Cost of Service Methodology Review Workshop

May 2016

Manitoba Hydro

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2016 Cost of Service Review

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Manitoba Hydro Cost of Service Overview

- Purpose is to determine each class' responsibility of MH's overall revenue requirement
- Cost of Service Important to Manitoba Hydro and its Customers:
  - Major determinant of Rates and scope for Rate Design and therefore affects key criteria of efficiency and fairness
  - Cost of Service impacts, through rates, load, planning, resource investment
  - We work with customers daily, and we want relations to be as amicable as possible
  - We are sensitive to the concerns of all customers
  - We want to treat all fairly
  - We want to ensure that the rates they pay for the services they receive are appropriate

Manitoba Hydro Cost of Service Overview

- Deal with substantive issues in terms of impact to class cost responsibility
- Bring closure to past un-resolved issues
- Bring back into GRA

Manitoba Hydro Cost of Service Overview

- MH retained CA in 2011 to review its Cost of Service Methodologies
- Review undertaken to confirm best practices and to address a number of issues that arose out of previous PUB proceedings
- Resulted in tune-up rather than an overhaul
- Recommendations flowing from CA's 2012 Report largely adopted in PCOSS14

Manitoba Hydro Cost of Service Overview

- As a result of the Stakeholder meetings in the fall of 2014 and CA's Supplemental Report, Manitoba Hydro extensively reviewed its Cost of Service approach to exports

Key Conclusions :

1. Build to Serve Manitoba need
2. Creation of Export Class a Convention that recognizes the temporary use of Surplus
3. Simplicity
4. Only Impacts Domestic cost responsibility

- COS treatment of exports was modified consistent with these conclusions/goals as reflected in PCOSS14(Amended)

Key Considerations in COS

- Cost causation is a primary consideration (where practical)
  - Complex as not one view of cost causation
- Good to know what you are trying to achieve before committing to a method to get there
- MH - embedded cost of service study
  - Based on original accounting costs
  - Largely dependent on investment decisions in the past
  - $16 billion investment
  - MH – prospective
    - Embedded costs are forecasted based on Year 2 of IFF
    - PCOSS14 - $1.7 Revenue Requirement

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Key Considerations of Manitoba Hydro's COSS

- Generation and Transmission functions represent approximately 75% of total cost; it is the treatment of these assets that are most impactful
- Numerous techniques available to classify G&T
- Method chosen should reflect both the utility's system and customer's load characteristics
    - MH is predominantly (95%) hydraulic
        - Large fixed cost trade off for very low variable/energy cost
- The treatment of export revenues also has a major impact on COS results

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Functionalization

Investment cost and annual expenses (incl. Net Income) are grouped together according to Manitoba Hydro services:

- Generation
- Transmission (100kv and above)
- Sub transmission (33-66 kV)
- Distribution
- Customer Service

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Classification and Allocation

Classify costs according to cause of costs:

- Based on system design or operation and rationale for investment decision

The second step is to classify the functionalized cost:

- Energy—costs that vary based on usage
- Demand—costs that are related to capacity investment
  - Demand is maximum usage at a point in time (hourly)
- Customer—costs that vary with the number of customers

Allocation

- Factors that correspond to classification (cost drivers)

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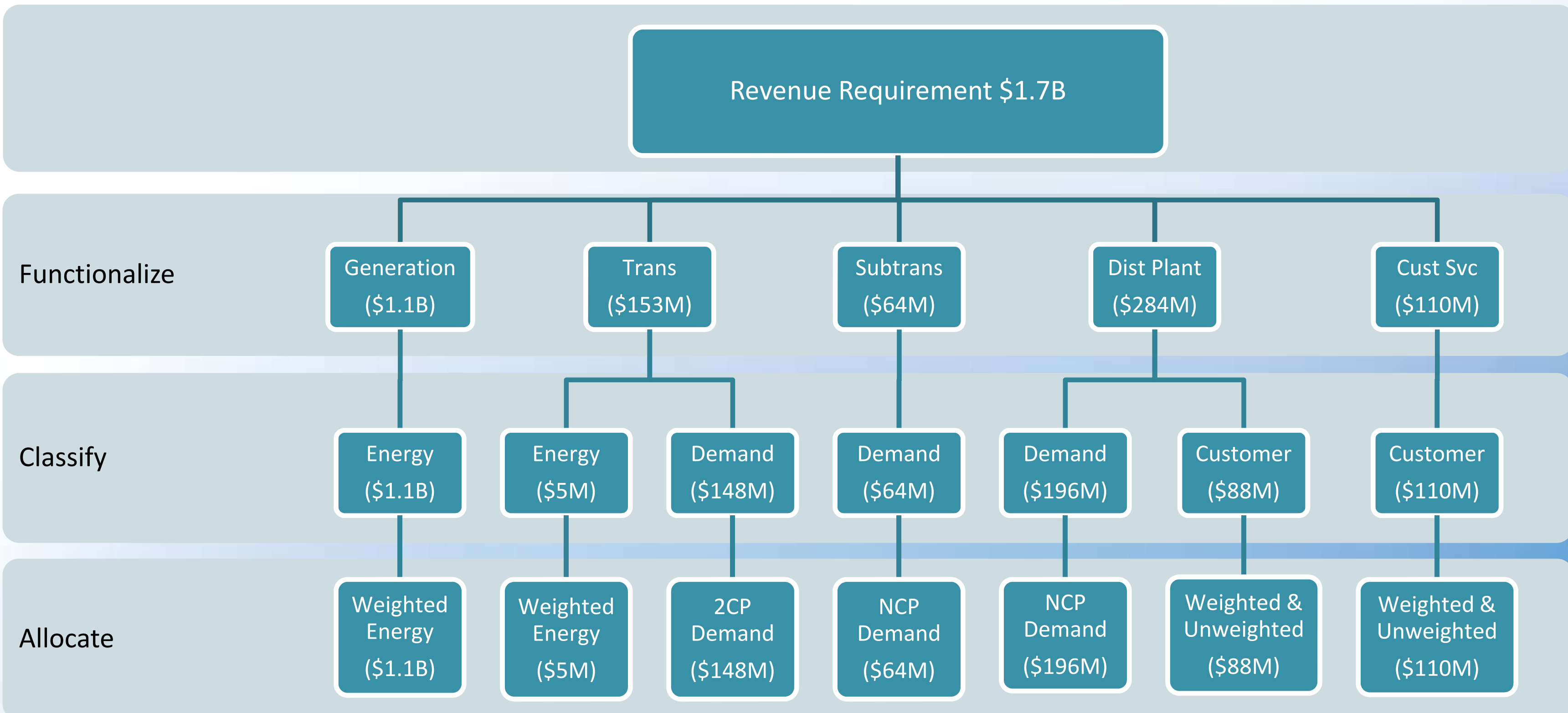
COS Schematic: PCOSS14-Amended



CP = Coincident Peak

NCP = Non Coincident Peak

Generation

Generation Function

15 Hydraulic Generating Stations:

- Limestone
- Long Spruce
- Kettle
- Jenpeg
- Wuskwatim
- Great Falls
- McArthur Falls
- Seven Sisters
- Pine Falls
- Pointe Du Bois
- Slave Falls
- Grand Rapids
- Laurie River

- Water Rentals
- Mitigation costs
- Thermal Generating Stations
  - Brandon Unit 5 (coal)
  - Brandon CT and Selkirk (natural gas)
- Power purchases

Generation Function

HVDC facilities

- Henday, Radisson, (Keewatinohk) convertor stations
- BPI and II, (BPIII)
- Dorsey (Riel) convertor stations

AC Collector Circuits

- Limestone-Henday 5- 230 kV lines
- Long Spruce – Radisson 3-230 kV lines
- Long Spruce – Henday 3-230 kV line
- Kettle – Radisson 7-138 kV line

Switching Stations (Kettle, Limestone, Long Spruce)

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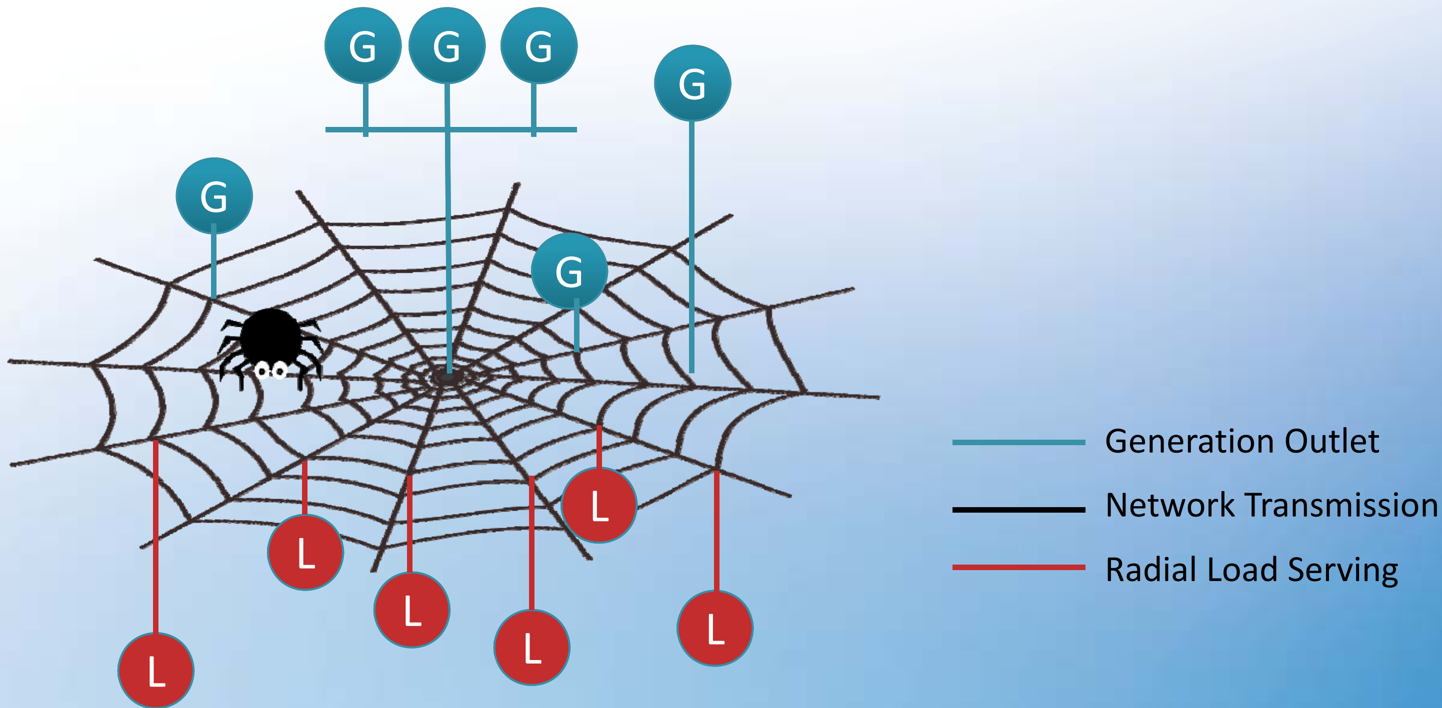
Generation-HVDC-Meshed Transmission



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Generation Function

- Total Embedded cost in PCOSS14 (Amended)
  - Approximately $1.1B (annualized)
  - Approximately $6.5B NBV
- Keeyask 2020/21
  - $6.5B investment
  - Approximately $366M
- BiPole III 2018/19
  - $4.5B investment
  - Approximately $304M net of BPIII reserve in 2019/20
    - Keewatinohk Converter Station
    - 1400 km HVDC Transmission Line
    - Riel Converter Station
- Addition of significant generation-related assets, at unit cost higher than embedded cost, decreases RCC of industrial classes and increases RCC of distribution level customers

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Illustrative Revenue Requirement by Function

Function	PCOSS14-Amended	Estimated 2021/22*
Generation	65.2%	72.9%
Transmission	8.7%	10.2%
Subtransmission	3.7%	2.3%
Distribution Plant	16.2%	10.3%
Distribution Service	6.3%	4.3%
Total	100.0%	100.0%

Generation - Key Issues

- Functionalization of HVDC
  - BiPole III
  - Dorsey (Riel) Converter Station
- Classification and Allocation
  - Weighted Energy

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Generation - Key Issues

Bipole III

- Purpose and function identical to Bipoles I & II
- Required to ensure the availability of power adequate to meet both the energy and demand needs of the Province
- Role is to move energy from remote generation to backbone transmission in 8,760 hours a year, not just in peak hours
- Inappropriate to differentiate the allocation methods for the HVDC facilities and Lower Nelson Generating Facilities
  - Bipoles integrate remote generation with main grid transmission
  - Bipoles are not directly accessible to load or transmission customers
- Appropriate to functionalize as Generation and Allocate on Weighted Energy
- Methodology endorsed by CA

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Illustrative RCC Impacts of Bipole III In-Service

Customer Class	RCC Change
Residential	2.2%
GSS – ND	2.4%
GSS – D	0.0%
GSM	(1.0%)
GSL <30	(2.0%)
GSL 30-100	(4.2%)
GSL >100	(5.5%)
ARL	13.9%

*Assuming across-the-board increases of 19%

Generation - Key Issues

Dorsey (upcoming Riel)

- Dorsey (DC facilities) functionalized as 100% Generation in PCOSS14-Amended
  - Previously functionalized 100% Transmission
  - Dorsey DC facilities are $640M, Riel is approx $ 1.2B
  - DC facilities approx. 80% of investment
- DC Facilities at Dorsey & Riel are dedicated to the bipoles, which are for the interconnection of generation of the northern hydro system
- Provides a generation injection and all the reliability of that generation injection
- Amended methodology based on advice of CA

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Illustrative RCC Impacts of Dorsey and Riel (DC Facilities) as Generation

Customer Class	Dorsey and Riel (DC Facilities) as Generation Illustrative RCC Change
Residential	0.6%
GSS – ND	0.6%
GSS – D	0.2%
GSM	0.2%
GSL <30	0.0%
GSL 30-100	(1.5%)
GSL >100	(2.0%)
ARL	(0.7%)

Note: Riel impacts isolated to change in functionalization, not additional in-service costs

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Generation - Key Issues

- Generation provides 2 services (inseparable):
  - Demand
  - Energy
- Both valid cost drivers
  - Choice of methodology is based on judgment:
  - MH's hydraulic facilities large fixed costs incurred to lower operating costs and will offset high initial capital cost over the long term
    - Fixed costs in a hydraulic utility more heavily driven by energy
  - Based on principle of cost causation should be allocated to customer classes on the basis of their energy usage
  - MH interconnected to substantial US energy market
  - Incorporates consideration of rate making objective of efficiency within embedded COS
  - Simple

Generation - Key Issues

Weighted Energy Allocator

- Marginal Cost weightings approach using SEP rates
- Effectively short-run marginal energy costs
- Well suited to Manitoba Hydro operations
- While notionally 100% energy, implicit consideration of demand
- Endorsed by CA, and previously NERA
- Approved in Order 117/06

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Generation - Key Issues

- CA recommended additional capacity incorporation in Weighted Energy Allocator
  - CA views that capacity may not sufficiently be reflected in energy price differentials on a go-forward basis
- In PCOSS14-Amended MH incorporated capacity adder to all peak periods for illustrative purposes
  - Approx. 2000 hrs/yr
  - based on Reference Discount used in Curtailable Rate Program

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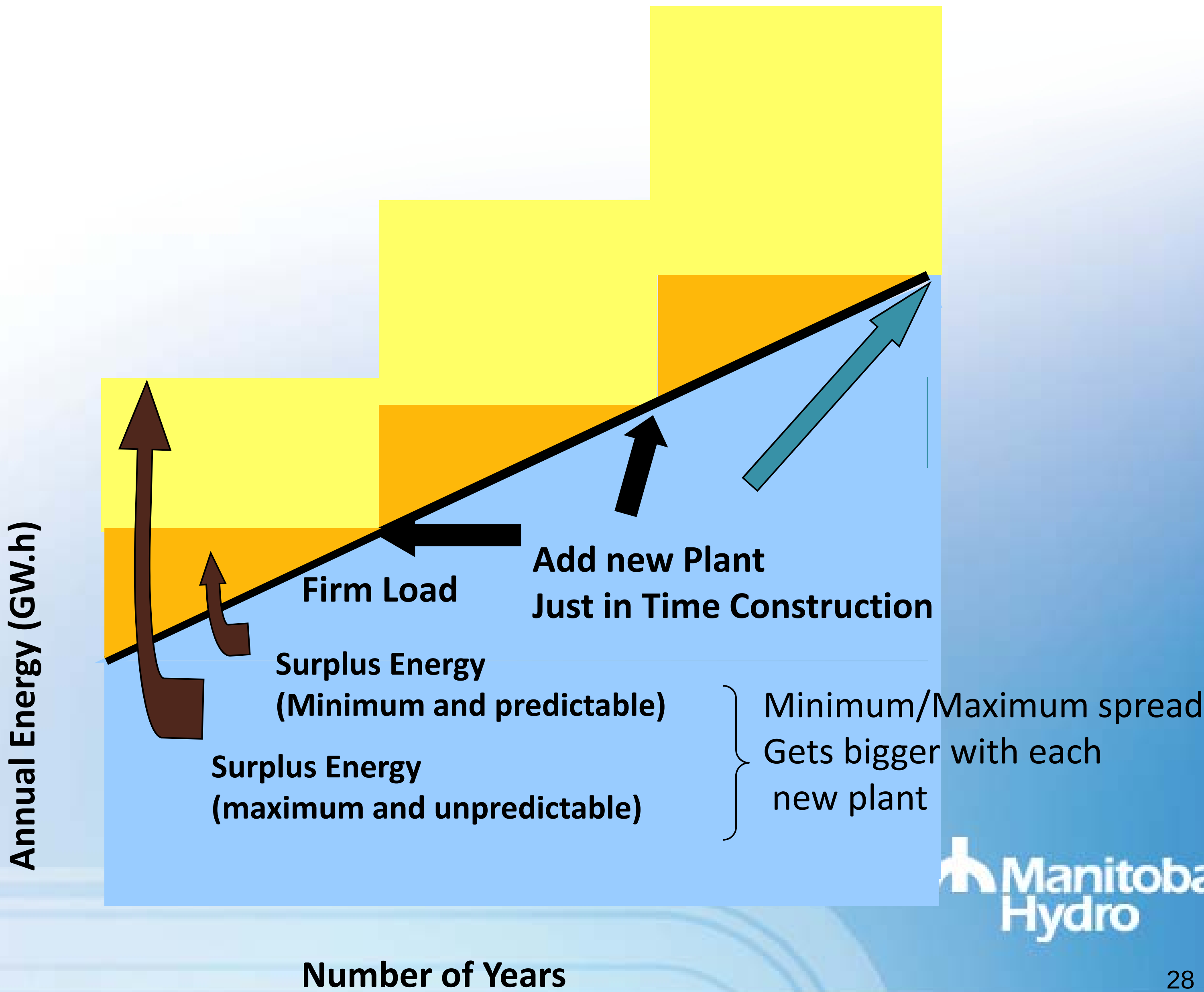
EXPORT COS TREATMENT

Key Issues

1. Build to Serve Manitoba need
2. Creation of Export Class a Convention that Recognizes use of Capability Temporarily Surplus to Manitoba Need
3. Simplicity and Fairness
4. Only Impacts Domestic cost responsibility

Build to Serve Manitoba Need



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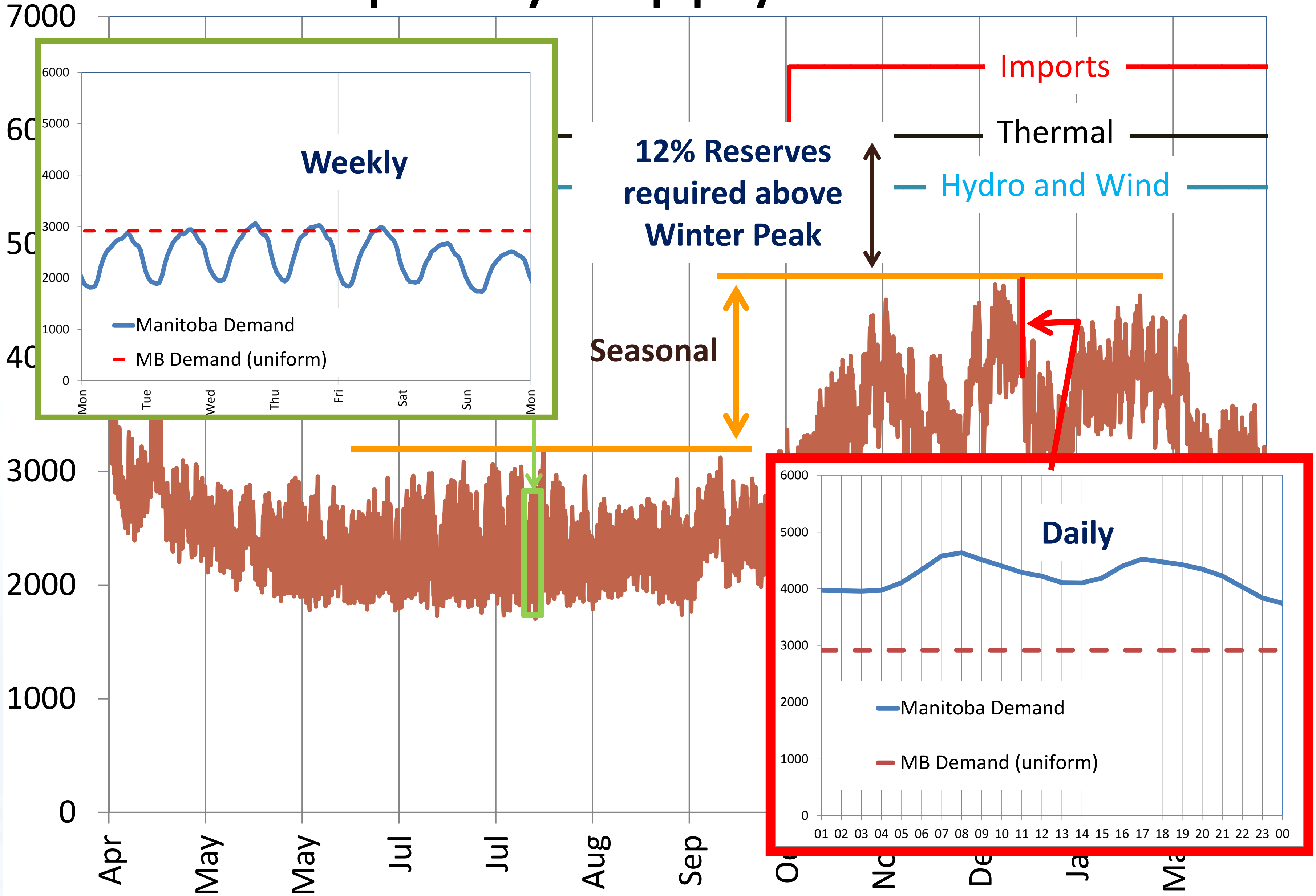
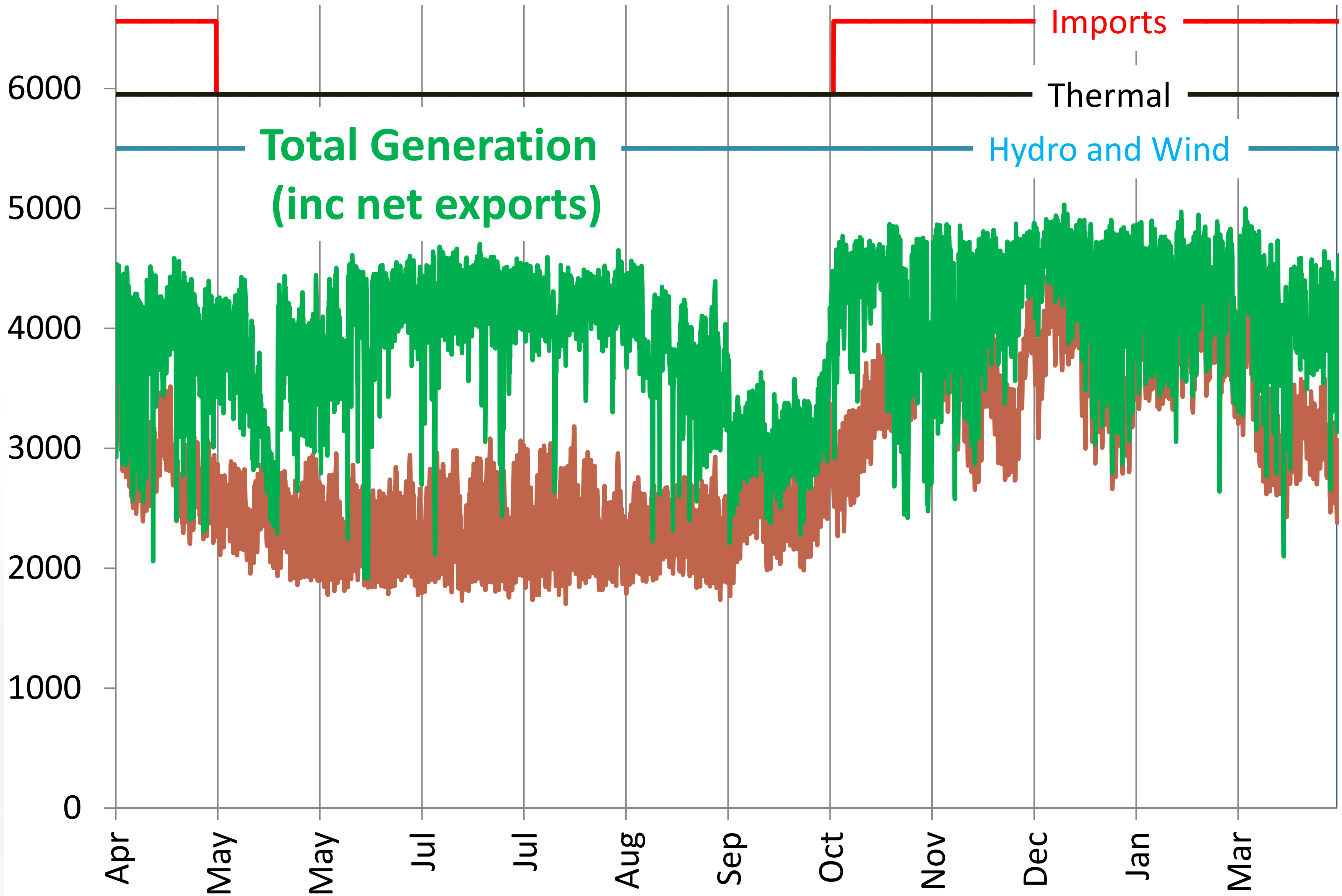
Capacity Supply vs Demand

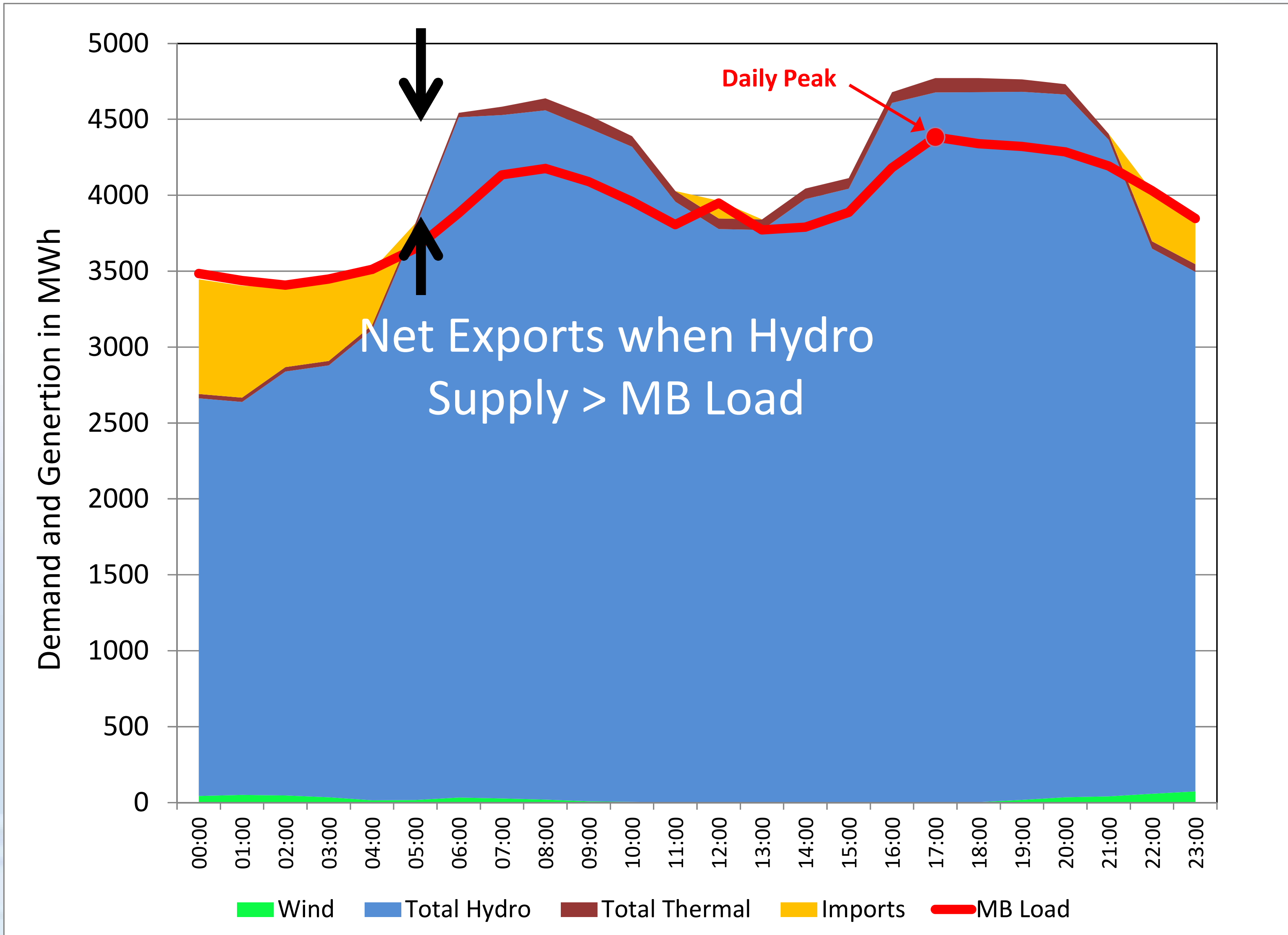


Exports are from Surplus Wind and Hydro



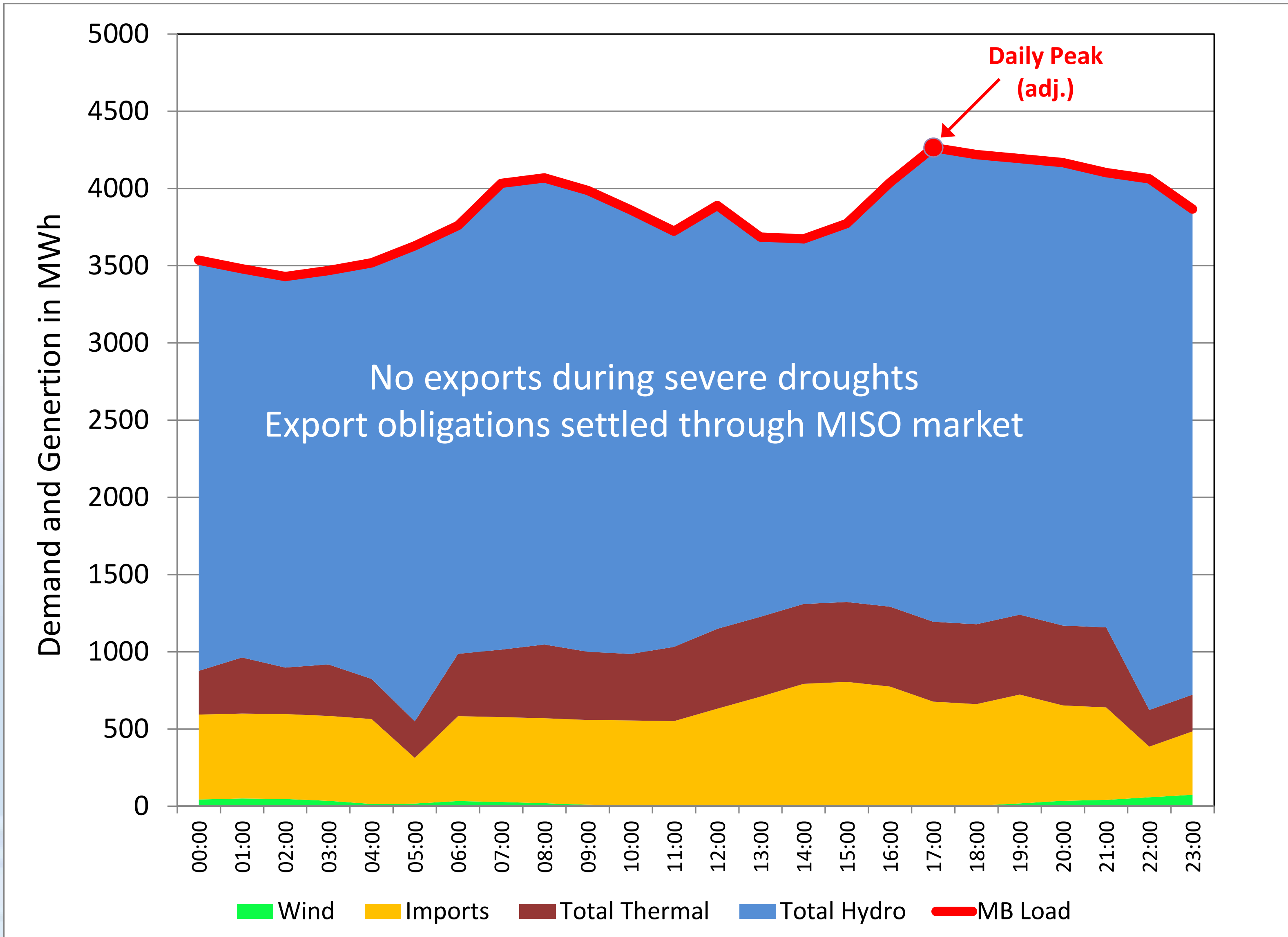
Normal Winter Supply/Demand Profile

(December 11th 2012, normal winter flows)



Drought Winter Supply/Demand Profile

(December 11th 2012 load and wind, 2004 river flows)



Summary

- **Manitoba load varies seasonally, weekly, daily and hourly**
  - Load is met every hour under all conditions
- **Exports are only made from surplus MH resources**
  - Exports are curtailed when necessary
  - MH has the option to maintain exports if economic
- **MH must have capacity resources in place to meet winter peak domestic demand plus planning reserve**
  - Planning reserves are met from thermal and import resources
  - Any surplus hydro resources can be used for export
- **MH must have sufficient energy supplies available:**
  - Normally hydraulic generation is more than enough to meet total energy demand
  - During drought import and thermal energy are used to make up hydro energy shortfall

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Creation of Export Class

- **System is built to meet Manitoba power needs**
- **Very difficult, if not possible, to identify cost of exports**
- **A solution that meets broad fairness perspectives**
  - Not engineering based, not a science
  - An approach that Recognizes temporary use of surplus
  - An approach to moderate potential unfair class revenue requirements that can occur from incorporating significant export revenue at market prices above embedded cost

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Simplicity – Key Principle

Simplicity important:

- Treatment should not be unduly complicated
- Adopted convention to recognize service level differences between Dependable and Opportunity Export Sales
- Dependable treated equal to Manitoba customers assigned full share of embedded G&T costs
  - Recognizes
    - Degree of firmness of dependable sales;
    - Some level of fixed cost may be incurred such as decisions to advance plant ahead of what is needed for Manitoba
    - Sales involves risk
- Opportunity treated as byproduct, assigned variable cost
    - Not firm

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Simplicity – Key Principle

PCOSS14(Amended):

- Pooled all fixed generation costs
  - Pro-rata shared between domestic and dependable exports
- Pooled all variable generation costs
  - Pro-rata shared between all sales

		Domestic	Dependable Export	Opportunity Export
Gen Pool 1	Hydraulic Generation	✓	✓	✗
	Wind	✓	✓	✗
	Natural Gas Thermal	✓	✓	✗
	Coal Thermal	✓	✓	✗
Gen Pool 2	Power Purchases & Transmission Fees	✓	✓	✓
	Water Rental & Variable Hydraulic O&M	✓	✓	✓
	Trading Desk	✓	✓	✓

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Simplicity – Key Principle

PCOSS14(Amended):

- Dependable surplus above that needed for Manitobans assumed to be dependable export
- Surplus above dependable assumed opportunity export
- Result is approximately:
    - 50% of export sales are deemed dependable for COS
    - Remaining 50% deemed opportunity sales

Only Impacts Domestic Customers

Export Class only impacts class cost responsibility for Manitobans:

1) assignment of G&T costs to exports explicitly shifts away from domestic customer costs responsibility for those costs
2) NER available to be used to offset domestic customer's cost responsibility

The greater generation and transmission costs assigned to Exports:

- Shifts cost responsibility to residential customers and away from industrial customers
- No impact to export customers as rates for export customers determined in competitive market

Export Class treatment does not impact MH's overall revenue requirement

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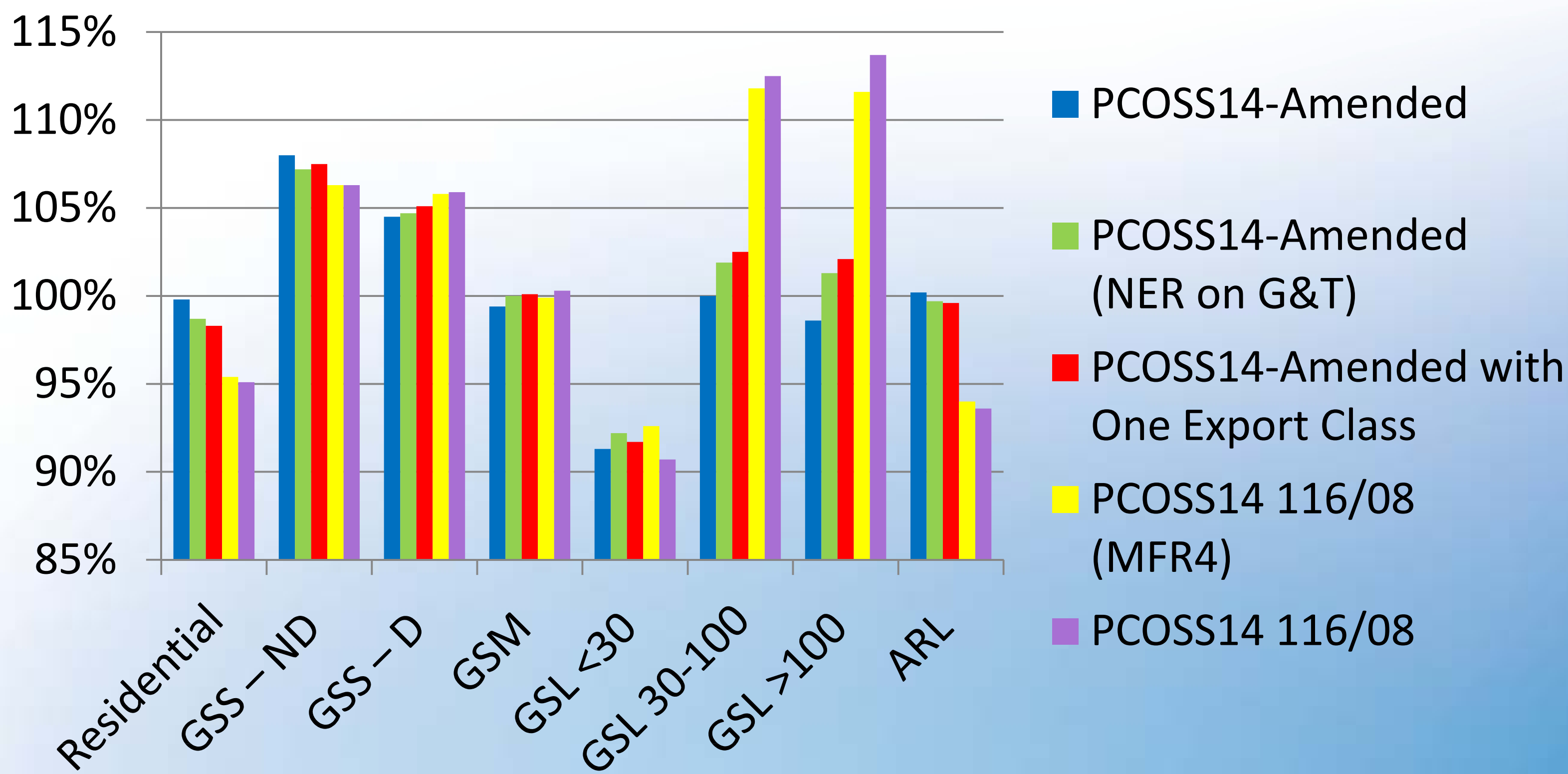
Range of RCC



115%
110%
105%
100%
95%
90%
85%
Residential
GSS – ND
GSS – D
GSM
GSL <30
GSL 30-100
GSL >100
ARL
PCOSS14-Amended
PCOSS14-Amended (NER on G&T)
PCOSS14-Amended with One Export Class
PCOSS14 116/08 (MFR4)
PCOSS14 116/08

Only Impacts Domestic Customers

To establish whether impact to Manitoban class cost responsibility reasonable:

- Appropriate test for whether export sales are beneficial is incremental benefits vs. incremental costs
- Under well-founded cost assignment to exports, there should be no negative export revenue

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Only Impacts Domestic Customers – Reasonability of Export Cost Assignment

	PCOSS14 (116/08) $ million	PCOSS14 Amended $ million	PCOSS14 (Variable Only) $ million
Gross Export Revenue	340	345	345
<u>Less Costs:</u>			
Allocated G&T	207	*183	n/a
Assigned Thermal Generation	33	n/a	n/a
Water Rentals and Variable O&M	n/a	n/a	34
Purchased Power	171	35	n/a
DSM	40	n/a	n/a
Policy Related Charges (AEF & URA)	<u>36</u>	<u>36</u>	<u>36</u>
Net Export Revenue	(147)	91	275

*includes an allocation of NG Thermal costs

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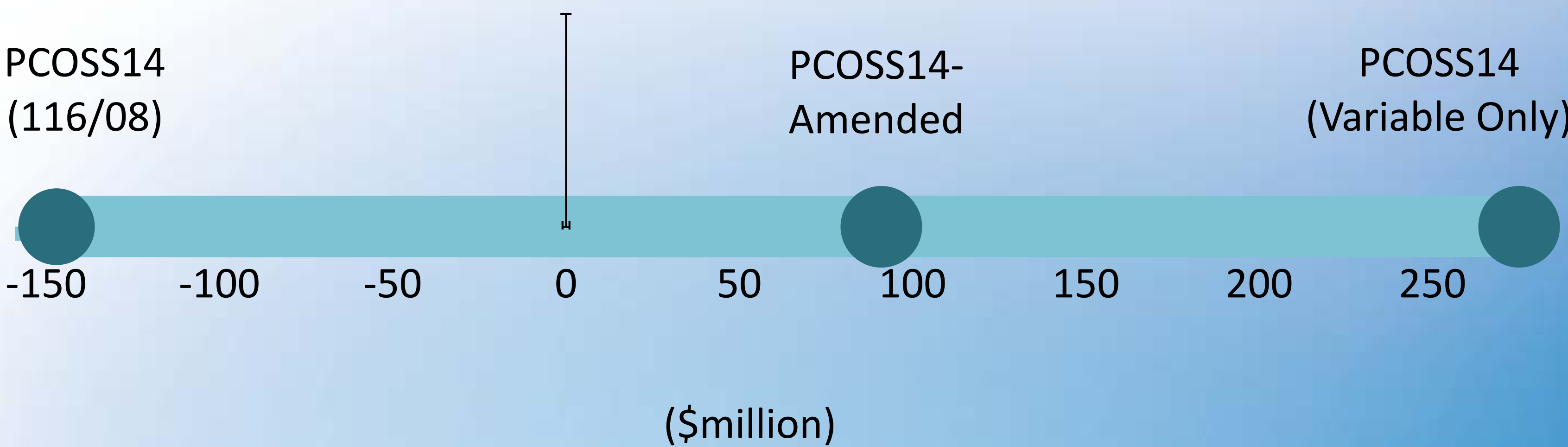
Only Impacts Domestic Customers – Reasonability of Export Cost Assignment



Reasonability of Export Cost Assignment

System built to serve Manitoba need

Firm exports are not equivalent to firm domestic load:

- All energy is for Manitoba customers first
- Planning, regulation and contingency reserves for Manitoba load
- Manitobans receive priority service on HVDC system
- Firm exports are take or pay
- Curtailment provisions result in lower level of supply reliability to exports

On this basis it is not reasonable that a costing methodology results in export unit costs that exceed a domestic customer

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Reasonability of Export Cost Assignment (Unit Costs)

Customer Class	PCOSS14 116/08 (¢/kWh)	PCOSS14 Amended (¢/kWh)	PCOSS14 Variable Only (¢/kWh)
GSL >100	3.08	4.12	4.86
Exports (excl AEF & URA)	5.01	4.07*	0.37

*Dependable Exports only

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PCOSS14-Amended: Export Cost Assignment

Endorsed by CA to large extent :

- Reasonable to maintain an Export Class
- Appropriate to recognize different cost assignment for Dependable and Opportunity Sales
- CA recommended no assignment of URA and AEF to Exports
- CA recommended Hybrids to be treated as Opportunity Sales

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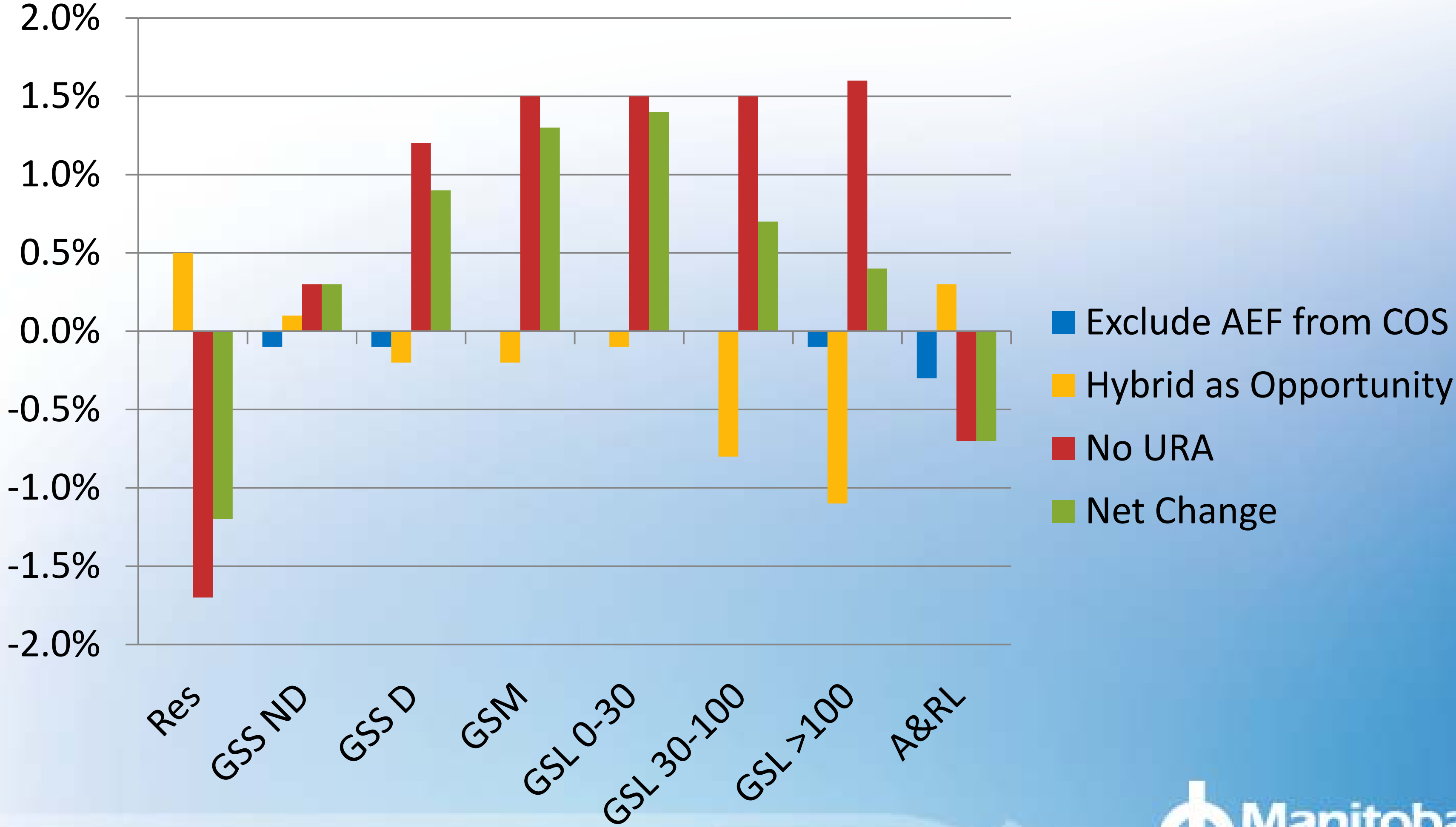
PCOSS14-Amended: Export Cost Assignment RCC Impacts



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Treatment of NER in COS

- NER is viewed as a system dividend to be shared in a fair and equitable manner, and is allocated based on total allocated cost
- Majority of export revenues continue to be used to offset Generation and Transmission costs (which represent 71% of allocated costs)
- CA supportive of current NER treatment

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TRANSMISSION

Transmission Functionalization

Transmission Function includes:

- High voltage (>66 kV) transmission lines
- AC Switchyard Dorsey (Riel)
- Transmission Substations
  - High voltage portion of substations
  - Entire station if low side at transmission voltage (ie 230/115kV stn)
- Switching Stations (excl Long Spruce, Kettle and Limestone)
- Interconnections

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Transmission - Key Issues

- 2CP Allocator
- Treatment of US Interconnections

Transmission

Transmission cost (excluding US Interconnections)

- allocated to Domestic and Dependable Exports based on 2CP

- Reflects the two dominant and approximately equivalent in magnitude seasonal peaks in MH system
  - Winter peaking domestically
  - Summer peaking due to extra-provincial sales
    - Gives recognition to the use of an Export Class and use of AC networked Transmission by Dependable Exports
  - Directed by PUB in Order 101/04
  - Endorsed by CA

US Interconnections

- Functionalized as Transmission
- Allocated to Domestic and Dependable Exports according to Weighted Energy
- Change to recognize the role of US Interconnections of moving energy to (energy security) and from the Province
  - Reflects heavier emphasis on energy as a cost driver
- Even without export sales activity, US Interconnections are still necessary:
  - Additional generation resources would otherwise be required
- Change made upon advice of CA

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US Interconnections

Project Name	Date	Reason for Project
L20D Letellier to Drayton	1970	• Construction of Grand Rapids (1965-68) • Agreement to exchange power with NSP, OTP and MPC. • 90 MW of winter capacity purchased in 1970 rather than add another thermal plant at Selkirk
R50M Richer to Moranville	1976	• Construction of Kettle (1974) • Agreement to export firm and interruptible power to MP and MPC
M602F Riel to Forbes	1980	• Long Spruce (1979) • Addition more than doubled ability to exchange power with the US • Allowed for a major sale of surplus power to NSP • Seasonal diversity was used to help provide economic justification for the line • Also recognized to improve reliability in case MH lost the HVDC
Manitoba Minnesota Upgrades	1993–96	• Capacity increase needed to provide a 400 MW increase in transfer capability • The driver was a 1989 diversity exchange agreement between MH and NSP and UPA • MH would export an additional 400 MW to the US in the summer and import 400 MW in the winter
G82P Glenboro to Peace Garden	2002	• Limestone (1991) • Line built primarily to firm up import capability to meet NSP's obligation of 500 MW but it also improved export capability • Surplus power from Limestone was exported to NSP over all US interconnections

Source: Information Request PUB-MH 61a-b

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Illustrative RCC Impact
US Interconnection from 2CP to Weighted Energy

Customer Class	RCC Change
Residential	0.3%
GSS – ND	0.3%
GSS – D	0.1%
GSM	0.1%
GSL <30	0.0%
GSL 30-100	(0.8%)
GSL >100	(0.9%)
ARL	(0.3%)

PCOSS14-Amended including future interconnection classified as Weighted Energy (with Capacity Adder) vs 2CP

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OTHER FUNCTIONS

DSM
SUBTRANSMISSION
DISTRIBUTION

DSM

Primary objectives of DSM are to:

- Meet energy needs of province in most economic and sustainable manner
- Assist customers with managing their energy bills

- DSM costs are directly assigned in COS based on estimates of class participation
- Approach most cost causal
  - aligns cost of DSM programs with classes that participate and benefit

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DSM

DSM may be viewed as a substitute for generation, transmission and distribution resources

- The effect of DSM on class use of these resources not necessarily aligned with class share of total cost of these resources
- Timing can favor some classes through significantly reduced usage and cost responsibility in COS while others allocated DSM cost
  - Can distort COS results in short term
  - In long run, it is expected that DSM costs and benefits will be more evenly distributed

DSM

While energy freed up by DSM is sold in export markets above costs provides value to MH customers

- Cost of Service allocates based on cost causation, not value
- Exports do not drive DSM
- Inappropriate to directly assign DSM cost to exports
- Endorsed by CA
- Assignment of DSM cost to exports have significant impact to export revenue

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Illustration of Electrical System Components

Note: graphic is from BC Hydro

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Sub-Functions Used By Class

	Res	GSS - ND	GSS - D	GSM	GSL 0-30	GSL 30-100	GSL >100	ARL	Exp	Total
Generation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Transmission	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Subtransmission	✓	✓	✓	✓	✓	✓		✓		
Dist - Substation	✓	✓	✓	✓	✓			✓		
Dist - P&W Primary	✓	✓	✓	✓	✓			✓		
Dist - Transformers	✓	✓	✓	✓				✓		
Dist - P&W Secondary	✓	✓	✓	✓				✓		
Dist - Services	✓	✓	✓	✓	✓					
Dist - Meters	✓	✓	✓	✓	✓	✓	✓			
Customer Service	✓	✓	✓	✓	✓	✓	✓	✓		

Subtransmission

- Approximately 3% of total revenue requirement
- Allocated on basis on class NCP
- CA advises that use of NCP very common in industry
- CA stated use of CP or NCP demand allocator depends on load diversity across Subtransmission networks
    - Subtransmission not driven by Energy
- Subtransmission system serves domestic loads which tend to peak more in the winter than summer
- Illustrative impacts to RCC assuming 2CP allocator weighted 75% to winter peak and 25% summer peak do not materially impact cost depiction by class:

Illustrative Impacts to RCC Subtransmission

Customer Class	2CP vs NCP RCC Change
Residential	0.3%
GSS – ND	(0.2%)
GSS – D	(0.3%)
GSM	(0.6%)
GSL <30	(0.6%)
GSL 30-100	0.2%
GSL >100	0.0%
ARL	0.8%

Modified 2CP allocator weighted 75% Winter and 25% Summer

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Distribution

- Distribution plant approximately 16% of revenue requirement
- Poles and Wires classified 60% Demand and 40% Customer
- Line transformers are classified as 100% demand (NCP)
- Service Drops 100% customer weighted 5x for larger customers
  - CA endorsed classification of Distribution plant between demand and customers, no energy classification
  - CA recommended some review given age of studies
  - Treatments comparable to that seen at other utilities
  - MH views such reviews requires significant volume of data and effort and in many cases minimal overall improvements to cost depiction by class

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Distribution Classification

Customer Class	Demand (NCP)	Customer
Distribution Stations	100%	
Poles and Wires	60%	40%
Line Transformer	100%	
Service Drops		100%
Meters		100%

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Illustrative RCC Impacts: Distribution Pole & Wire Classification

Customer Class	60% Customer 40% Demand RCC Change	50% Customer 50% Demand RCC Change	30% Customer 70% Demand RCC Change
Residential	(1.3%)	(0.7%)	0.6%
GSS – ND	0.1%	0.0%	(0.1%)
GSS – D	1.9%	1.0%	(0.9%)
GSM	2.1%	1.1%	(1.0%)
GSL <30	1.3%	0.7%	(0.7%)
GSL 30-100	0.0%	0.0%	0.0%
GSL >100	0.0%	0.0%	0.0%
ARL	(0.7%)	(0.3%)	0.4%

Compared to PCOSS14-Amended 40% Customer, 60% Demand

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Illustrative RCC Impacts : Distribution Line Transformer Classification

Customer Class	50% Customer 50% Demand RCC Change	100% Customer 0% Demand RCC Change
Residential	(0.6%)	(1.1%)
GSS – ND	0.1%	0.3%
GSS – D	1.0%	2.0%
GSM	1.1%	2.2%
GSL <30	0.0%	0.0%
GSL 30-100	0.0%	0.0%
GSL >100	0.0%	0.0%
ARL	(0.9%)	(1.8%)

Compared to PCOSS14-Amended 100% Demand

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