Long-Term Reliability Assessment Webinar

Thursday, January 25, 2024 | 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

WebEx Login:
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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 "All Panelists." If we are unable to get all questions asked/answered during the webinar, a response will be provided later either directly to the requestor or through another form of outreach.

Presentations
All presentations from today's webinar are available in this packet. The presentations and recordings from today's webinar will be posted on MRO's website soon.

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

AGENDA

Thursday, January 25, 2024 | 10:00 a.m. to 12:00 p.m. Central

10:00 a.m. – 10:10 a.m.	**Introduction and Welcome** *Moderator: Jeremy Severson, Vice President of Transmission, Basin Electric Power Cooperative*
10:10 a.m. – 10:35 a.m.	*David Browning, Midcontinent Independent System Operator (MISO)*
10:35 a.m. – 11:00 a.m.	*Kelly Hunter, Manitoba Hydro*
11:00 a.m. – 11:25 a.m.	*Chris Haley, Southwest Power Pool*
11:25 a.m. – 11:50 a.m.	*Suman Thapa, Saskatchewan Power Corporation*
11:50 a.m. – 12:00 p.m.	**Wrap up/Questions/Feedback/Adjourn** *Moderator: Jeremy Severson, Vice President of Transmission, 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 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.

Contact Chris: chaley@spp.org

David Browning

Resource Adequacy Engineer, Midcontinent Independent System Operator

David Browning has been with Midcontinent Independent System Operator (MISO) as a Resource Adequacy Engineer for four and a half years. In that time, he has worked on administering the Planning Resource Auction (PRA), with a focus on Load Modifying Resource (LMR) accreditation and registration and Generating Availability Data System (GADS) data validation. He has also assisted with the Loss of Load Expectation study.

Contact David: dbrowning@misoenergy.org

Jeremy Severson

Vice President of Transmission, Basin Electric Power Cooperative

Jeremy Severson joined Basin Electric Power Cooperative in 2003 and is currently the Vice President of Transmission. He holds a Bachelor of Science degree in Electrical Engineering from North Dakota State University. He is actively involved in the electric utility industry and has contributed to various transmission studies, spanning planning, operations, compliance, protection, construction, and regulatory aspects. In his current role, Severson oversees Transmission System Maintenance, Transmission Services, and Transmission Rates divisions at Basin Electric.

Severson has been an engaged member and past chairman of the Missouri Slope Section of IEEE and has participated in various technical groups and committees with SPP, MISO, MRO, NATF, NERC, and WECC.

Contact Jeremy: JSeverson@bepc.com

Kelly Hunter

Senior Engineer, Manitoba Hydro

Kelly is a Senior Engineer who has been with Manitoba Hydro for over 30 years and currently has responsibilities for market and resource adequacy analysis with Manitoba Hydro's Resource Planning Department. 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.

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

Contact Kelly: khunter@hydro.mb.ca

Suman Thapa

Senior Engineer, Saskatchewan Power Corporation

Suman Thapa works as a Senior Engineer in SaskPower's System Planning and Asset Management Department and has been with SaskPower for ten years. His work at SaskPower focuses on Transmission System Planning, Generation Interconnections, and Interconnections with adjacent areas. His work also includes reliability assessments for several NERC Reliability Standards (TPL, PRC and MOD) that are adopted in Saskatchewan. Thapa represents SaskPower on the SaskPower-Manitoba Hydro Planning Committee and Canadian Utility Forum.

Thapa received a Ph.D. in Electrical Engineering from the University of Saskatchewan and is a registered Professional Engineer in Saskatchewan.

Contact Suman: sthapa@saskpower.com

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Midwest Reliability Organization (MRO) is committed to providing outreach, training, and non-binding guidance to industry stakeholders on important industry topics. Subject Matter Experts (SMEs) from MRO's organizational groups and the industry may develop materials, including presentations, provided as a part of the event. The views expressed in the event materials are those of the SMEs and do not necessarily express the opinions and views of MRO.

PRESENTATIONS

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

MIDWEST RELIABILITY ORGANIZATION

MRO Reliability Advisory Council (RAC) Webinar

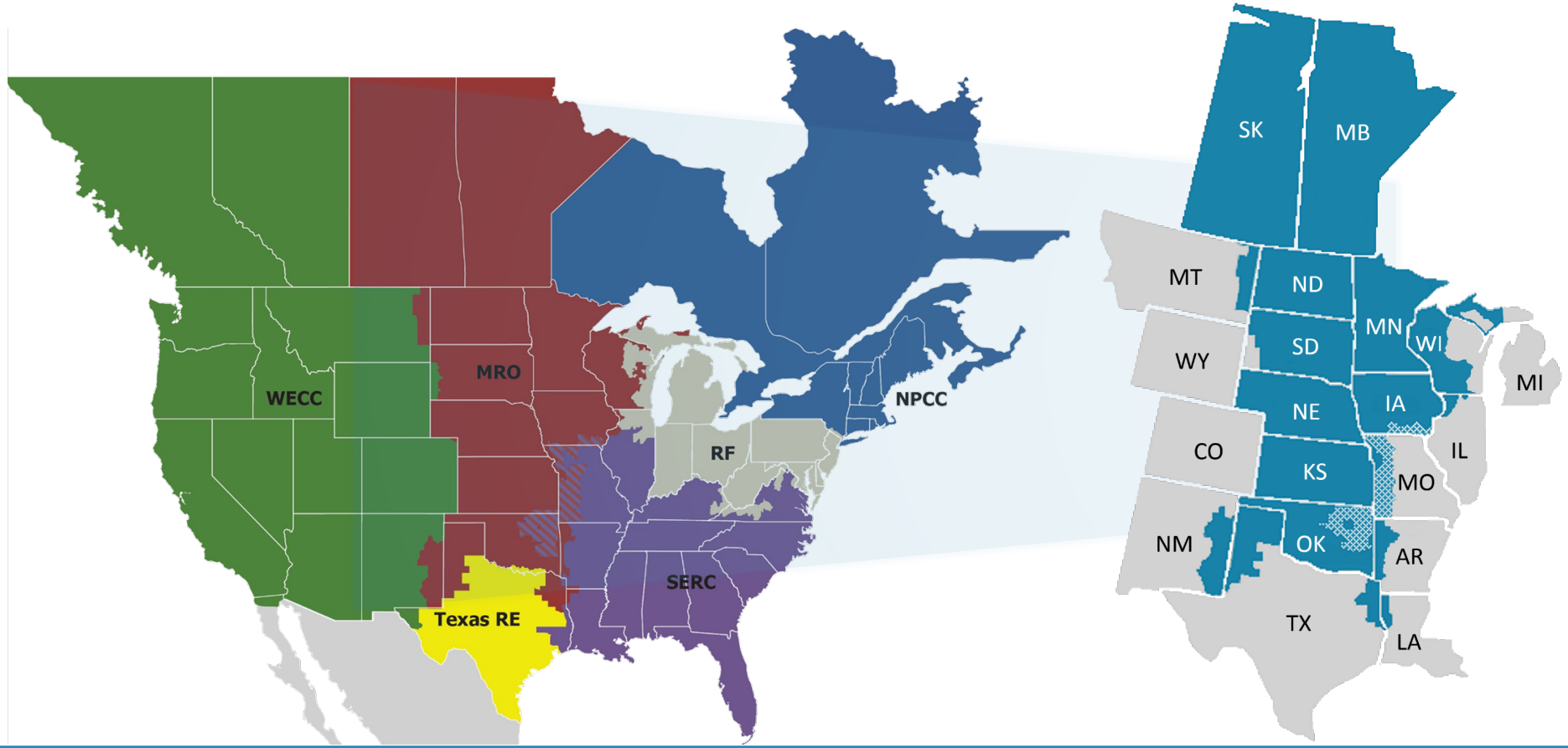
2023 Long-Term Reliability Assessment Overview

January 25, 2024

CLARITY | ASSURANCE | RESULTS

Manager of Outreach and Stakeholder Engagement

Cris Zimmerman



The ERO Enterprise and MRO

MRO's Mission Supports the Vision

To identify, prioritize and assure effective and efficient mitigation of risks to the reliability and security of the North American bulk power system by promoting Highly Effective Reliability Organizations™ (HEROs).

HERO

HIGHLY EFFECTIVE RELIABILITY ORGANIZATION

- MRO's HERO Award recognizes individuals from industry that have shown exemplary commitment to reliability and security of the regional bulk power system.
- The qualifications are based on the theory and principles of High Reliability Organizations: https://www.mro.net/about/hero/annual-hero-award/

Previous HERO Award Winner

- **Rowley is an active member of the RAC and led the council's effort to develop MRO's Reliability Risk Matrix.**
- **The Risk Matrix is used to identify and prioritize reliability and security risks in the Regional Risk Assessment.**
- **The tool has been shared with others across the ERO Enterprise.**

Dallas Rowley
Director of System Operations, Oklahoma Gas & Electric

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Nominate Someone Today!

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MRO Upcoming Events

- **Q1 2024 Outreach Events**
  - Feb 28 (9 -10 am): Regional Risk Assessment (RRA) Webinar
  - Feb 29 (10 - 11 am): Defending Against Ransomware Webinar
  - March 20 (8 am - 4 pm): RAM Virtual Conference
- **2024 Reliability Hybrid Conference**
  - May 14 (5 - 7 pm): Conference Reception, St. Paul
  - May 15 (8 am – 4 pm): Conference, MRO Offices St. Paul, MN

Disclaimer Slide

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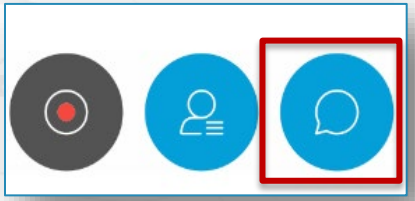
WebEx Chat Feature

Open the Chat Feature:



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

Attendees should chat their questions to: “All Panelists”.

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

2023 Long-Term Reliability Assessment Overview

- Jeremy Severson, Vice president of Transmission, Basin Electric Power Cooperative and MRO RAC Member
- David Browning, Midcontinent Independent System Operator
- Kelly Hunter, Manitoba Hydro
- Chris Haley, Southwest Power Pool
- Suman Thapa, Saskatchewan Power Corporation

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 Assessment (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

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

Assessment Area Summary

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

Questions?

2023 MISO LTRA

NERC MRO

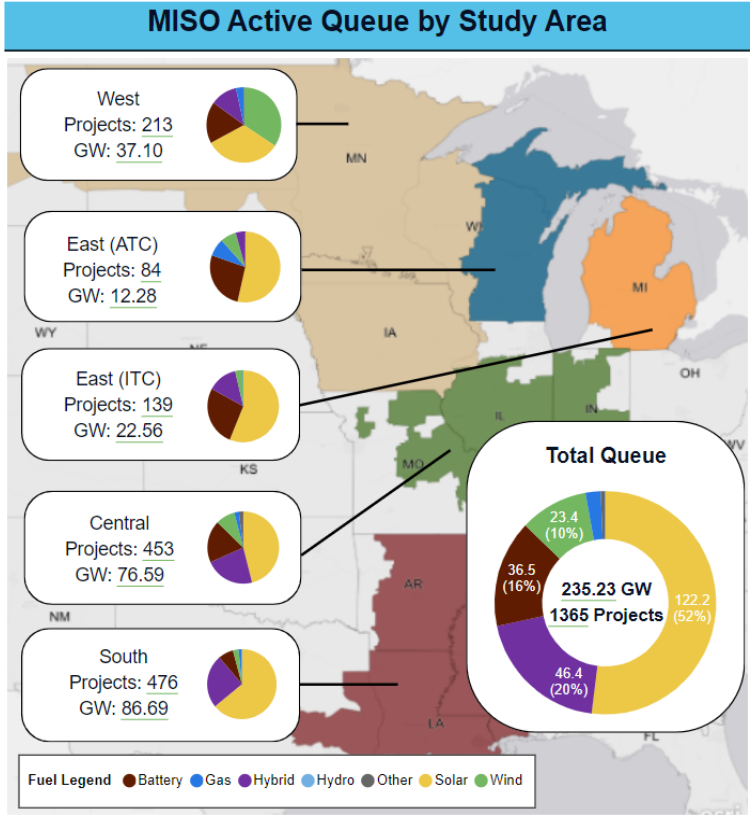
January 25, 2024

Executive Summary

- MISO is projecting sufficient capacity in the near term while falling below the reference margin mid to long term
- MISO's capacity market is now seasonal and LTRA inputs updated
- Capacity deficits are projected to widen in subsequent years, consistent with past LTRA results
- Prospective queue capacity additions will contribute to alleviating the deficit.
  - 49+ GW resources with executed GIA's
  - 235+ GW in Queue for study

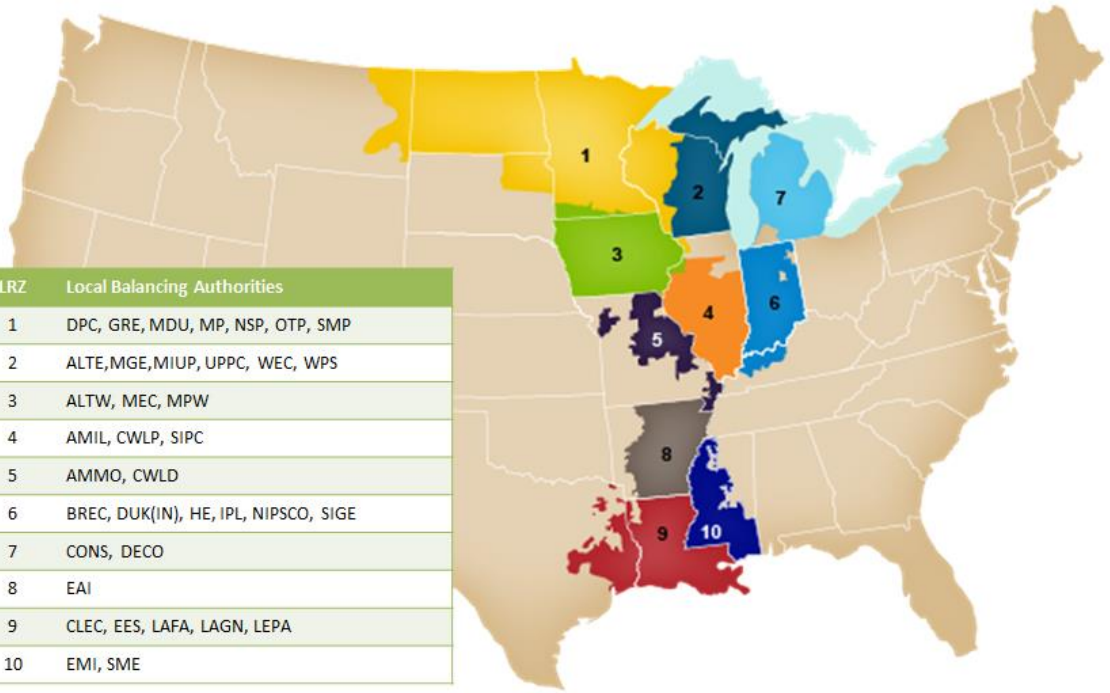
Key Takeaways

- MISO's Anticipated Reserve Margin at 20% is sufficient through 2027. The Prospective Reserve Margin at 19% is sufficient through 2028.
- Fleet mix is changing; thermal resources largely being replaced by wind, solar, hybrid and storage from the queue
- The regional resource adequacy picture will evolve as LSEs and states continue to firm up their plans in the face of existing risks.
- New to the 2023 LTRA, MISO is derating capacity in the queue depending on what phase it is in, and account for the capacity over time following OMS-MISO process



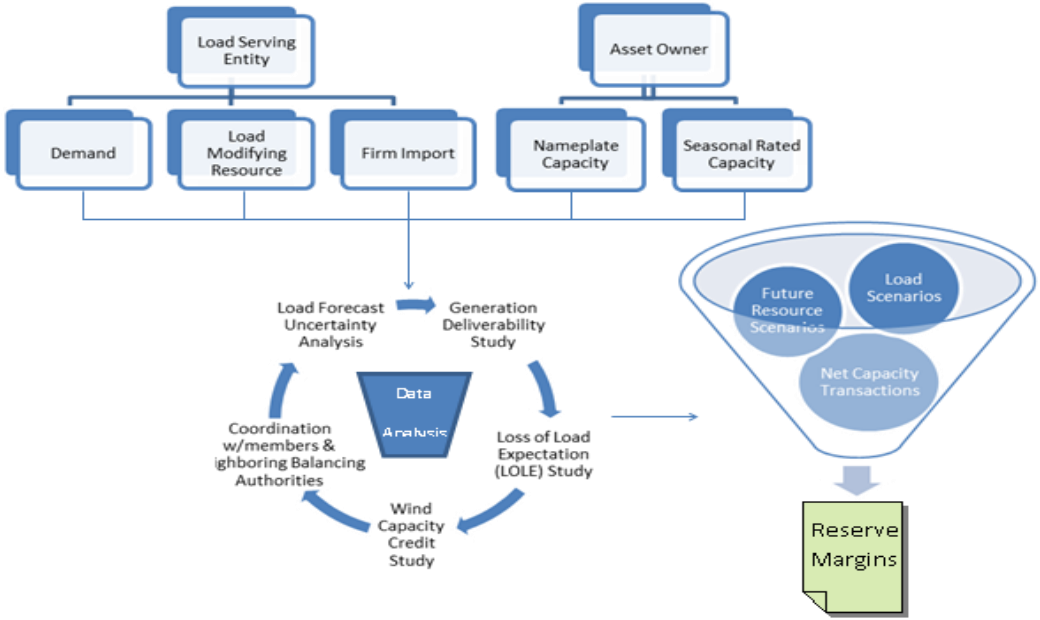
MISO 15-State Resource Zone Footprint

LRZ	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, DUK(IN), HE, IPL, NIPSCO, SIGE
7	CONS, DECO
8	EAI
9	CLEC, EES, LAFA, LAGN, LEPA
10	EMI, SME



Assessment Process

- A combination of member supplied data and internal processes are used to analyze the data to forecast these reserve margins.



New Changes to MISO's LTRA Reporting

- Inputs are following MISO's changes to seasonal auctions providing season specific accreditation and Planning Reserve Margins
- With the large Generation Interconnection Queue and GIA resources, prospective new resources are derated
  - 10% Study not Started and Phase 1
  - 50% Phase 2 for intermittent, 75% for all others
  - 90% for phase 3 and GIA
    - These new resources are now counted over time from COD date
      - GIA: 80% +1 year, 95% +2 years, 100% after 3 years
      - In Queue: 30% +1 year, 60% + 2 years, 100% + 3 years

Seasonal variations in renewable accreditation, load and PRMs for PY23-24

- New Solar

Summer	Fall	Winter	Spring
50%	50%	5%	50%

- Wind ELCC

Summer	Fall	Winter	Spring
18.1%	23.1%	40.3%	23%

- New Batter Storage
  - 95% in all seasons

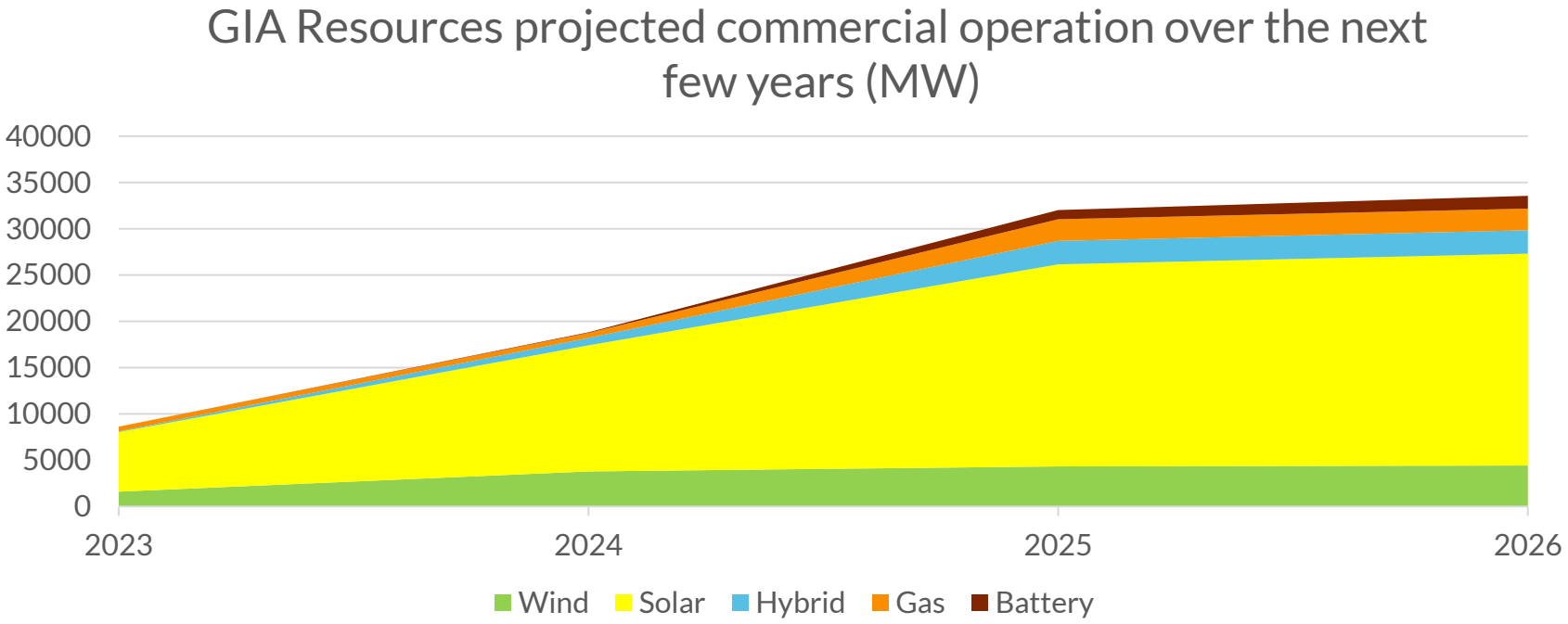
- Coincident Peak Load + Transmission Losses

Summer	Fall	Winter	Spring
123,735	109,483	102,075	99,911

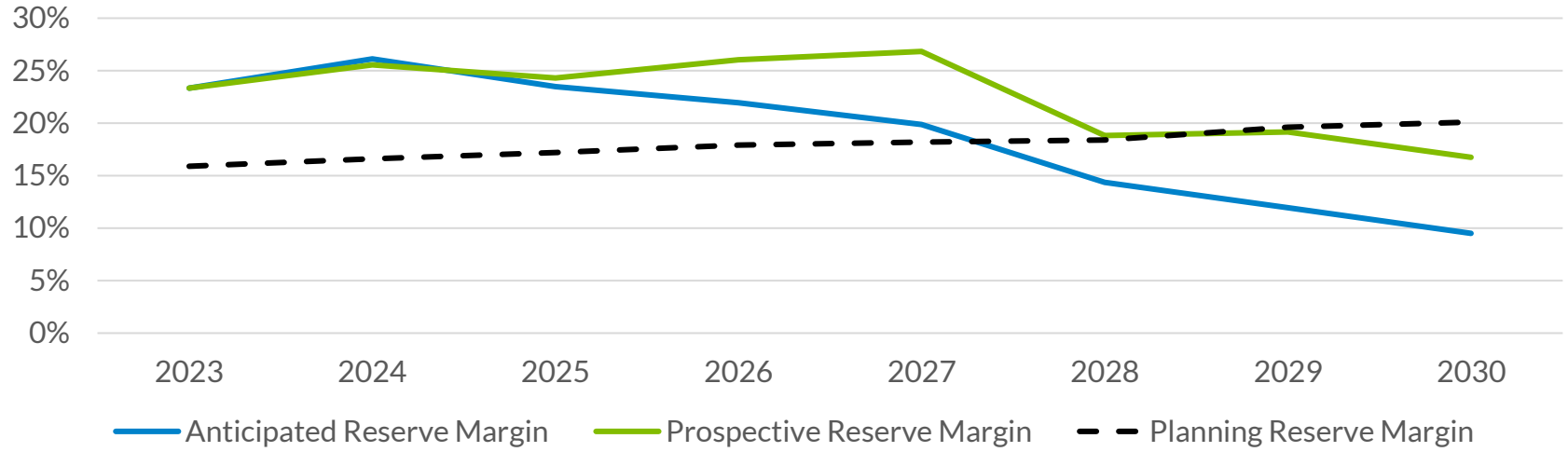
- Planning Reserve Margin ICAP

Summer	Fall	Winter	Spring
15.9%	25.8%	41.2%	39.3%

Uncertainty around delays and when new resources will come online to meet RA requirements

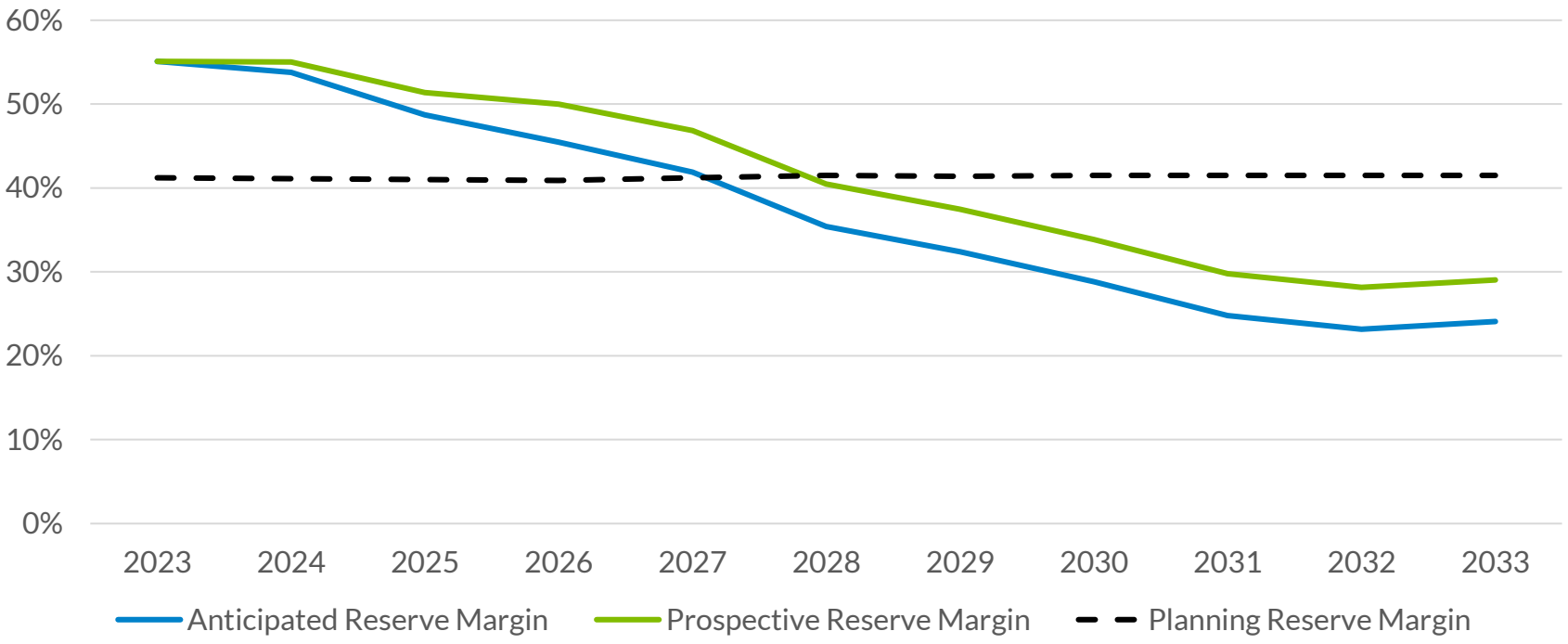


Summer Planning Reserve Margin



- The Planning Reserve Margin is derived form the MISO LOLE Study on a seasonal basis
- MISO Reserve Margin may fall short of the 18% requirement after 2027 then continue to fall short without new generation
- The LTRA represents a point in time forecast changing significantly as capacity plans solidify with load-serving entities and States

Winter Planning Reserve Margin



Energy Risk and Reliability Issues

- MISO's 2023-24 Planning resources auction demonstrated sufficient capacity to meet reserve margins across all seasons
- New 31-day outage rule and Schedule 53 accreditation process encourages stakeholders to be more strategic when planning outages
- LMR accreditation changes allows MISO to call upon them during times of need up to 16+ times throughout the year
- Seasonal accreditation sheds more light on risk during all times of the year
- MISO does not anticipate energy risks in the near term (1-2 years)

https://cdn.misoenergy.org/2023%20Planning%20Resource%20Auction%20(PRA)%20Results628925.pdf

Planning Reserve Margin – Reference Margin Levels

- Member responses project a regional shortfall for the summer of 2026, then potential for continued deficiencies or surpluses depending on solidification of member plans.
- Anticipated Reserve Margin shows sufficient capacity longer into the study horizon
- With the new changes the prospective reserve margin is more useful and realistic showing sufficient capacity
- Results are driven by three main factors:
  - A decrease in committed resources
  - An increasing reliance on lower capacity contribution resources
  - Delays in new resources coming online

Planning Reserve Margin – Methods and Assumptions

- Per Module E-1 of the MISO Tariff, MISO performs a probabilistic analysis annually using the Loss of Load Expectation (LOLE) study to determine the appropriate Planning Reserve Margin (PRM) for the prompt year and future years.
- 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, split out by season
- The ICAP PRM increases from 15.9% in 2023 to 20.1% in 2030. 2022 LTRA was around 18% throughout the study horizon

Demand – Load Forecasts

- MISO does not forecast load; Load Serving Entities (LSEs) report load projections under the Resource Adequacy Requirements section (Module E-1) of the MISO Tariff.
- DER is not included in the load forecast
- Slight changes in demand forecast over last year
  - Still modest growth, lack of significant electrification
    - 5-year growth rate still very low at 0.3-0.5% CAGR
- Peak load has come in less than last years LTRA but projects to increase slowly over the study horizon

Load Modifying Resources – Demand Response and Behind the Meter Generation

- MISO Separates Demand Response resources into two categories
  - Direct Control Load Management
  - Interruptible Load
- LMRs are registered in the MECT and their availability updated daily in the DSRI tool
  - To receive SAC accreditation LMRs need a response time of at most 6 hours and be available for a minimum of 5 interruptions in the Summer and winter, and 3 interruptions in the Fall and Spring
- MISO is improving modeling and collecting information on LMRs
- MISO has roughly
  - 8.3GW; Demand Response
  - 4.2 GW; Behind the Meter Generations
    - Approximately 1,200MW of distributed solar
  - 5MW of Energy Efficiency

Transmission Updates

- LRTP Tranche 1, a $10.3B transmission portfolio is approved as part of MTEP21 oriented in MISO North/Central regions
- LRTP Tranche 2 study is under development
- JTIQ joint study (~$1B) with SPP in cost allocation phase
  - DOE grants MISO & SPP $460M in funding
- MTEP2023 approved $9B in transmission
  - South was 47% of total investment
  - $1.7B baseline reliability projects
  - $1B in new load growth
  - $1.2B from the generation interconnection queue

https://cdn.misoenergy.org/MTEP23%20Full%20Report630587.pdf

Reliability Based Demand Curve and Intermittent Resource Accreditation underway

- RBDC went through scoping and design in the stakeholder process. The initial filling occurred in Q4 of 2023 with FERC with effective date of 1-2 years.
- Non-thermal accreditation is currently being worked on and developed through out stakeholder process, with hopes to be implemented in 2-3 years

Questions?

Manitoba Hydro's 2023 Long Term Reliability Assessment

Presented to Midwest Reliability Organization's (MRO) Reliability Advisory Council (RAC)

January 25, 2024

Kelly Hunter

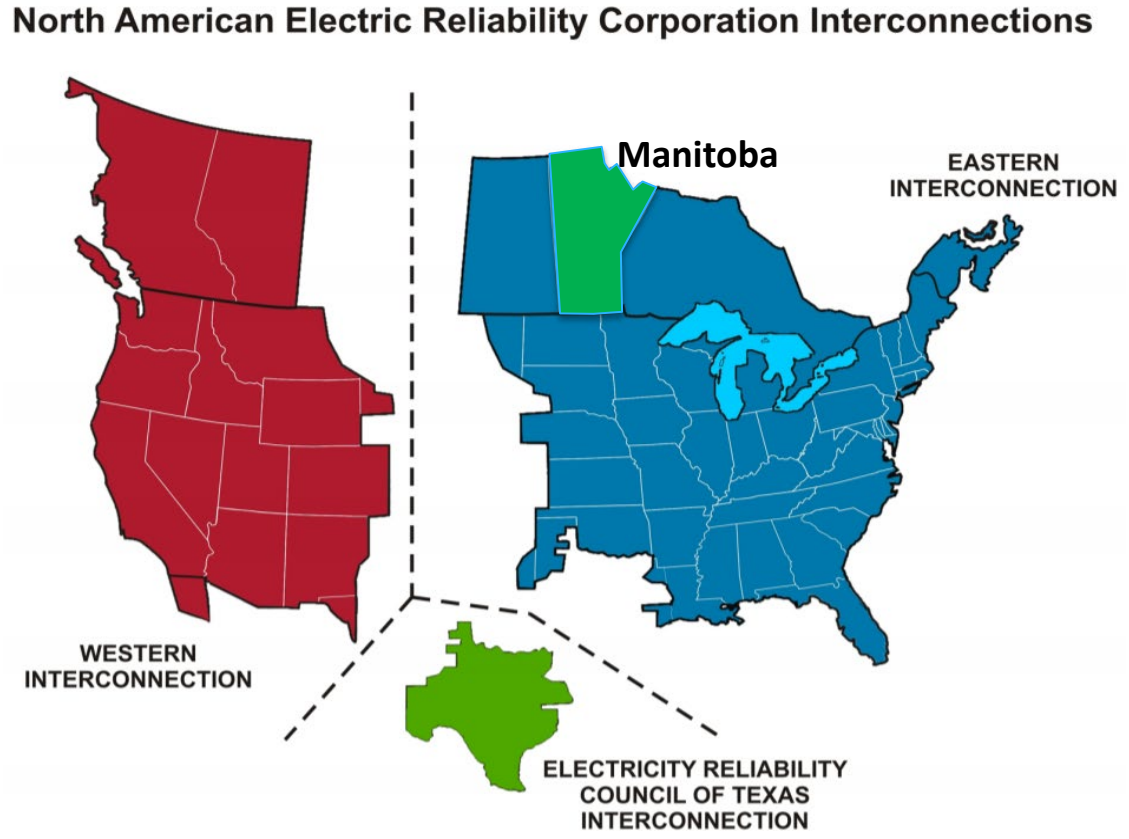
Energy Resource Planning

Manitoba Hydro

Assessment Area Overview

- 608,500 electric customers
- Anticipated generation capacity:

  ~6100 MW Winter



Assessment Area Overview: Manitoba

- Predominantly hydroelectric system
- 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

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
- Completed an IRP process subsequent to assessment – results incorporated for next planning year

Assessment Process

Annual supply and demand analysis to meet Manitoba Hydro's generation planning criteria for the long-term planning horizon

Key Inputs:

- Electric Load Forecast
- Demand Side Management Forecast
- Resource Capabilities: MISO Generation Verification Test Capacity (GVTC)

Prepare transmission system reliability studies periodically as part of applicable NERC and Manitoba Standards

Planning Reserve Margin

- 12% Reference Margin Level
  - Higher than 10% default for predominately hydroelectric systems
- Reference Margin Level 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)
- Probabilistic Assessment also tracks annual loss of load hours (LOLH) and the expected un-served energy (EUE)
- 12% Reference Margin Level reviewed by the Manitoba Public Utilities Board

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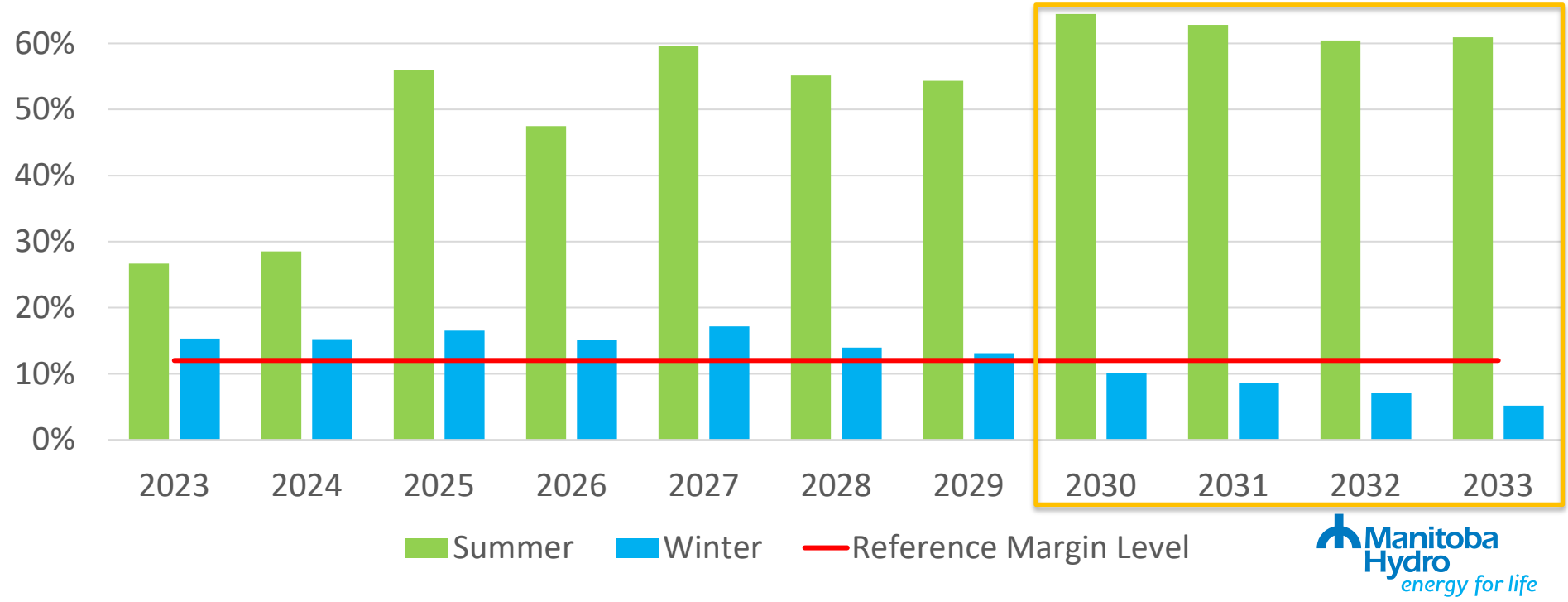
Anticipated Reserve Margin

Manitoba Hydro exceeds the 12% Reference Margin Level until Winter 2030-31



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Energy Risk

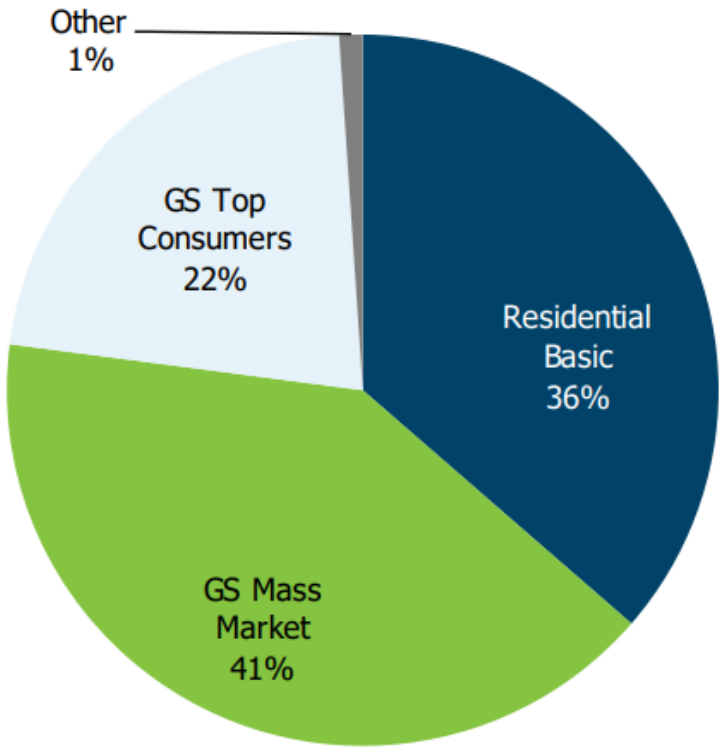
- Predominately hydro system – main energy risk is low water conditions/low water inflows/drought
- Primary drivers of an energy adequacy event would be an extended cold weather event in winter combined with a severe drought condition
- In addition to the Reference Margin Level of 12%, Manitoba Hydro also has an Energy Criterion
  - Plan to the worst system wide inflow conditions of > 100-year hydrologic record

Energy Risk Analysis

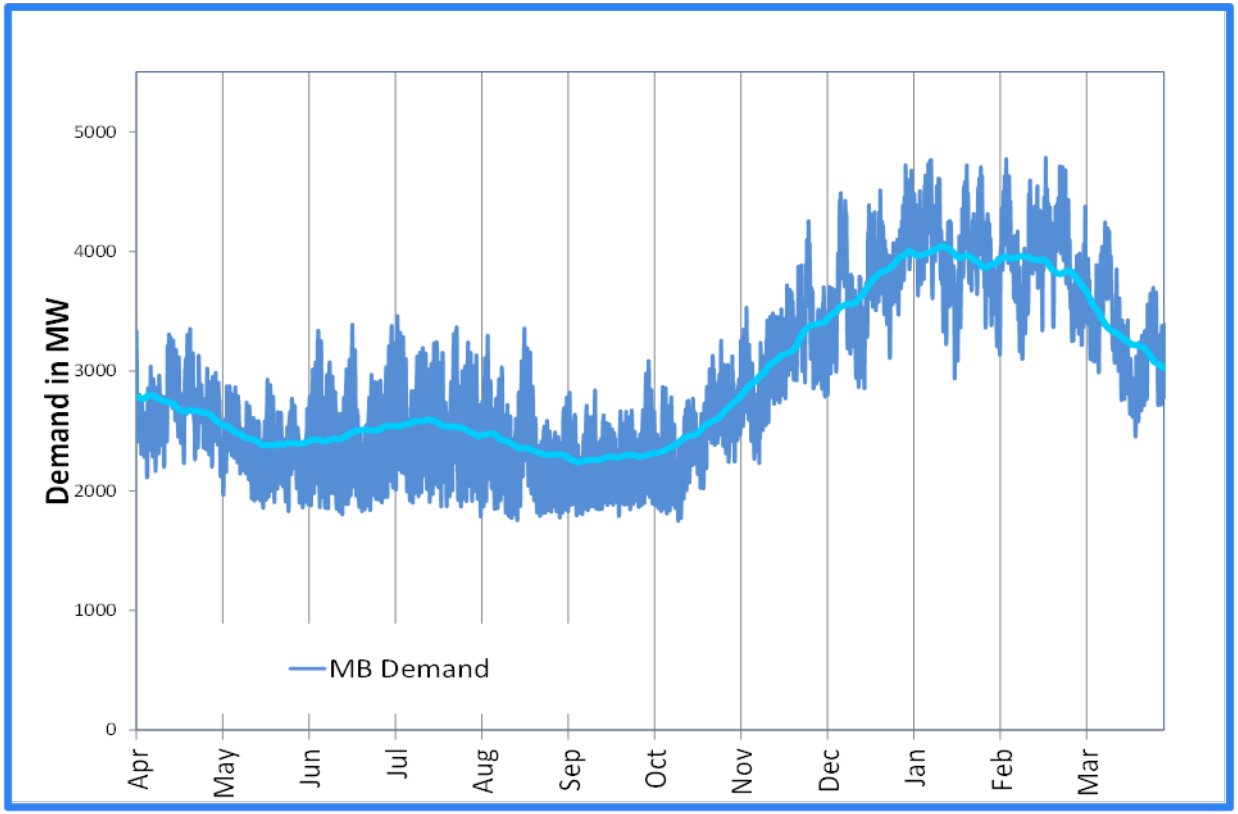
- Performed Weekly: All-hours season ahead energy adequacy analysis to manage near term to seasonal reservoir energy storage while meeting system demands
  - Production costing tools use representations of water inflows, reservoir levels, hydro generator power output curves, electric load, wind and thermal generation, operational constraints, transmission interchange limitations, generation and transmission outages, and external region factors
- Energy assessments/analysis results in timing of releases of water from reservoir storage for use at hydro stations, informs 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

- 50/50 electric load forecast
- Weather normalized
- Considers population growth, electricity rates, economy, behind-the-meter generation, electric vehicles, provincial and federal policies
- Primarily based on three market segments:
  - Residential
  - General Service Mass Market
  - Top Consumers



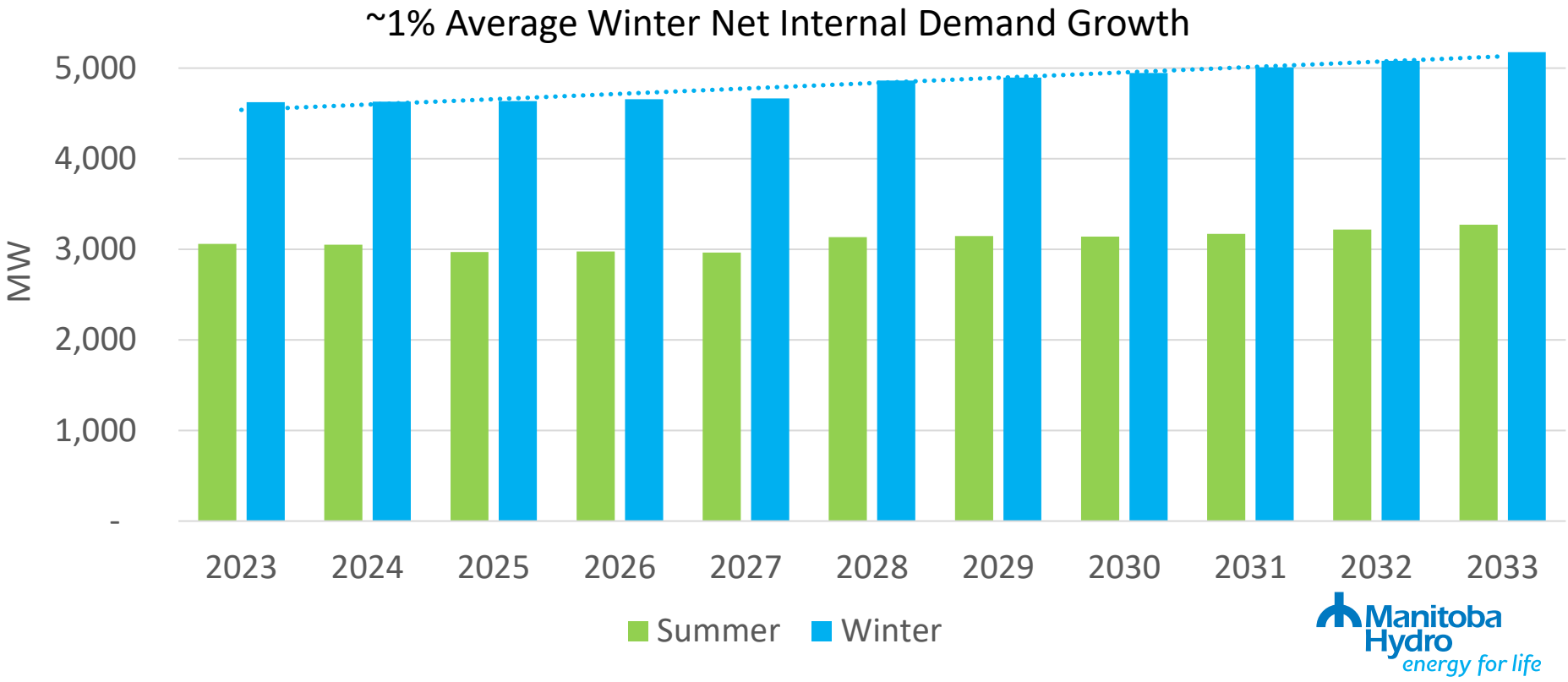
Actual Demand: Winter Peaking



Demand Side Management

- No directly controllable and dispatchable demand response
- Indirectly controlled Curtailable Rate Program
- 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 undertaken by an independent third-party evaluator contracted by Efficiency Manitoba

Net Internal Demand



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Distributed Energy Resources (DER)

- DER and behind the meter generation:
  - 36.4 MW AC of solar PV (<200 kW)
  - 17.3 MW residential
    19.1 MW commercial
  - Modest solar growth anticipated in next 5 years
  - Solar has zero impact at winter peak

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Manitoba Hydro's Generation is Predominantly Hydroelectric

Resource	Nameplate Capacity MW	Accredited Winter Capacity MW	Number of Generating Stations
Hydro	6190	5774	15
Natural Gas	280	278	1
Wind	259	52	2 Wind Farms
Total	**6744**	**6104**	**18**

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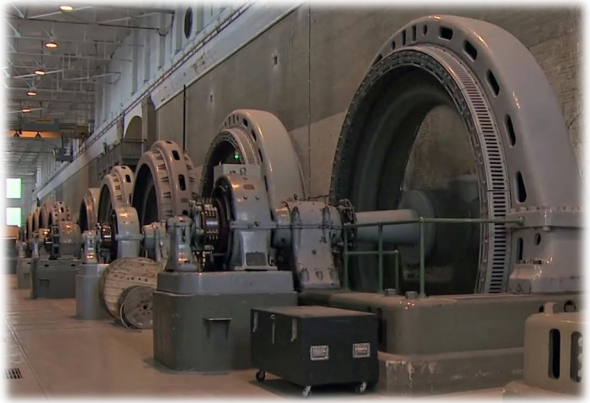
Generation Additions and Unconfirmed Retirements



- Keeyask Generating Station (new)
  - 630 MW summer / 619 MW winter
  - All units now in Commercial Operations
- Pointe du Bois Generating Station (existing)
  - Eight-unit replacement project, +~50 MW
    - Anticipated by 2027/28
  - Unconfirmed retirements: ~25 MW by 2029
    - End of life: > 100 years of service

Wind Capacity Accreditation

- For summer season:
  - 18.1% percent based on the Effective Load Carrying Capability (ELCC) analysis in MISO's Planning Year 2023-2024 Wind and Solar Capacity Credit Report
- For winter season:
  - 20% 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

- 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
- Assume a capacity value of 35% for utility scale solar generation during summer season
- Assume a capacity value of 0% during winter season

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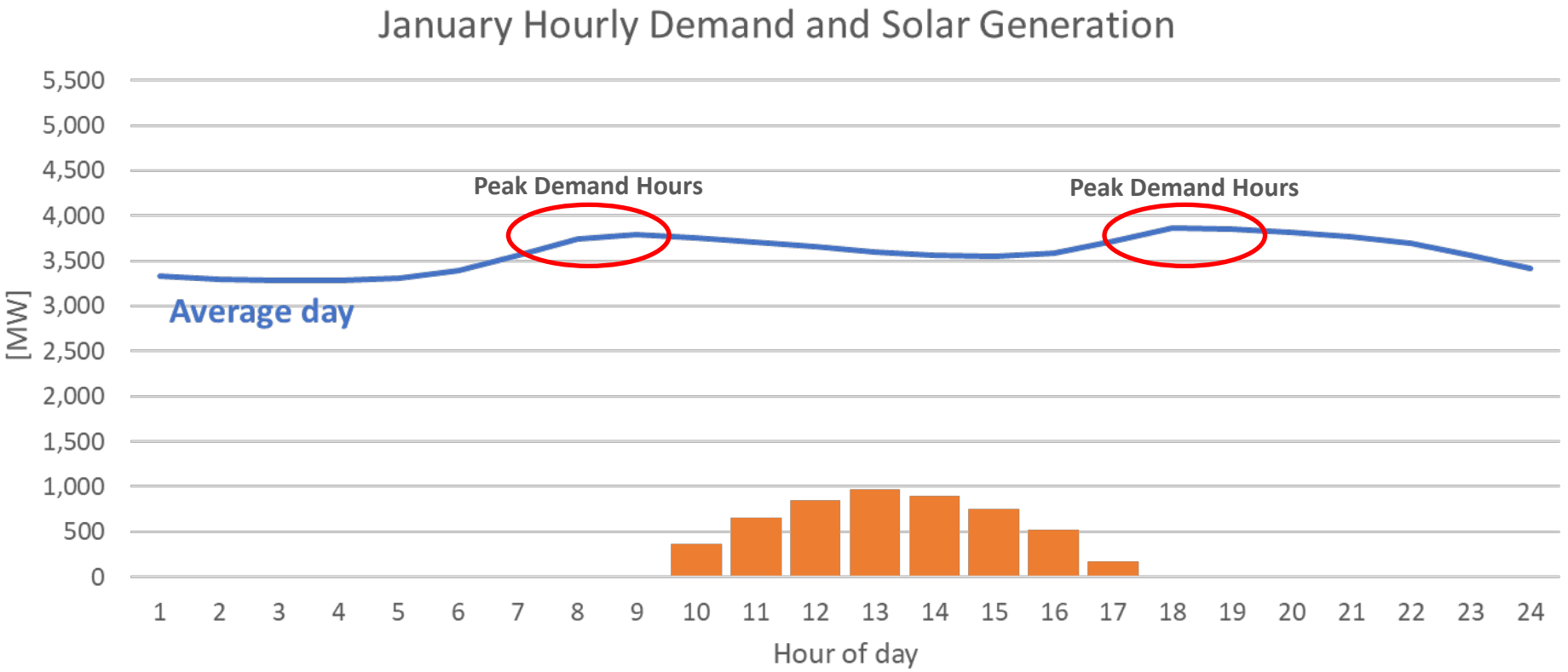
Solar has a zero-capacity value during winter because Manitoba load typically peaks in January before sunrise or after sunset



Energy Storage

- Currently no traditional energy storage resources
- No plans for energy storage in the next 10-years
- No detailed studies for energy storage resources to date
- Hydroelectric system has energy in storage in the form of water in its reservoirs, which can be converted into energy when released

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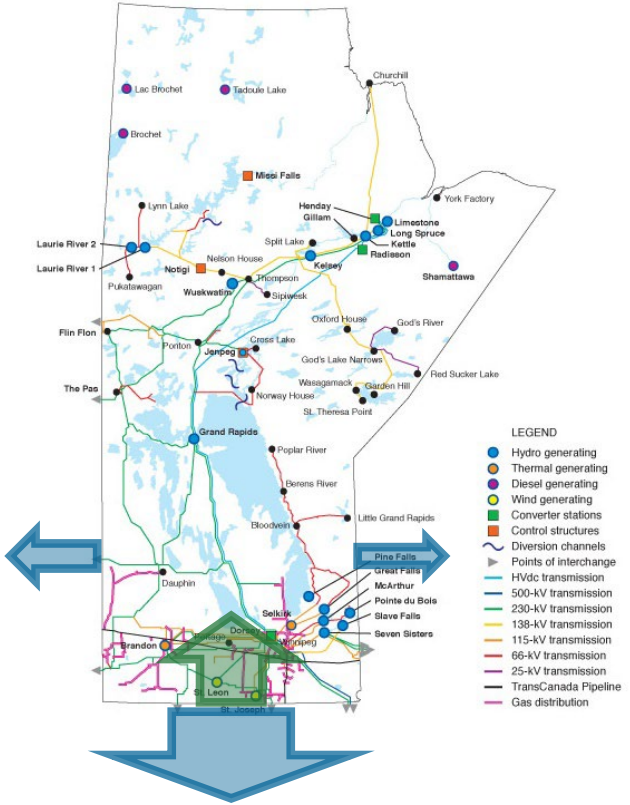
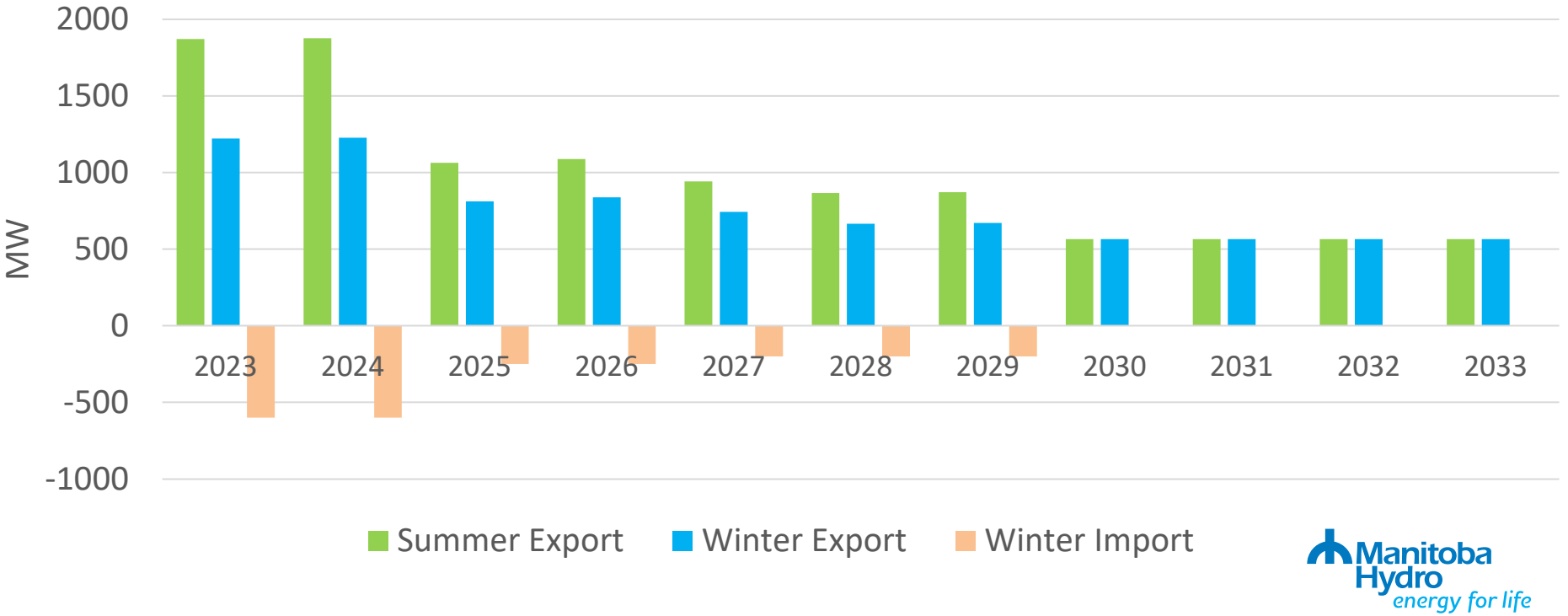
Capacity Transfers

- Firm imports/exports
  - More exports in summer when Manitoba peak load is lower
- All capacity transfers coordinated, reviewed, vetted by neighbouring Assessment Areas
  - SaskPower
  - MISO



Capacity Transfers



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Transmission

- Manitoba Hydro prepares transmission system reliability studies periodically as part of applicable and mandatory Manitoba and NERC Reliability Standards including but not limited to the following:
  - Transmission planning assessment every year
    (MH-TPL-001-4 Transmission System Planning Performance Requirements)
  - Under frequency load shedding (UFLS) design assessment every five years
    (PRC-006-5 Automatic Underfrequency Load Shedding)
  - Physical security risk assessment every three years
    (CIP-014-2 Physical Security)
  - Review of Remedial Action Schemes (RAS) every five years
    (PRC-012-2 Remedial Action Schemes)
  - Geomagnetic disturbance (GMD) vulnerability assessment every five years
    (MH-TPL-007-2 Transmission System Planned Performance for Geomagnetic Disturbance Events)

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Transmission

- Several transmission projects projected to come online during the assessment period
  - Expand the transmission system to reliably serve growing loads
  - Improve export/import capability
  - Increase efficiency
  - Connect new generation (e.g. Point du Bois 8 Unit replacement)
  - Improve safety
- No anticipated reliability issues due to variable renewable energy
- No transmission limitations or transmission constrained areas identified

Manitoba Hydro
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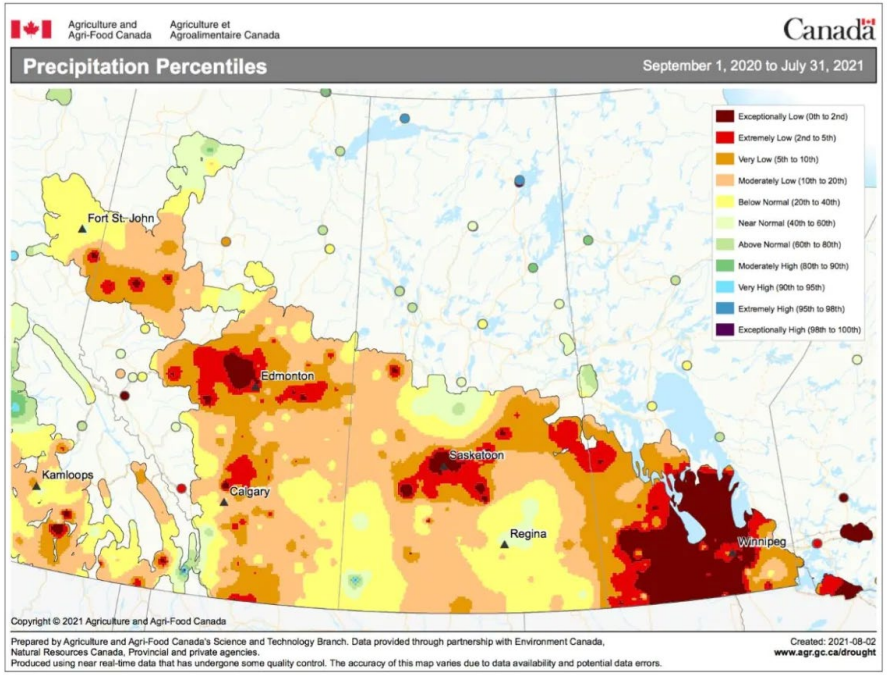
Reliability Issues



Precipitation during 2021 Drought

- Low inflows / severe drought
- Prolonged extreme cold weather
  - -40 °C temperatures occur
  - Feb 2021 and Dec 2022 polar vortex temperatures not the coldest in last 4 years
  - January 2024 – record cold in Alberta – not Manitoba
- Flow variability – changed from drought (2021) to flood condition (2022) in 6 months
- Regional- Transition to winter peaking

Manitoba Hydro
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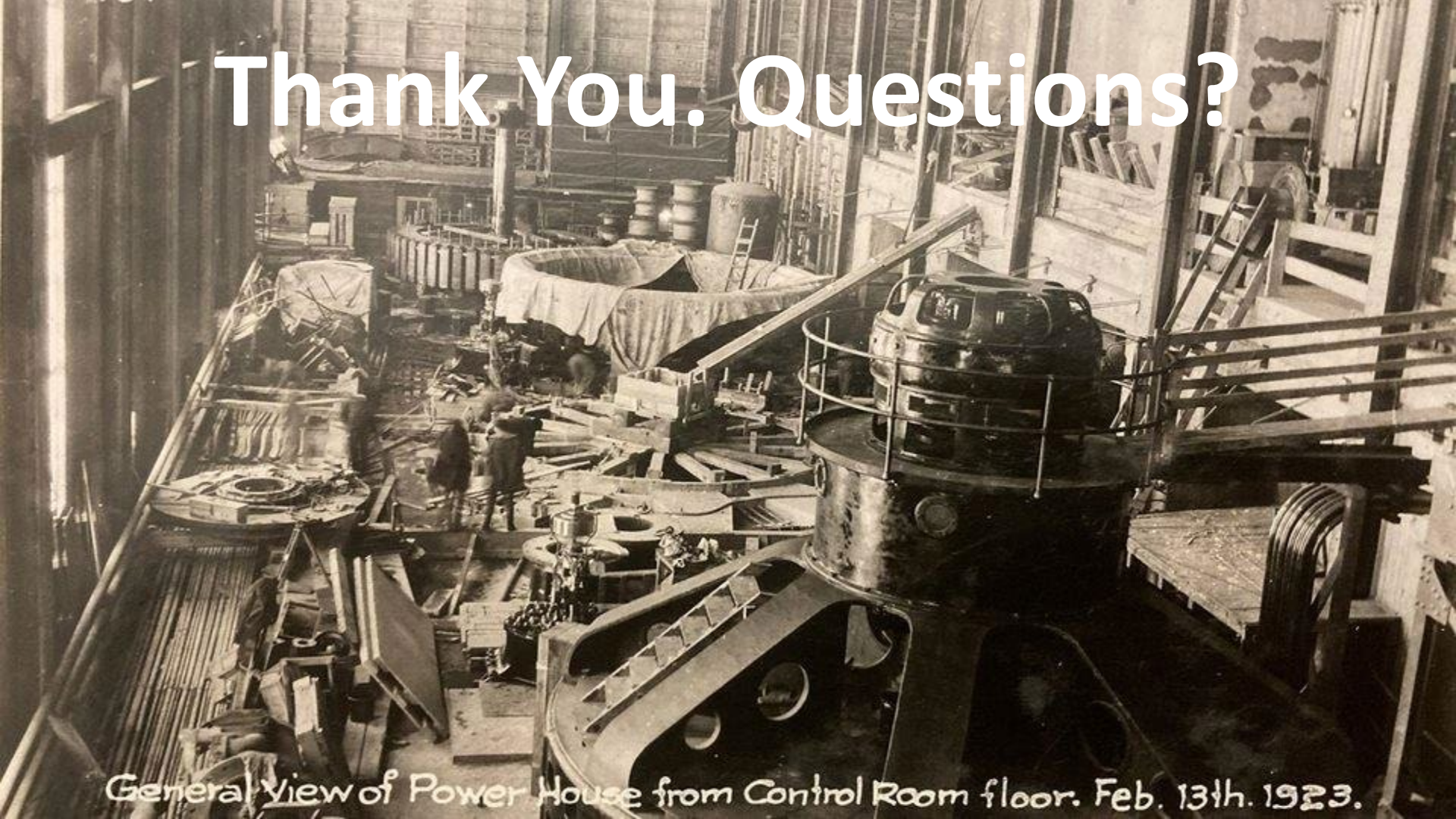
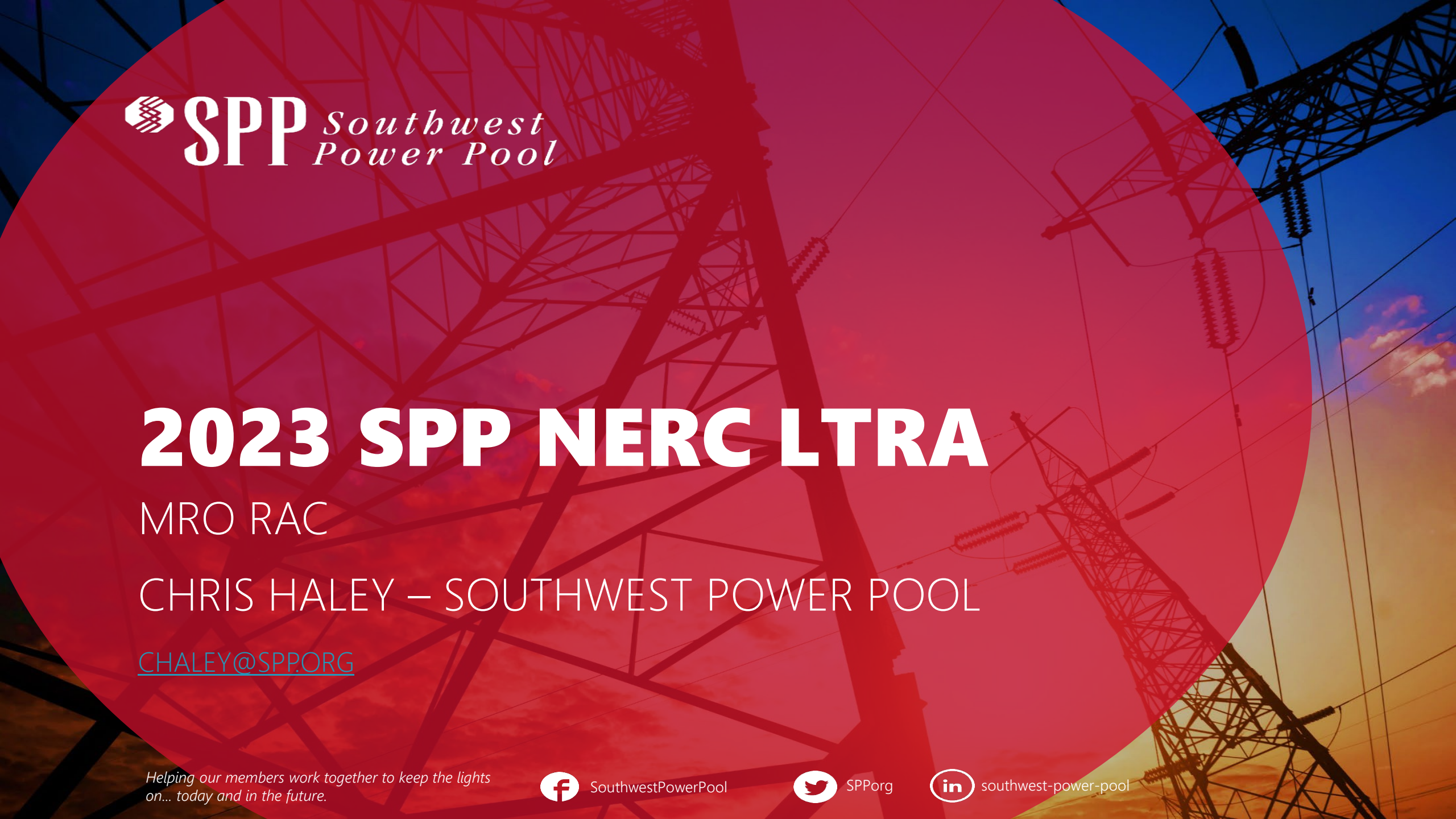
Thank You. Questions?





2023 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 set new renewable peaks in March of 2023 and with this has seen increased operational challenges

- Currently just over 32GWs of wind on the system

In the 2023 LTRA, SPP, as a Planning Coordinator, is projected to fall below the target Reserve Margin in 2031.

- This is based on the Existing Certain Reserve margin, the Anticipated Reserve Margin remains above target for the entire assessment timeframe.

SPP and ERCOT continue to communicate and maintain a coordination plan, which was recently updated

- 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

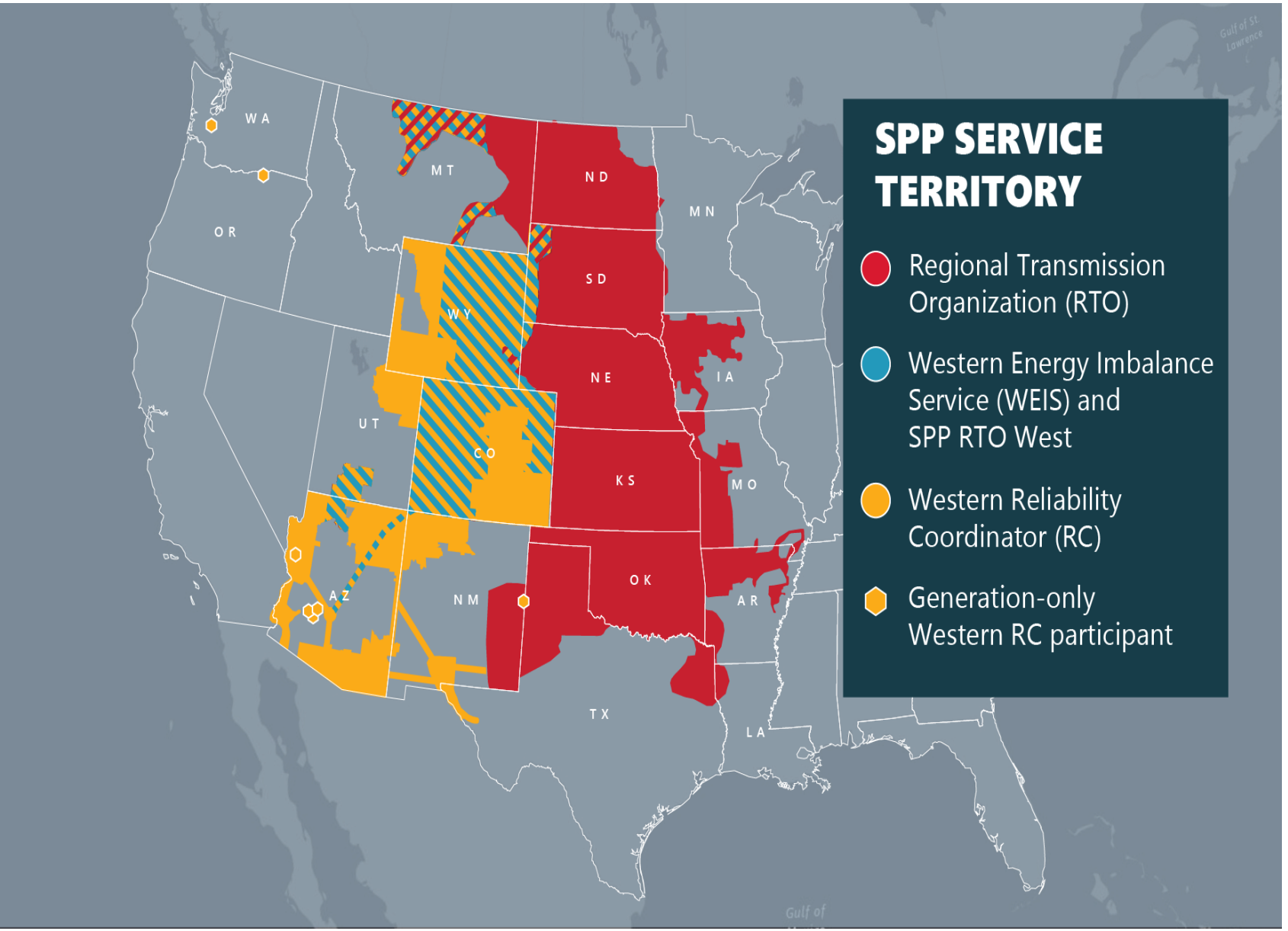
The SPP Assessment Area coordinates with neighboring areas to ensure that adequate transfer capabilities are available

- 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 set peak load records in 2022 and 2023 for the winter and summer seasons

- This month SPP set an all time peak for the month of January

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

Over the assessment timeframe the confirmed and projected retirements total ~1,391MWs

- Unconfirmed retirements total ~ 3,788MWs
- Does not include impact assumptions based on the LOLE study request

No significant changes to the LTRA data or processes

The required target planning reserve margin has increased from 12% - 15% non-coincident peak

- For purposes of the NERC Assessments SPP converts the 15% NCP to 19% coincident peak

SPP GENERATION INTERCONNECTION QUEUE

Southwest Power Pool Generation Interconnection Queue Dashboard

The current generator interconnection active queue consists of 518 projects totaling 106.3 GW

North

Projects: 44
Size 8.9 GW

Nebraska

Projects: 74
Size 14.6 GW

Central

Projects: 162
Size 34 GW

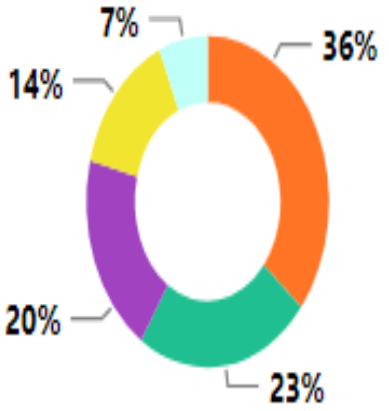
Southeast

Projects: 170
Size 31.06 GW

Southwest

Projects: 68
Size 17.7 GW

Total Queue



Generation Type Battery/Storage Hybrid Solar Thermal Wind

Cluster	MW	Projects
01 NORTH	**8,900.29**	**44**
Battery/Storage	525.00	3
Hybrid	1,095.50	8
Solar	3,087.00	12
Thermal	783.15	6
Wind	3,409.64	15
02 NEBRASKA	**14,602.50**	**74**
Battery/Storage	905.00	6
Hybrid	1,758.00	10
Solar	3,883.47	25
Thermal	3,606.56	14
Wind	4,449.47	19
03 CENTRAL	**34,001.15**	**162**
Battery/Storage	7,473.19	44
Hybrid	3,550.00	13
Solar	13,924.48	65
Thermal	166.56	4
Wind	8,886.92	36
04 SOUTHEAST	**31,061.64**	**170**
Battery/Storage	9,898.79	61
Hybrid	6,149.60	34
Solar	9,687.15	54
Thermal	953.00	1
Wind	4,373.10	20
05 SOUTHWEST	**17,700.38**	**68**
Battery/Storage	2,182.00	13
Hybrid	2,835.00	10
Solar	7,686.88	29
Thermal	1,423.00	3
Wind	3,573.50	13
Total	**106,265.96**	**518**

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
- FERC rejected the Winter Season Resource Adequacy Requirement filing
  - SPP is working to refile in early 2024

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

2023 LOLE STUDY ASSUMPTIONS

PRM impact analysis performed on Incremental cold weather outages assumption, Planned and Maintenance Outages assumption, and seasonal reliability metric application

Assumptions	2023 Study	2021 Study
Historical Wind, Solar, & Load Profiles	43 Years (1980-2022)	9 Years (2012-2020)
Planning Years	Year 3 and Year 6 (2026 and 2029)	Year 2 and Year 5 (2023 and 2026)
Reliability Metric Application	Seasonal	Annual (Summer Based)
Temperature Outages	Incremental cold weather outages applied for extreme winter temperatures	None
Demand Response Programs	Actual Program Parameters	No limits
Forced Outage Rates	GADS 2015-2022	GADS 2015-2020
Value of Wind, Solar, and Battery in PRM Calculation	System ELCC (all weather years)	Methodology similar to ELCC
Load Forecast Uncertainty	Considered in the 43 Historical Weather year	7 discrete standard deviation points
Determination of 1 day in 10 year threshold	Perfect Negative Generation	Generation Removal

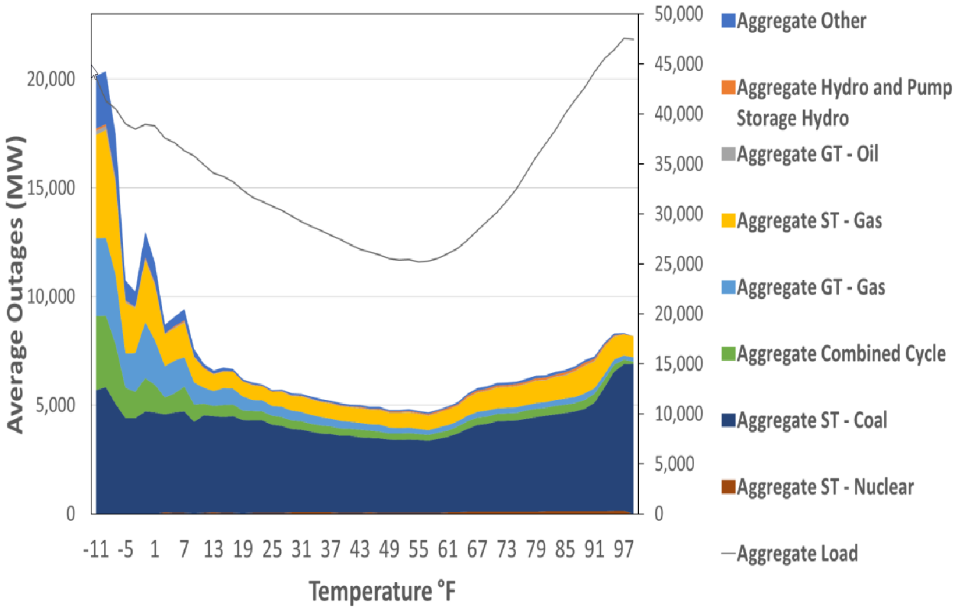
SIR227 RESOURCE PLANNING & AVAILABILITY 2.7

2023 LOLE study drivers:

- Derive a level of planned outages from historical analysis that occur during summer and winter seasons
- Analyze outage trends driven by temperature
- Analyze outage trends driven by common mode outage failures
  - Common mode examples could include:
    - Simultaneous gas transportation limitations
    - Simultaneous gas line pumping station failures
    - Simultaneous loss of capacity due to temperature extremes, flooding and drought conditions
    - Simultaneous loss of facilities due to transmission outages
    - Simultaneous loss of output from renewable facilities (e.g. 'icing' conditions)
- Model extreme weather event correlations LOLE study for RPA 2.6 to capture common mode outages and outage thresholds driven by extreme temperature

Shows the temperature impacts on forced outages considered in the 2023 LOLE Study

Figure 4: Aggregate Average Outages with Load

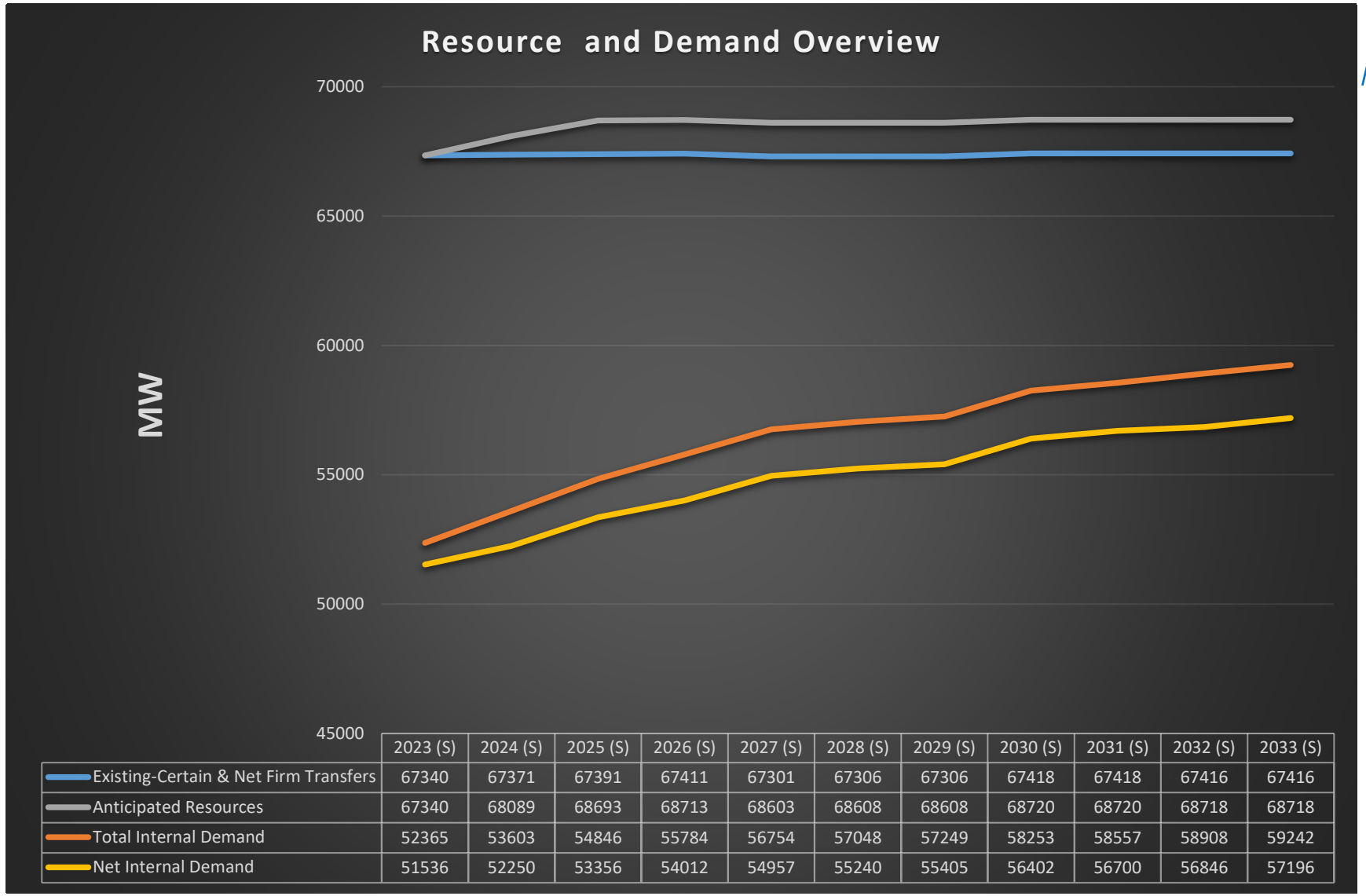


SEASONAL RISK DISCUSSION

- Establish LOLE thresholds for each season while considering maximum annual LOLE risk
  - Do we maintain strictly 1-in-10 annual threshold?
  - Of the annual LOLE (0.1 LOLE), do we balance the LOLE across the year (0.05 LOLE in winter and 0.05 in summer)?
- Consideration of EUE risk
  - What is the maximum annual EUE threshold?

SPP LTRA HIGHLIGHTS

CAPACITY AND DEMAND OVERVIEW



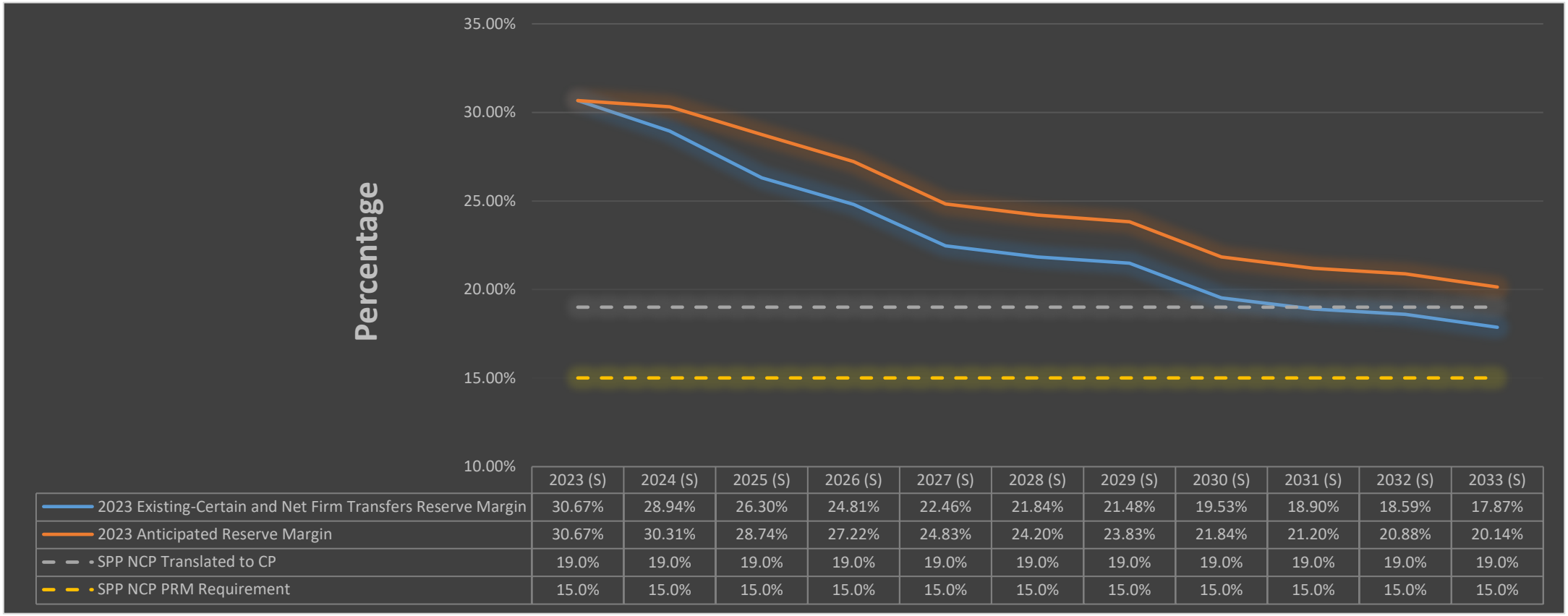
	2023 (S)	2024 (S)	2025 (S)	2026 (S)	2027 (S)	2028 (S)	2029 (S)	2030 (S)	2031 (S)	2032 (S)	2033 (S)
Existing-Certain & Net Firm Transfers	67340	67371	67391	67411	67301	67306	67306	67418	67418	67416	67416
Anticipated Resources	67340	68089	68693	68713	68603	68608	68608	68720	68720	68718	68718
Total Internal Demand	52365	53603	54846	55784	56754	57048	57249	58253	58557	58908	59242
Net Internal Demand	51536	52250	53356	54012	54957	55240	55405	56402	56700	56846	57196

- 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



	2023 (S)	2024 (S)	2025 (S)	2026 (S)	2027 (S)	2028 (S)	2029 (S)	2030 (S)	2031 (S)	2032 (S)	2033 (S)
2023 Existing-Certain and Net Firm Transfers Reserve Margin	30.67%	28.94%	26.30%	24.81%	22.46%	21.84%	21.48%	19.53%	18.90%	18.59%	17.87%
2023 Anticipated Reserve Margin	30.67%	30.31%	28.74%	27.22%	24.83%	24.20%	23.83%	21.84%	21.20%	20.88%	20.14%
SPP NCP Translated to CP	19.0%	19.0%	19.0%	19.0%	19.0%	19.0%	19.0%	19.0%	19.0%	19.0%	19.0%
SPP NCP PRM Requirement	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%

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 2023 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

QUESTIONS?

SASKATCHEWAN 2023 LONG TERM RELIABILITY ASSESSMENT SUMMARY

January 2024

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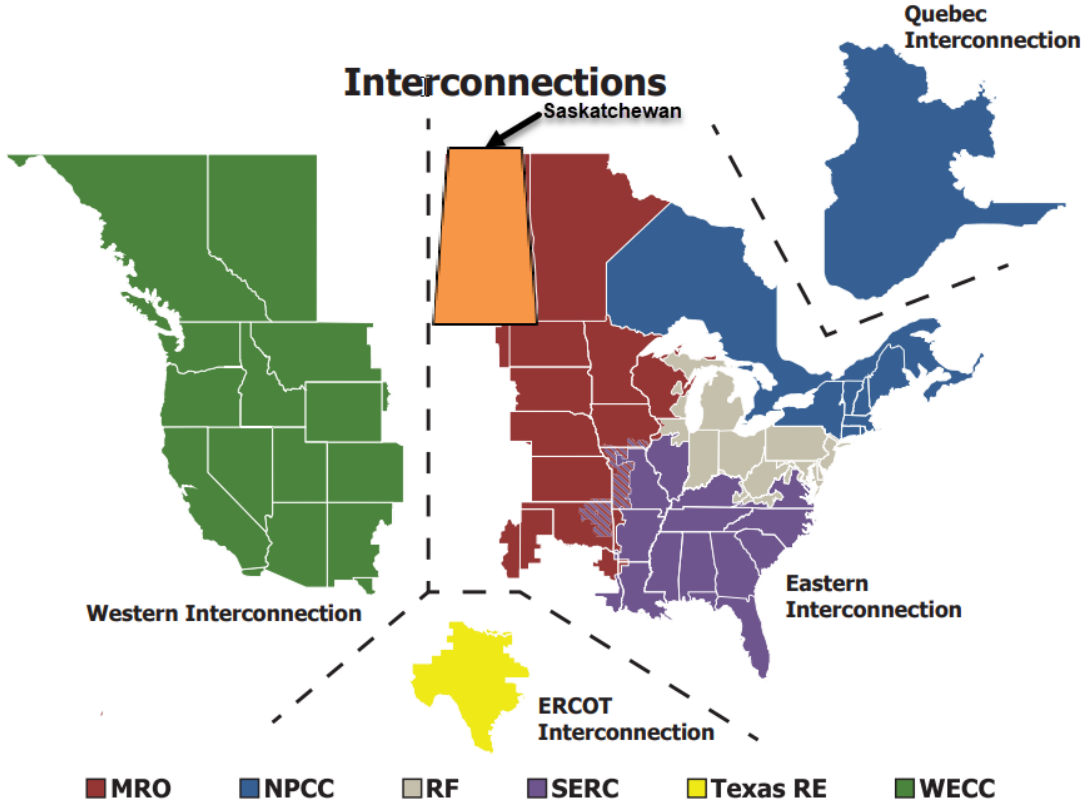
Saskatchewan

Location in North American Interconnection



Source: NERC Interconnections.pdf

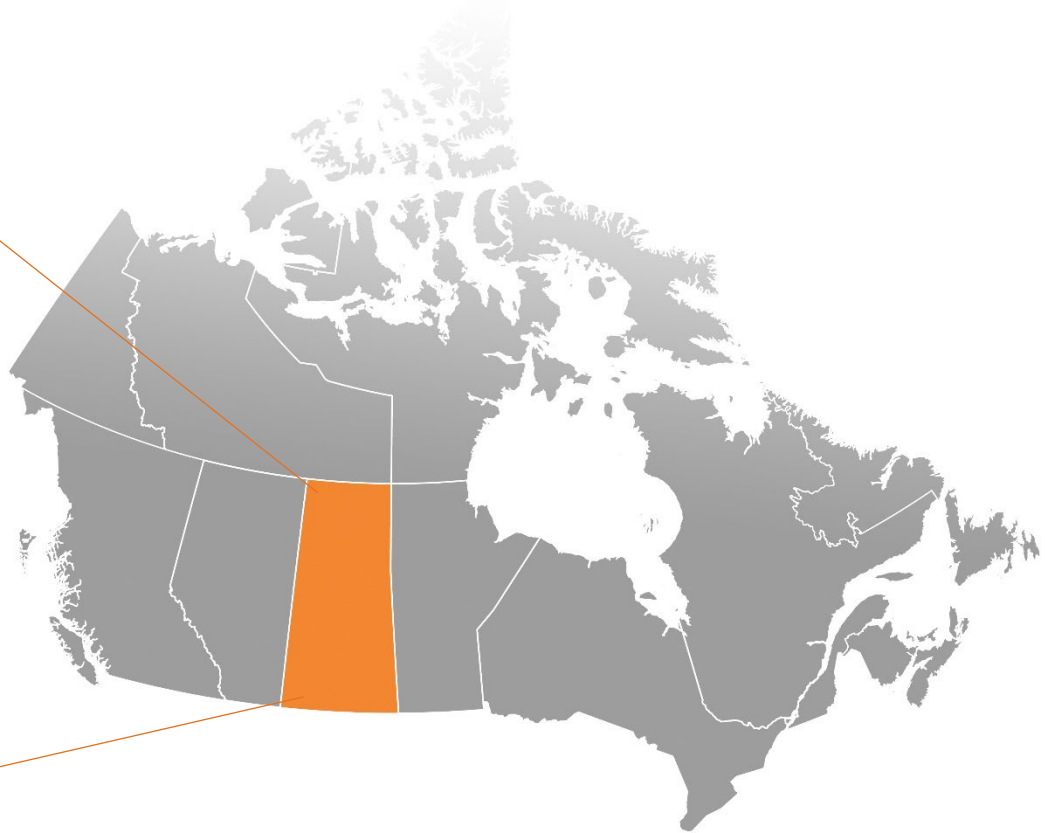
SASKATCHEWAN'S PRIMARY ELECTRICITY SUPPLIER

553,849
CUSTOMER ACCOUNTS

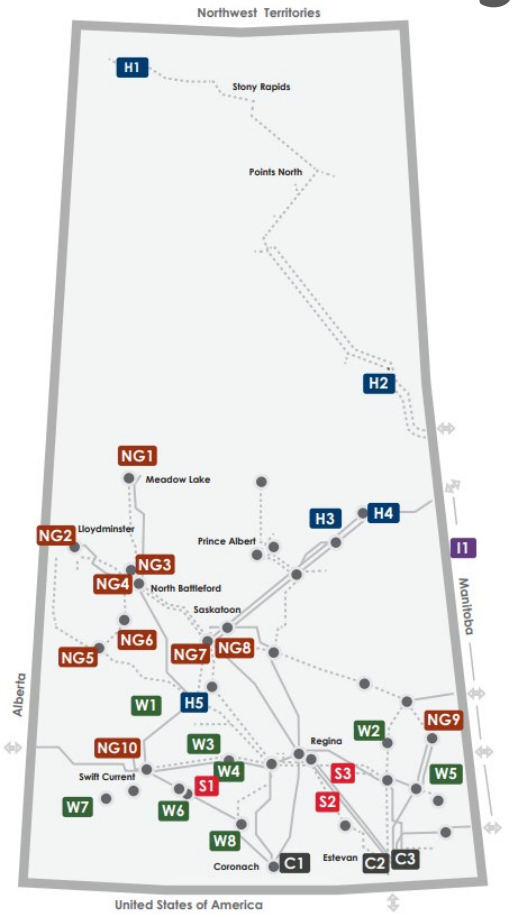
160,707 KM OF POWER LINES

3,910 MW SET ON DEC. 30, 2021

3,669 MW SET ON JULY 31, 2023



Saskatchewan's Power Map



7	3	10	8	3
Hydro Facilities	Coal Facilities	Natural Gas Facilities	Wind Facilities	Solar Facilities

Name Plate MW							
Hydro	Coal	Natural Gas	Wind	Solar	Other Small	Import	Total
865	1389	2065	617	86	34	290	5346

Major Projects: Supply

- New combined cycle gas facility
  - Great Plains Power Station 377 MW (Summer 2024)
- New simple cycle gas units
  - Ermine Power Station 45MW (Summer, 2025)
  - Yellowhead Power Station 45 MW (Winter, 2025)
- New Wind and Solar PV generation facilities
  - Bekevar Wind Energy Project 200 MW (Winter, 2024)
  - Estevan Solar Facility Project 100 MW (Winter, 2026)

Major Projects: Transmission

- New Transmission Service Between SaskPower and Southwest Power Pool (SPP)
    - Two - 230 kV International Power 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 2023 LTRA Highlights

Assessment Process

System Reliability Studies

- Planning studies required for NERC: 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

Resource Adequacy Assessments

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

Saskatchewan 2023 LTRA Highlights

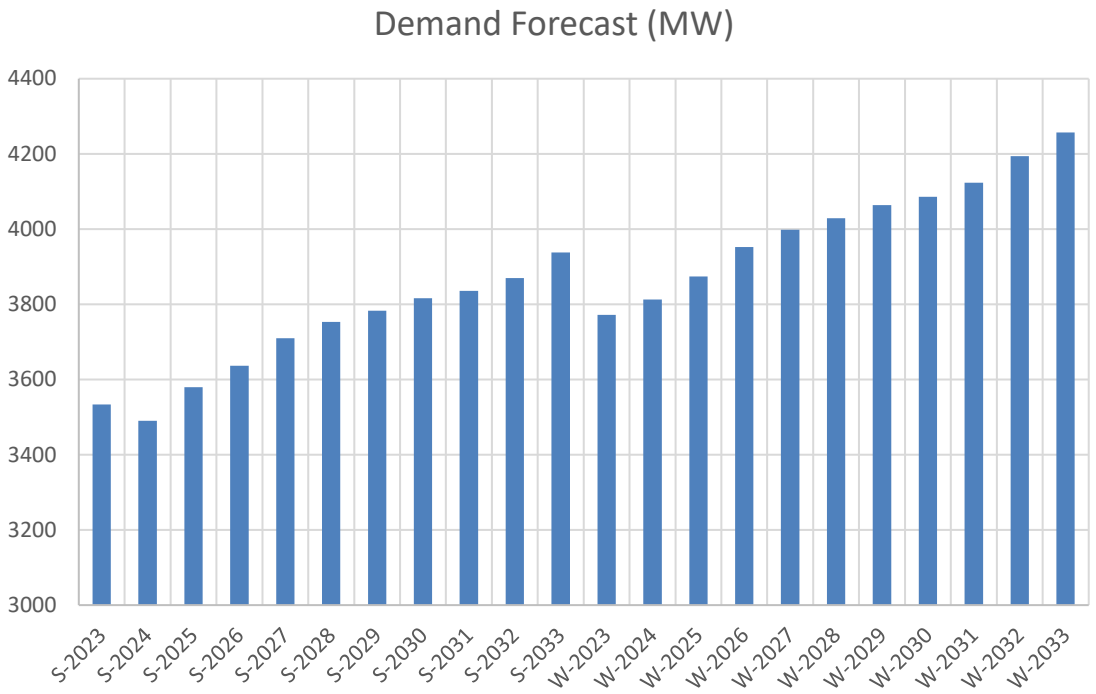
Demand (Methods & Assumptions)

- 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 January and sustained hot weather in July.
- Net-metering generation is considered as a reduction in both peak load and energy forecasts

Saskatchewan 2023 LTRA Highlights

Demand (Summary)

- Average annual growth ~1.0%



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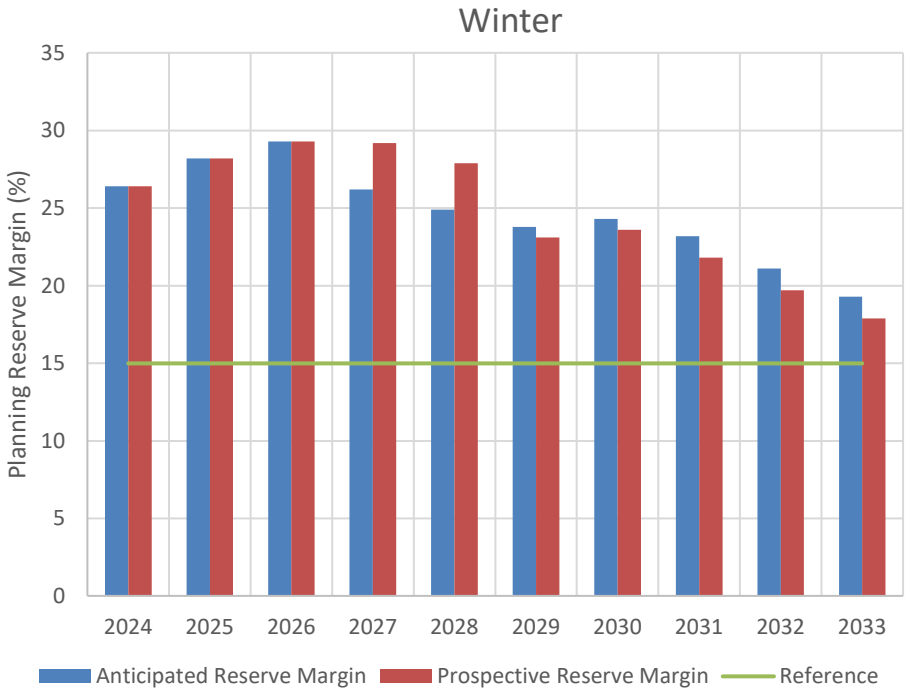
Saskatchewan 2023 LTRA Highlights

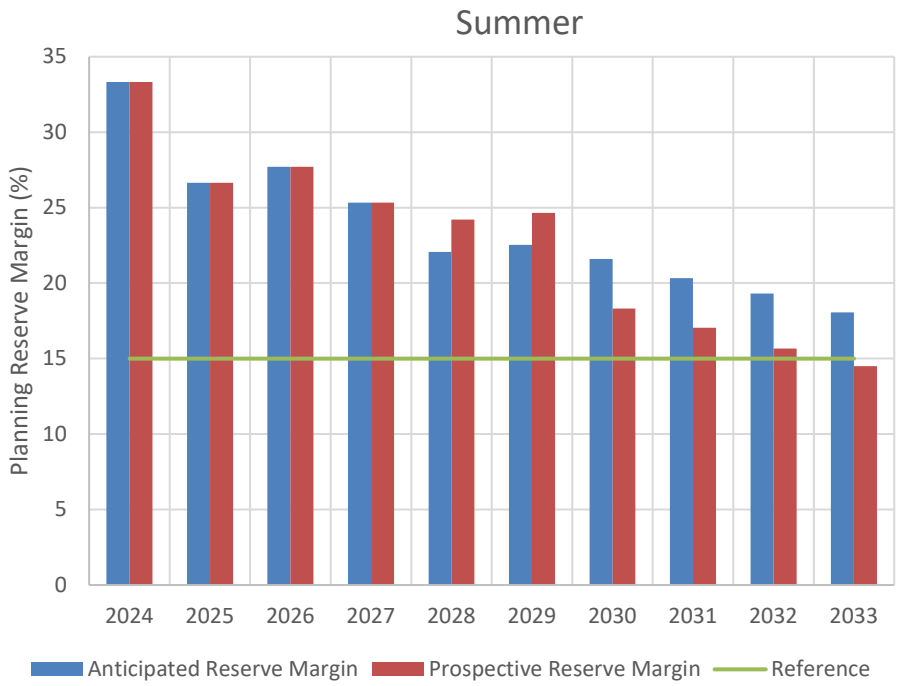
Planning Reserve Margins (Methods and Assumptions)

- Reference Reserve Margin level is 15%.
- Saskatchewan uses two criteria for determining adequate resources
  - 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.

Saskatchewan 2023 LTRA Highlights

Planning Reserve Margins





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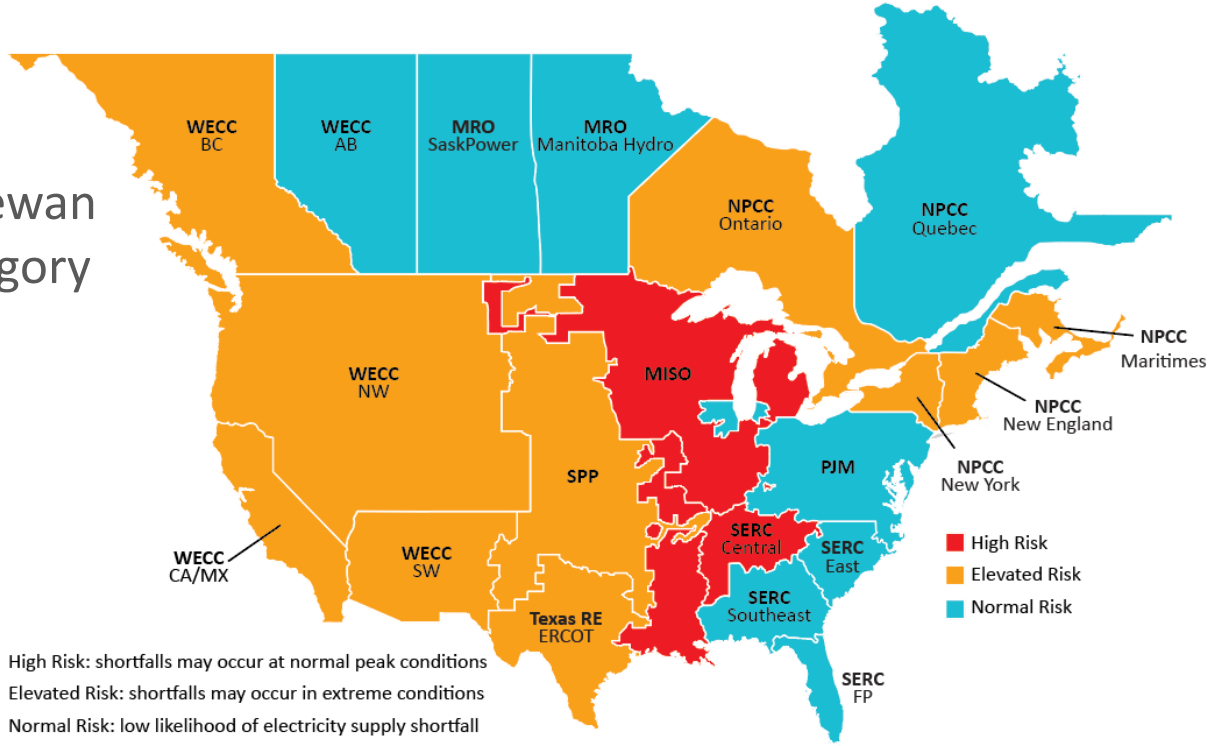
Saskatchewan 2023 LTRA Highlights

NERC Risk Area Summary

- In the near-term, Saskatchewan falls under normal risk category



Saskatchewan 2023 LTRA Highlights

Energy Risk Assessments

- Saskatchewan energy risk assessment is performed by utilizing the MARS program to calculate LOLE and EUE.
  - Load forecast (demand and energy), expansion sequence, unit characteristics, maintenance are included in the model
  - Looking at scenarios such as the impact of higher load growth, higher seasonal capacity derates, reduced firm capacity of wind facilities and critical failure of units approaching end of life.
  - Also evaluating capacity value from Variable Energy Resources (VERs) using the probabilistic Effective Load Carrying Capability (ELCC) approach
- Saskatchewan doesn't anticipate resource adequacy issues during off-peak hours in the first five-year period.
  - Current penetration of VERs in Saskatchewan is not significant. Studies are ongoing to supplement addition of future VERs through fast ramping capacity available from other sources

Saskatchewan 2023 LTRA Highlights

Generation (Summary)

Planned new generation additions (2023-2033)

- Approximately up to 2735 MW of internal generation projected to be added (including Tier 1, Tier 2 and Tier 3) throughout the assessment period
  - 735 MW of Tier 1 additions include 467 MW Natural gas, 200 MW wind, etc.
  - 1280 MW of Tier 2 additions which will be a mix of Natural Gas, and Solar PV
  - 720 MW of Tier 3 additions which is mainly wind and solar

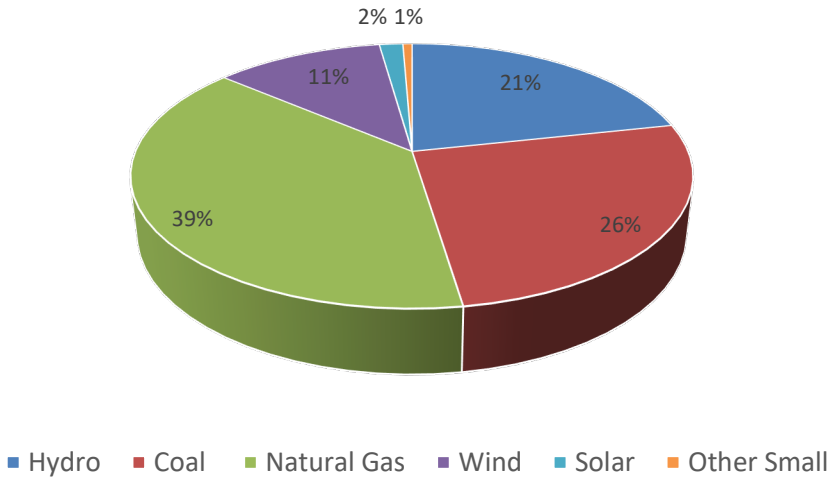
Projected Generation Retirements (2023-2033)

- Confirmed: Approximately 212 MW projected for retirement, mainly driven by end of life.
- Unconfirmed: Timing of retirements under consideration includes 1200 MW of conventional coal and 150 MW of wind.

Saskatchewan 2023 LTRA Highlights

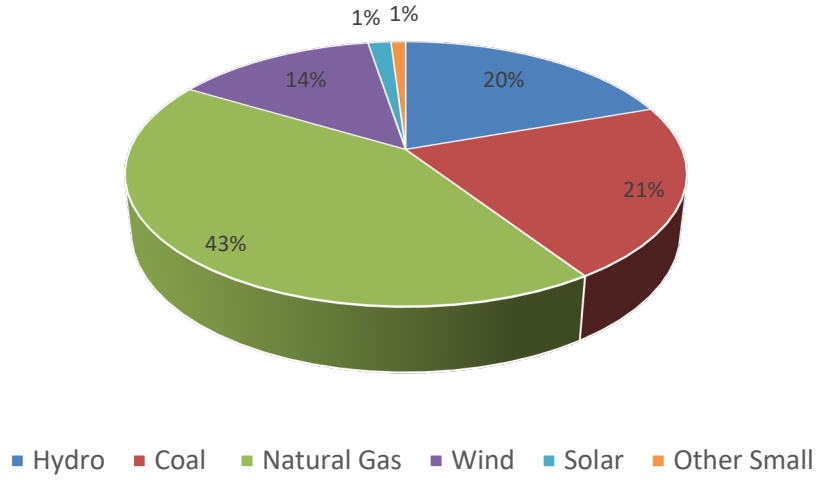
Generation Mix (Name Plate MW)

Existing Resources



5346 MW

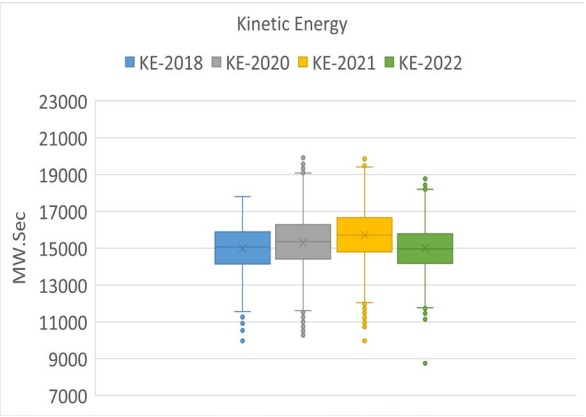
Expected Resources (2028)

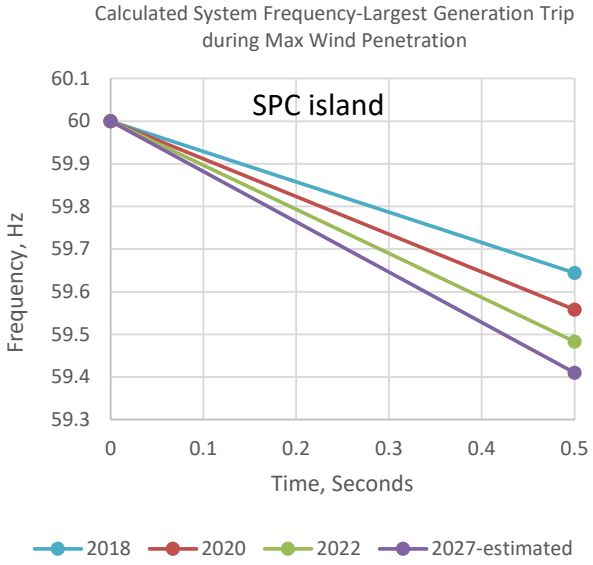


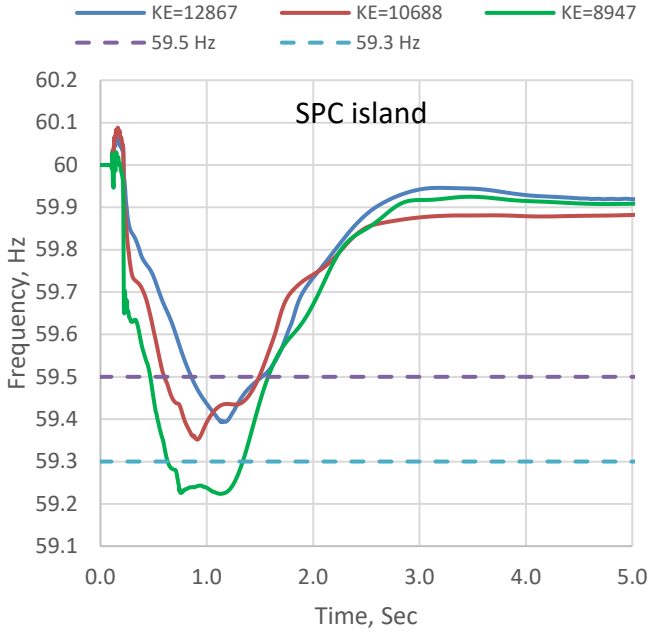
5900 MW

Saskatchewan 2023 LTRA Highlights

Transmission Planning: Synchronous Inertia Trend

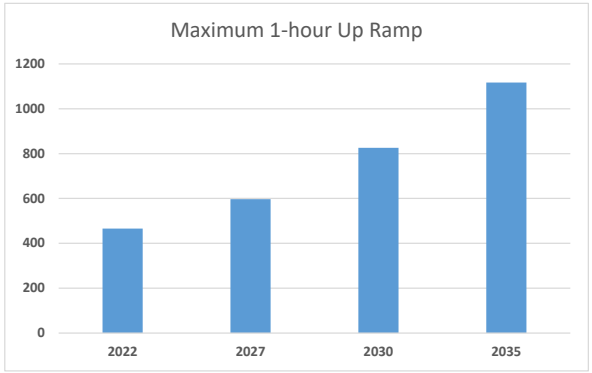


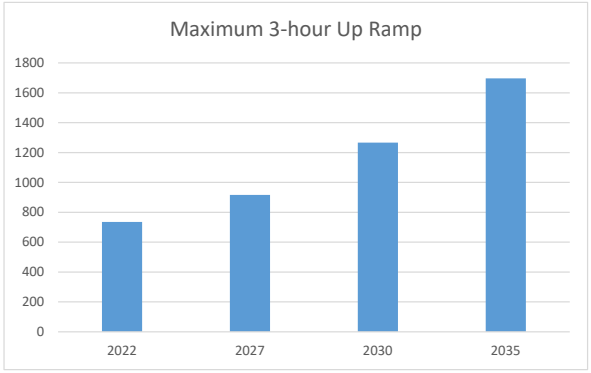


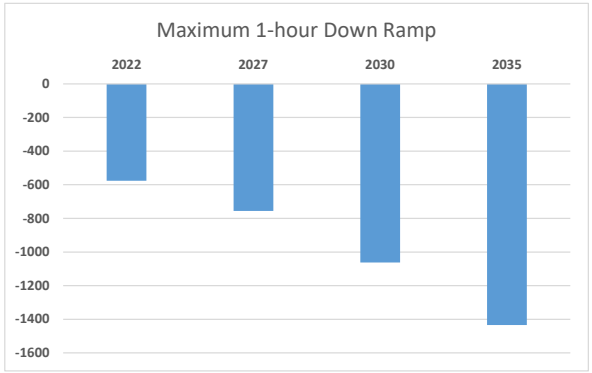


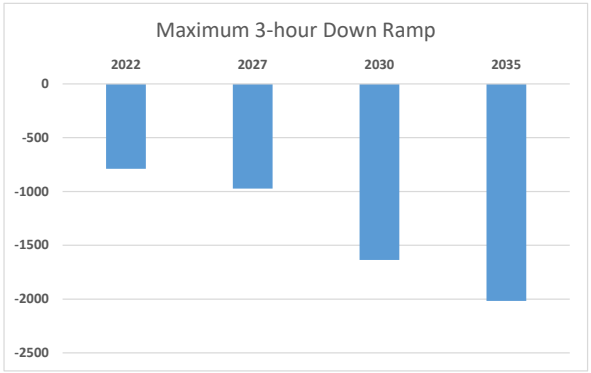
Saskatchewan 2023 LTRA Highlights

Transmission Planning: Net Demand Ramping Trend









Saskatchewan 2023 LTRA Highlights

Transmission Planning: Electricity Storage

- SaskPower currently has a 20MW/20MWh battery under construction
  - plans to expand this site by 60 MW/60MWh
- Model storage as both a generator and load in planning studies
- Updated interconnection requirements to incorporate key requirements from IEEE 1547, IEEE 2800 and NERC reliability guideline: performance, modeling and simulation of BPS-connected battery energy storage systems.

Saskatchewan 2023 LTRA Highlights

Capacity Transfers

- Transactions included in the assessment period aligns with the counterparty expectation of a firm contract
- Up to 315 MW of firm import contracts during the assessment period
- SaskPower is expanding its interconnection with SPP.
  - Two new 230 kV tie lines are being added to facilitate up to 500 MW of import contracts from SPP
  - Transmission service is expected to begin in October 2027

Saskatchewan 2023 LTRA Highlights

Reliability Issues

- Issues with loop flows:
  - Saskatchewan experiences loop flows on its interface with SPP and Manitoba Hydro.
  - Has a phase shifting transformer (PST) on interface with SPP to control the unscheduled flows
  - PST reaches its limits resulting loss of control under certain operating scenarios largely due to increase in transfers out of North Dakota and transfers out of Manitoba.
- Growing supply chain issues:
  - Impacting project schedules due to longer lead time for major equipment
  - Identifying and initiating projects earlier and advancing procurement as necessary

Saskatchewan 2023 LTRA Highlights

Reliability Findings

- No changes to the assessment area footprint have occurred or are expected.
- Average demand growth has been steady around 1%.
- Changes to the resource mix is expected in the Long-Term planning horizon.
- With the planned facilities, reliability requirements are met in the assessment period.

Saskatchewan 2023 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/R626KDG or QR Code.