

OVERVIEW OF MANITOBA HYDRO'S SYSTEM

David Cormie

Joanne Flynn



Outline

- Manitoba Hydro's Existing System
- Hydro System Characteristics
- Planning Objective and Criteria
- Lake Winnipeg Impacts
 - Keeyask and/or Conawapa



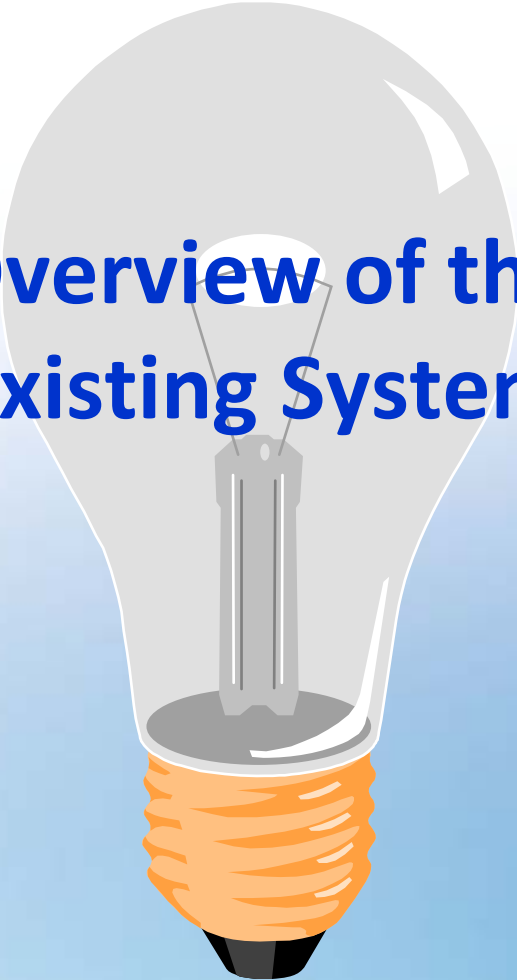
Capacity and Energy Defined

– Capacity available

- Maximum rate of power output
 - Megawatts (MW) that the generator can be relied upon to produce
- MH system = 6,265 MW

– Energy produced

- 1 GWh = 1,000 MWh = 1,000,000 kWh
- MH system generates an average of 32,000 GWh annually
- Manitoba domestic demand 25,500 GWh annually



Overview of the Existing System



Manitoba Hydro

- A medium sized utility
- Predominately hydro power
- Large variability in generation
- Physically remote in northwest corner of Eastern Interconnection
- Surrounded by predominately summer peaking thermal generation utilities mainly to the southeast
- Transmission constrained

Power System

Installed Capacity:

Hydro (winter peak) 5200 MW

Thermal 515 MW

Purchases Capacity:

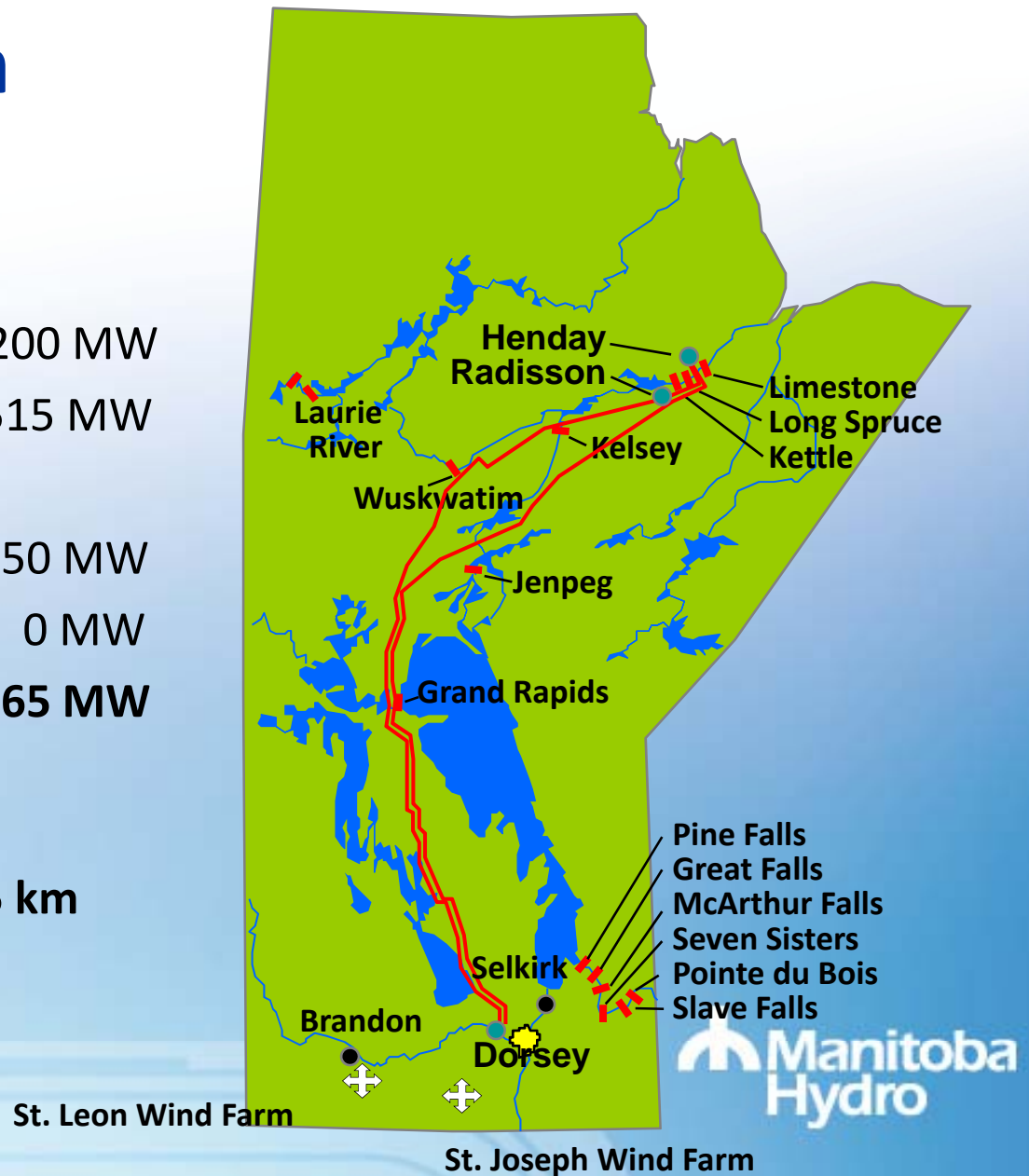
Imports (Diversity) 550 MW

Wind (250 MW) 0 MW

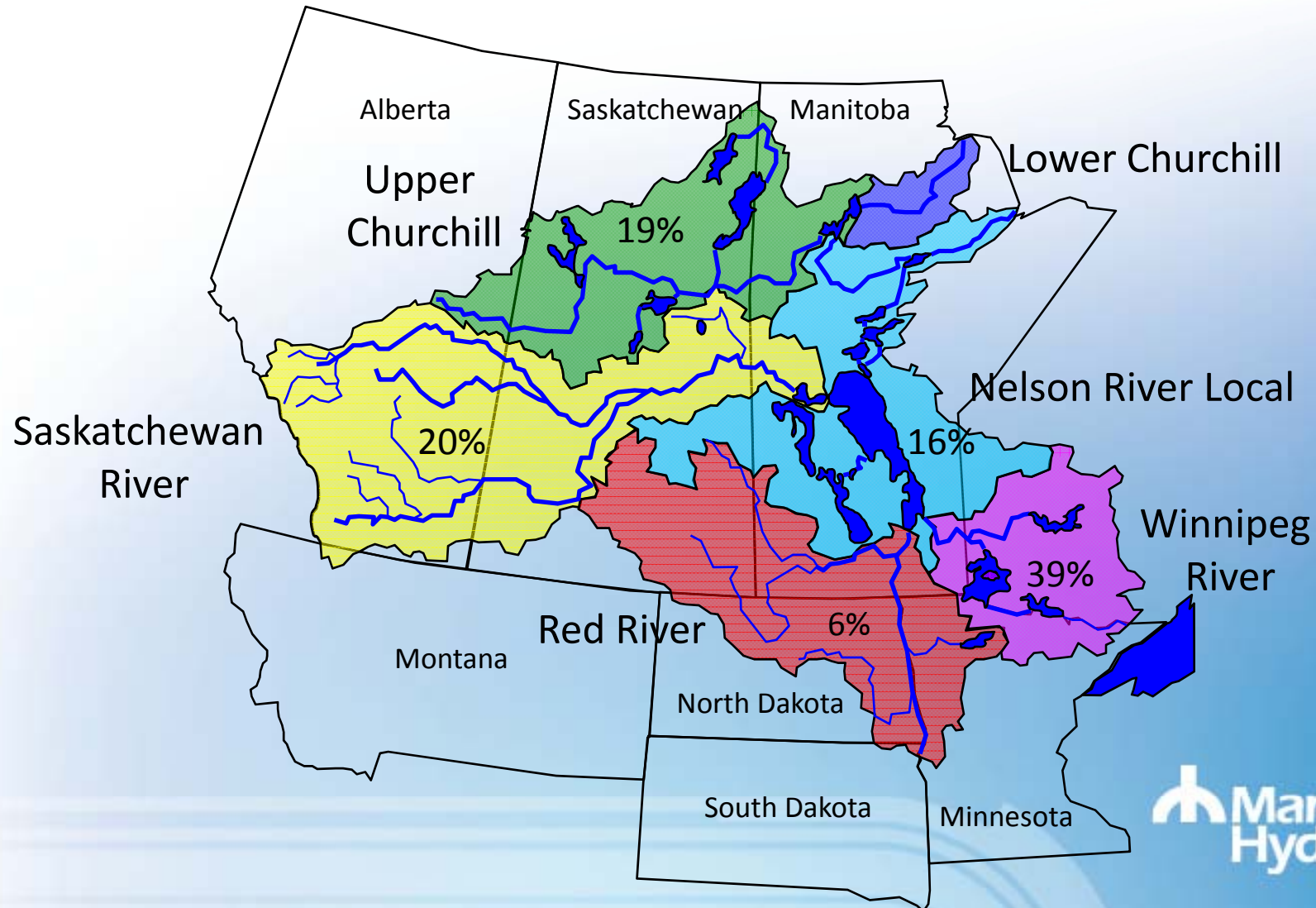
Total 6265 MW

Transmission Lines:

Total km 6885 km

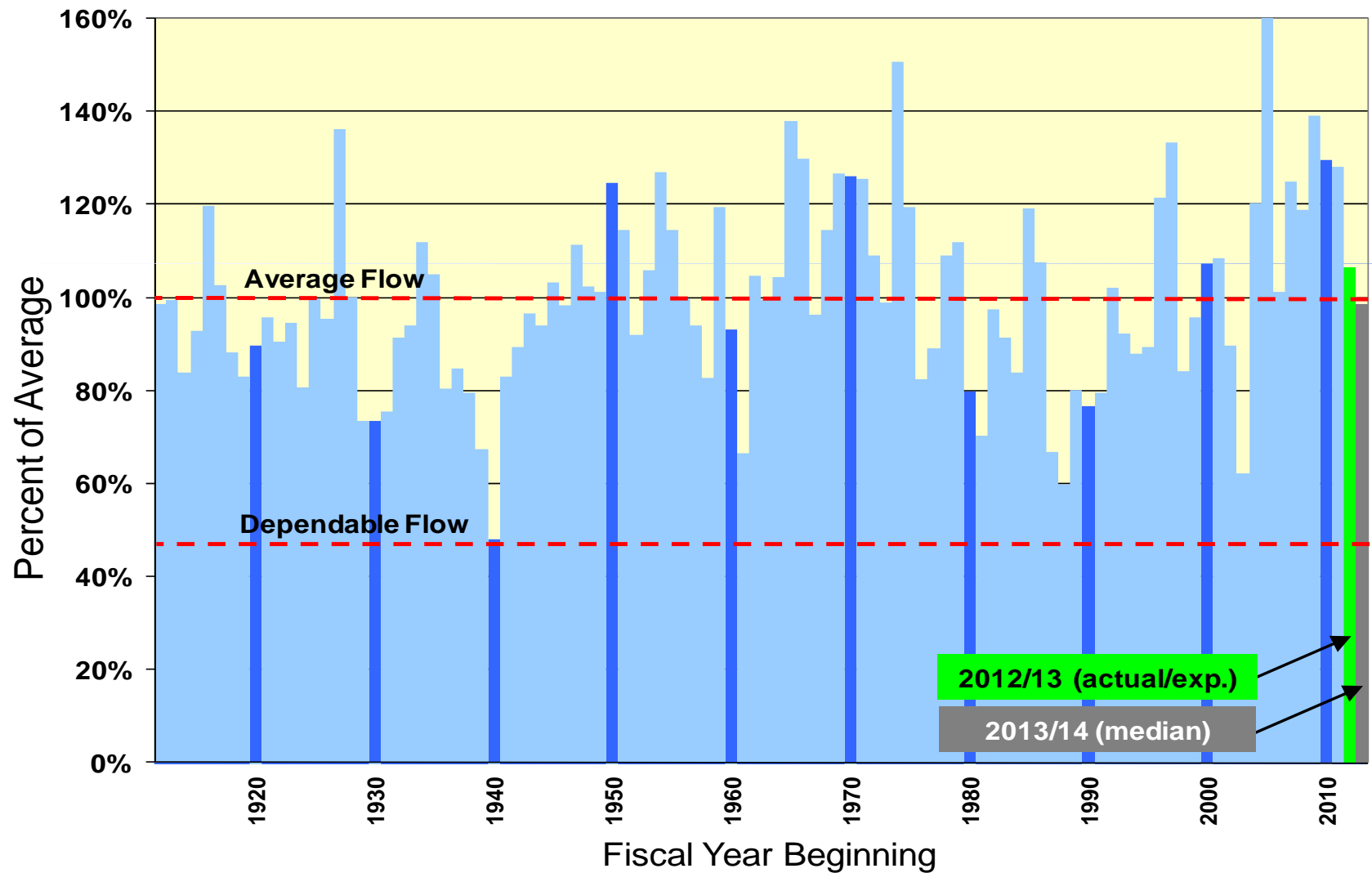


Manitoba Hydro Drainage Basins

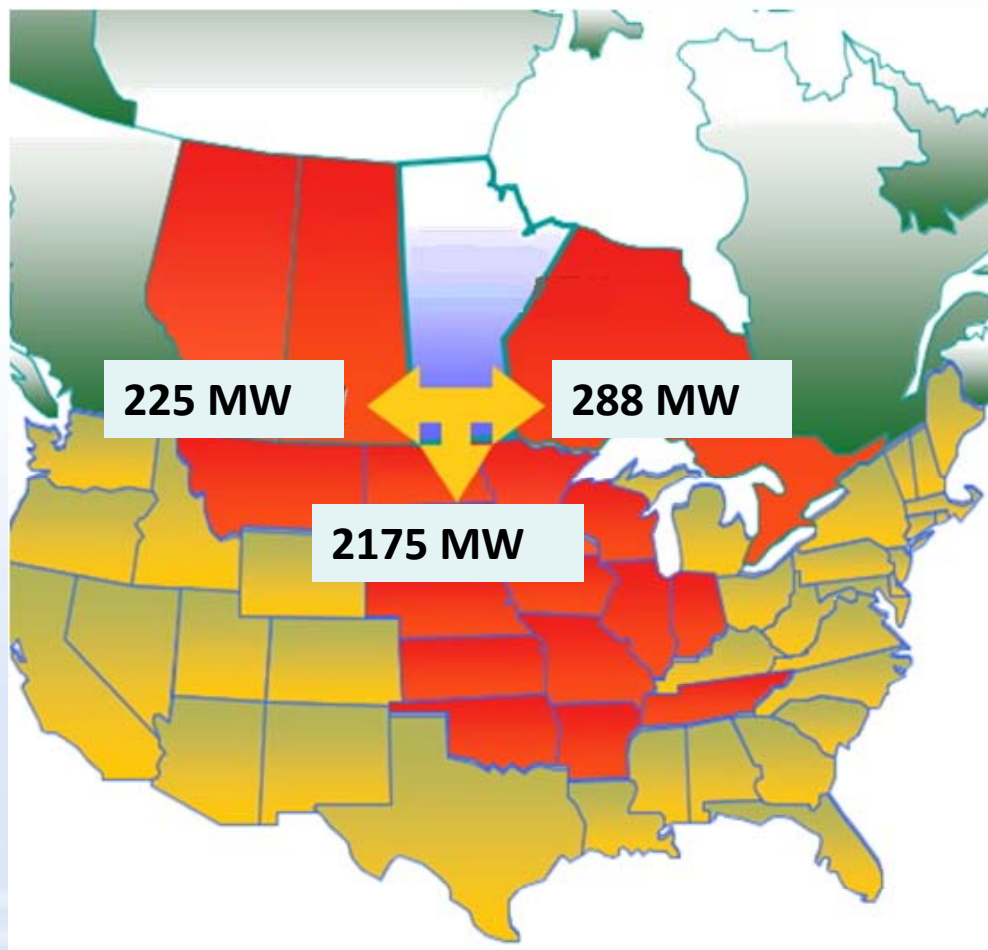


Historical Water Supply

System Inflows



Transmission Interconnections



Long Term Firm Transfer Capabilities (Scheduling Limits)

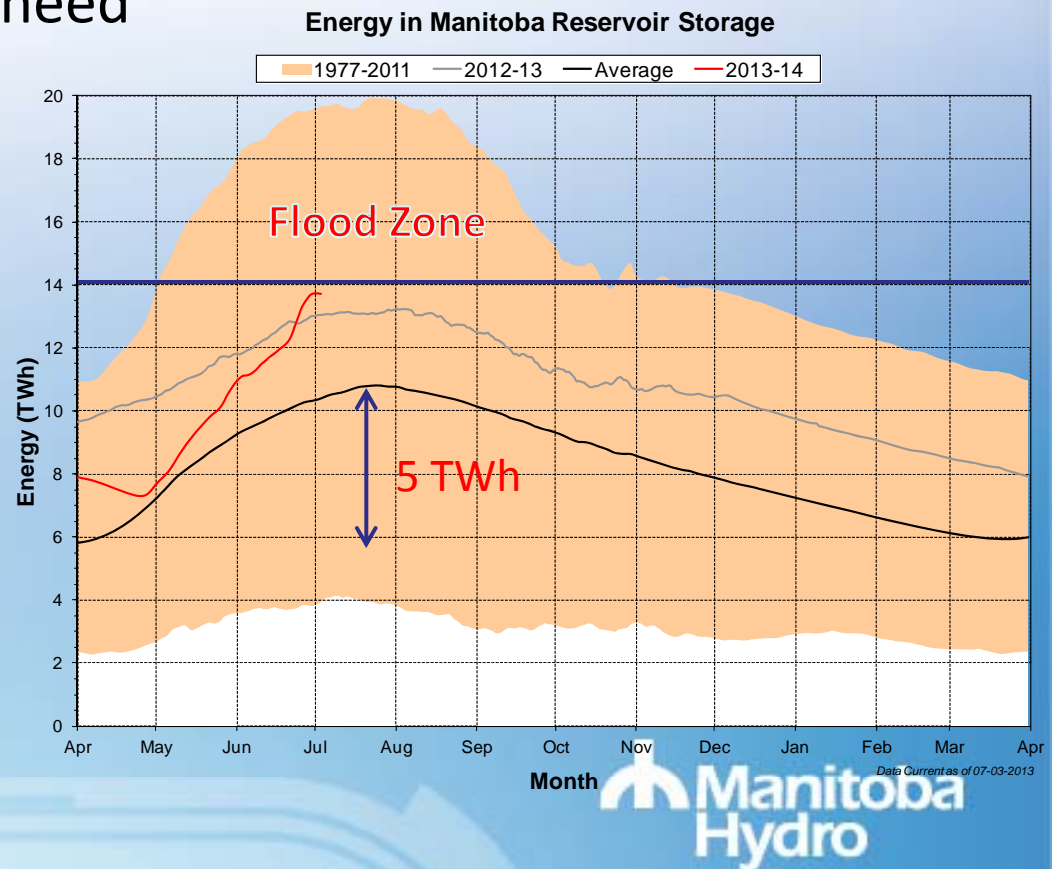
	Export	Import
U.S	1950 MW	700 MW
Ontario	200 MW	0 MW
Sask.	150 MW	0 MW



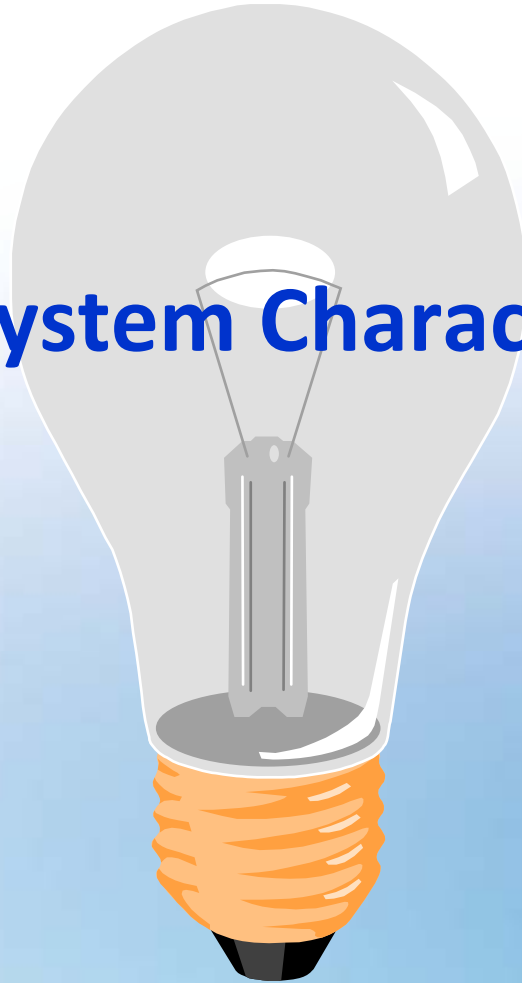
Interconnections built to maximize the value of surplus capacity and energy

Reservoir Storage

- Store water for future generation
 - Time of greater value/need
 - 2 - 12 TWh
- Key reservoirs
 - Lake Winnipeg
 - Cedar Lake
 - Southern Indian Lake
- Subject to limits
 - Maximum
 - Minimum



Hydro System Characteristics



Characteristics of a Predominantly Hydro System

- Large Water Variability
- Energy Constrained System
- Resource Diversity
- Transmission Limitations
- Long Lead Times
- Large Investments



Energy Constrained System

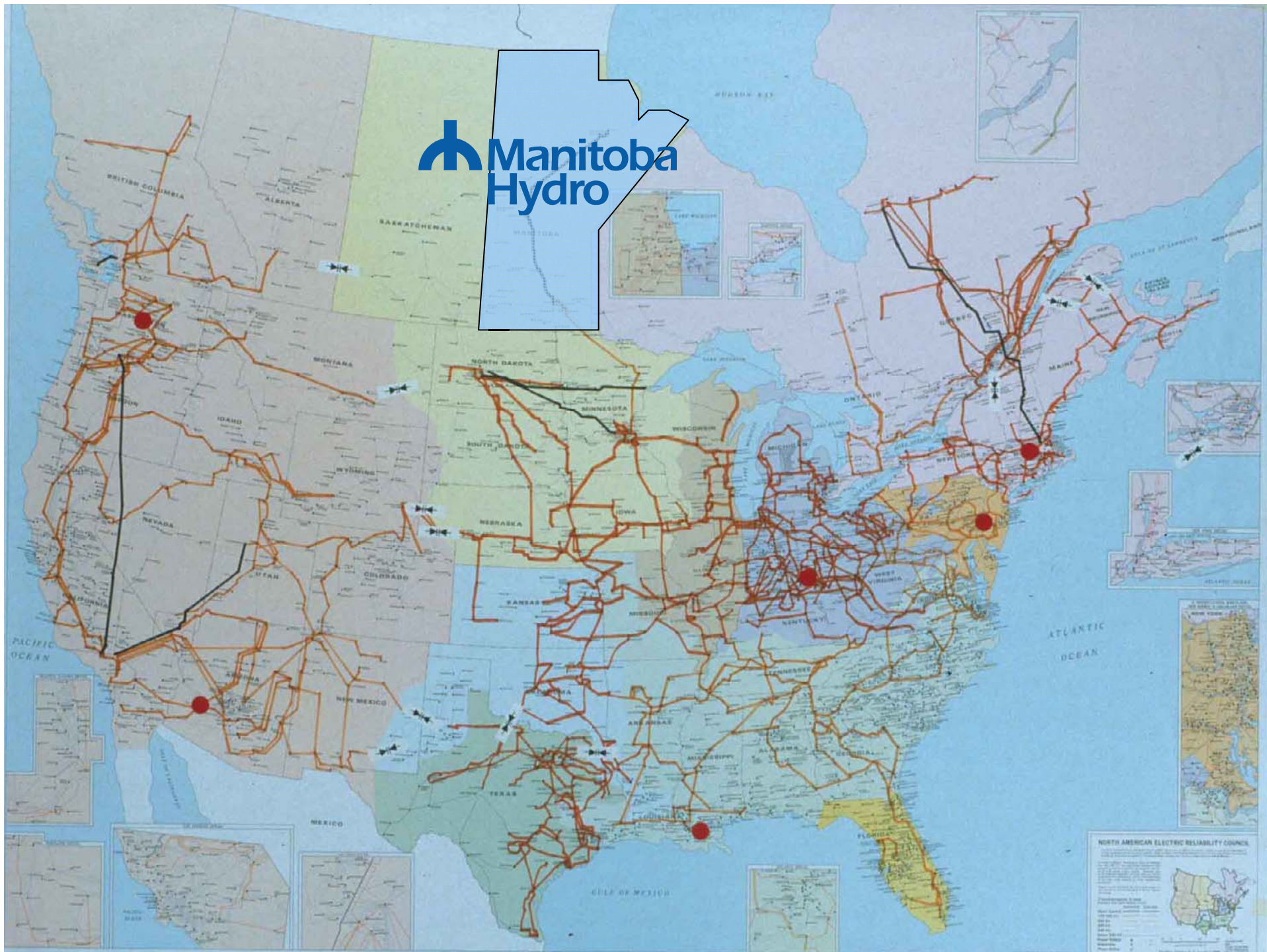
- Designed to meet energy requirements under the critical flow period
- Designed to meet peak load requirements
- Surplus in all flow conditions other than critical flow period

Resource Diversity

- Provides a mix of generation types in times of drought or high fuel prices
- Mix of resources can be achieved by building in Manitoba or by relying on purchased power over interconnections

Transmission Limitations

- Hydro generation is remote
 - requires transmission to move power to load centers
- Lack of transmission means congestion
 - More congestion unless new transmission is built to handle additional surplus
 - Congestion exists today
 - Export to Ontario
 - North Dakota wind
 - Limited ability to move power across Canada/US



Planning Objectives and Criteria



Planning Objectives

- Secure resources to meet the future energy and capacity needs of Manitoba
 - Obligation to serve
- Meet committed firm sales
- Do so at the least net cost to Manitoba customers
- Environmental and social impacts considered

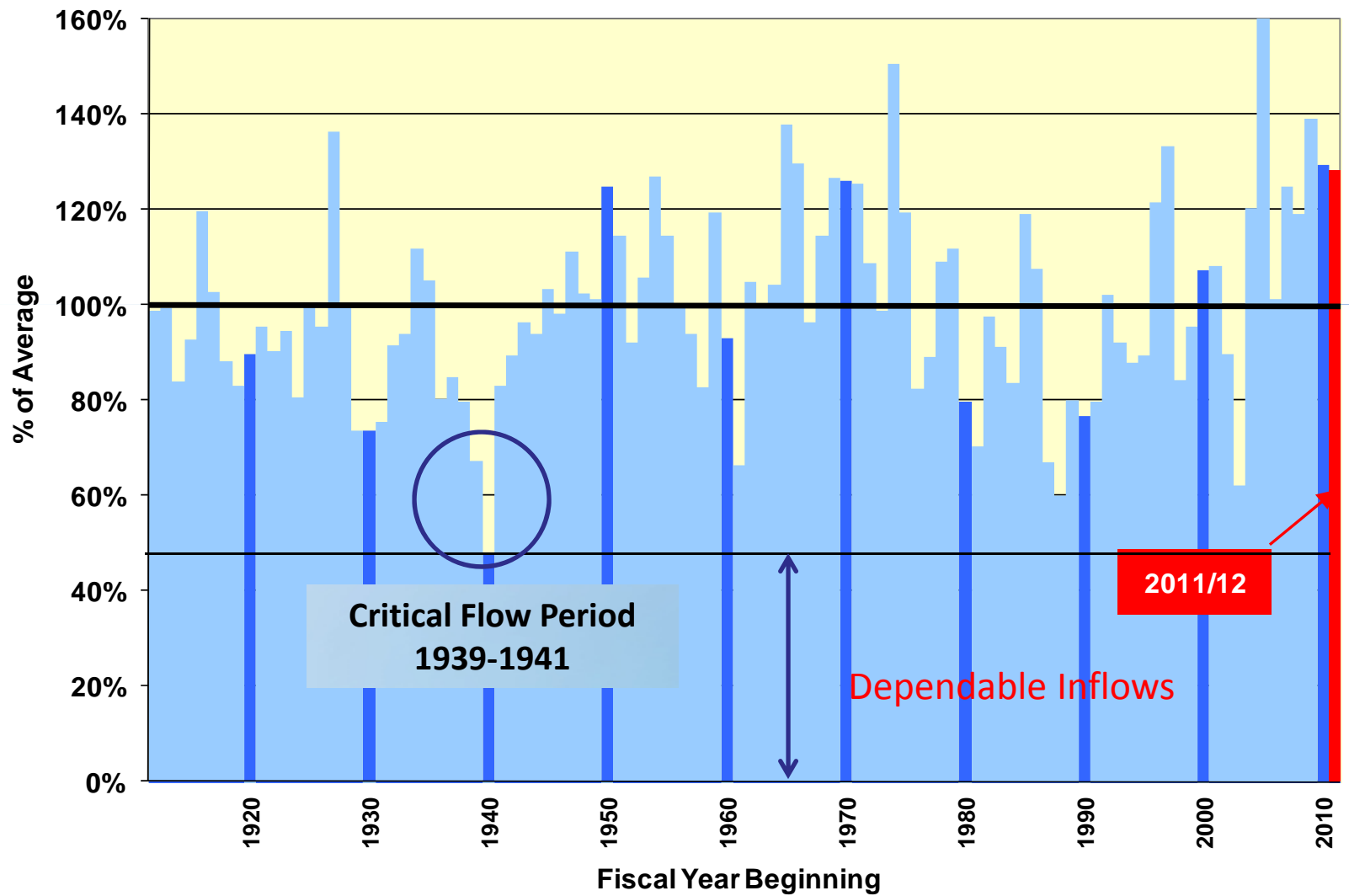
Manitoba Hydro's Generation Planning Criteria

- **Capacity Criterion**
 - Sufficient capacity to meet forecast peak load, plus
 - 12% reserve
 - increase in demand above forecast
 - breakdown of plant
 - recognizes that load growth and equipment availability is subject to uncertainty
- **Energy Resource Planning Criterion**
 - There must be sufficient energy supply available to meet firm energy demand in the event the lowest recorded coincident water supply conditions are repeated
 - Sources of dependable energy are
 - hydro, thermal, wind purchases
 - energy imports

Energy Defined

- Dependable Energy
 - Energy produced by the system under the lowest flow conditions on record
- Average Energy
 - The average of energy produced based on all historic flow conditions
- Maximum Energy
 - Energy produced as a result of most favorable flow conditions on record

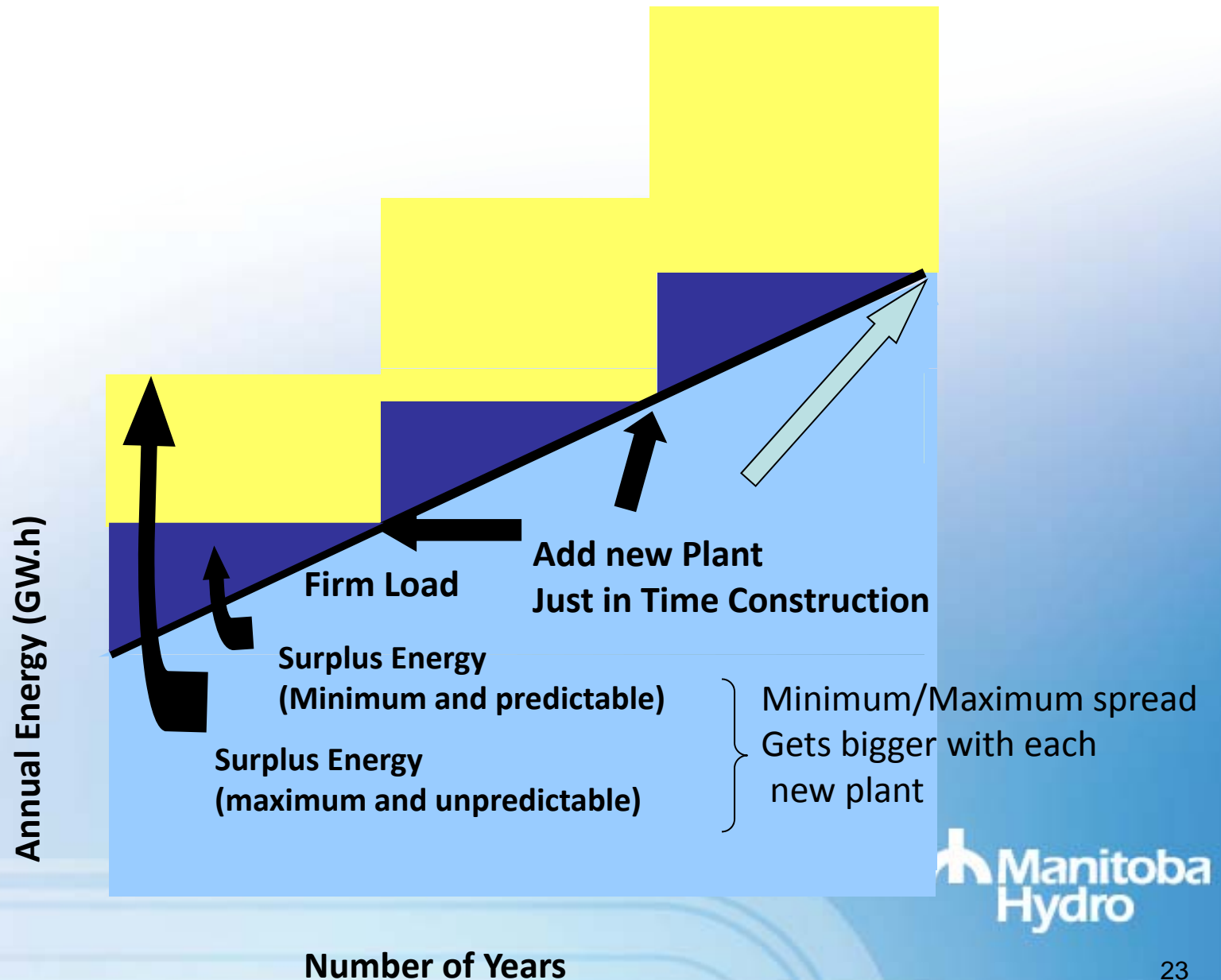
Hydro Energy



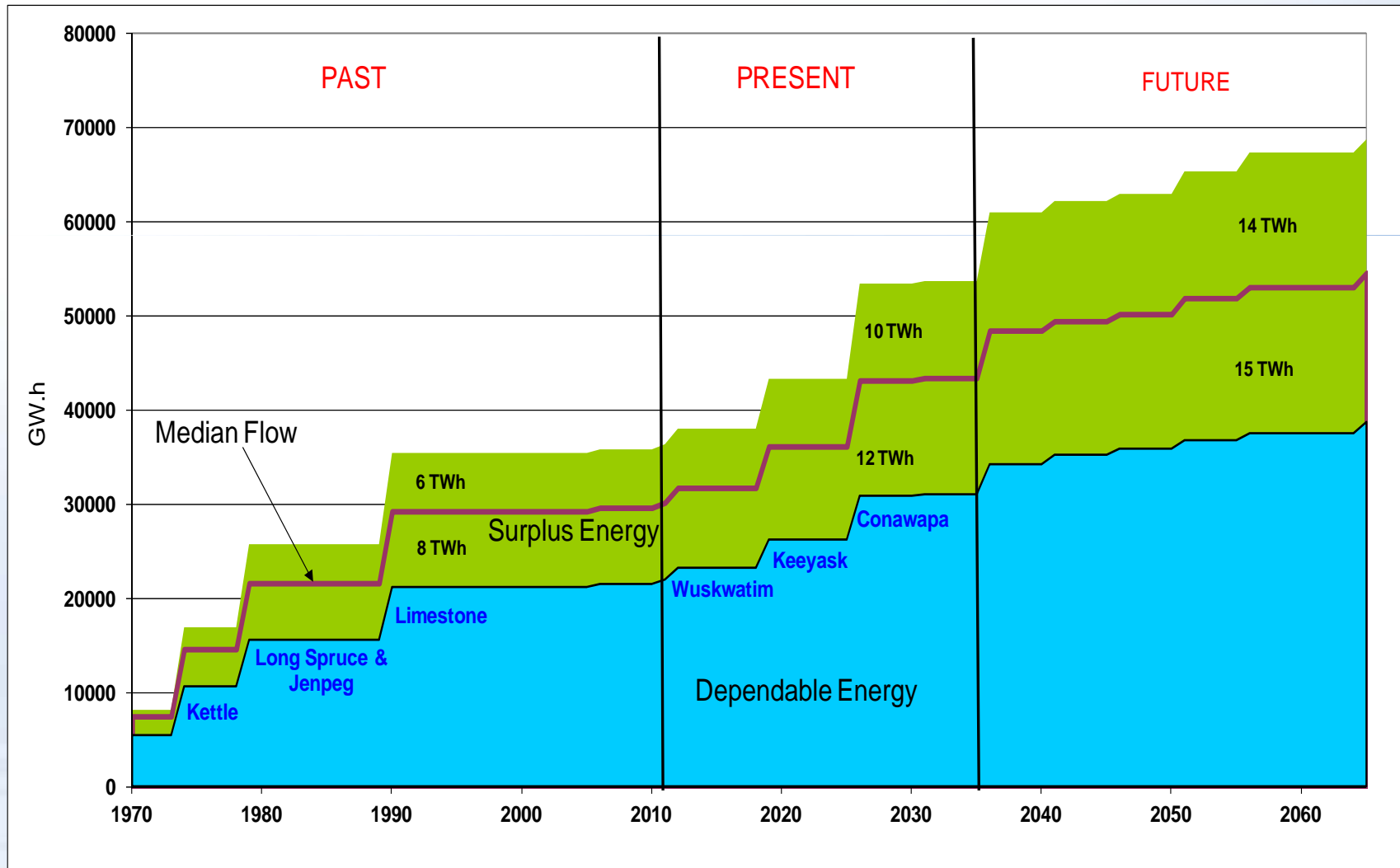
Energy Sources

- Hydro Energy
 - Dependable Inflows, plus
 - Maximum Use of Manitoba Reservoir Storage
- Thermal Energy
 - Station output if operated continuously
 - Derated for outages and maintenance
 - Coal, natural gas
- Wind Energy
 - 85% of average annual wind generation
- Purchased Energy
 - Must be on firm transmission
 - Available under contract
 - Available in off peak periods from organized market

Surplus Energy - By Design

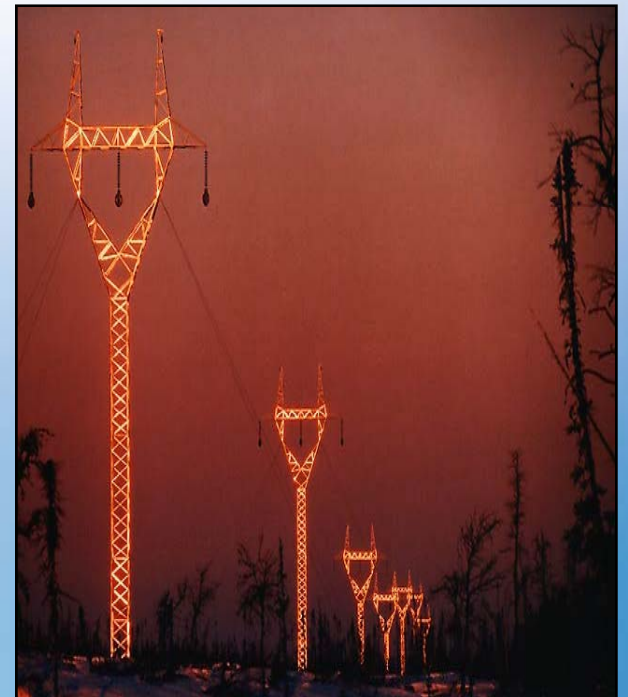


Variability in Hydro Energy Supply



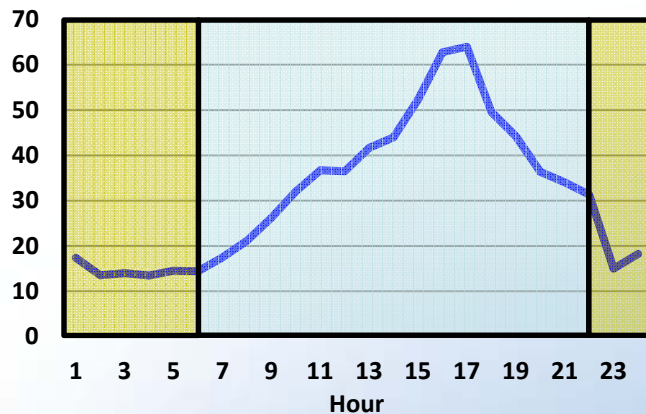
Value of Interconnections

- Provides Market Access
 - Export of surplus power
 - Import of a diverse source of power
- Capacity sharing due to load diversity
- Risk mitigation
 - Emergencies
 - Load forecast
 - Climate change
- Enhances Grid Reliability
 - Sharing of required reserves
- Decreases Overall Regional GHG's

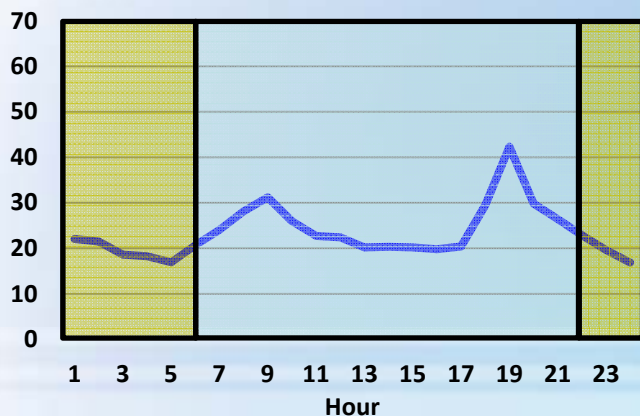


Market Access = Market Price

Summer Day

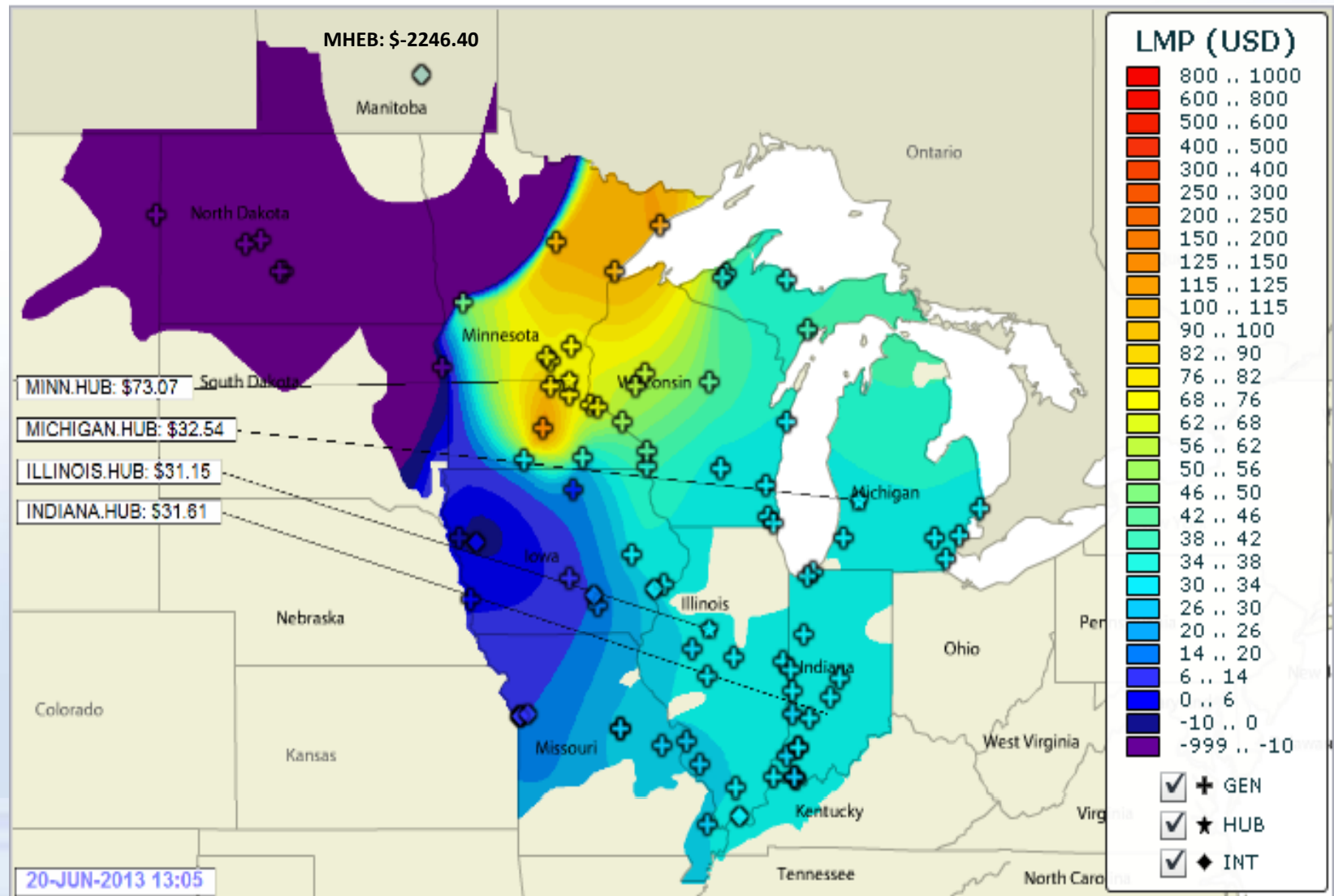


Winter Day



- Spot market wholesale electricity price
 - Highly variable - dependant on many, many factors
 - -\$2000 to +\$2000 per MWh
- No typical price
 - Always changing
 - On-peak, off-peak averages used
- Marginal cost of hydraulic energy \$5/MWh
- Hydro is flexible

Spot Price - Change every 5 minutes



Hydro - Large Investments

- High capital cost investment
- Majority of cost in civil structures
- Low, stable operating costs that contribute to stable rate increases
- Large plants can satisfy many years of Manitoba load growth

Hydro -

Extremely Long Lead Times

- Exploration, Engineering, Environment
- Negotiations, Approvals, Licensing
- Construction
- Increasingly complex
- 20 years becoming normal - 1/2 a career or more
- Keeyask – 2019
- Conawapa – 2026

Preferred Development Plan

- Keeyask G.S. (695 MW) – 2019/20
- Conawapa G.S. (1485 MW) – 2026/27
- New 500 kV US Interconnection – 2020
- Sale Agreements
 - Minnesota Power
 - Wisconsin Public Service
 - Northern States Power
 - Others

Resource Sequence Comparisons

- Consistent methodology used to evaluate all new resource additions
 - PUB, CEC and NFAT submissions
- Standard Industry Practice
- Applied to all forms of new supply options
 - Hydro
 - Thermal
 - Wind
 - Purchases

System Impacts

- Adding new generation can impact the entire MH system
 - Existing hydro and thermal stations
 - Imports
 - Exports
- Adding new generation in combination with new interconnections, new export and import contracts becomes even more complicated
- Physical, Financial, Environmental and Rates
 - Impacts from new generation only one of many variables

Lake Winnipeg

- 12th largest lake in world
 - 50% of storage in Nelson Churchill watershed
- Primarily regulated for
 - Hydropower - 711 to 715 feet
 - Flood Control - >715 feet
 - WPA Licence
- LWR regulates flow of Nelson River
 - Outflows controlled at Jenpeg GS
 - 50% more outflow is possible
 - 69% of MH generation downstream
 - Post Keeyask/Conawapa 78%



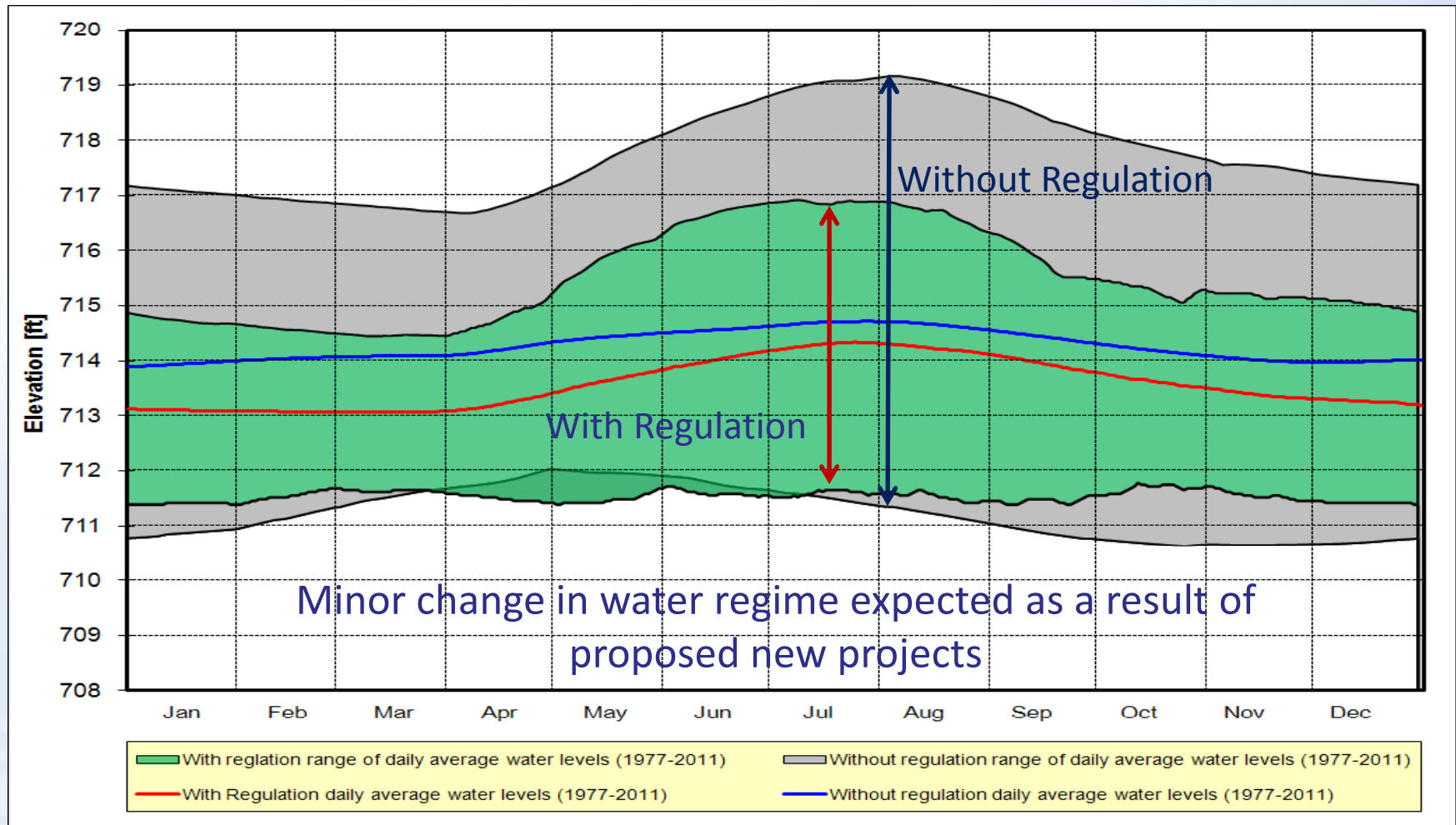
Preferred Development Plan

Impact on Lake Winnipeg

- What won't change
 - Terms of WPA License
 - Approach to Lake Winnipeg regulation
 - Obligations to stakeholders
- What will change
 - Outflows and Levels
 - Changes will be minor
 - Major driver is water supply

Lake Winnipeg Water Levels

(with and without regulation - 1977-2011)



Questions

