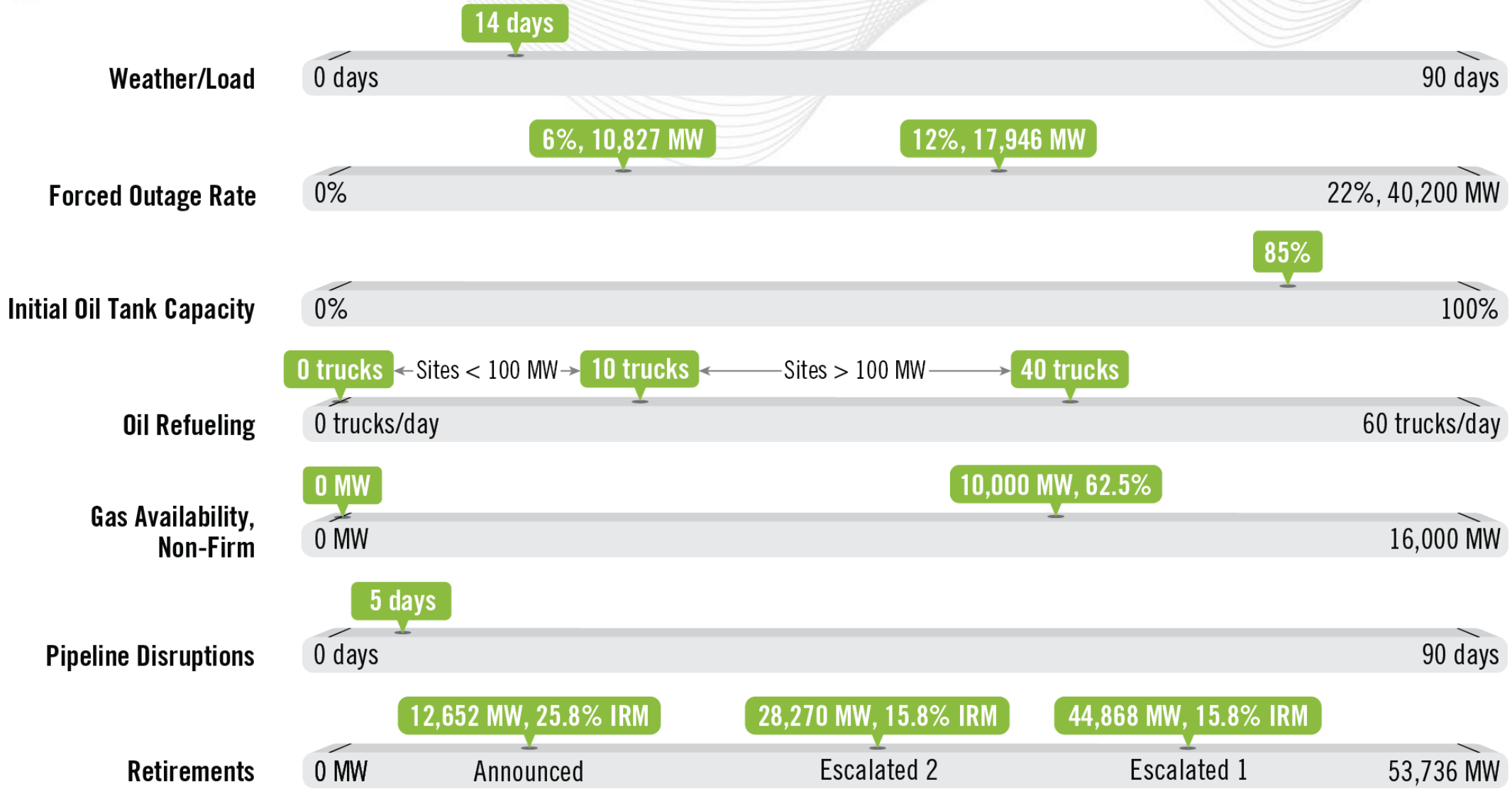
Inform development of "fuel secure" definition

Locational/regional fuel secure MW methodology to mitigate risks, if needed

External Coordination & Outreach Update

Outreach	Information Collected	Study Impact
Stakeholder Feedback	Written comments submitted directly to PJM and additional comments offered during stakeholder meetings	Development of approach and assumptions
PJM Generation Owner Surveys	Unit-specific information and statistics	Baseline data and unit-specific study inputs
Direct Generation Owner Conversations	Detailed information about oil refueling operations	On-site oil inventories and oil refueling assumptions
Natural Gas Pipelines & Industry Groups	Operating information and reliability details	Study scenario development and natural gas supply assumptions/disruptions
Renewable Industry Groups	Operating information and disruption details	Study scenario development and dispatch
DR Representative & Industry Groups	Operational information and expected customer response	Baseline data and unit-specific study inputs
Coal Industry Groups	Supply chain and transportation logistics information	Study scenario development and refueling assumptions
Nuclear Industry Groups	Operational information and logistics	Baseline data and unit-specific study inputs
Regulators	Discussions held with NERC, ReliabilityFirst	Feedback on study assumptions and overall approach
Independent Market Monitor (IMM)	Discussion on study assumptions and overall approach	Review of forward-looking economic profit and loss analysis as part of escalated retirement scenarios
Other RTO/ISOs	Discussions held with neighboring RTO/ISOs regarding similar initiatives to analyze fuel security	Detailed review of study assumptions and approach
Department of Energy	Information on physical/cyber threat actors and capabilities to impact gas pipelines. PJM will work with DOE to determine level of information sharing with PJM stakeholders (and define risk scenarios).	**Phase 3 Input:** Disruption events for extreme cyber and physical threats PJM will work with gas pipelines to assess impacts.

Key Model Assumption Ranges



Assumptions

Study Year	Weather Scenario
2023/2024	14 days
Load	
Peak Load	**Typical:** 50/50 – 1 in 2 years; (134,976 MW peak) / **Extreme:** 95/5 – 1 in 20 years; (147,721 MW peak)
Load Profile	**Typical:** 2011/2012 winter / **Extreme:** 2017/2018 winter
Dispatch	
Dispatch	**Typical:** Economic / **Extreme:** Economic; optional maximum emergency if extreme cases present operational issues
Retirements	
Announced: Generation retirements announced by Oct. 1, 2018, and new generation in the PJM interconnection queue and slated to be in operation by 2023	**Escalated 1:** Generation retirements of 32,216 MW by 2023, with 16,788 MW of capacity added to meet the installed reserve margin requirement (15.8%)	**Escalated 2:** Generation retirements of 15,618 MW by 2023 with no capacity replacement
Escalated 1 Replacement Capacity Approach • Replacement resources reflective of PJM interconnection queue and commercial probability • Replacement combined cycle natural gas resources modeled as firm supply and transport • Replacement combustion turbine natural gas resources modeled as dual-fuel with interruptible gas	
Natural Gas	
Non-Firm Gas Availability	**Typical and Extreme:** 62.5% and 0%
Pipeline Disruption	**Medium Impact:** Days 1–5: 50%–100% disruption; days 6-14: 100% output (0% derate) / **High Impact:** Days 1–5: 100% disruption; days 6–14: 20% derate

Assumptions (cont.)

Fuel Oil		
Initial Oil Inventory Level	85%	
Oil Refueling (>100 MW site)	**Moderate:** 40 trucks daily refueling rate, capped at maximum tank capacity	**Limited:** 10 trucks daily refueling rate, capped at maximum tank capacity
Oil Refueling (<100 MW site)	**Moderate:** 10 trucks daily refueling rate, capped at maximum tank capacity	**Limited:** 0 trucks daily refueling rate, capped at maximum tank capacity
Expected Forced Outage Rates		
5-Year Average: Historic 5-year average, discounting gas and oil fuel supply outages	**Modeled:** Regression model of expected outage rates, discounting gas and oil fuel supply outages	
Transmission Modeling		
Announced Retirements: Transmission constraints that are greater than or equal to 230 kV	**Escalated Retirements:** Individual transmission constraints were not modeled; transfers into eastern PJM were limited based on CETO with a 15% transfer margin adder	
Scheduled Interchange	Total interchange with neighboring systems limited to +/-2,700 MW	
Demand Response	7,092 MW modeled locationally based on MW cleared by zone and nodal modeling	
Renewable Modeling	2017/2018 cold snap profile	
Distributed Energy Resources and Energy Efficiency	Explicitly accounted for in the load forecast	
Fuel Prices	2023/2024 futures prices adjusted by day-to-day fluctuations in price (volatility)	

Winter Load Assumptions

Winter Load Forecast

Typical Winter Load (50/50)

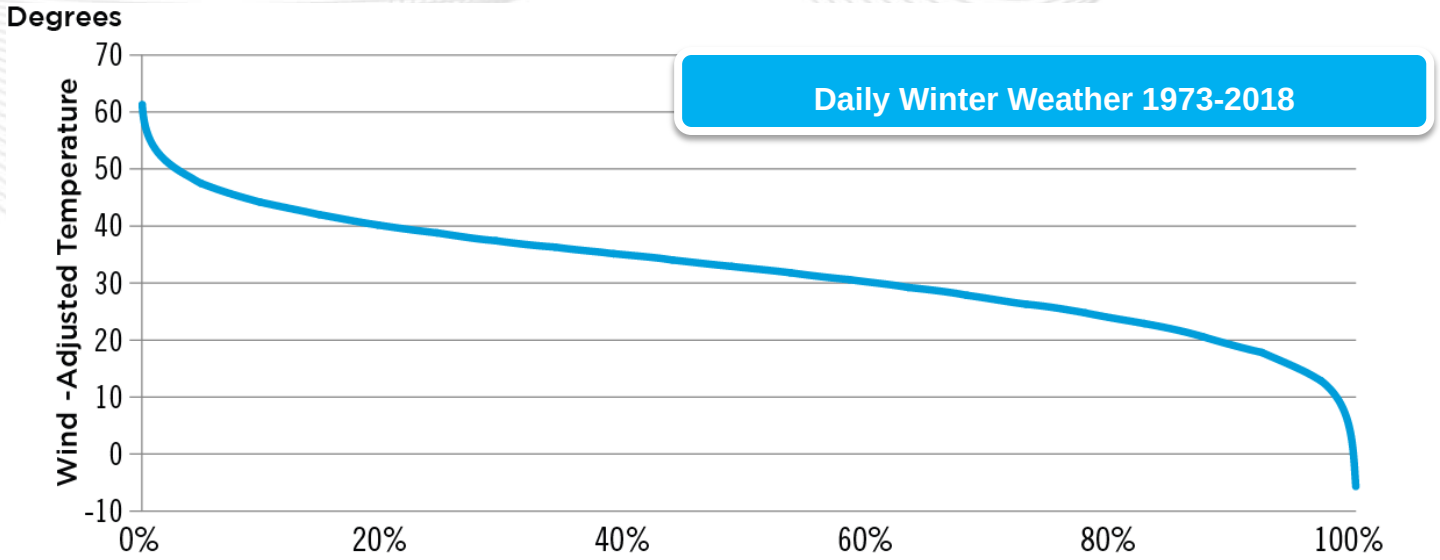
- **Peak = 134,976 MW**
  Winter 2023/24 forecast
- Average 50/50 winter hourly load shape from 2011/12

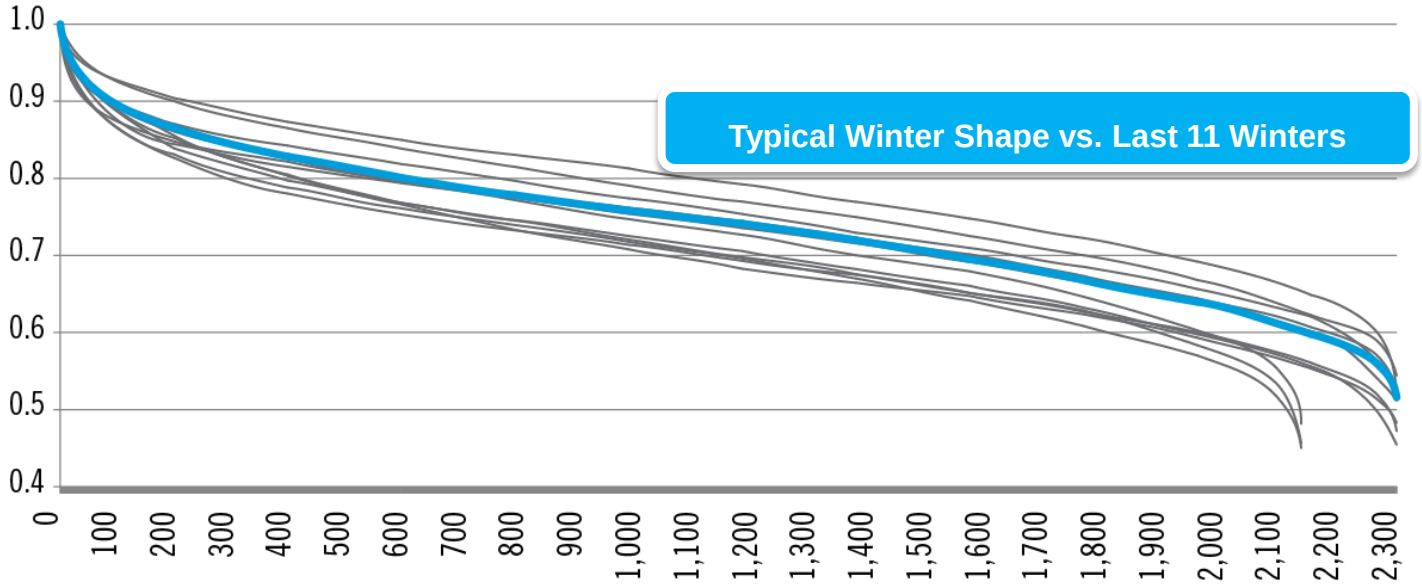
Extreme Winter Load (95/5)

- **Peak = 147,721 MW**
  Median of three historical cold snaps in last 45 years

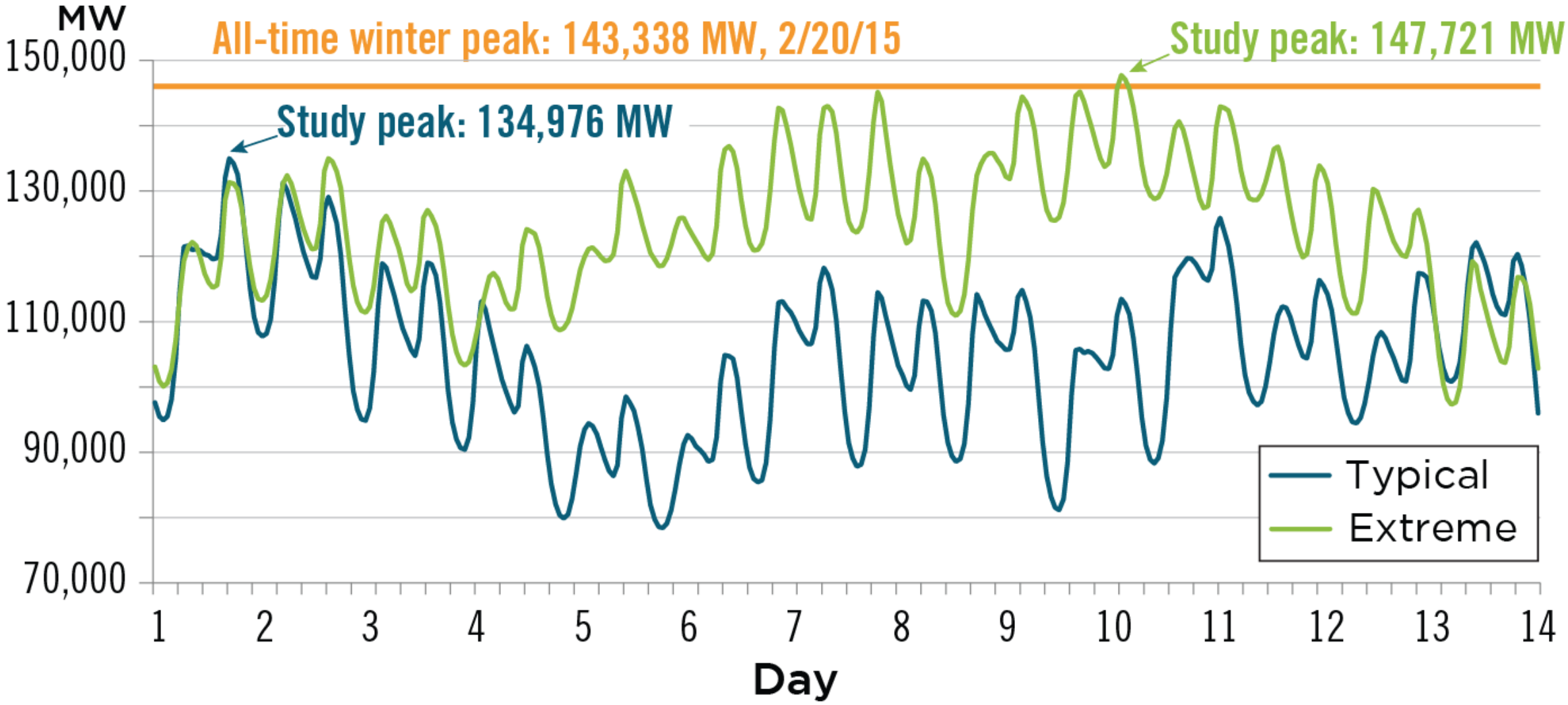
1989 peak	**1994 peak**	**2017/18 peak**
95th percentile	99th percentile	82nd percentile

- 2017/18 winter hourly load shape



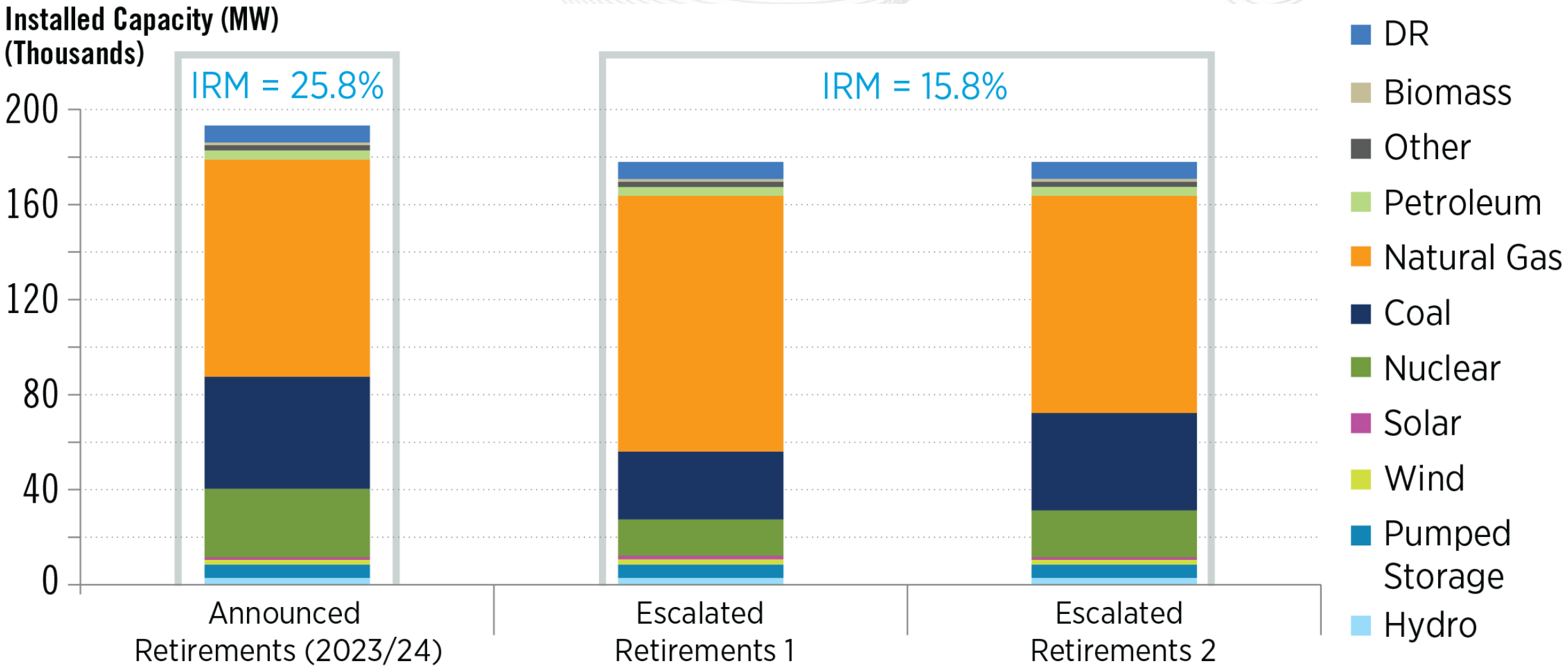


Winter Load in 14-Day Periods



Portfolio Assumptions

Portfolios Analyzed



Methodology, Escalated Retirement 1

Retirement

2021 Market Efficiency Planning Model
Net Energy Revenue

+

2021/2022 Capacity Auction
Capacity Revenue

−

Avoidable Cost Rate
(Fixed costs)

=

Forecasted
Profit & Loss

Replacement

Replacement for 2023 Delivery Year

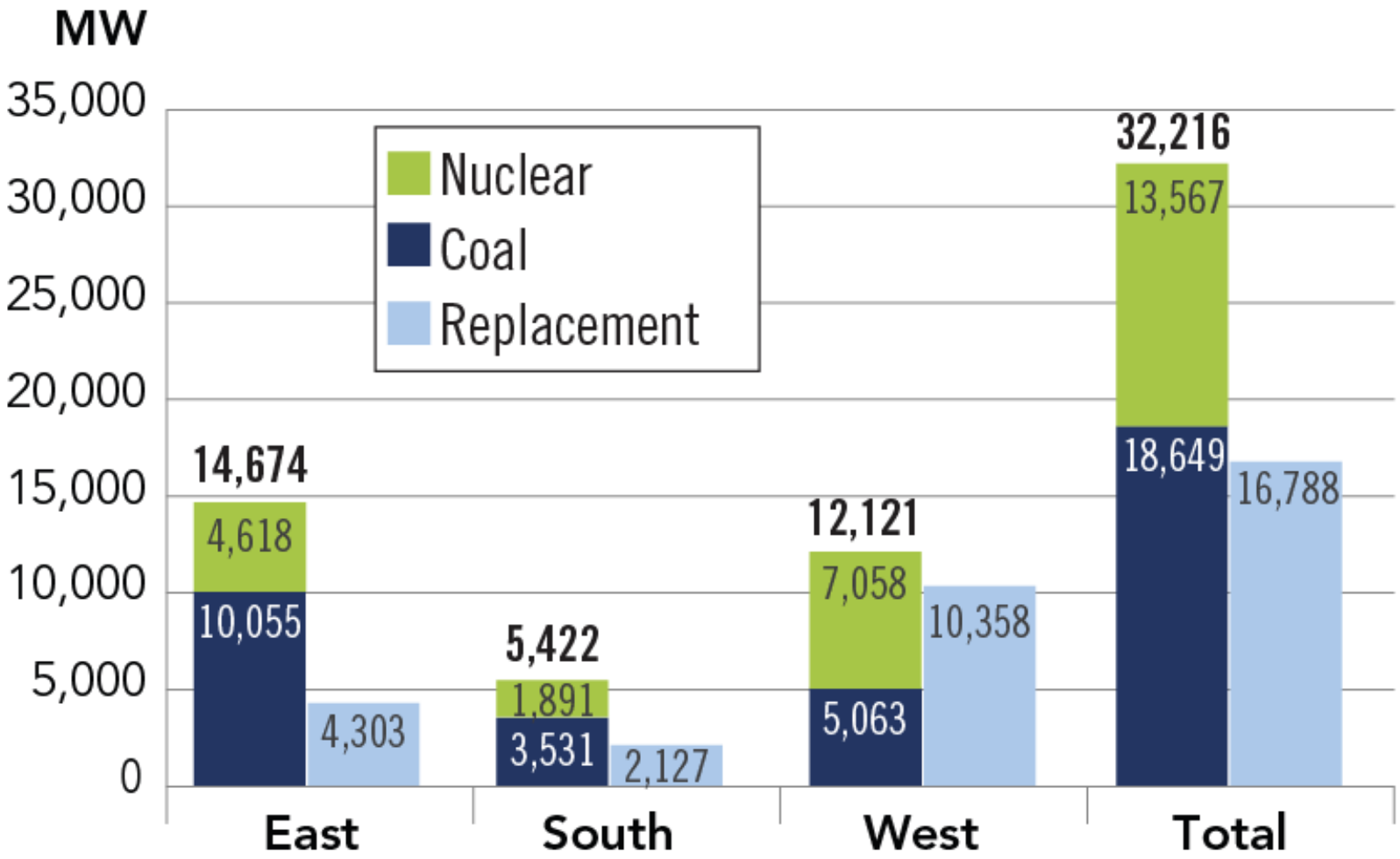
→

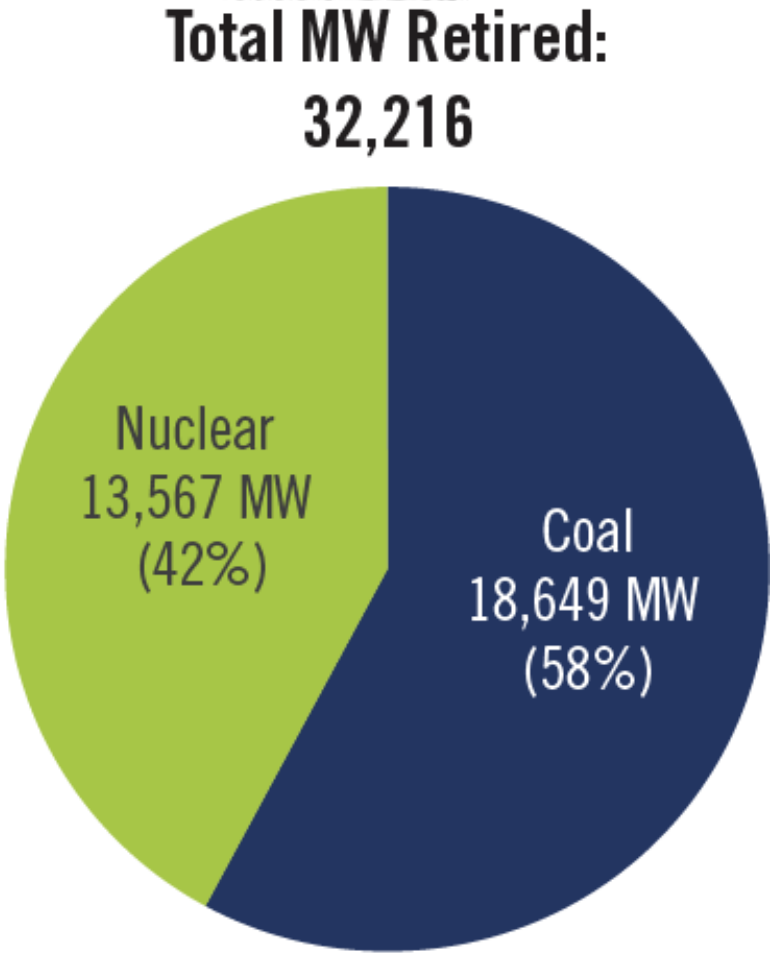
Facility Service Agreement Units
Commercial Probability

→

15.8% IRM

Escalated Retirement 1 Portfolio





Natural gas is 96% of replacement megawatts

Methodology, Escalated Retirement 2

Retirement

2021 Market Efficiency Planning Model
Net Energy Revenue

+

2021/2022 Capacity Auction
Capacity Revenue

−

Avoidable Cost Rate
(Fixed costs)

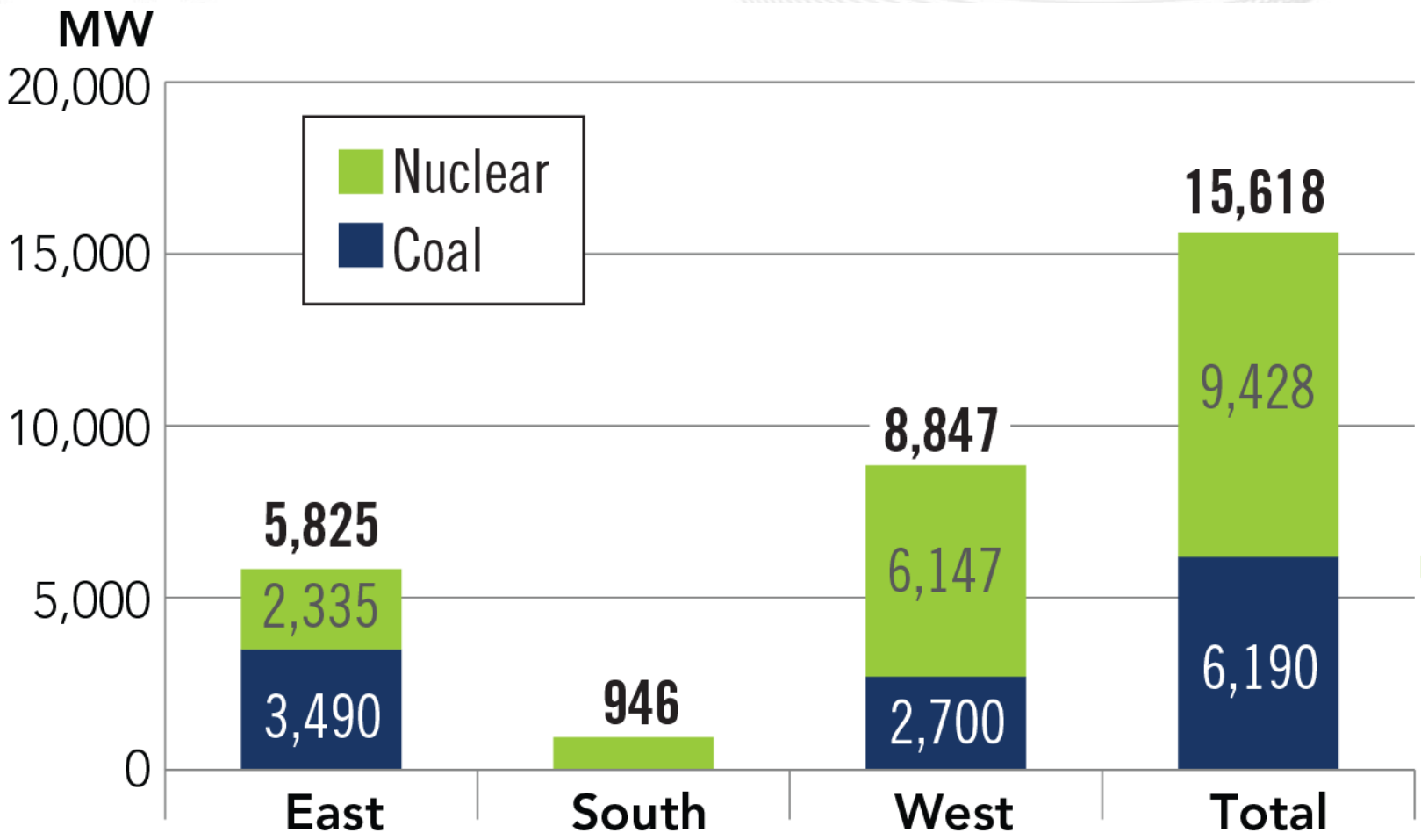
=

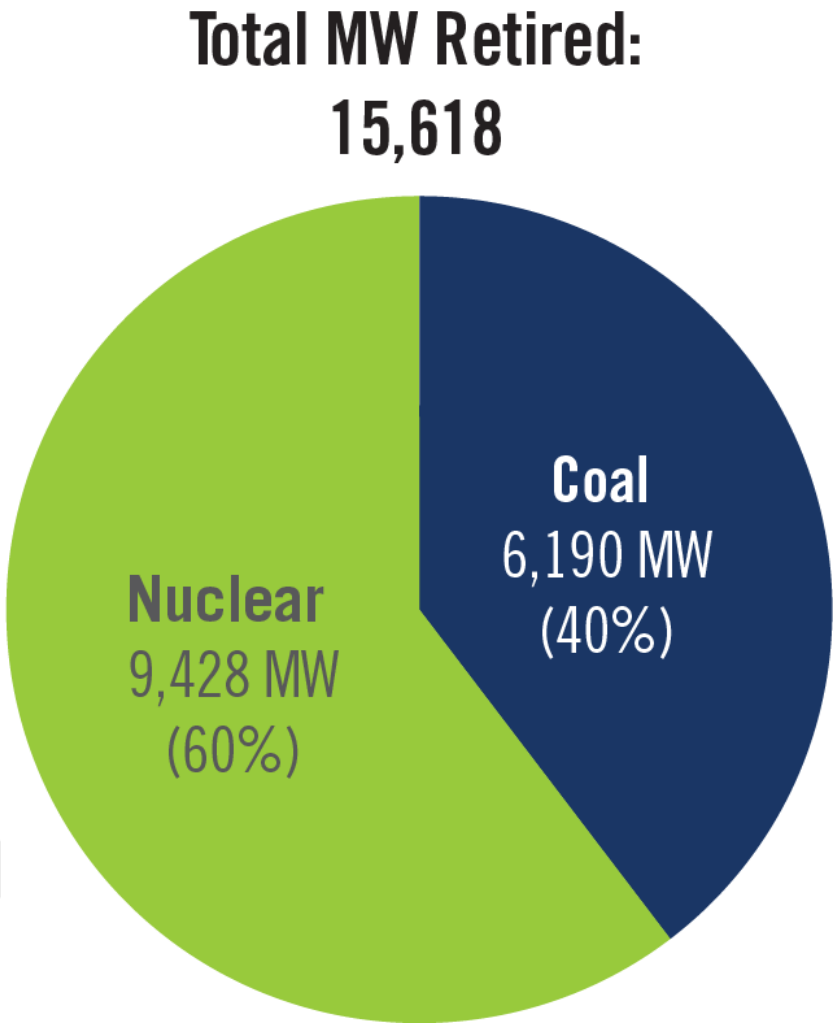
Forecasted
Profit & Loss

→

15.8% IRM

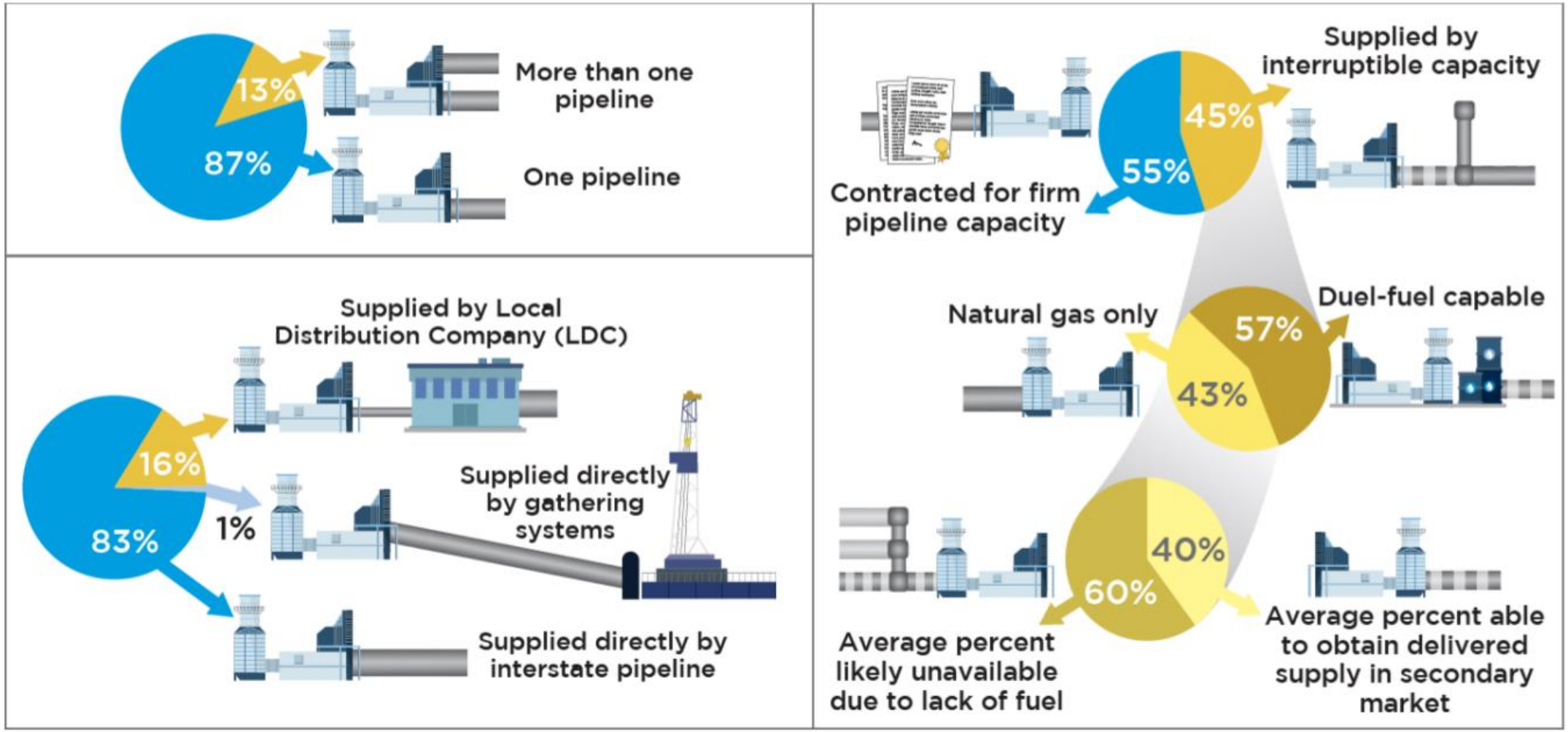
Escalated Retirement 2 Portfolio





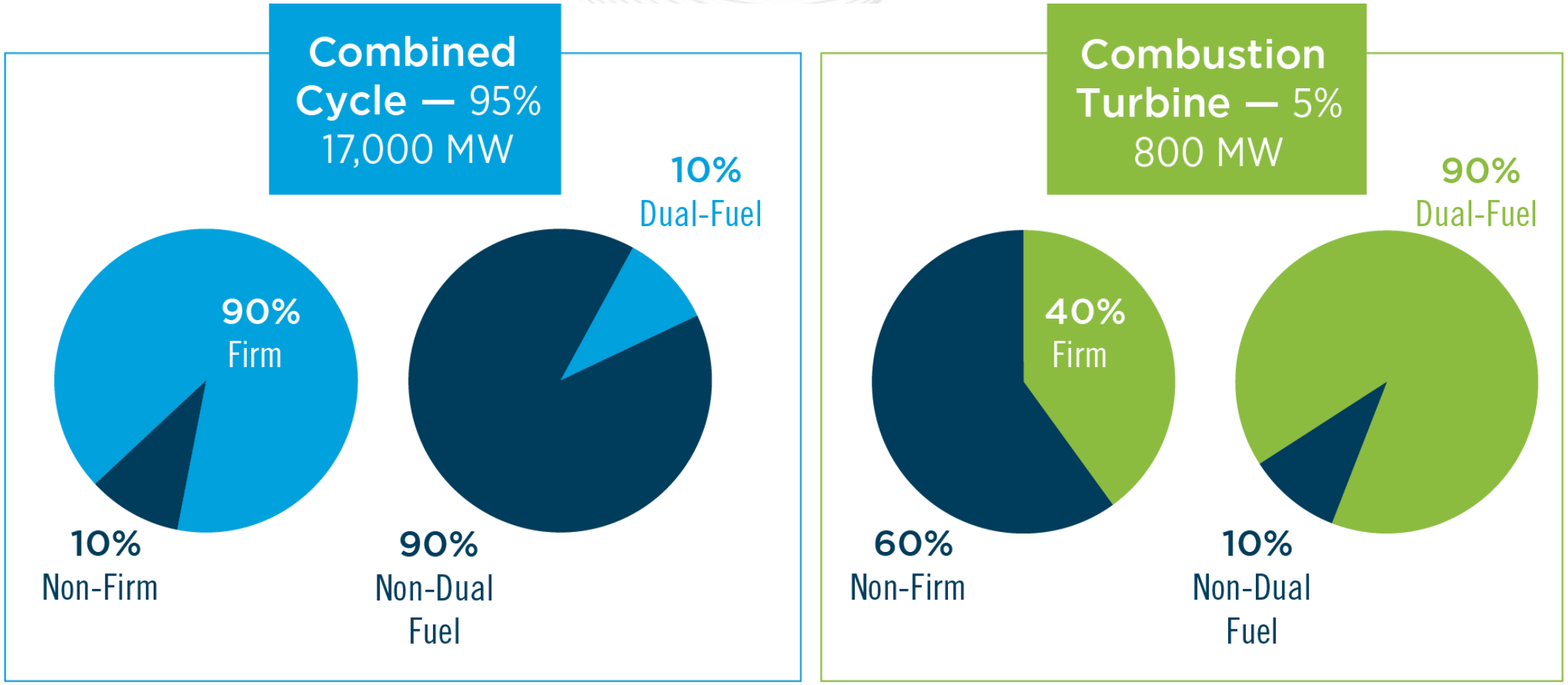
Operational Assumptions

Natural Gas Generator Fuel Delivery Characteristics

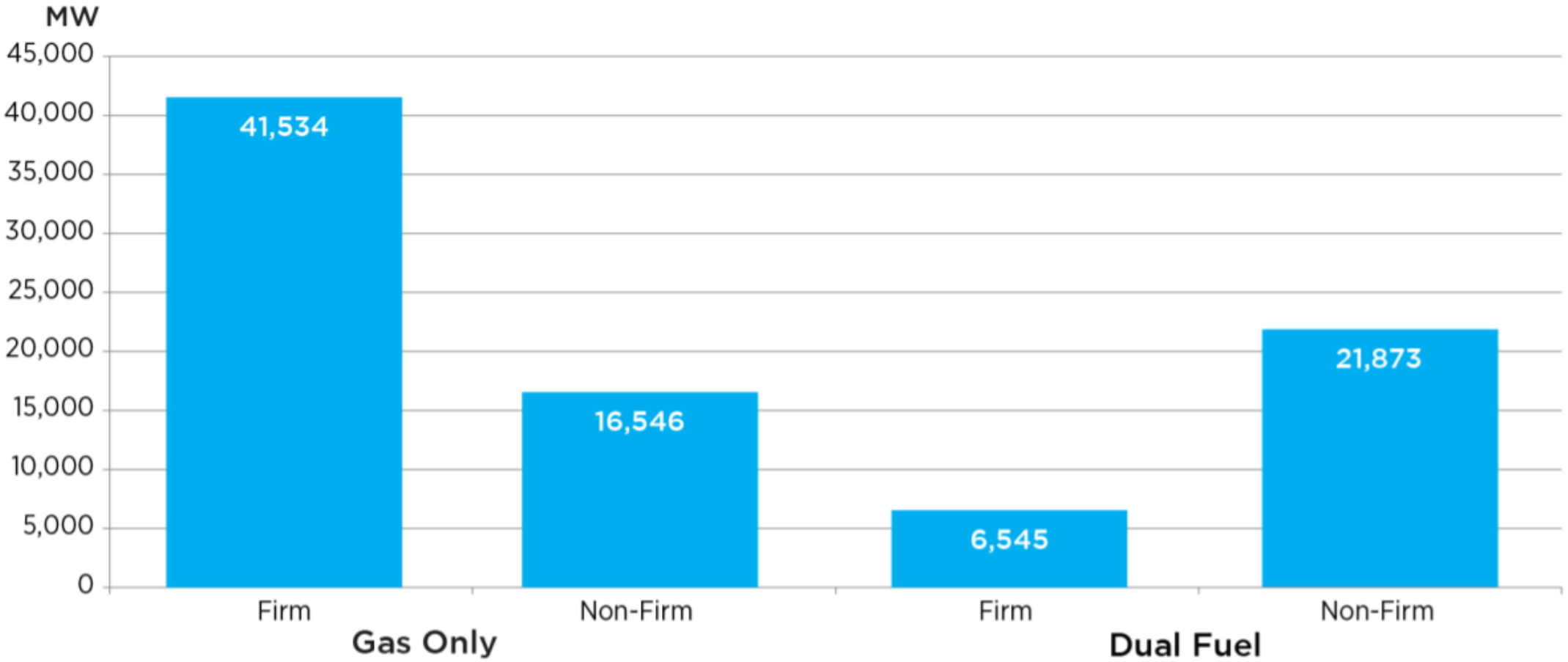


Taking into account the existing and planned generation in interconnection queue with interconnection service agreements and known gas delivery characteristics: approximately 87,000 MW

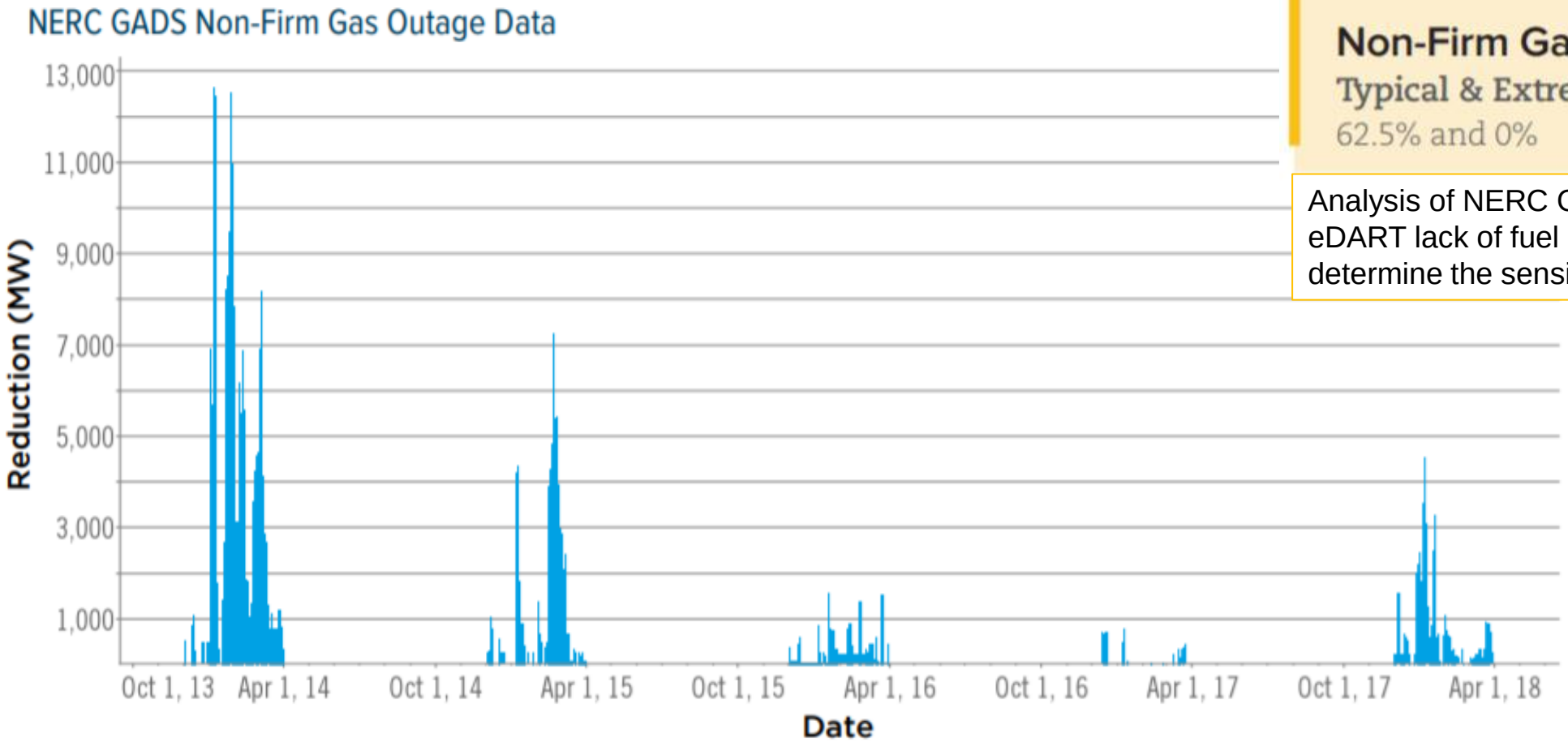
Fuel Trends for Recently Commercial and Queue Natural Gas Generators since 2017



Modeled Natural Gas Supply Attributes



Non-Firm Natural Gas Availability



ASSUMPTIONS

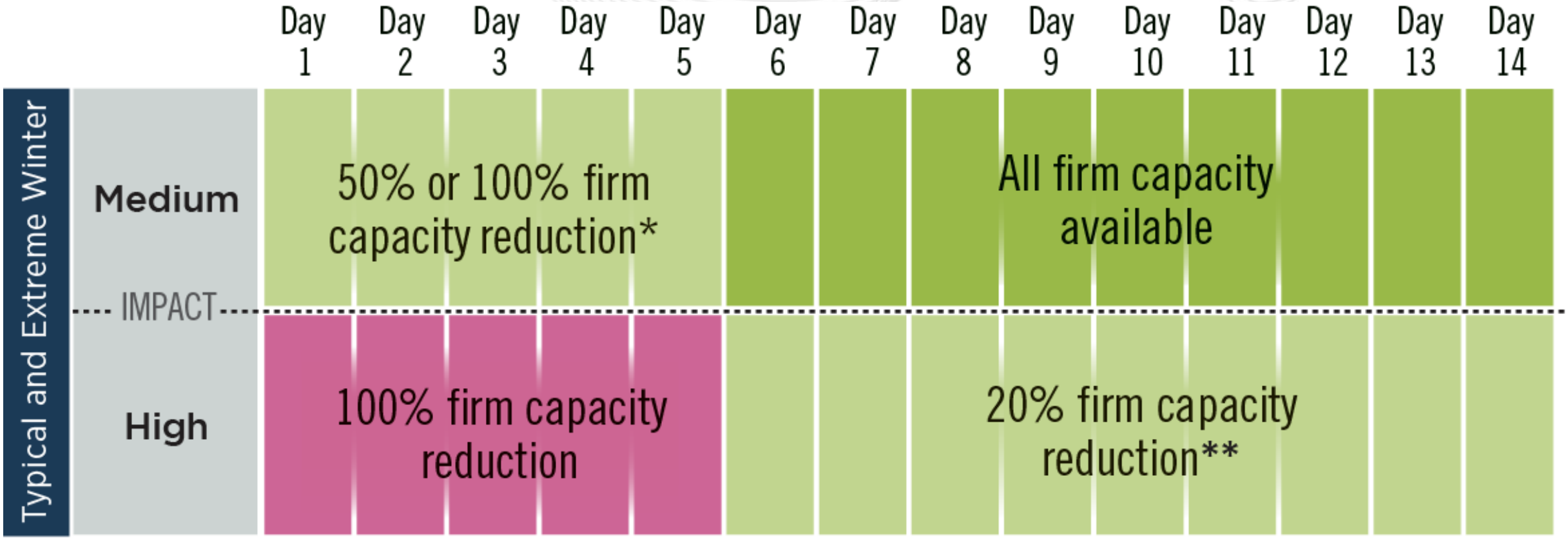
Non-Firm Gas Availability

Typical & Extreme:

62.5% and 0%

Analysis of NERC GADS and PJM eDART lack of fuel outage data to determine the sensitivity thresholds

Pipeline Disruptions: Impact & Duration



* Firm capacity reduction level depends on pipeline design redundancy.

** 20% of capacity remains unavailable due to assumed PHMSA (Pipeline Hazardous Material and Safety Administration) requirements.

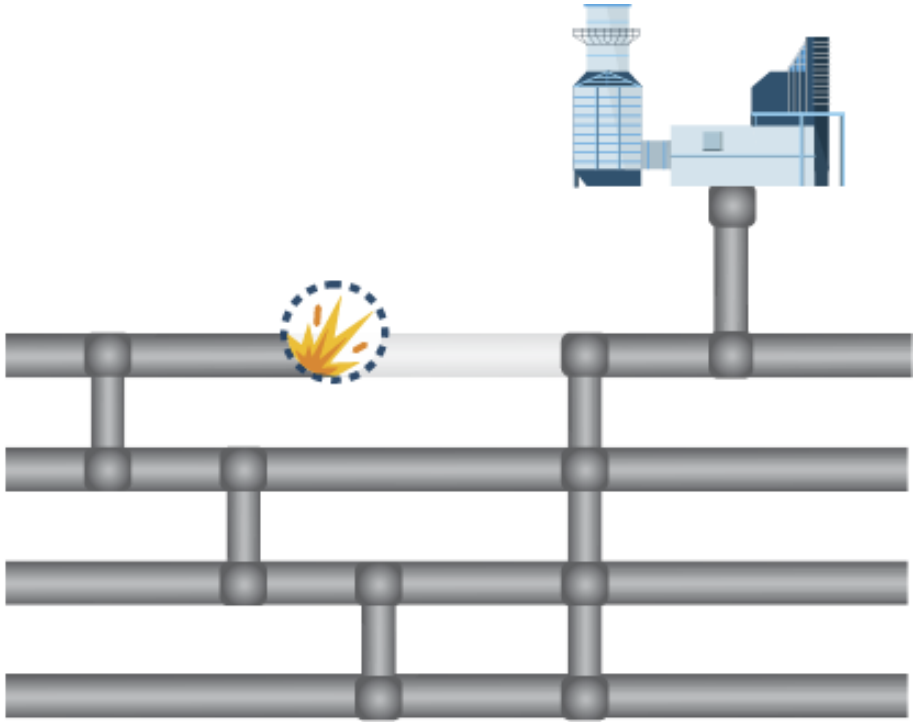
Pipeline Disruptions: Impacted Generation

Pipeline Disruption	Gas-Only Generation (MW)			Dual-Fuel Generation (MW)			Total (MW)
	Non-Firm	Firm	Total	Non-Firm	Firm	Total	
Looped 1	2,690	3,094	**5,784**	7,828	103	**7,931**	**13,715**
Looped 2		3,015	4,483	2,720	1,380	4,100	8,583
Replacement Generation (Escalated 1 Portfolio)		+ 435	+ 435	+ 225			+ 660
	1,468	3,450	**4,918**	1,468	3,450	**4,325**	**9,243**
Single 1		1,821	3,004	470	803		4,277
Replacement Generation (Escalated 1 Portfolio)		+ 774	+ 774		+ 774		+ 774
	1,183	2,595	**3,778**	1,183	2,595	**1,273**	**5,051**
Single 2	330	750	**1,080**	1,872	1,769	**3,641**	**4,721**

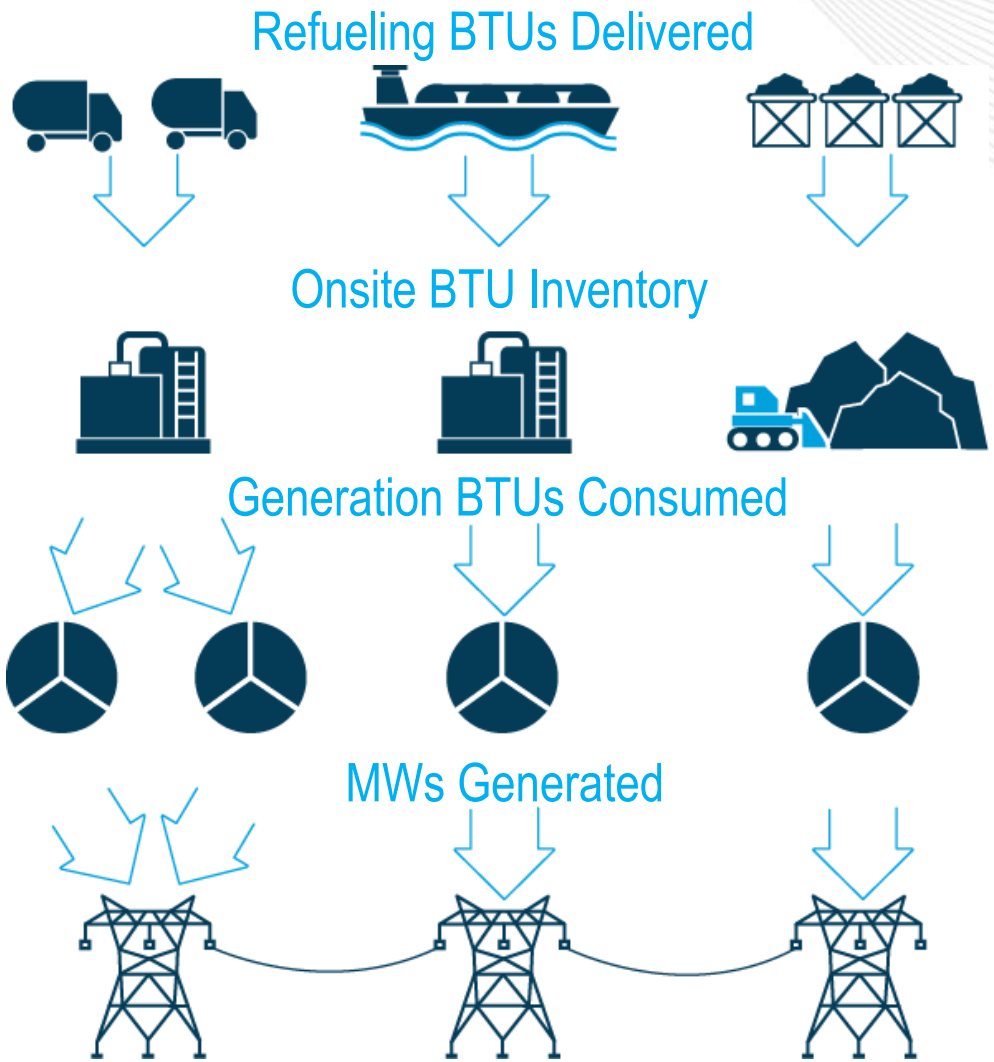
Pipeline Disruptions: Single vs. Looped

Generator connected to a **single** pipeline segment

Generator connected to a **looped** pipeline segment



Onsite Fuel Replenishment



Study refueling based on transportation method and maximum on-site inventory

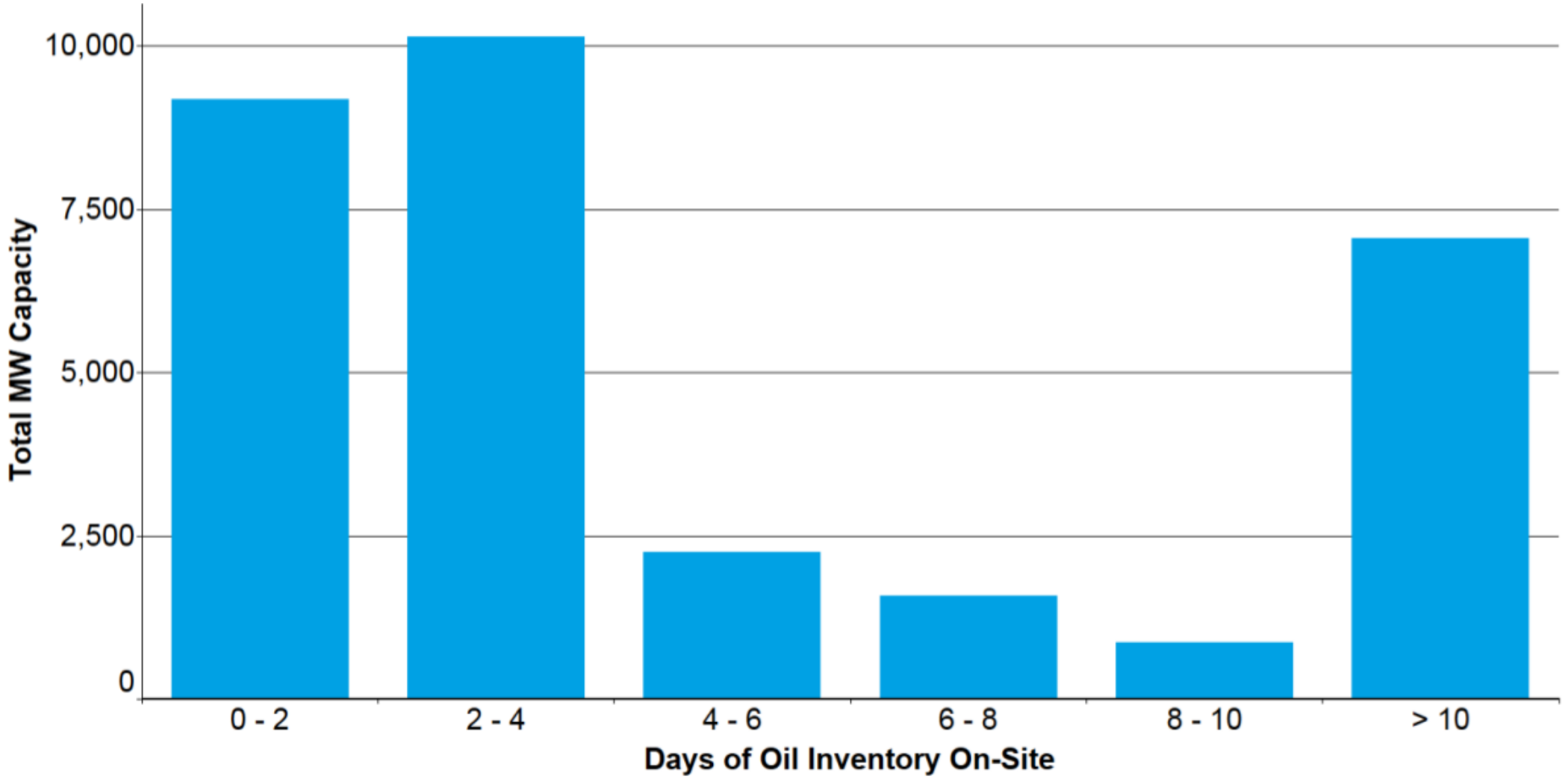
- **Transportation** assumed limiting factor rather than fuel.

Starting Coal Inventory – unit-specific seasonal inventory target

Starting Oil Inventory – 85 percent of max tank capacity

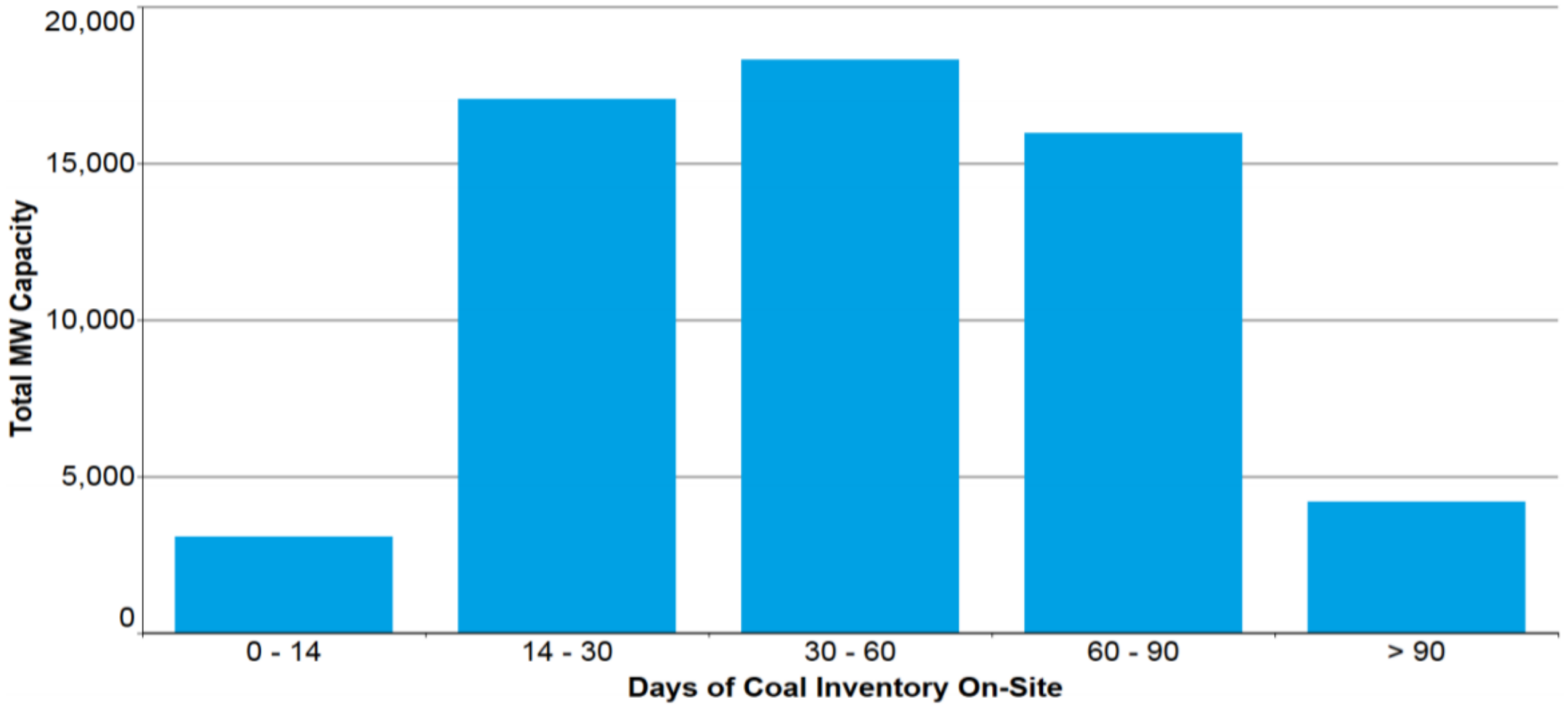
- **Oil refueling sensitivities** run modeling a range of 10 to 40 truck deliveries per day for sites > 100 MW and 0 to 10 trucks per day for sites < 100 MW to determine the magnitude of impact refueling has.

On-Site Oil Inventories



PJM eDART Generation Survey Data

On-Site Coal Inventories



PJM eDART Generation Survey Data

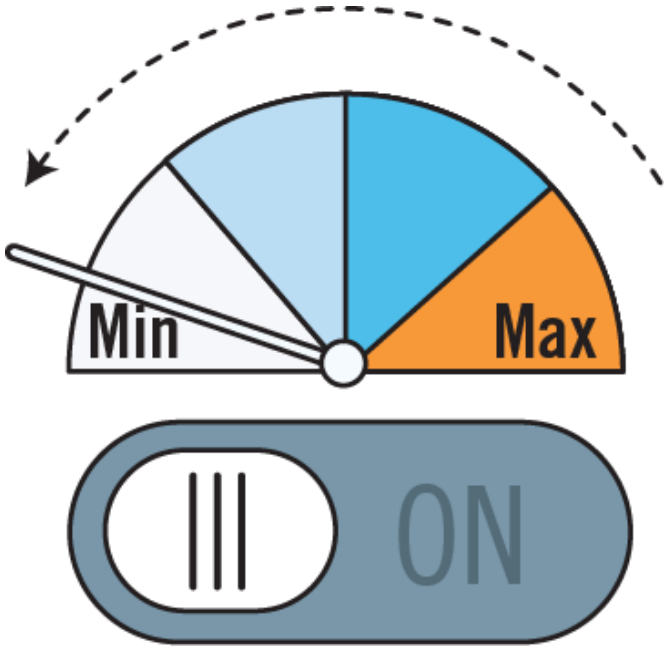
Estimated Capacity Performance Demand Response (CP DR)= **7,092 MW for 2023/24**

CP DR amount cleared in the 2021/22 Base Residual Auction

+

Fixed Resource Requirement (FRR)

- CP DR is reduced by three-year average 32 percent replacement rate.
- CP DR will be used for both Base Case and Extreme Weather Case.
- DR will be modeled in the simulation prior to a load shed event consistent with existing procedures.



Forced Outage Rates

	Typical	Extreme
Coal	8.45	11.77
Gas Combined Cycle*	5.68	16.91
Gas CT*	5.73	9.13
Gas Steam*	10.14	15.24
Hydro	13.06	11.76
Nuclear	1.38	2.38
Oil CT*	15.24	11.95
Oil Steam*	13.70	12.14
Biomass/Landfill Gas/Wood	10.83	18.28

ASSUMPTIONS

Expected Forced Outages

Five-Year Average: Historic five-year average, discounting gas and oil fuel supply outages

Modeled: Regression model of expected outage rates, discounting gas and oil fuel supply outages

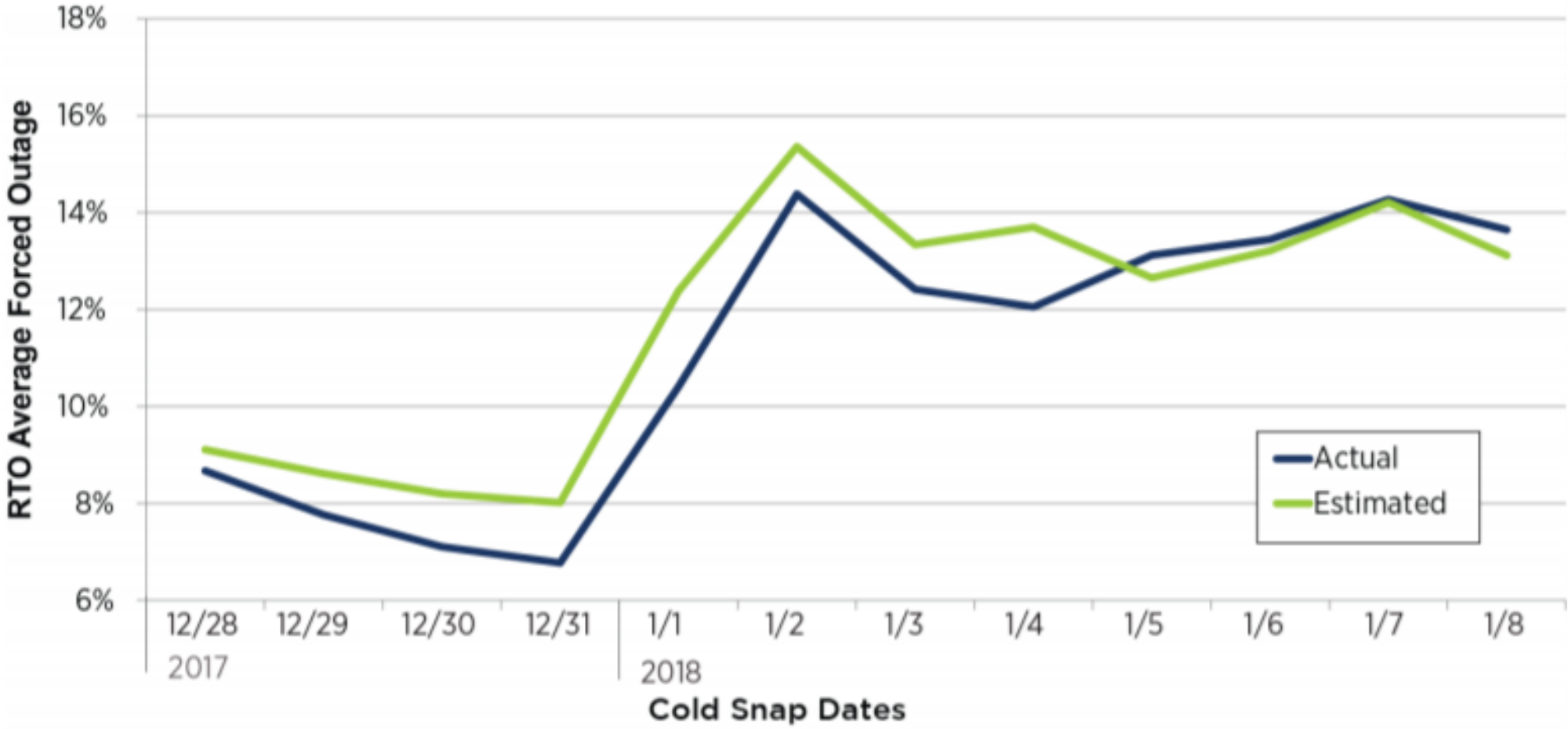
* Calculations exclude forced outages with "Fuel Supply" NERC GADS cause code

Forced Outage Rate Regression Model Methodology

Category	Key Variables	Correlation
Unit Characteristic	Age	✓
Weather	Wind Adj. Temp.	–
	Persistent Cold Weather	✓
Utilization	Run hours	–
	Basepoint Volatility	✓

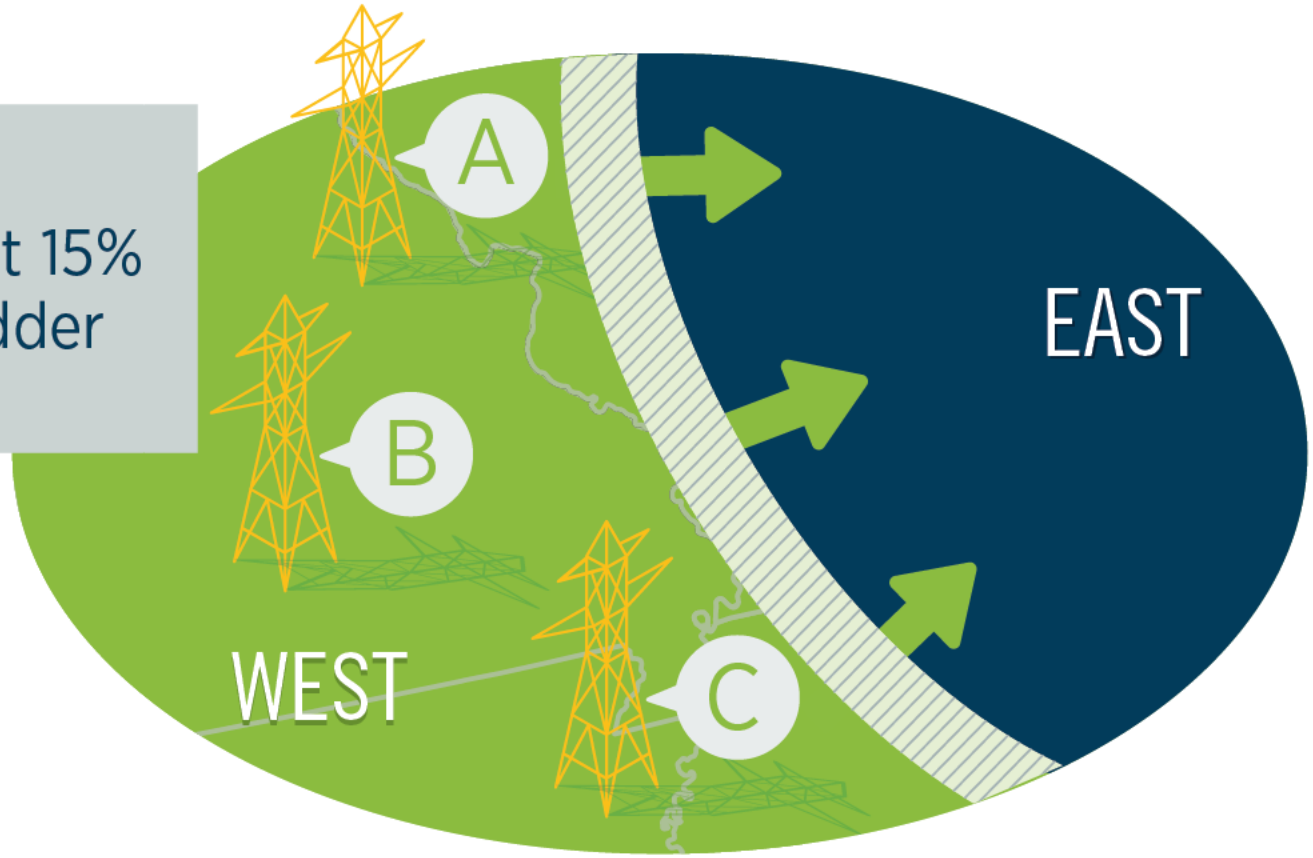
- Goal – % generator forced outage rate
- Using Jan. 2014 through 2018 data

Estimated Forced Outages Rates vs. Actual Forced Outage Rates



Transmission Modeling in Escalated Retirement Scenarios

Transfers limited to East = East CETO (1 in 25) + East 15% adder



Scenarios Analyzed

Dispatch	Retirement	Winter Load	Non-Firm Gas	Refueling	Pipeline Disruption (med. impact)	Pipeline Disruption (high impact)	Forced Outages
Economic	Announced	Typical 50/50 134,976 MW	62.5% Avail.	Moderate	Looped 1	Looped 1	Five-Year Avg.
Max. Emergency	Escalated 1	Extreme 95/5 147,721 MW	0% Avail.	Limited	Looped 2	Looped 2	Modeled Outages
	Escalated 2				Single 1	Single 1	
					Single 2	Single 2	

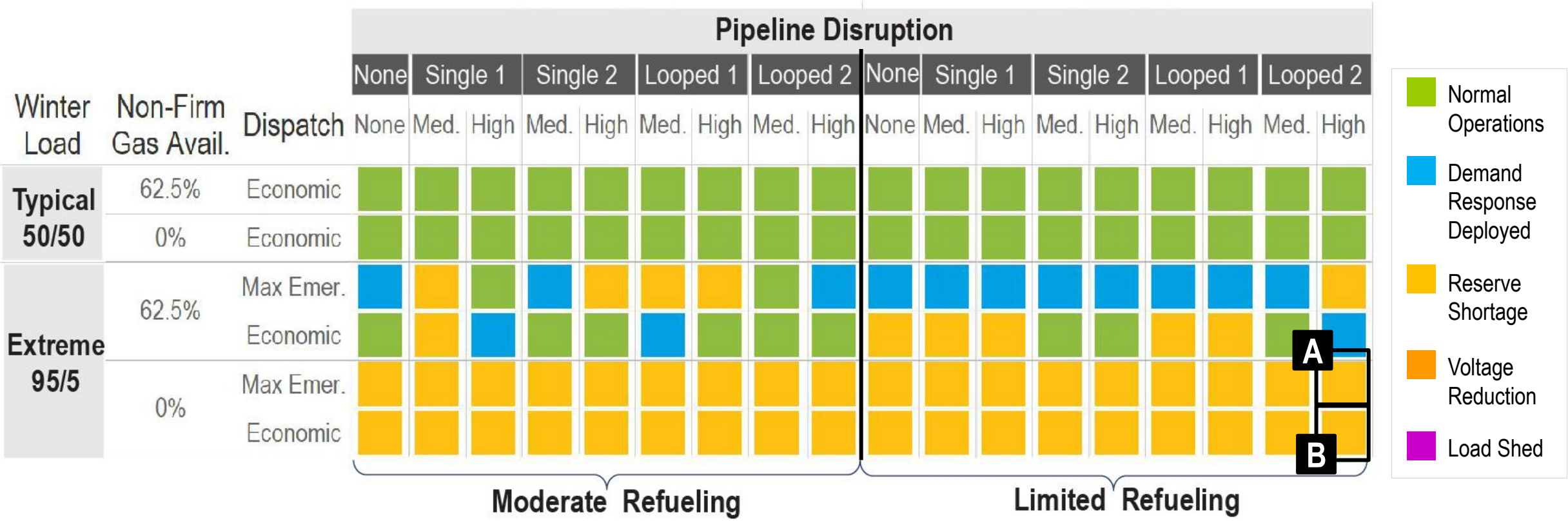
324

combinations

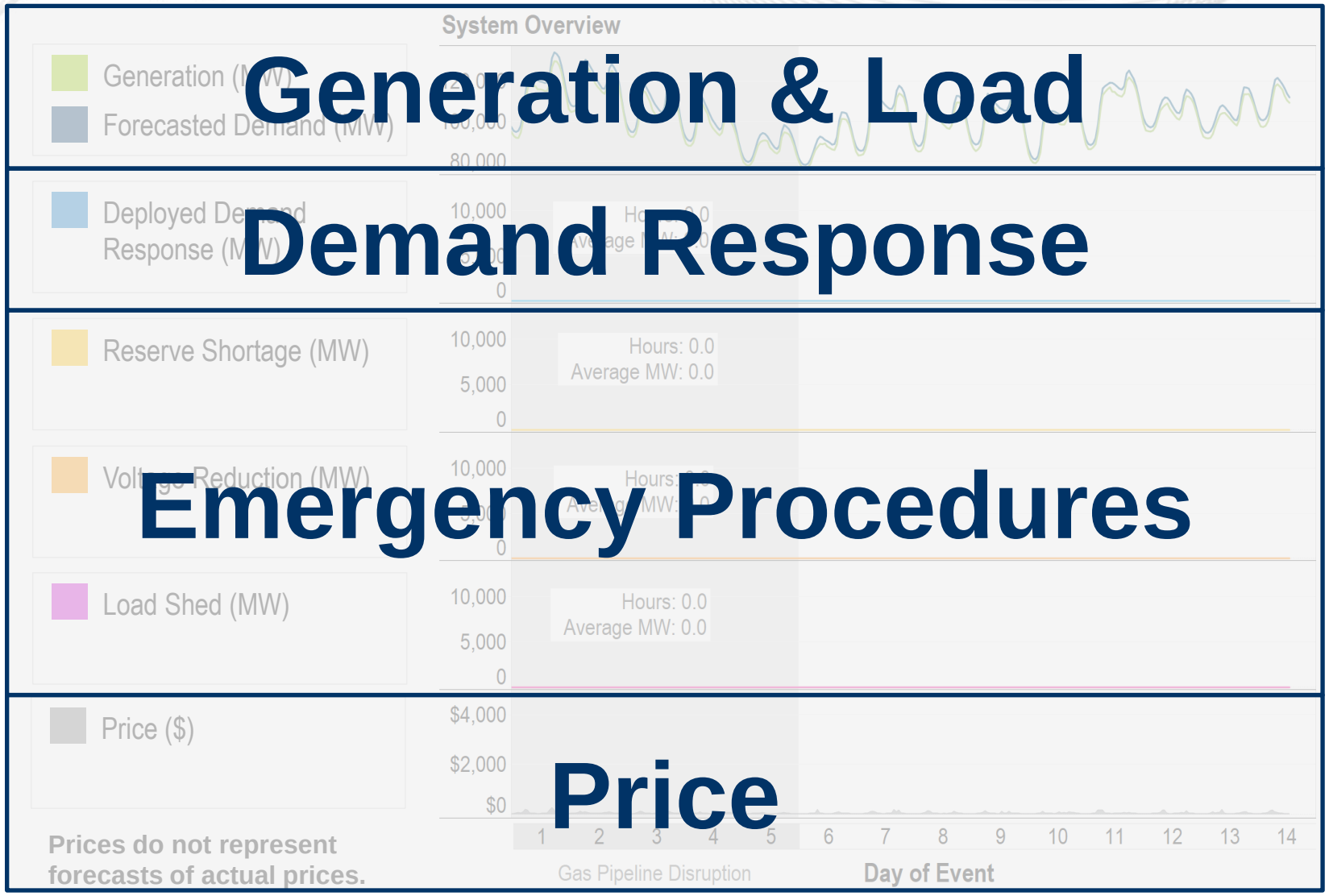

Context for Fuel Security Study
Approach & Assumptions
Results & Conclusions

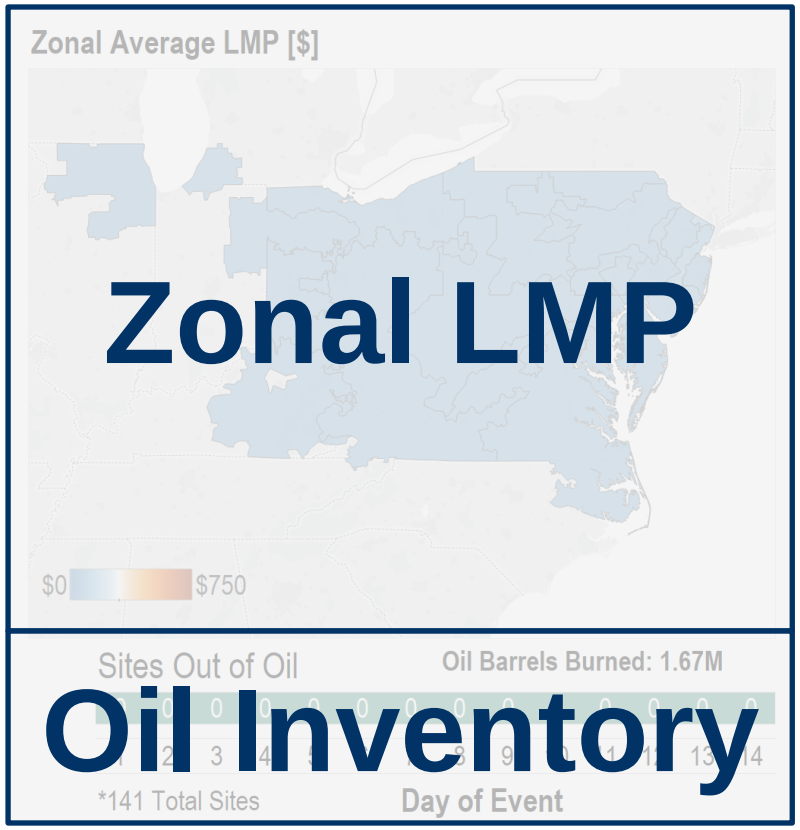
Announced Retirements Analysis Results

Emergency Procedures Summary
Announced Retirement Models



Announced Retirements Scenario Model: Example



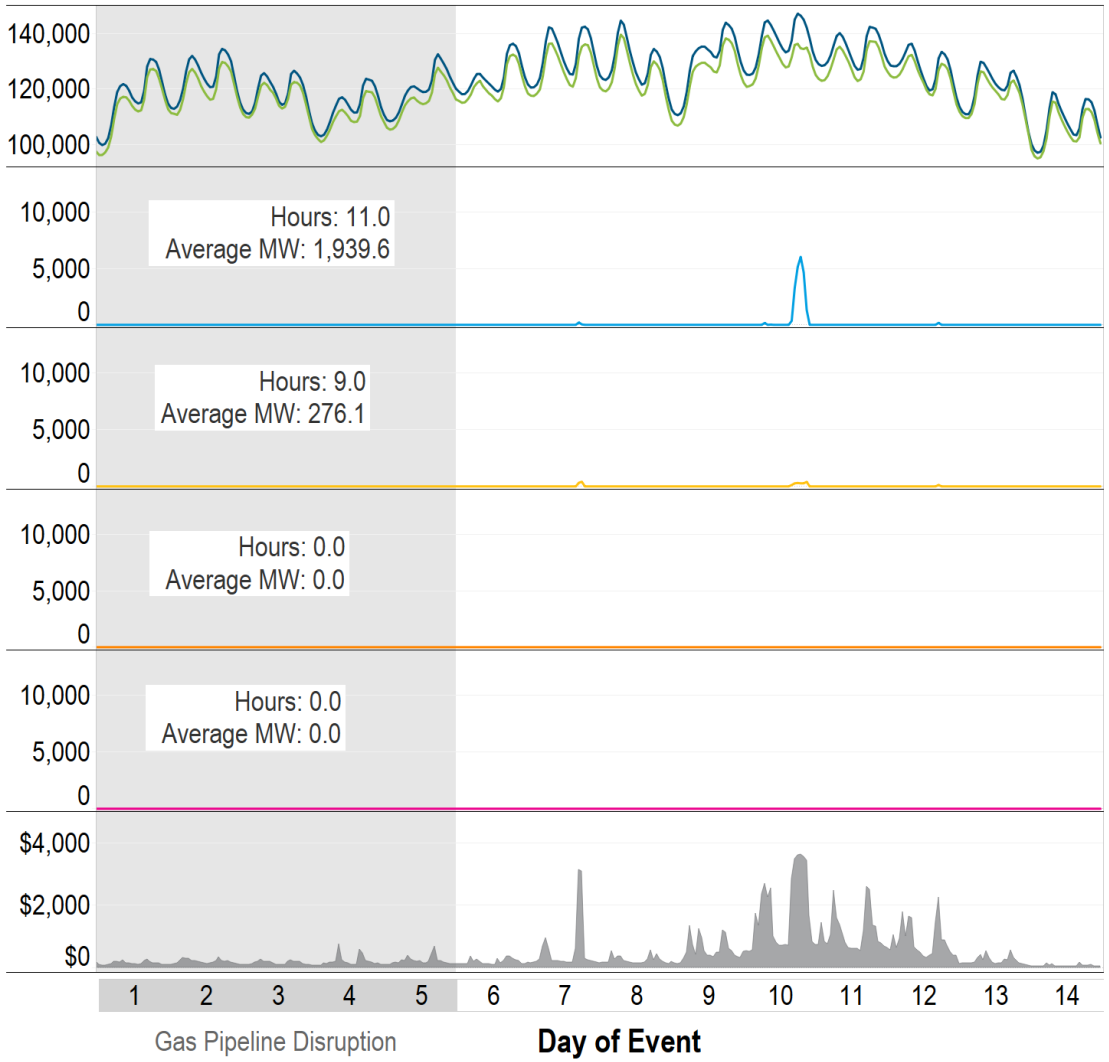


Announced Retirements Scenario Example A

- Generation (MW)
- Forecasted Demand (MW)
- Deployed Demand Response (MW)
- Reserve Shortage (MW)
- Voltage Reduction (MW)
- Load Shed (MW)
- Price ($)

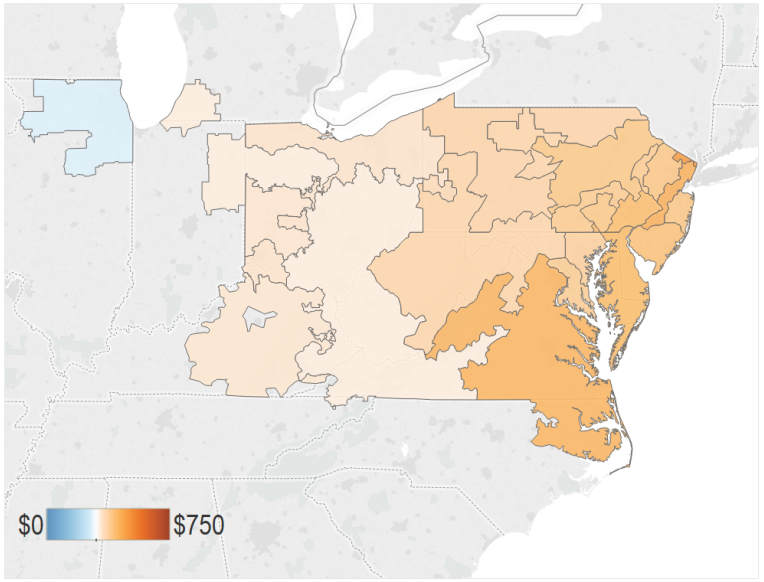
Prices do not represent forecasts of actual prices.

System Overview



Load:	Extreme
Refueling:	Limited
Disruption:	Looped 2 High
Non-Firm Avail:	0%
Retirement:	Announced
Dispatch:	Economic

Hourly Zonal Average LMP [$]



Sites Out of Oil

Oil Barrels Burned: 4.55M

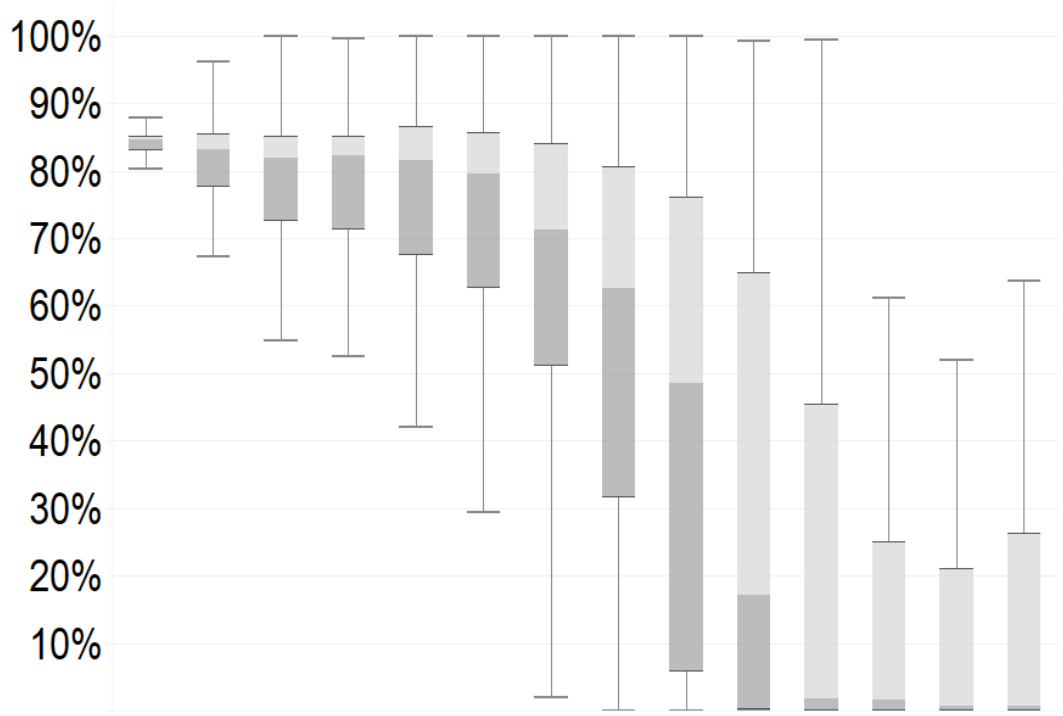
1	2	3	4	5	6	7	8	9	10	11	12	13	14
0	3	6	7	8	12	16	21	47	61	74	80	74	66

*141 Total Sites

Day of Event

Oil Inventory | Sites Out of Oil

Limited Refueling



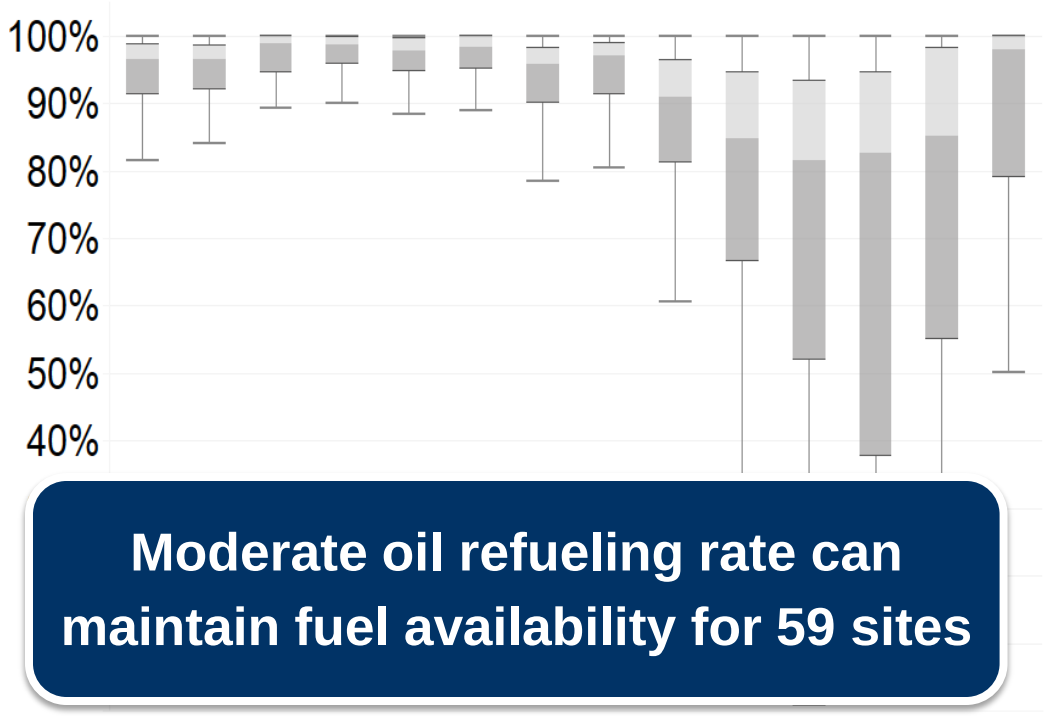
Sites Out of Oil

0	3	6	7	8	12	16	21	47	61	74	80	74	66
1	2	3	4	5	6	7	8	9	10	11	12	13	14

*141 Total Sites

Day of Event

Moderate Refueling



Moderate oil refueling rate can maintain fuel availability for 59 sites

Sites Out of Oil

0	0	0	0	1	1	3	2	4	9	22	21	3	1
1	2	3	4	5	6	7	8	9	10	11	12	13	14

*141 Total Sites

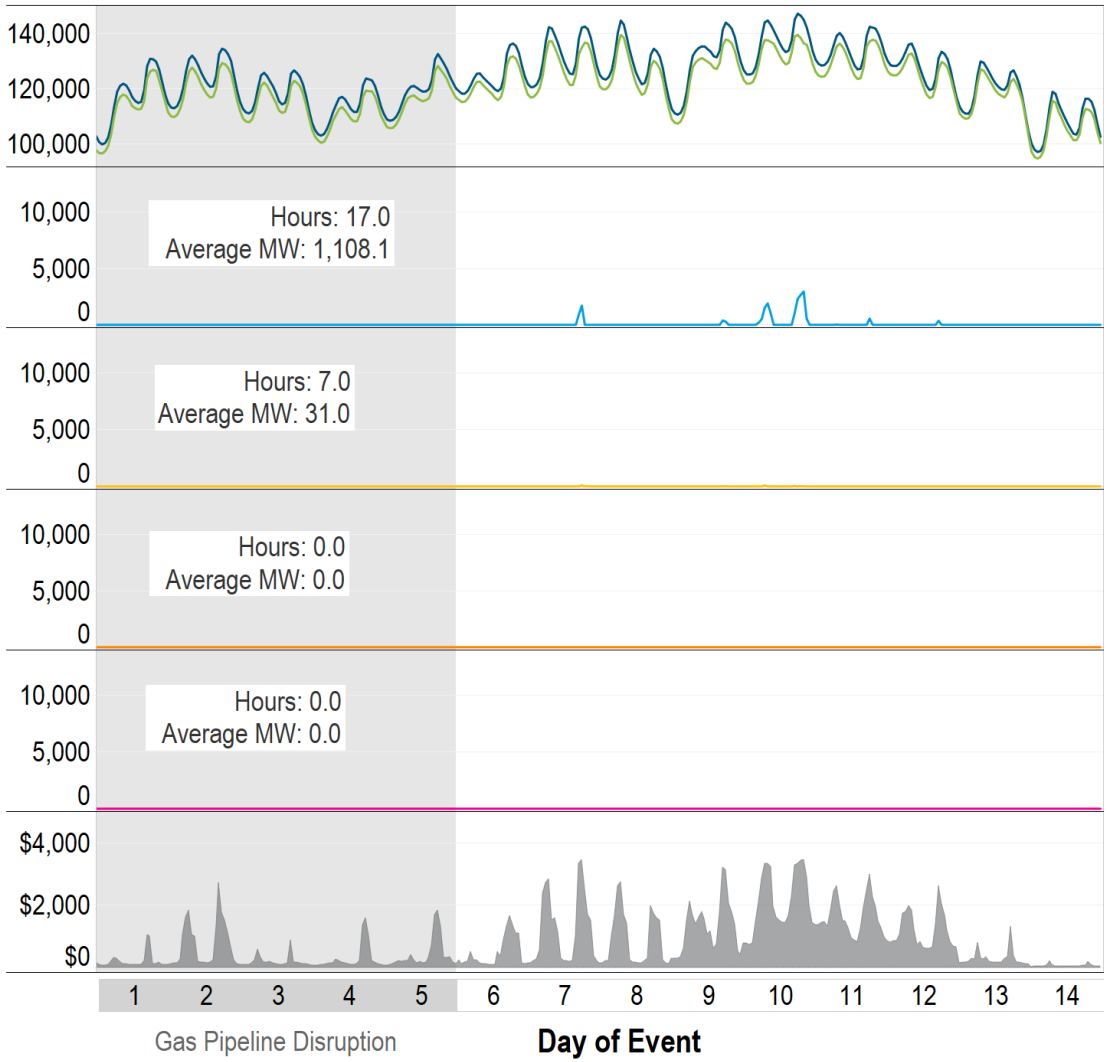
Day of Event

Announced Retirements Scenario Example B

- Generation (MW)
- Forecasted Demand (MW)
- Deployed Demand Response (MW)
- Reserve Shortage (MW)
- Voltage Reduction (MW)
- Load Shed (MW)
- Price ($)

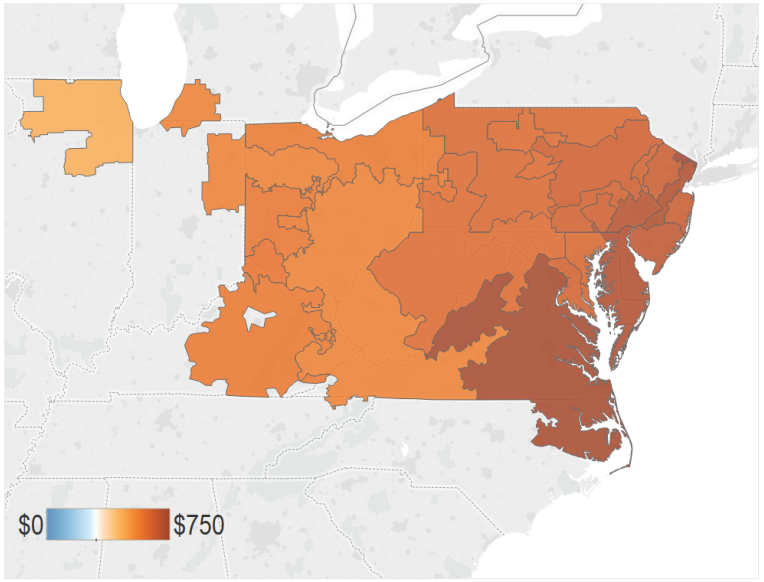
Prices do not represent forecasts of actual prices.

System Overview



Load:	Extreme
Refueling:	Limited
Disruption:	Looped 2 High
Non-Firm Avail:	0%
Retirement:	Announced
Dispatch:	Max Emergency

Hourly Zonal Average LMP [$]



Sites Out of Oil

Oil Barrels Burned: 1.32M

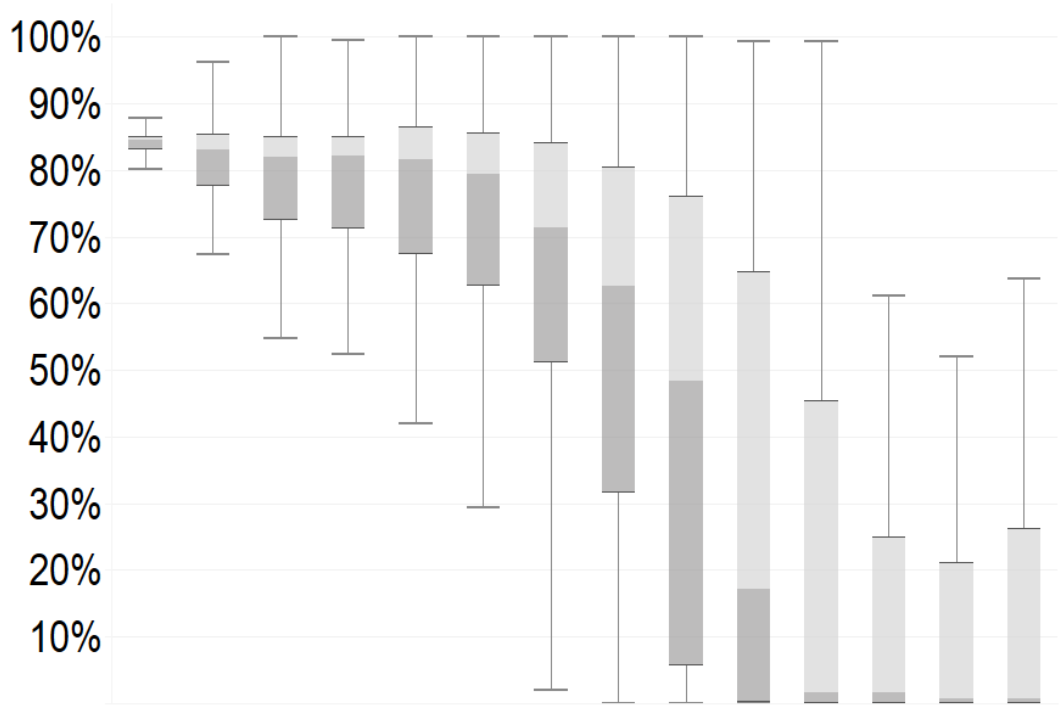
1	2	3	4	5	6	7	8	9	10	11	12	13	14
0	0	0	0	0	0	0	3	6	9	13	16	14	14

*141 Total Sites

Day of Event

Oil Inventory | Dispatch Comparison

Economic Dispatch



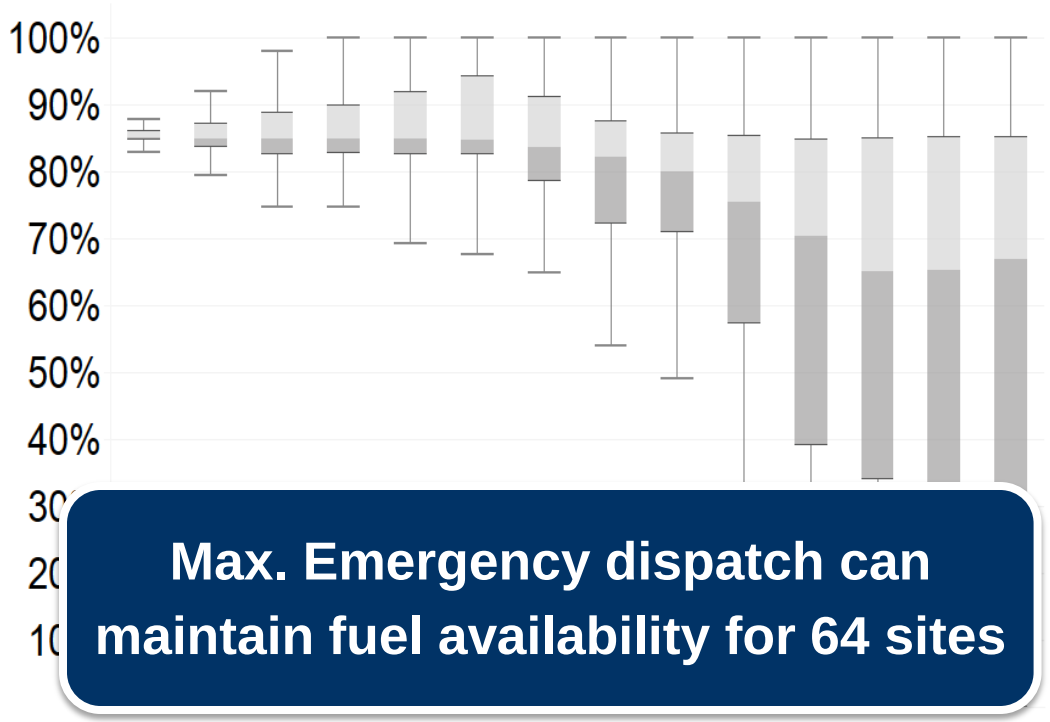
Sites Out of Oil

0	3	6	7	8	12	16	21	47	61	74	80	74	66
1	2	3	4	5	6	7	8	9	10	11	12	13	14

*141 Total Sites

Day of Event

Max. Emergency Dispatch



Max. Emergency dispatch can maintain fuel availability for 64 sites

Sites Out of Oil

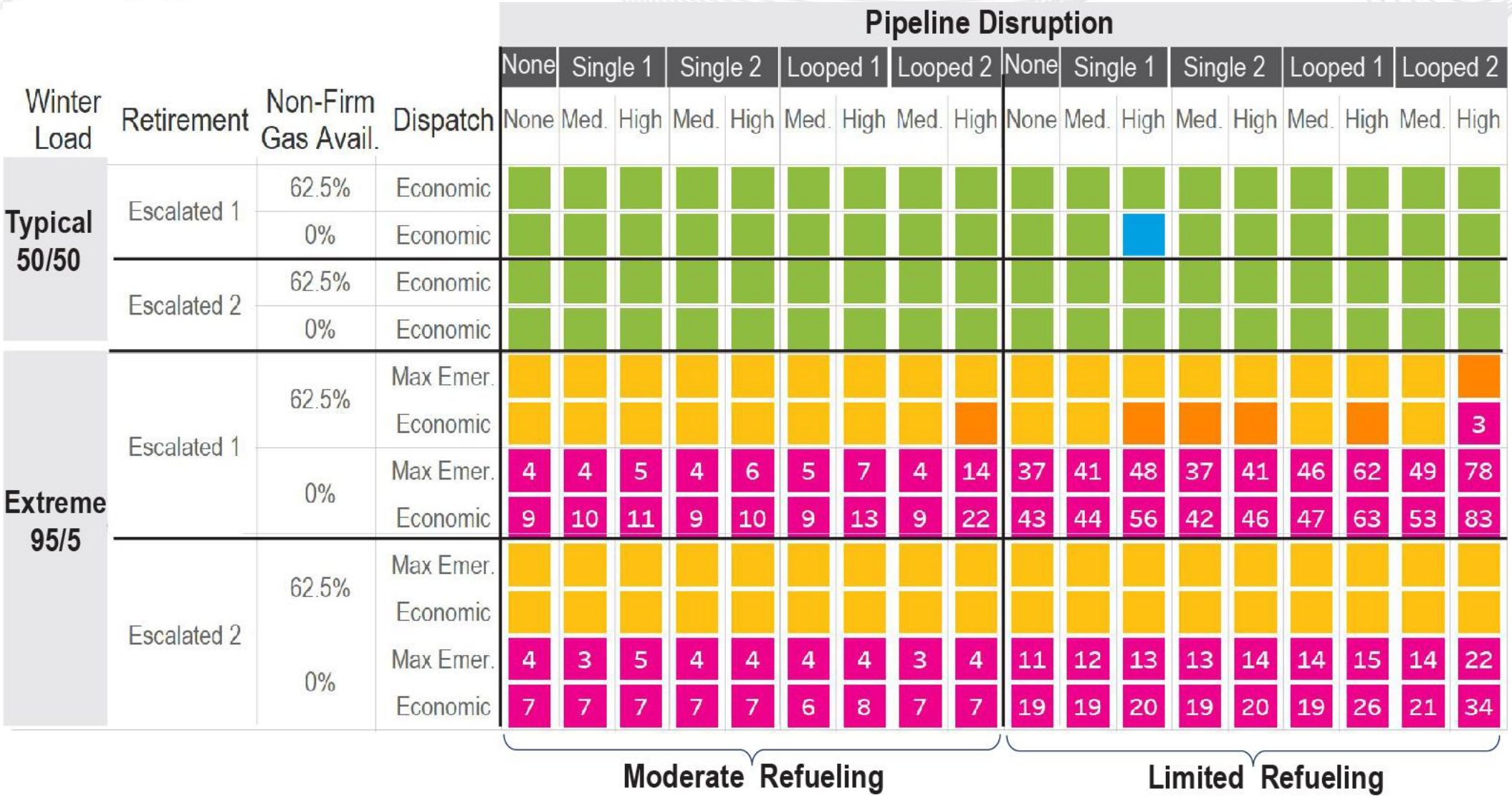
0	0	0	0	0	0	0	3	6	9	13	16	14	14
1	2	3	4	5	6	7	8	9	10	11	12	13	14

*141 Total Sites

Day of Event

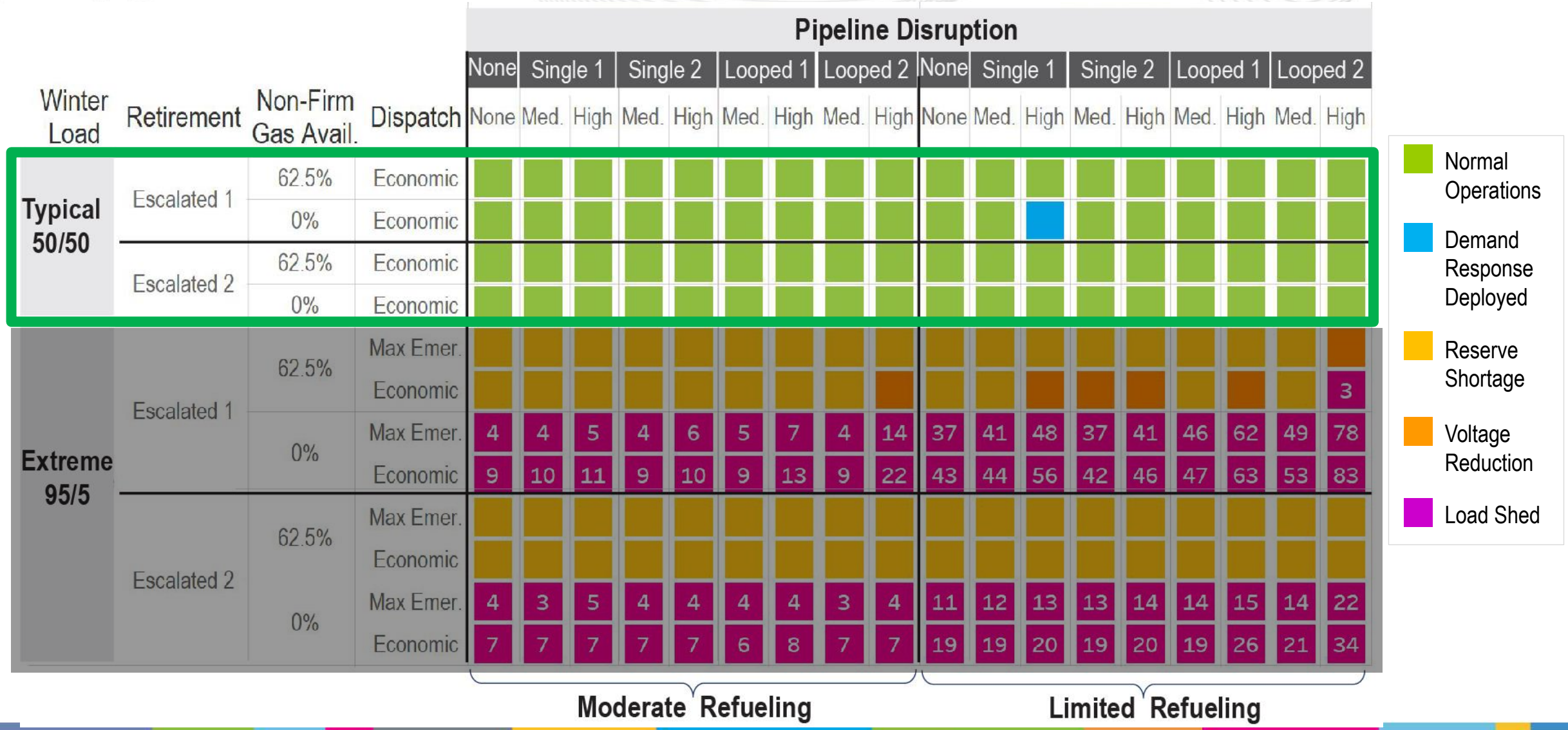
Escalated Retirements Analysis Results

Emergency Procedures Summary
Escalated Retirement Models



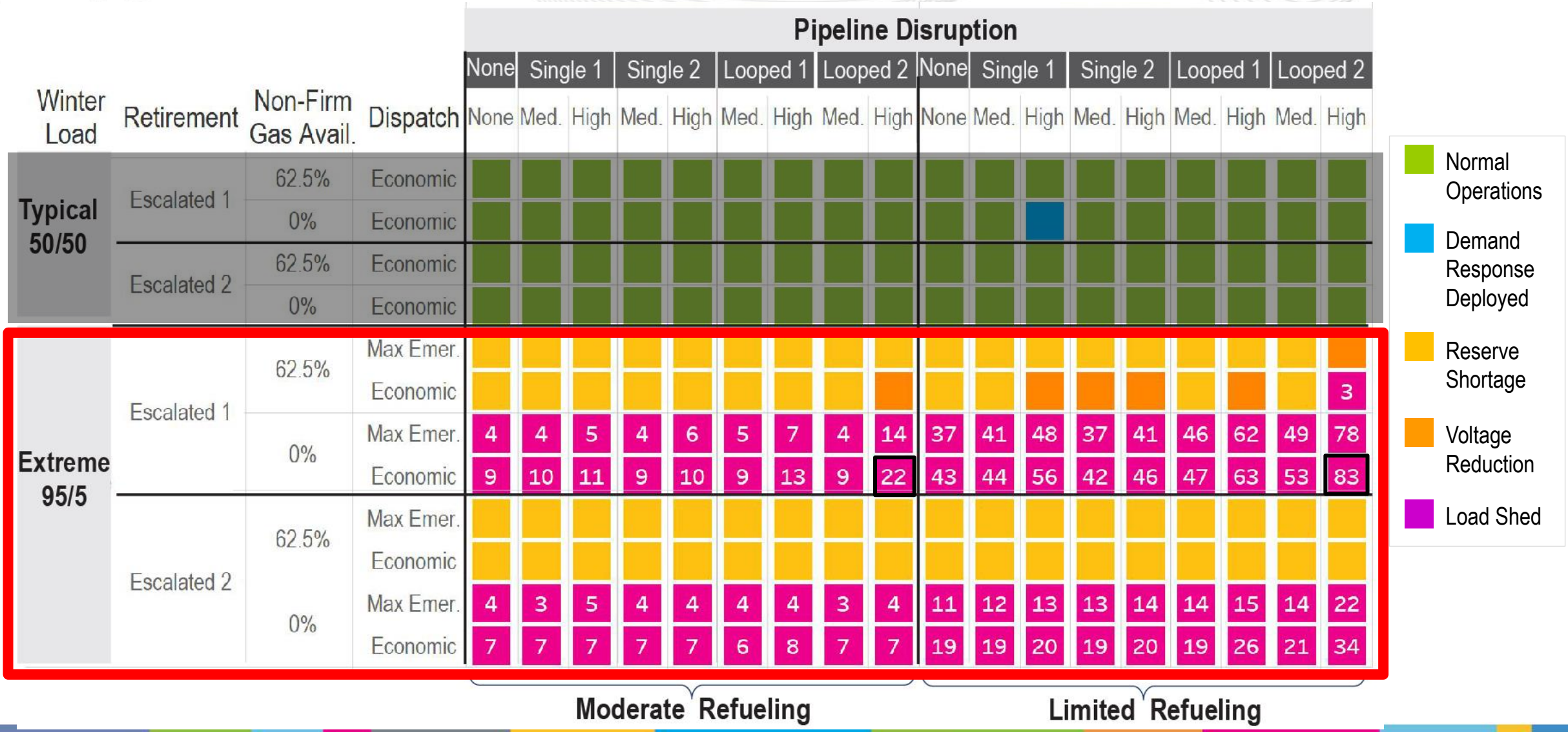
Winter Load	Retirement	Non-Firm Gas Avail.	Dispatch	None	Single 1 Med.	Single 1 High	Single 2 Med.	Single 2 High	Looped 1 Med.	Looped 1 High	Looped 2 Med.	Looped 2 High	None	Single 1 Med.	Single 1 High	Single 2 Med.	Single 2 High	Looped 1 Med.	Looped 1 High	Looped 2 Med.	Looped 2 High
Typical 50/50	Escalated 1	62.5%	Economic																		
		0%	Economic																		
	Escalated 2	62.5%	Economic																		
		0%	Economic																		
Extreme 95/5	Escalated 1	62.5%	Max Emer.																		
			Economic																		3
		0%	Max Emer.	4	4	5	4	6	5	7	4	14	37	41	48	37	41	46	62	49	78
			Economic	9	10	11	9	10	9	13	9	22	43	44	56	42	46	47	63	53	83
	Escalated 2	62.5%	Max Emer.																		
			Economic																		
		0%	Max Emer.	4	3	5	4	4	4	4	3	4	11	12	13	13	14	14	15	14	22
			Economic	7	7	7	7	7	6	8	7	7	19	19	20	19	20	19	26	21	34

Emergency Procedures Summary
Escalated Retirement Models

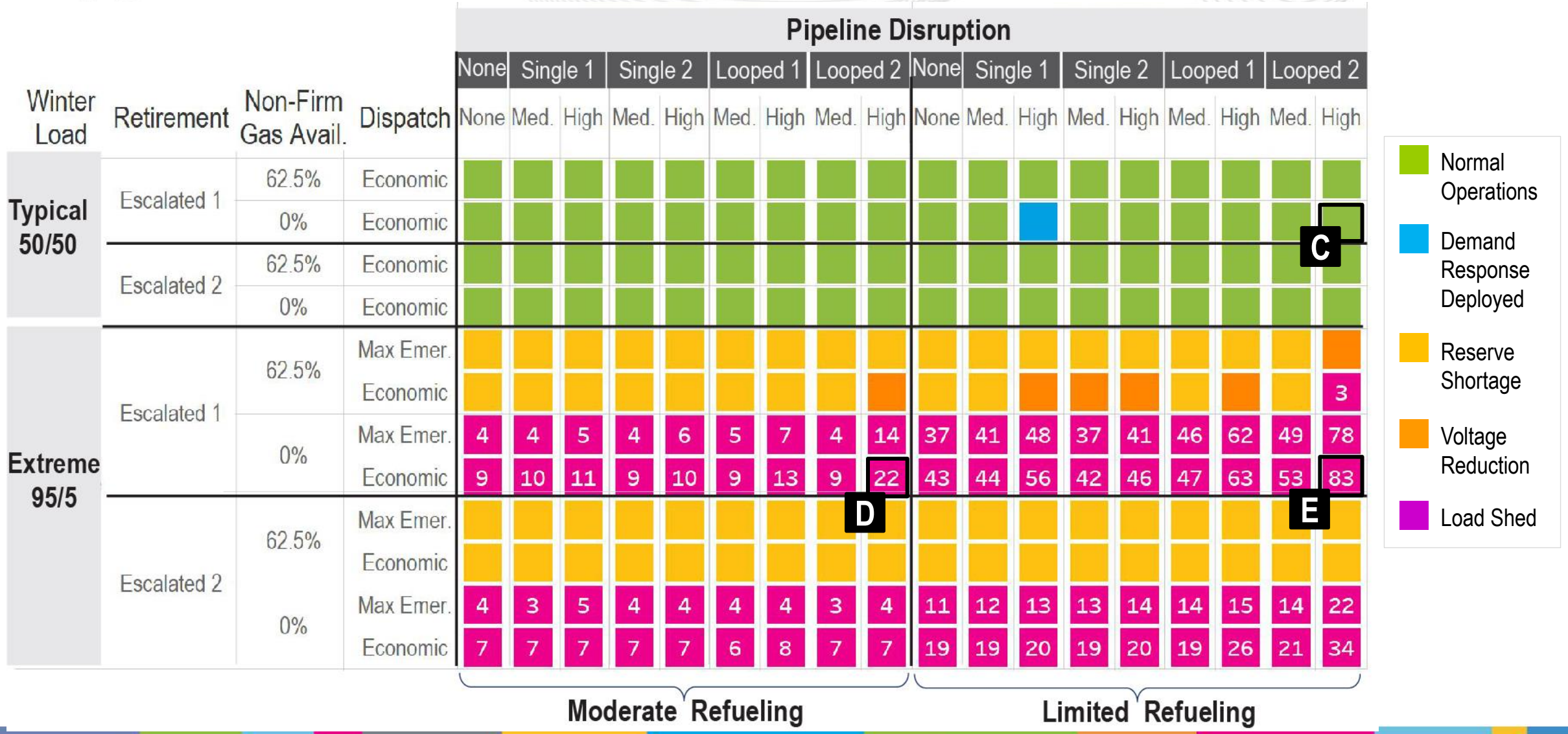


Winter Load	Retirement	Non-Firm Gas Avail.	Dispatch	None	Single 1 Med.	Single 1 High	Single 2 Med.	Single 2 High	Looped 1 Med.	Looped 1 High	Looped 2 Med.	Looped 2 High	None	Single 1 Med.	Single 1 High	Single 2 Med.	Single 2 High	Looped 1 Med.	Looped 1 High	Looped 2 Med.	Looped 2 High
Typical 50/50	Escalated 1	62.5%	Economic																		
		0%	Economic																		
	Escalated 2	62.5%	Economic																		
		0%	Economic																		
Extreme 95/5	Escalated 1	62.5%	Max Emer.																		
			Economic																		3
		0%	Max Emer.	4	4	5	4	6	5	7	4	14	37	41	48	37	41	46	62	49	78
			Economic	9	10	11	9	10	9	13	9	22	43	44	56	42	46	47	63	53	83
	Escalated 2	62.5%	Max Emer.																		
			Economic																		
		0%	Max Emer.	4	3	5	4	4	4	4	3	4	11	12	13	13	14	14	15	14	22
			Economic	7	7	7	7	7	6	8	7	7	19	19	20	19	20	19	26	21	34

Emergency Procedures Summary
Escalated Retirement Models



Emergency Procedures Summary
Escalated Retirement Models



Winter Load	Retirement	Non-Firm Gas Avail.	Dispatch	Pipeline Disruption	None	Med.	High	Single 1 Med.	Single 1 High	Single 2 Med.	Single 2 High	Looped 1 Med.	Looped 1 High	Looped 2 Med.	Looped 2 High
Typical 50/50	Escalated 1	62.5%	Economic	None											
		0%	Economic	None											
	Escalated 2	62.5%	Economic	None											
		0%	Economic	None											
Extreme 95/5	Escalated 1	62.5%	Max Emer.	None											
			Economic	None											3
		0%	Max Emer.	None	4	4	5	4	6	5	7	4	14	37	41
			Economic	None	9	10	11	9	10	9	13	9	22	43	44
	Escalated 2	62.5%	Max Emer.	None											
			Economic	None											
		0%	Max Emer.	None	4	3	5	4	4	4	4	3	4	11	12
			Economic	None	7	7	7	7	7	6	8	7	7	19	19

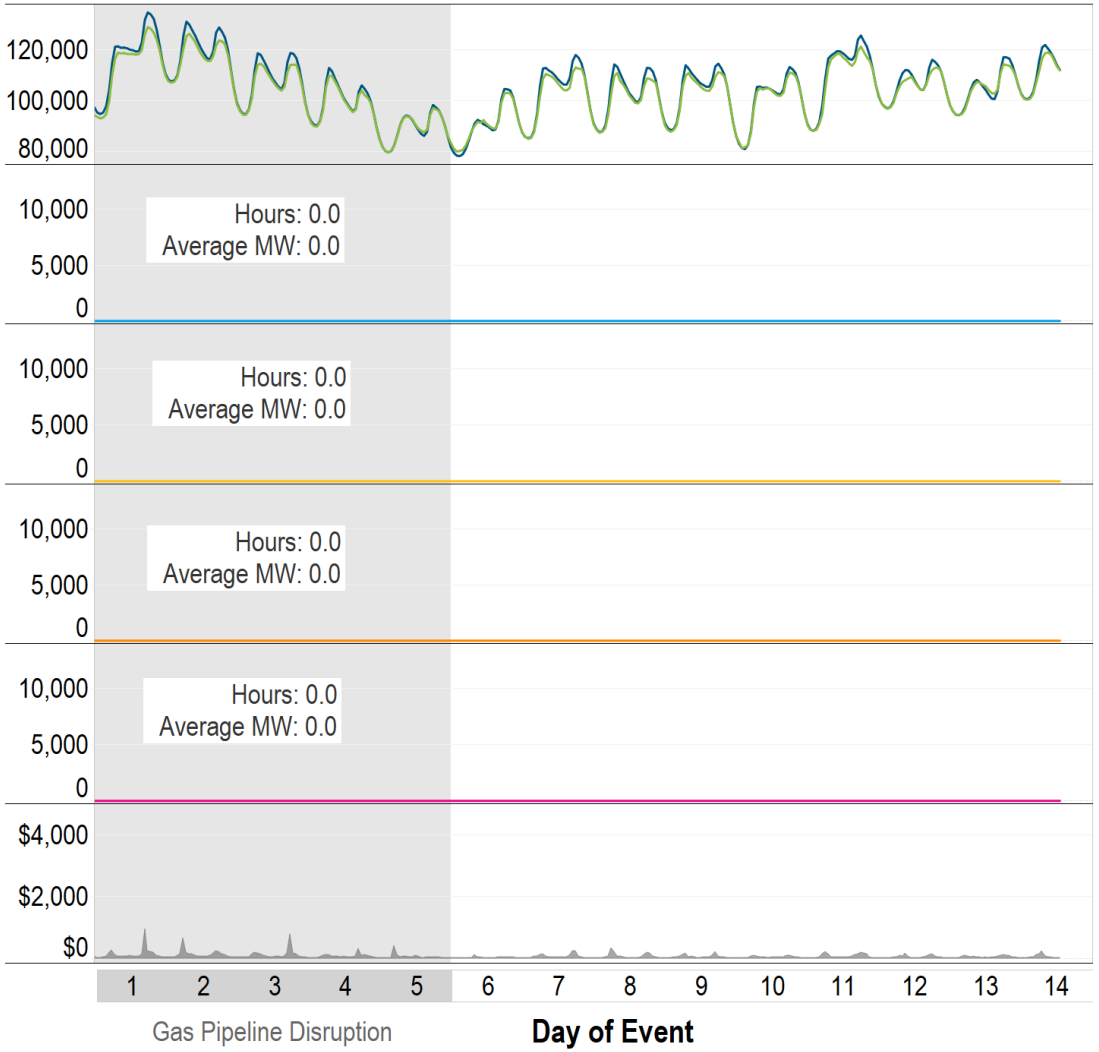
Winter Load	Retirement	Non-Firm Gas Avail.	Dispatch	Pipeline Disruption	Single 1 High	Single 2 Med.	Single 2 High	Looped 1 Med.	Looped 1 High	Looped 2 Med.	Looped 2 High
Typical 50/50	Escalated 1	62.5%	Economic	None							
		0%	Economic	None							
	Escalated 2	62.5%	Economic	None							
		0%	Economic	None							
Extreme 95/5	Escalated 1	62.5%	Max Emer.	None							
			Economic	None							
		0%	Max Emer.	None	48	37	41	46	62	49	78
			Economic	None	56	42	46	47	63	53	83
	Escalated 2	62.5%	Max Emer.	None							
			Economic	None							
		0%	Max Emer.	None	13	13	14	14	15	14	22
			Economic	None	20	19	20	19	26	21	34

Escalated Retirements 1 Scenario Example C

- Generation (MW)
- Forecasted Demand (MW)
- Deployed Demand Response (MW)
- Reserve Shortage (MW)
- Voltage Reduction (MW)
- Load Shed (MW)
- Price ($)

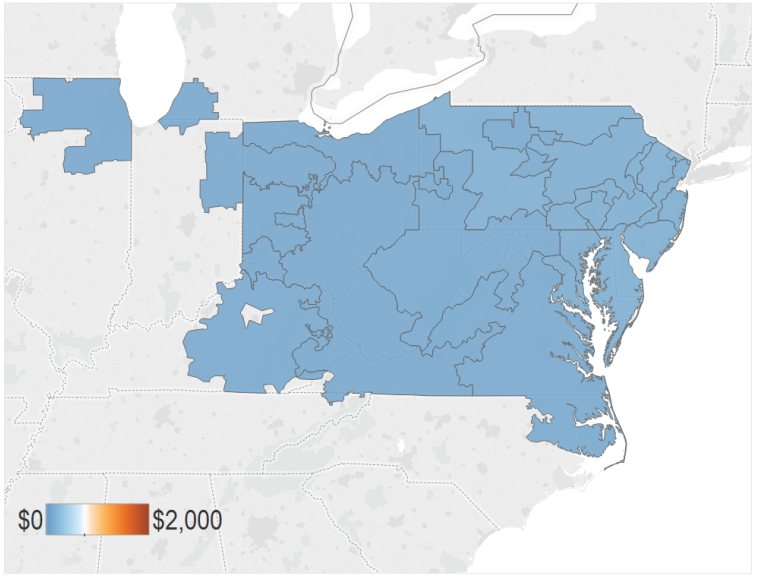
Prices do not represent forecasts of actual prices.

System Overview



Load:	Typical
Refueling:	Limited
Disruption:	Looped 2 High
Non-Firm Avail:	0%
Retirement:	Escalated 1 (32 GW)
Dispatch:	Economic

Hourly Zonal Average LMP [$]



Sites Out of Oil

Oil Barrels Burned: 1.22M

1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	3	4	5	4	5	8	15	16	16	16	16	16	16

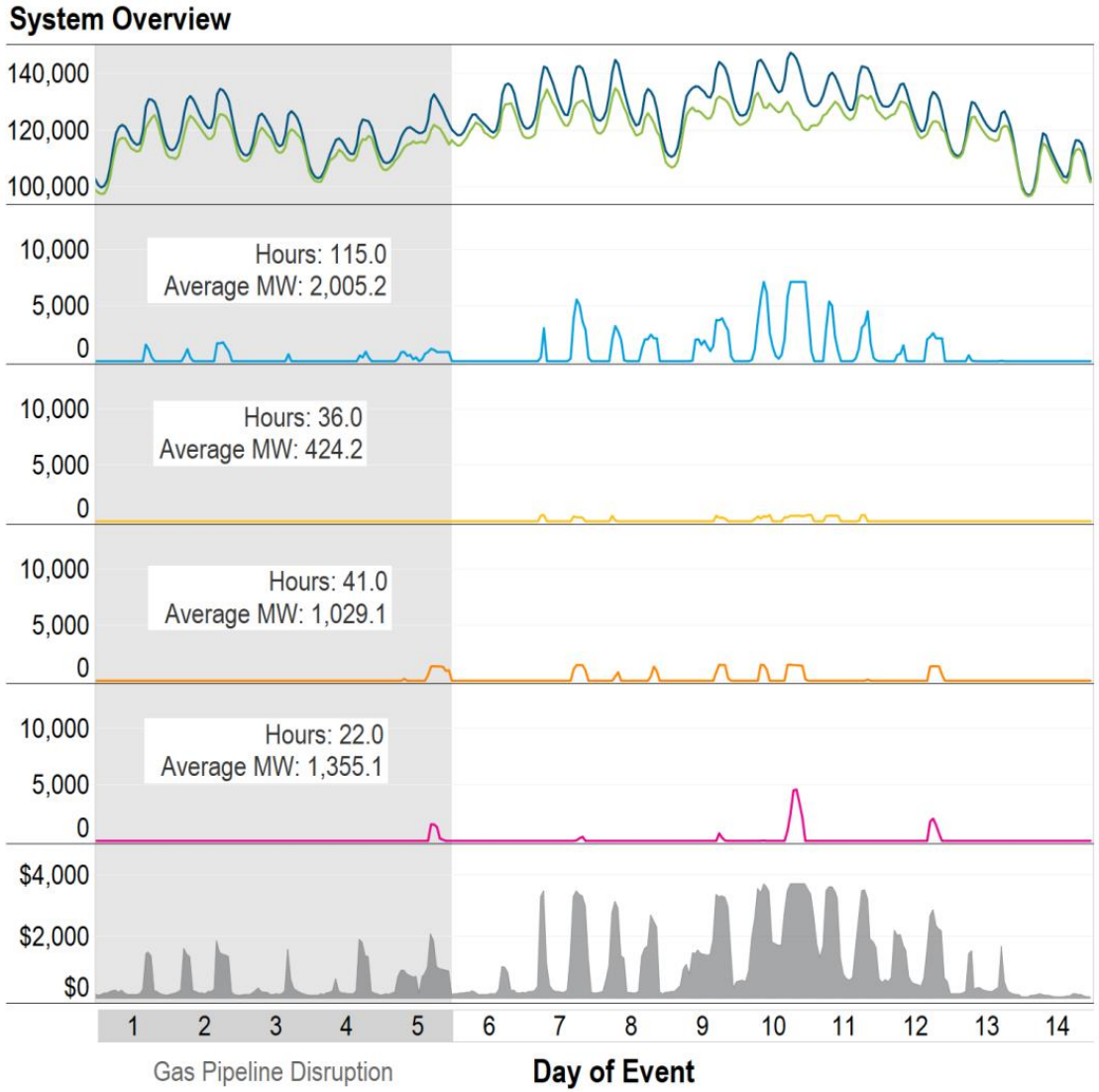
*141 Total Sites

Day of Event

Escalated Retirements 1 Scenario Example D

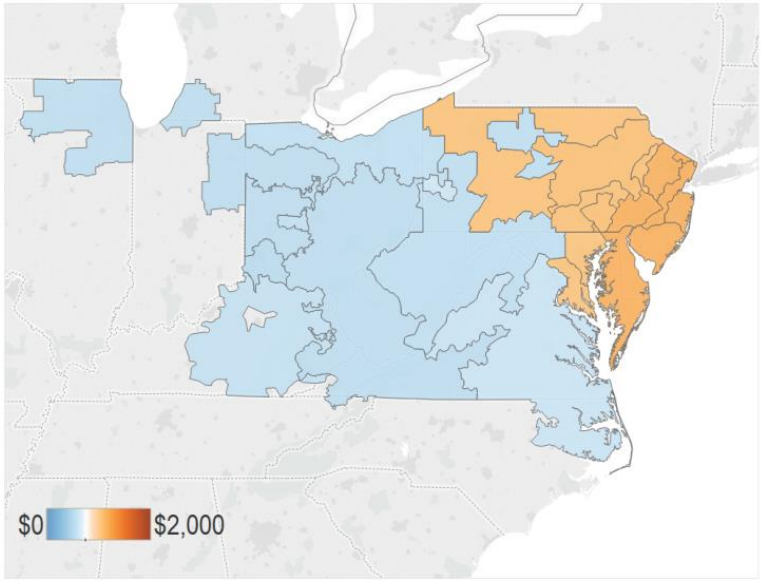
- Generation (MW)
- Forecasted Demand (MW)
- Deployed Demand Response (MW)
- Reserve Shortage (MW)
- Voltage Reduction (MW)
- Load Shed (MW)
- Price ($)

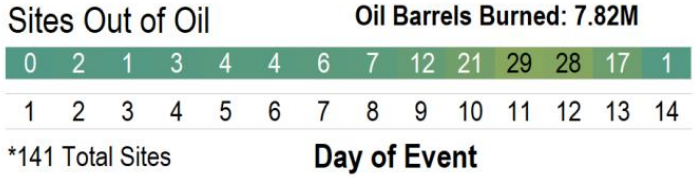
Prices do not represent forecasts of actual prices.



Load:	Extreme
Refueling:	Moderate
Disruption:	Looped 2 High
Non-Firm Avail:	0%
Retirement:	Escalated 1 (32 GW)
Dispatch:	Economic

Hourly Zonal Average LMP [$]

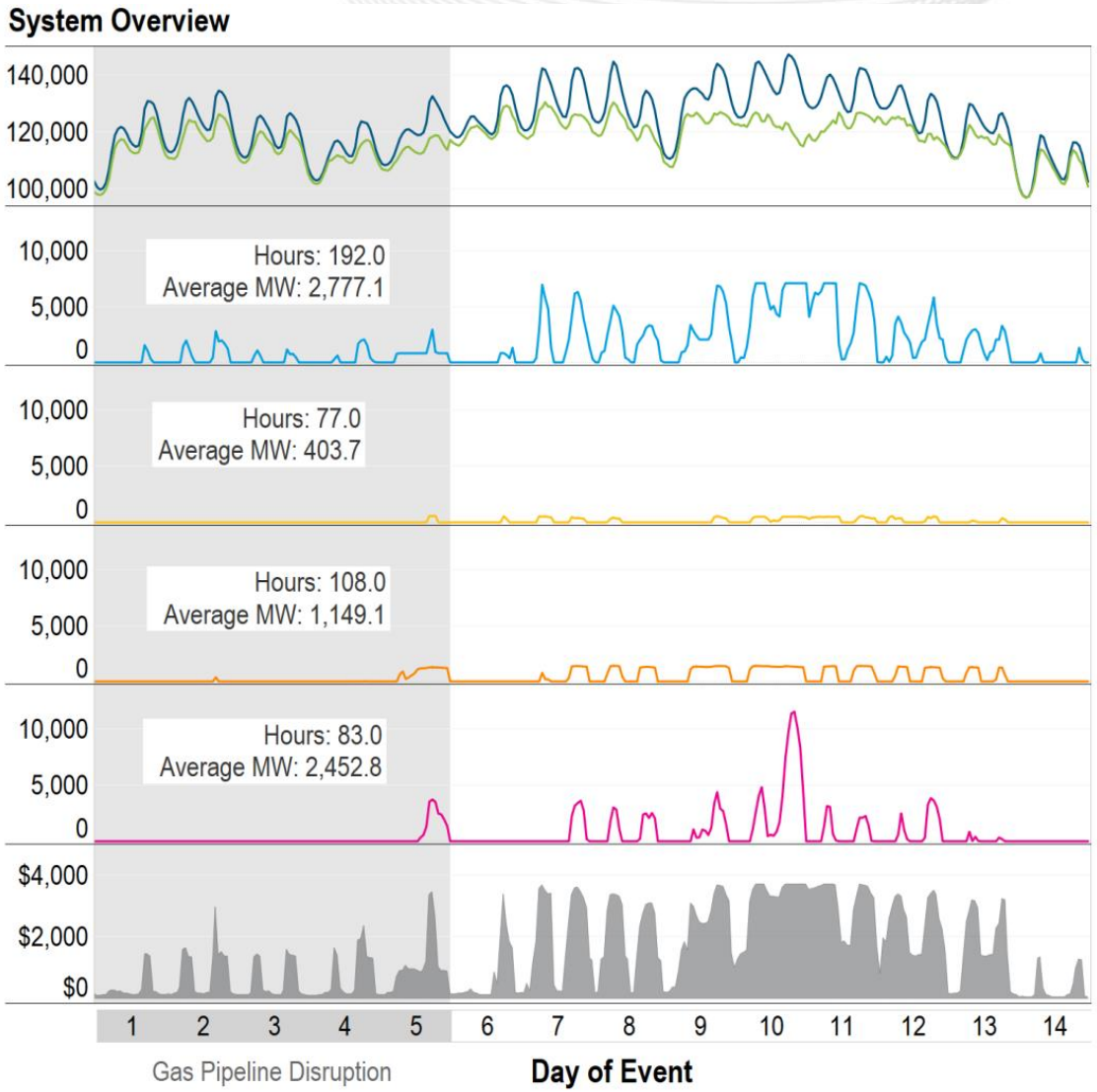




Escalated Retirements 1 Scenario Example E

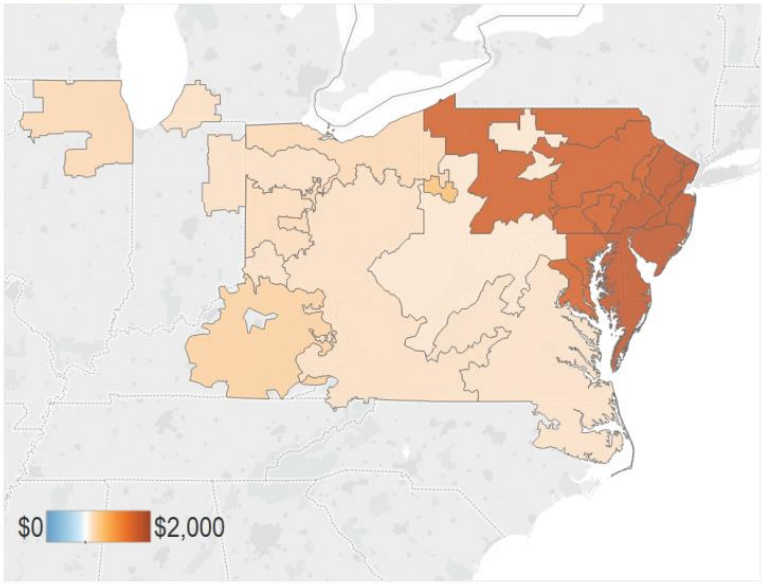
- Generation (MW)
- Forecasted Demand (MW)
- Deployed Demand Response (MW)
- Reserve Shortage (MW)
- Voltage Reduction (MW)
- Load Shed (MW)
- Price ($)

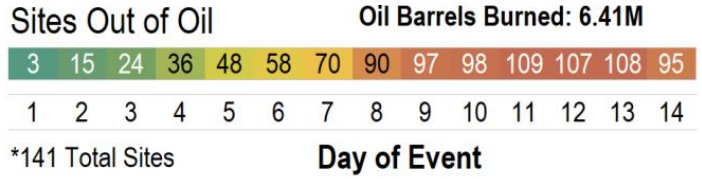
Prices do not represent forecasts of actual prices.



Load:	Extreme
Refueling:	Limited
Disruption:	Looped 2 High
Non-Firm Avail:	0%
Retirement:	Escalated 1 (32 GW)
Dispatch:	Economic

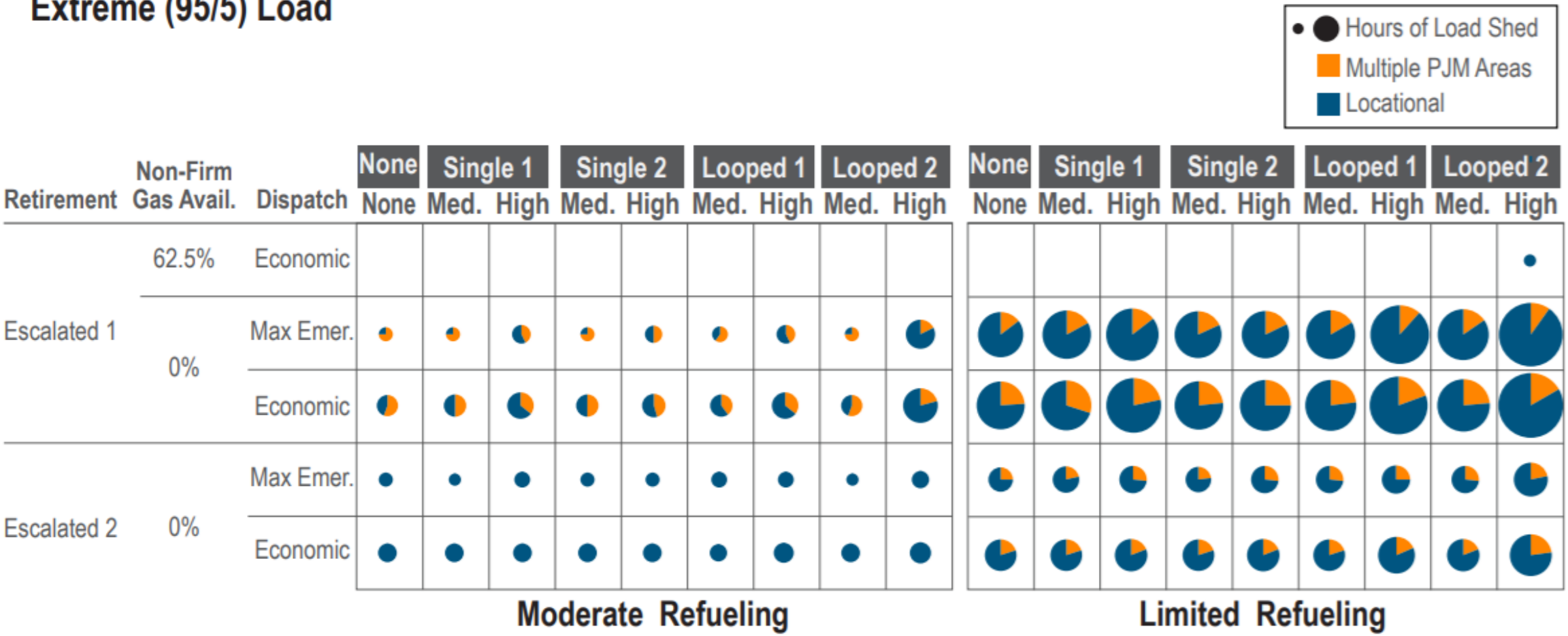
Hourly Zonal Average LMP [$]





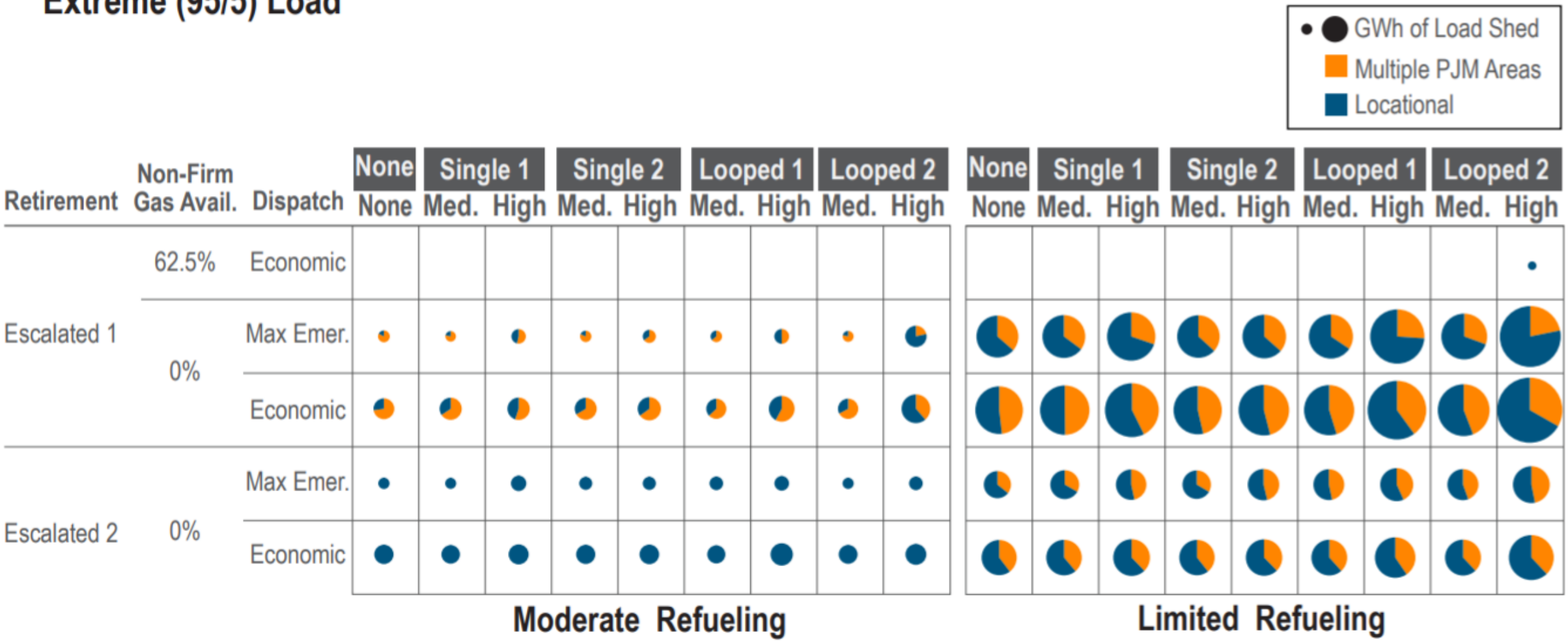
Hours of Manual Load Shed Locational and Multiple Area

Extreme (95/5) Load

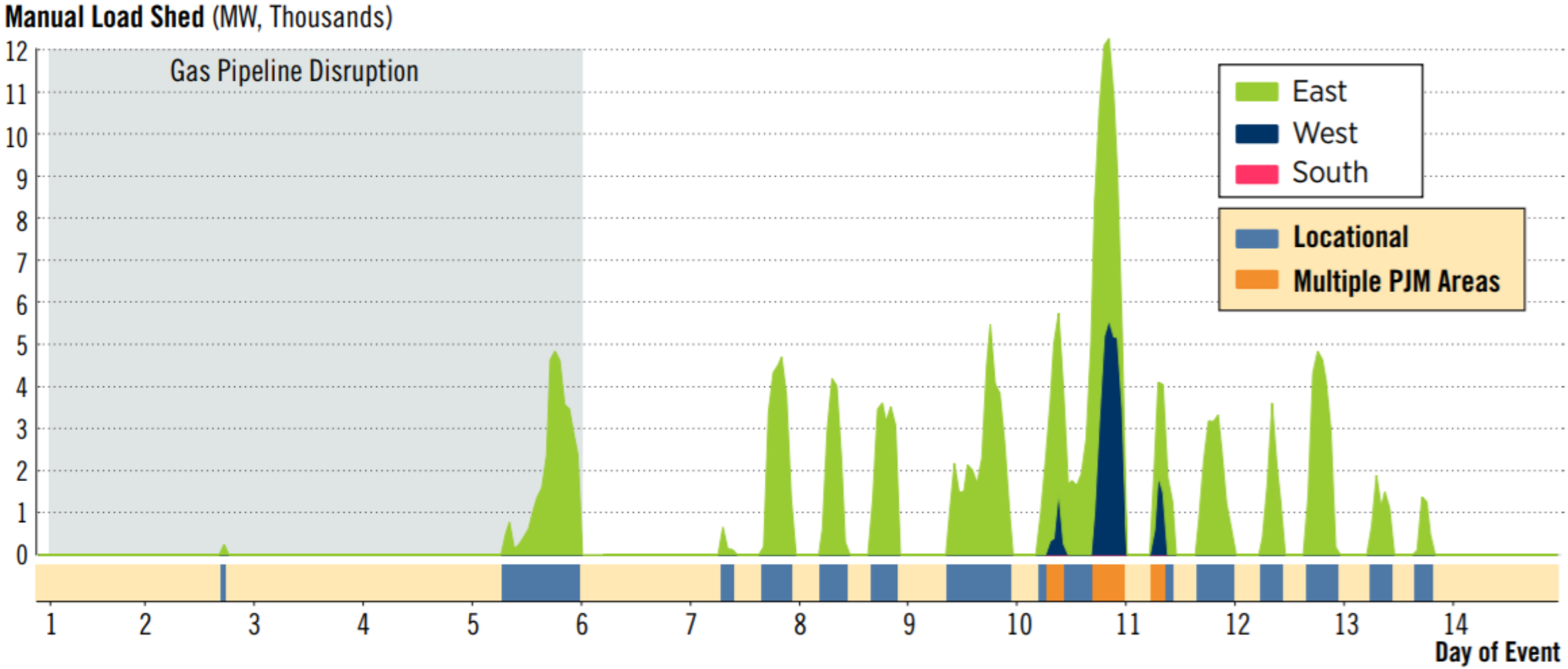


GWh of Manual Load Shed Locational and Multiple Area

Extreme (95/5) Load



Escalated Retirements 1 Scenario Example E



Conclusions

There is NO immediate threat to the reliability of the PJM RTO.

- PJM is reliable in the announced retirements and escalated retirements cases under all typical winter load scenarios.
- PJM is reliable in the announced retirements cases under all extreme winter load scenarios.

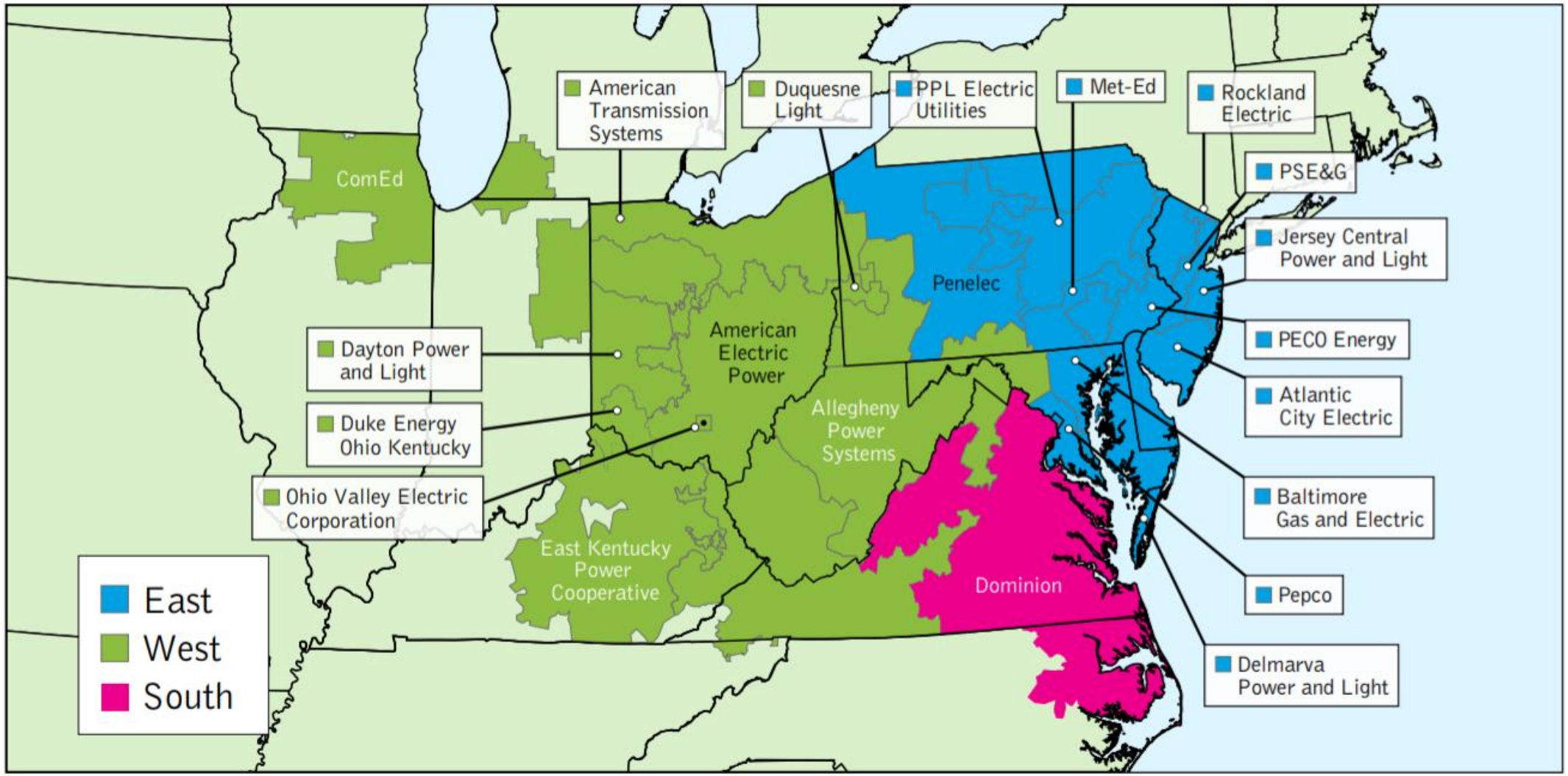
- Scenarios to identify points at which an assumption or combination of assumptions begin to impact the ability to reliably serve customers.
- The stressed scenarios resulted in a loss of load under extreme but plausible conditions.

Contributing factors:

- The level of retirements and replacements
- The level of non-firm gas availability
- The ability to replenish oil supplies
- The location, magnitude and duration of pipeline disruption
- Pipeline configuration

Appendix

PJM Areas and Transmission Zones



Emergency Procedures

Normal Operations	**No Emergency Procedures** Normal economic dispatch
Demand Response Deployed	**Pre-Emergency Action** Demand response deployment
Reserve Shortage	**Emergency Warning** An operational reserve shortage is triggered when 10-minute Synchronized Reserves are less than the largest generator in PJM. Depending on system conditions, a reserve shortage will trigger additional emergency procedures such as voltage reduction warnings and manual load shed warnings.
Voltage Reduction	**Emergency Action** Voltage reduction action enables load reductions by reducing voltages at the distribution level. PJM estimates a 1-2% load reduction resulting from a 5% load reduction in transmission zones capable of performing a voltage reduction.
Load Shed	**Emergency Action** Manual load shed action enables zonal or system-wide load shed. This is the last step of all emergency procedure actions.