SPP: A Look at the Queue and Congestion Issues

Casey Cathey, *Southwest Power Pool*

Moderator: Courtney Kennedy, *Omaha Public Power District*

Nebraska Wind & Solar CONFERENCE & EXHIBITION

SPP Southwest Power Pool

A LOOK AT THE QUEUE AND CONGESTION ISSUES

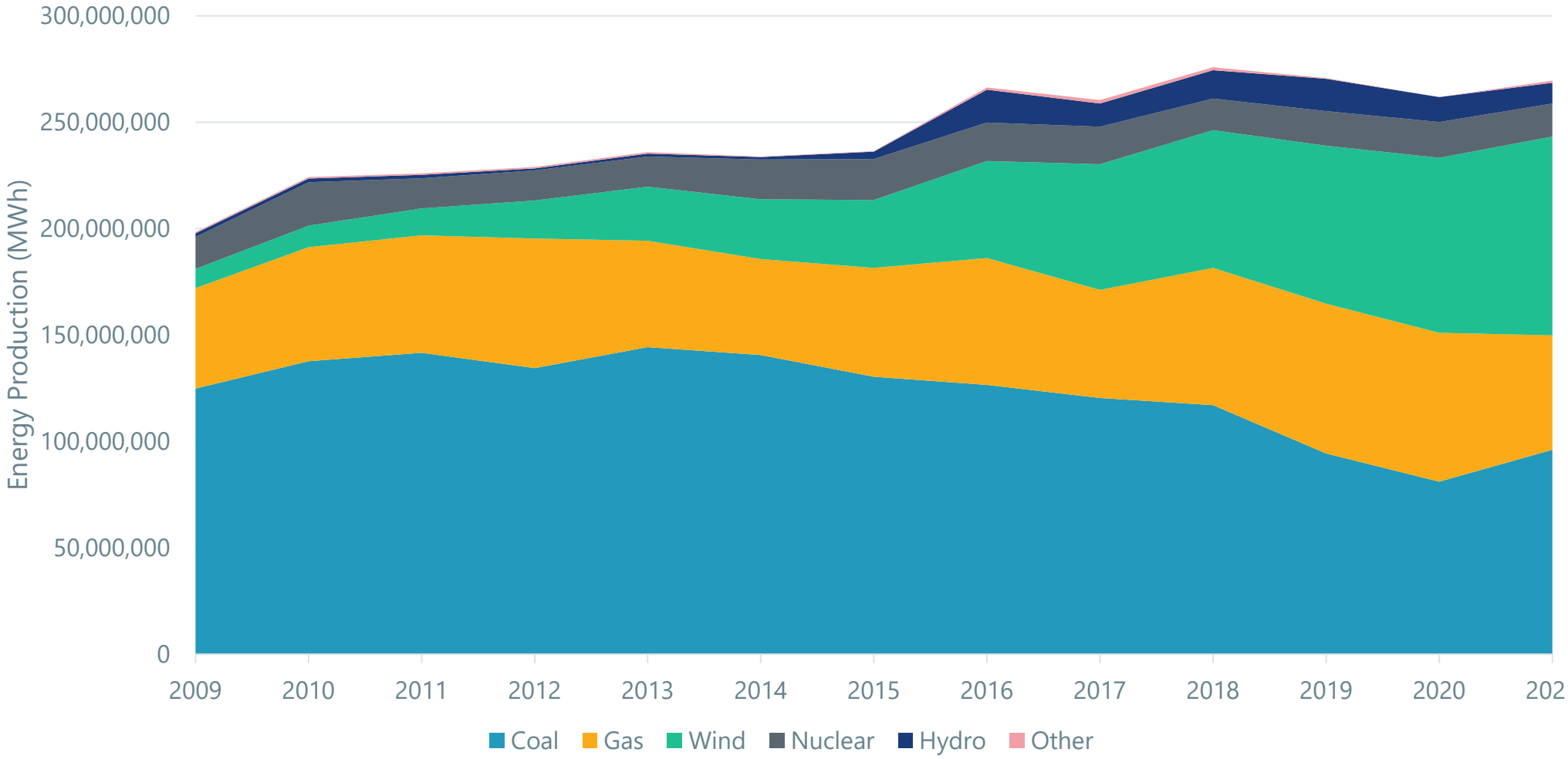
CASEY CATHEY

DIRECTOR, SYSTEM PLANNING

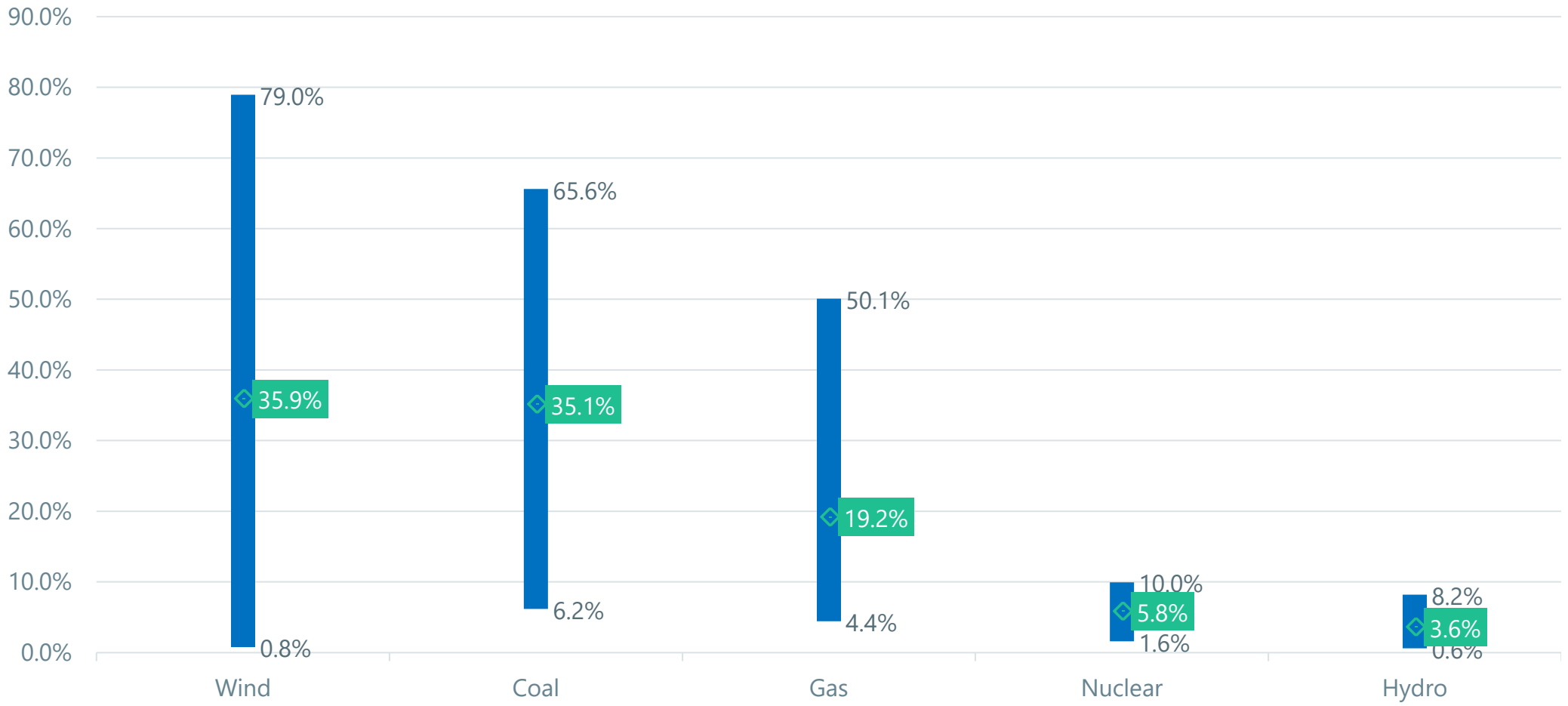
Helping our members work together to keep the lights on... today and in the future.

SouthwestPowerPool SPPorg southwest-power-pool

ENERGY PRODUCTION
BY GENERATION TYPE OVER TIME

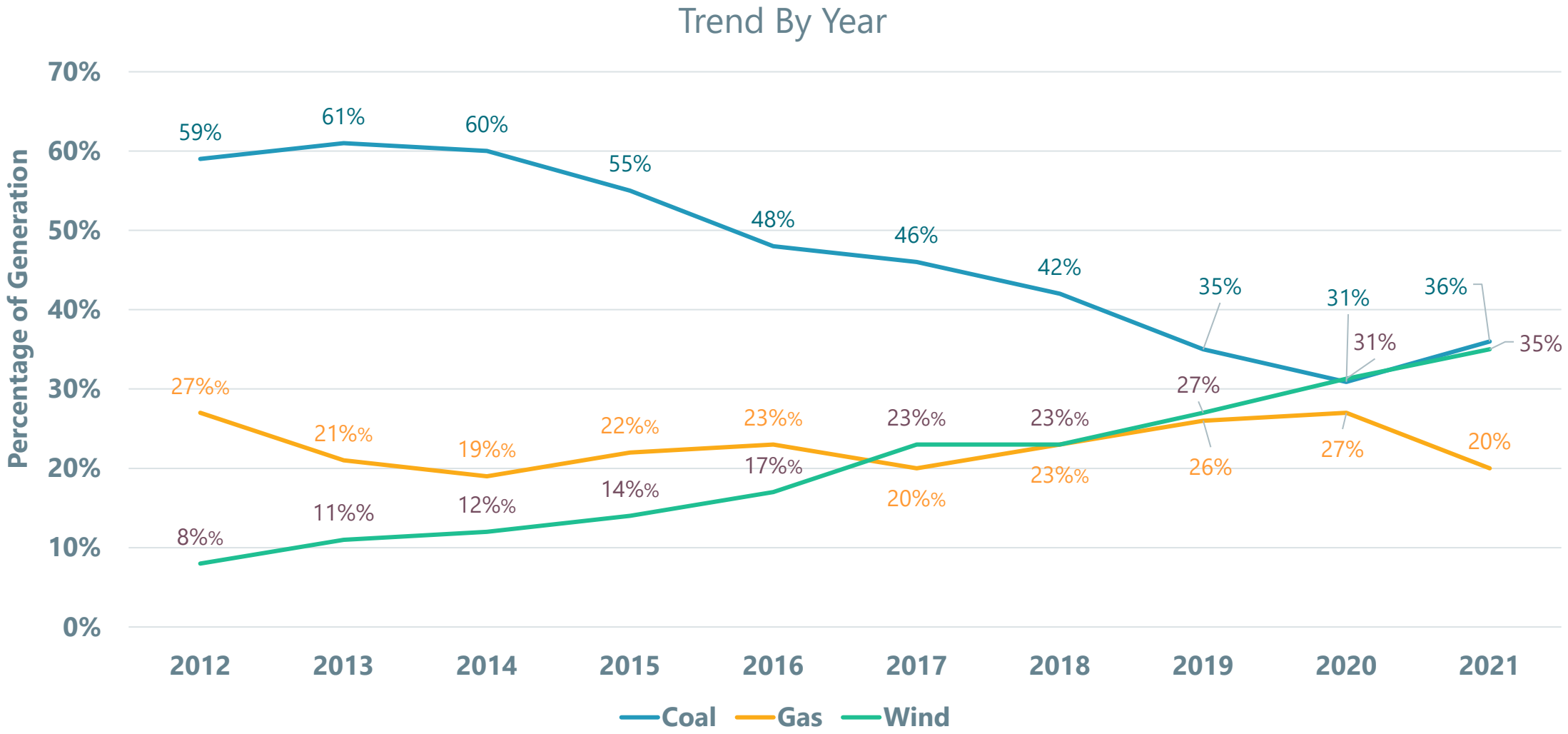


MIN AND MAX PERCENT OF GENERATION MIX BY FUEL TYPE

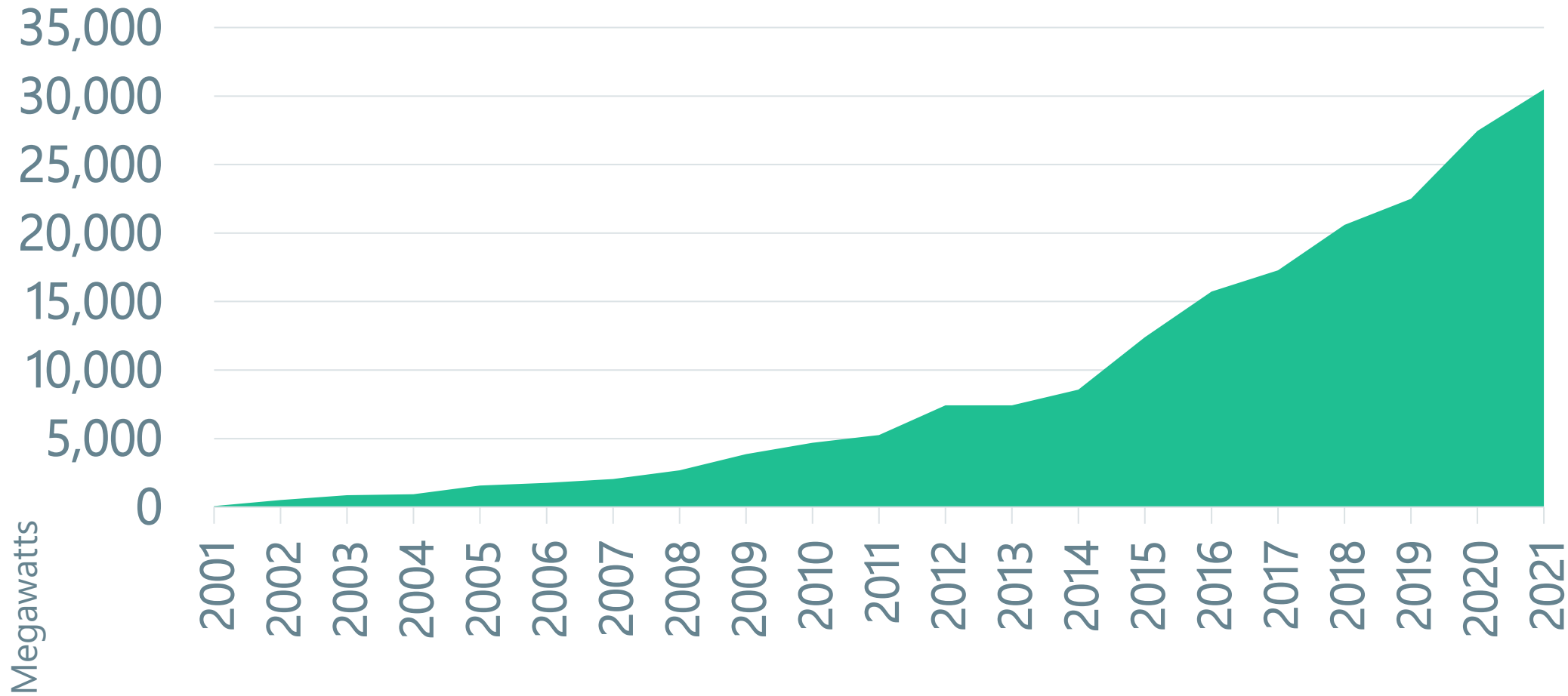


Jan. 1 – Dec. 31, 2021

OUR EVOLVING ENERGY MIX

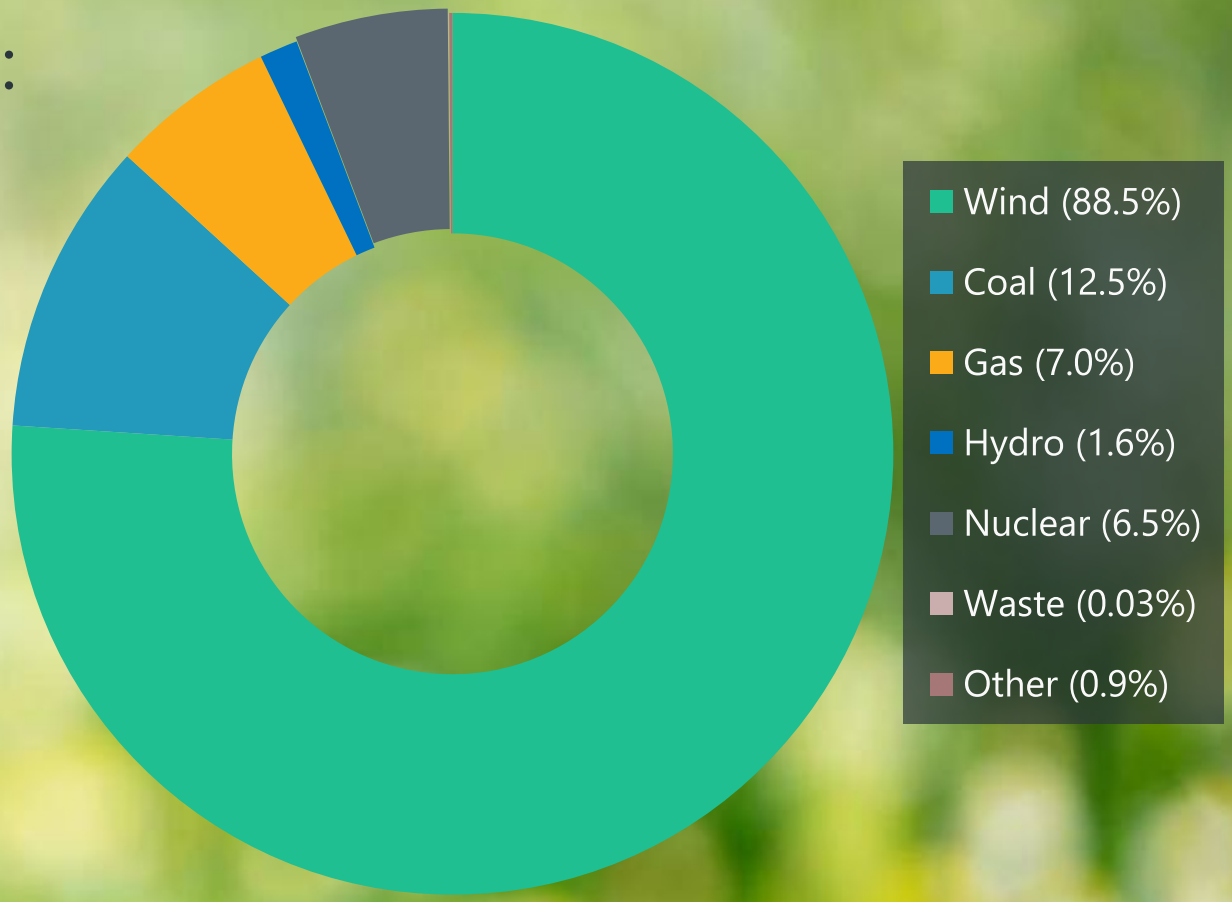


INSTALLED WIND CAPACITY BY YEAR



RENEWABLE PENETRATION

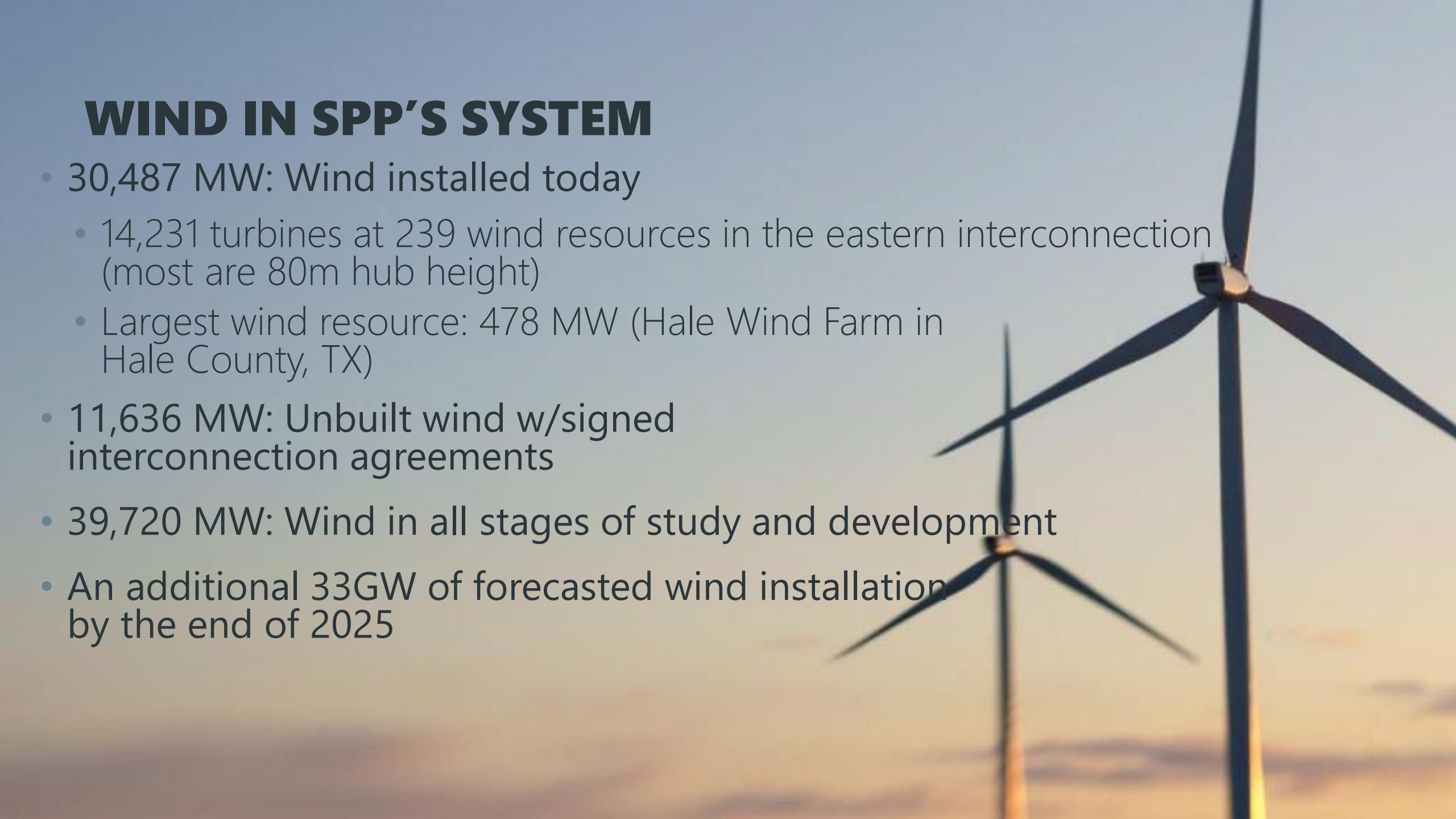
- Renewable penetration record: 90.2% of load
  - 2:42 a.m. on 3/29/22
  - 22,351 MW of 24,787 MW of load served by renewables
  - **90.17% of total generation** at that time was renewables



Penetration of Load by Fuel Type

WIND IN SPP'S SYSTEM

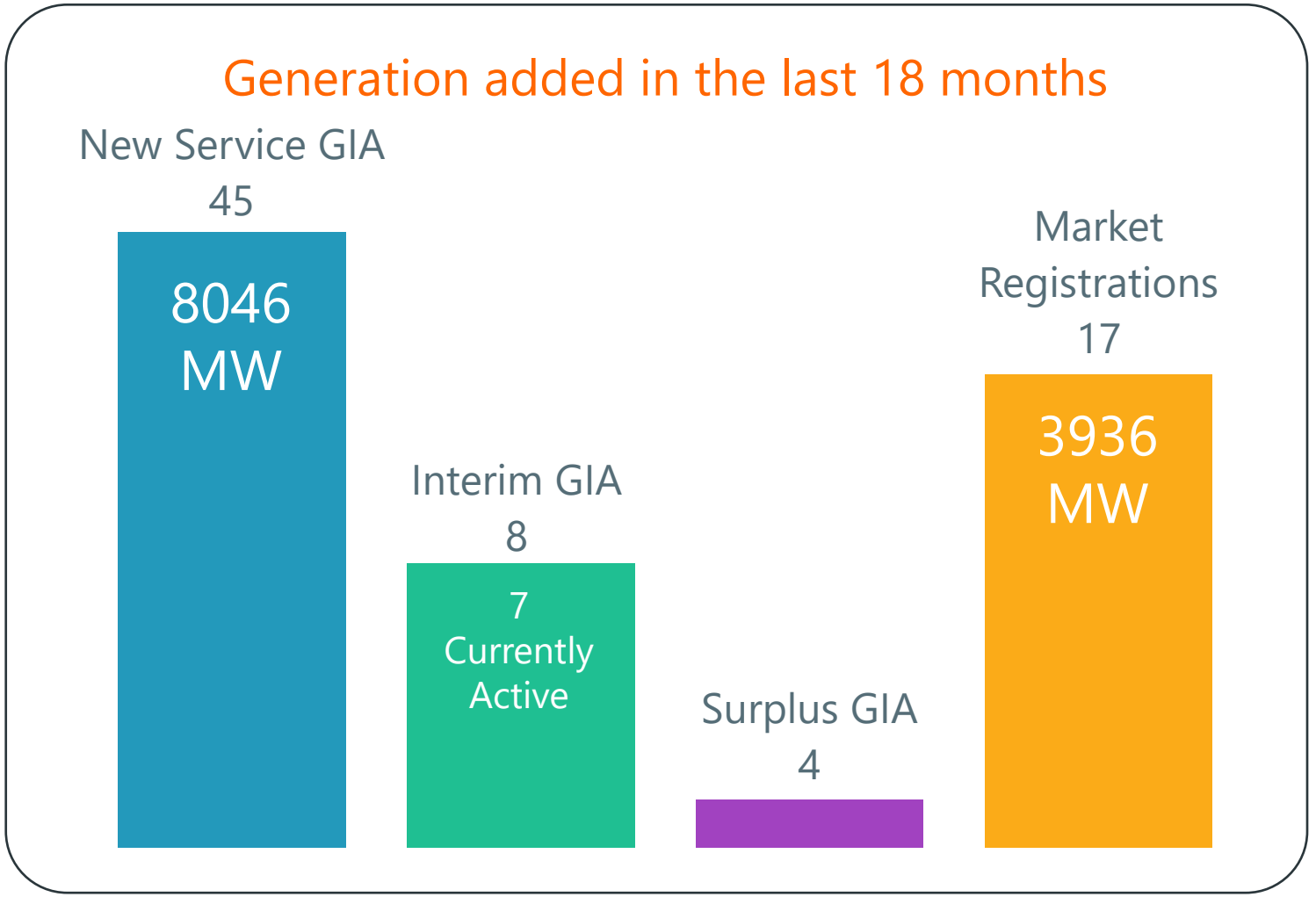
- 30,487 MW: Wind installed today
  - 14,231 turbines at 239 wind resources in the eastern interconnection (most are 80m hub height)
  - Largest wind resource: 478 MW (Hale Wind Farm in Hale County, TX)
- 11,636 MW: Unbuilt wind w/signed interconnection agreements
- 39,720 MW: Wind in all stages of study and development
- An additional 33GW of forecasted wind installation by the end of 2025



GENERATION QUEUE

HOW ARE WE DOING?
GENERATION ADDED TO THE SYSTEM

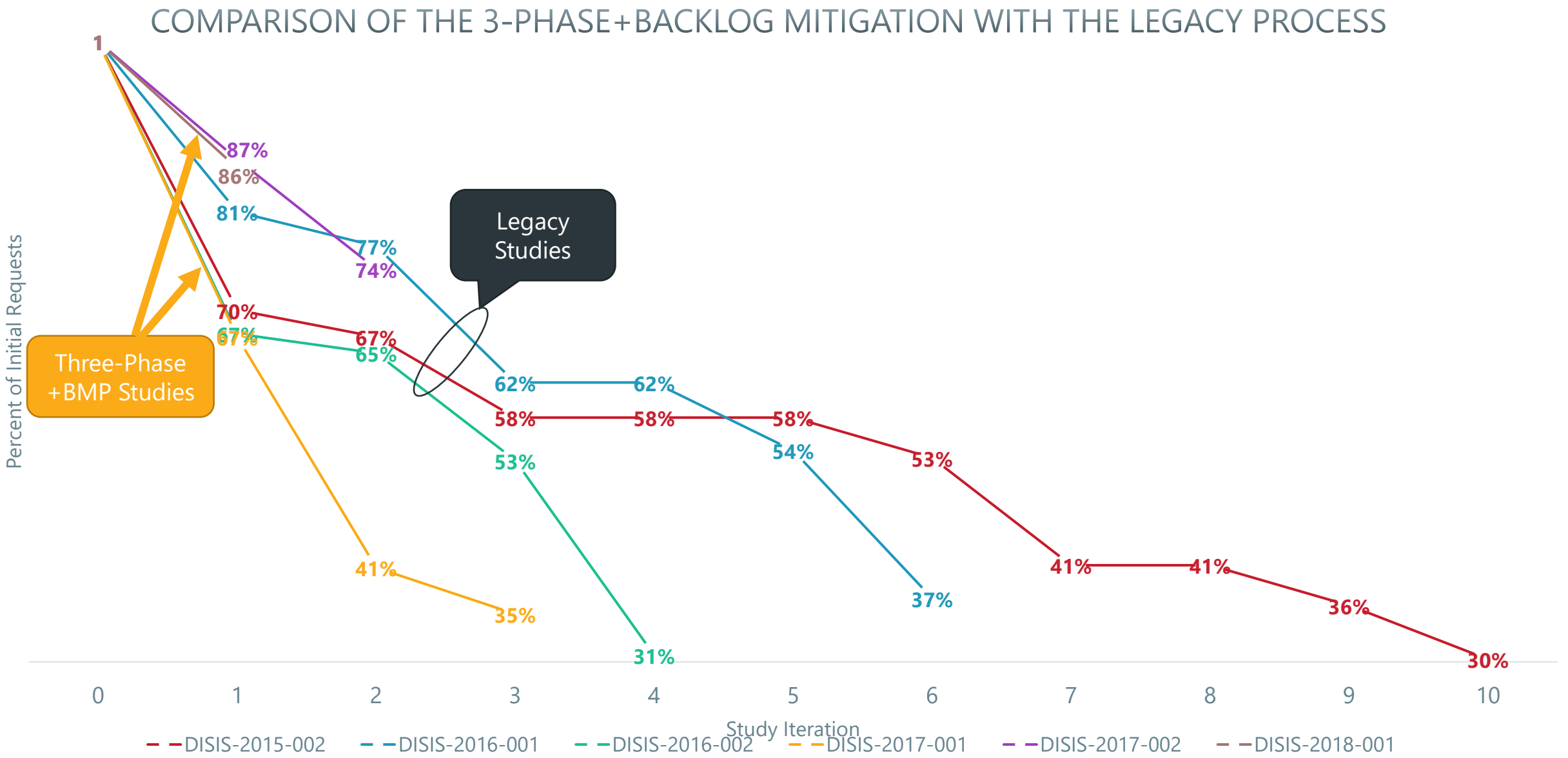
In spite of the backlog, new generators are being added to SPP's resource pool



Since January 2017:
26,846 MW added
to the system
140 GIAs executed

HOW ARE WE DOING?
GI 3-PHASE DISIS PROCESS

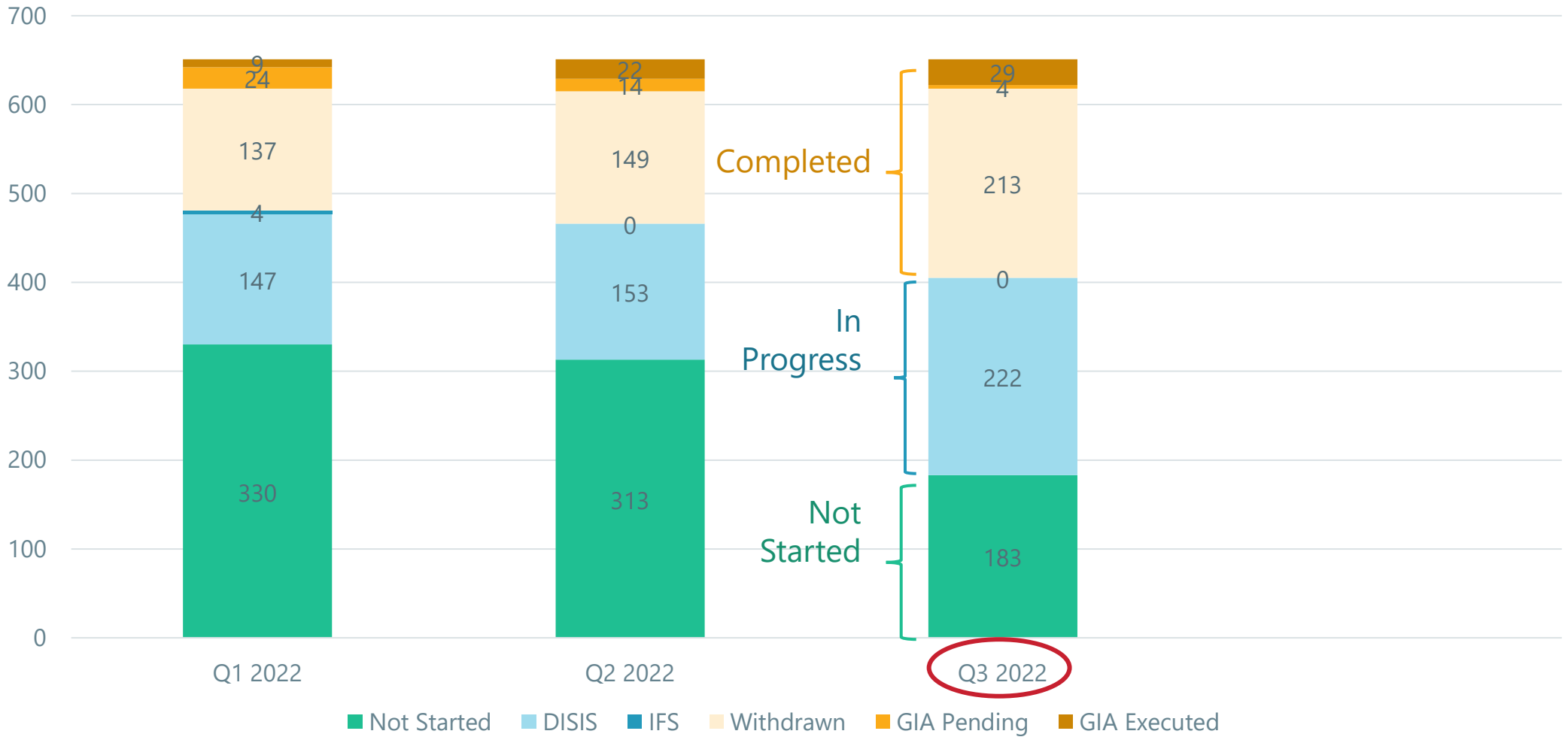
3-Phase + BMP continue to see faster progress compared with legacy



HOW ARE WE DOING?
BACKLOG MITIGATION

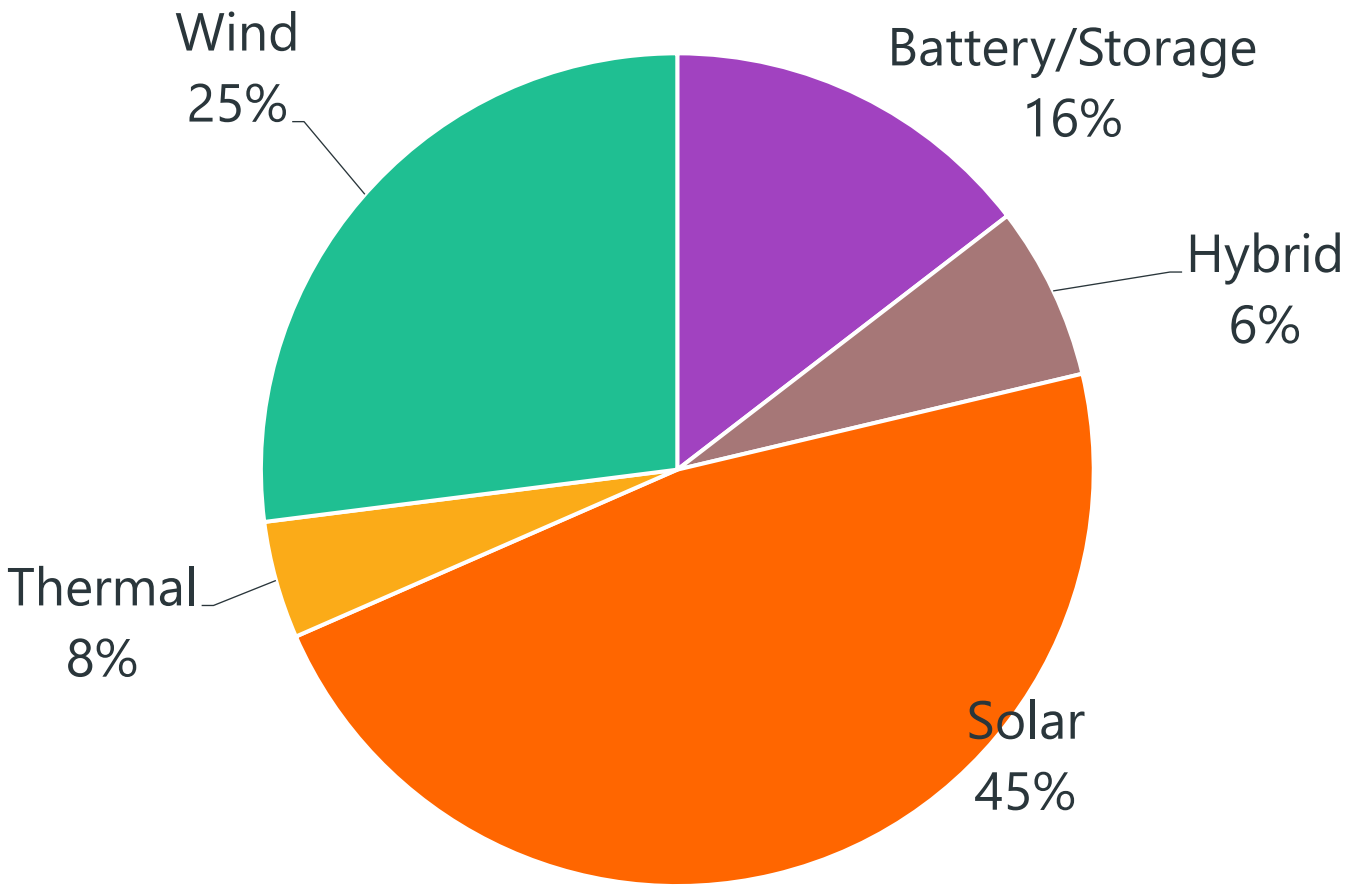
Progress towards eliminating the backlog

Active queue began with 651 Requests = 119.9 GW
As 9/28/22: 405 active requests = 77.9 GW



REQUESTS PENDING IN THE CURRENT GI QUEUE

GEN TYPE	Requests	GW Capacity
Battery / Storage	113	13.94 GW
Hybrid	30	6.44 GW
Solar	210	45.11 GW
Thermal	21	4.36 GW
Wind	113	25.84 GW
TOTAL	**487**	**95.69 GW**



Southwest Power Pool Generation Interconnection Queue Dashboard

The current generator interconnection active queue consists of 454 projects totaling 87.2 GW

North

Projects: 51
Size 9.39 GW

Nebraska

Projects: 92
Size 16.74 GW

Central

Projects: 144
Size 27.53 GW

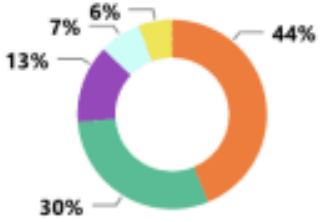
Southeast

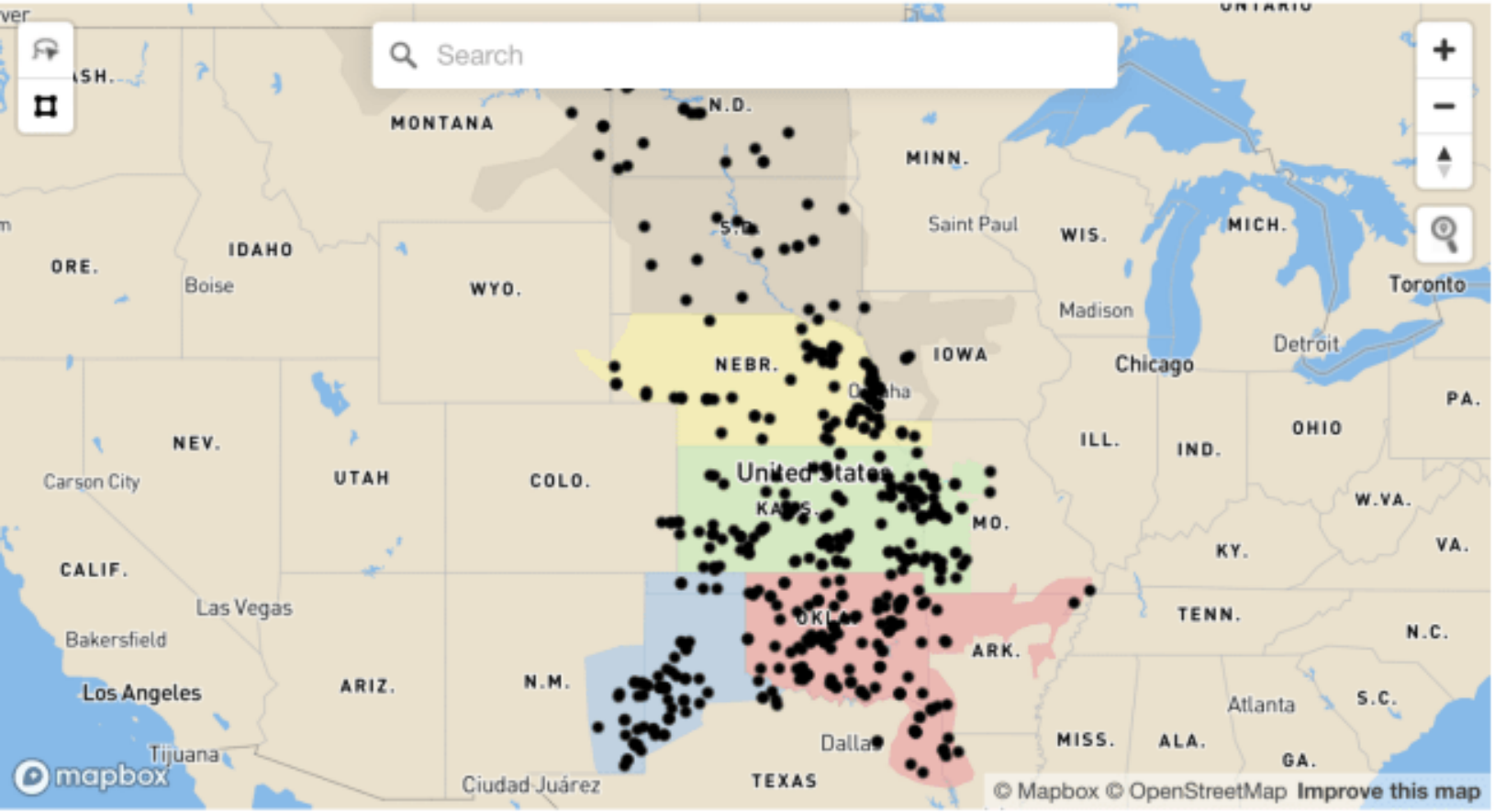
Projects: 115
Size 22.19 GW

Southwest

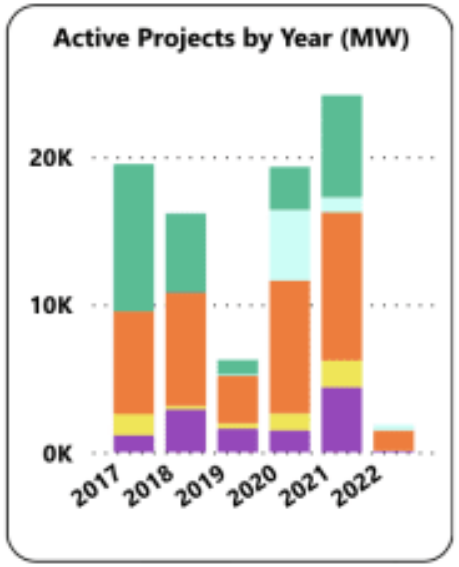
Projects: 52
Size 11.37 GW

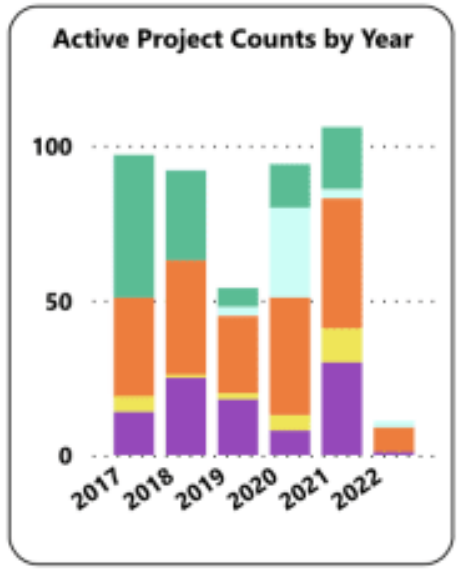
Total Queue





Generation Type Battery/Storage Hybrid Solar Thermal Wind



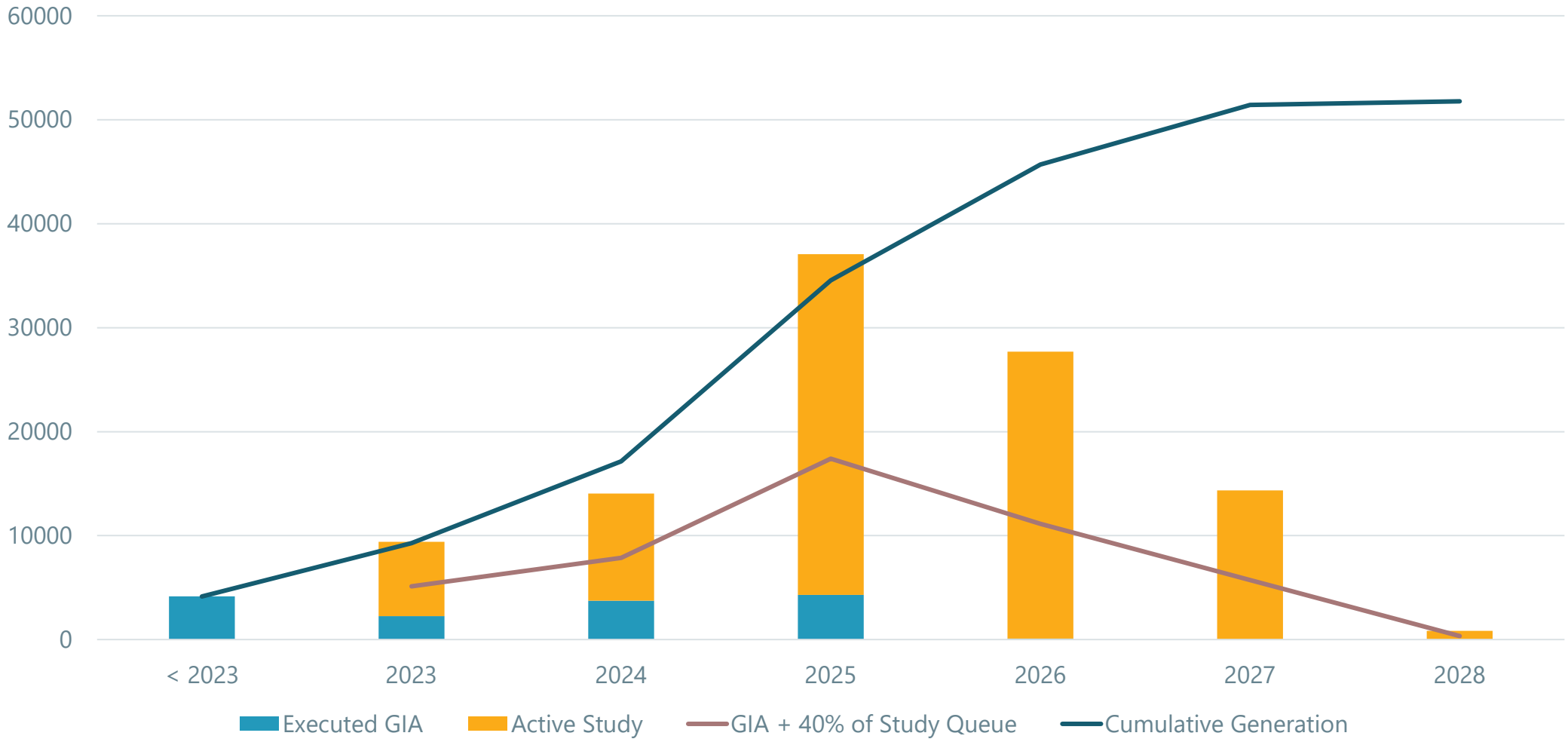


All

Cluster	MW	Projec
01 NORTH	**9,391.52**	**5**
Battery/Storage	931.90	
Hybrid	110.00	
Solar	2,466.00	1
Thermal	1,343.65	
Wind	4,539.97	2
02 NEBRASKA	**16,736.20**	**9**
Battery/Storage	1,475.64	1
Hybrid	845.00	
Solar	6,560.69	3
Thermal	3,571.32	2
Wind	4,283.55	1
03 CENTRAL	**27,530.68**	**14**
Battery/Storage	3,667.90	3
Hybrid	1,045.00	
Solar	13,492.80	6
Thermal	166.56	
Wind	9,158.42	4
04 SOUTHEAST	**22,188.65**	**11**
Battery/Storage	4,237.30	3
Hybrid	2,453.00	1
Solar	9,702.51	4
Thermal	109.00	
Wind	5,686.84	1
05 SOUTHWEST	**11,366.57**	**5**
Battery/Storage	1,310.00	1
Hybrid	540.00	
Solar	5,988.47	2
Thermal	1,059.00	
Total	**87,213.62**	**45**

Disclaimer: The data provided is for information purposes only and is subject to change without notification. Questions? Email: gistudies@spp.org.
Click HERE for SPP GI Web Site. Click HERE for Study Region Map

GENERATION EXPECTED TO COME ONLINE BY COMMERCIAL OPERATION DATE



SPP RESOURCE ADEQUACY OVERVIEW

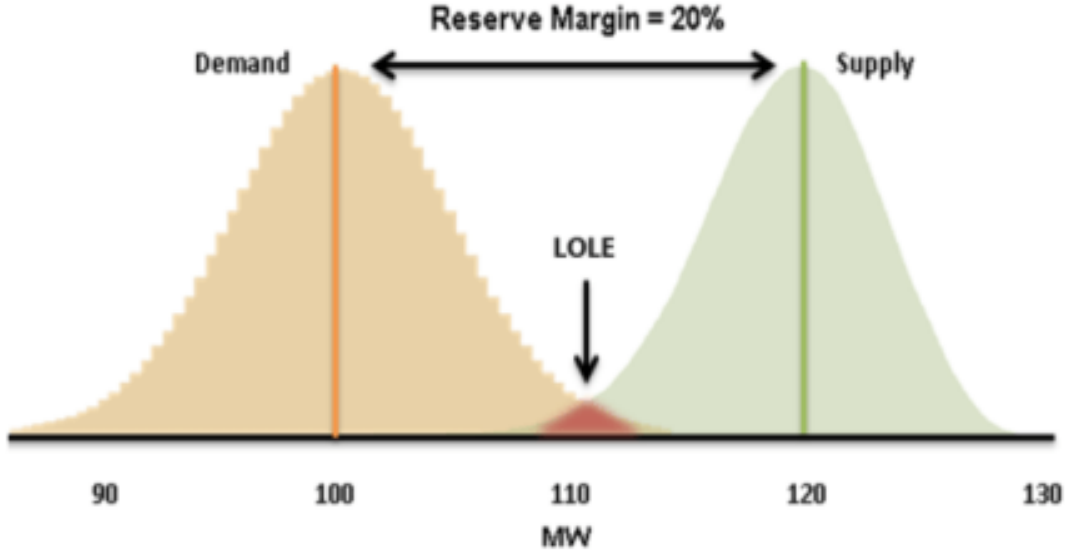
SPP'S RESOURCE ADEQUACY APPROACH

- Requirements imposed on load responsible entities
- Regional requirements for resource adequacy
- Bilateral capacity market
- Compliance measured through data submission and enforced by SPP tariff
- PRM requirement established through biennial Loss of Load Expectation (LOLE) analyses
- Forward looking 6 months to 5 years

Capacity
All team members' ability to play
Energy
Output of players on field
Reserve margin
Ability of bench members to play

LOSS OF LOAD EXPECTATION (LOLE)

- An LOLE Study is performed by SPP biennially (every two years) to assess the Planning Reserve Margin (PRM)
  - Probabilistic Study that analyzes the ability to reliably serve the SPP Balancing Authority Area's forecasted Peak Demand
    - SPP currently utilizes a 1 day in 10 years metric at assess minimum PRM
    - Evaluates each hour of the year using multiple sequential Monte-Carlo simulations
  - Inputs and assumptions are developed by SPP's stakeholder driven Supply Adequacy Working Group
  - Results give insight to SPP stakeholders and respective state commissions when making policy decisions related to resource adequacy



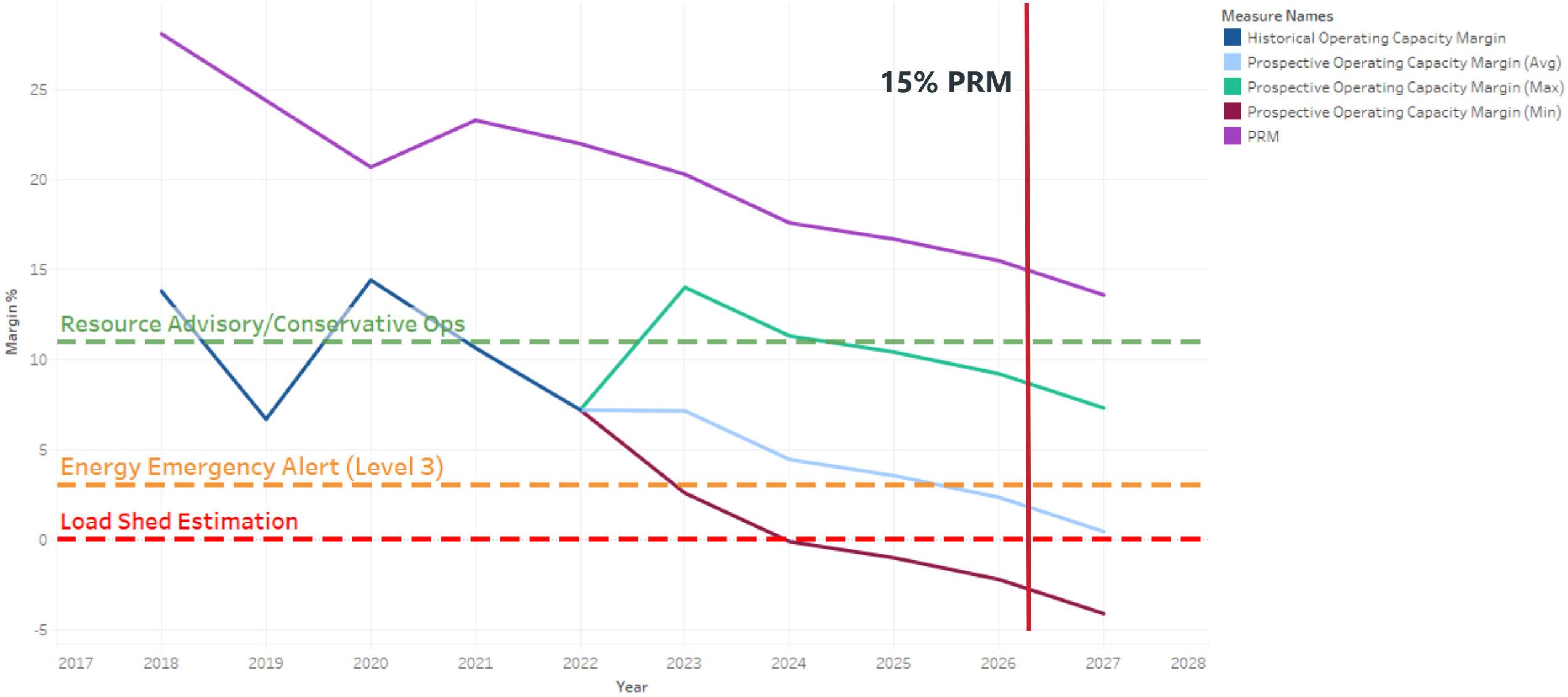
SPP'S PLANNING RESERVE MARGIN REQUIREMENT

Based on an LOLE probabilistic analysis:

- Planning Reserve Margin (PRM) is designed to measure the amount of generation capacity available to meet expected demand in planning horizon
  - SPP's current PRM requirement is 12%
    - Will be changed to 15% effective summer 2023
- The PRM requirement is allocated to each LRE based on their individual non-coincident summer peak load (NCP allocation)

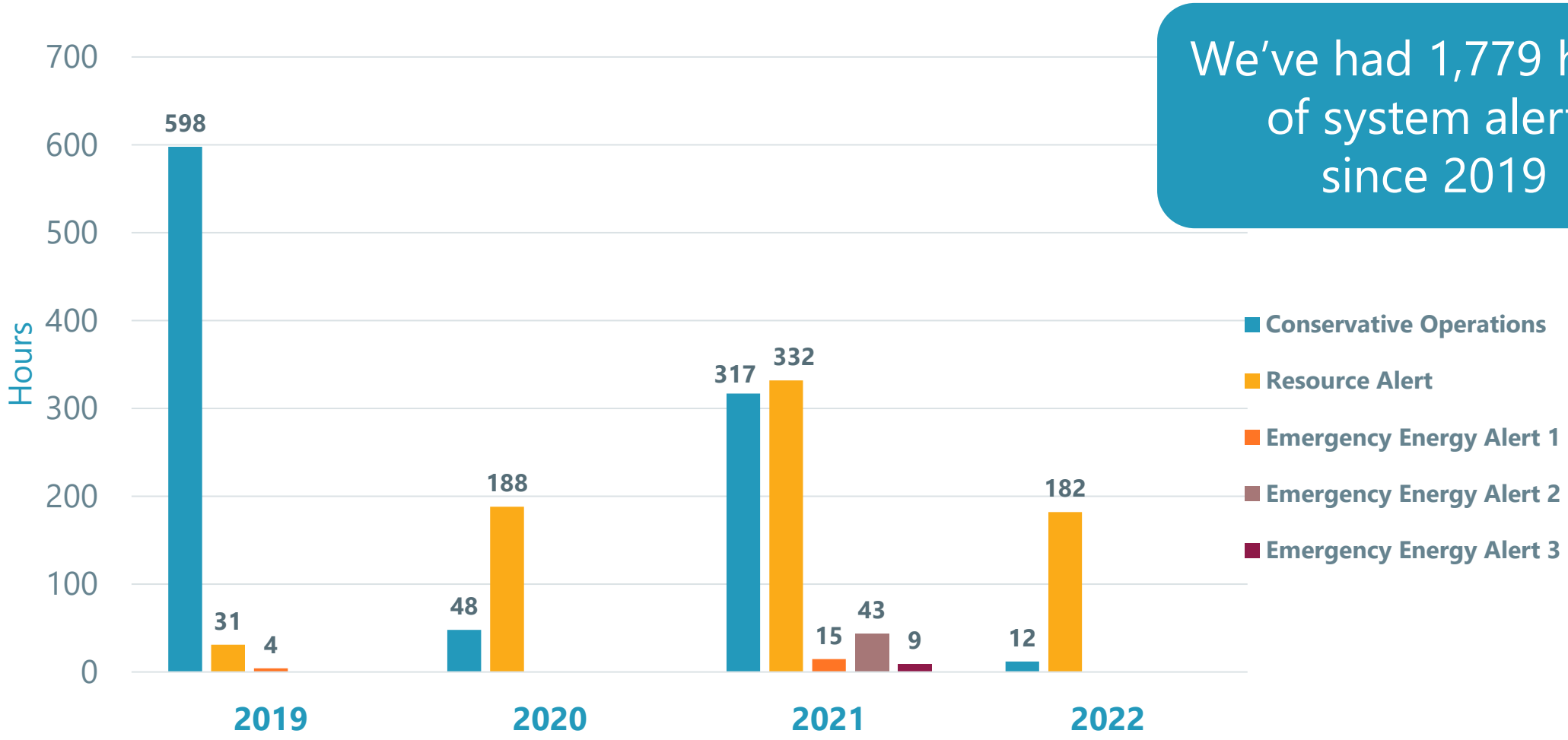
$$\textbf{\textit{Planning Reserve Margin}}\ \% = \frac{\textbf{\textit{Capacity} - \textbf{\textit{Demand}}}}{\textbf{\textit{Demand}}}\ x\ 100\%$$

PRM VS. OPERATING CAPACITY MARGIN



Operating Capacity Margin – Minimum value per year of total capacity MWs available minus load shown as a percentage of the load (Note the WWE has been excluded)

SYSTEM ALERT HOURS 2019-2022



We began using the category "Resource Alert" in late 19. Some 19 "Conservative Operations" would be categorized today as Resource Alerts.

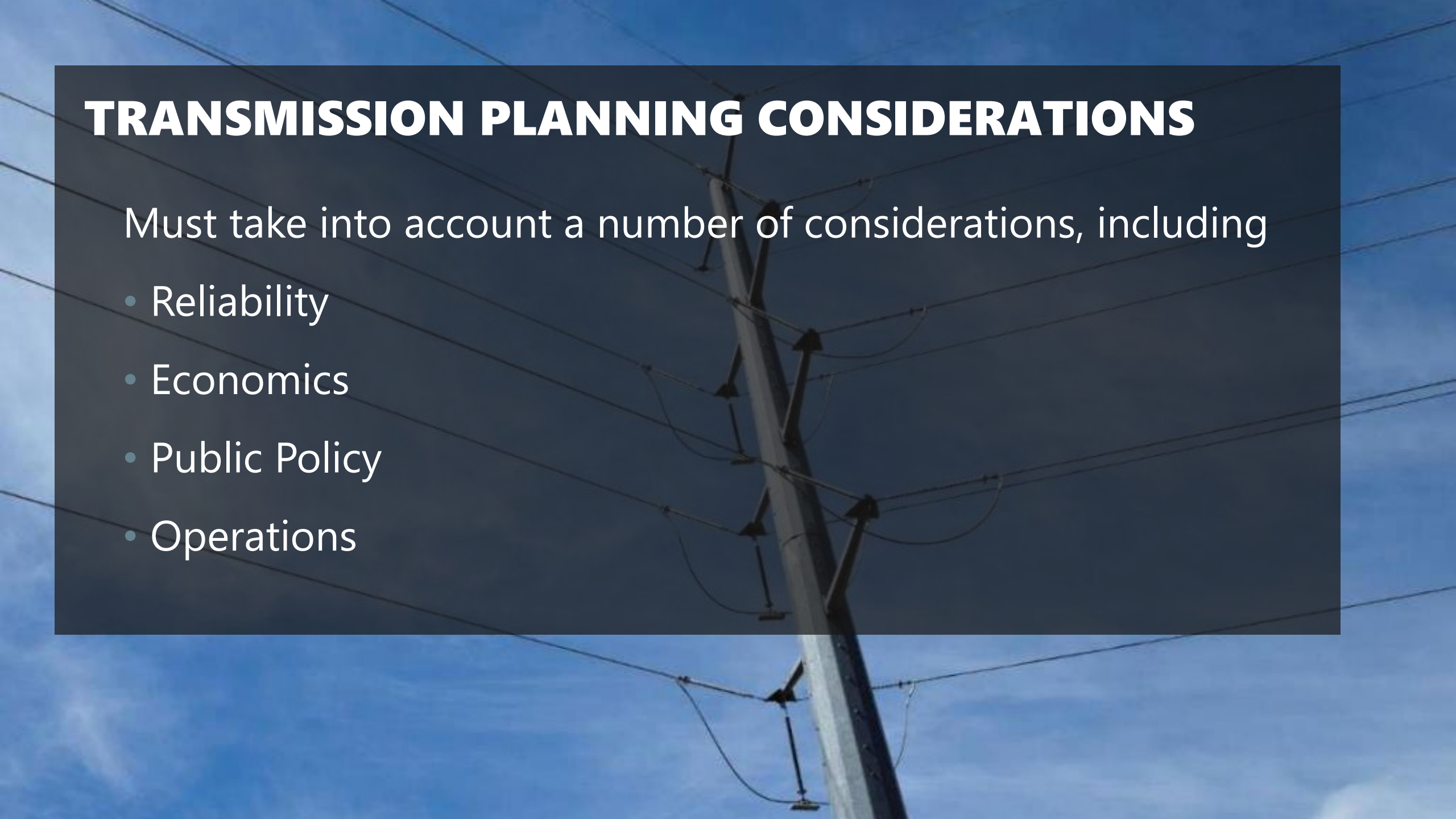
CURRENT PLANNING RESERVE MARGIN SUMMARY

The SPP BA Area Planning Reserve Margin determined from the 22 Summer Season submissions has decreased 1.2% from the 21 Summer Season where the Planning Reserve Margin was 23.2%

BENEFITS & VALUE OF INCREASED PRM

INCENTS	companies to keep their capacity in SPP
INCENTS	companies to build additional capacity
INCREASES	reliability
REDUCES	risks
REDUCES	costs associated with extreme events
IMPROVES	public's perception that SPP & stakeholders are working together to ensure reliability

TRANSMISSION PLANNING

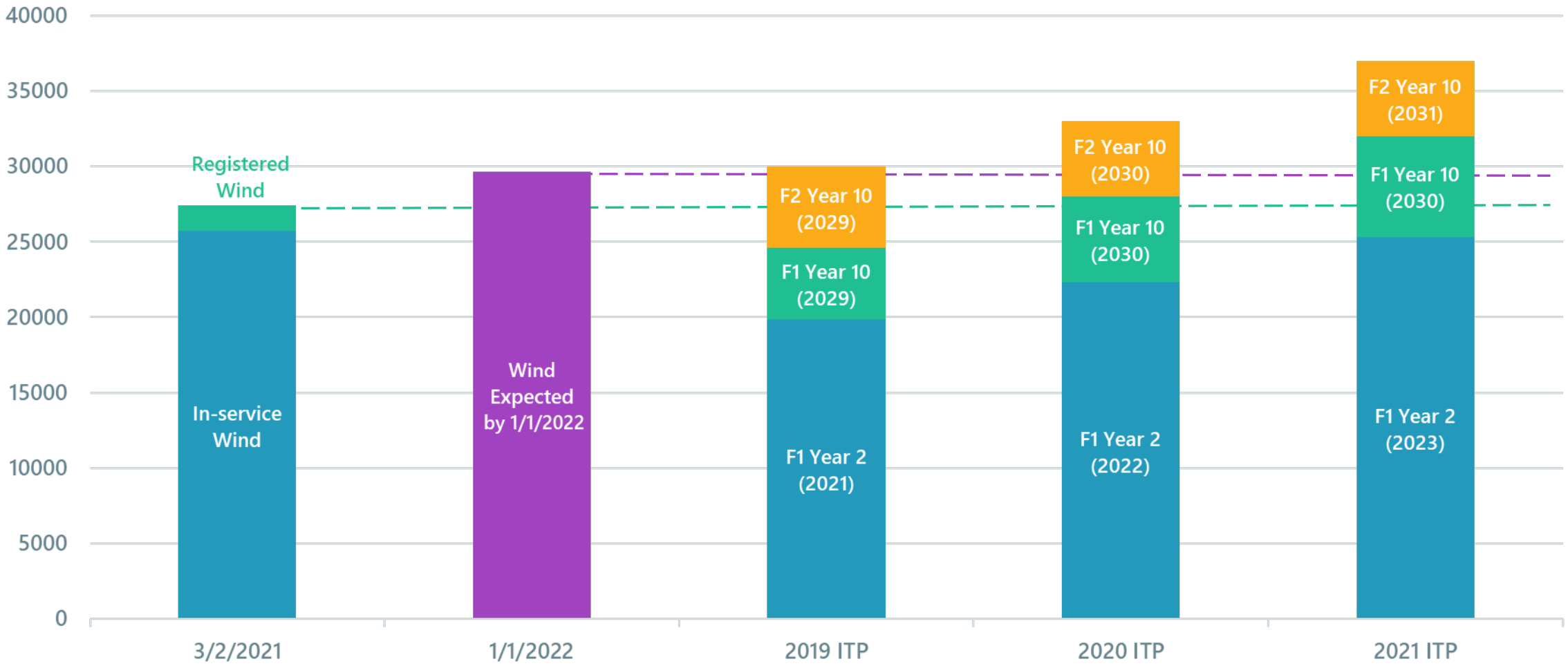


TRANSMISSION PLANNING CONSIDERATIONS

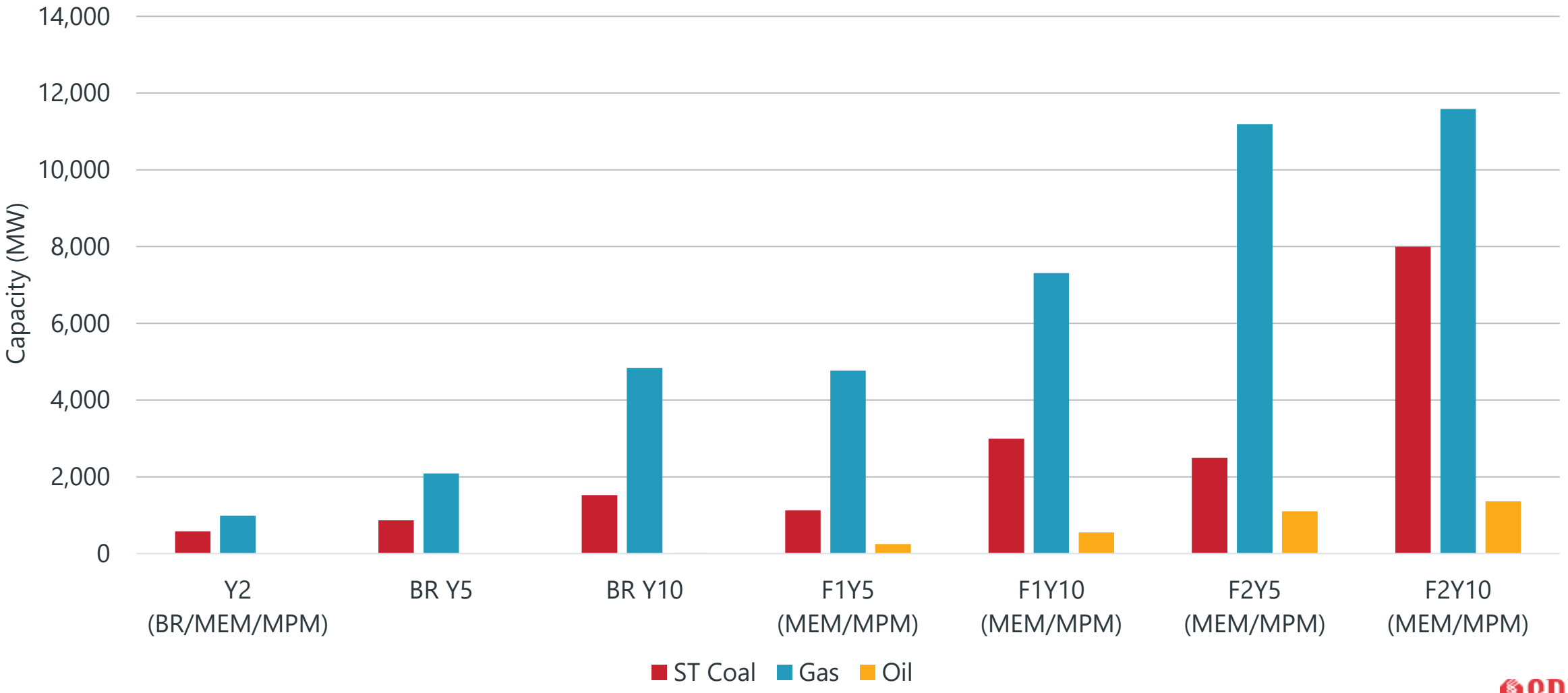
Must take into account a number of considerations, including

- Reliability
- Economics
- Public Policy
- Operations

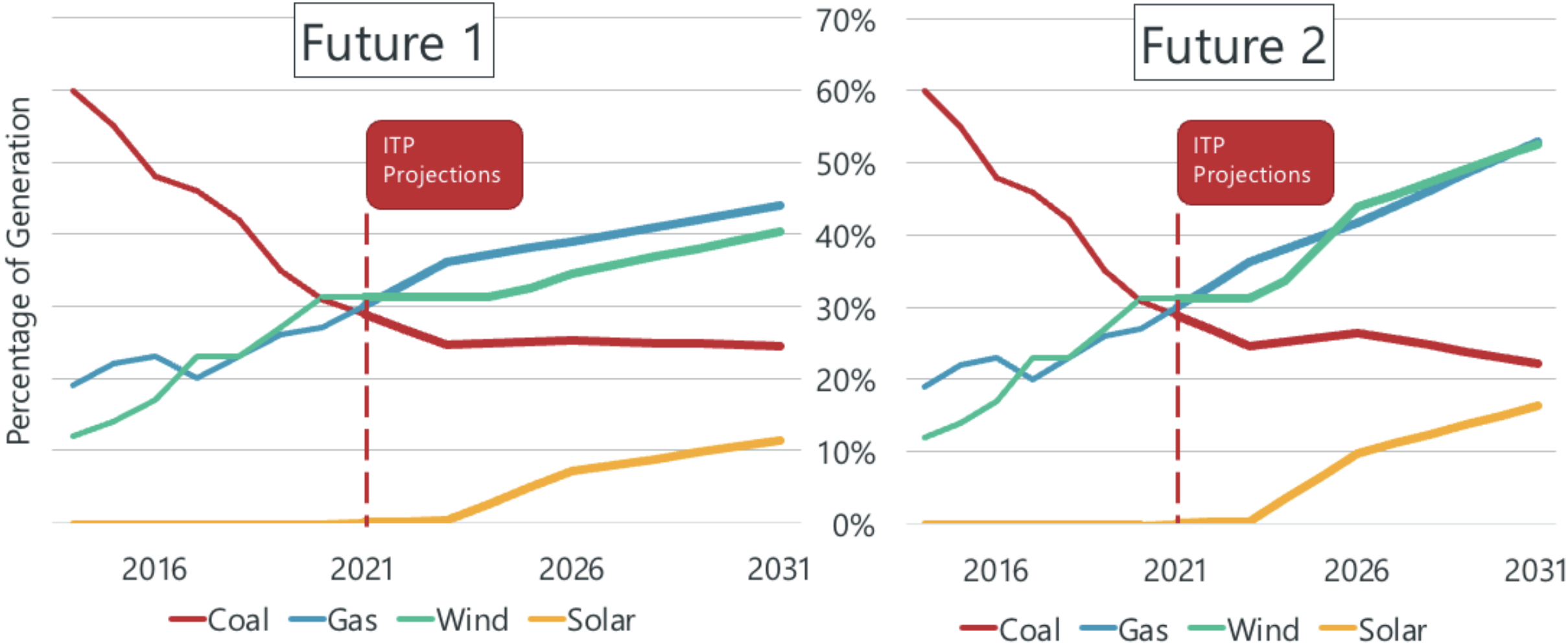
WIND GROWTH VS PLANNING ASSUMPTIONS



2021 ITP PROJECTED RETIREMENTS



EVOLVING GEN MIX AND ITP PROJECTIONS



FUTURES DEVELOPMENT

- Create and develop assumptions to test a wide range of potential future conditions
- SPP staff and stakeholders work together to determine assumptions that should be altered based upon the determined futures
- Example of assumptions include:
  - Renewable/storage amounts
  - Load and energy growth
  - Retirement assumptions
  - Gas prices
  - Public policy updates, i.e. carbon tax, PTC

2024 ITP FUTURES

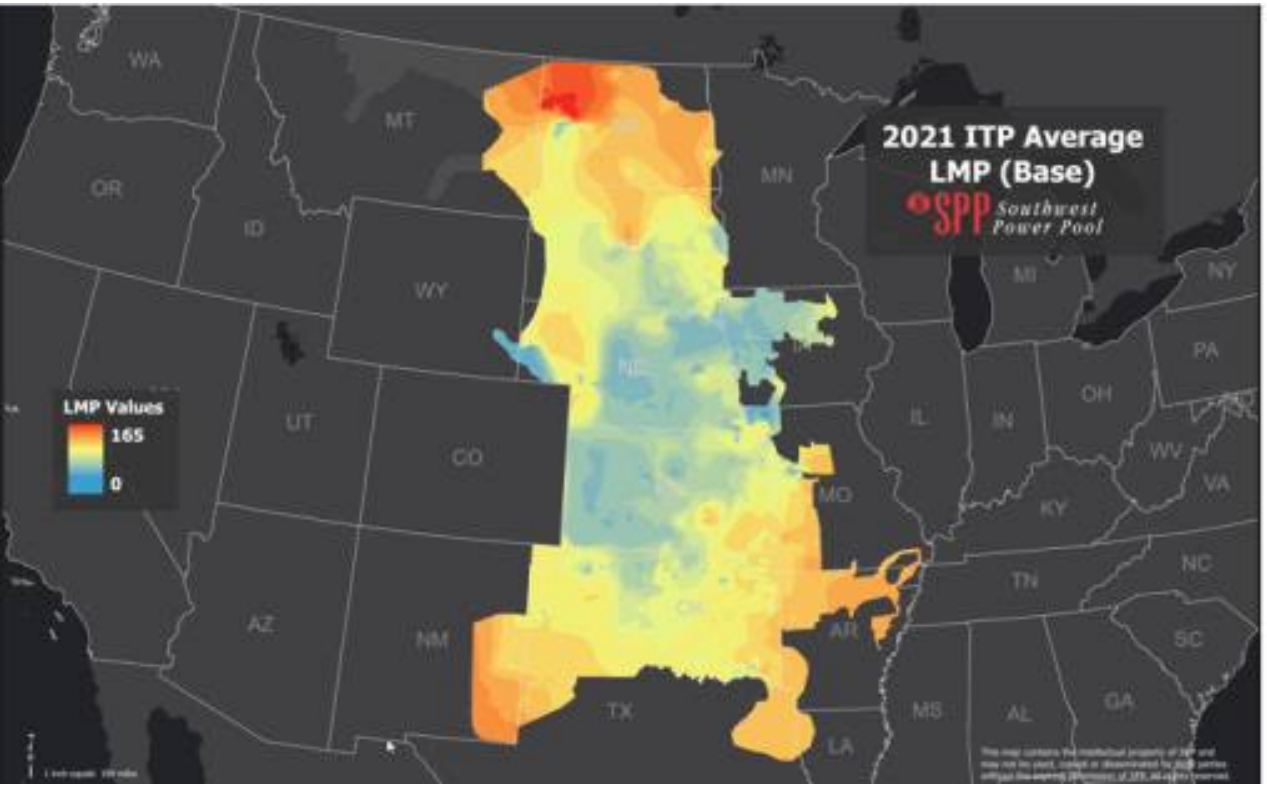
KEY ASSUMPTIONS	DRIVERS				
	Year 2	Future 1 – Reference Case		Future 2 – Emerging Technologies	
	2	5	10	5	10
Peak Demand Growth Rates	As submitted in load forecast	**Increase due to electric vehicle growth**		**Higher Increase due to electric vehicle growth**	
Energy Demand Growth Rates	As submitted in load forecast	**Increase due to electric vehicle growth**		**Higher Increase due to electric vehicle growth**	
Natural Gas Prices	Current industry forecast	Current industry forecast		Current industry forecast	
Coal Prices	Current industry forecast	Current industry forecast		Current industry forecast	
Emissions Prices	Current industry forecast	Current industry forecast		Current industry forecast	
Fossil Fuel Retirements	Current forecast	**based on IRP feedback; subject to generator owner (GO) review**		**based on IRP feedback; subject to generator owner (GO) review**	
Environmental Regulations	Current regulations	Current regulations		Current regulations	
Demand Response	As submitted in load forecast	As submitted in load forecast		As submitted in load forecast	
Distributed Generation (Solar)	As submitted in load forecast	As submitted in load forecast		As submitted in load forecast	
Energy Efficiency	As submitted in load forecast	As submitted in load forecast		As submitted in load forecast	
Storage	Existing + RARs	**30% of projected solar (2.1. GW / 4.2 GW)**		**40% of projected solar (4.4 GW / 8.8 GW)**	
Total Renewable Capacity					
Solar (GW)	Existing + RARs	**7.1**	**14**	**11**	**22**
Wind (GW)	Existing + RARs	**43.8**	**49.9**	**48.2**	**54.9**

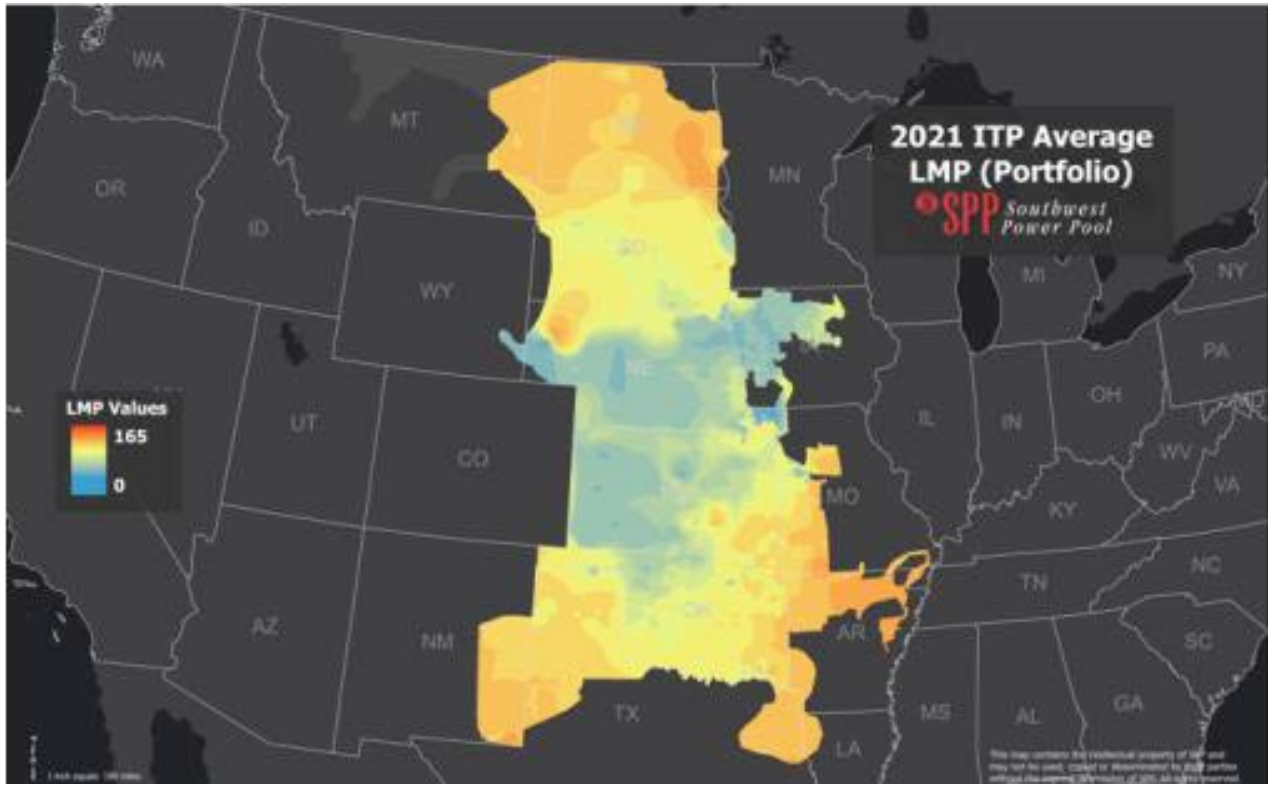
MOPC APPROVED 20-YEAR – FUTURES

	Drivers			
	Future 1 (F1)	Future 2 (F2)	Future 3 (F3)	Future 4 (F4)
Key Assumptions	2022 ITP Reference Case	2022 ITP Emerging Technologies	Accelerated Decarbonization (New administration and aggressive energy/ environmental policy change)	Based on SPP F3 with hurdle rate of zero between MISO and SPP
Year	20	20	20	20
Peak Demand Growth Rates	As submitted in load forecast	As submitted in load forecast	Moderate increase due to switching to electric home heating and increased electric transportation, potential shift to a winter peaking SPP	Moderate increase due to switching to electric home heating and increased electric transportation, potential shift to a winter peaking SPP
Energy Demand Growth Rates	As submitted in load forecast	Increase due to electrification growth	Higher demand due to electrification compared to F2 due to aggressive policy	Higher demand due to electrification compared to F2 due to aggressive policy
Natural Gas Prices	Current industry forecast	Current industry forecast	Increase prices incluenced by emissions pricing policy	Increase prices incluenced by emissions pricing policy
Coal Prices	Current industry forecast	Current industry forecast	Increase prices influenced by emissions pricing policy	Increase prices influenced by emissions pricing policy
Emissions Prices	Current industry forecast	Current industry forecast	Emission prices based on new policy	Emission prices based on new policy
Fossil Fuel Retirements	Coal age-based 56+, Gas/Oil age-based 50+, subject to generator owner (GO) review	Coal age-based 52+, Gas/Oil age-based 48+, subject to GO review and ESWG approval	All Coal and Oil retired. More Gas retirements, driven by higher emission reduction levels relative to F2 driven by new policy	All Coal and Oil retired. More Gas retirements, driven by higher emission reduction levels relative to F2 driven by new policy
Environmental Regulations	Current regulations	Current regulations	Federal Policy, mandated carbon cuts, carbon tax	Federal Policy, mandated carbon cuts, carbon tax
Demand Response[1]	As submitted in load forecast	As submitted in load forecast	Increase from F2	Increase from F2
Distributed Generation (Solar)	As submitted in load forecast	900MW	Increase from F2 due to policy shift and significant incentives to behind-the-meter installation	Increase from F2 due to policy shift and significant incentives to behind-the-meter installation
Energy Efficiency	As submitted in load forecast	As submitted in load forecast	Increase in F2	Increase in F2
Storage	20% of projected solar	35% of projected solar	Increase from F2	Increase from F2
Total Renewable Capacity				
Solar (GW)	19	27	48	48
Wind (GW)	41	50	65	65
Additional Assumptions				
Emissions Reduction Target	N/A	N/A	93% to 95% Emissions Reductions Target in 2042 from 2017 Levels	93% to 95% Emissions Reductions Target in 2042 from 2017 Levels
Hurdle Rate	N/A	N/A	N/A	SPP-MISO and MISO-SPP Hurdle Rate set to $0

[1] As defined in the MDWG Model Development Procedure Manual: MDWG Manual

2021 ITP PORTFOLIO BEFORE/AFTER





SPP'S CREATIVE RE-ENGINEERING OF INTEGRATED PLANNING TEAM (SCRIPT)

ORIGINS OF CPPTF

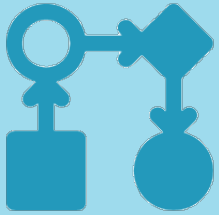
- CPPTF originated from SPP's Strategic and Creative Re-Engineering of Integrated Planning Team (SCRIPT) effort in 2020 and 2021
  - SCRIPT team made up of Board members, SPP staff and stakeholders
  - Tasked with development of changes to SPP's planning process and addresses changes in the industry
- Planning challenges in SPP such as a large generation queue, planning assumption uncertainty and cost allocation drove the need to identify a process changes
- CPPTF formed by SPP Board of Directors in October 2021

WHAT IS IN THE SCRIPT RECOMMENDATIONS?

Reduce Queues & Improve Services

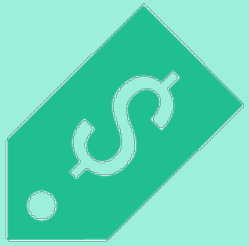
SPP will mitigate the GI backlog and implement process improvements for GI, long-term transmission service and Attachment AQ

Streamlined & Optimized Planning



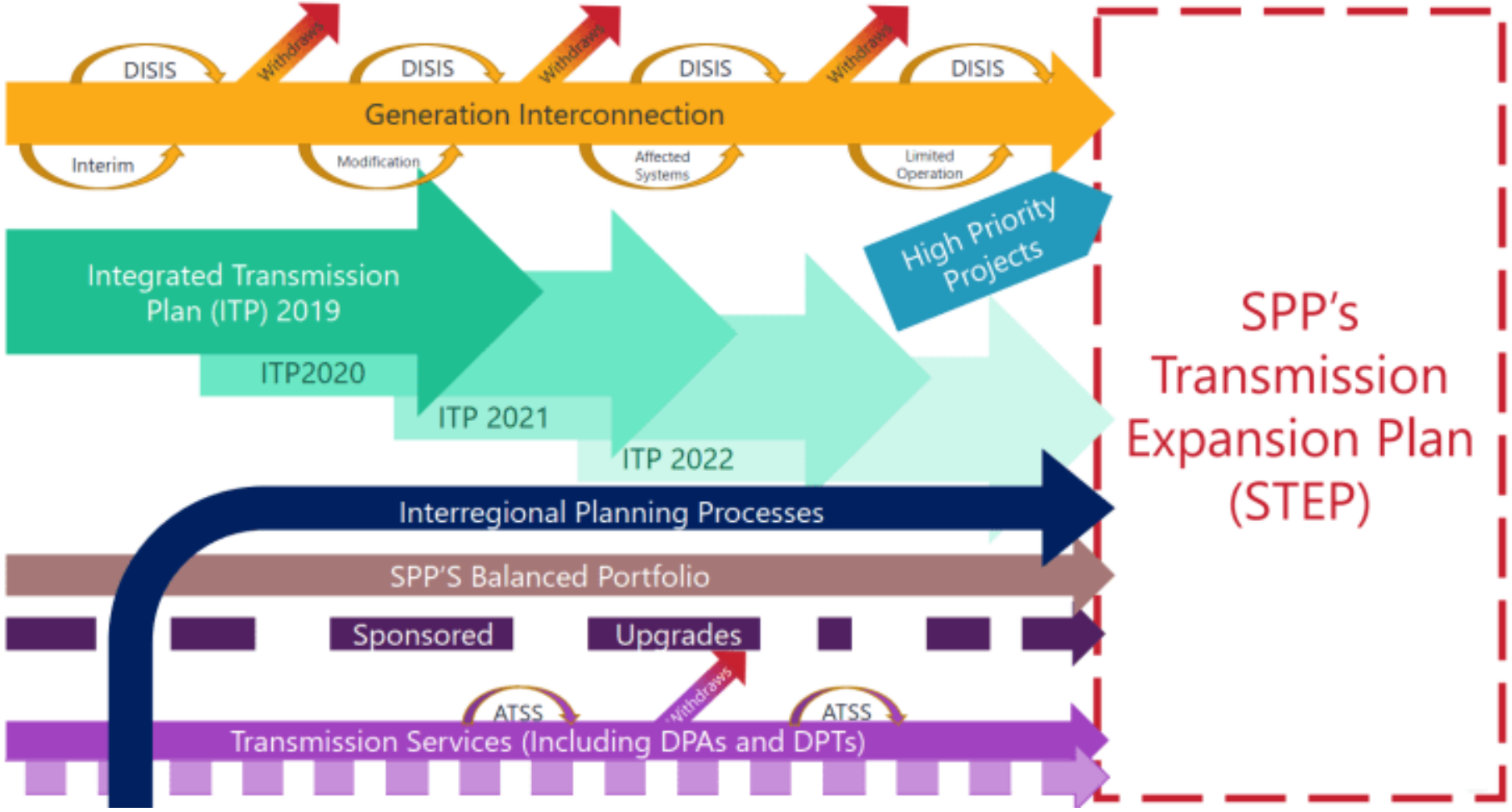
Planning will be more timely, require fewer resources & find more holistic, optimized solutions with a simplified base model.

Improved Cost-Sharing

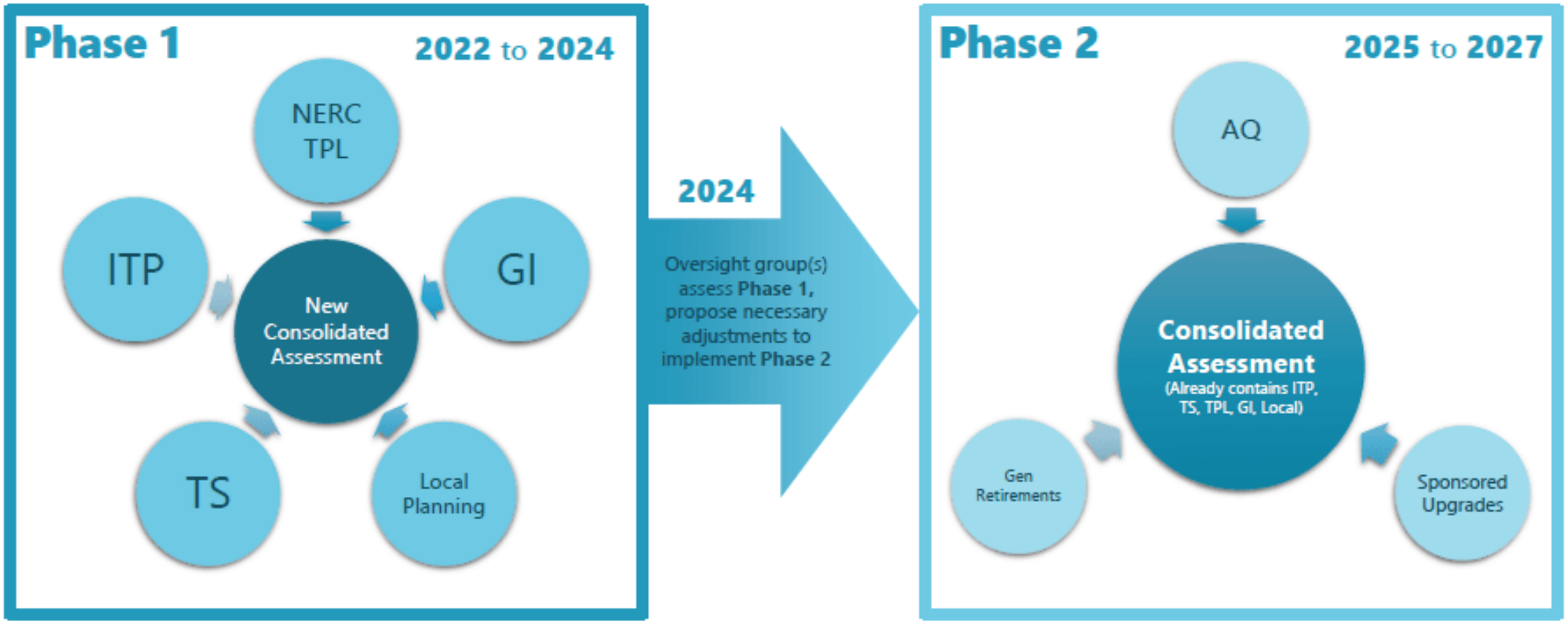


It will provide greater cost-certainty and create new funding structures for upgrades that meet multiple needs or require joint funding.

CURRENT SPP PLANNING PROCESS FLOWS



CONSOLIDATED PROCESS IMPLEMENTATION



Phase 1 Goals: Design complete by Q3 2023
Implementation complete by Q3 2024

Phase 2 Goal: Implemented by third cycle of consolidated assessment

BENEFITS EXPECTED

- Timely and Accurate Planning Studies
- Consistency in process through use of automation and other technology improvements
- On-going and evolving process identifying benefits to SPP system in close to real-time
- Cost savings for SPP customers

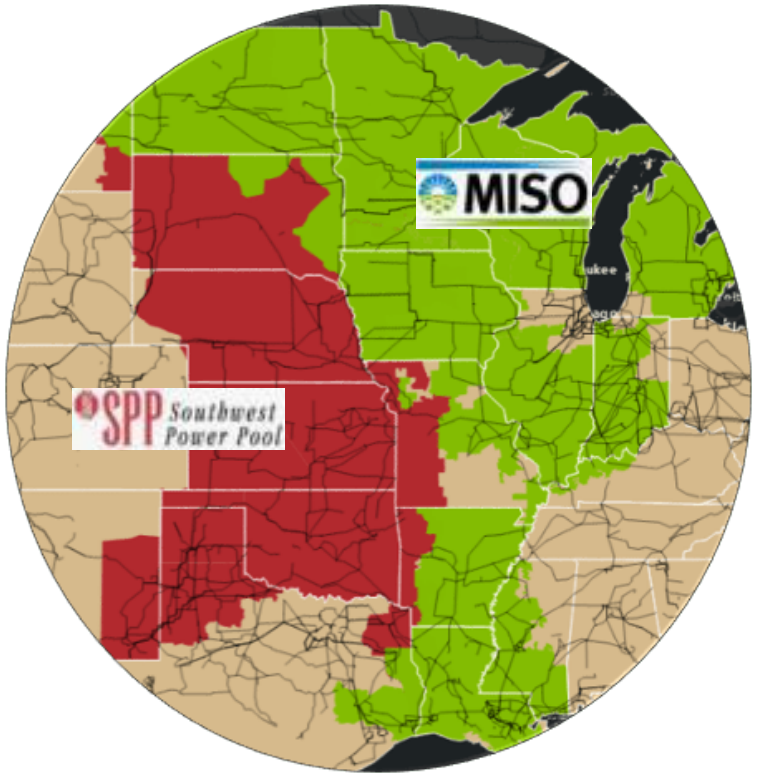
SPP-MISO JOINT TARGETED INTERCONNECTION QUEUE ("JTIQ") EDUCATION

KEY TAKEAWAYS

- The SPP-MISO Joint Targeted Interconnection Queue **("JTIQ") Study** was published in March 2022. The JTIQ Study:
  - targeted constraints that are significant barriers to interconnecting new generation near the seam and that are contributing to clogged interconnection queues
  - identified a group of transmission projects to optimize the transmission needed to enable interconnection of low-cost resources along the seams that benefit the MISO and SPP regions
- Although the primary goal is to unlock queues and facilitate interconnection, the JTIQ transmission also provides **benefit to load in each RTO**, which supports **novel cost sharing** between generation and load
- **Cost allocation** for SPP's regional load share is an open question
- Initial JTIQ study potentially serves as a model for **transformational improvement** to GI Affected System Study processes

SPP-MISO JTIQ STUDY FOCUS

JTIQ concentrated on optimizing transmission for interconnection along the SPP-MISO seam and unlocking clogged interconnection queues



- SPP and MISO are experiencing similar resource mix shifts with significant queue sizes
- The transmission system is at capacity along the SPP-MISO seam
- Upgrades are too costly for small groups of interconnection customers, contributing to churn in the queue which leads to delays
- The study accomplishes what Affected System Studies were meant to achieve and is consistent with the principles envisioned in SCRIPT CPP and recent FERC NOPRs

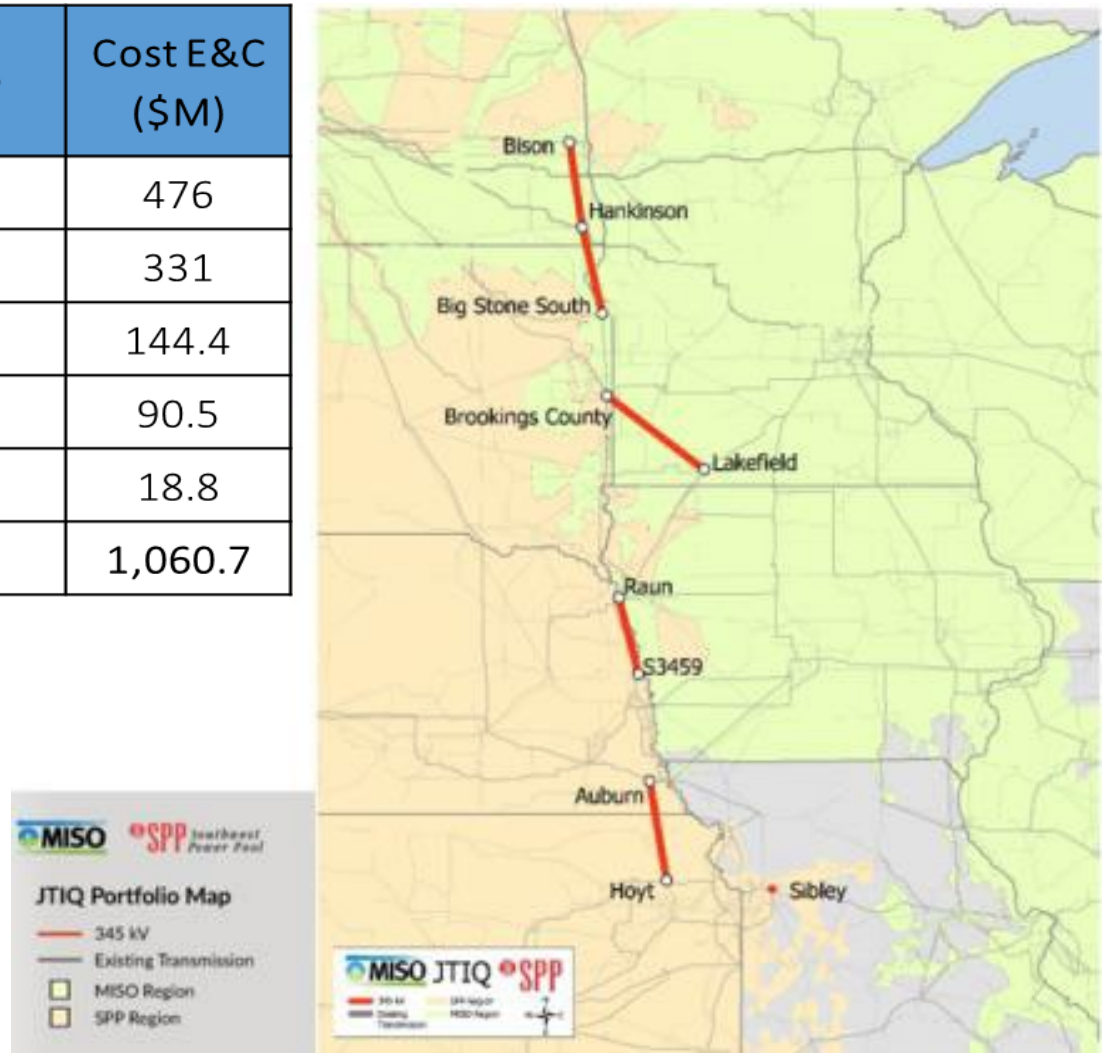
KEY JTIQ STUDY ASSUMPTIONS

- SPP and MISO leveraged models and assumptions from regional planning futures
  - SPP's 2021 ITP Future 2
  - MISO's MTEP 2021 Future 1
- Powerflow analysis was conducted consistent with each RTO's GI study process
- Economic production cost analysis was conducted consistent with each RTO's regional planning methodologies

JTIQ PORTFOLIO COSTS & BENEFITS

JTIQ Portfolio	Location by RTO	Cost E&C ($M)
Bison – Hankinson – Big Stone South 345 kV	MISO	476
Brookings Co – Lakefield 345 kV	MISO	331
Raun – S3452 345 kV	MISO - SPP	144.4
Auburn – Hoyt 345 kV	SPP	90.5
Sibley 345 Bus Reconfiguration	SPP	18.8
Total Cost of Portfolio of Projects	MISO - SPP	1,060.7

10-year Adjusted Production Cost (APC) Benefits		
MISO	SPP	Total
$55.7	$132.9	$188.6
		0.16 **B/C**[1]

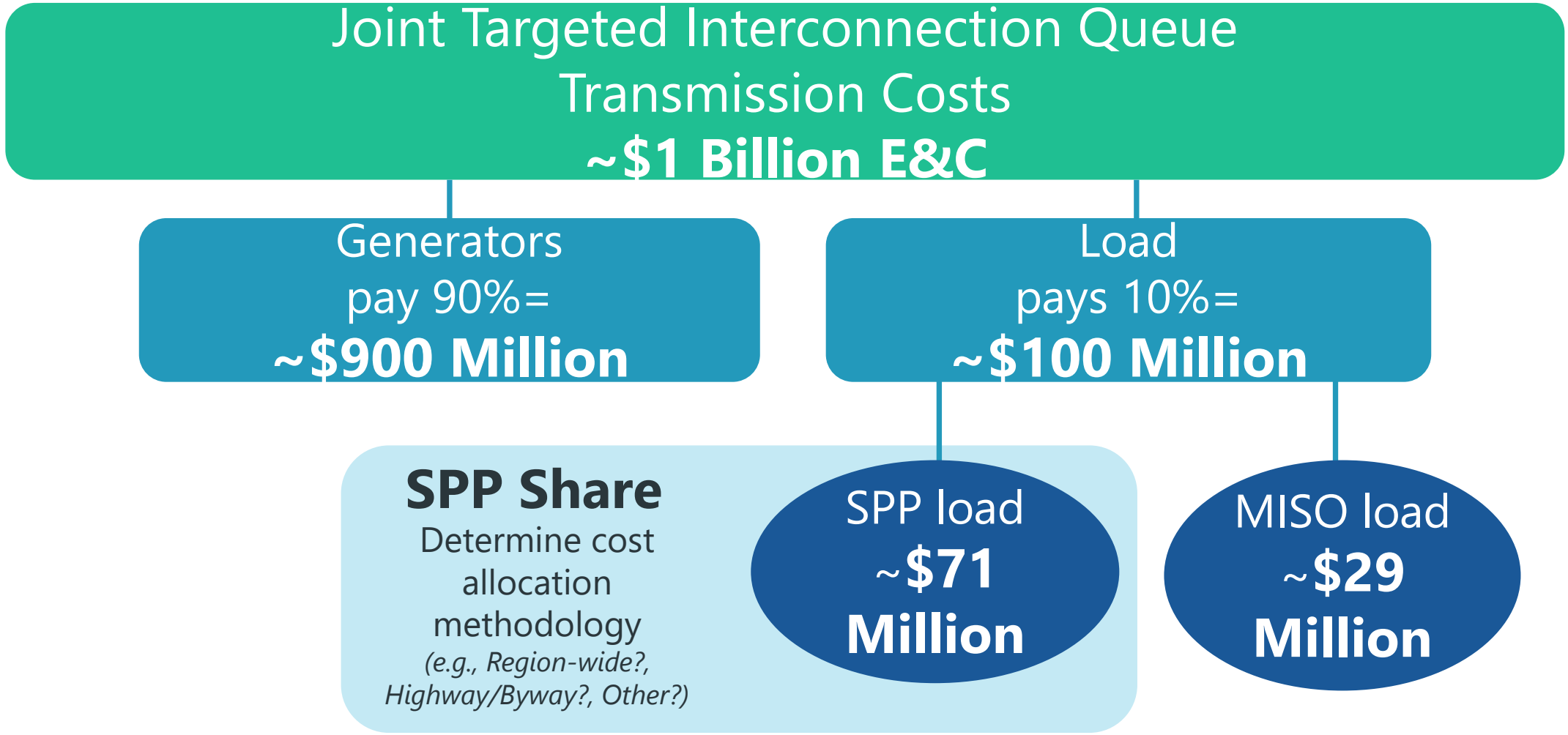


JTIQ Portfolio provides **other benefits** in addition to APC:

- Improves **reliability** and mitigates existing constraints
- Increases interregional **transfer capability**

1. This B/C ratio = (10-year PV APC Benefits) / (10-year PV Est. ATRR). The ATRR rough estimate is not tied to specific TOs' formula rates.

JTIQ PORTFOLIO POTENTIAL COST SHARING[1]

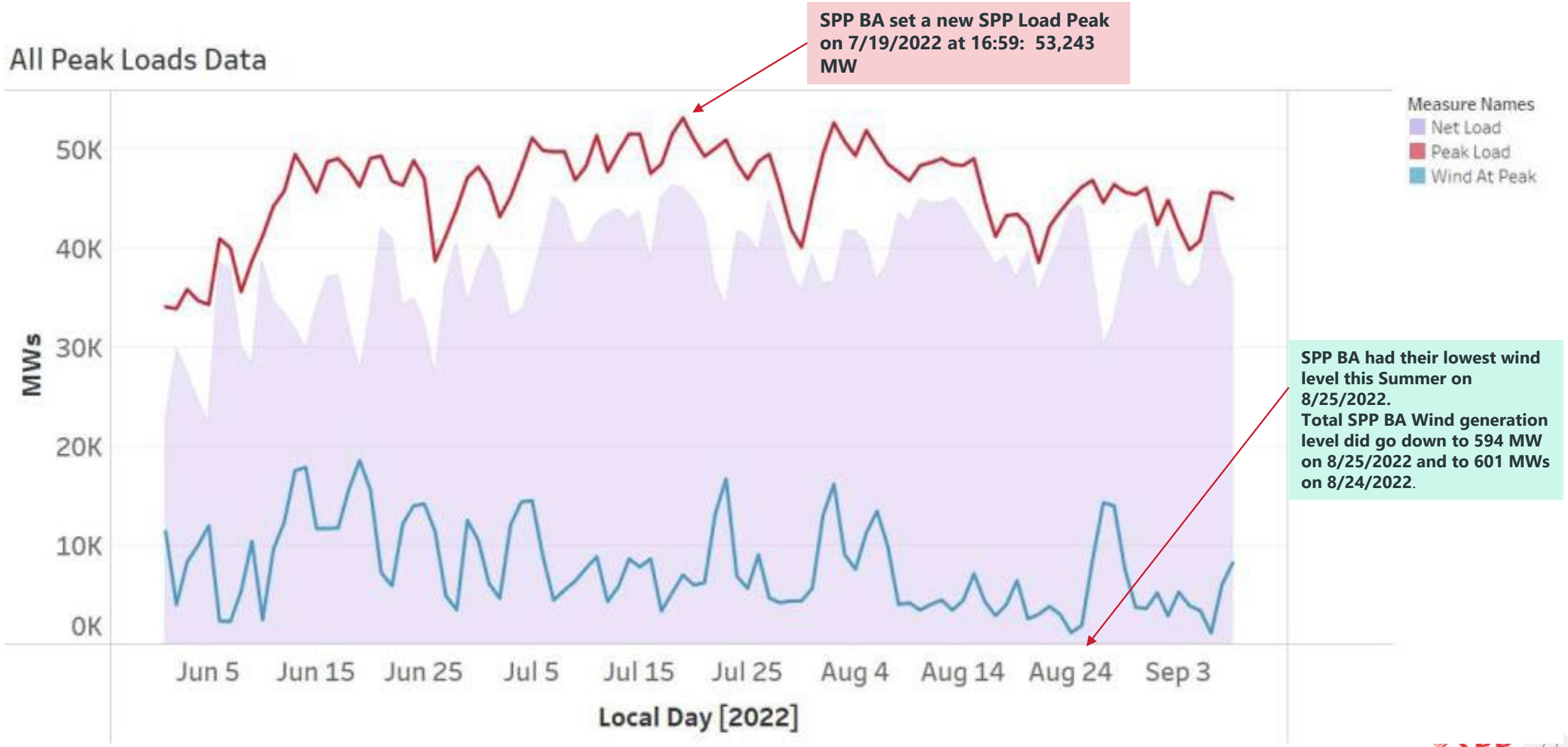


1. All cost figures are illustrative and based on potential cost sharing methodologies and project costs and benefits that have yet to be finalized.

SPP OPERATIONS SUMMER 2022

SPP OPERATIONS

DATA AT PEAK OF DAY (BA LOAD – WIND – NET LOAD)



SPP BA LOAD, WIND, MEC ON PEAK LOAD DAY JULY 19TH