



FEBRUARY 2021 WINTER STORM EVENT

DENNIS GRENNAN
NEBRASKA POWER REVIEW BOARD
SPP REGIONAL STATE COMMITTEE

*Helping our members work together to keep
the lights on... today and in the future.*



SouthwestPowerPool



southwest-power-pool



SPPorg

AGENDA

- Introduction
- Southwest Power Pool Overview
- February Weather Events
- Causes and Lessons Learned
- Questions

WHO IS SPP?

501(c)(6) nonprofit corporation

One of 9 regional grid operators

104 member companies in 14 states

“Air traffic control” for high-voltage grid

Balances supply and demand across region

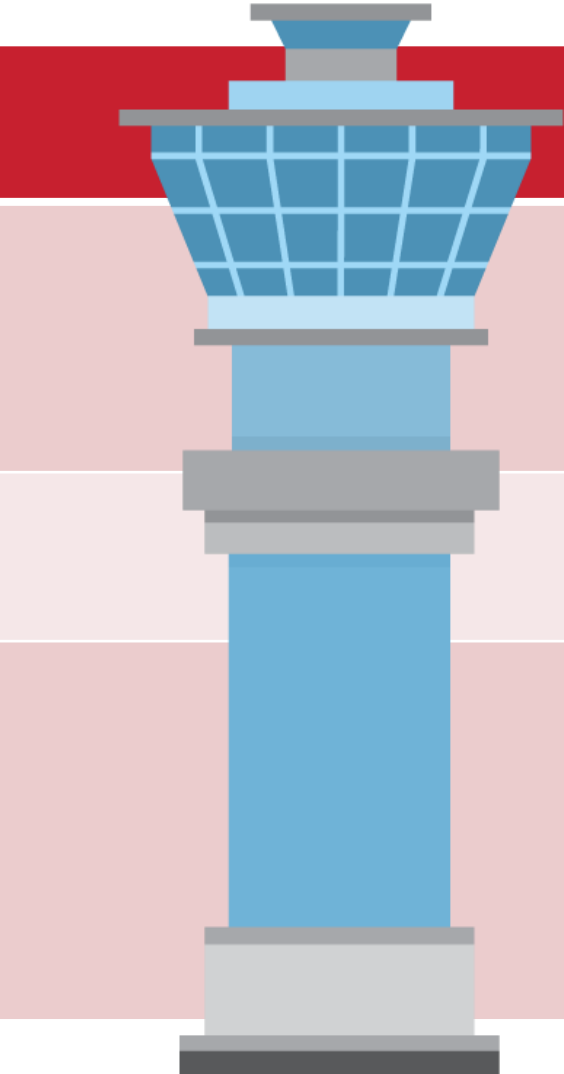
Maintains reliable grid operations

Operates wholesale energy market

Plans future transmission needs

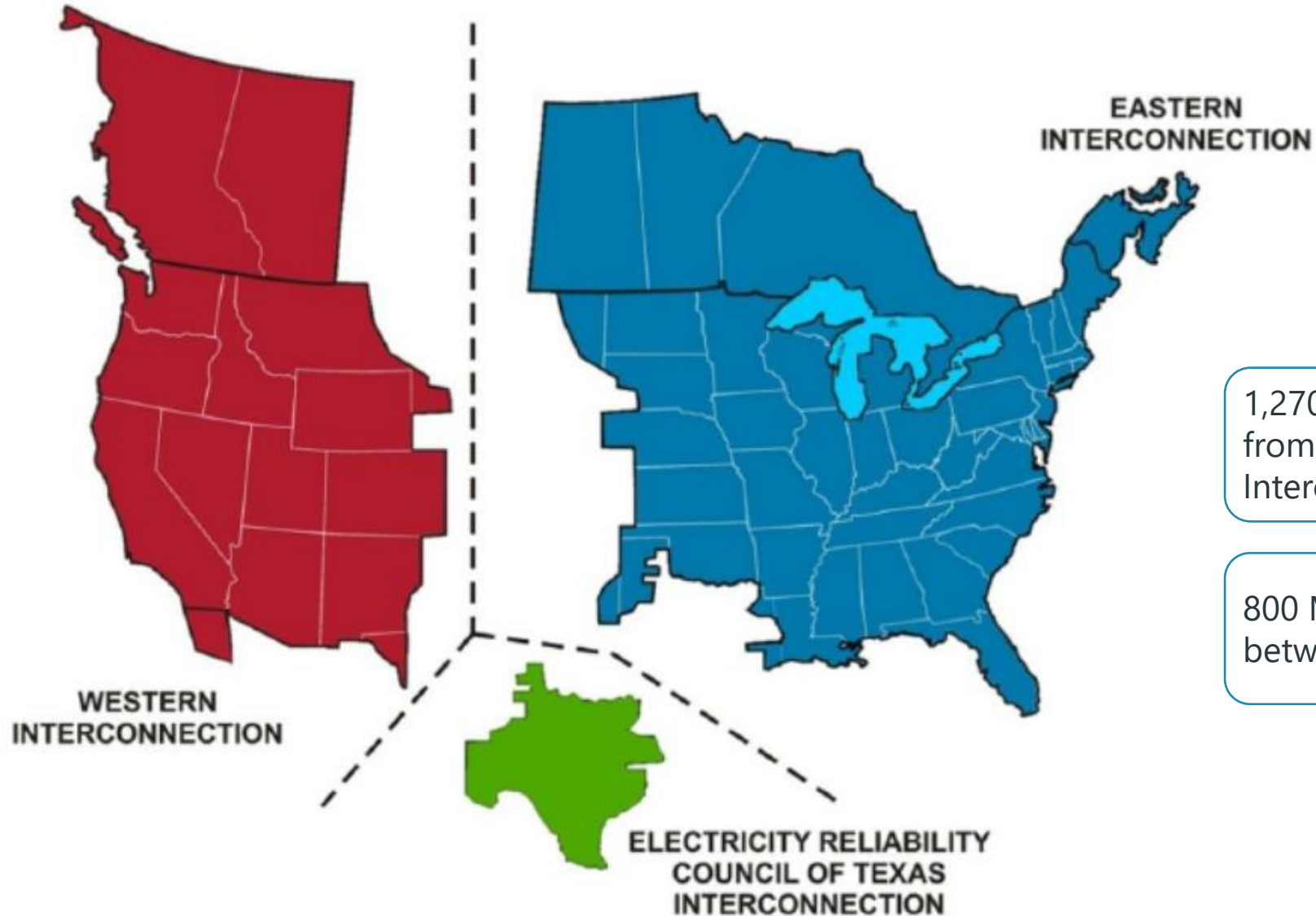


AIR TRAFFIC CONTROL: AN ANALOGY



Air Traffic Control		Southwest Power Pool
Does not own airplanes, airlines or airports		Does not own utilities, power generators or transmission lines
Does not own the airspace it monitors		Does not own the land electricity flows across
Directs air routes to ensure airplanes and passengers are safely transported		Monitors and directs regional bulk power grid to ensure electricity gets from where it's made to where it's needed

THREE ELECTRIC INTERCONNECTIONS



1,270 MW potential transfer capability from Western to Eastern Interconnection

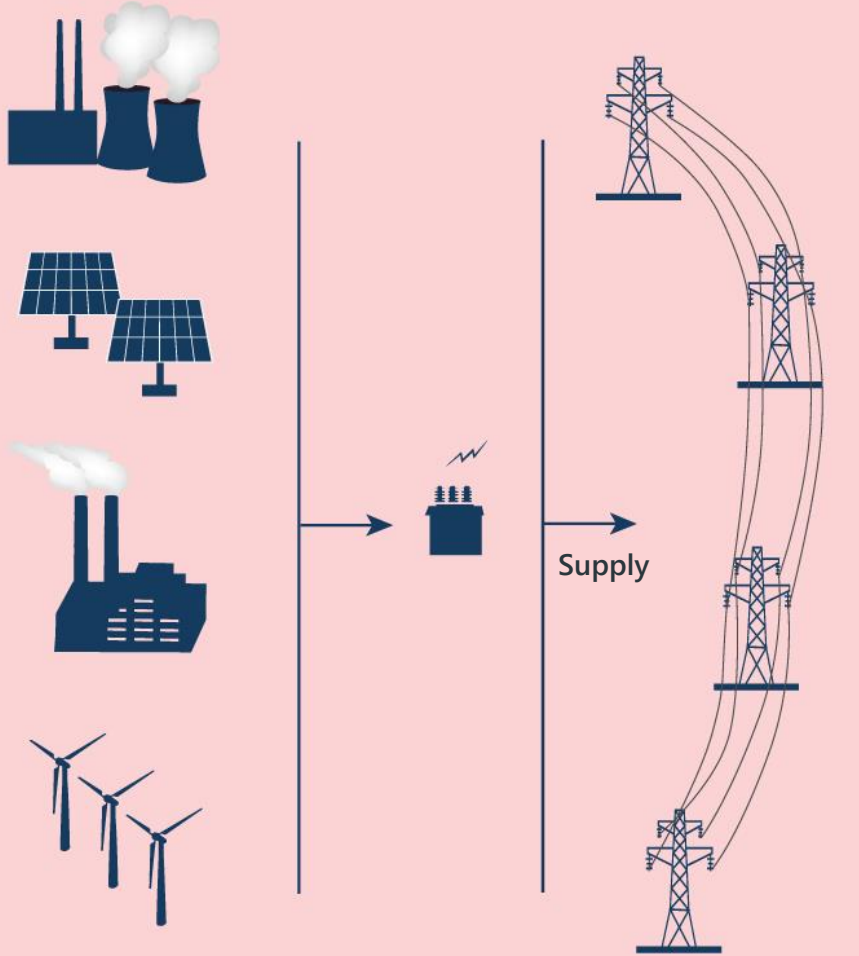
800 MW potential transfer capability between SPP and ERCOT

SPP's Reliability Objectives

1: Energy supplied to grid must equal energy demands

2: Transmission system must be operated within safe, reliable limits

WHOLESALE ENERGY AND TRANSMISSION

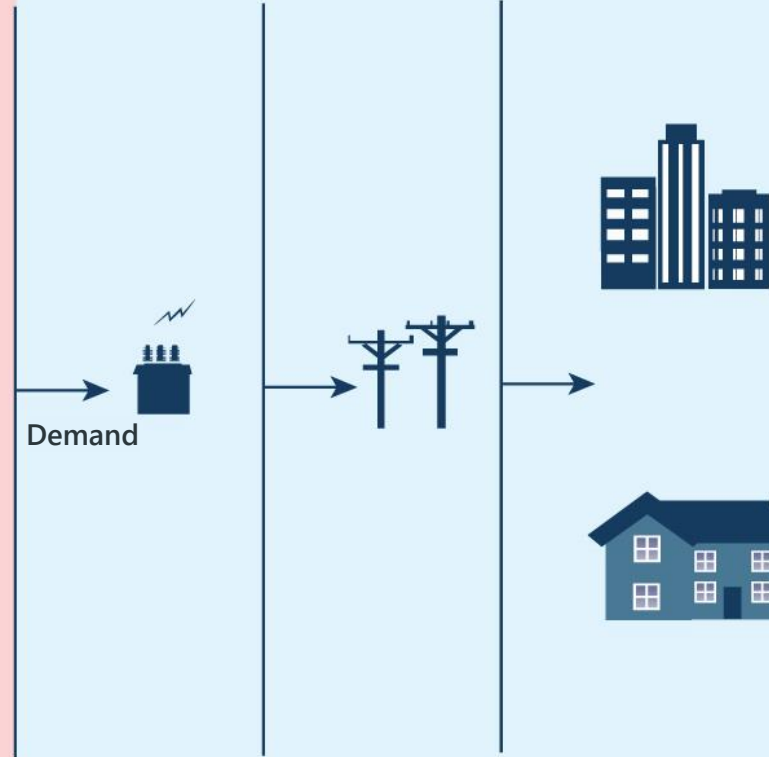


Power plant generates electricity

Transformer steps up voltage for transmission

Transmission lines carry electricity long distances

RETAIL ENERGY AND DISTRIBUTION



Neighborhood transformer steps down voltage

Distribution lines carry electricity to homes and businesses

Transformers on poles step down electricity before it enters houses

FERC AND NERC JURISDICTIONAL

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION



SPP and utilities must comply with mandatory, enforceable NERC standards

Government enacted reliability standards after 2003 blackout

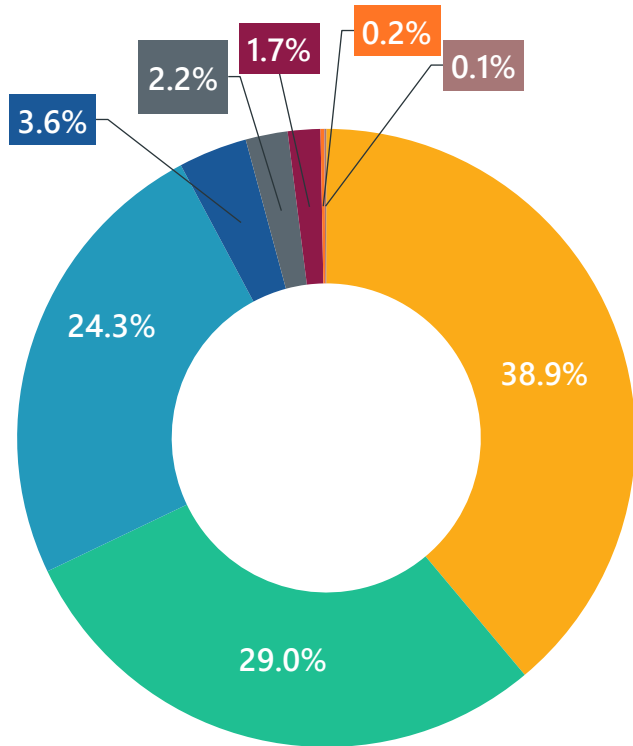
NERC regularly audits SPP

NERC directs how much energy SPP must keep for emergencies

FERC approves NERC standards

SPP must comply with FERC directives

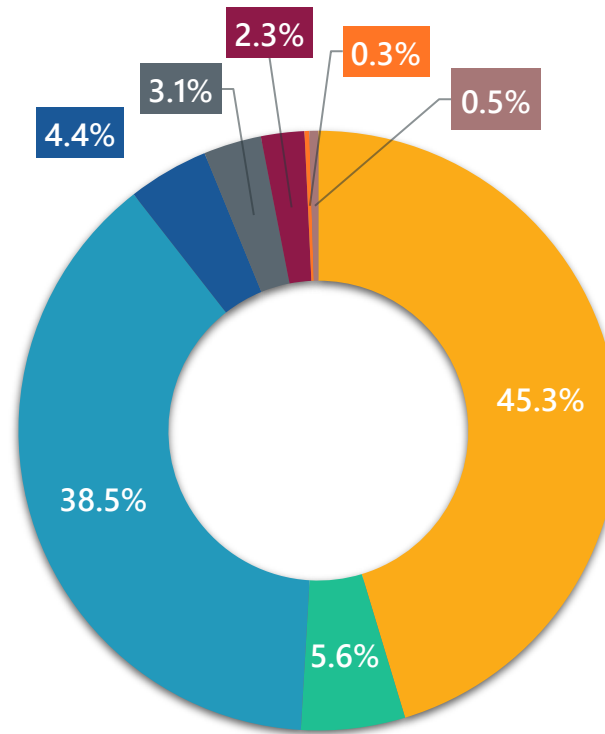
NAMEPLATE CAPACITY* 94,648 MW



- Natural Gas (38.9%)
- Wind (29%)
- Coal (24.3%)
- Hydro (3.6%)
- Nuclear (2.2%)
- Fuel Oil (1.7%)
- Solar (0.2%)
- Other (0.1%)

* As of 1/13/21

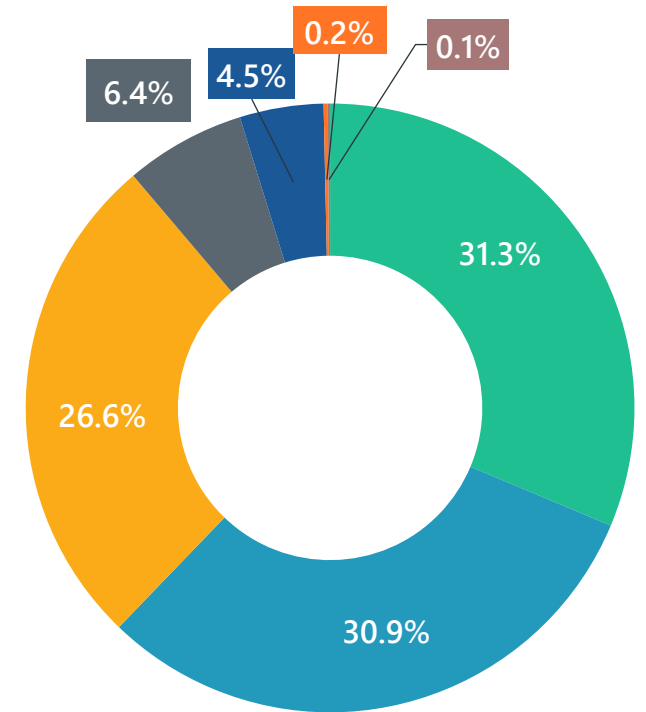
ACCREDITED CAPACITY† 62,281 MW



- Natural Gas (45.3%)
- Wind (5.6%)
- Coal (38.5%)
- Hydro (4.4%)
- Nuclear (3.1%)
- Fuel Oil (2.3%)
- Solar (0.3%)
- Other (0.5%)

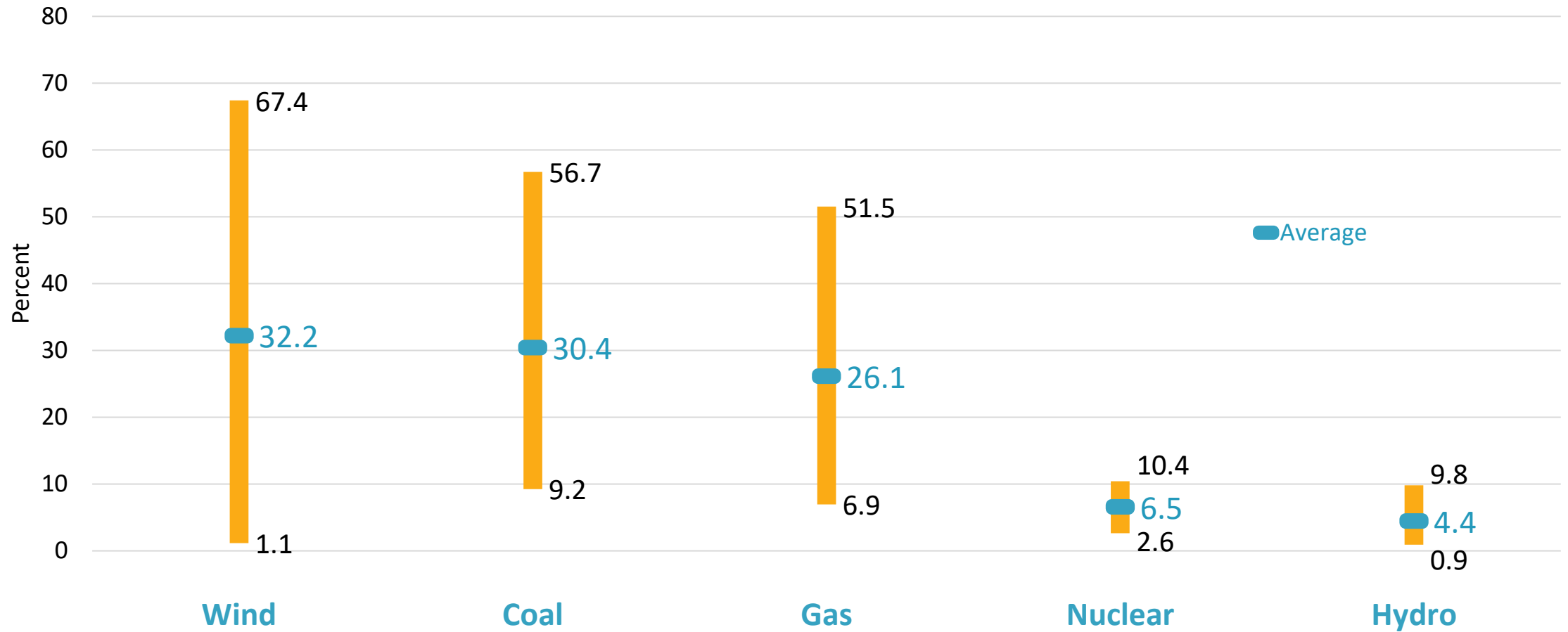
†As of 6/15/20

2020 ENERGY PRODUCTION 262.730 TWH



- Wind (31.3%)
- Coal (30.9%)
- Natural Gas (26.6%)
- Nuclear (6.4%)
- Hydro (4.5%)
- Solar (0.2%)
- Other (0.1%)

MINIMUM & MAXIMUM PERCENT OF GENERATION BY FUEL TYPE*



*Real-time balancing market five-minute average

Jan. to Dec. 31, 2020

THE BIG PICTURE



Early prep helped

2/4: Issued cold weather alert

2/8: Issued resource alert

2/11: Committed long-lead generation



Public appeals reduced demand

Demand dropped below forecast, helping minimize interruptions



We used every MW we could get

We ran every available generator and imported energy from neighbors



Service interruptions required

2/15
~1.5% of system demand - 57 min.

2/16
Up to ~6.5% of system demand - 3 hr. 23 min.



Collaboration reduced impact

Controlled, temporary interruptions prevented uncontrolled blackouts

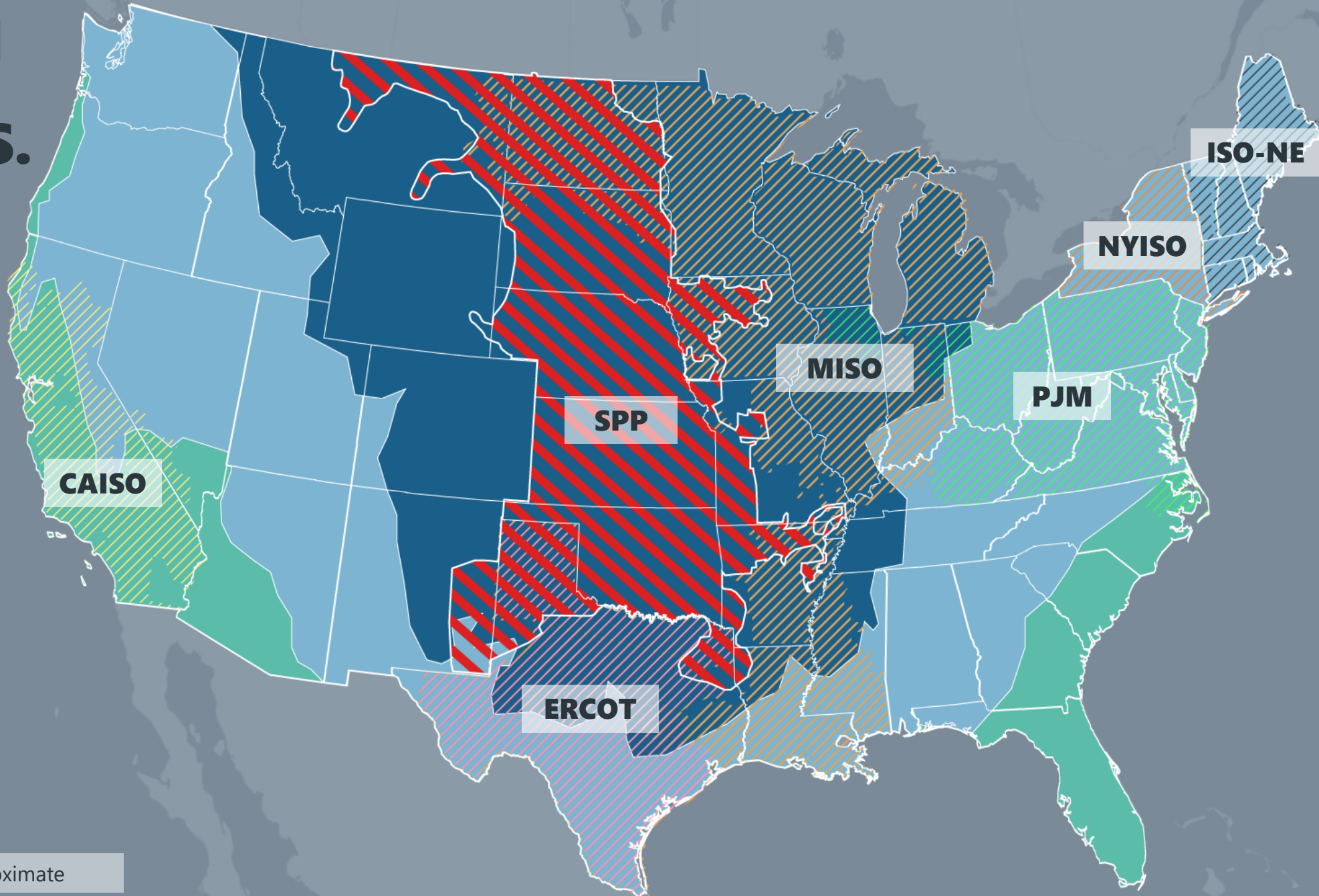
SPP REGION IN COLDEST PART OF U.S.



Lowest temperatures forecast
for Feb. 14-16, 2021

Sources: National Weather Service,
Global Forecast System

- SPP service territory/
balancing authority
- Temperatures below 0°F
- Between 0° and 32°F
- Above 32°F



* Locations of ISOs/RTOs are approximate

BALANCING AUTHORITY (BA) ALERT LEVELS

Alert levels defined by SPP operating plans

Normal Operations	SPP has enough generation to meet demand, has available reserves and does not foresee extreme or abnormal reliability threats
Weather alert	SPP expects extreme weather in its reliability coordination service territory
Resource alert	SPP's BA area expects severe weather conditions, significant outages, wind-forecast uncertainty and/or load-forecast uncertainty with potential to impact total capacity.
Conservative Operations	SPP determines the need to operate system conservatively to avoid an emergency based on weather, environmental, operational, terrorist, cyber or other events
Maximum emergency generation notification	SPP foresees the need to use emergency ranges of resources for a certain hours.

Alert levels defined* by NERC EOP-011-1

Energy Emergency Alert (EEA) Level 1	All available generation resources in use <ul style="list-style-type: none"> All generation is committed, and there is concern about maintaining required reserves for BA Non-firm wholesale energy sales curtailed.
EEA Level 2	Load management procedures in effect <ul style="list-style-type: none"> BA is no longer able to provide its expected energy requirements and is energy deficient Operating plan implemented, including public appeals and demand response BA is still able to maintain minimum reserves Market participants and other BAs notified Transmission limitations evaluated and revised BA makes use of all available resources
EEA Level 3	Firm load interruption imminent or in progress <ul style="list-style-type: none"> BA is unable to meet minimum contingency reserve requirements System & reliability limits reevaluated and revised Immediate action taken to mitigate undue risk to the Interconnection, including load shedding.

* These are paraphrased, summarized definitions. Full definitions: <https://www.nerc.com/pa/Stand/Reliability%20Standards/EOP-011-1.pdf>

SPP BALANCING AUTHORITY OPERATIONS: FEB. 4-20, 2021

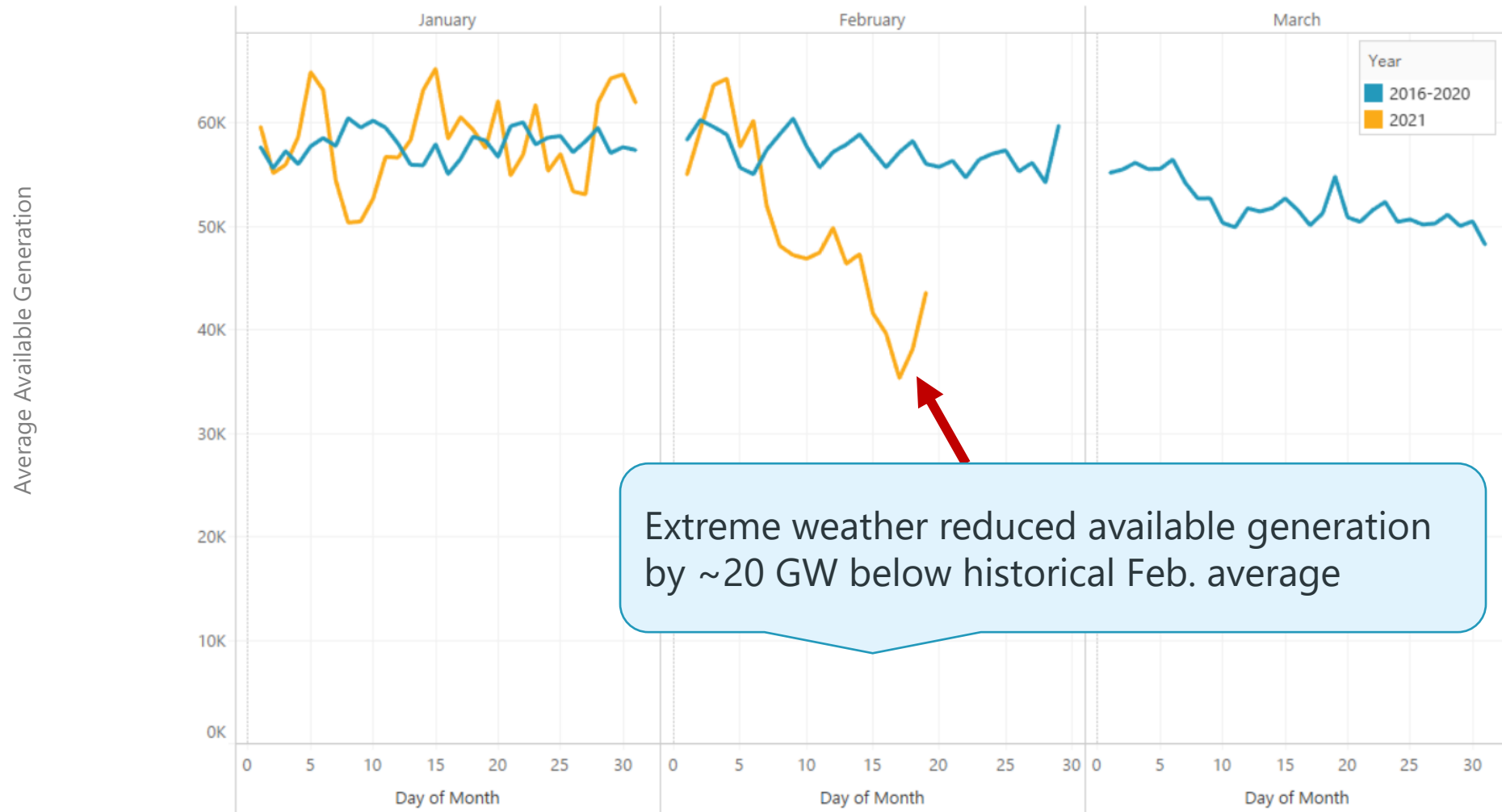
Time blocks are not to scale

Thurs. 2/4 to Mon. 2/8	Tues 2/9 to Sat. 2/13	Sun. 2/14	Mon. 2/15	Tues. 2/16	Wed. 2/17	Thurs. 2/18	Fri. 2/19	Sat. 2/20			
Normal operations in effect	<p>Tues. 2/9: Declared conservative operations until further notice</p> <p>Thurs. 2/11: Committed longer-lead time generating resources for Sat. 2/13 to Tues. 2/16</p> <p>Sat. 2/13: Reminded market participants of emergency cap & offer processes</p>	<p>Requested member companies issue public appeals for conservation</p> <p>Declared EEA1 to be effective 2/15 at 05:00</p>	Conservative operations in effect	EEA2 in effect	<p>EEA 2 in effect</p>	<p>EEA1 in effect</p>	<p>EEA1 in effect</p>	<p>Conservative operations in effect</p>			
<p>Thurs. 2/4: Issued cold weather alert to grid operators</p>			05:00 Declared EEA1	06:15 Declared EEA3					06:44 Firm load interruption	09:30 Ended EEA and remained in conservative operations through 22:00 Sat. 2/20, with appeal for public conservation	<p>09:20 Ended EEA and remained in conservative operations through 22:00 Sat. 2/20, with appeal for public conservation</p>
			07:22 Declared EEA2	10:07 – EEA3					10:08 Declared EEA3 New record peak	11:30 Declared EEA2	
			12:04 - Firm load interruption	12:31 Declared EEA1					13:01 - EEA3	13:15 Declared EEA1	
			14:00 Declared EEA2	18:20 Declared EEA2					18:25 – Declared EEA1		
				18:28 Declared EEA2					22:59 Declared EEA1		
			<p>Mon. 2/8: Issued resource alert to grid operators: "Implement resource preparations...ensure resource commitment start-up and run times ...report fuel shortages & transmission outages..."</p>	22:00 Declared normal operations							

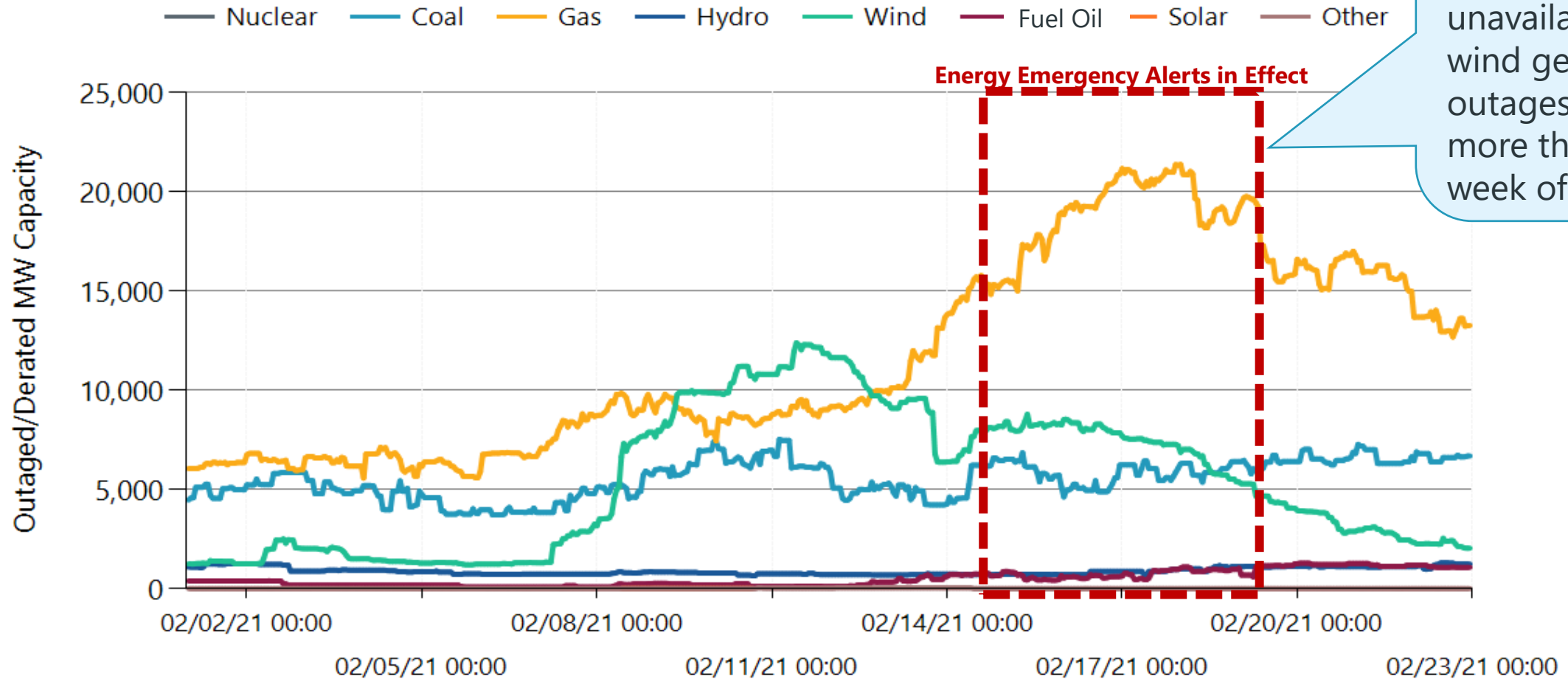
DRIVERS OF TEMPORARY SERVICE INTERRUPTIONS

1. **Generation unavailability**
 - Lack of fuel supply
 - Icing and extreme cold weather-related outages
2. **Rapid reduction of energy imports**
 - Transmission congestion related
 - Tightening supply conditions in neighboring areas
3. **Record wintertime energy consumption**

AVAILABLE GENERATION IN SPP MARKET



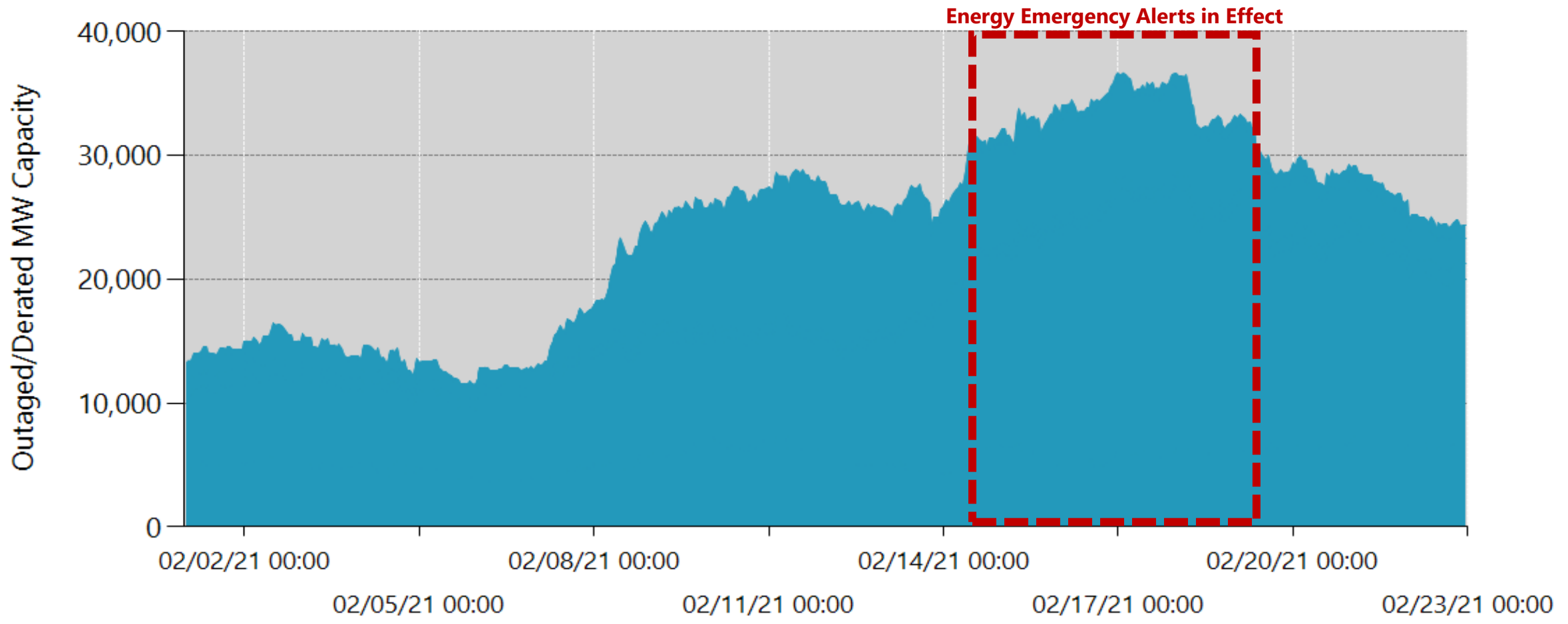
GENERATING CAPACITY OUTAGES



During peak conditions, gas generation contributed to ~60% of total unavailability, wind generation outages ~5x more than first week of Feb.

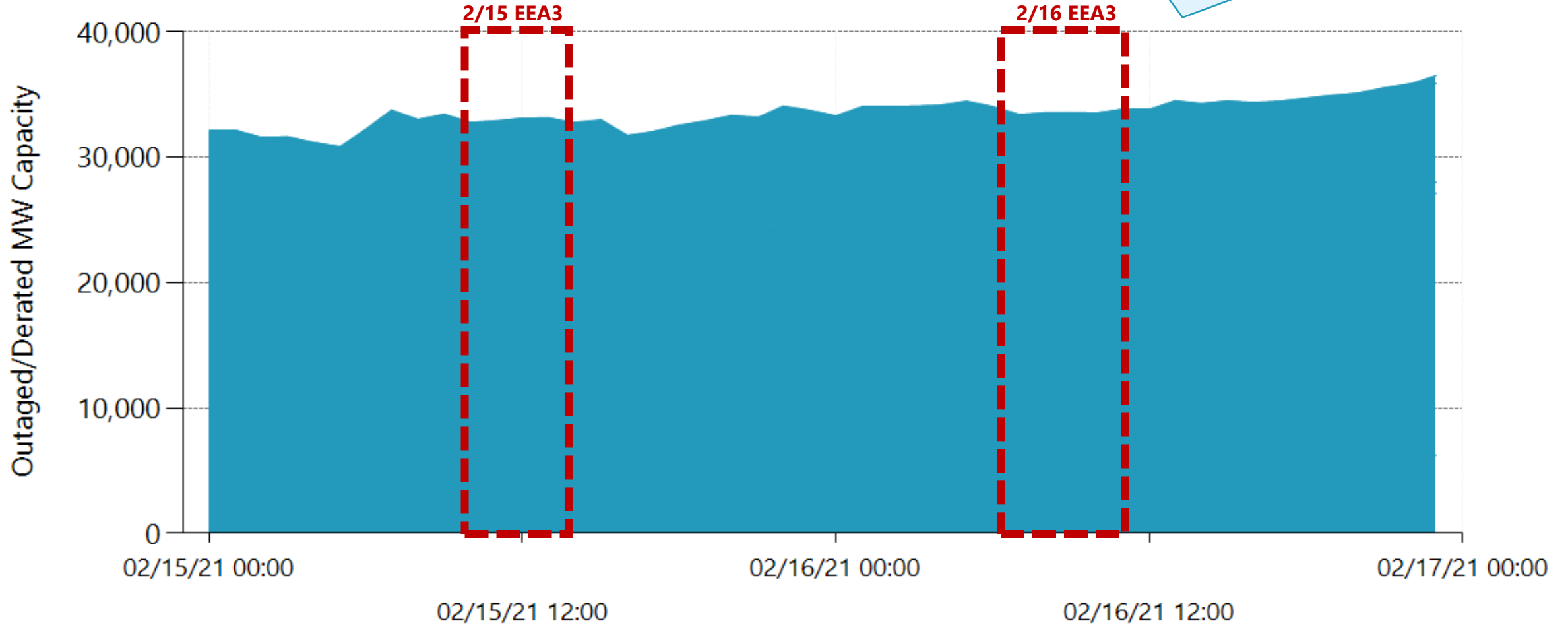
TOTAL GENERATION OUTAGES

Up to 35,000 MW of generating capacity unavailable to meet demand, nearly 2.5x more outages than first week of Feb.



TOTAL GENERATION OUTAGES

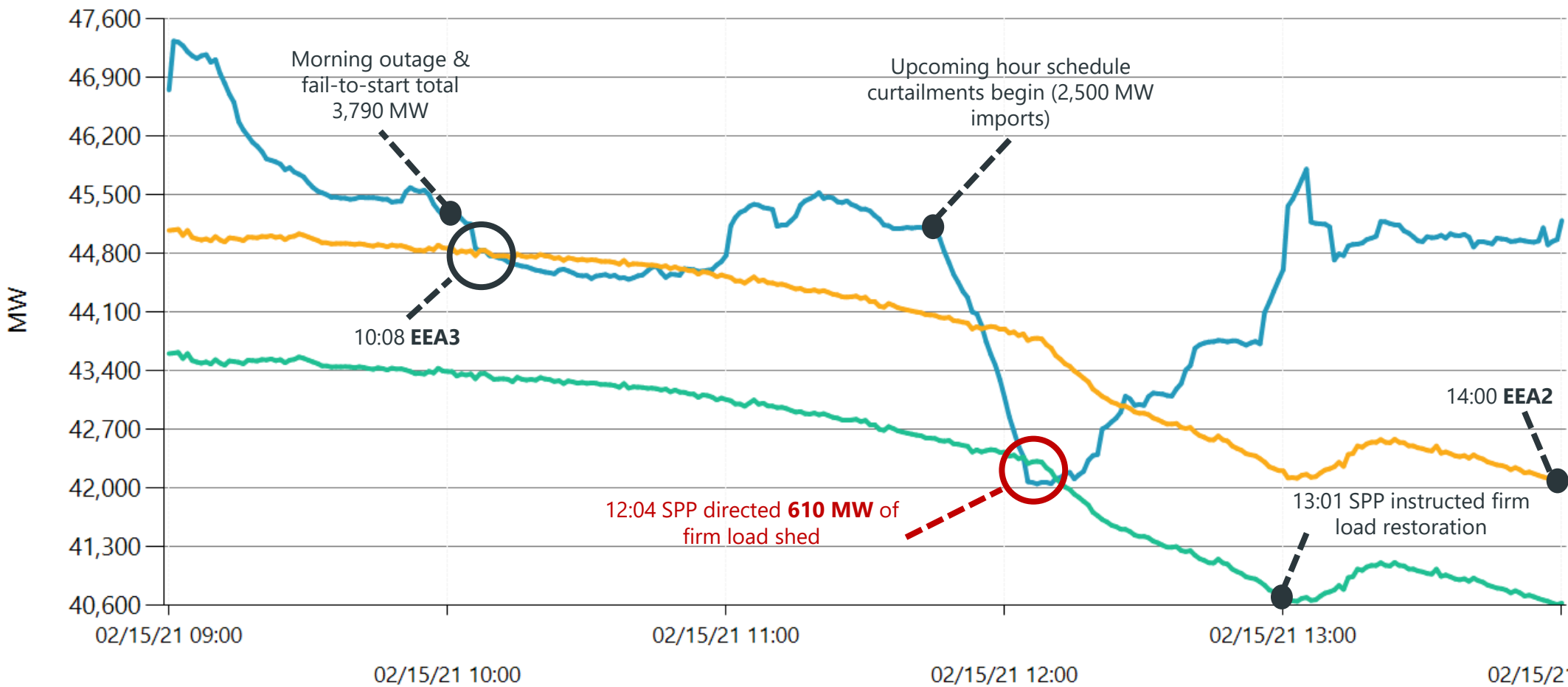
Lack of generating capacity was a large contributor to SPP's EEA3 conditions



2/15 LOAD & ONLINE GENERATION WITH NET ENERGY IMPORTS

SPP issued EEA3 when unable to maintain required reserves
 Reduced imports created supply vs. demand imbalance

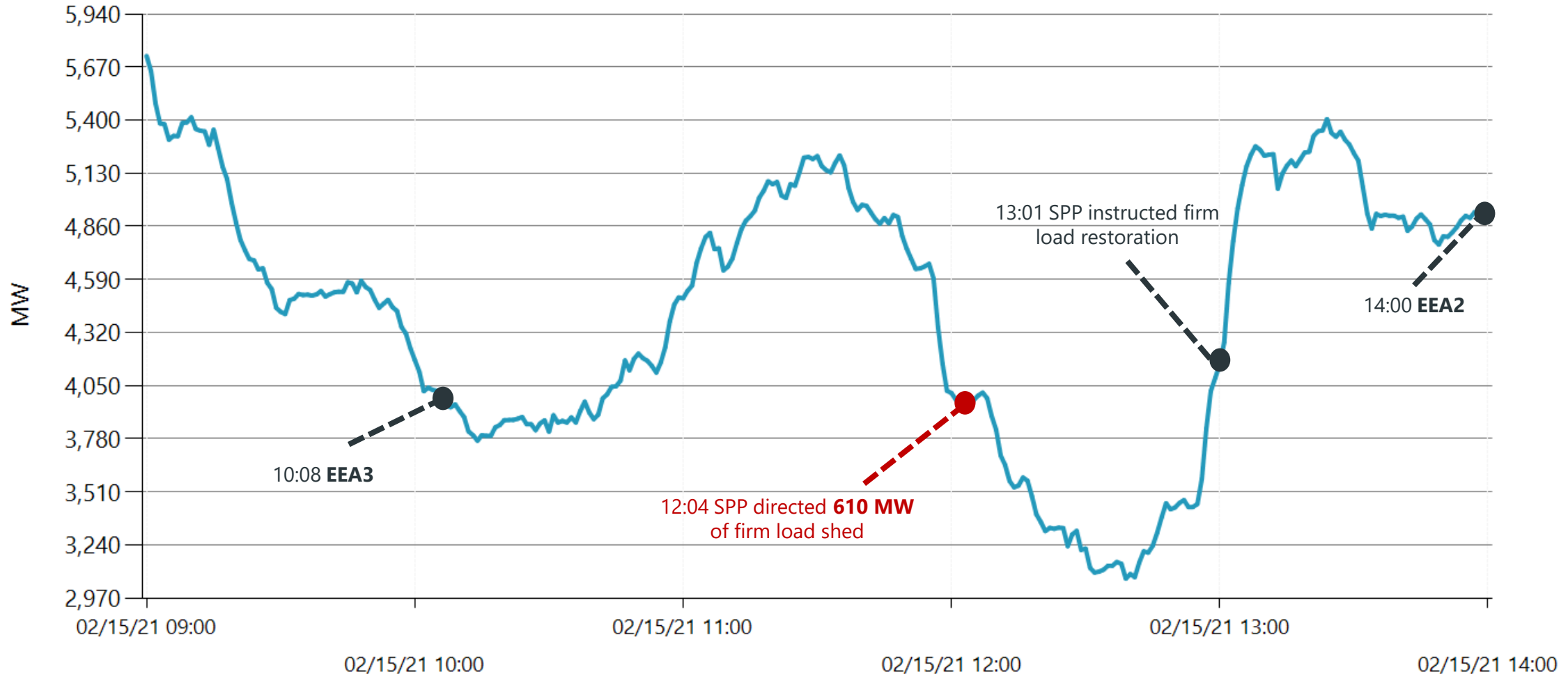
— Online Generation & Scheduled Interchange — BA Load — BA Load & Contingency Reserves



2/15 NET ENERGY IMPORTS

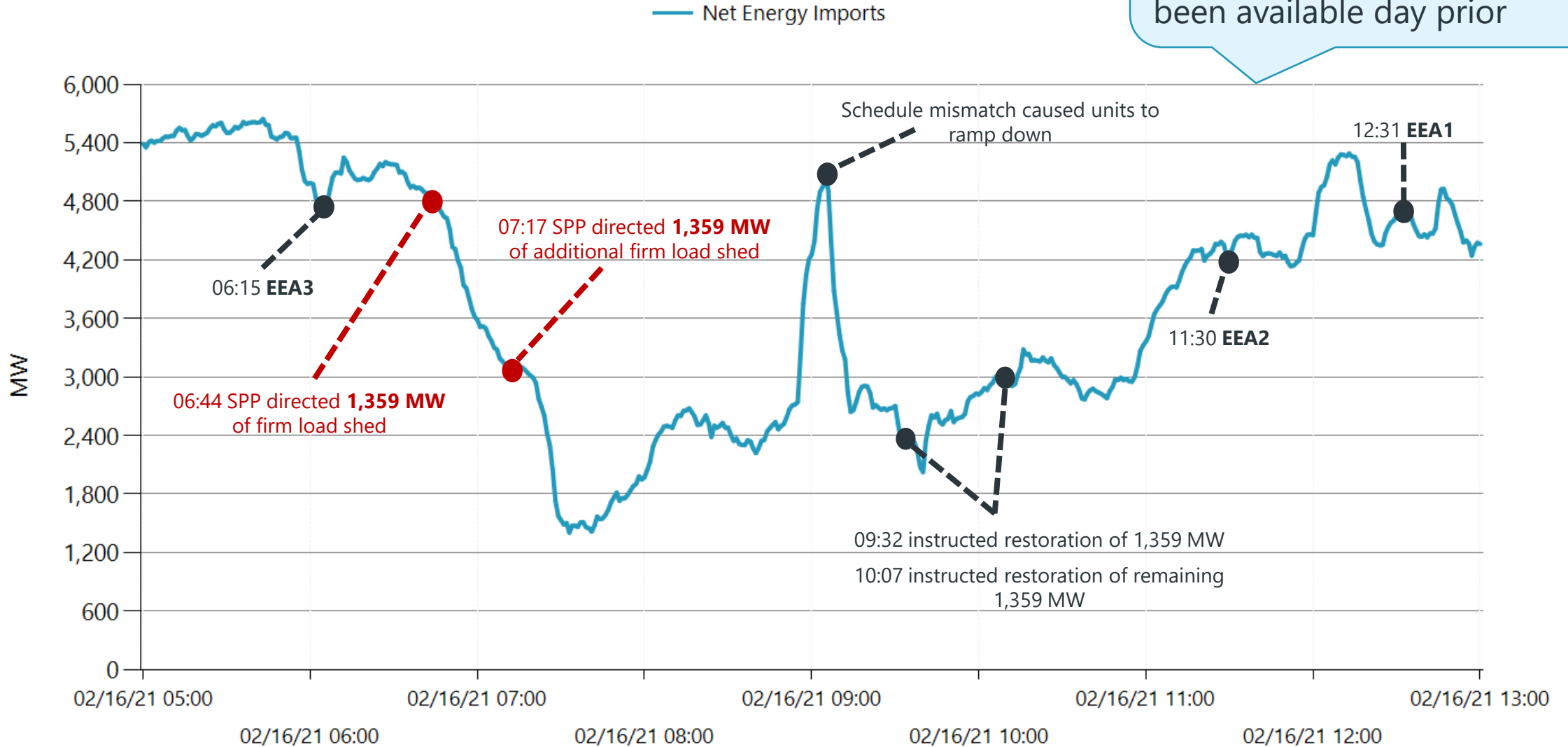
At times, SPP was importing significant amounts of energy

— Net Energy Imports



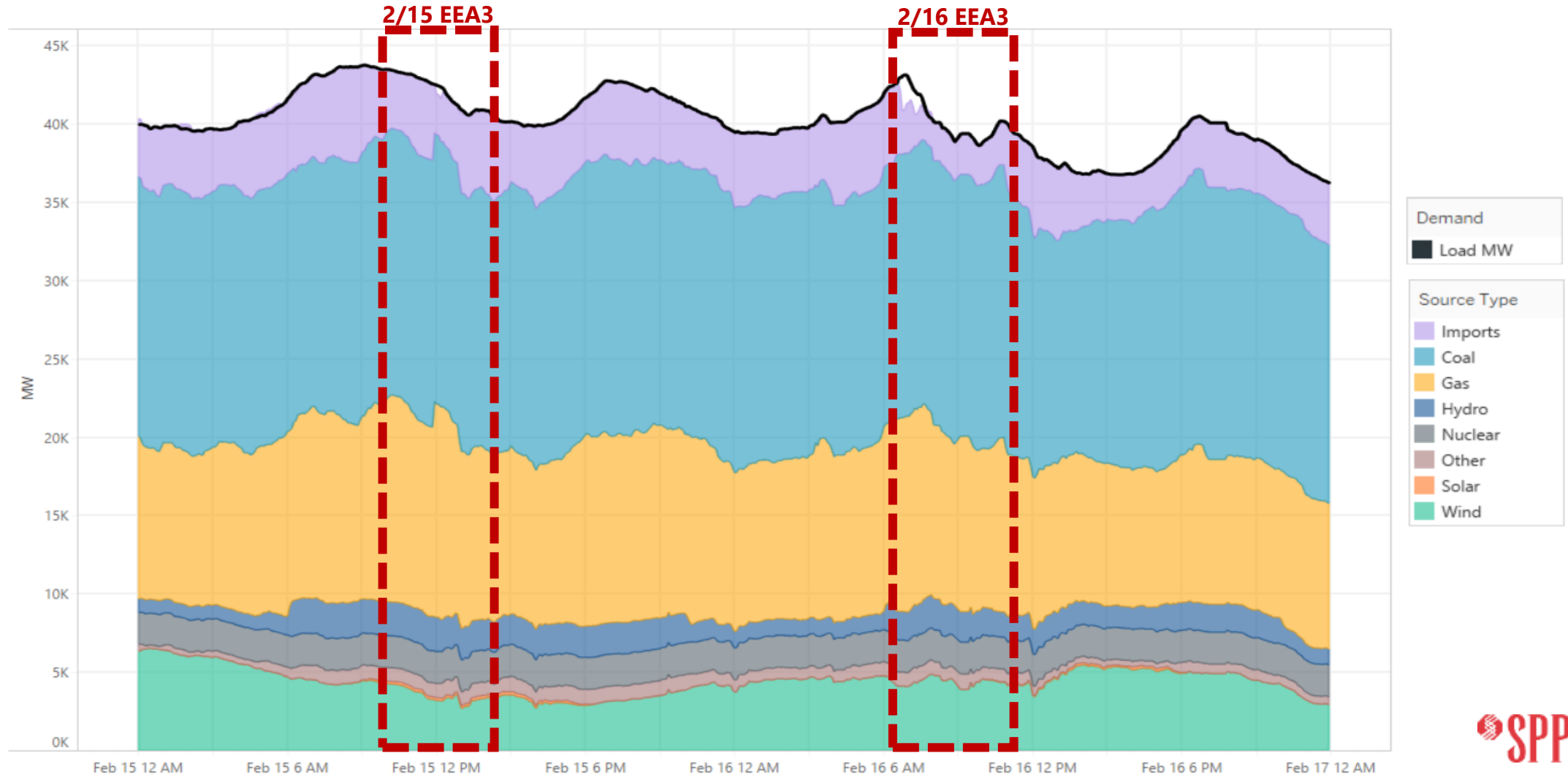
2/16 NET ENERGY IMPORTS

At times, SPP was importing significant amounts of energy, although less than what had been available day prior



ENERGY THAT MET DEMAND IN REAL-TIME MARKET

SPP relied on energy from multiple sources, including imports from neighbors

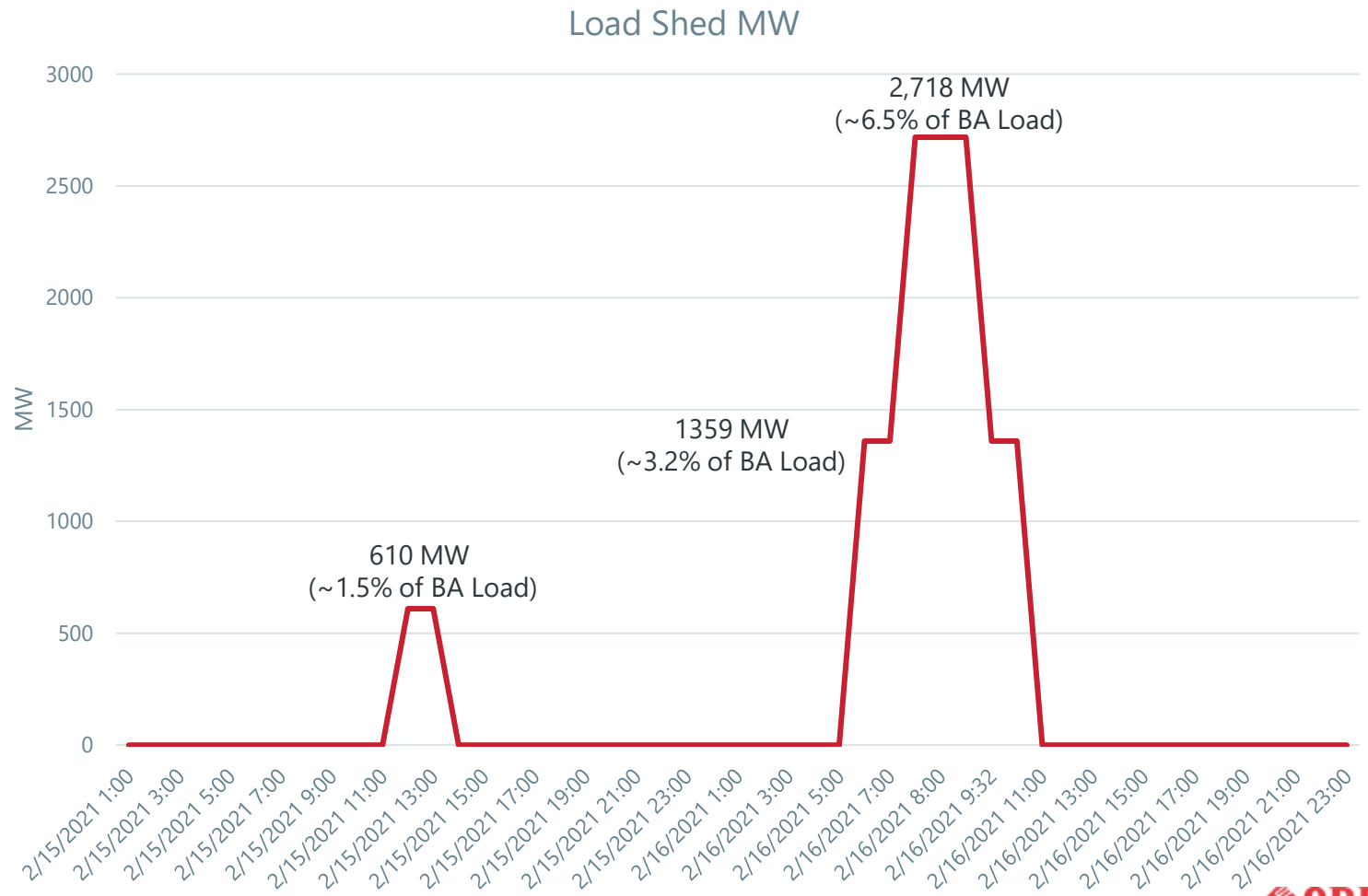


INTERRUPTIONS BY ENTITY

Directed interruptions allocated to transmission operators on pro-rata basis

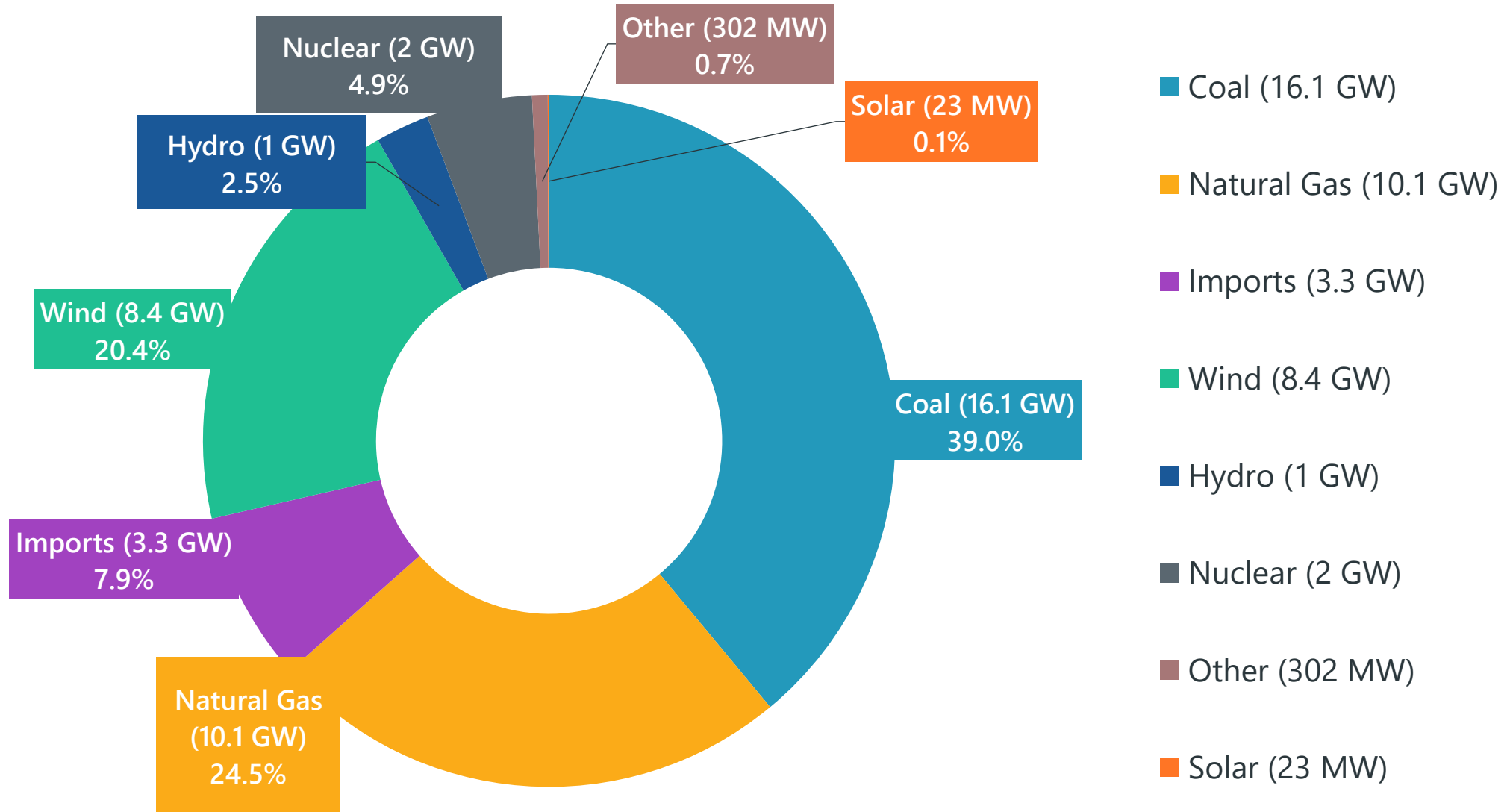
Participating Entity	% of MW
CSWS	16.8
WAPA	13.5
SPS	12.4
OKGE	12.4
KCPL	9.68
WR	8.49
NPPD	6.57
OPPD	4.6
WFEC	3.78
GRDA	2.22
SECI	2.22
EDE	2.19
LES	1.36
SPRM	1.22
KACY_N	0.92
CBPC	0.83
INDN	0.38
SPA	0.28
TSGT	0.13
SPP Total	100%

Winter percentages effective 12/1 through 2/28



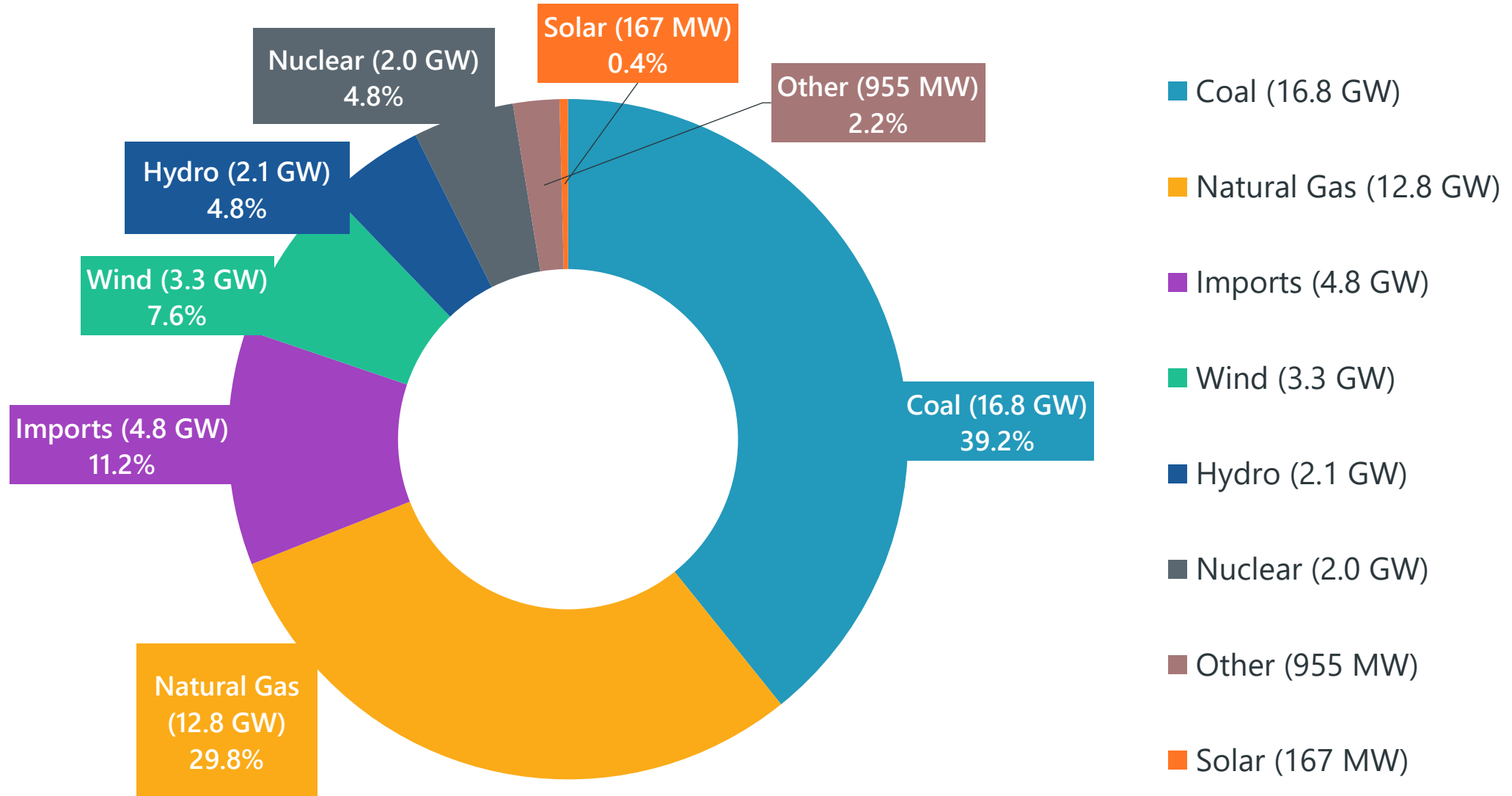
AVERAGE SUPPLY MIX

FEBRUARY 14 DAILY AVERAGE



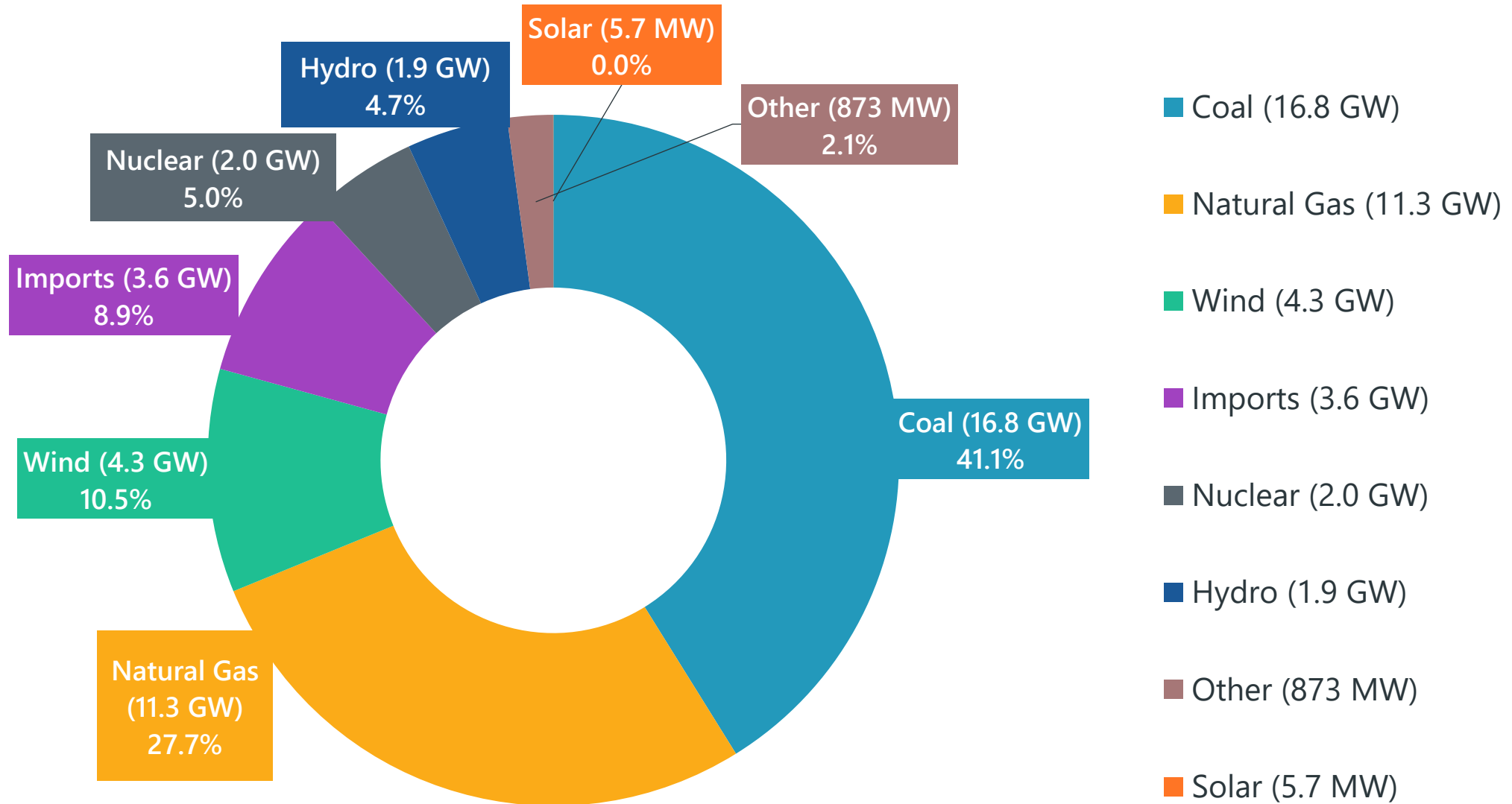
AVERAGE SUPPLY MIX

FEBRUARY 15 CONTROLLED OUTAGE TIMEFRAME



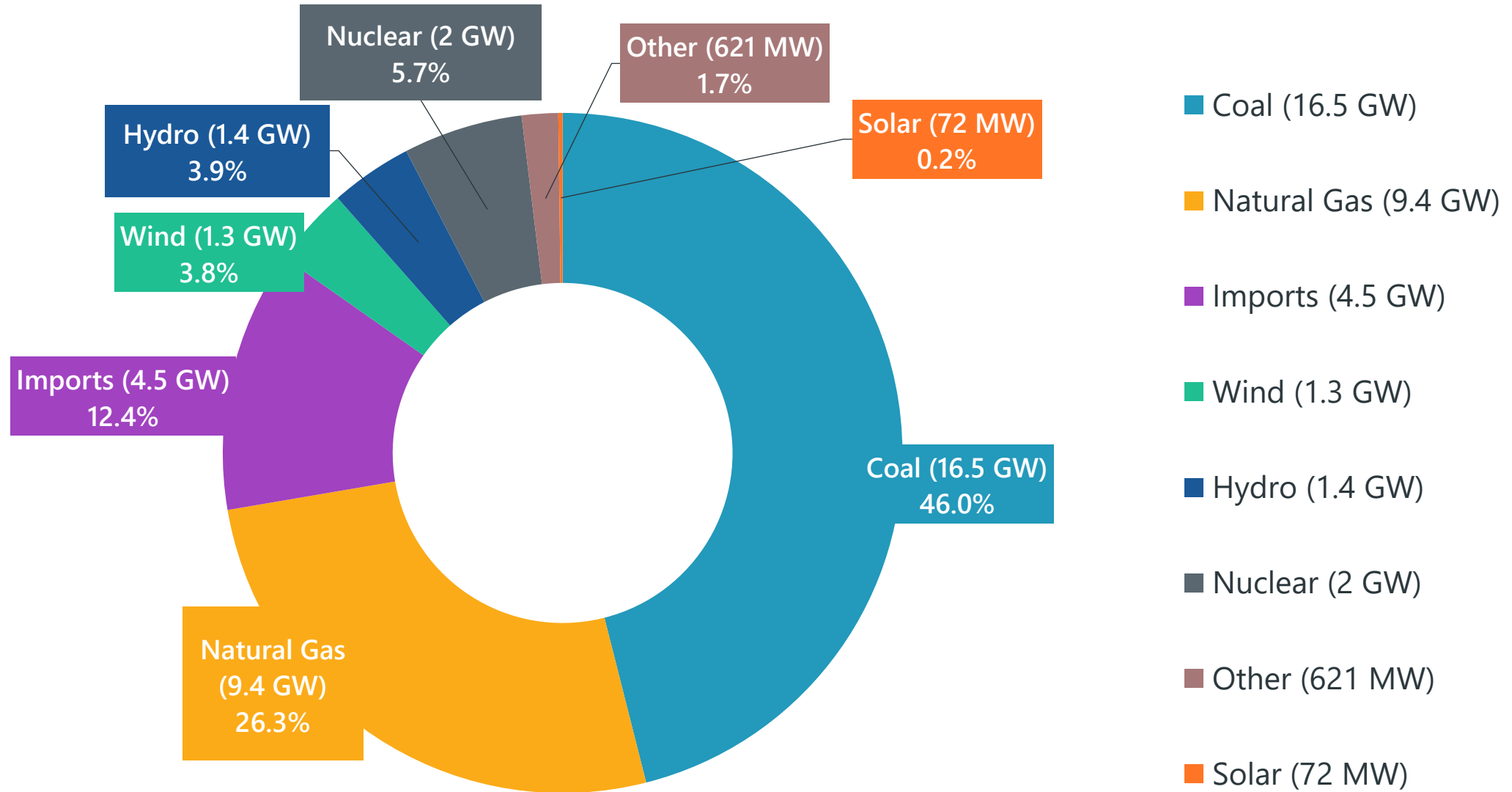
AVERAGE SUPPLY MIX

FEBRUARY 16 CONTROLLED OUTAGE TIMEFRAME



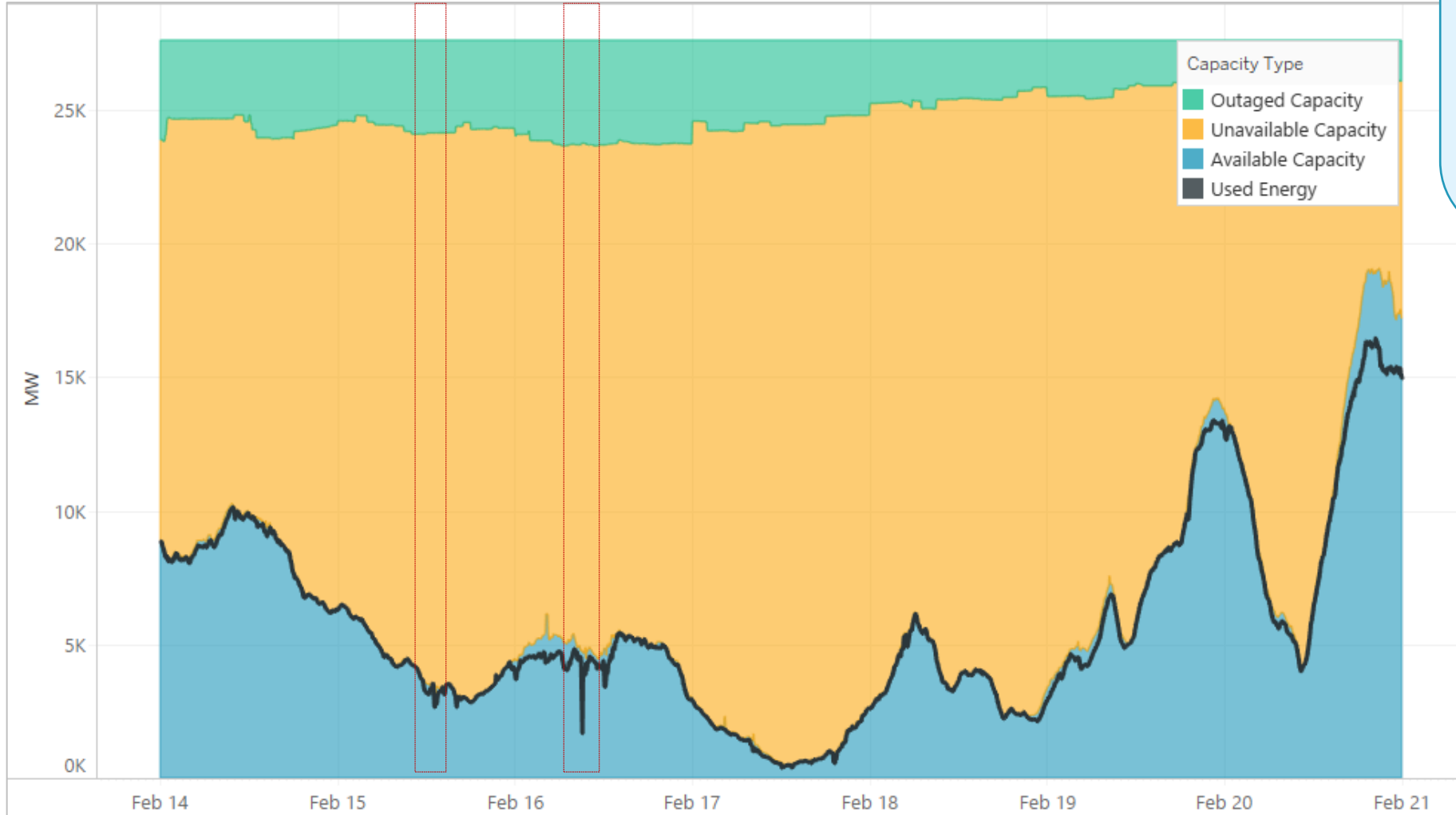
AVERAGE SUPPLY MIX

FEBRUARY 17 DAILY AVERAGE



GENERATING CAPACITY IN SPP – WIND

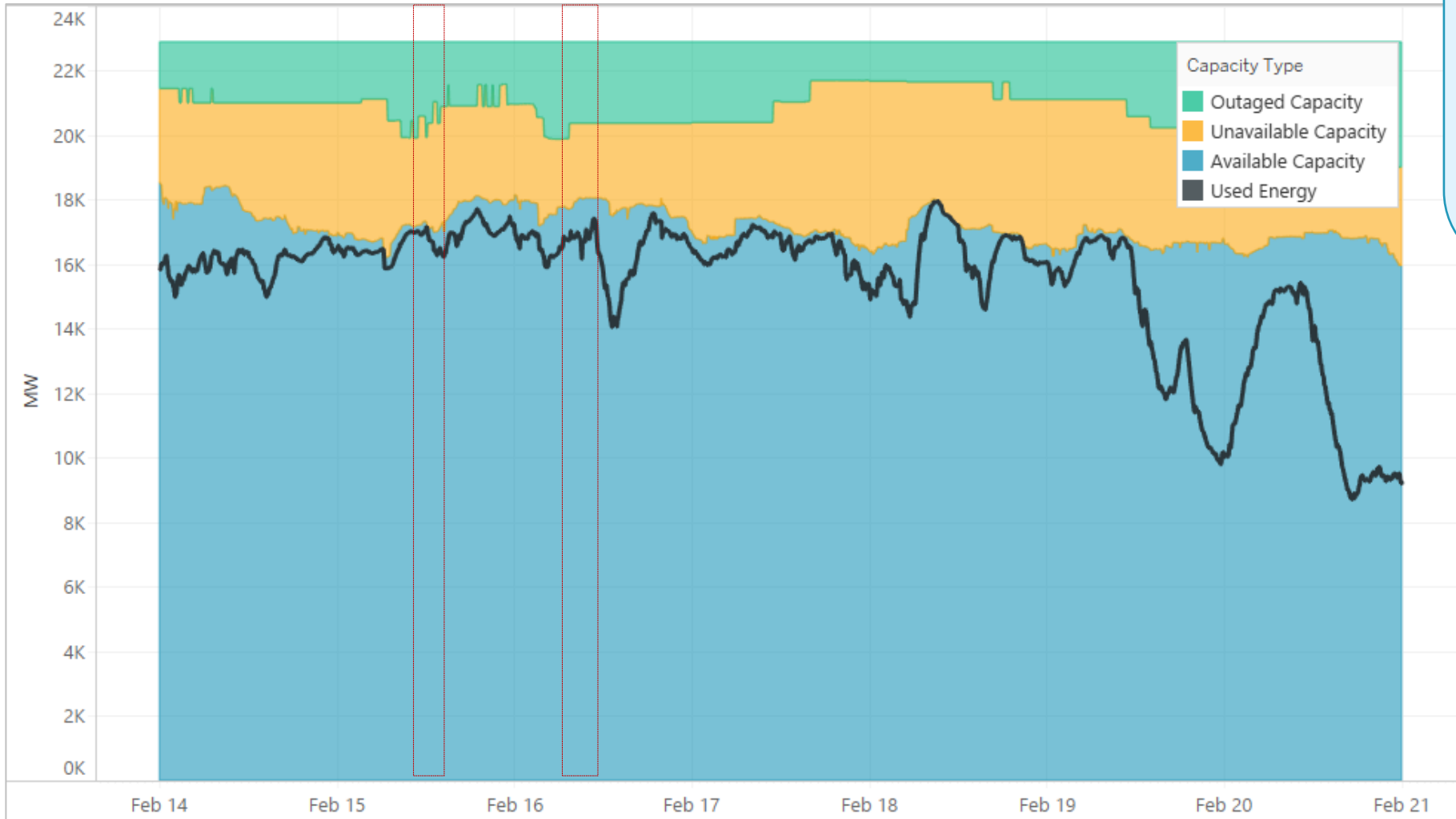
2/15 EEA3 2/16 EEA3



Wind generation during EEA3 periods constituted ~12-16% of nameplate capacity & ~90-115% of accredited capacity, with ~43-54% of that provided by accredited resources

GENERATING CAPACITY IN SPP – COAL

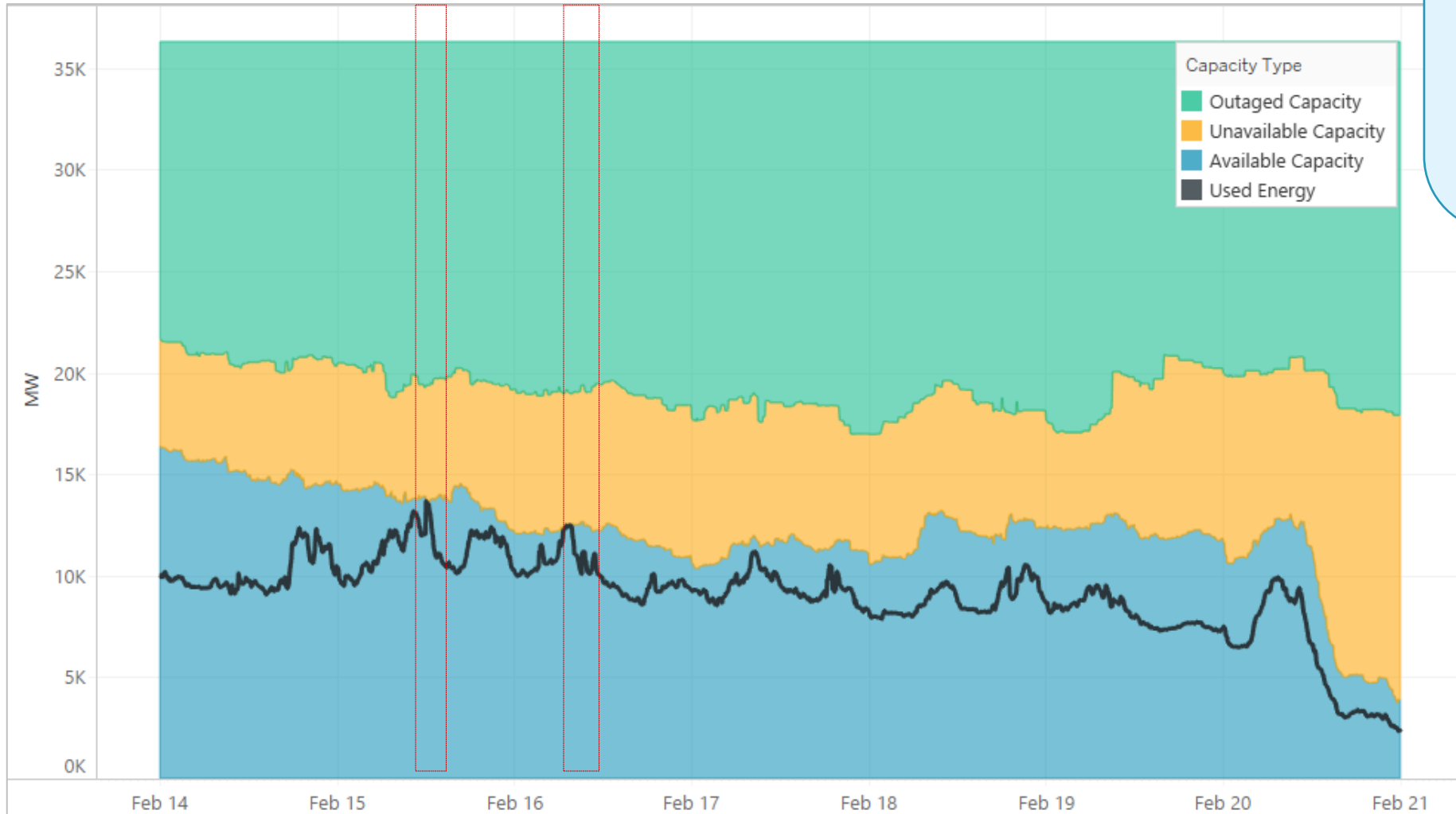
2/15 EEA3 2/16 EEA3



Coal generation during EEA3 periods constituted ~77-79% of nameplate capacity and ~80-82% of accredited capacity, with ~98% of that provided by accredited resources

GENERATING CAPACITY IN SPP – GAS

2/15 EEA3 2/16 EEA3



Gas generation during EEA3 periods constituted ~34-37% of nameplate capacity & ~42-48% of accredited capacity, with ~95% of that provided by accredited resources

KEY OBSERVATIONS

KEY OBSERVATIONS



1. UNAVAILABLE GENERATION AND FUEL

Lack of available generation was the primary cause of the event's reliability impacts.

Lack of fuel was the biggest cause of generation unavailability.



2. HIGH GAS PRICES

Extremely high natural gas prices were the primary driver of record-high energy offers, exceeding SPP's market offer caps for the first time.

KEY OBSERVATIONS



3. INCREASED CREDIT EXPOSURE

Rapid spike in SPP's market prices raised concerns about market participants' liquidity & exponentially increased short-term credit exposure.



4. HELPFUL INTERCONNECTIONS

Relationships & interconnections with neighboring systems facilitated critical helpful assistance.



5. CONGESTED TRANSMISSION

Full use of generation in certain locations was limited by congestion on SPP's system.

KEY OBSERVATIONS



6. MINIMIZED RELIABILITY IMPACTS

Early preparation, timely decisions & effective communication helped minimize reliability impacts while effective execution of load-shed procedures mitigated the risk of uncontrolled blackouts.



7. CREDIBLE COMMUNICATIONS & RESPONSE

Stakeholders indicated general satisfaction with SPP's emergency communications, information sharing & credibility, while recognizing the need for improvements.

PRIORITIZATION LEVELS

TIER 1	<p>Necessary and urgent to avoid severe reliability, financial, operational, compliance or reputational risks.</p> <p>Address system-related root causes of the 2021 winter event or mitigate occurrence of future extreme system event impacts.</p>
TIER 2	<p>Necessary to minimize the risk of severe reliability, financial, operational, compliance or reputational consequences associated with extreme system events.</p> <p>Important and expected to significantly improve SPP's response to extreme system events in the future.</p>
TIER 3	<p>Improve SPP's response, communications and public perception during extreme system events, but are not necessary or urgent.</p>

RECOMMENDATION TYPES



Action: Development and/or implementation of a new process, requirement, protocol or other activity.



Policy: Development of principles to be used to guide subsequent development of requirements, protocols, and/or processes using the stakeholder process in accordance with bylaws, tariff provisions and applicable regulations.









Assessment: Performance of analysis that informs development of solutions through the stakeholder process.





SUMMARY OF RECOMMENDATIONS

	Tier 1	Tier 2	Tier 3
Fuel Assurance (FA)			
Resource Planning & Availability (RPA)			
Emergency Response Process & Planning (ERP)			
Operator Tools, Communication and Processes (OTCP)			
Seams Agreements (SEAMS)			
Market Design (MKT)			
Transmission Planning (TXP)			
Credit (CR)			
Communications (COMM)			
22 TOTAL	4	13	5

FUEL ASSURANCE

#	TIER	TYPE	DRIVER	RECOMMENDATION
FA 1	TIER 1			Develop policies that enhance fuel assurance to improve generation availability & reliability in SPP region
FA 2	TIER 1			Evaluate and, as applicable, advocate for improvements in gas industry policies, including use of gas price cap mechanisms, needed to assure gas supply is readily & affordably available during extreme events
FA 3	TIER 2			Develop policies to improve gas-electric coordination that better inform & enable improved emergency response

RESOURCE PLANNING & AVAILABILITY

#	TIER	TYPE	DRIVER	RECOMMENDATION
RPA 1	TIER 1			Perform initial & ongoing assessments of minimum reliability attributes needed from SPP's resource mix
RPA 2	TIER 1			<p>Improve or develop policies that ensure sufficient resources will be available during normal & extreme conditions. May include:</p> <ul style="list-style-type: none"> • Required performance of seasonal resource adequacy assessments • Developing accreditation criteria • Incorporating minimum reliability attribute requirements • Utilizing market-based incentives

SPP'S BOARD TOOK THE FOLLOWING ACTIONS

1. Accepted SPP's report: "A Comprehensive Review of Southwest Power Pool's response to the February 2021 Winter Storm"
2. Directed work to begin on immediately on recommendations that address root causes (Tier 1)
3. Directed organizational prioritization of work needed to address remaining recommendations
4. Directed staff to provide quarterly updates on status of progress being made
5. Directed staff to submit for board approval in October a project plan of activities needed to resolve the Tier 1 recommendations
6. Directed issuance of letters to all generator operators in the SPP region requiring them to inform SPP about their plans to have and maintain fuel necessary to assure availability of all generation treated as accredited capacity for the upcoming winter season
7. Directed staff to perform additional root cause analyses to explain the failure of natural gas fuel supply during the weather event needed to better inform SPP's three fuel assurance recommendations

AFTER THE STORM

- Collaborate with members and industry to ensure region is equipped to manage future crises effectively
- Comply with FERC and NERC inquiries
- Document lessons learned
- Review processes for improvement areas and implement recommendations

