Manitoba Hydro’s Export Markets

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Manitoba Hydro
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Topics

- What is Surplus
- Export Background
- The Border and Loop Flows
- Curtailment Rights, Events and Priority
- Markets
- Merchant Transactions
- Prices, Pricing and Price Example and Volumes Relationships
- Transmission, Transfer Capability, TX Rights
- Manitoba Hydro’s Future in the Market
Planning in Uncertainty

- Accurate long term forecasts are not available
- History is only an indicator
  - Statistics help
- Reliability of Supply
  - Societal costs of power shortages are enormous
  - MH does not rely on its predictive ability
  - Decisions made on the worst case
    - 95%-99% CI
  - Export curtailment rights
- Economics
  - Decisions made on expected outcome
  - Understand the risks
What is Available to Export?

- Surpluses not needed by Manitobans
  - Firm load
    - Energy
    - Capacity
  - Reserves
- All transactions asset backed
50 Years of Exports

Sales = $8.5 billion
Changing Nature of Export Market

Sales ($M)

- Direct Interconnects
  - 1990: 50+ (Bilateral)
  - 1992: 7 (AESO)
  - 1994: 10 (AESO)
  - 1996: 20 (AESO)
  - 1998: 30 (AESO)
  - 2000: 40 (AESO)
  - 2002: 50 (AESO)
  - 2004: 60 (AESO)
  - 2006: 70 (AESO)
  - 2008: 80 (AESO)
  - 2010: 90 (AESO)

- Open TX Access
  - 1990: 50+ (AESO)
  - 1992: 7 (AESO)
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  - 2010: 90 (AESO)

- Emergence of Markets
  - 1990: 50+ (IESO)
  - 1992: 7 (AESO)
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  - 2008: 80 (AESO)
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Legend:
- Bilateral
- AESO
- IESO
- MISO
Export Customers - 2009/10

<table>
<thead>
<tr>
<th>Customer</th>
<th>Revenue (millions)</th>
<th>Market Share (%)</th>
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<tbody>
<tr>
<td>Customer A</td>
<td>$164</td>
<td>40%</td>
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<tr>
<td>MISO</td>
<td>$102</td>
<td>25%</td>
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<tr>
<td>IESO</td>
<td>$49</td>
<td>12%</td>
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<tr>
<td>Customer B</td>
<td>$23</td>
<td>6%</td>
</tr>
<tr>
<td>Customer C</td>
<td>$18</td>
<td>4%</td>
</tr>
<tr>
<td>Customer D</td>
<td>$15</td>
<td>4%</td>
</tr>
<tr>
<td>Customer E</td>
<td>$8</td>
<td>2%</td>
</tr>
<tr>
<td>Customer F</td>
<td>$6</td>
<td>1%</td>
</tr>
<tr>
<td>Others</td>
<td>$17</td>
<td>4%</td>
</tr>
</tbody>
</table>

Markets = 40% But Who?
MH Export Functions

- 1998 Functional Separation

- Transmission System Operations Division
  - Reliability - “Keep the lights on”
  - Operate MH transmission system
  - Dispatch MH generation fleet
  - Provide wholesale non-discriminatory transmission service

- Power Sales and Operations Division
  - MH merchant function
  - Maximize the value of MH surplus assets in the export markets
National Energy Board

- Regulates MH’s export activities to US
- All US exports are licensed
  - General export permits
    - Firm and non-firm
    - Duration less than 5 years
  - Specific sale permits
  - Transmission line licences
- MH reports monthly
  - Energy physically delivered
    - Does not include the portion of sales served from the market
  - Revenues
The Borders

- Title transfers at the border
  - Canada - US
    - Sale of electricity in Canada
    - Not subject to US/state tax law
    - Not subject to US jurisdiction
    - MH does not have Market Based Rate Authority
      - Can’t sell at market based rates in US
  - Ontario
  - Saskatchewan
- Meters are deemed to be at the border
  - Compensated
Electricity Flows

- **Physical flows**
  - MH is electrically connected to the entire Eastern Interconnection
  - Electricity flows over a transmission network
  - It follows path of least resistance
  - Vary second by second
  - MH responsible to control flows in/out MB
  - Metered
  - Includes inadvertent loop flows

- **Scheduled flows**
  - Includes exports and imports on interface
    - Not just MH transactions
  - Vary hourly
  - Assumed to follow contract path
  - NERC tagged for reliability
  - Cut when necessary by NERC priority

- **Financial transactions**
  - No effect on power flows

MH-US Interface
MHEX_S
Net flow on
1 x 500 kV
3 x 230 kV
MH Curtailment Rights

- All export sales include the right to physically curtail delivery in order to give Manitoba firm load priority
- Defined in contract

- Corollary: Dependable sale contracts improve the reliability of supply
  - Generation reserved for export sale is ultimately available to serve MB
  - TX lines built for export provide import capability
  - Import lines help in emergencies
Curtailment Events

- **Generation**
  - Forced outages
  - Scheduled outages
  - Derates
  - Loss of HVDC capacity
  - Unavailability of purchased power
  - Events of Force Majeure

- **Transmission**
  - Loss of Transmission Service
Generation Curtailment Priority

4. MH’s firm load
3. Energy sales backed by planning capacity
2. Firm energy sales
1. Other energy sales

- On a prorata basis within a priority group
- Vintage contracts may vary
Transmission Curtailment Priority

- NERC transmission service priority
  - Firm 7
  - Non firm
    - 6 – network
    - 5 – monthly
    - 4 – weekly
    - 3 – daily
    - 2 – hourly
    - 1 – secondary

- On a prorata basis within a priority group
- Vintage contracts may vary
Generation Curtailments

- MH can only curtail to the extent necessary to serve higher priority sale

- Economics is **not** a reason for curtailment
  - Would destroy the value of fixed price contract

- MH may choose to continue to serve
  - Economics
    - Sale = $60/MWh  Replacement Cost = $45/MWh
  - Reputation
Curtailment LD Risk

- Liquidated Damages
  - Cost of replacement power
  - Seller pays LD to buyer

- Generation curtailments
  - MH Dependable sales do not include LD provisions
  - Market Sales include LD
    - Most sales are Day Ahead
    - DA trades above Real Time on average

- Transmission curtailments
  - LD risk depends on market rules
System Sales

- Sales from MH resources
  - Asset backed
- Surplus to the needs of Manitobans
- Expectation of net benefit
- Dependable sales
  - Strategic
  - Long term
  - From dependable energy and accredited capacity resources
  - Fixed or market priced
- Opportunity sales
  - All other (long term, term, firm, non-firm, merchant, ancillary services, environmental attributes, etc.)
## 2009/10 Sales

<table>
<thead>
<tr>
<th>Category</th>
<th>Millions</th>
<th>GWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependable</td>
<td>$186 (46%)</td>
<td>3,263</td>
</tr>
<tr>
<td>Merchant</td>
<td>$ 26 (6%)</td>
<td>775</td>
</tr>
<tr>
<td>Opportunity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bilateral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Term</td>
<td>$ 59 (15%)</td>
<td>2,594</td>
</tr>
<tr>
<td>Day Ahead</td>
<td>$ 0.5 (0%)</td>
<td>25</td>
</tr>
<tr>
<td>Real Time</td>
<td>$ 0.5 (0%)</td>
<td>10</td>
</tr>
<tr>
<td>Market</td>
<td>$130 (32%)</td>
<td>4,969</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$402</strong></td>
<td><strong>11,636</strong></td>
</tr>
</tbody>
</table>
Electricity Markets

- Centrally dispatched electricity markets
  - many generators in competition
- MH generation and load are outside the markets
- MH is a market participant
MISO
Mid-West Independent System Operator

- 159,000 MW generation
- Locational Marginal Price LMP
  - 2072 pricing nodes
- Day Ahead Financial Market
  - Energy and Ancillary Services
  - MH can set price
  - Hourly pricing
  - Hedging products
  - Clears and Settles DA
- Real Time Physical Market
  - 5 min pricing...paid hourly
  - MH is price taker on energy
  - Deviation from DA subject to penalties
- MH offer in up to 1950 MW
IESO
Ontario Independent Electricity System Operator

- 38,000 MW
  - 20 power producers
- Real Time Market
  - MH can set price
  - 5 min pricing...paid hourly
  - Hedging products
- CMSC Payments
  - Congestion managed at the border first
  - IESO pays make whole payments
  - $20 million in 2009/10
- MH can offer in 263 MW
AESO
Alberta Electricity System Operator

- 11,000 MW
- Real Time Market
  - 5 minute pricing
    - paid hourly
  - MH is price taker
- Transmission into Alberta from Saskatchewan is limited to 150 MW
- Transmission across Saskatchewan is limited
Sales/Purchase Types

- Dependable
  - Physical
  - Financial
- Opportunity
  - System
    - Bilateral or Term
      - Physical
      - Financial
    - Market
      - Day Ahead
      - Real Time
- Merchant
Merchant Transactions

- Arbitrage
  - Off system
  - Buy for immediate resale
  - In markets where MH already has a presence
  - Profits (>2005) $12.0 million
    - Revenues $44.4 million
    - Expenses $32.4 million

- Non-Arbitrage
  - Not permitted
  - Speculative

Wheel Through MISO to Ontario
Hydro Can Concentrate Generation into Highest Value Hours

Limited by storage and transmission
Under High Flows
Hydro Cycling Is Limited

Exports

Tielines Maxed Out In All Hours
Pricing

- **Fixed**
  - Long term contracts are indexed to inflation
- **Market**
  - Day Ahead and Real Time
- **Market Traded Term Products**
  - 5 x 16
  - 7 x 8
  - Wrap
  - Traded at electricity hubs
    - Minn Hub, Cinergy
    - Liquid
Prices

- Locational Marginal Prices reflect the marginal cost of supplying the next MW of load
  - 5 minute prices are aggregated into an hourly price
- Hourly prices follow load pattern
  - Low loads = low prices
    - Low cost generation is run first
  - High loads = high prices
    - High cost generation is run last
- On Peak / Off Peak
  - Averaging periods
  - MH average prices aren’t necessarily average market prices
    - Volume weighted
Normalized MISO Market Prices
Monday – Friday Winter

$18 for H.E. 4 (@36%)

$50 5x16
Normalized MISO Market Prices
Monday – Friday  Winter

On peak hours
- No single price
- Some prices lower than off peak
Normalized MISO Market Prices
Monday – Friday Summer

Average Weekday Hourly Prices Normalized with the Monthly 5x16 Price for Summer (Apr 1 - Dec 1) for 2005-2008 historic hourly data in /local/db/marketforecast/history/export/usa/miso_mb_node

- Buying: Buy HE 3 first
- Selling: Sell HE 14 first
Opportunity Sales Pricing Example

- 5000 MW Operating Reserves, Outages
- Accredited Capacity
- Available Capacity
- Tieline Limit
- Maximum Export Load
- 16 hours Dependable Sales
- 24 Hours Manitoba Load

Capacity available for 5x16 Term Sale
Add 100 MW Bilateral Term Sale
1600 MW @ $150/MWh

Accredited Capacity
Available Capacity
Tieline Limit

<table>
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<tr>
<th>Block</th>
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<th>$/MWh</th>
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Next Add 600 MWh On Peak Day Ahead Sales @ $105/MWh

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Next Add 240 MWh On Peak Day Ahead Sales @ $95/MWh

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Accredited Capacity: 5000
Available Capacity: 24 Hours
Tieline Limit: 16 hours

Dependable Sales
Manitoba Load

5000 MW
Next Add 230 MWh On Peak
Day Ahead Sales @ $55/MWh

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Accredited Capacity
Available Capacity
Tieline Limit

5000 MW

16 hours

24 Hours

Dependable Sales

Manitoba Load
Next Add 1000 MWh Off Peak Day Ahead Sales @ $50/MWh

Accredited Capacity
Available Capacity
Tieline Limit

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Next Add 1000 MWh Off Peak
Day Ahead Sales @ $24/MWh

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Accredited Capacity
Available Capacity
Tieline Limit

5000 MW

24 Hours

16 hours

Dependable Sales

Manitoba Load
Next Add 1000 MWh Off Peak Day Ahead Sales @ $19/MWh

Accredited Capacity
Available Capacity
Tieline Limit

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<tr>
<td>6</td>
<td>1000</td>
<td>19</td>
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</table>
Lastly Add 1000 MWh Off Peak Day Ahead Sales @ $18/MWh

Extra Energy Gets Spilled

Accredited Capacity
Available Capacity
Tieline Limit

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<tr>
<td>7</td>
<td>1000</td>
<td>18</td>
<td>67</td>
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</table>
Illustrative MISO Selling Price-Volume Relationship
April - November

Price ($/MWh)

Volume (MWh x 1000)

On peak

Off peak

Term
Illustrative MISO Buying
Price-Volume Relationship
April - November

This PV relationship is because of MH load shape
Not because MH market activity affects market price
Transmission Service

- Each RTO has Transmission Tariff
  - Network Service
    - Serve network load
  - Point to Point Service
    - Merchant transactions (across SK)

- MH-MISO Coordination Agreement
  - Tariffs
    - MISO waives PTP when sinking in MB
    - MH waives PTP when sinking in MISO
  - Coordinated TX operations
    - Outage scheduling
    - Transfer limits
Total Transfer Capability

- Ratings
  - Export/Import
  - On Both Sides
    - May be different
  - Varies Seasonally
- System Intact
Transmission
Physical

- Total Transfer Capability (TTC)
  - Maximum Rated Capacity
- TX Reliability Margins (TRM)
  - Set aside to manage unscheduled flows
- Capacity Benefit Margin (CBM)
  - Set aside to enable delivery of reserves
- Scheduling limits (ATC)
  - ATC = TTC – TRM - CBM
  - Firm (7)
    - If unused goes to non-firm
    - Like keys to the car
  - Non-firm (1-6)
Who Controls Transmission?
(Who owns the keys?)

- In Manitoba
  - MH controls 100%

- No load at border

- In US
  - MH controls 27%
  - MH’s customers control 73%
US Firm Transmission Reservations

- Holders
  - NSP
  - MH
  - GRE
  - WPS
  - OTP
  - MMPA
  - MP
- Roll Over Rights
- Right to Redirect
Market Access is...

- Free trade (open borders)
  - No legal impediments
- Being physically connected
  - Having partners willing to invest in TX
  - Having a say in establishing the rules/limits
- Having the right to the transmission
  - Owning the keys
  - Coordinated TX Tariffs
- Non-discriminatory treatment
  - Market rules
  - Economic development policies
Manitoba Hydro is Small

- Relative to other utilities/suppliers
- By itself MH lacks significant influence
  - Outside of markets
    - Market rules are designed for those inside
  - Outside of Manitoba/Canada
    - Public policy is designed for local jurisdictions
- Strategic relationships are important
  - Government to government
  - Industry organizations
  - Customers
Manitoba Hydro is a Preferred Partner

- Highly respected and trusted
  - Shared values
- History of mutually beneficial relationships
- Sells products that provide value
  - Diversity
  - Storage
  - Flexible
  - Renewable
Transmission Is Key

- Manitoba is remote
  - Long transmission lines are required to reach large load centers
- Most of that transmission is outside of Manitoba
- New transmission is
  - Expensive and not built on spec
  - Unpopular
  - Very difficult to permit
- Transmission pays benefits in perpetuity
Wind is the Jet Stream on which new major transmission will be justified and built

- Renewable Portfolio Standards
  - 25 by 25 in MN
- Wind is seen as a major part of the solution in the US to climate change
  - 60,000 MW in the MISO transmission queue
  - Minnesota, Iowa, North Dakota
- In addition to being renewable hydro provides regional benefits
  - Manitoba Battery
State renewable portfolio standard
State renewable portfolio goal

Minimum solar or customer-sited requirement
Extra credit for solar or customer-sited renewables
Includes separate tier of non-renewable alternative resources

29 states & DC have an RPS
5 states have goals

2020: WA 15%, CA 20%, NV 25%, OR 25%, CO 20%
2025: HI 40%, TX 5,880 MW, NV 25%, CO 20%, WA 15%
2030: OR 25% (large utilities), NV 25% (smaller utilities)

ATLAS: 10% by 2015
10% by 2015 (co-ops & large munis)
15% by 2017 (IOUs)
15% by 2020 (co-ops & large munis)
20% by 2019 (IOUs)
20% by 2022 (Class I Renewables)
U.S. Transmission Policy

- Who builds, owns, pays for it
  - Congress and the Federal Energy Regulatory Commission are struggling over cost allocation, siting and planning issues
  - Lack of clarity over the above issues makes connecting remote resources difficult

- Solutions will be developed soon
  - Will large hydro count?
Manitoba
Part of the Solution

- Opportunity for Manitoba to leverage its hydro advantage into a new 1100 MW MB-US interconnection
  - 750 MW of long term sales to MP and WPS
  - 1800 MW of new major hydro
- Secure access for MH surplus in perpetuity to a large valuable market
- US will meet its renewable goals with or without Manitoba Hydro
  - 80% reduction by 2050
The End

Thank You!