Long-Term Reliability Assessment Webinar

Thursday, January 26, 2023 | 10:00 a.m. to 12:00 p.m. Central

Via Webex

MIDWEST RELIABILITY ORGANIZATION

380 St. Peter St, Suite 800
Saint Paul, MN 55102
651-855-1760
www.MRO.net

LOGISTICS

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Audio
Participants will be muted upon entry and will not be able to unmute themselves to speak.

Questions
If you have questions for a speaker, please utilize Webex's chat feature. Please submit all questions to "MRO Host". If we are unable to get all questions asked/answered during the conference, a response will be provided after the workshop either directly to the requestor or through another form of outreach.

Presentations
All presentations from today's workshop are available in this packet. The individual presentations and recordings from today's workshop will be made available in the near future.

Feedback
Your feedback is very important to us. Please utilize the survey link to provide your feedback.

AGENDA

Thursday, January 26, 2023 | 10:00 a.m. to 12:00 p.m. Central

10:00 a.m. – 10:10 a.m.	**Introduction and Welcome** *Moderator: Jeremy Severson, Manager Transmission Services, Basin Electric Power Cooperative*
10:10 a.m. – 10:35 a.m.	*Kelly Hunter, Manitoba Hydro*
10:35 a.m. – 11:00 a.m.	*Chris Haley, Southwest Power Pool*
11:00 a.m. – 11:25 a.m.	*Nick Przybilla, Midcontinent Independent System Operator*
11:25 a.m. – 11:50 a.m.	*Joseph Veitenheimer, Saskatchewan Power Corporation*
11:50 a.m. – 12:00 p.m.	**Wrap up/Questions/Feedback/Adjourn** *Moderator: Jeremy Severson, Manager Transmission Services, Basin Electric Power Cooperative*

SPEAKER BIOGRAPHIES

Chris Haley

Supervisor, Resource Adequacy Policy, Southwest Power Pool

Chris Haley is currently the Supervisor, Resource Adequacy Policy, which consists of engineers and technical professionals that administer SPP's Resource Adequacy responsibilities for the SPP RTO and contract responsibilities in the Western Interconnection. Chris has been with SPP since 2006 and has more recently been focused on NERC and Tariff responsibilities regarding Resource Adequacy. Chris is still considered a subject matter expert for Resource Adequacy policy issues. He is the SPP group sponsor for the Supply Adequacy Working Group (SAWG) and is a member of the NERC Reliability Assessment Subcommittee.

Jeremy Severson

Manager Transmission Services, Basin Electric Power Cooperative

Jeremy Severson joined Basin Electric in 2003 and is currently the Manager of Transmission Services at Basin Electric Power Cooperative. He received a bachelors' degree in Electrical Engineering from North Dakota State University and is an active member and past chairman of the Missouri Slope Section of IEEE. Severson's electric utility experience includes participating, leading, and reviewing various transmission studies associated with long-term and short-term planning, operations, compliance, protection, construction, and regulatory aspects of the utility industry.

Mr. Severson has served or participated on several technical groups and committees including those from SPP, MISO, MRO, NATF, NERC, WECC, and the former MAPP entity.

Joseph Veitenheimer

Senior Engineer, Interconnections, Saskatchewan Power Corporation

Joseph Veitenheimer works as a Senior Engineer in SaskPower's System Planning and Asset Management department, and he has been with SaskPower for five years. His work at SaskPower focuses on Transmission System Planning, Generation Interconnections and Interconnections with adjacent areas. Veitenheimer's work also includes reliability assessments for several NERC reliability standards (TPL, PRC, CIP and MOD) that were adopted in Saskatchewan.

Mr. Veitenheimer received his M.Sc. in Electrical Engineering from the University of Saskatchewan, and he is a registered Professional Engineer in Saskatchewan.

Kelly Hunter

Senior Engineer, Manitoba Hydro

Kelly Hunter is a senior engineer with responsibilities for market and resource adequacy analysis with Manitoba Hydro's Resource Planning Department. Kelly has been with Manitoba Hydro over 30 years. The first decade of his career was spent in the mechanical design and construction areas working on the rehabilitation of hydro generation equipment and auxiliary systems. The second decade of his career was spent in Manitoba Hydro's Export Power Marketing Department, with responsibilities that included regulatory affairs, market modeling, risk analysis, credit oversight, wind integration studies and MISO market stakeholder relations. For the last 10 years, his responsibilities in Resource Planning have included long-term price forecasting, market, reliability and risk modeling, provincial regulatory affairs, and overseeing Manitoba Hydro's submissions for NERC's Long-Term Reliability Assessment.

Mr. Hunter graduated from the University of Manitoba with a Bachelor of Science in Mechanical Engineering in 1987. He later received his Master of Business Administration, also from the University of Manitoba, in 1995.

Nick Przybilla

Resource Adequacy Operations Engineer, Midcontinent Independent System Operator (MISO)

Nick Przybilla has been at MISO for more than five years after previously working as a student intern. He works on the Resource Adequacy team facilitating and administering MISO's Planning Resource Auction, performing engineering studies related to the Loss of Load Expectation studies and conducting the OMS-MISO Survey which provides an out-year look at our Resource Adequacy. He previously worked in Economic Studies on the team that built MISO's production cost models utilizing PROMOD and PLEXOS. He also performed transmission studies and evaluated long term plans in the MISO Transmission Expansion Plan.

Nick earned a B.S in Electrical Engineering from the University of Minnesota and is currently studying for a Master of Business Administration at the University of Minnesota Carlson School of Management.

MRO DISCLAIMER

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PRESENTATIONS

All presentations for today's workshop are included in order of presentation.

MIDWEST RELIABILITY ORGANIZATION

MRO Reliability Advisory Council (RAC) Webinar

2022 Long-Term Reliability Assessment Overview

January 26, 2023

2022 Long-Term Reliability Assessment Overview

Jeremy Severson, Manager Transmission Services, Basin Electric Power Cooperative and MRO RAC Member

Kelly Hunter, Manitoba Hydro

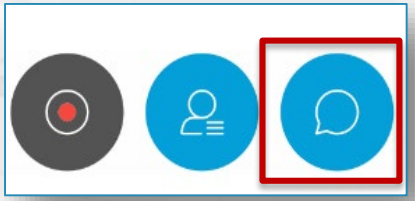
Chris Haley, Southwest Power Pool

Joseph Veitenheimer, Saskatchewan Power Corporation

Nick Przybilla, Midcontinent Independent System Operator

WebEx Chat Feature

Open the Chat Feature:



The chat feature will appear to the right of the WebEx window.

Attendees should chat their questions to: “Panelists”.

Select Panelists by using the drop down arrow in the “To” field.

Disclaimer Slide

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MRO Reliability Advisory Council (RAC)

- **Serves as subject matter experts in Bulk Power System operations and planning for the Region**
  - Reliability assessments on resource and transmission adequacy
    - Review and assess the overall reliability of the MRO region and interregional bulk electric system for long-term planning horizons based on reports from regional Planning Coordinators
  - Integration of renewables and essential reliability services
  - Event Analysis and system protection

Long-Term Reliability Assessments (LTRA)

- Provides a high-level assessment of resource adequacy
- Provides an overview of projected electricity demand growth and generation and transmission additions
- Identifies long-term emerging issues and trends that do not necessarily pose an immediate threat to reliability, but will influence future Bulk Power System planning and operations, development and system analysis

MRO Assessment Areas

- Manitoba Hydro
- Southwest Power Pool
- Saskatchewan Power Corporation
- Midcontinent Independent System Operator

Assessment Area Summary

- Key Takeaways
- Change since last year's assessment
- Reliability impact for the next 10 years
- Study process or methodology changes

Questions?

Manitoba Hydro's 2022 Long-Term Reliability Assessment

MRO 2022 Long-Term Reliability Assessment Webinar

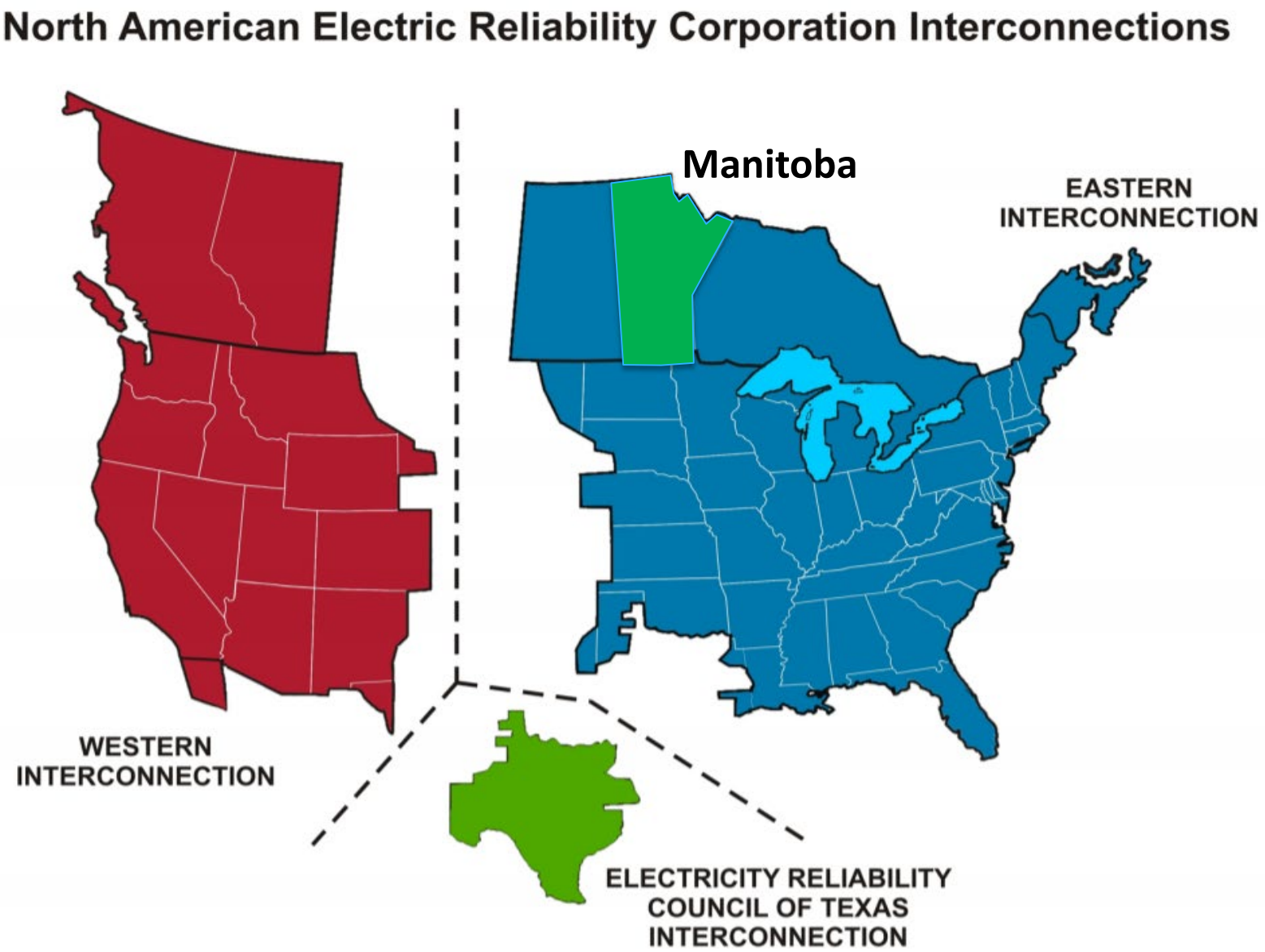
Presented By: Kelly Hunter

Manitoba Hydro

Assessment Area Overview: Manitoba

- 601,000 electric customers
- Anticipated generation capacity:

  6195 MW Winter



Manitoba Hydro

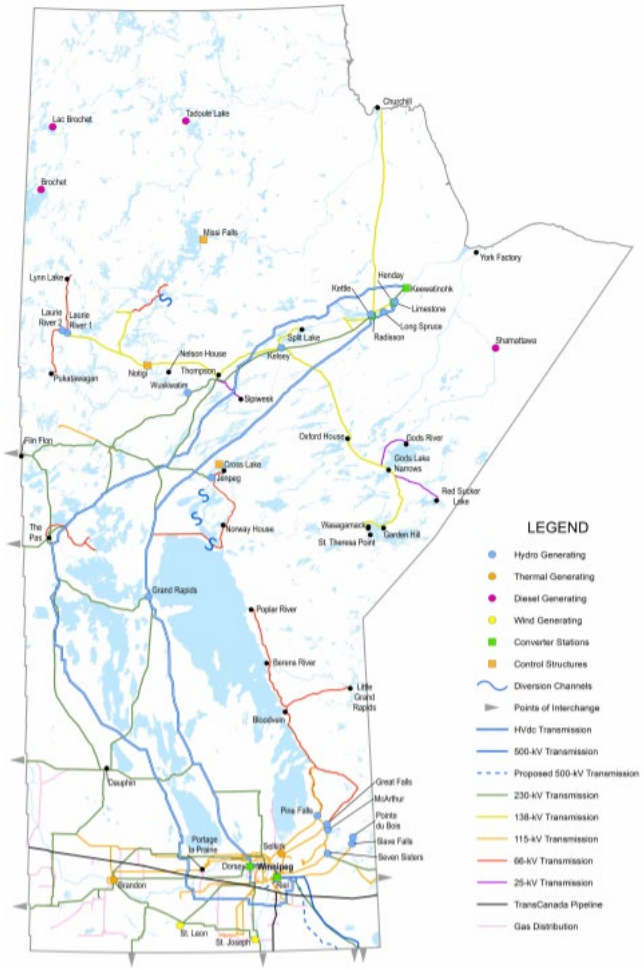
Assessment Area Overview: Manitoba

- Predominantly hydroelectric system
- Strongly winter peaking

  All-time peak:

  – 4910.5 MW on January 30, 2019

  – Temperature: -39.8 °C
- Manitoba Hydro is planning coordinator and balancing authority
- Coordinating member of MISO
- No change in footprint since last LTRA



Assessment Summary

- No significant methodology changes
- Anticipated Reserve Margin does not fall below the Reference Margin Level of 12% in the first five years of the assessment period
- Manitoba Hydro's system is evolving slowly
  - Not anticipating off-peak hour risk increases in next 5 years
- Conduct weekly energy assessments

Assessment Process

- Annual resource plan update with a supply and demand balance assessment to meet Manitoba Hydro's generation planning criteria for the long-term planning horizon
- Key inputs:
  - Electric Load Forecast
  - Demand Side Management Forecast
    (energy efficiency and conservation programs)
  - Resource capabilities: MISO Generation Verification Test Capacity (GVTC)
- Prepare transmission system reliability studies periodically as part of applicable NERC and Manitoba Standards

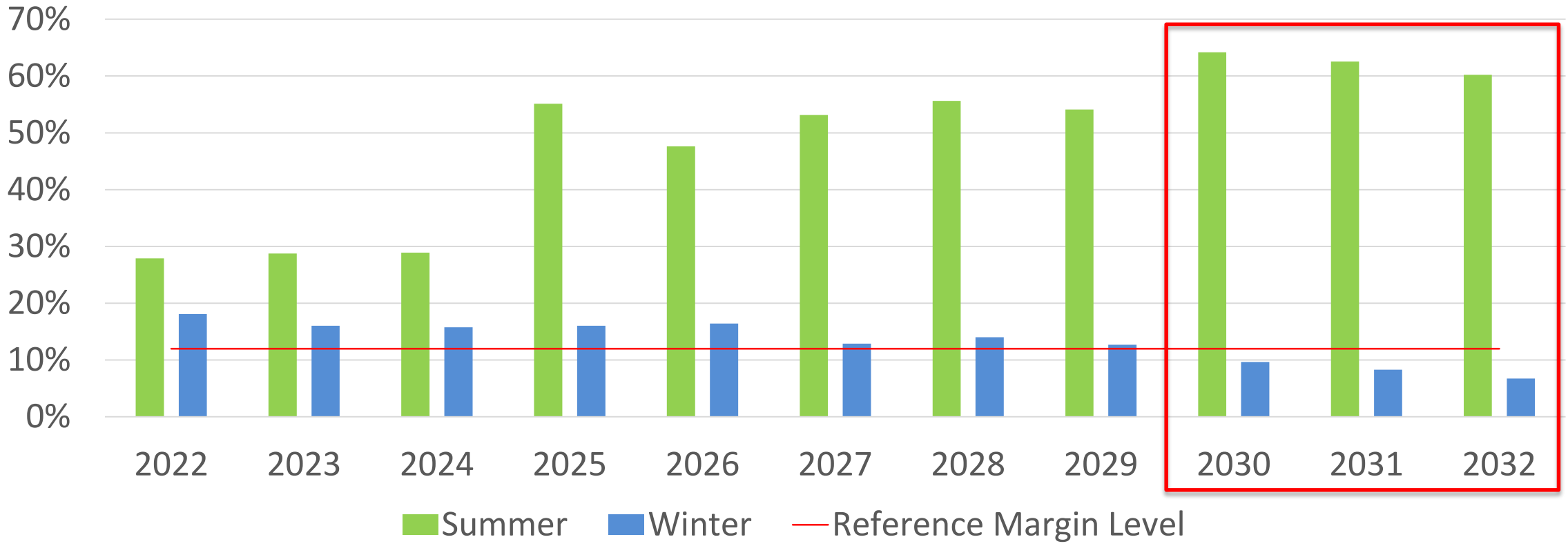
Manitoba Hydro

Planning Reserve Margin

- Predominately hydroelectric system
- Utilize 12% Reference Margin Level
  - Higher than 10% default for predominately hydro systems
- The Reference Margin Level is based on both system historical adequacy performance analysis and reference to probabilistic resource adequacy studies using the index of loss of load expectation (LOLE) and loss of energy expectation (LOEE)

Manitoba Hydro

Anticipated Reserve Margin



Off-Peak Demand Periods

- Risk of loss of load is concentrated in the peak and near peak (99 percentile load and greater) hours
- Not identified off-peak demand periods with increased risk of resource shortage
- Predominately hydro system which is energy (fuel) limited
  - Extreme drought scenario does drive additional risk of resource shortage
  - Have energy criterion in addition to a Planning Reserve Margin to ensure resource adequacy in the event of an extreme drought

Manitoba Hydro

Energy Adequacy

- Predominately hydro system – main issue is water/ energy flows
- On at least a weekly basis, Manitoba Hydro performs an all-hours season ahead energy adequacy analysis as required to manage near term to seasonal reservoir energy storage while meeting system demands
  - Use Production Costing Tools with representations of current hydro inflows and reservoir levels, hydro generator power output curves, electric load, wind and thermal generation, operational constraints, transmission interchange limitations, generation and transmission outages and external regions
  - Energy management decisions are informed by deterministic stress cases of extreme load and low water conditions
- Multiple uses of energy assessments, including timing of releases of water from reservoir storage for use at hydro stations, outage planning, compliance with operating restrictions, determination of surplus hydro energy available for short term export, and determination of thermal and imported energy that may be needed during low flow periods

Demand

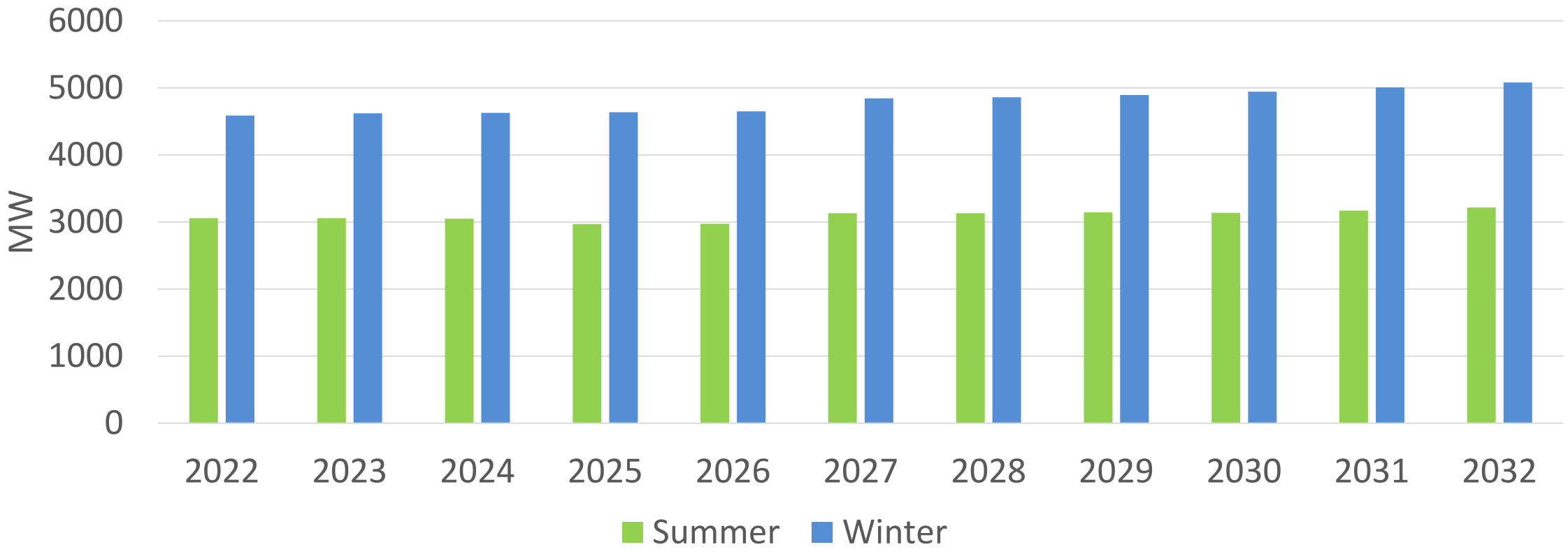
- Electric Load Forecast comprised of:
  - Residential
  - General Service Mass Market (Commercial)
  - Top Consumers
- Population and economy are main drivers
- Includes provisions for potential large industrial load, electric vehicles, behind the meter generation
- Adjust historical load to remove weather effect
- Normal weather based on past 25 years of temperatures (50/50 forecast)

Energy Efficiency and Conservation (Demand Side Management or DSM)

- No Controllable and Dispatchable Demand Response
- Indirectly controlled Curtailable Rate Program – included as a demand reduction for a five-year planning period
- DSM Forecast contains significant energy efficiency and conservation programs
- Energy efficiency and conservation programming are implemented by a separate Crown Corporation, Efficiency Manitoba
- DSM measurement and verification activities, will be undertaken by an independent third-party evaluator that will be contracted by Efficiency Manitoba

Manitoba Hydro

Net Internal Demand

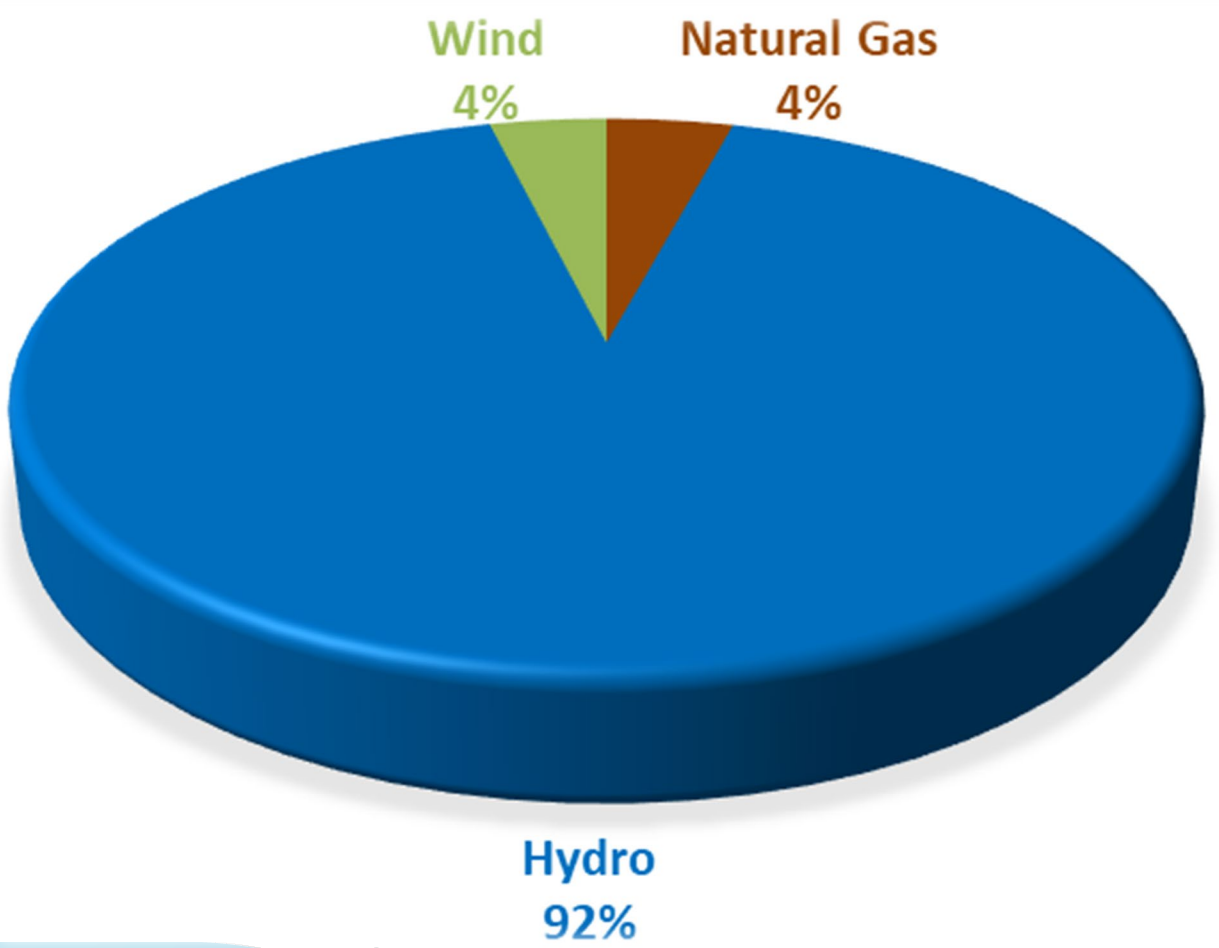


Distributed Energy Resources

- Distributed energy resources and behind the meter generation:
  - 36 MW AC of solar PV distributed energy resources (<200 kW) in Manitoba as of April 2022
    - 17.6 MW residential, 18.4 MW commercial
  - Modest solar growth anticipated over the next 5 years
  - No impact to winter peak load

Generation: Installed Nameplate Capacity

Resource	Nameplate Capacity
Hydro	6205 MW
Natural Gas	280 MW
Wind	259 MW
Total	**6744 MW**



Manitoba Hydro

Manitoba System is Evolving Slowly

- No new wind generation since 2011
- Solar PV has less favorable economics further north and in meeting a winter peaking load
- Hydro plants last 100+ years
- Thermal is small portion of system

Energy Policy

- At this time, there are no energy policy directives from the Province of Manitoba that impact future resource selection
- The electric vehicle (EV) load forecast in Manitoba now assumes Canadian federal targets of zero emission vehicles (ZEVs) reaching 10% of light-duty passenger vehicles sales by 2025, 30% by 2030 and 100% by 2040
- On March 15, 2022, the Government of Canada issued a discussion paper titled “A Clean Electricity Standard in support of a net-zero electricity sector”. The document states that the Government of Canada is planning to take further action to reduce greenhouse gas emissions from the generation of electricity to achieve a net-zero electricity supply by 2035.

Generation Additions

- Keeyask Generating Station (new)
  - 630 MW net addition
  - All seven generating units now operating
- Pointe du Bois Generating Station (existing)
  - Eight-unit replacement project
  - Additional ~50 MW
  - All eight units are anticipated to be in service by 2027/28
- No planned retirements

Manitoba Hydro

Wind Capacity Accreditation

- For wind generation in the summer months, Manitoba Hydro assumes a capacity value of 15.5% percent, based on the Effective Load Carrying Capability (ELCC) analysis in MISO's Planning Year 2022-2023 Wind & Solar Capacity Credit Report
- For wind generation in the winter months, Manitoba Hydro assumes a 20% capacity value, based on a peak period analysis of 2007-2015 data for the top 8 daily winter peak Manitoba load values per year using the 70th exceedance percentile of hourly production values

Solar Capacity Accreditation

- For solar photovoltaic, a peak period analysis of 2007-2015 data for top 8 daily winter peak Manitoba load values per year utilizing the 70th exceedance percentile of simulated hourly solar production values was conducted
- Manitoba Hydro assumes a capacity value of 35% for utility scale solar generation during summer peak months
- Manitoba Hydro assumes a capacity value of 0% during winter peak months
- Solar has a very low capacity value during the winter because the Manitoba load typically peaks in January at or before sunrise or after sunset

Manitoba Hydro

Electricity Storage (ES) Impacts

- Manitoba Hydro currently has no energy storage resources
- None have been committed to in the next 10-year period
- Therefore, detailed studies for energy storage resources have not been undertaken to date
- The hydro generation resources, while not storing electricity directly, do store water in a reservoir for conversion to electricity, and have been in use for over 100 years

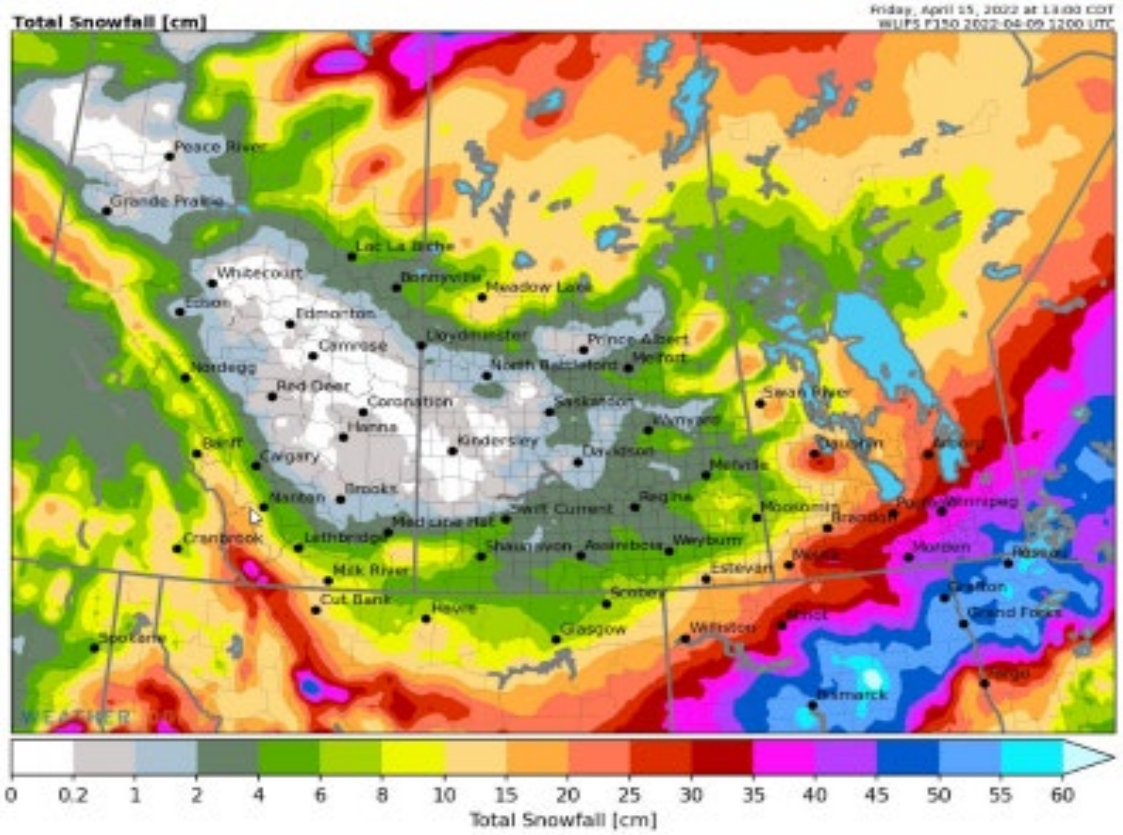
Capacity Transfers

- Includes all firm imports and exports
  - Higher level of capacity exports in summer when Manitoba peak load is lower
- All capacity transfers coordinated, reviewed, vetted by neighboring Assessment Areas
  - SaskPower
  - MISO
  - IESO (Ontario)

Transmission Assessment Process

- Manitoba Hydro prepares transmission system reliability studies periodically as part of applicable Manitoba and NERC Standards including but not limited to the following:
  - Transmission planning assessment every year (MH-TPL-001-4)
  - Under frequency load shedding design assessment every five years (PRC-006-3)
  - Physical security risk assessment every three years (CIP-014-2)
  - Review of Remedial Action Schemes every five years (PRC-012-2)
  - Geomagnetic disturbance vulnerability assessment every five years (MH-TPL-007-2)

Reliability Issues Being Monitored



- Extreme weather
  - Winter Peaking System
    - Feb 2021 and Dec 2022 Polar vortex type temperatures not coldest temp experienced in last 4 years
  - Summer peaks not extreme: well insulated houses/buildings
- Severe drought
  - Energy planning criterion assumes worst drought on record of greater than 100 years
- Flow variability – changed from drought to major flood condition in 6 months

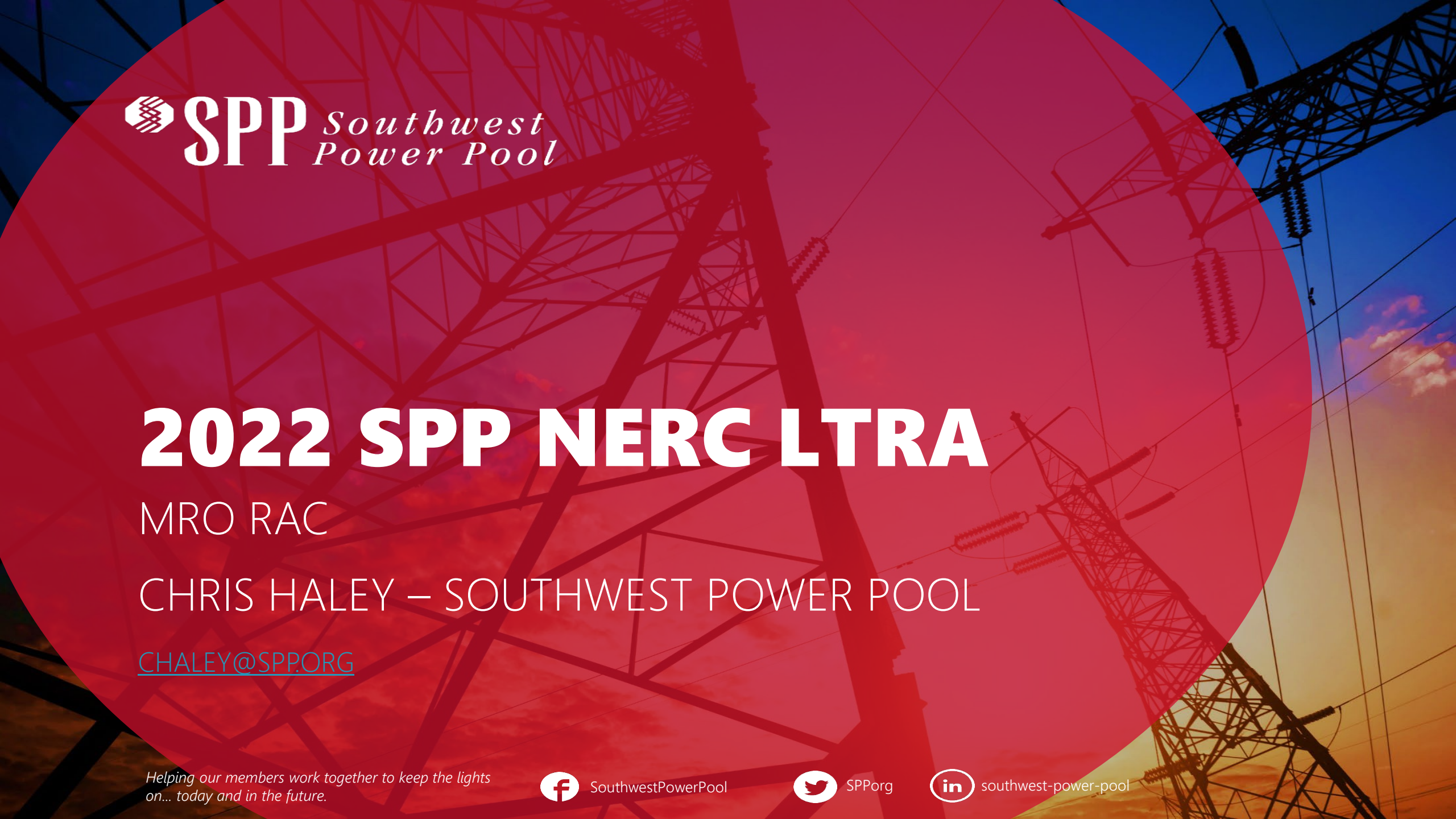
2021 Fall Drought
vs.
2022 Spring Flood

Emergency Response Planning/Preparedness

- Approach focused on emergency planning, building on experience in the province in dealing with widespread natural disasters including several Red River floods, the October 2019 ice storm, and wildfire events
- Minimal in province gas production – gas supply not interdependent upon power system
- Vast majority of energy from hydro – not dependent on gas supply
- Have Corporate Emergency Management Program (CEMP) which provides a framework to enhance resiliency against current and emerging hazards
- There is also provincial Emergency Measures Organization for Manitoba

Winter Storms


Thank You. Questions?



2022 SPP NERC LTRA

MRO RAC

CHRIS HALEY – SOUTHWEST POWER POOL

CHALEY@SPP.ORG

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

SouthwestPowerPool SPPorg southwest-power-pool

OVERVIEW

HIGHLIGHTS

SPP continues to see significant increase in wind penetration along with setting new wind records

- Currently just over 31GWs of wind on the system

SPP has been coordinating with SaskPower through the long-term transmission service request process to increase the transfer capability between the two regions from 150 MW to 650 MW

- Under the terms of the transmission service agreement, SaskPower will have 650 MW of firm point-to-point transmission service to export generation out of SPP into SaskPower.

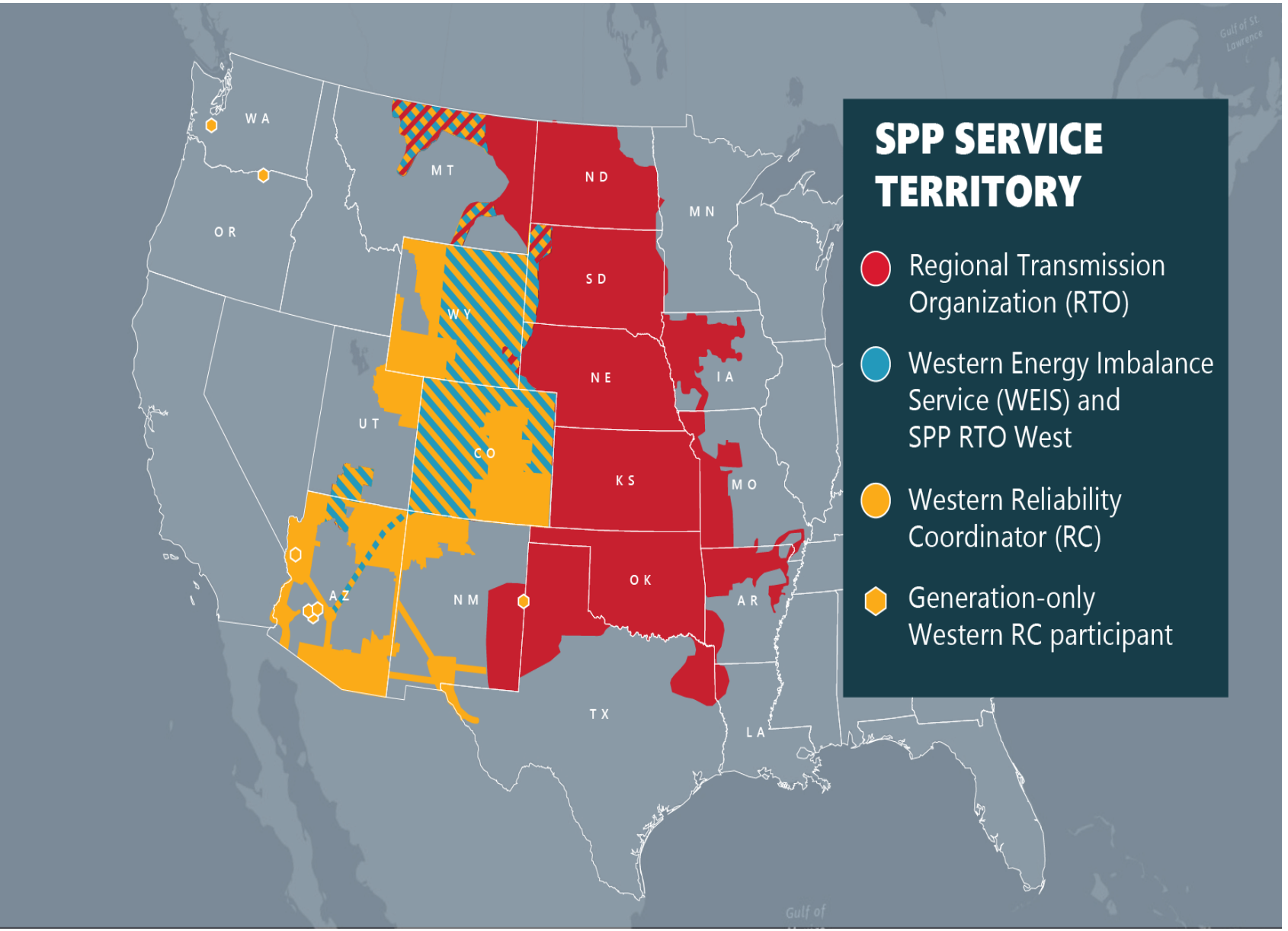
SPP and ERCOT continue to communicate and maintain a coordination plan

- The coordination plan addresses operational issues for coordination of the DC ties between the Texas Interconnection and Eastern Interconnection and switchable generation resources (SWGRs).
- SPP has priority to recall the capacity of any SWGRs that have been committed to satisfy the resource adequacy requirements contained in Attachment AA of the SPP Open Access Transmission Tariff

The SPP Assessment Area coordinates with neighboring areas to ensure that adequate transfer capabilities are available

- Annually, SPP coordinates the modeling of transfers between Planning Coordinator footprints
- The modeled transactions are fed into the models created for the SPP planning process

SPP PLANNING COORDINATOR FOOTPRINT



- SPP manages the electric grid across 17 central and western U.S. states and provides energy services on a contract basis to customers in both the Eastern and Western Interconnections
- Currently, the SPP LTRA is only performed on the SPP Regional Transmission Organization footprint

SPP PLANNING COORDINATOR KEY TAKEAWAYS

SPP projects that the Anticipated Reserve Margin over the assessment timeframe does not fall below the target planning reserve

Over the assessment timeframe the confirmed and projected retirements total ~215MWs

- Unconfirmed retirements total ~ 4,100MWs
- Does not include impact assumptions based on the latest policy rulings

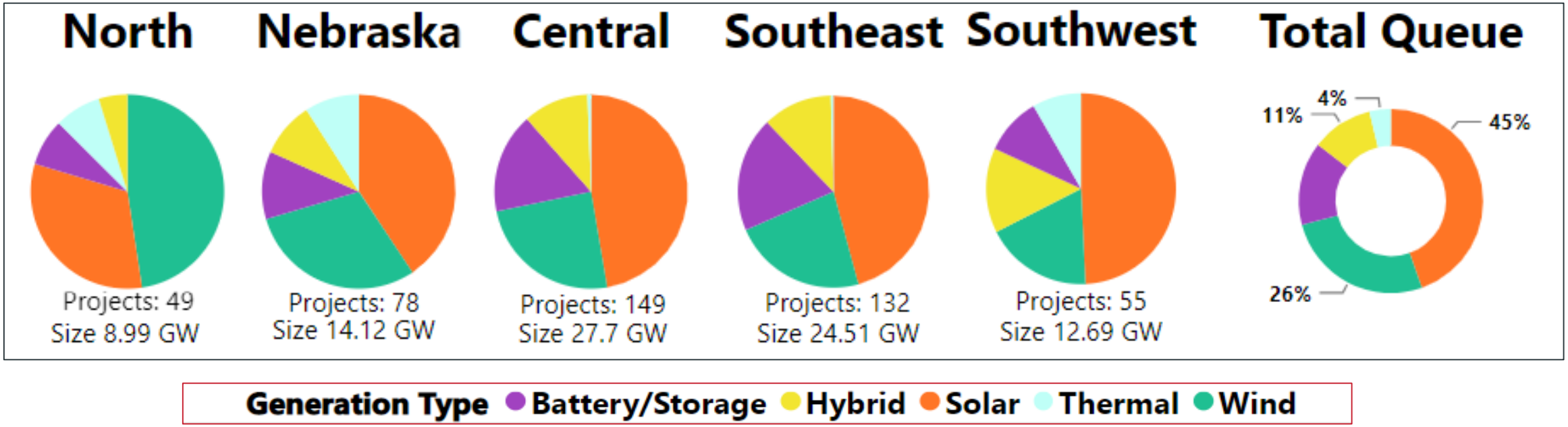
No significant changes to the LTRA data or processes

The required target planning reserve margin of 12% non-coincident peak is still applicable at this time

- For purposes of the NERC Assessments SPP converts the 12% NCP to 16% coincident peak

SPP GENERATION INTERCONNECTION QUEUE

- Resource mix planned to evolve over the assessment period is predominantly wind, solar and storage
- There are 463 projects active in the queue, though not all resources will end up interconnected and are in various stages
  - Queue totals ~88 GWs



ASSESSMENT PROCESS

Created with data/information submitted by SPP members

SPP staff validates and cross-checks data to verify consistency

SPP staff and stakeholders have the opportunity to provide input

Attachment AA requires a Load Responsible Entity (LRE) to maintain adequate capacity to meet the upcoming Summer Season Resource Adequacy Requirement (RAR)

- The RAR includes the capacity to cover load plus planning reserves
- SPP is working to implement an RAR for the Winter Season

LOLE BACKGROUND

Planning Reserve Margin validated/determined by a probabilistic Loss-of-load expectation (LOLE) study

LOLE is the expected number of days or hours per year, that an entity does not have enough capacity to reliably serve the BA forecasted Peak Demand

- The impact is measured with a reliability target, commonly expressed as an expected value, or LOLE of 0.1 days/year or 1 day in 10 years (“1 in 10”)
- LOLE generally occurs in the summer months during peak hours

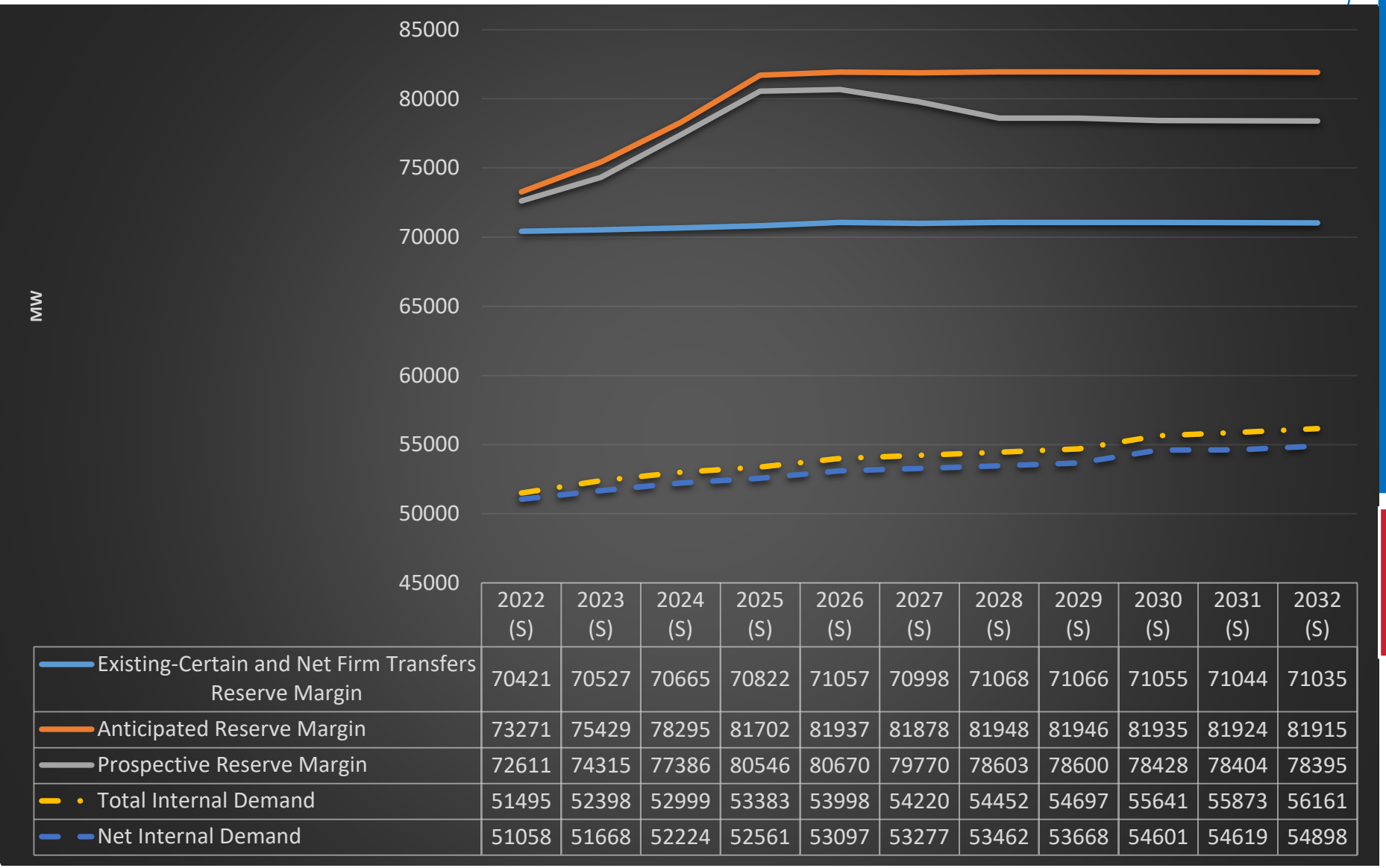
Stakeholder Supply Adequacy Working Group approves scope and report

SPP performs an LOLE study every two years

- 2021 LOLE Study shows that the current NCP Planning Reserve Margin of 12% is no longer appropriate
- The PRM in the SPP Balancing Authority was increased from 12% to 15% starting in the 2023 summer season

SPP LTRA HIGHLIGHTS

CAPACITY AND DEMAND OVERVIEW



	2022 (S)	2023 (S)	2024 (S)	2025 (S)	2026 (S)	2027 (S)	2028 (S)	2029 (S)	2030 (S)	2031 (S)	2032 (S)
Existing-Certain and Net Firm Transfers Reserve Margin	70421	70527	70665	70822	71057	70998	71068	71066	71055	71044	71035
Anticipated Reserve Margin	73271	75429	78295	81702	81937	81878	81948	81946	81935	81924	81915
Prospective Reserve Margin	72611	74315	77386	80546	80670	79770	78603	78600	78428	78404	78395
Total Internal Demand	51495	52398	52999	53383	53998	54220	54452	54697	55641	55873	56161
Net Internal Demand	51058	51668	52224	52561	53097	53277	53462	53668	54601	54619	54898

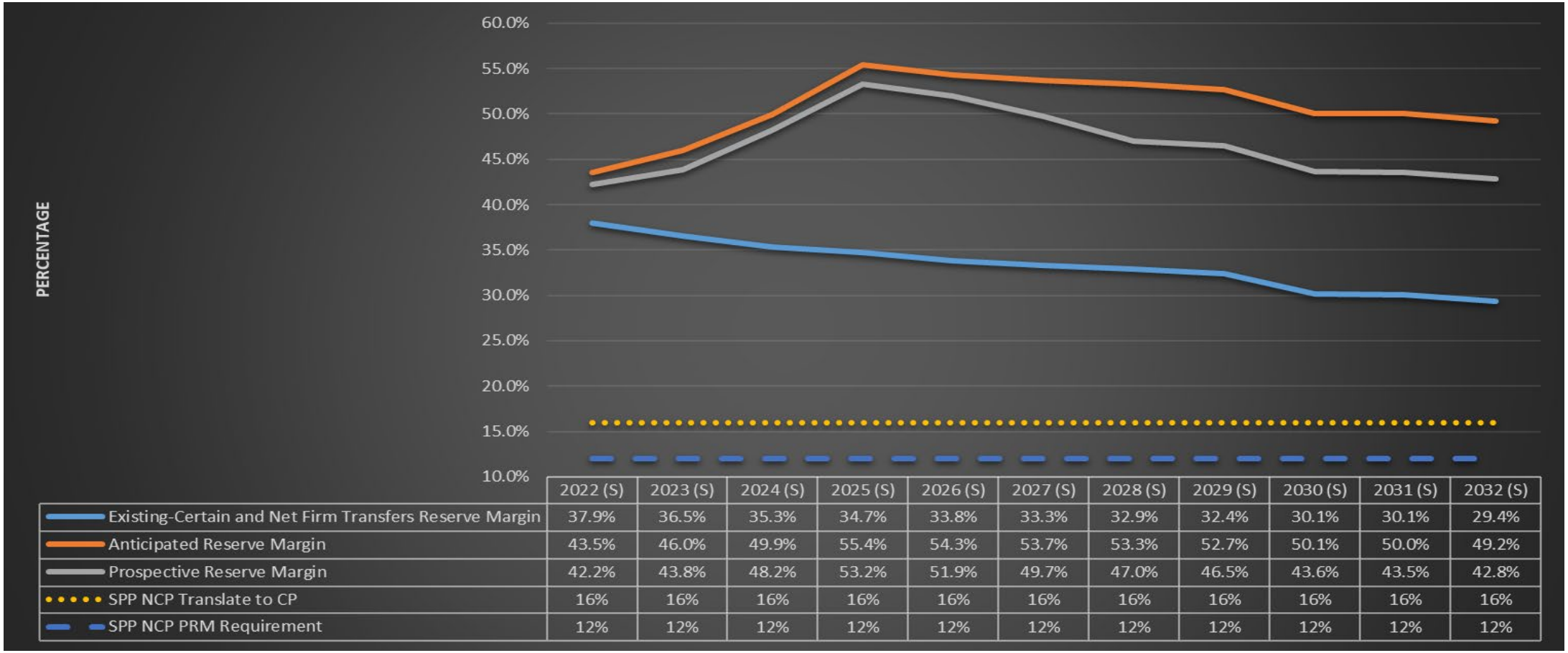
- SPP Assessment Area is a summer peaking region
- Peak Demand is an aggregated coincident peak value-based on member-submitted data
  - Member submitted non-coincident was 53,385 MW
- Demand is based on 50/50 forecast
- Net Peak Demand reflects the reduction of available Controllable and Dispatchable Demand Response

Record summer peak load

New record set 7/18/22 @ 16:59
53,243 MW

PLANNING RESERVE MARGIN

- The Existing - Certain and Net Firm Transfers Reserve Margin is forecasted to increase compared to the previous years forecasted reserve margin
- The increase in reserve margin is due to additional accredited wind and the coincident peak is projected to decrease based on the member submitted peak forecast being lower than the previous year



	2022 (S)	2023 (S)	2024 (S)	2025 (S)	2026 (S)	2027 (S)	2028 (S)	2029 (S)	2030 (S)	2031 (S)	2032 (S)
Existing-Certain and Net Firm Transfers Reserve Margin	37.9%	36.5%	35.3%	34.7%	33.8%	33.3%	32.9%	32.4%	30.1%	30.1%	29.4%
Anticipated Reserve Margin	43.5%	46.0%	49.9%	55.4%	54.3%	53.7%	53.3%	52.7%	50.1%	50.0%	49.2%
Prospective Reserve Margin	42.2%	43.8%	48.2%	53.2%	51.9%	49.7%	47.0%	46.5%	43.6%	43.5%	42.8%
SPP NCP Translate to CP	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%
SPP NCP PRM Requirement	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%

CAPACITY TRANSFERS

- While SPP does utilize capacity imports there is no dependency on the capacity transfers to meet or maintain reliability
- Capacity transactions are scheduled from market to market
- SPP only relies on the firm commitments in the LTRA and LOLE
  - There are no non-firm commitments
  - Total available contract path is not used

RELIABILITY ISSUES

- Not anticipating unique emerging reliability issues over the assessment timeframe
- Do not expect adverse reliability impacts resulting from fuel supply or transportation constraints during the assessment timeframe
  - SPP staff continues to monitor this area to ensure that there are no issues
- Do not expect any reliability concerns, at this time, due to extreme weather events
  - SPP performs a biennial LOLE study to determine the reserve margin based on the Loss of Load Expectation (LOLE) standard of one occurrence in ten years
  - Study recognizes, among other factors, load forecast uncertainty, generator availability and transmission constraints
  - Weather assumptions and load forecast includes a probability of extreme weather in its distribution
  - SPP Resource Adequacy, Operations, and Market staff frequently meet to discuss the coordination of efforts to ensure that planning understands the real time issues and needs and how to best access those scenarios in the planning processes

RELIABILITY ISSUES

While the SPP Planning Reserve Margin shows a robust amount of excess capacity, these margins reflect the full availability of accredited capacity and does not account for planned, forced or maintenance outages.

- Does not reflect de-rates based on real time operational impacts
- Similar to the Generation Unavailability scenario in the 2022 NERC Summer Assessment, SPP shows the potential to utilize all of the current projected LTRA Planning Reserve Margin capacity
- There could be times of capacity shortfall based on performance impacts during high load periods
- The potential to utilize all of the current projected LTRA Planning Reserve Margin capacity has a lower probability, the assumptions and projections are based around historical unavailability during on peak periods

SPP BALANCING AUTHORITY RECENT SEASONAL EVENTS

KEY POINTS FOR ELLIOTT& URI COMPARISON

For SPP, Elliott was not as severe as winter storm Uri (Feb. 2021)

Fewer gas and wind outages in Elliott than Uri

Coal outages and derates were worse in Elliott

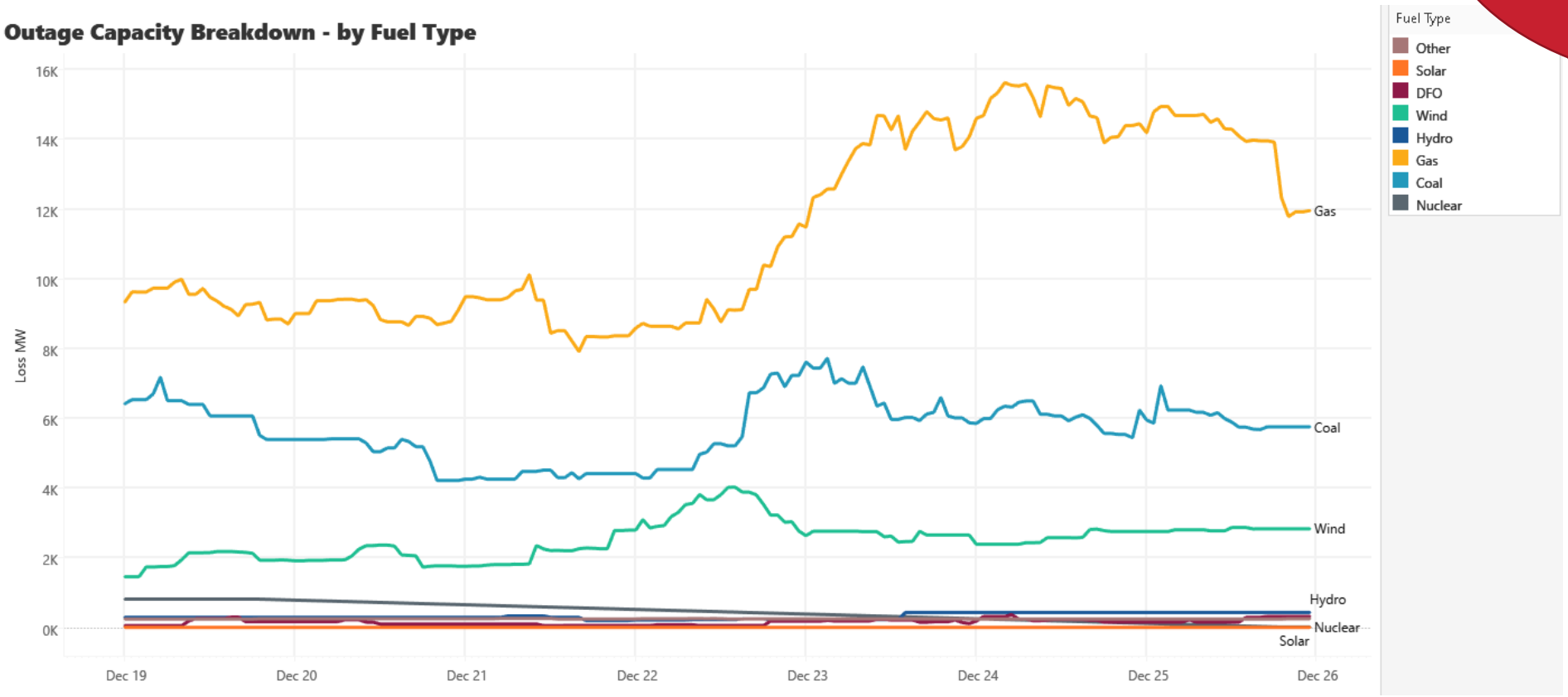
While there was no BA directed load shed in Elliott, there was BA load shed potential

DRIVERS OF ENERGY EMERGENCY ALERTS

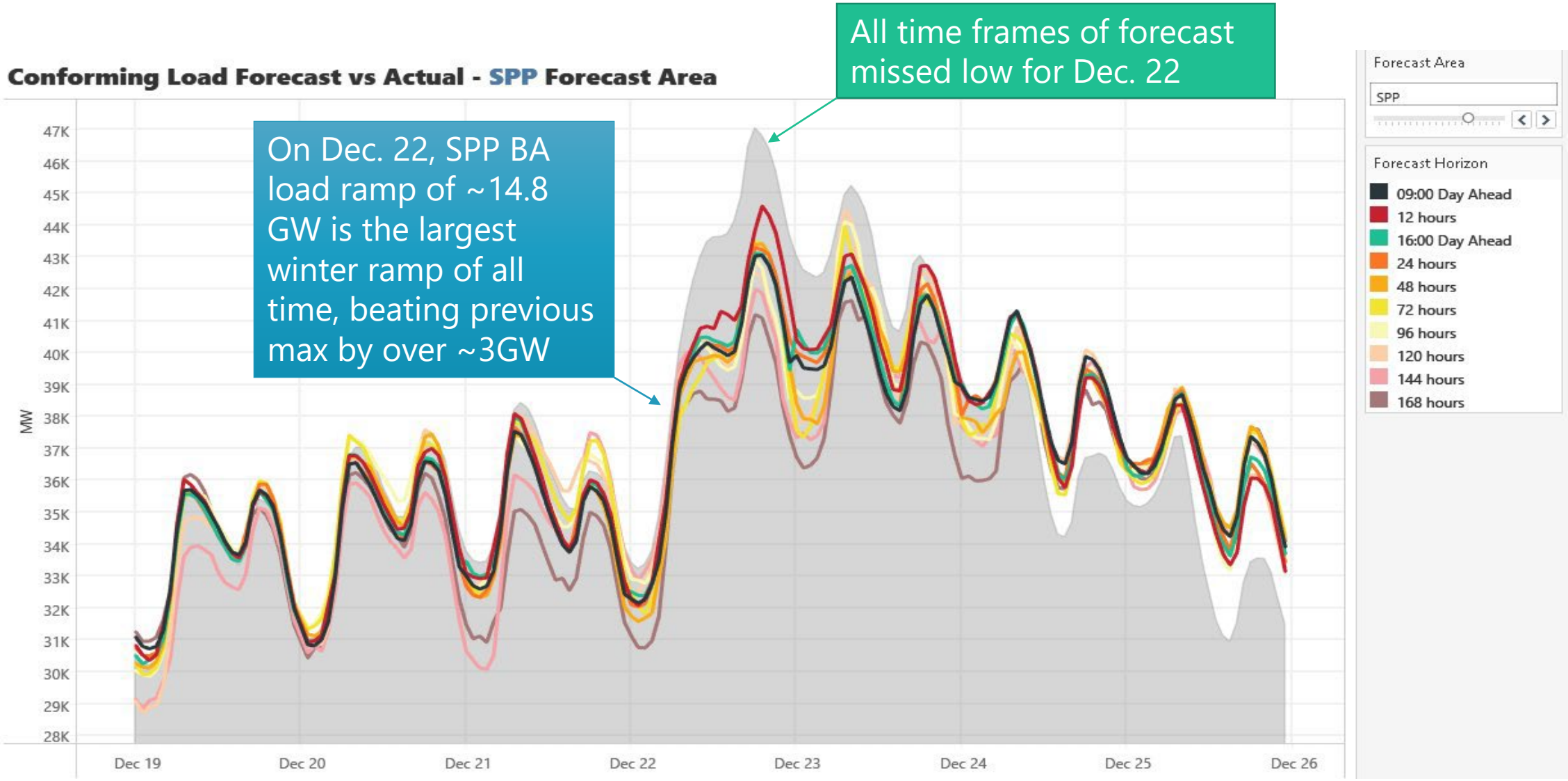
- Generation unavailability
  - Lack of fuel supply
  - Extreme cold weather-related outages
- Record winter energy consumption
- New record set 12/22/22 @ 18:27: 47,157 MW
  - 2022/23 Total Internal Winter Demand submitted by members was 41,650 MW

GENERATING CAPACITY OUTAGES ELLIOTT

Gas and wind outages were below Uri levels and coal outages were roughly the same as URI



SPP LOAD FORECAST ELLIOTT



QUESTIONS?

2022 MISO LTRA

MRO RAC

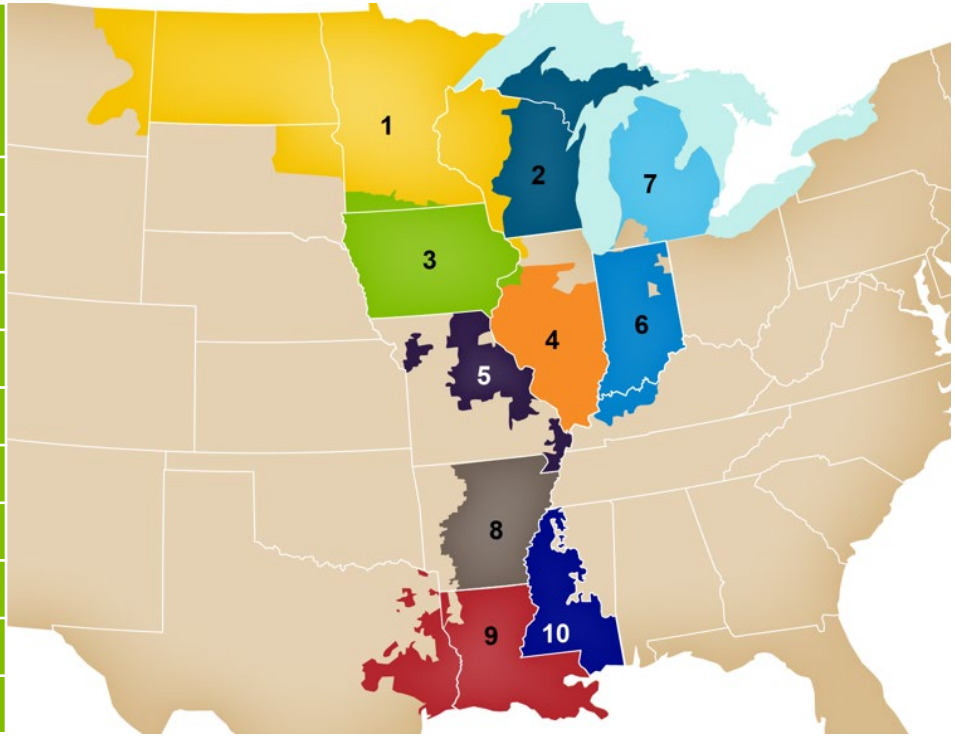
January 26, 2023

Key Takeaways

- Although reserve margins have been declining over the past several years, this trend may reverse in the future based on the size of the Generation Interconnection (GI) queue
- Approval of Long Range Transmission Plan Tranche 1 will address challenges of resource fleet evolution
- Planning Year 23-24 will be seasonal (Summer, Fall, Winter Spring) adding more insight into off peak risk scenarios
- Resource accreditation improvements for all resources to properly credit each resource type in meeting LOLE targets

MISO Local Resource Zones

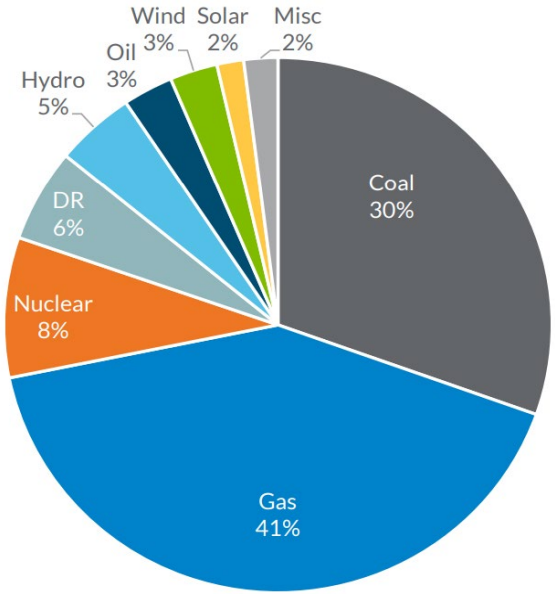
Local Resource Zone	Local Balancing Authorities
1	DPC, GRE, MDU, MP, NSP, OTP, SMP
2	ALTE, MGE, MIUP, UPPC, WEC, WPS
3	ALTW, MEC, MPW
4	AMIL, CWLP, SIPC
5	AMMO, CWLD
6	BREC, CIN, HE, IPL, NIPSCO, SIGE
7	CONS, DECO
8	EAI
9	CLEC, EES, LAFA, LAGN, LEPA
10	EMBA, SME



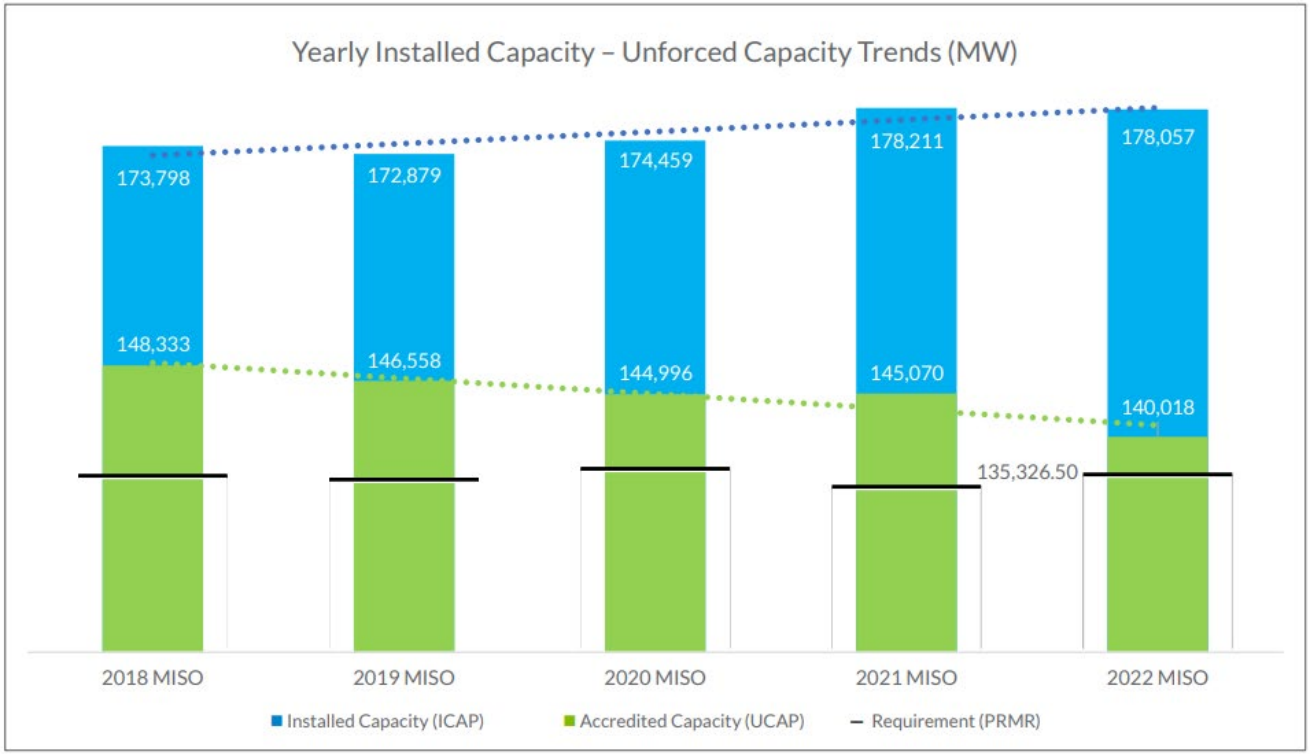
Drivers for Changes in Capacity Position in 2022

- Post Covid load increase of 1+ GW
- Slight growth-rate decrease from 0.25% to 0.2% beyond 2023
- Accelerated retirements
- 20 GW of possible retirements by 2031
- Attachment X (transfer of interconnection service) will allow some new resources to interconnect faster

134.1 GW UCAP cleared generation from 2022-23 PRA %

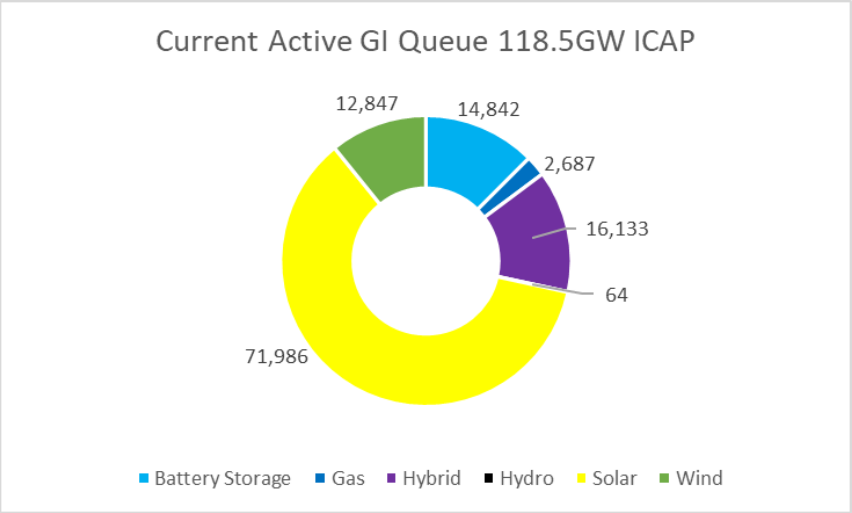


Although installed capacity has increased, accredited capacity has decreased due to thermal retirements and transition to renewables



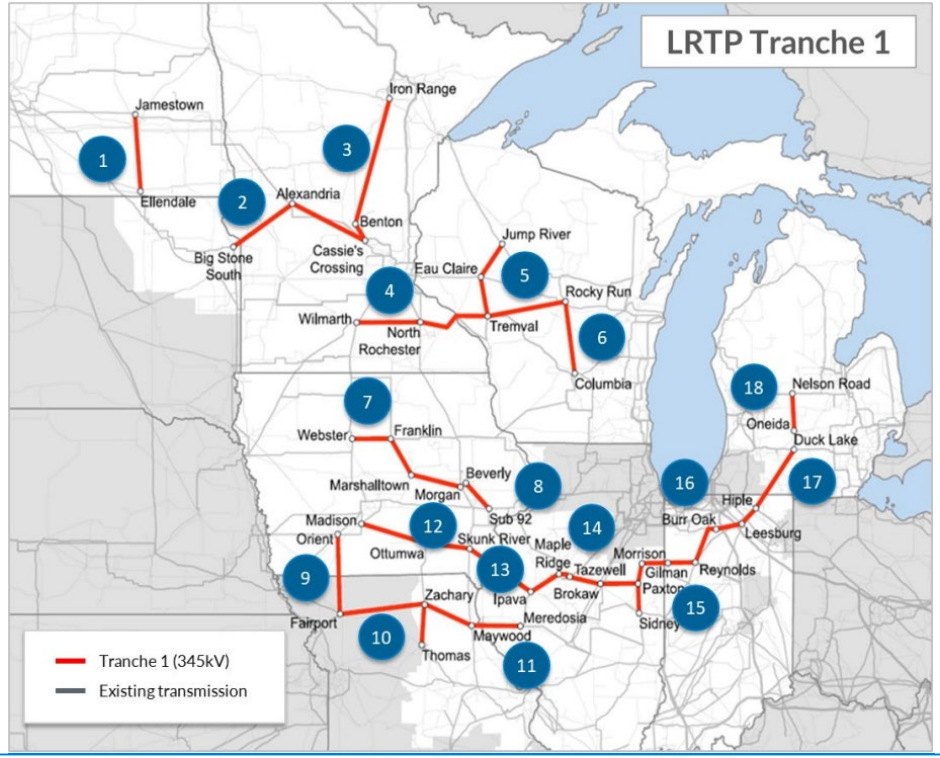
MISO Resource Mix Projected to Change More with Queue Resources

- No major LTRA changes to data, study processes or study methodology
- Near-future resource plans may keep MISO closer to PRMR; new unit additions should prevent overall capacity deficiencies.
- **160.3**GW additional generation joined MISO GI queue in 2022
- LRTP and JTIQ designed to facilitate integration of new resources
- Improved methodology on when to include new resources in studies, not only their accredited values



Long Range Transmission Plan (LRTP)

- LRTP Tranche 1 studies completed and approved
- Future LRTP Tranche's are being scoped
- Enhances deliverability and facilitates integration of new renewable resources
- Provides reliability and economic benefits



MTEP21 Report Addendum

Resource Adequacy construct enhancements address today's issues and prepare the region for meeting our Reliability Imperative into the future

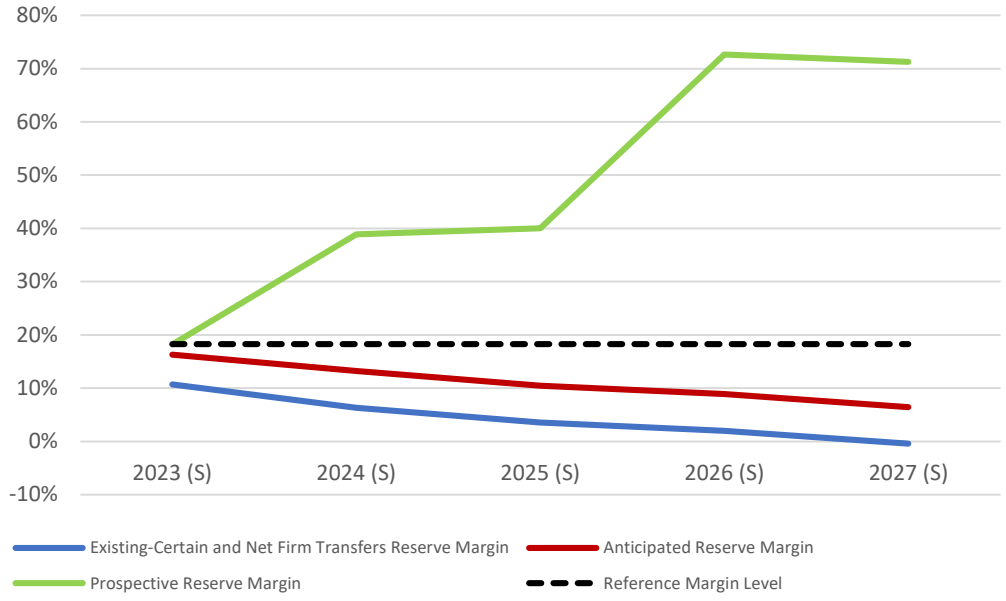
Sub-annual construct: Change from current annual summer-based construct to four distinct seasons
Outcomes: (1) Identify reliability needs unique to each season (2) Align resource availability with seasonal needs (3) Facilitate seasonal outages or partial year operations

- Will provide greater insight into winter and off-peak reliability scenarios

Improved accreditation: Align resource accreditation with availability in the highest risk periods
Outcomes: (1) Increase confidence in capacity that MISO can count on (2) Provide improved signals for availability and coordination (3) Improve outage coordination processes

- Schedule 53 accreditation in effect for PY23-34 (Thermal Resources)
- Non-thermal accreditation still being designed/discussed through MISO's stakeholder process

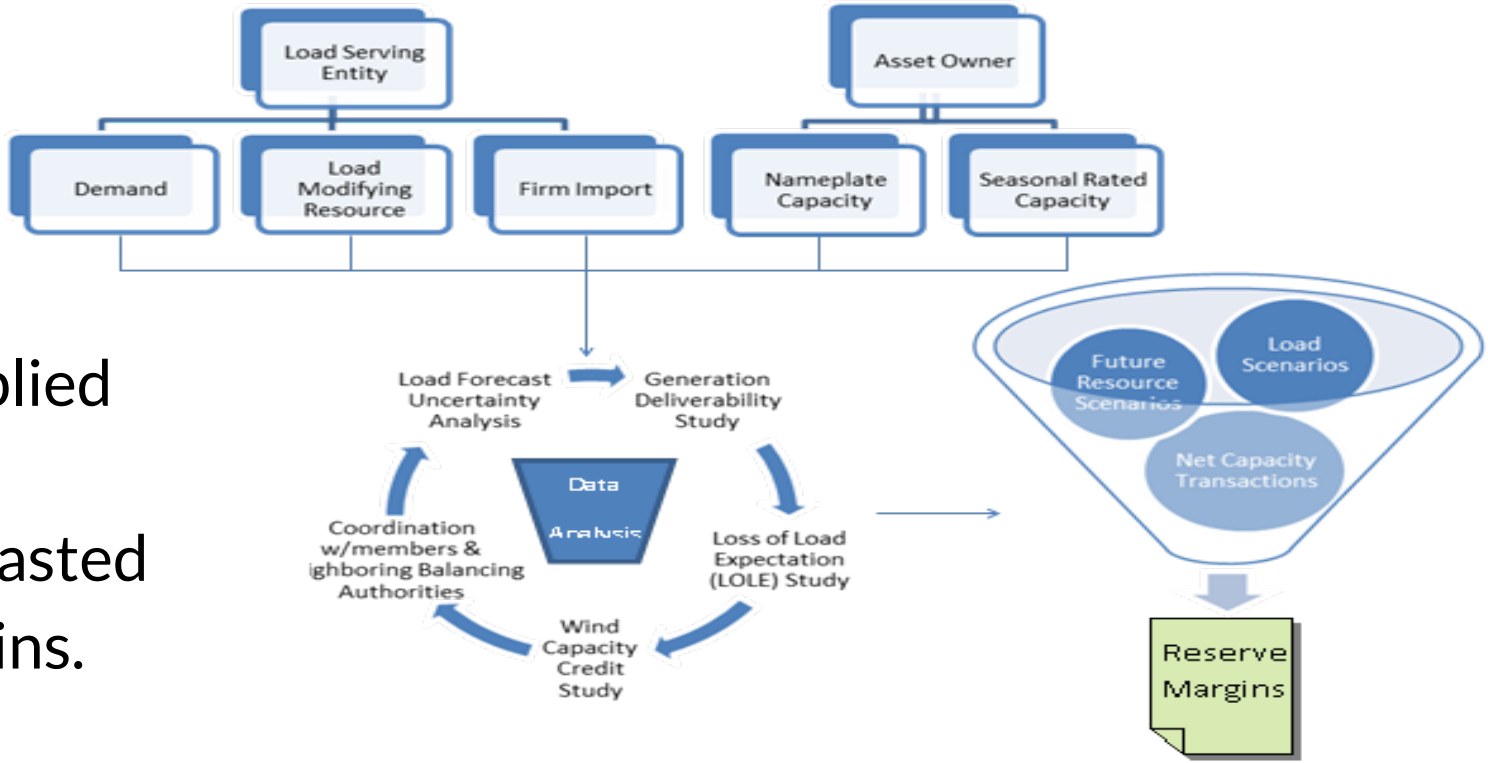
Broad Future Resource Adequacy Range



- Anticipated Planning Reserve Margin below 18.3% requirement through 2027.
- All resource zones can meet Local Clearing Requirements.
- Point-in-time results will change as plans solidify.
- Regional Resource Assessment (RRA) is another resource that provides long term resource adequacy outlook

Assessment Process Unchanged Since Last Year, Will Change Next Year to Include 4 Seasons

Member supplied data used to analyze forecasted reserve margins.



PRM – Methods and Assumptions

- Per Module E-1 of the MISO Tariff, MISO annually performs a probabilistic analysis using the Loss of Load Expectation (LOLE) study to determine the appropriate Planning Reserve Margin (PRM).
- MISO calculates the PRM such that the LOLE for the next planning year is one day in 10 years, or 0.1 days per year.
- Same PRM reference level at 18.3%
  - Changes in load shape
  - Changes in Generation Verification Test Capacity (GVTC)
  - Changes to Retirements & Suspensions & New Resources

Demand – Load Forecasts

- MISO does not forecast load
- Members supply load projections per the RA Requirements section (Module E-1) of the MISO Tariff.
- Forecast changes driven by
  - Post COVID19 bounce back
    Changing economic outlooks

Post Covid19 bounce back

- Peak forecast up by 1+ GW
- 5-year growth rate stable at 0.2%

Demand-Side Management – Controllable and Dispatchable Demand

- MISO separates DR resources into two categories;
  - Direct Control Load Management
  - Interruptible Load
- MISO has roughly 7.5 GW of Direct Control and Interruptible Load
- MISO has roughly 4.2 GW of Behind-the-Meter Generation

Demand-Side Management - Energy Efficiency and Conservation

- Energy Efficiency not explicitly forecasted by MISO
- New energy efficiency qualifies for up to three years
  - While program growth qualifies as new capacity, existing MWs become part of the load forecast after three years
- Beginning in Planning Year 2021 MISO members have registered 0 MW of EE program capacity.

Distributed Energy Resources

- Currently MISO does not collect distributed generation information
- Need to be registered within the MISO Resource Adequacy construct to receive Capacity Credit
- Load forecasts received are not granular enough to discern any DER within them
- MISO State regulators conduct an annual survey on DERs
  - Roughly 861 MWs of BTM solar reported

Questions?

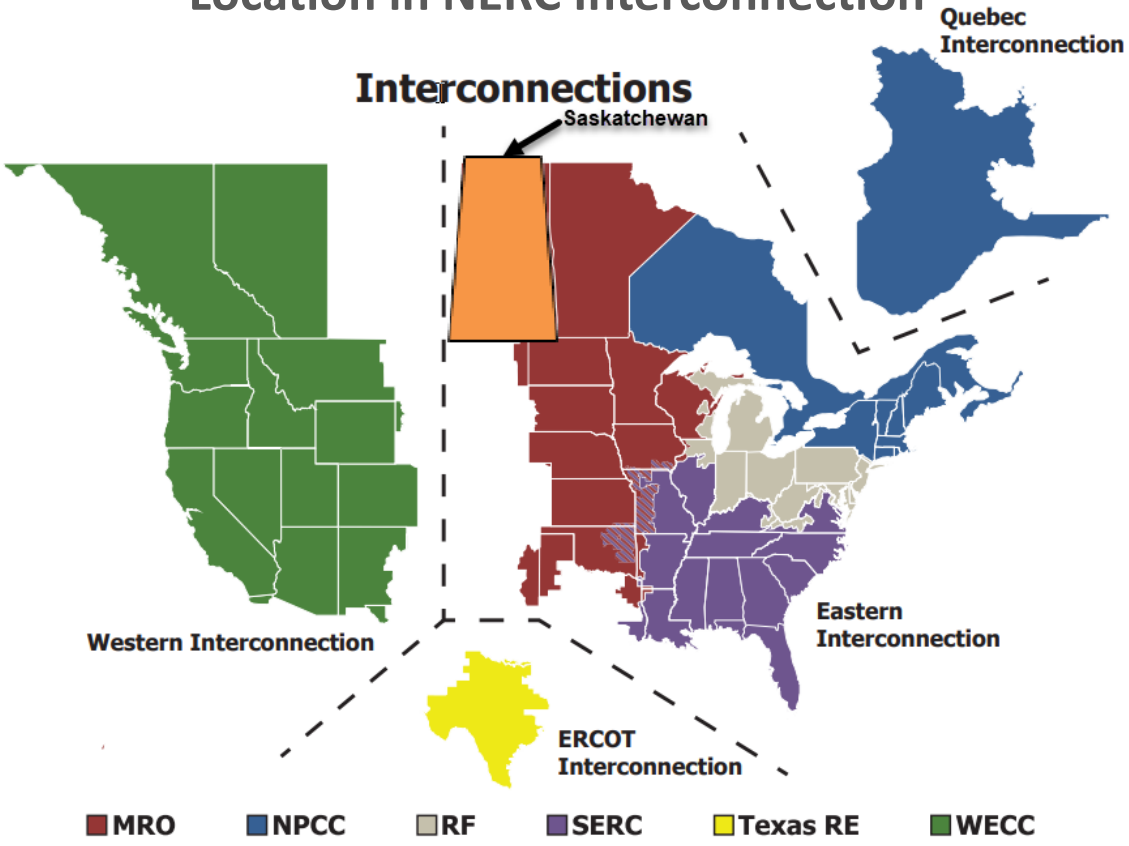
SASKATCHEWAN 2022 LTRA SUMMARY

January 2023

SaskPower
Powering our future®

Saskatchewan

Location in NERC Interconnection



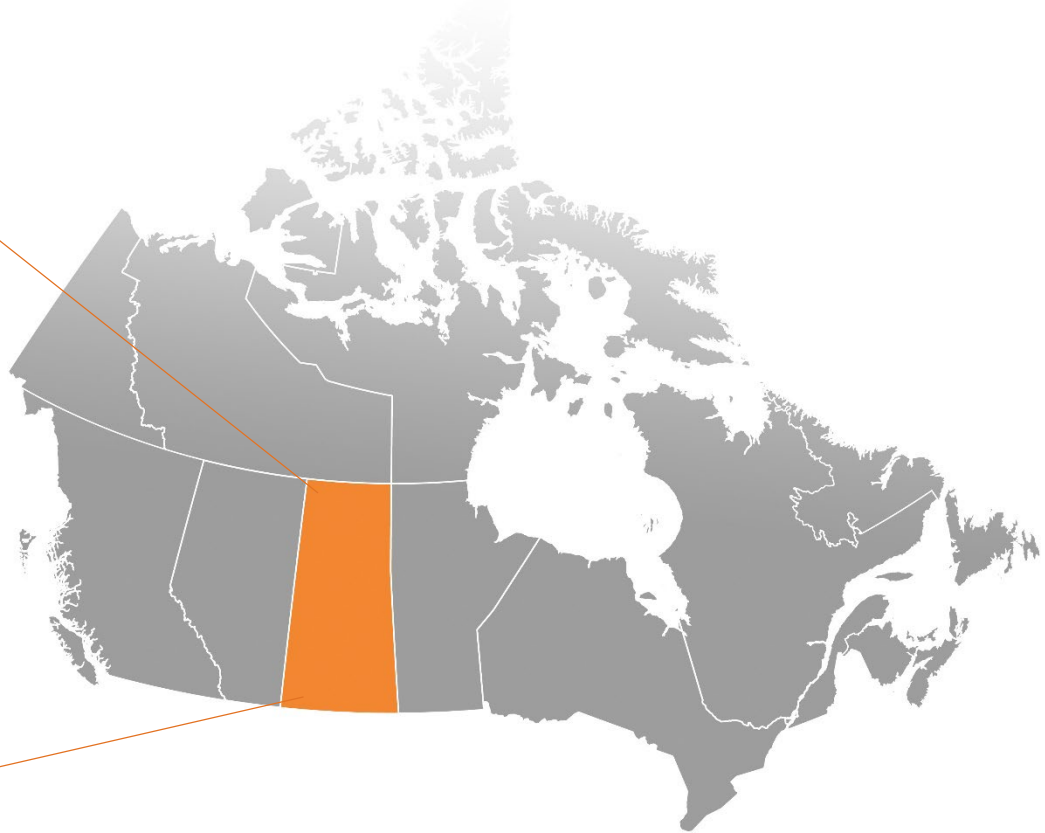
Source: NERC Interconnections.pdf

SASKATCHEWAN'S PRIMARY ELECTRICITY SUPPLIER

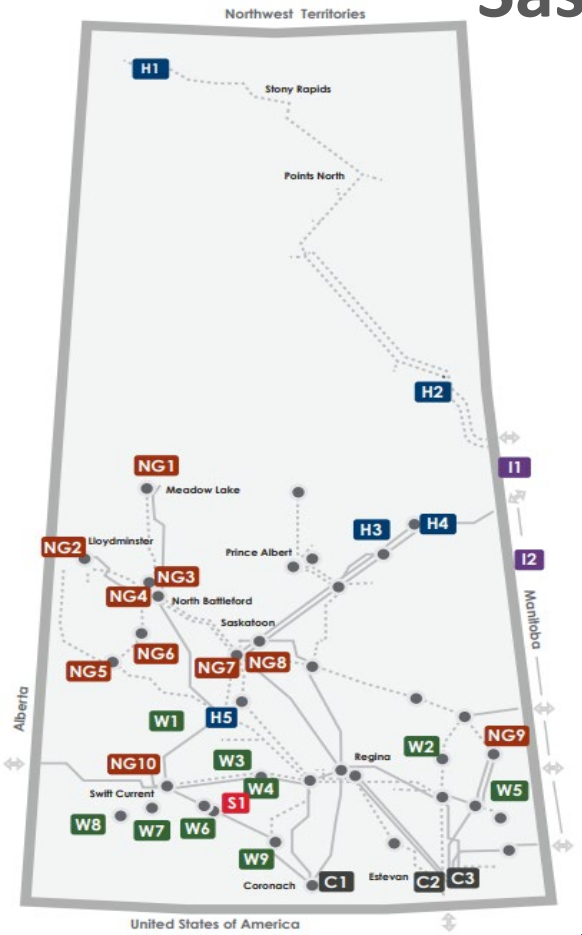
545,000 CUSTOMERS

157,000 KM OF POWER LINES

3,910 MW HIT ON DEC. 30, 2021



Saskatchewan's Power Map

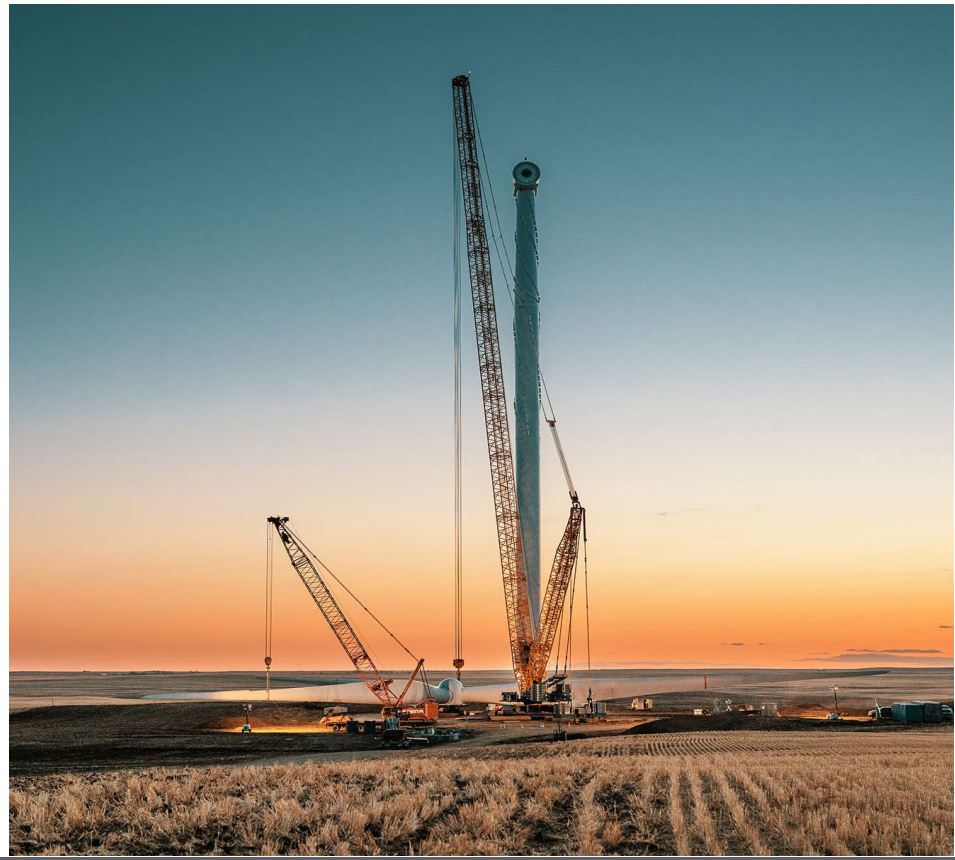


7	3	10	9	3
Hydro Facilities	Coal Facilities	Natural Gas Facilities	Wind Facilities	Solar Facility

MW							
Hydro	Coal	Natural Gas	Wind	Solar	Other Small	Other Import	Total
864	1389	2160	626	74	28	290	5431

Major Projects: Generation

- Blue Hill – 175 MW Wind Facility (February 2022)
- Golden South – 200 MW Wind Facility (March 2022)
- Great Plains Power Station – 377 MW Combined Cycle Gas Turbine (April 2024)



Major Projects: Transmission

- New 230 kV transmission reinforcement near Regina under construction
- New Transmission Service Between SaskPower and SPP
  - Two - 230 kV International Transmission Lines between SaskPower and SPP (Saskatchewan – North Dakota)
  - New 230 kV transmission reinforcements in the Regina, South-East Saskatchewan Area to facilitate the new transmission service between SaskPower and SPP

Saskatchewan 2022 LTRA Highlights

Assessment Process

Periodic Reliability Studies

- Planning studies required for NERC: ie TPL, PRC, and CIP
- Generation and load interconnection studies (contingency power flow, stability analysis, voltage control and reactive power analysis, short circuit analysis, and protection and control system analysis
- Transmission service request studies
- Cascading Studies

Resource Adequacy Assessments

- Annual 10 year supply plan
  - Considers retirements of existing units, planned outages, degradation of unit performance between overhauls, escalating fuel prices, and regulatory requirements

Saskatchewan 2022 LTRA Highlights

Planning Reserve Margins (Methods and Assumptions)

- Saskatchewan uses two criteria for determining adequate generating capabilities
  - Calculate Expected Unserved Energy (EUE) through probabilistic modeling
  - Employ a deterministic criterion in which the reserve margin for Saskatchewan's system must not fall below the reference margin level
- Reference margin level is based on the Expected Unserved Energy Criterion

Saskatchewan 2022 LTRA Highlights

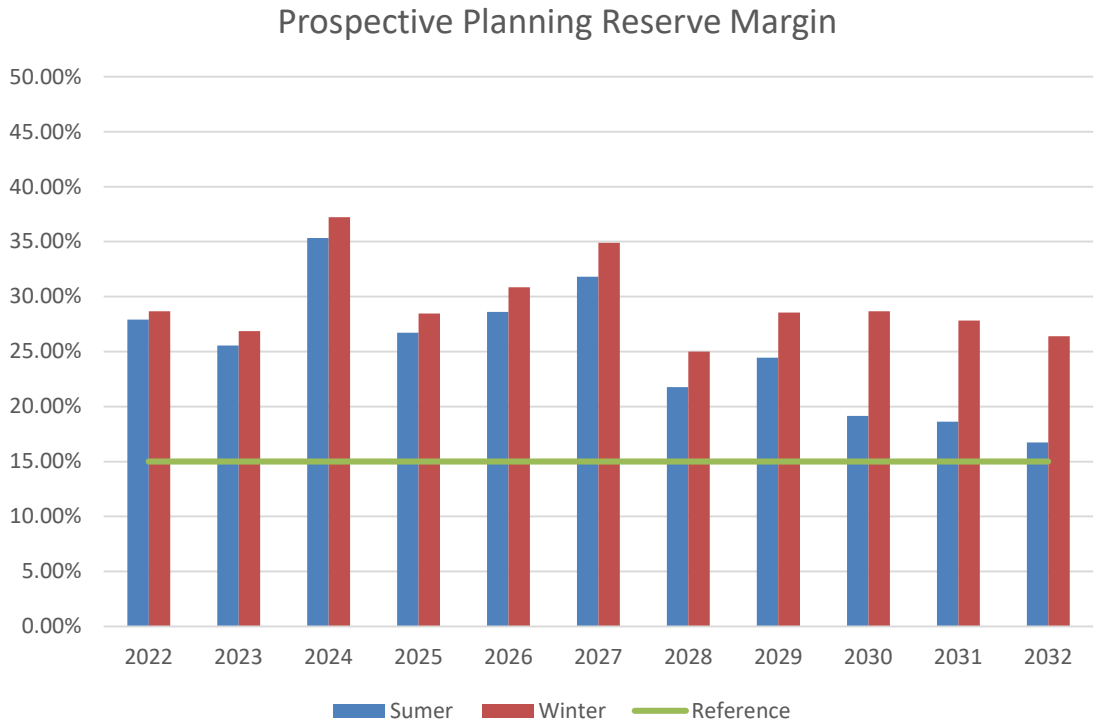
Planning Reserve Margins

- Saskatchewan's Reference Reserve Margin is 15%
- Saskatchewan has planned for adequate resources to meet anticipated load and reserve requirements
- Anticipated reserve margin ranges from 20% to 37%

Saskatchewan 2022 LTRA Highlights

Planning Reserve Margins

- Prospective reserve margin ranges from 17% to 37%



Saskatchewan 2022 LTRA Highlights

Energy Assessments

- Saskatchewan doesn't anticipate resource adequacy issues during its off-peak hours
  - Probabilistic analysis was performed to look at high Loss of Load contribution during off-peak months
  - Results showed scheduled maintenance for thermal units as a major driver, which can be mitigated by rescheduling maintenance
- Saskatchewan uses energy assessment to indicate the energy required to meet an acceptable level of unserved energy and corresponding capacity requirements to meet the reserve margin level
- As part of risk scenario analysis, SaskPower is looking at the impact of higher load growth and higher seasonal capacity derates due to hotter temperatures to test robustness of reliability criteria

Saskatchewan 2022 LTRA Highlights

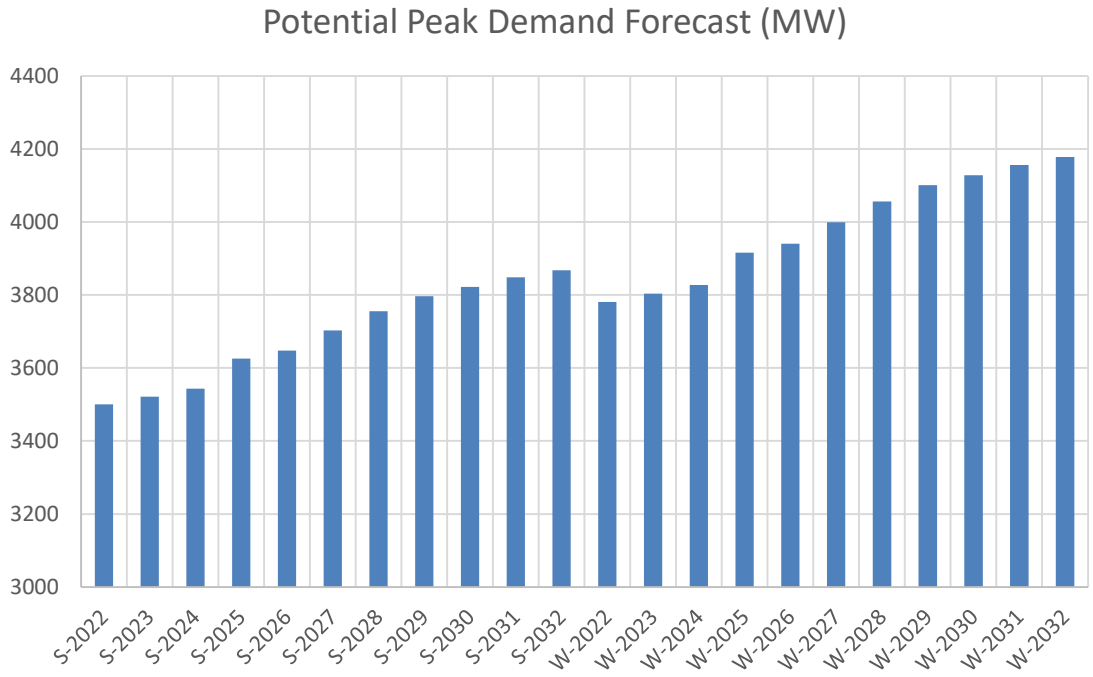
Demand (Methods & Assumptions)

- Load forecast is based on SaskPower Economic Forecast, historical energy sales, and individual customer forecasts
- Weather normalized daily peaks are computed on monthly and annual basis assuming historical average (normalized) daily weather conditions
- Winter and Summer potential peak demand forecast represents the highest level of demand placed on the supply system required by sustained cold weather in December and sustained hot weather in July.
- Net-metering generation is considered as a reduction in both peak load and energy forecasts
- Demand and energy saving from energy efficiency/energy conservation has not been considered in the Near-term.

Saskatchewan 2022 LTRA Highlights

Demand (Summary)

- Average annual growth ~1.0%



Saskatchewan 2022 LTRA Highlights

Demand Side Management and DER

Demand Response

- 67 MW of load connected to the Saskatchewan grid can be removed within 12 minutes of notification to curtail
- Additional programs with lead times of 2 hours or longer which are not included in planning reserve margin.

Distributed Energy Resources

- Saskatchewan has approximately 38 MW of BTM DER and 6 MW of non-BTM DER
- Addition of 15 MW of net metering solar PV expected over the next 5 years

Saskatchewan 2022 LTRA Highlights

Generation (Methods & Assumptions)

- Saskatchewan has planned resources to meet its planning reserve requirements
- Existing Certain units are expected to be available to meet peak demand, less the expected capacity not available due to seasonal derates or planned maintenance
- Saskatchewan considers 10% of wind nameplate capacity in the Summer months, and 20% of wind nameplate capacity in the Winter months
- On-peak expected values for hydro assume nameplate net generation less expected seasonal derates due to water conditions

Saskatchewan 2022 LTRA Highlights

Generation (Summary)

Planned new generation additions (2022-2032)

- Approximately up to 2350 MW of internal generation projected to be added (including Tier 1, Tier 2 and Tier 3) throughout the assessment period
  - 761 MW of Tier 1 additions include 467 MW Natural gas, 200 MW wind, etc
  - 1462 MW of Tier 2 additions which will be a mix of Natural Gas, Wind, and Solar
  - 130 MW of Tier 3 additions which is mainly Solar

Saskatchewan 2022 LTRA Highlights

Generation (Summary)

Projected Generation Retirements (2022-2032)

- Approximately 343 MW projected for retirement, mainly driven by end of life.
  - 139 MW of Coal, 41 MW of Natural Gas, 95 MW of steam host, 21 MW of waste heat recovery and 22 MW of wind
- Timing of retirements under consideration including 1200 MW of conventional coal and 60 MW of steam generation.

Saskatchewan 2022 LTRA Highlights

Electricity Storage

- SaskPower currently has a 20MW/20MWh battery under construction
  - Conceptual plans to expand this site by 60 MW/60MWh
- Primary use for planned energy storage is to provide frequency response/managing area control error
- Model storage as both a generator and load

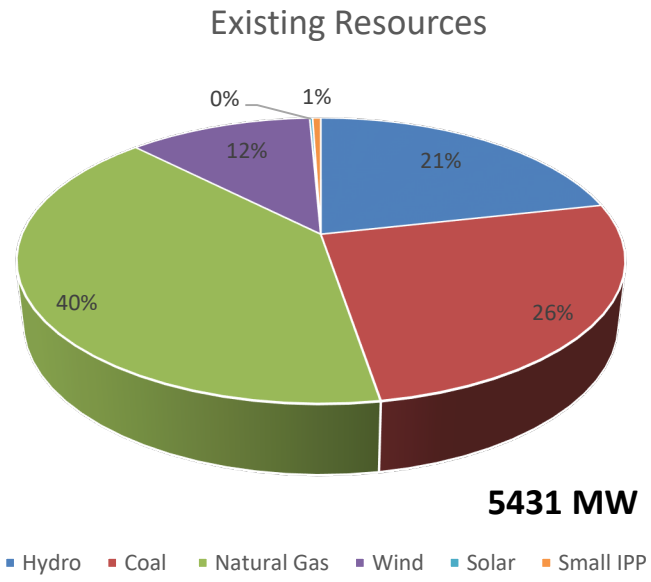
Saskatchewan 2022 LTRA Highlights

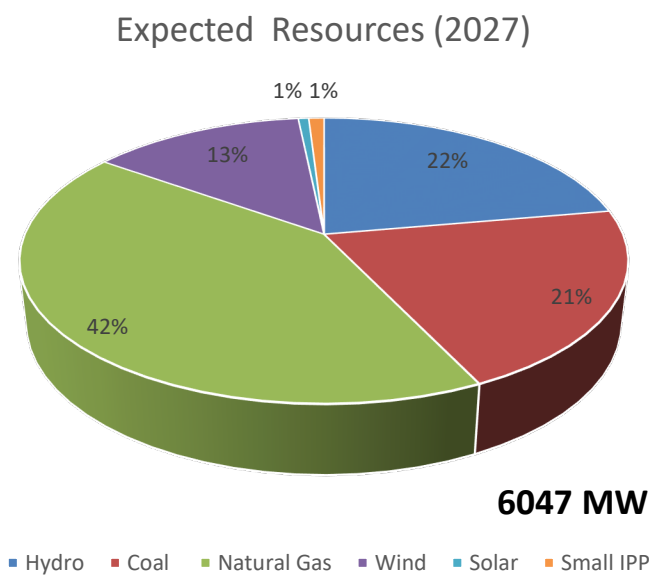
Capacity Transfers

- Transactions included in the assessment period aligns with the counterparty expectation of a firm contract
- Up to 290 MW of firm imports during the assessment period
  - 190 MW of this is new which began this summer (2022) until the end of the assessment period
- SaskPower is expanding its interconnection with SPP.
  - Two new 230 kV tie lines are being added to facilitate up to 650 MW of capacity transfers from SPP
  - The transmission service is expected to begin in October 2027

Saskatchewan 2022 LTRA Highlights

Generation Mix





Saskatchewan 2022 LTRA Highlights

Reliability Findings

- No changes to the assessment area footprint have occurred or are expected.
- Average demand growth has slightly increased compared to the previous assessment.
- Changes to the resource mix (additional wind, solar and reduced coal) is expected in Long Term Planning Horizon.
- With the planned facilities, reliability requirements are met in the assessment period.

Saskatchewan 2022 LTRA Highlights

Thank You!

CLOSING

Thank you all for attending this event!

Your feedback is very important to us. Please provide your feedback using the link: https://www.surveymonkey.com/r/K6TY3CQ or QR Code below: