Manitoba Hydro
Supply and Demand Planning

Joanne Flynn
Division Manager, Power Planning
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Supply and Demand

- Characteristics of Hydro System
- Supply Planning Process
- Supply and Demand

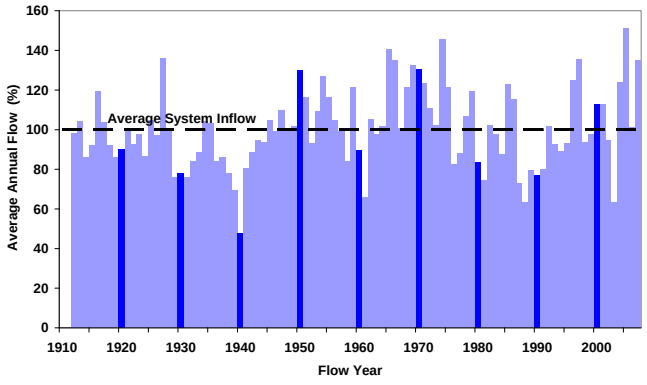
Planning for a Predominantly Hydro System

Characteristics of Hydro System

Characteristics of MH Predominant Hydro System

- Water Variability
- Long Lead Times
- Lumpy Investment
- Resource Mix
- Energy Constrained System

Manitoba Water Supply



Characteristics of a Predominantly Hydro System

- Long lead times for hydro plants
  - Planning, design, licensing, construction
- Resource mix
  - Mix of resources can be achieved by building or by relying on interconnections

Characteristics of a Predominantly Hydro System

- Lumpy investment
  - Majority of cost in civil structures
  - Large plants can satisfy many years of Manitoba load growth
- 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

Supply Planning Process

Supply Planning process

- Objective:
  - *To plan for an adequate supply of electricity to meet customer requirements.*
    - Must satisfy reliability criteria at lowest reasonable cost to Manitoba customers which includes the integration of economic, environmental and social factors.

Planning Criteria

- Approved by MHEB
- Technical criteria
- Reviewed to reflect current conditions

Planning Criteria

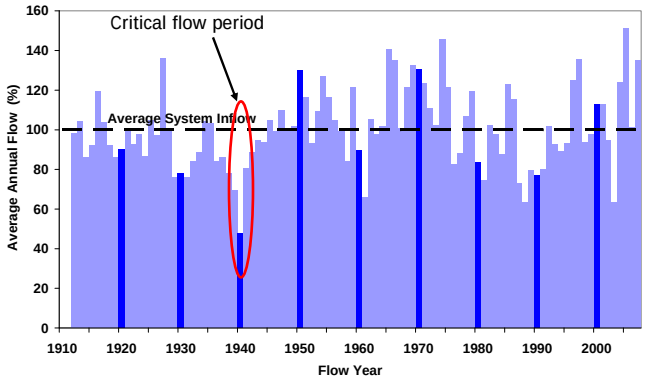
Capacity Criterion

- Planned generation capacity (MW) must not be less than forecast firm annual peak demand plus a reserve requirement of 12% of forecast firm loads.

Energy Resource Planning Criterion

- There must be sufficient firm energy sources to meet firm energy demand in the event of a repeat of the lowest historic river flow conditions.
- Dependable supply includes energy from hydro-electric and thermal stations, purchases from wind farms, firm energy imports from out-of-province, as well as contracted non-firm imports from the reserves of neighbouring utilities.
- Contracted non-firm imports for meeting firm load should not exceed 10% of firm energy requirement.

Critical Flow Period



Drought Research

- Canadian Foundation for Climate and Atmospheric Sciences (CFCAS) Prairie drought research project entitled the, *Drought Research Initiative (DRI)*.
- Probabilistic Analysis of Drought
- Drought Analysis Using Synthetically Generated Data and Paleoclimatic Information
- Reconstruction of Precipitation and Streamflow in the Churchill & Saskatchewan River basins using Tree-rings
- Reconstruction of Hydrologic Extremes in the Winnipeg River Basin from Lake Sediments
- Frequency, Severity and Causes of Extreme Droughts in the Winnipeg River Basin (tree-rings)
- Paleoclimatic Indicators of Drought

Drought Research

To date research is inconclusive on:

- Assignment of probabilities to a specific drought
- Whether there is more appropriate drought to protect against
- Using paleoclimatic or other indicators to reconstruct streamflows

Drought Research

- Value of research to date

  Reasonable to use droughts which have been experienced and are quantified for planning and operation analysis.

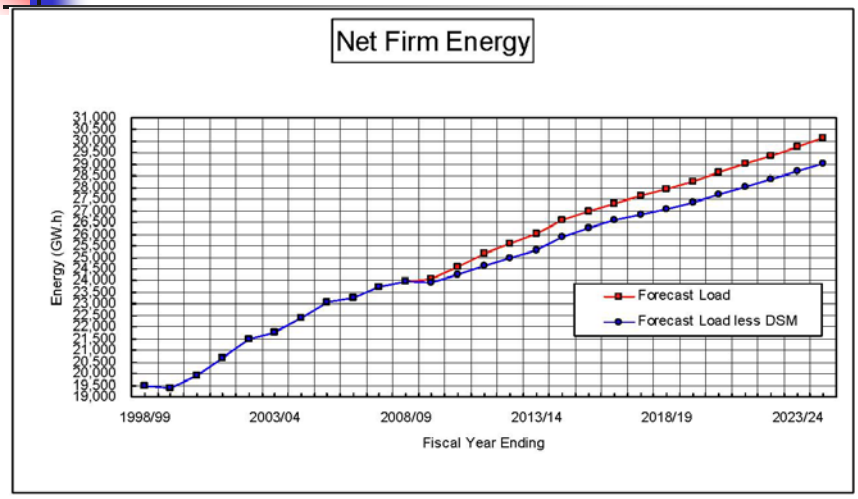
  - Droughts since 1900

Supply Planning process

- Planning Criteria
- Demand for Power
- Supply of Power
- Need for and timing of new resources
- Supply Options
- Development plans
- Evaluations – economic, financial social environmental, risk
- Recommend power resource plan – basis for IFF
- Approvals – study plan, protect plan, pursue licence, commitment to construct

Manitoba Energy Demand

(from Tab 7)



Existing Supply

Source	Capacity MW
Installed:	
Hydro (winter peak)	4900
Thermal	535
Purchases:	
Imports (Diversity)	500
Wind (100 MW)	0
Total	5935

Need for New Resources under 2009/10 resource plan

- Under dependable flow conditions new generation is required by 2022/23
- New capacity resources are required in 2024/25

Range of supply options

Hydro

Biomass

Nuclear

Gas turbines

Imports

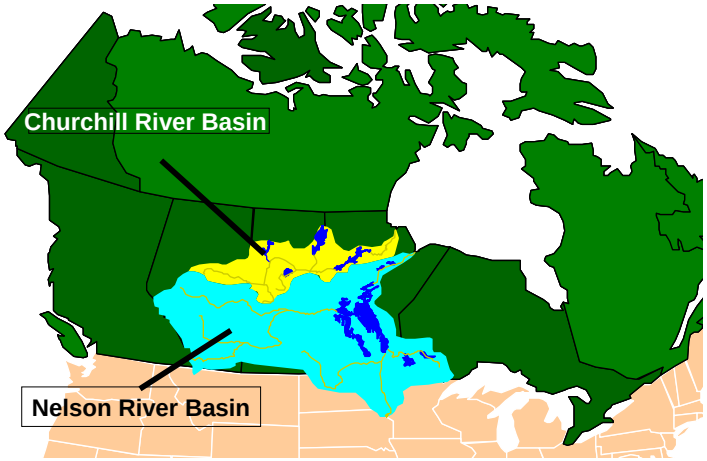
Solar

Wind

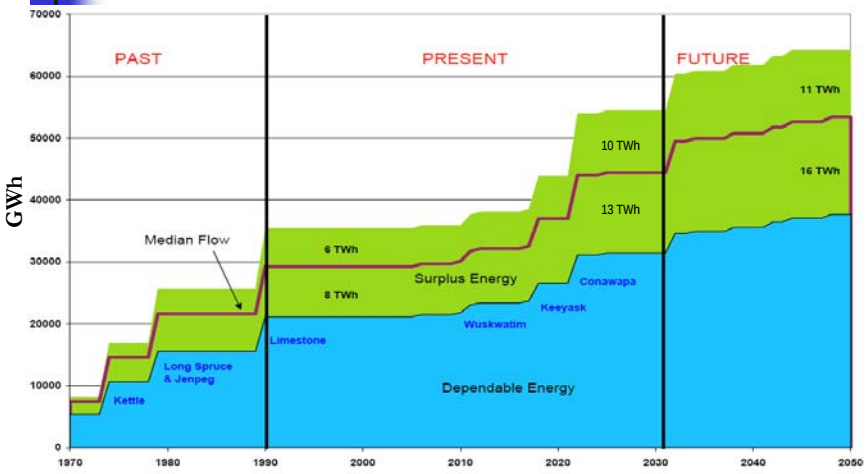
Development Plans

- Supply options in various stages of readiness
- Meet requirements under dependable flow conditions
- Potential to advance options

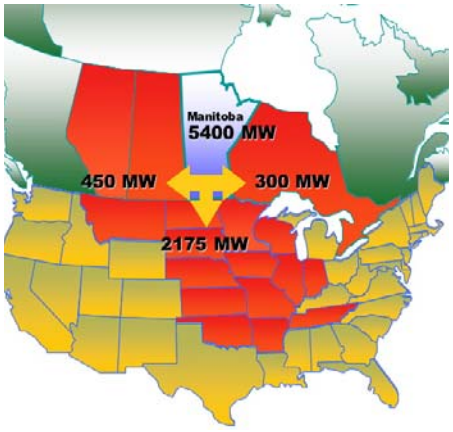
The Hydro Province



Variability in Hydro Energy Supply



Transmission Interconnections

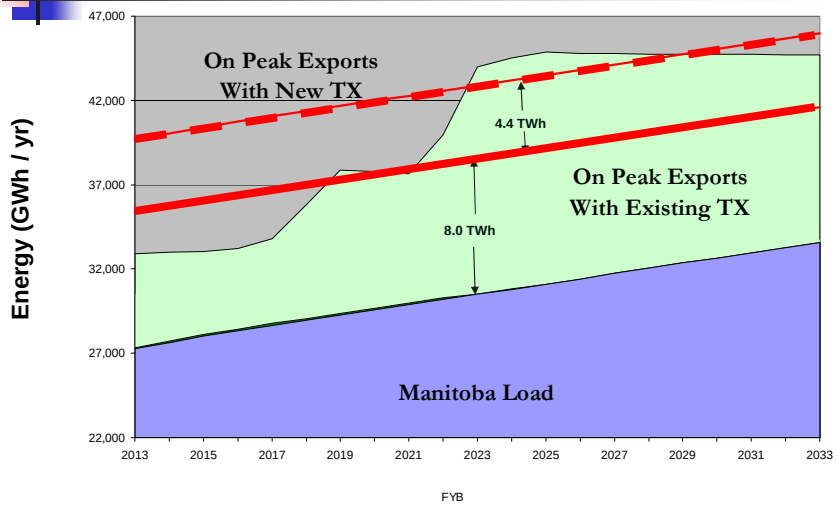


MB →

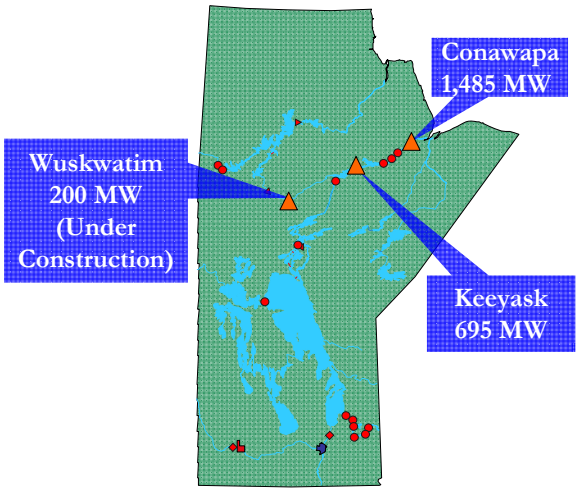
- Ontario
- Saskatchewan
- US: 3200 MW with new tie-line (estimated)

Existing Interconnection Limits

(median flows)



Proposed New Hydro



New Hydro Projects

Project	Capacity Addition (MW)	Dependable Energy (GWh)	Median Energy (GWh)	Maximum Energy (GWh)
Wuskwatim	200	1250	1520	1650
Keeyask	695	2900	4430	5250
Conawapa	1485	4550	7000	9500

Supply Planning process

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Development Plans

- Continually under review
- Commitment decisions require MHEB approval
  - No “blanket” approvals are given
- Inclusion in plan is authorization to continue to pursue the plan but is not a commitment to construct.

Recommended Development Plan 2009/10

- Plan to develop major infrastructure and resources to pursue a new interconnection which is dependent on facilitating the Wisconsin Public Service (WPS) and Minnesota Power (MP) sales

Recommended Development Plan

from 2009/10 power resource plan

- The 500 MW Sale to WPS and the 250 MW Sale to MP
- Keeyask with a 2018/19 ISD (In-Service Date)
- Conawapa with a 2022/23 ISD.
- New interconnection with a 2018/19 ISD
- The 375/500 MW Sale to Northern States Power (NSP) as described in the Term Sheet in effect.
- 300 MW (now 138) of additional wind generation with a 2010/11 ISD.
- Wuskwatim with a 2011/12 ISD.
- Pointe du Bois rebuilt with a 2016/17 ISD. (Now spillway only)

Alternative Development Plan

from 2009/10 power resource plan

- Conawapa with a 2021/22 ISD.
- A Combined Cycle Gas Turbine (400 MW) with a 2033/34 ISD.
- The 375/500 MW Sale to NSP as described in the Term Sheet in effect.
- 300 MW (now 138 MW) of additional wind generation with a 2010/11 ISD.
- Wuskwatim with a 2011/12 ISD.
- Pointe du Bois rebuilt with a 2016/17 ISD. (Now spillway only)

Supply and Demand

System Firm Energy Demand and Dependable Resources

(Note: Reference Supply/Demand Tables)

Dependable Energy

- Dependable Energy is defined as
  - *the maximum energy that the Manitoba Hydro system can produce during the lowest (critical) flow period*
- Dependable Energy available to Manitoba Hydro is the sum of dependable energy from
  - Hydro Generation (within Manitoba)
  - Long-term Contracted Imports
  - Thermal Generation (within Manitoba)
  - Wind Generation (within Manitoba)

Dependable Energy from Hydro Generation

- *Maximum energy available from hydraulic resources in the Manitoba Hydro system during the worst drought in the flow history. Record begins in 1912.*
- Critical drought period: from 1939 through 1941
- Based on hydraulic generation from system inflows during the critical period and generation from water held in reservoir storage.
  - Includes existing and planned hydro generating stations and water management facilities of:
    - Lake Winnipeg Regulation
    - Churchill River Diversion
    - Cedar Lake
  - Inflows modified to reflect forecast upstream withdrawls

Dependable Energy from Long-term Contracted Imports

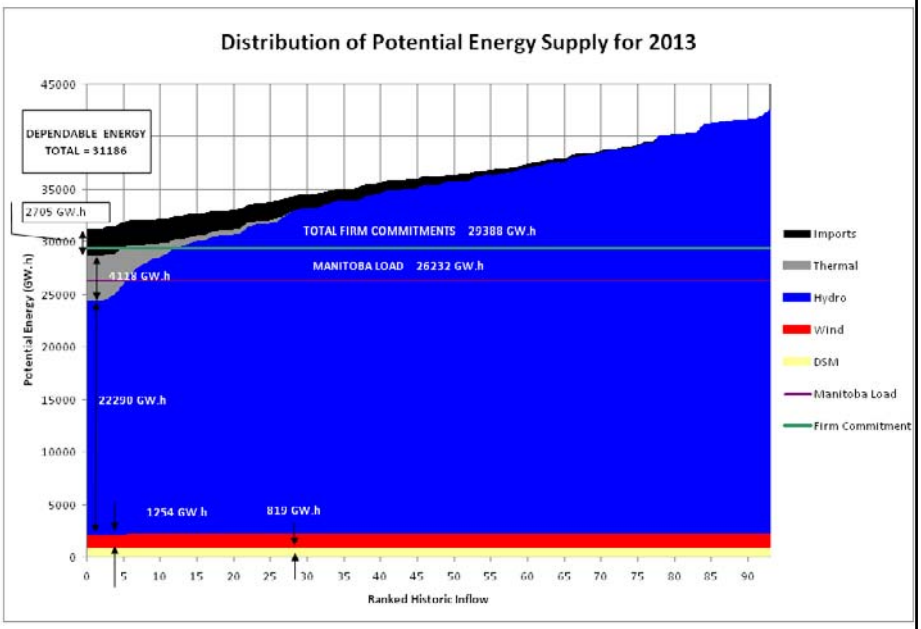
- Long-term contracted firm imports are included as dependable energy
- Export commitments that include clauses that reduce the obligation to deliver under adverse water are modeled as an import
- U.S. firm import transmission capability limited to 700MW
- No firm imports assumed from Ontario or Saskatchewan.

Dependable Energy from Thermal Resources

- *Maximum energy available from gas and/or coal fired generation, adjusted for planned and forced outage rates*

Dependable Energy from Wind Generation

- Dependable energy from wind generation within Manitoba under contract to Manitoba Hydro calculated as follows:
  - 85% of average annual wind generation,
  - Monthly generation pattern



Treatment of Supply Options on the Planning Horizon

- New generation is included based on plant energy and capacity ratings of the proposed plants
- Rerunnering of existing plant is included based on the incremental capacity and / or energy of the modified units
- Bipole III is represented as a supply option as is DSM - technically speaking they are not generation.

Supply Options - Major Rerunnering

- Capacity gains due to increased flow through modified generating stations
- Dependable Energy gains would be available if the modifications result in either an increase in unit efficiency, or reduced spill during drought conditions.

Supply Options - Bipole III HVDC Line

- Bipole III will reduce transmission losses within Manitoba
- Loss savings reduce when a plant the size of Conawapa comes on line

Supply Options - Demand Side Management

- DSM is studied as if it where a generation supply option
- Represents load reductions from the base load forecast resulting from the continuation of existing and new Power Smart Programs

Demand

- Base Load Forecast reflects the forecast Manitoba Load
  - Includes transmission losses associated with domestic loads
  - Incorporates load reductions due to codes and standards

Components of Demand

- Exports
  - Committed exports are included, reflecting 10% transmission losses on the incremental load (i.e. Generation value must be 10% more than the export quantity).

Need for New Resources

- *Any deficiency of dependable supply over demand signals a need for additional resources*
- A deficiency would only occur if actual flows were at or near critical conditions

Manitoba Water Supply