



Generation Issues in Michigan

Cathy Cole, Public Utilities Engineer
Electric Reliability Division, Generation & Certificate of Need
Section
Michigan Public Service Commission

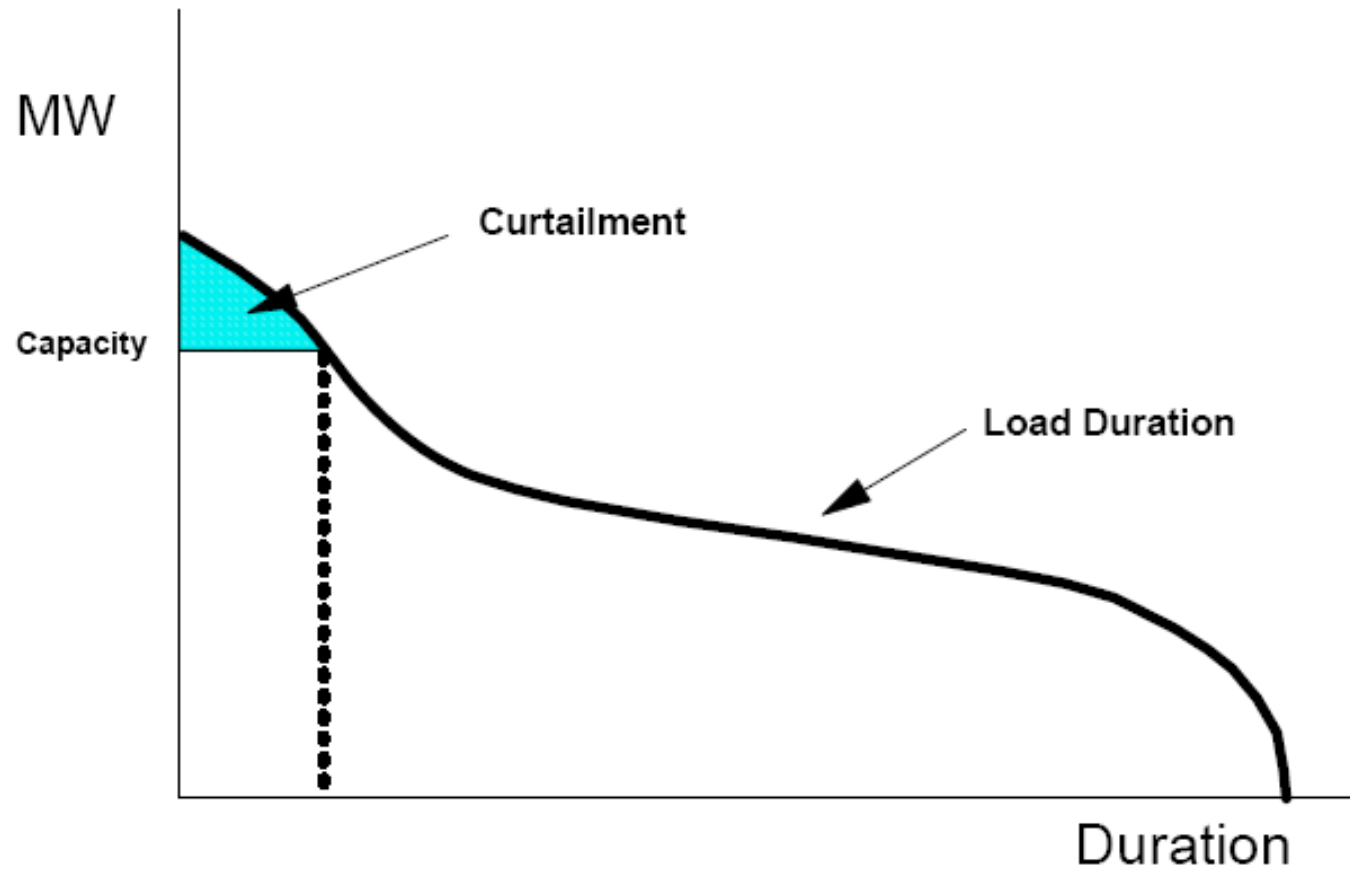
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Generation Issues in Michigan

- Resource Adequacy in Michigan
 - What is it?
 - How is it measured?
 - How do we know if we have enough?
- New Energy Paradigms in generation
 - Technical challenges integrating intermittent renewables into the grid

- Resource Adequacy: What is it?
- Definitions of Adequacy:
 - **Adequacy** (from NERC glossary - North American Electric Reliability Corporation; www.nerc.com)
 - The ability of the electric system to supply the aggregate electrical demand and energy requirements of the end-use customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements. (emphasis added)
 - **Resource Adequacy** (from MRO – Midwest Reliability Organization; www.midwestreliability.org)
 - the ability of supply-side and demand-side resources to meet the aggregate electrical demand and energy requirements of the end-use customers with a specified degree of reliability.

A Simple Reliability Model



Resource Adequacy: How is it measured?

- Goal
 - Supply end-use customer demand
- Key Variables
 - Generator Availability
 - Account for outage of system elements
 - Planned Outages (scheduled, maintenance, etc.)
 - Forced outages (unplanned, random)
 - Load
 - Forecasted peak load
 - Weather conditions – 50/50 forecast
 - Economic activity
 - Load forecast uncertainty
 - Diversity factors

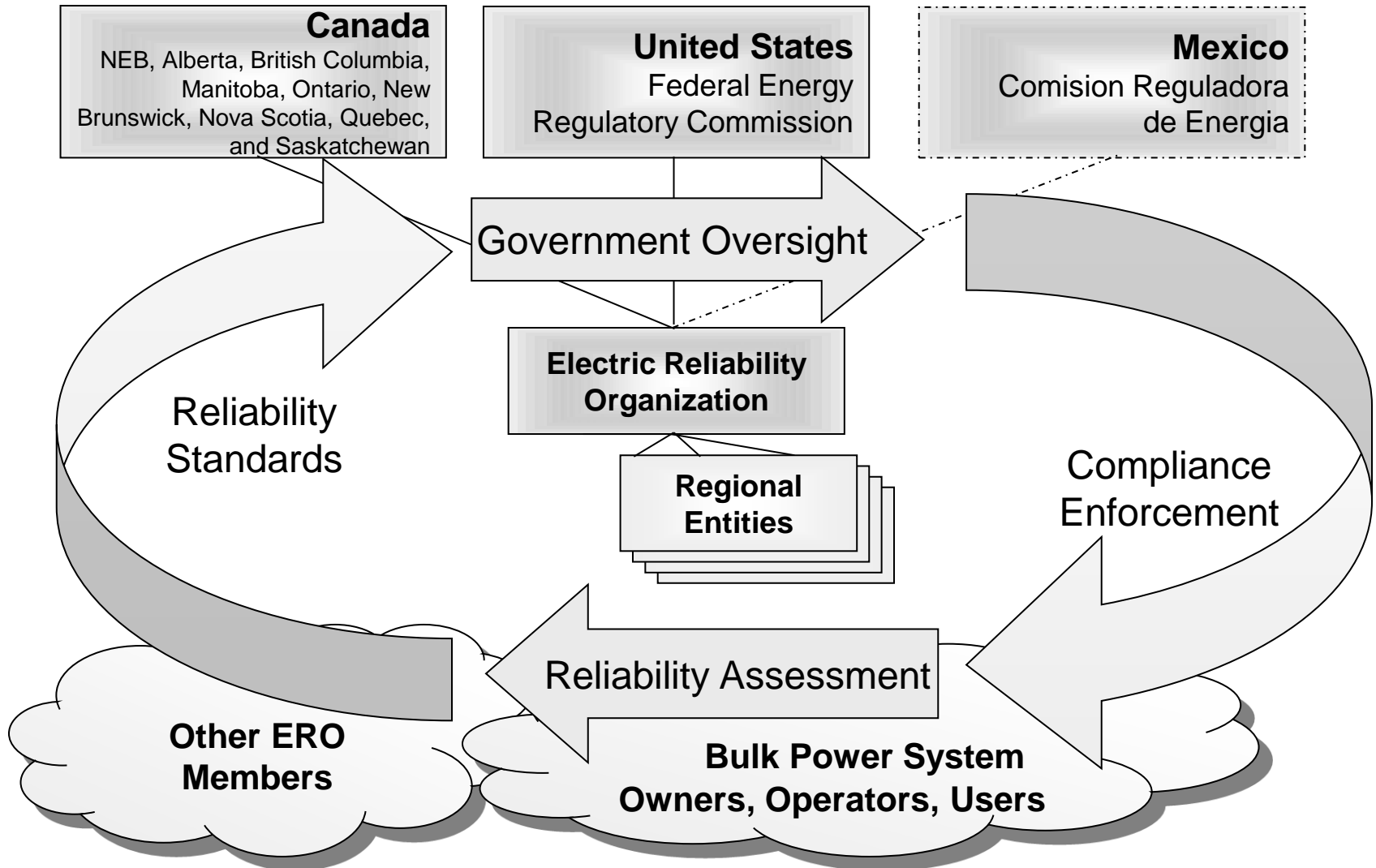
Resource Adequacy: How is it measured?

- Loss of Load Expectation (LOLE) Study
 - LOLE is the expected number of days per year for which available generating capacity is insufficient to serve the daily peak demand (load). The LOLE is usually measured in days/year or hours/year. LOLE is sometimes referred to as loss of load probability (LOLP), where LOLP is the proportion (probability) of days per year, hours per year, or events per season that available generating capacity/energy is insufficient to serve the daily peak or hourly demand.
 - This analysis is generally performed for several years into the future and the typical standard metric is the loss of load probability of one day in ten years or 0.1 day/year.”
 - Computer Simulation
 - Monthly load data, hourly load curve, peak load curve
 - Generating unit capacity, scheduled and forced outage parameters
 - Can be for all 8,760 hours per year
 - Or can be for 260 peak hours (peak hour Monday thru Friday)

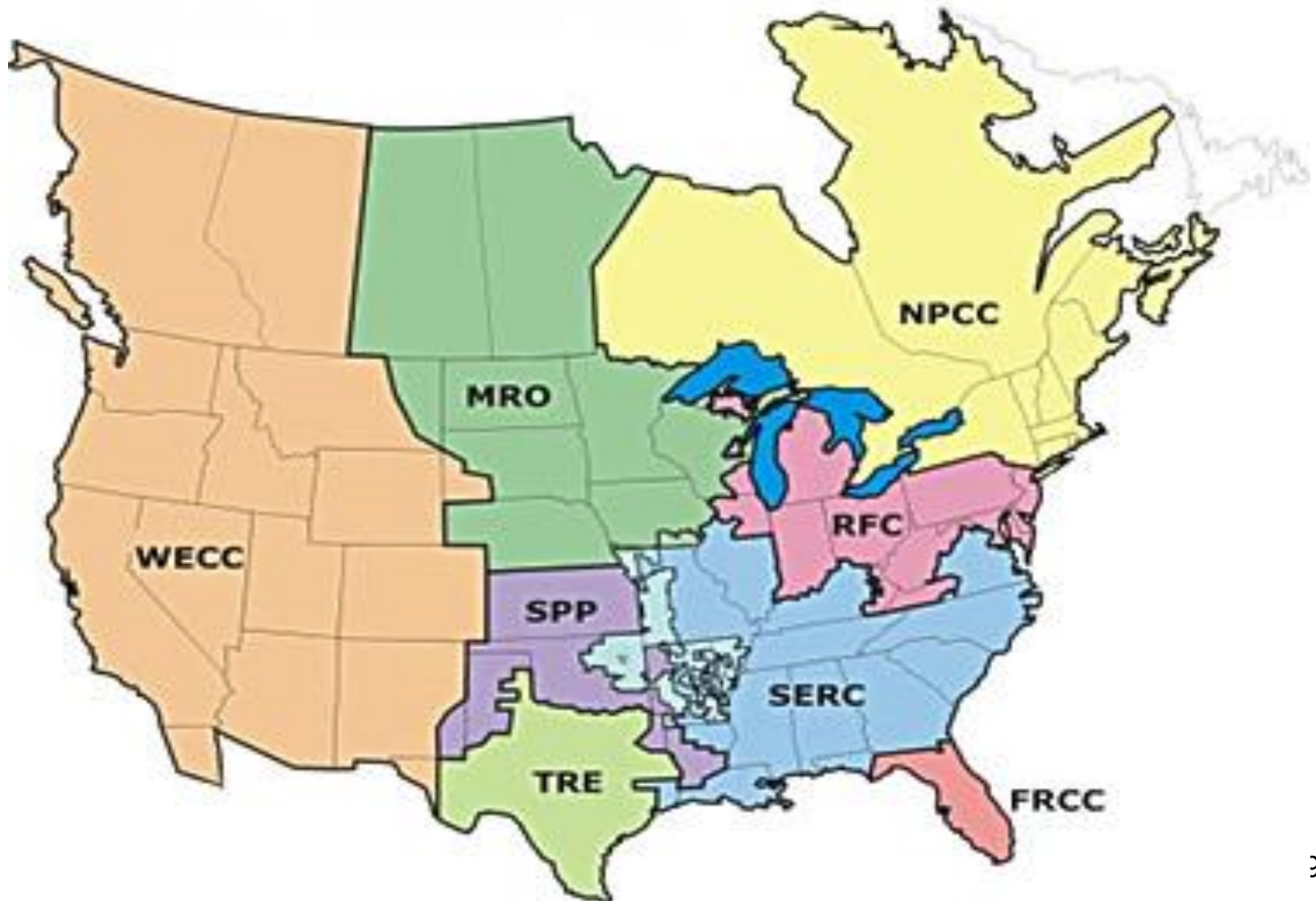
Resource Adequacy: How do we know if we have enough?

- Federal Standards and Assessments
 - NERC, Regional Entities (RFC, MRO)
- RTO Constructs
 - Midwest ISO Energy Markets Tariff
 - Module E
- Michigan Public Service Commission
Yearly Inquiry of Utilities and Load-Serving Entities
 - Plans to meet summer peak demand

Electric Reliability Organization Overview



North American Electric Reliability Corporation - Regions

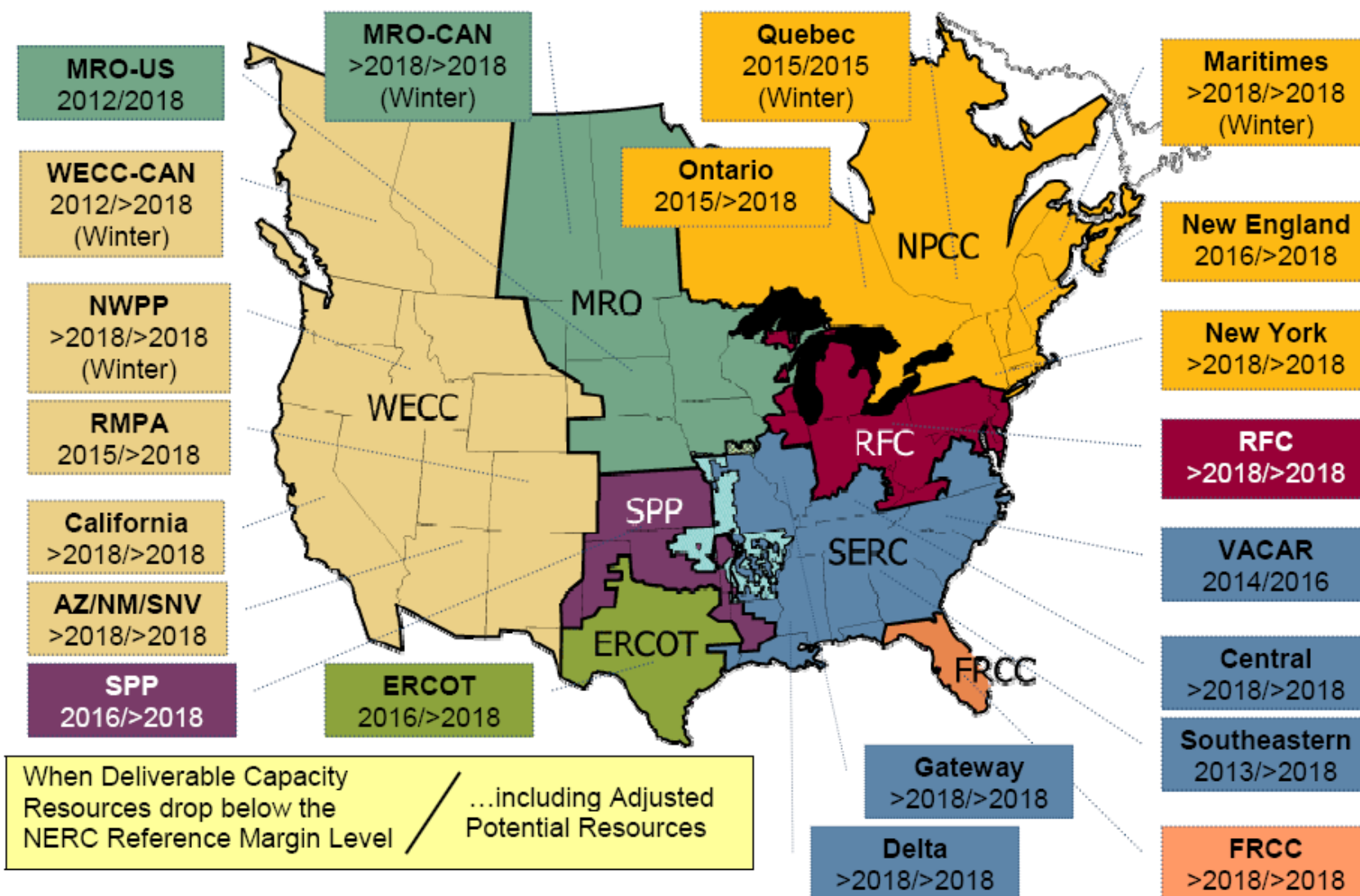


NERC Assessments

- NERC regularly publishes reports that assess the reliability of the North American bulk electric system.
 - **Long-Term Reliability Assessments** annually assess the adequacy of the bulk electric system in the United States and Canada over a ten-year period. The report projects electricity supply and demand, evaluates transmission system adequacy, and discusses key issues and trends that could affect reliability.
 - **Summer and Winter Assessments** assess the adequacy of electricity supplies in the United States and Canada for the upcoming summer and winter peak demand periods.
 - **Special Assessments** are conducted on a regional, interregional, or interconnection-wide basis as needed.

<http://www.nerc.com/page.php?cid=4|61>

Figure Summary 1: Prospective and Adjusted Potential Resources Reserve Margins Compared to NERC's Reference Margin Level



Regional Resource Adequacy Assessments and Standards

- Regional Entities are required by NERC Rules of Procedure to assess and report resource adequacy.
- **Purpose:** Define requirements for and to ensure that a common methodology is used to determine the minimum level of generation reserves required for the short term and long term planning horizon.

Note: LOLE method compares the probabilistic distribution of expected generating capacity with the probabilistic distribution of expected peak demand to give an expected risk of load exceeding capacity. Loss of Load Probability (LOLP) values (probabilities) for each weekday in the year are summed to give a Loss of Load Expectation (LOLE), expressed as days per year.

Regional Resource Adequacy Standards (RFC and MRO)

- “Planning Coordinator” performs and documents a Resource Adequacy analysis annually. (MISO)
 - Resource Adequacy analysis includes calculating the level of reserves necessary to meet a ‘1 day in 10’ level of reliability using an LOLE method
 - Direct Control Load Management or Interruptible Demand is subtracted from the load forecast such that Net Internal Demand is used for the analysis
 - The analysis is performed for year 1, one year between years 2 and 5, and one year between years 6 through 10
- Analysis considers load characteristics
 - Median 50/50 forecast
 - Load forecast uncertainty (due to weather, economics, etc.)
 - Load diversity
 - Seasonal load variations
 - Daily demand modeling assumptions (firm, interruptible)
- Analysis considers resource characteristics
 - Type, number, size, availability of generators
 - Historic resource performance and any projected changes
 - Seasonal resource ratings
 - Modeling assumptions of firm capacity purchases into or sales out of the area
 - Planned outage schedules, deratings and retirements
 - Modeling assumptions of intermittent and energy limited resources such as wind
 - Criteria for including planned resource additions in the analysis

Regional Resource Adequacy Standards (RFC and MRO)

- Analysis considers transmission limitations that prevent the delivery of reserves
- Analysis considers the following resource availability characteristics documenting how and why they either were or were not included
 - Availability and deliverability of fuel
 - Environmental or regulatory restrictions
 - Any other load response programs not included as a reduction to demand
 - Sensitivity to resource outage rates
 - Impacts of extreme weather or drought conditions that affect unit availability
 - Market resources not committed to serving Load (uncommitted resources) within the planning area
- Analysis considers transmission maintenance outage schedules
- Documentation requirements include a demonstration that all load in the planning coordinator area is accounted for within the resource adequacy analysis

Regional Resource Adequacy Standards (RFC and MRO)

- Load and Resource Assessments
 - Required for each transmission constrained sub-area identified in the resource adequacy analysis
 - Documentation of load and resource capability for each year in years one through ten
 - Documentation of the planning reserve margins calculated for each of the three years in the analysis
 - Penalties for non-compliance
- The regional resource adequacy assessments are then submitted to NERC and rolled up for use in NERC's assessments

Regional Resource Adequacy Standards (RFC and MRO)

- The standards do NOT:
 - Make a determination of how best to meet resource needs
 - Transmission vs. Generation
 - Coal vs. Nuclear vs. Renewables vs. Gas vs....
 - Order the construction of new facilities
 - Require a single reserve level across the Region
 - Establish reserve requirements
- The Midwest ISO Module E portion of their open access transmission tariff provides the provisions for MISO to gather the data from Michigan load-serving entities and generators to perform the resource adequacy analysis and the load and resource assessments

Module E of the Midwest ISO Tariff

- Market Participants (MPs) must continue to comply with all applicable Regional Reliability Organization (RRO) requirements.
- MPs must also comply with all state/provincial authority regarding Resource Adequacy or reliability.
- MPs that are members of a Planning Reserve Sharing Group must comply with the Resource Adequacy standards established by the group.
- The Midwest ISO will monitor Resource Adequacy compliance by MPs, including determinations as to whether a Resource qualifies as satisfying RRO, state/provincial and Planning Reserve Sharing Group reliability requirements or guidelines.
- If the Midwest ISO determines that no Resource Adequacy standard or guideline exists for an MP within a state/province, the Midwest ISO will require an annual reserve margin of 12% for the MP obligated to serve that load served in that state/province.
- All Resources identified by MPs as available to meet Resource Adequacy requirements must comply with the requirements under the Tariff for designation of Network Resources (NRs).

Module E of the Midwest ISO Tariff

- Module E is the resource adequacy portion of MISO's Open Access Transmission Tariff
 - MISO performs the LOLE study
 - Stakeholder working groups assists with the development of the assumptions (MPSC Staff participate in the MISO Supply Adequacy Working Group, Loss of Load Expectation Work Group, Load Forecast Uncertainty Task Team, and the Diversity Factor Task Team)
 - MISO publishes the LOLE analysis and the resulting reserve margin requirements for the entities within their area.

Module E of the Midwest ISO Tariff

- MISO's tariff (Module E) requires load-serving entities to demonstrate adequacy.
 - Monthly load forecasts and resource capability is submitted for year one and year two
 - Seasonal load forecasts and resource capability is submitted for years three through ten
 - Revisions to the load forecast and resource capability may be made on a monthly basis
 - MISO holds a monthly voluntary capacity auction that is optional for buyers and sellers

Potential Changes to MISO's Module E

- First Energy and Duke leaving MISO partly to participate in PJM's RPM capacity market
- MISO is investigating a more forward looking capacity requirement

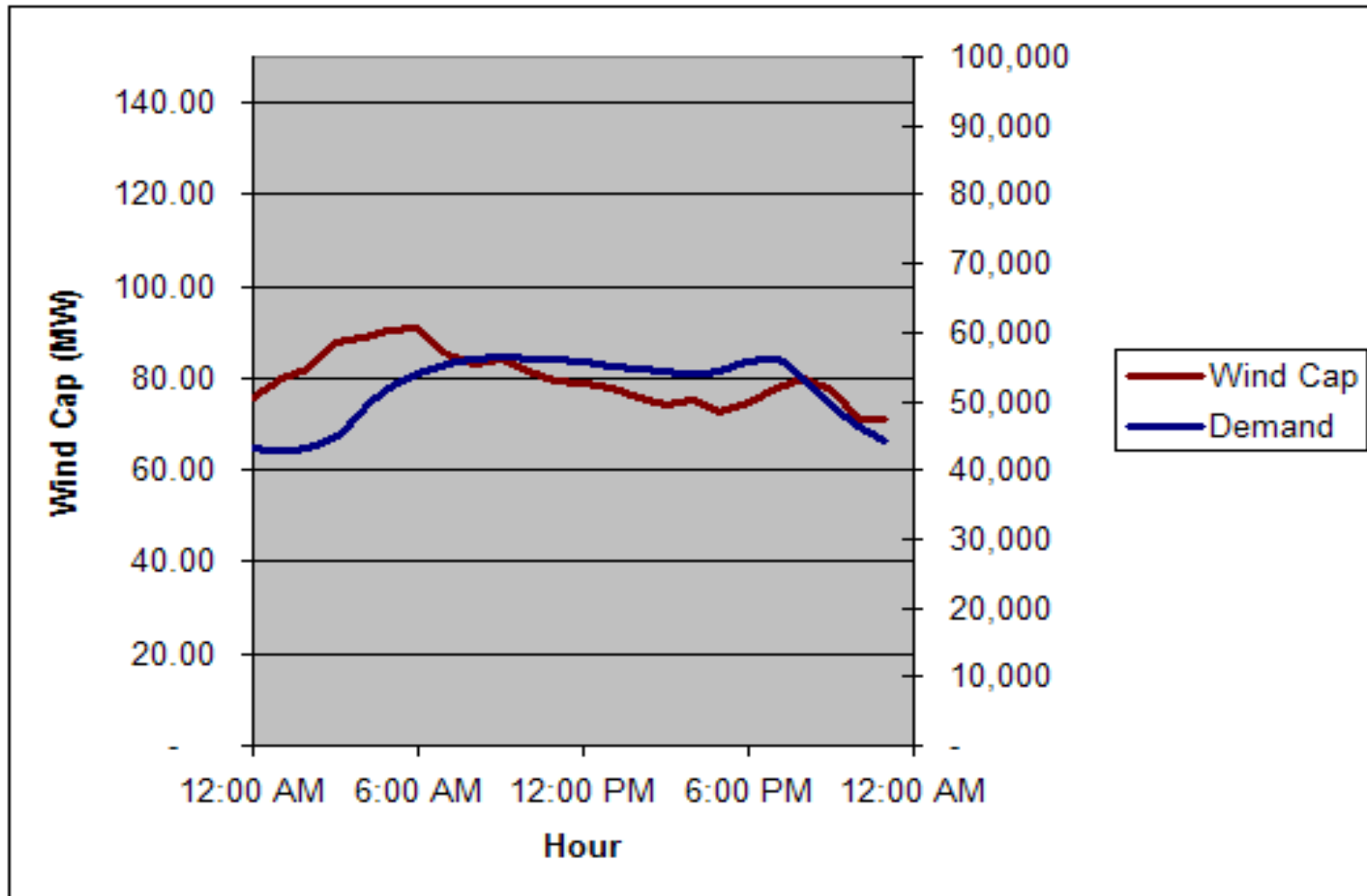
Michigan Public Service Commission Annual Resource Adequacy Inquiry

- MPSC issues an Order each January
 - Requesting a self-assessment of jurisdictional entities to meet upcoming summer peak
 - Requests same from Alternative Electric Suppliers
 - Requests comments from Transmission Companies and the Midwest ISO as well
 - Comments or Reports are due in the Spring prior to the peak summer season

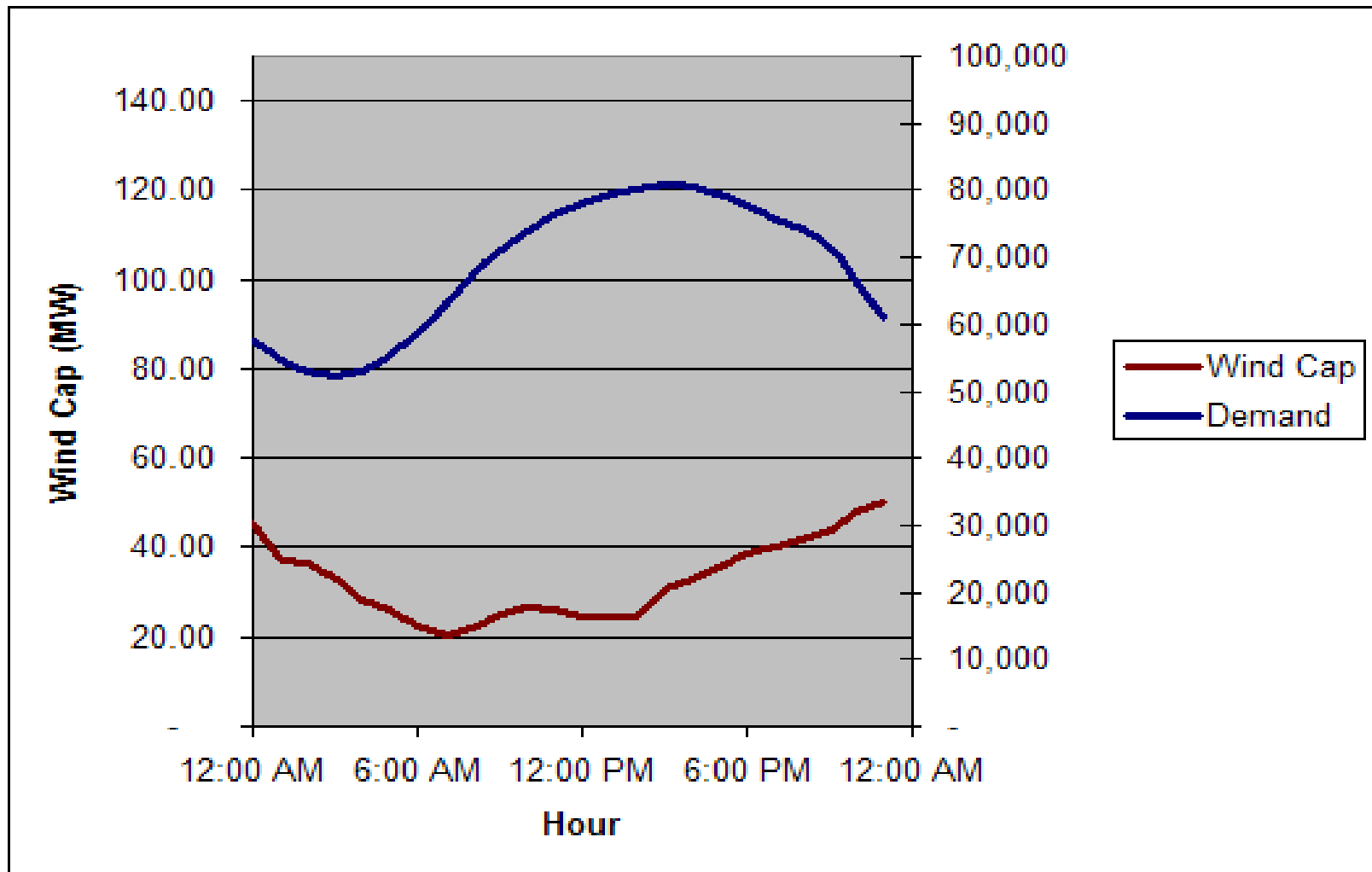
New Paradigms in generation:

Technical challenges integrating intermittent
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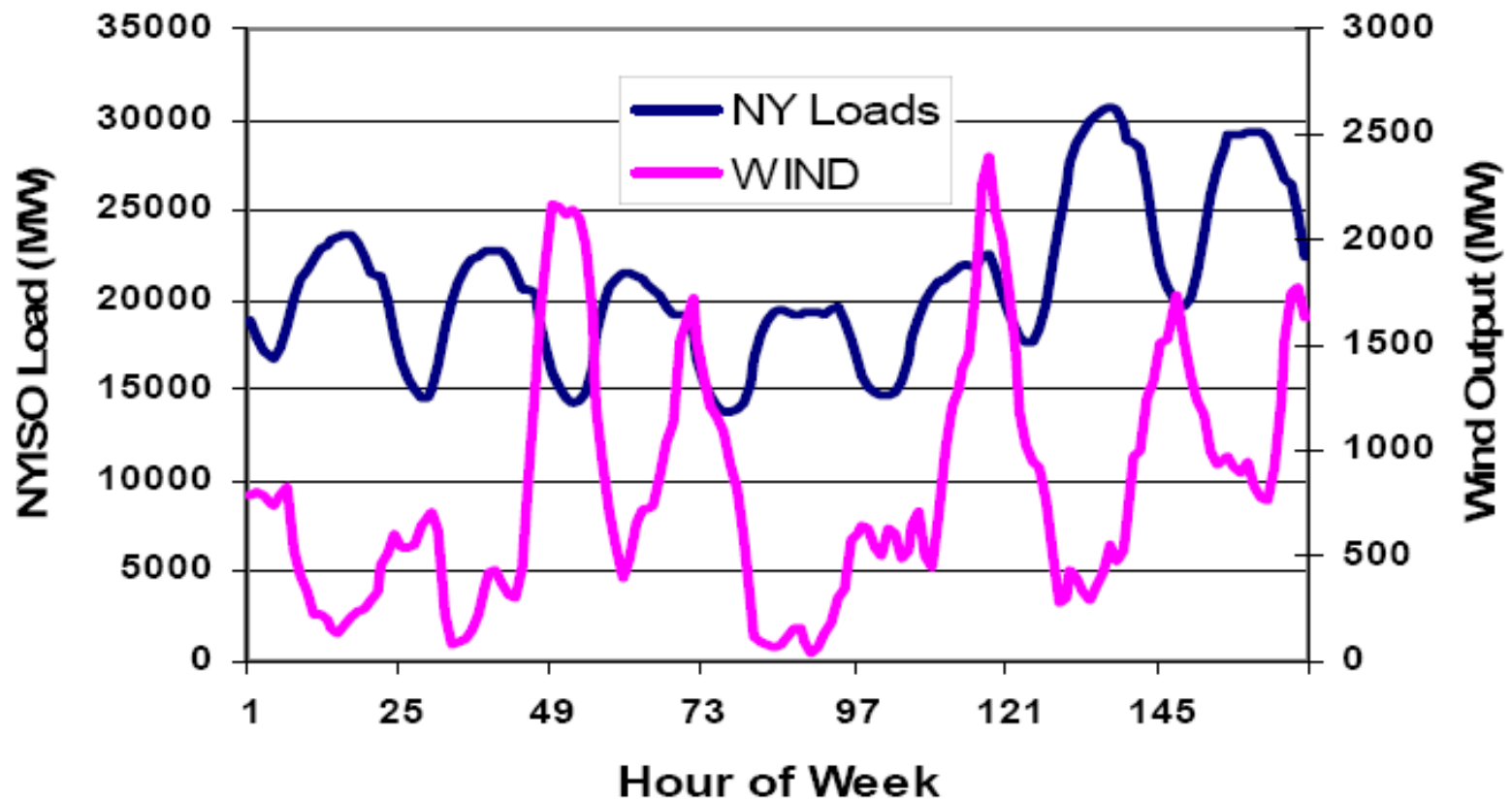
Example: Intermittent Resources



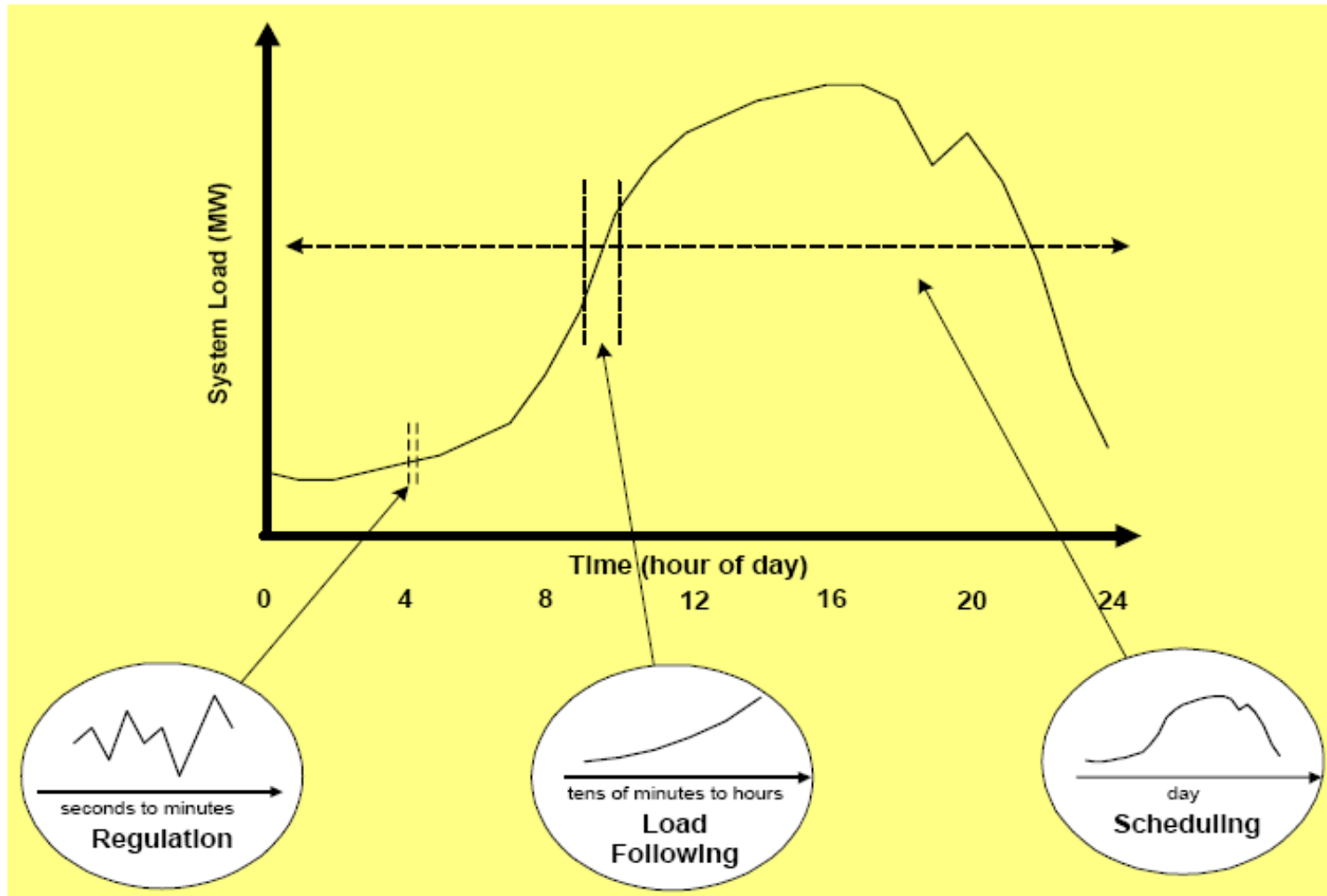
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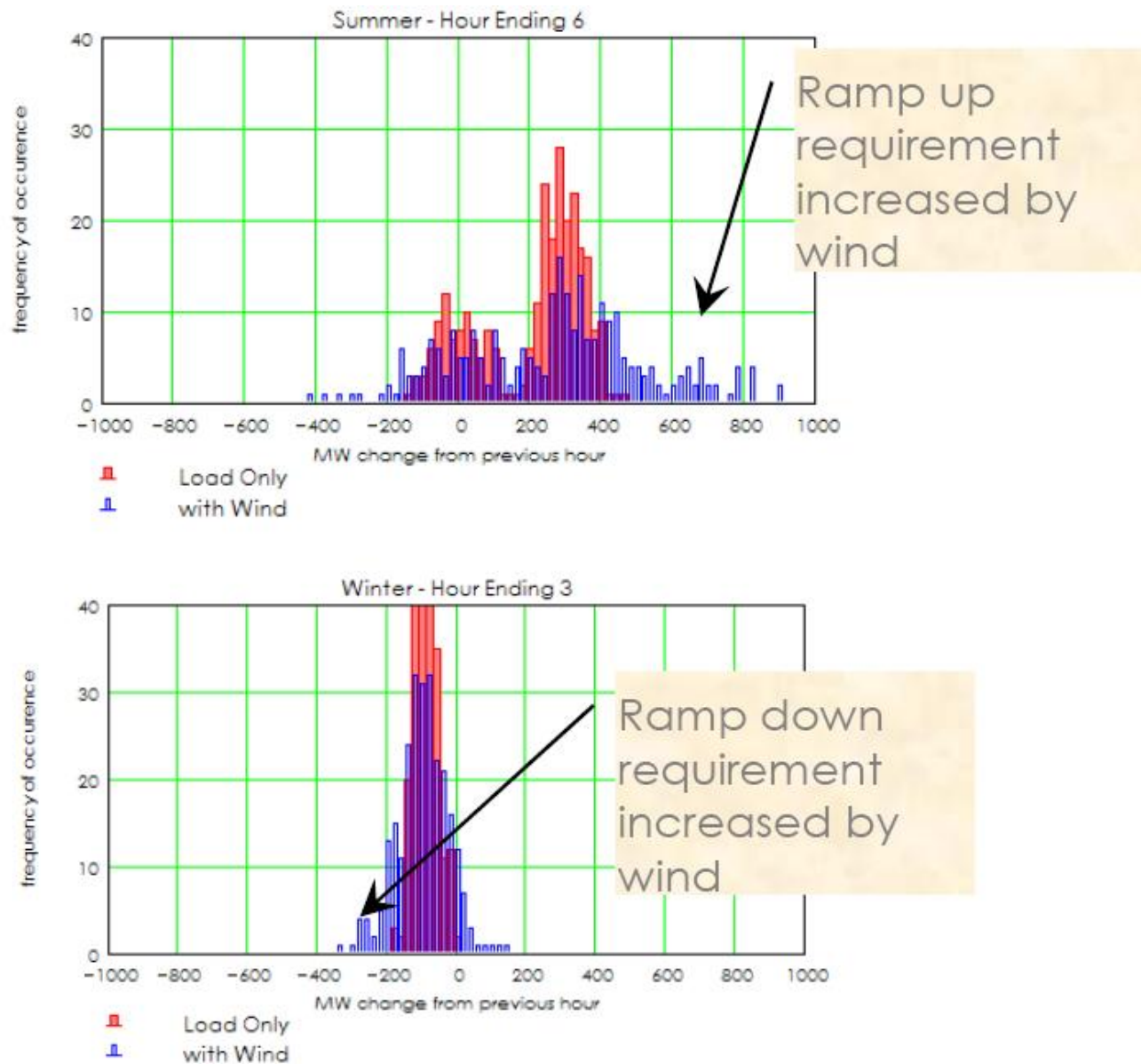


Figure 3. Load following impact on morning/evening ramps for Xcel Energy North

Intermittent Generation: Resource Adequacy

- Establishing a capacity credit for intermittent generation (on peak)
 - 2009 MISO credited wind resources with 20% of its nameplate capacity
 - 2010 MISO is crediting wind resources with only 8% of its nameplate capacity

Integrating Renewables

- Geographic diversity
- Add transmission
- Energy storage
- Diversified portfolio of resources including solar, demand response, etc.
- New market products with shorter commitment timeframes?
- MISO is working on a “Dispatchable Intermittent Resource” definition in their tariff

Questions?