Tab 7

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May 12, 2017

MANITOBA HYDRO

2017/18 & 2018/19 GENERAL RATE APPLICATION

ELECTRIC LOAD FORECAST, DEMAND SIDE MANAGEMENT & ENERGY SUPPLY

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Appendices

MANITOBA HYDRO

2017/18 & 2018/19 GENERAL RATE APPLICATION

ELECTRIC LOAD FORECAST, DEMAND SIDE MANAGEMENT & ENERGY SUPPLY

7.0 OVERVIEW

Tab 7 provides an overview of Manitoba Hydro's Load Forecast projections, Manitoba Hydro's Demand Side Management ("DSM") and information on energy supply planning as well as an estimate of energy generation based on prevailing water conditions.

Section 7.1 of this Tab provides a summary of the Electric Load Forecast and information on both current load and projected growth. Section 7.2 provides a summary of the current DSM plan and progress of Power Smart Programs to date. Section 7.3 and 7.4 provide highlights of the Manitoba Hydro energy supply system, including the criteria used to ensure an adequate supply of capacity and dependable energy. Section 7.5 provides supply and demand tables that summarize the capacity and energy for each year up to 2025/26. Section 7.6 provides a description of export market conditions and Manitoba Hydro's export sales activities. Section 7.7 provides an update on water conditions and hydraulic generation based on recent water conditions.

In accordance with the filing requirements of Directive 5 of Order 43/13, Appendix 7.4 provides monthly hydraulic generation information, water conditions and extra-provincial energy exchange data up to March 2017. Manitoba Hydro will provide monthly updates to this information until a rate Order in respect of the August 1, 2017 interim rate request is issued by the Public Utilities Board. In addition to Appendix 7.4, detailed information on export revenues and power purchases will be provided in PUB MFR 27, PUB MFR 28 and PUB MFR 31.

Manitoba Hydro considers all available options for meeting the energy needs of Manitobans, including both demand-side and supply-side resources as discussed in this Tab. The current Demand Side Management plan, as detailed in Section 7.2, is combined with the load forecast to represent the forecast net load, which is used to forecast domestic revenues in MH16. The Manitoba load requirements are reliably met through

generating resources currently available within Manitoba and imports from neighboring U.S. utilities, as discussed in Sections 7.4 to 7.6. Manitoba Hydro also engages in the sale of electricity to neighbouring markets, which serves to reduce the revenue required from Manitoba customers.

7.1 ELECTRIC LOAD FORECAST SUMMARY

The Electric Load Forecast provides a long term projection of future electricity demand in Manitoba with a forecast provided for both energy and capacity requirements. The load forecast is reviewed and updated on an annual basis, with the 2016 Electric Load Forecast having been prepared in June 2016.

Given the timing of this Application, it was appropriate to adjust the 2016 Electric Load Forecast in order to reflect the most current information (including nine months of actual load for 2016/17) and to reflect forecasting methodology improvements that were being developed for the next Electric Load Forecast. The load forecast adjustments were based on a preliminary updated population forecast and also considered enhancements planned for the econometric forecast model. In addition, Manitoba Hydro has adopted a more conservative approach in forecasting Potential Large Industrial Loads in the Top Consumer sector, and that direction was considered in making the adjustments to the 2016 Electric Load Forecast. Given energy not sold to Large Industrial Loads is sold on the opportunity market at comparable forecast pricing, there is minimal impact from this change on forecast financial results.

Manitoba Hydro determined that it was not practical to prepare an entirely new electricity load forecast in early 2017. Steps were taken to assess the impact of the changes discussed above, and then apply a high level adjustment to the 2016 Electric Load Forecast.

An assessment was made of the estimated impact of these changes in assumptions and methodology to the load in the 20th year of the 2016 forecast. The estimated impact in the 20th year of the forecast suggested an overall net reduction in annual load equivalent to that determined under the 24th percentile probability point of the 2016 Electric Load Forecast. The 24th percentile probability point is derived from the load

variability analysis presented on page 44 of Appendix 7.1. Based upon this analysis, the forecast under the 24th percentile point of the 2016 Electric Load Forecast was chosen as a proxy to represent the updated future load requirements for the purposes of MH16 and this Application.

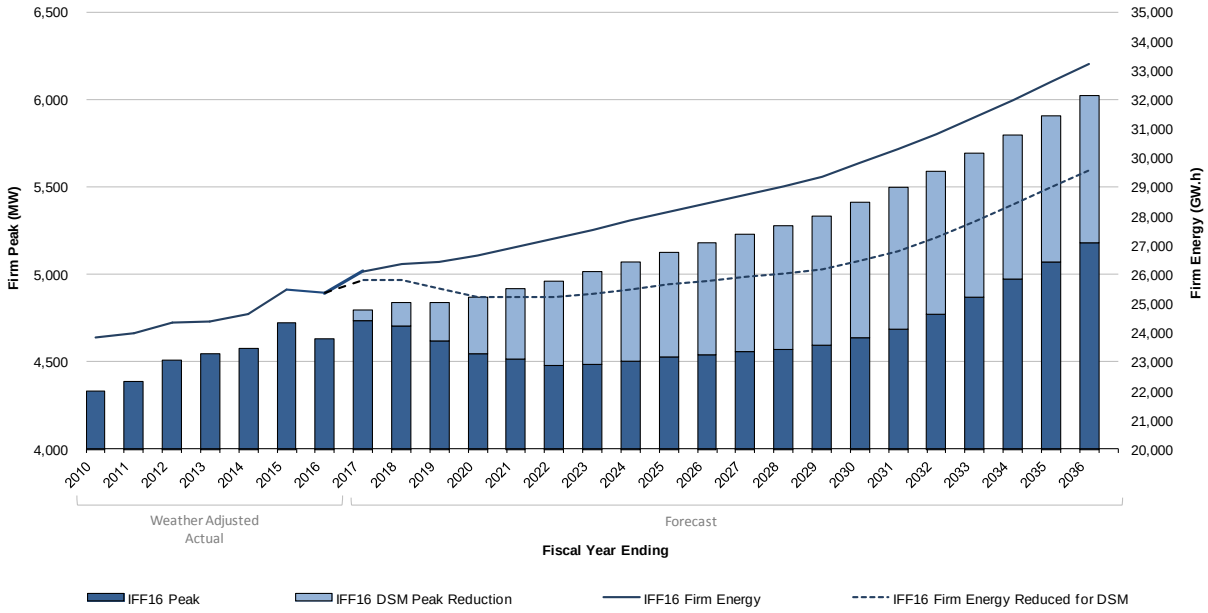
A copy of the 2016 Electric Load Forecast is provided in Appendix 7.1.

The 2016 Electric Load Forecast, and correspondingly the adjustments to the 2016 Load Forecast, reflects the following with respect to DSM:

- Historical load values include the effect of Manitoba Hydro's past DSM efforts, including both improvements to energy codes and standards, as well as past market-based Power Smart programs.
- Forecast load values reflect the future impact of implemented or committed energy codes and standards, but not future activity under planned market–based DSM programs.
- Forecast savings from future activity under market-based DSM programs is not reflected in the 2016 Electric Load Forecast. The energy savings forecast to be achieved through future market-based DSM programs are considered in the Demand Side Management 2016/17 – 15 Year Supplemental Report, discussed in Section 7.2.

Figure 7.1 below provides the forecast growth in Manitoba Hydro's load, as well as the reduction to forecast load growth including the impacts of the forecast DSM activities. For clarity, MH16 includes the impacts of Manitoba Hydro's current DSM plan. Draft legislation that would create the Efficiency Manitoba crown corporation includes legislated targets for electric savings that are in excess of forecast DSM reductions in the corporation's current plan. In addition, Manitoba Hydro anticipates updating its load forecast to consider load growth impacts associated with the proposed level of rate increases.

Figure 7.1 Forecast Growth in Manitoba Hydro's Load



The impacts of DSM activities are combined with the load forecast to represent the forecast net load, which is used to forecast domestic revenues in MH16.

Manitoba load is forecast for the following sectors: Residential, General Service – Mass Market, General Service – Top Consumers, Losses and Station Service, and Miscellaneous. The Residential and General Service sectors combined represent the majority of energy use in Manitoba. The following is an overview of the historical and forecast growth in Manitoba total gross firm energy and peak load requirements.

7.1.1 Gross Firm Energy

Gross Firm Energy includes all electricity that is generated to meet firm energy requirements for all customers within Manitoba. Gross Firm Energy excludes non-firm (interruptible load).

Historical Period (1996/97 - 2015/16):

During the past 20 years, Gross Firm Energy has grown 352 GWh or 1.6% per year on a weather-adjusted basis. The trend in Gross Firm Energy growth has been relatively consistent over the period and reflects the effects of past improvements in energy efficiency codes and standards and past participation in Power Smart programs. The

economic downturn had a significant impact on some General Service Top Consumers in 2009/10 and was the main reason for the decline that year; however, excluding the loss of one Top Consumer, this segment has since recovered and continued to grow.

Forecast Period (2016/17 – 2035/36):

The 2016 Electric Load Forecast, and the corresponding adjustments to the 2016 Electric Load Forecast, reflects a forecast over a 20 year period from 2016/17 to 2035/36. During this forecast period, Gross Firm Energy is expected to grow 394 GWh or 1.4% per year. The growth is primarily due to the anticipated growth in population which accounts for 0.9% of the expected growth. The inclusion of Power Smart programs will lower Gross Firm Energy growth to 211 GWh or 0.8% per year.

7.1.2 Gross Total Peak

The Gross Total Peak is the maximum hourly load required to serve Manitoba Hydro's customers on the Integrated System. It excludes exports and diesel customers with curtailed loads added back in. The term "integrated" indicates that the average load within the peak hour is used.

Historical Period (1995/97 - 2015/16):

During the past 20 years, Gross Total Peak has grown 60 MW or 1.5% per year on an adjusted basis. Gross Total Peak has grown significantly since 2000/01, reflecting the general growth in energy load over that period.

Forecast Period (2016/17 – 2035/36):

During the forecast period, Gross Total Peak is projected to grow 69 MW or 1.3% per year. The inclusion of Power Smart programs will lower the demand growth to 27 MW or 0.6% per year.

The following section outlines the DSM energy and demand savings included in Manitoba Hydro's current long range plan and reflected in the forecast domestic revenues in MH16.

7.2 CURRENT DEMAND SIDE MANAGEMENT PLAN AND PROGRESS TO DATE

In this Application, Manitoba Hydro is providing its "Demand Side Management Plan 2016/17 – 15 Year Supplemental Report" which is found at Appendix 7.2.

It is worth noting that the Province of Manitoba has tabled legislation to create a new crown corporation to be known as Efficiency Manitoba which will have a mandate to provide Demand Side Management programming. While Efficiency Manitoba is still in its formative stage, Manitoba Hydro continues to deliver Power Smart programs to meet the needs of Manitoba customers.

Under Manitoba Hydro's current long range plan for DSM, Power Smart initiatives are targeted to achieve energy and demand savings of 4,506 GWh and 1,232 MW by 2030/31. This activity represents 16.9% of the adjusted 2016 Electric Load Forecast offsetting 76% of projected load growth during the 2016/17–2030/31 period. Combined with the energy savings to date, total electric savings of 7,355 GWh and 1,860 MW will be realized by 2030/31.

DSM Initiatives

Since Manitoba Hydro's last GRA, a number of new DSM initiatives and enhancements to existing initiatives have been introduced to assist residential, commercial and industrial customers in managing their energy bills. New programs launched include the Solar Energy Program, Power Smart Shops Program, Condensing Commercial Water Heater Program, Commercial Heat Recovery Ventilation (HRV) Program, Parking Lot Controller Program, New Homes Program, Residential Instant Rebates & Bill Credits Program, and Residential HRV Controls Program. Manitoba Hydro also introduced Community Energy Plans, a pilot program funding the hiring of energy advocates in Dauphin and The Pas to establish community wide plans to encourage increased participation in energy efficiency across all sectors. In addition, a number of enhancements to existing Power Smart programs were introduced, such as increased incentives, new measures, and enhanced sales and technical support. Some examples are as follows:

- Increased incentives for commercial geothermal customers;

- Increased incentives for windows and insulation in commercial buildings, and introduced incentives for single swinging glazed doors;
- Expanded the Residential Earth Power Loan to cover financing for eligible Solar PV technology as well as Air Source Heat Pumps;
- Expanded the Affordable Energy Program to target suites within multi-unit residential buildings for lower income customers;
- Introduced incentives to address electrical permit costs for commercial lighting upgrades and new prescriptive incentives for LED fixtures;
- Introduced incentives for intelligent evaporator control systems under the Commercial Refrigeration Program; and,
- Expansion of the Water and Energy Saver Program and Residential LED Lighting program to target suites within multi-unit residential buildings.

Power Smart Solar Energy Program

Manitoba Hydro launched its Power Smart Solar Energy Program on a pilot program basis in 2016. This two-year pilot offers incentives to qualifying customers for the installation of Solar Photovoltaic (PV) systems to displace a customer's electricity requirements.

The pilot program targets residential and small commercial customers and forecasts 95 customers to participate. Installation of solar PV self-generation is forecast to supply a total of 2.05 GWh of energy annually over the two years with a utility investment of $1.4 million. After 12 months, 47 residential customers have installed systems representing 0.56 GWh of self-generation with 182 customer applications pending.

For residential customers, installations under the program range from 3 kW to 20 kW with the average system size being 9 kW. The average electrically heated home uses 26,000 kWh, which would require approximately 20 kW of solar power to offset annual energy consumption. The average natural gas heated home uses 12,000 kWh of electricity, requiring 9 kW of solar power to offset annual consumption. To date no installations have been completed by commercial customers under the pilot. However, for the commercial project applications pending, the systems average 100 kW.

Incentives under the Solar Energy Program pilot are applied toward the capital cost of the installation. Manitoba Hydro provides an incentive of $1/watt of installed capacity. The costs to date of installations under the pilot have ranged from $2.90 - $3.30/watt installed. The average cost per watt based upon program participation is $3.06. Total incentives per customer are limited to the PV capacity that generates energy less than or equal to a customer's annual consumption.

Participating customers are required to install their solar PV systems according to all applicable codes. The installation is then subject to electrical inspection and upon successfully completing the inspection, Manitoba Hydro will install a bidirectional meter which monitors power imported from the grid as well as power exported from the solar PV installation. If the amount of energy exported to the grid is greater than the hydro electricity consumed in that month, a credit based upon Manitoba Hydro's current PUB-approved residential energy rate would be provided on the customer's bill which is carried over to offset future higher energy use months. Customers are billed at the appropriate PUB-approved electricity rates for their energy consumed.

The pilot offers the opportunity to evaluate the opportunities and challenges of solar PV in the Manitoba market, the processes required to support the technology, and the effects on the Manitoba Hydro distribution system.

Power Smart Program Results

Manitoba Hydro's Power Smart Programs have been and continue to be very successful at reducing customers' energy bills while contributing to a sustainable energy supply for the needs of the Province of Manitoba as a whole. Manitoba Hydro is currently evaluating the energy savings realized during 2015/16, with the 2015/16 DSM Annual Review expected to be finalized later in 2017. The corporation's DSM efforts are on target with estimated savings of 2,928 GWh and 797 MW as of March 31, 2016.

Manitoba Hydro's continued commitment to DSM was recognized in 2016 with the Corporation being named the 2015 ENERGY STAR Utility of the Year by Natural Resources Canada (NRCan presents the ENERGY STAR Canada awards annually to recognize participants who are the best in their class and have demonstrated excellence in energy efficiency).

Figures 7.2 and **7.3** below depict the energy and demand savings realized through to 2015/16 compared to plan.

Figure 7.2 Electric Energy Savings

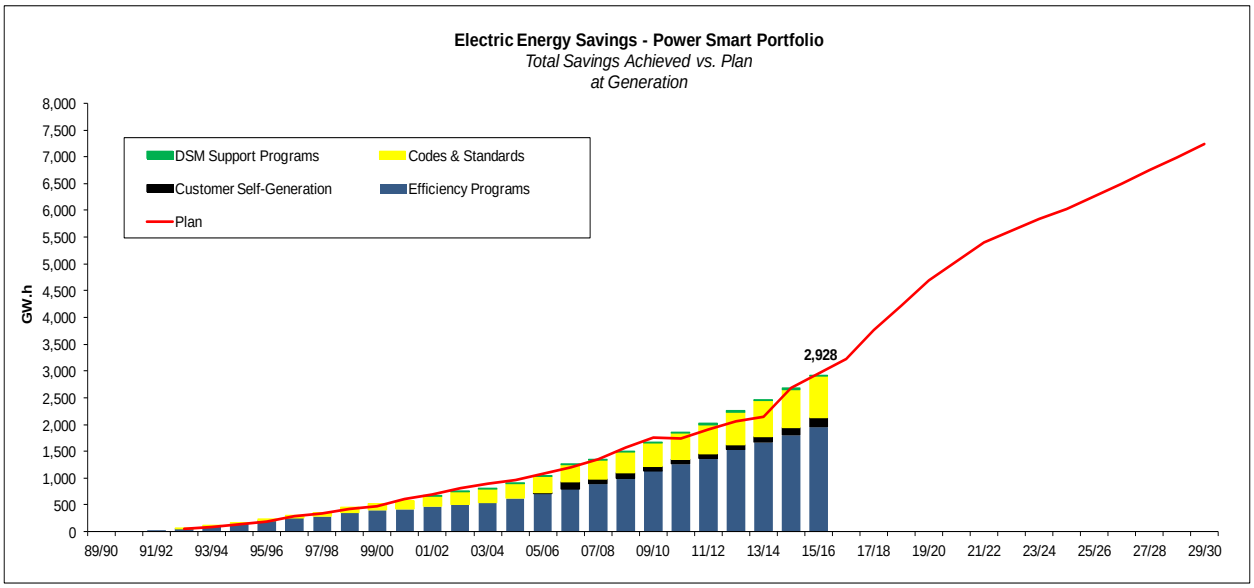
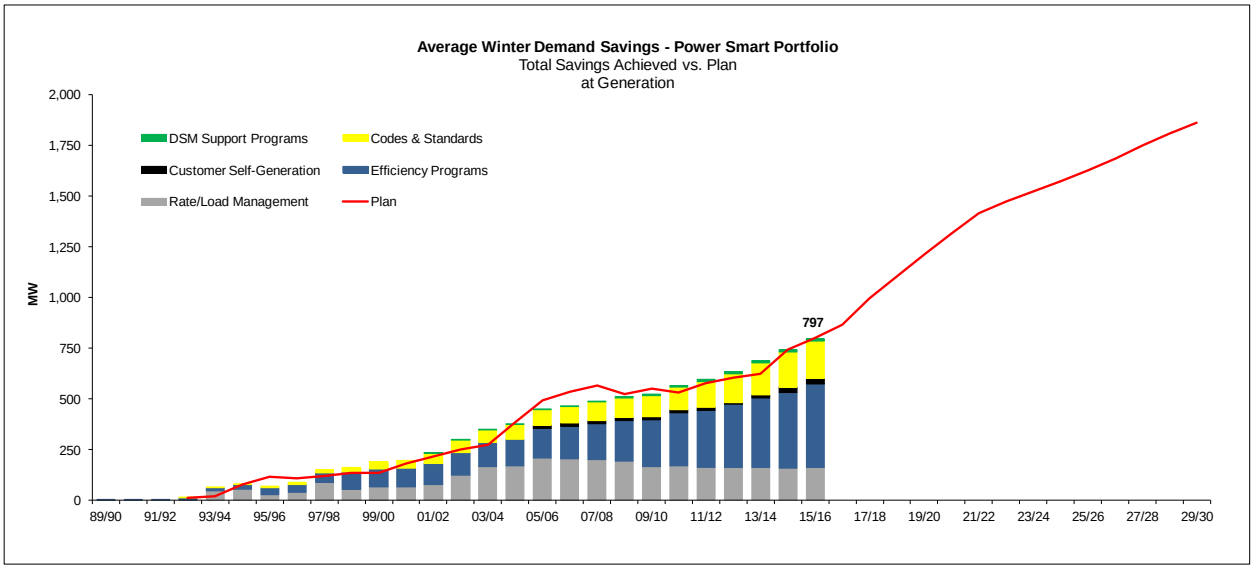


Figure 7.3 Average Winter Demand Savings



7.3 ENERGY SUPPLY

The existing supply of power available to meet Manitoba load requirements is comprised of generating resources currently available within Manitoba and imports from neighboring U.S. utilities. IFF16 also includes the addition to the supply resources of the Keeyask Generating Station and a 500 kV U.S. interconnection (the Manitoba-Minnesota Transmission line), which increases import capability.

Due to a decrease in forecasted Manitoba load, new generation resources are now projected to be required to meet persistent dependable energy shortfalls in 2040/41 and capacity shortfalls starting in 2043/44. The projection of the need date for new resources is based on the 2016 Load Forecast, with corresponding adjustments, as discussed in Section 7.1 of this Application. Further this projection assumes that existing generation assets will continue to perform at their current levels throughout the planning horizon, with the exception of Brandon Unit No 5 which is projected to cease coal operations by the end of 2019. Reduced generating unit performance, either through reduced capacity or increased forced outage rates has the potential to accelerate the need date for new resources. This projection of the need date for new resources also assumes that Manitoba Hydro's DSM programs are fully successful in offsetting 76% of projected load growth of the adjusted 2016 Electric Load Forecast during the 2016/17-2030/31 period and continuing beyond.

7.4 POWER RESOURCE PLANNING CRITERIA

In planning for a reliable supply of electric power, Manitoba Hydro has established criteria to ensure an adequate supply of capacity and energy for Manitoba. The generation planning criteria consist of two components, both of which must be satisfied in order to reliably serve the Manitoba load. These components include a capacity criterion, used to determine the minimum quantity of generation capacity required, and an energy criterion, used to determine the minimum quantity of energy required. These two criteria are outlined in the following sections. Meeting only the energy criterion while not meeting the capacity criterion would most likely result in insufficient capacity resources to meet annual peak demand during very cold weather events in the winter season.

Capacity Criterion

Manitoba Hydro's capacity criterion requires that the Corporation carry a minimum reserve which is intended to protect against capacity shortfalls resulting from breakdown of generation equipment, or increases in winter peak load due to extreme weather conditions. The reserve is calculated as 12% of the Manitoba forecast peak winter demand plus the reserve required by any export contract in effect at the time for each year that is forecasted. The maximum demand for capacity in Manitoba occurs in the winter season, and therefore the reserve margin of 12% is applied to the winter peak demand.

The reserve margin of 12% has been adequate for Manitoba Hydro's predominantly hydro-electric generation based system because of relatively low outage rates combined with the relatively small size of hydro-generating units. In comparison, reserve margins in predominantly thermal generation based systems are typically in the 15% range, when expressed on an installed capacity basis.

Energy Criterion

In addition to a capacity criterion, Manitoba Hydro has an energy criterion which recognizes the energy-constrained limitation of a hydro-electric generating system during drought conditions.

Manitoba Hydro's energy criterion requires that the corporation plan to have adequate energy resources to supply the firm energy demand in the event that the lowest recorded coincident water supply conditions are repeated; the energy supply under these conditions is referred to as dependable energy.

Historic system inflows are derived from the available record of river flows (1912-2013), which have been adjusted to represent present-use conditions and to account for systemic changes due to expected future water use and withdrawals upstream of Manitoba.

Dependable energy available in the Manitoba Hydro system is the total energy supplied from:

- hydro-electric generating stations

- thermal generating stations
- wind generation
- planned DSM
- imports from neighbouring utilities.

7.5 SUPPLY AND DEMAND SUMMARY

Manitoba Hydro's 2016/17 Resource Planning Assumptions & Analysis ("RPAA") document dated July 25, 2016 is provided in Appendix 7.3.

Subsequent to the completion of the 2016/17 RPAA, there have been changes in the supply and demand balance which have resulted in Manitoba Hydro updating the supply and demand balance information. The updated supply and demand balance information includes the 21 month delay in the in-service date for the Keeyask Generating Station, and the adjustments to the 2016 Electric Load Forecast, and is summarized in **Figures 7.4**, **7.5** and **7.6**.

Figure 7.4 provides a summary of the firm capacity (MW) supply and demand during the winter peak for the Manitoba system between fiscal years 2016/17 and 2025/26. Demand is based on the 2016 Electric Load Forecast, and the corresponding adjustments to the 2016 Electric Load Forecast, plus contracted extraprovincial exports and capacity reserve requirements. **Figure 7.5** provides a similar summary for firm energy (GWh) supply and demand under dependable supply conditions during each year of the same 10 year period. **Figure 7.6** reflects the supply and demand for energy (GWh) for expected flow conditions for 2016/17, and the average of all flow conditions for 2017/18 to 2025/26.

Figure 7.4: System Firm Winter Peak Demand and Capacity Resources (MW) @ generation

Fiscal Year		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
Power Resources											
New Power Resources											
New Hydro											
1 **Total New Hydro**											
New Thermal											
SCGT											
CCGT											
2 **Total New Thermal**											
3 **Total New Power Resources**	1+2										
Base Supply Power Resources											
Existing Hydro		5 088	5 105	5 150	5 165	5 150	5 321	5 766	5 766	5 766	5 766
Existing Thermal											
Brandon Coal - Unit 5		92	92	92							
Selkirk Gas		33	33	33	33	33	125	125	125	125	125
Brandon Units 6-7 SCGT		278	278	278	278	278	278	278	278	278	278
Contracted Imports		688	688	688	688	605	605	605	605	605	220
Proposed Imports											
Existing Wind		52	52	52	52	52	52	52	52	52	52
Generation Outages Over System Peak		- 113	- 14								
Bipole III Reduced Losses				90	90	90	90	80	80	80	80
4 **Total Base Supply Power Resources**		**6 118**	**6 234**	**6 383**	**6 306**	**6 208**	**6 471**	**6 906**	**6 906**	**6 906**	**6 521**
5 **Total Power Resources**	3+4	**6 118**	**6 234**	**6 383**	**6 306**	**6 208**	**6 471**	**6 906**	**6 906**	**6 906**	**6 521**
Peak Demand											
2016 Adjusted Load Forecast		4 776	4 790	4 816	4 846	4 895	4 940	4 995	5 050	5 105	5 155
Less: 2016 DSM Forecast		- 218	- 291	- 222	- 321	- 406	- 487	- 532	- 569	- 603	- 638
6 **Manitoba Net Load**		4 558	4 499	4 594	4 525	4 489	4 453	4 463	4 481	4 502	4 517
Contracted Exports		793	849	727	727	889	1 018	990	990	990	495
Proposed Exports											
7 **Total Exports**		793	849	727	727	889	1 018	990	990	990	495
8 **Total Peak Demand**	6+7	**5 351**	**5 348**	**5 321**	**5 252**	**5 378**	**5 471**	**5 453**	**5 471**	**5 492**	**5 012**
9 Reserves		548	542	541	533	531	528	530	532	535	535
10 System Surplus	5-8-9	**219**	**344**	**521**	**521**	**299**	**472**	**923**	**903**	**879**	**974**

Figure 7.5: System Firm Energy Demand and Dependable Resources (GWh) @ generation

Fiscal Year		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
Power Resources											
New Power Resources											
New Hydro											
1 **Total New Hydro**											
New Thermal											
SCGT											
CCGT											
2 **Total New Thermal**											
3 New Wind											
4 **Total New Power Resources**	1+2+3										
Base Supply Power Resources											
Existing Hydro		21 892	21 878	21 880	21 863	21 816	23 157	24 746	24 746	24 736	24 726
Existing Thermal											
Brandon Coal - Unit 5		706	706	706	515						
Selkirk Gas		899	899	899	899	899	899	899	899	899	899
Brandon Units 6-7 SCGT		2 343	2 343	2 343	2 343	2 343	2 343	2 343	2 343	2 343	2 343
Contracted Imports		2 809	2 809	2 809	2 809	3 502	3 688	3 688	3 688	3 688	2 321
Proposed Imports											
Hydro Adjustment		903	903	903	903	844	844	844	844	844	406
Market Purchases		258	258	258	258	957	1 050	1 050	1 050	1 050	2 417
Additional Market Resources											
Existing Wind		780	780	780	780	780	780	780	780	780	780
Bipole III Reduced Losses				101	101	101	101	177	177	177	177
5 **Total Base Supply Power Resources**		**30 590**	**30 576**	**30 679**	**30 471**	**31 242**	**32 862**	**34 527**	**34 527**	**34 517**	**34 069**
6 **Total Power Resources**	4+5	**30 590**	**30 576**	**30 679**	**30 471**	**31 242**	**32 862**	**34 527**	**34 527**	**34 517**	**34 069**
Manitoba Domestic Load											
2016 Adjusted Load Forecast		26 174	26 297	26 418	26 636	26 935	27 208	27 519	27 833	28 146	28 436
Construction Power Adjustment						40	40	35	35		
Less: 2016 DSM Forecast		- 285	- 544	- 934	-1 416	-1 732	-2 020	-2 201	-2 369	-2 526	-2 688
7 **Manitoba Net Load**		**25 889**	**25 753**	**25 484**	**25 220**	**25 243**	**25 228**	**25 353**	**25 499**	**25 620**	**25 748**
Contracted Exports		3 394	3 576	3 441	3 412	4 451	5 155	5 054	5 027	5 027	2 744
Proposed Exports											
Less: Adverse Water		- 370	- 370	- 370	- 370	- 370	- 489	- 512	- 512	- 512	- 85
8 **Total Net Exports**		**3 024**	**3 206**	**3 071**	**3 042**	**4 081**	**4 666**	**4 542**	**4 515**	**4 515**	**2 659**
9 **Total Energy Demand**	7+8	**28 913**	**28 959**	**28 555**	**28 262**	**29 324**	**29 894**	**29 895**	**30 014**	**30 135**	**28 407**
10 **System Surplus**	6-9	**1 678**	**1 617**	**2 124**	**2 210**	**1 918**	**2 968**	**4 632**	**4 513**	**4 382**	**5 662**

Figure 7.6: System Firm Energy Demand and Resources (GWh) @ generation (2016/17 Expected Water Flow Conditions; 2017/17 -2035/36 Average of All Flow Conditions)

Fiscal Year	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
Manitoba Hydro Power Resources										
Hydro Generation	36 494	34 270	30 835	31 117	31 306	32 314	35 202	35 421	35 418	35 427
Bipole III Reduced Losses			324	324	324	324	352	352	352	352
Thermal Generation	53	59	401	257	95	76	65	65	66	58
Wind	964	911	917	917	917	917	917	917	917	917
Imports			988	812	1 567	1 407	881	893	904	638
1 Total Power Resources	**37 511**	**35 240**	**33 465**	**33 426**	**34 209**	**35 038**	**37 417**	**37 647**	**37 657**	**37 392**
Demand										
2016 Adjusted Load Forecast	25 347	26 369	26 418	26 636	26 935	27 208	27 519	27 833	28 146	28 436
Demand Side Management	- 386	- 522	- 934	-1 416	-1 732	-2 020	-2 201	-2 369	-2 526	-2 688
2 Net Load	**24 961**	**25 847**	**25 485**	**25 220**	**25 203**	**25 188**	**25 318**	**25 463**	**25 620**	**25 747**
3 Contracted Exports	3 538	3 634	3 624	3 594	5 091	5 903	5 829	5 802	5 802	3 520
Total Demand 2+3	**28 499**	**29 481**	**29 109**	**28 815**	**30 295**	**31 090**	**31 147**	**31 266**	**31 422**	**29 268**
4 System Surplus 1-4	**9 012**	**5 759**	**4 356**	**4 612**	**3 914**	**3 948**	**6 270**	**6 382**	**6 235**	**8 124**

Figure 7.7 below summarizes the changes in supply and demand balances as a result of the projected delay in the in-service dates for Keeyask in comparison with the projections in the 2016/17 RPAA:

Figure 7.7: Changes in Supply/Demand Balances from 2016/17 RPAA – Keeyask 21 month delay

Changes to Dependable Energy (GWh)						
Fiscal Year	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**2022/23**	**2023/24**
System Surplus (Deficit) No New Resources, Keeyask 2019	**1757**	**2279**	**4534**	**4185**	**4105**	**3946**
Decrease to load forecast	367	424	475	521	563	602
Decrease to existing Hydro (delay in Keeyask ISD)		(493)	(2974)	(1621)	0	
Bipole III Reduced Losses			(76)	(76)		
Increase to Construction Power			(40)	(40)	(35)	(35)
System Surplus (Deficit) No New Resources, Keeyask 2021	**2124**	**2211**	**1919**	**2969**	**4633**	**4513**

Changes to Winter Peak Capacity (MWs)						
Fiscal Year	**2018/19**	**2019/20**	**2020/21**	**2021/22**	**2022/23**	**2023/24**
System Surplus (Deficit) No New Resources, Keeyask 2019	**421**	**497**	**699**	**770**	**771**	**739**
Decrease to load forecast	89	103	115	126	136	145
Decrease to existing Hydro (delay in Keeyask ISD)	0	(90)	(540)	(450)		
Bipole III Reduced Losses	0		10	10		
Decrease in Planning Reserves	11	12	15	16	18	18
System Surplus (Deficit) No New Resources, Keeyask 2021	**519**	**522**	**300**	**472**	**925**	**903**

IFF16 includes several major supply, demand and reliability projects to which Manitoba Hydro has committed including the Keeyask GS, Manitoba-Minnesota Transmission Project, Bipole III transmission, and Demand Side Management. Information on these resources, including forecast in-service dates, is provided in Tab 5.

7.6 EXPORT MARKETS AND EXPORT SALES

Export Market Outlook

A shown in **Figure 7.8**, average MISO energy market prices declined significantly beginning in mid-2008 with the economic downturn coincident with a significant drop in natural gas prices, and have not recovered since. The drop in natural gas prices was driven by significant new supplies of natural gas from shale formations, developed at low cost using fracturing ("fracking") drilling technology.

Export market prices are forecast to rise but remain low as compared to prior years' forecasts, with the potential for further decreases, for the next two to five years. This weaker five year outlook is a result of continued low natural gas prices, combined with modest load growth, and the growing presence of wind generation in the MISO market. The growing presence of wind generation is being driven in part by the continuation of subsidies for wind generation in the US.

The same factors that have made the short term electricity market low have continued to put further downward pressure on long term power prices. The primary driver of reduced long term power price expectations is a reduction in long term natural gas prices. Increased renewable development, primarily wind generation, in the MISO market is also contributing downward pressure on long term power prices. Significant changes in US energy and environmental policy could now be expected as a result of the November 2016 election, including a potential for the easing of current regulations with regard to coal mining and the use of coal in thermal generation, the easing of regulation on oil and natural gas exploration and the elimination carbon pricing programs such as the Clean Power Plan.

Manitoba Hydro updated the electricity export price forecast in February 2017 to reflect recent changes in the long term market outlook. Overall, electricity export prices are down about 20% relative to the comparable 2015 forecast.

Manitoba Hydro anticipates that in the state of Minnesota, the main export market into which Manitoba Hydro sells, there will be little change in state policy direction and the interest in Manitoba Hydro's renewable hydro product will remain relatively the same. In the states of Wisconsin and North Dakota which were seen as areas of potential new market activity, state policies support continued use of existing coal generation, which reduces the needs for Manitoba Hydro's renewable product.

In Canada, the federal government has announced the elimination of all coal fired electricity by 2030 and a nationwide carbon tax. These initiatives have increased interest in Manitoba Hydro's surplus renewable energy especially in Saskatchewan. However with very limited transmission capacity to Saskatchewan, significant new

export sales to the west will need to be accompanied by the construction of additional new transmission infrastructure.

Market Access

Market access is defined as the ability to sell into accessible markets without undue trade barriers or market rule restrictions on external supply. Manitoba Hydro continues to have good access to the MISO market and is continuing to work with MISO on projects that provide additional export value.

In December 2016, Manitoba Hydro began participating in the Southwest Power Pool, Inc. (SPP) market providing an additional US market outlet for surplus energy. Based in Little Rock, Arkansas, SPP manages a power market similar to the MISO market in all or parts of fourteen states: Arkansas, Iowa, Kansas, Louisiana, Minnesota, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas and Wyoming. The SPP market is about half the size of the MISO market. Manitoba Hydro's transmission access to SPP is small relative to the MISO and in most hours power prices will be similar. However, Manitoba Hydro anticipates that there will be some periods when power prices in SPP will exceed MISO prices, providing additional revenue.

Progress continues on the new 500 kV interconnection to the US with Minnesota Power having received all the major permits necessary for this project. Access to the US will expand with the planned in-service of the new line in 2020/21 and the granting of associated firm transmission reservations for access into Wisconsin.

Although the outlook for physical access to the US market is currently favorable, the result of the US election adds some uncertainty as to whether free trade in electricity will continue. Manitoba Hydro, other Canadian exporters in conjunction with the Canadian Electrical Association, US importing utilities and border states will work with the new federal administration to maintain the status quo with regard to maintaining free trade in electricity.

Although demand for Manitoba Hydro's electricity is strong in Saskatchewan, physical access is limited. Manitoba Hydro has however entered into an agreement for the sale of 100 MW of renewable energy electricity to SaskPower which requires the

construction of a new 230 kV interconnection in the 2021 timeframe. Manitoba Hydro and SaskPower are also studying the possibility of other additional transmission investments and power purchase agreements. SaskPower's peak load is currently about 3,700 MW. In 2014, SaskPower obtained 44% of its energy from coal generation. SaskPower is expected to close 278 MW of coal generation at the end of 2019, and a further 850 MW by the end of 2029.

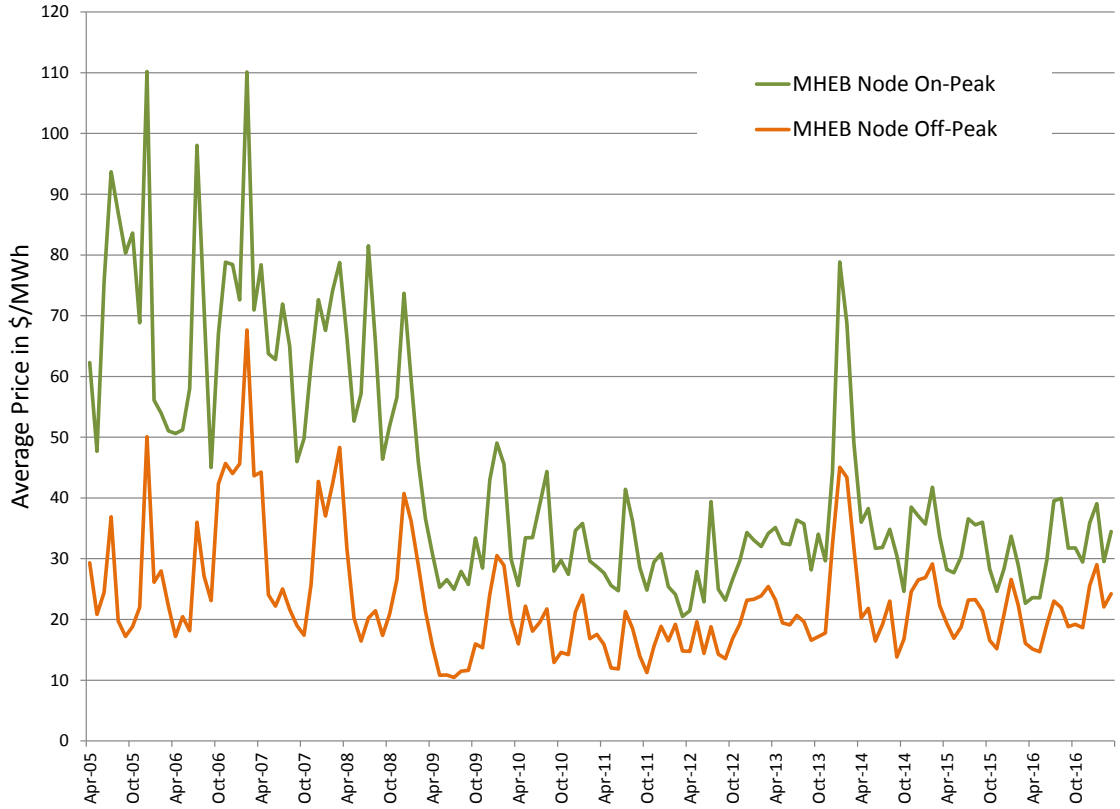
The Ontario market continues to provide Manitoba Hydro with an alternative to the MISO market. Operated by the Independent Electricity System Operator (IESO), the Ontario market has a real time energy market similar to MISO. While the Ontario market provides value to Manitoba Hydro, access is limited by the transmission interconnection into the weak transmission grid in northwestern Ontario, and by Ontario market rules provide preferential treatment to internal generators which at times restricts Manitoba Hydro's exports to the IESO market.

From an overall perspective, open transmission access in the US and open energy markets continue to be of critical importance to Manitoba Hydro. With new capacity and energy supplies from Keeyask, expanded access to the US and Saskatchewan will provide additional export opportunities, import capability and will enhance reliability.

Market Price History

Figure 7.8 below shows the history of monthly average on-peak (5 days × 16 hours) and off-peak (balance of hours) market electricity prices for the MISO Manitoba Hydro Commercial Pricing Node.

Figure 7.8 Monthly Average On-Peak and Off-peak Prices at the MHEB Commercial Pricing Node



Manitoba Hydro's recent average pricing experience of long-term dependable sales versus on-peak (5×16) opportunity sales is depicted in **Figure 7.9**. As most dependable sales are for on-peak energy, the price comparison to on-peak opportunity sales is appropriate. Note however that the prices shown for dependable sales include demand charges. In November 2015, the on-peak dependable price significantly increases reflecting the commencement of a new firm export sale. In May 2016, this average price decreases, reflecting that some market priced energy was delivered under several of the dependable contracts. Prices for the dependable energy in those contracts remained within the same range as the previous winter.

Figure 7.9 Monthly Average On-Peak Pricing (Dependable vs. Opportunity)

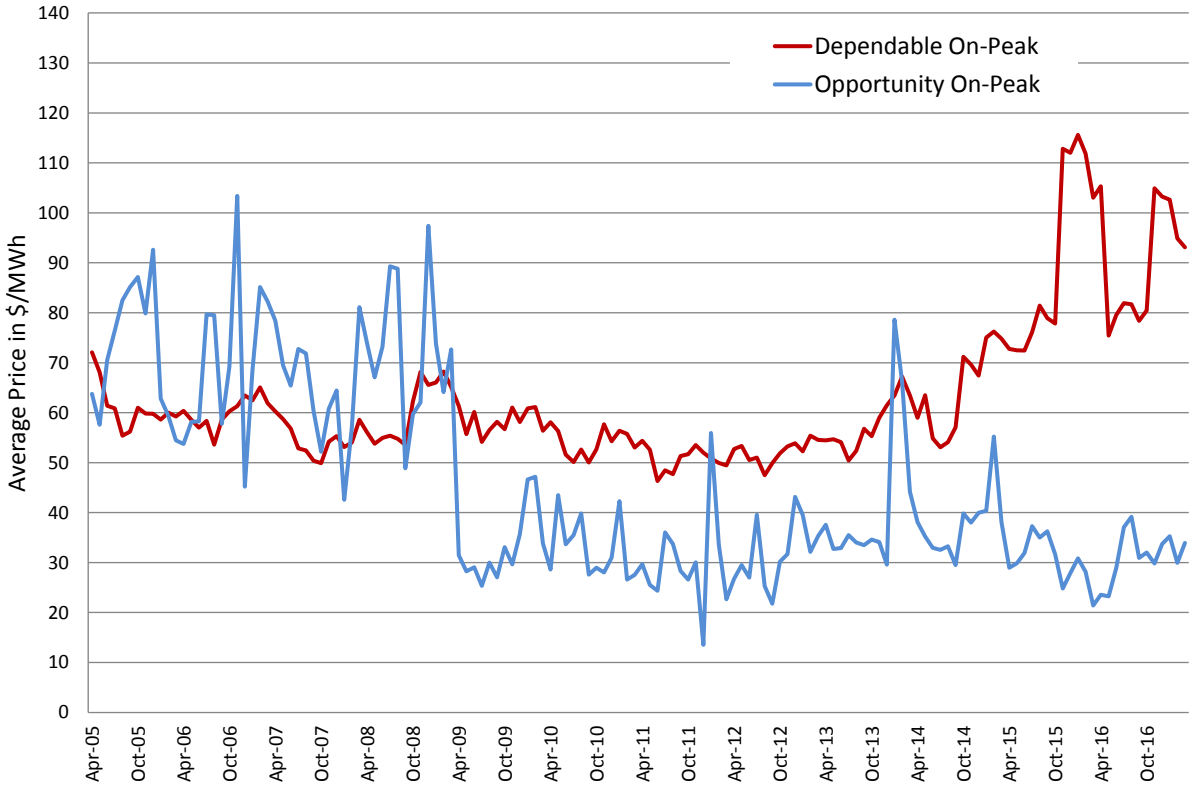
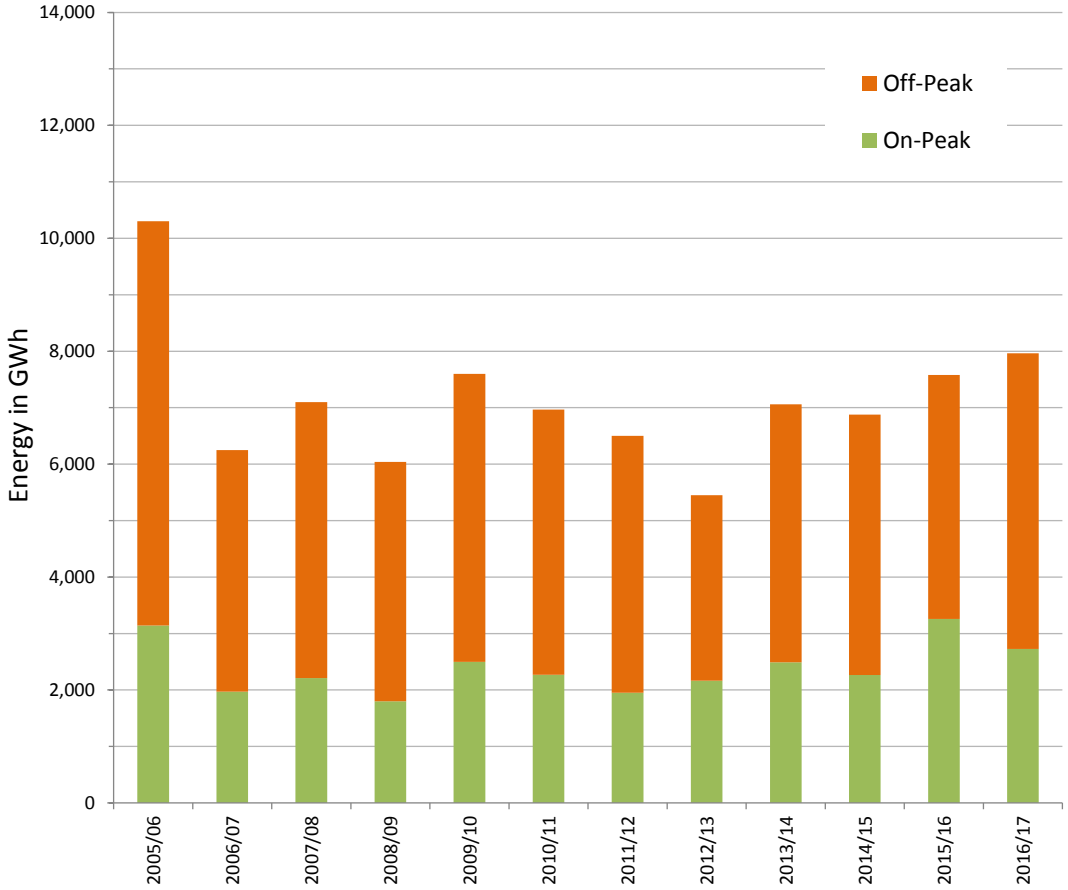


Figure 7.10 below charts opportunity export volumes by fiscal year for both on-peak (5×16) and off-peak periods from the start of the MISO Day 2 Energy Market in April 2005 through January 2017. Opportunity export volumes are affected by water supply conditions, dependable export sales, and Manitoba load requirements. As a result, opportunity export volumes show significant variability year-to-year.

Figure 7.10 Opportunity Export Volumes

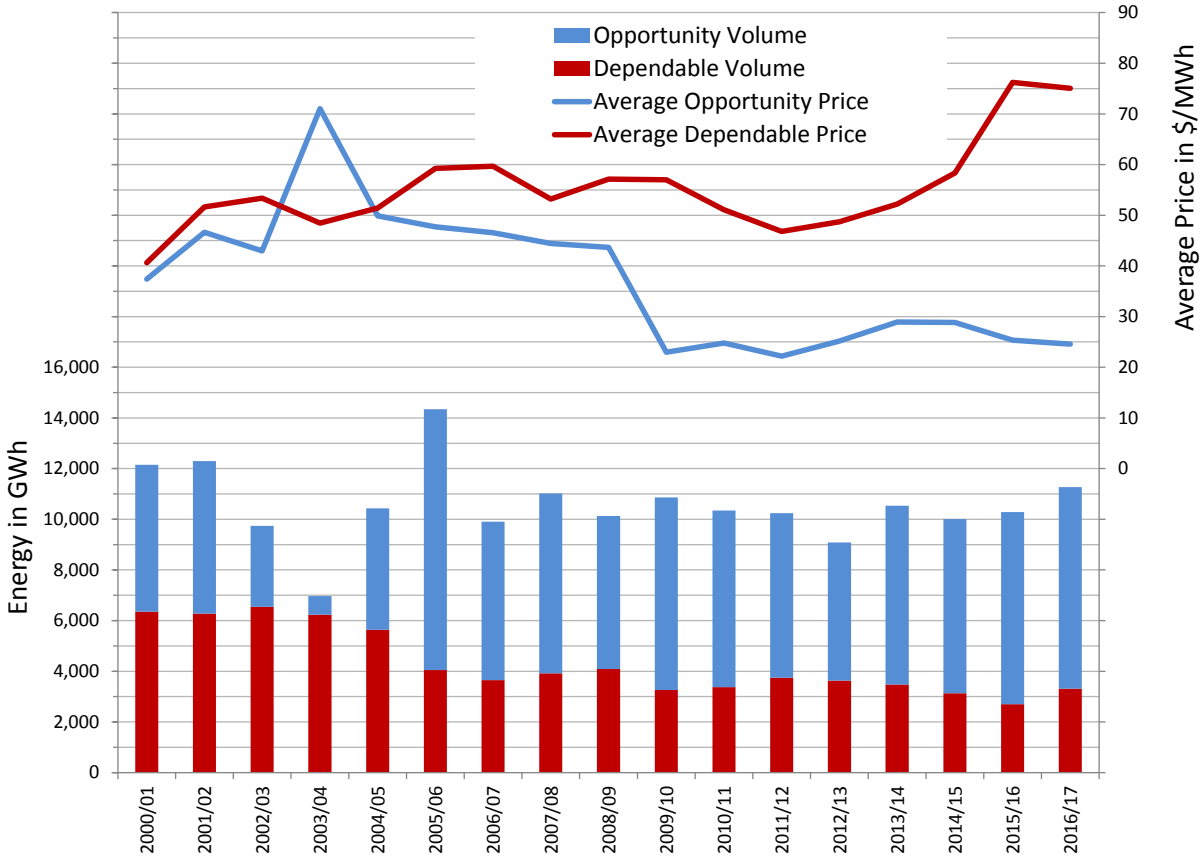


*Fiscal year through January 2017.

Figure 7.11 on the following page, charts both dependable and opportunity export volumes and average prices, including demand charges. The chart illustrates the relative variability in opportunity prices and volumes as compared to dependable exports. Although other factors such as economic activity and natural gas prices can affect opportunity prices, the inverse relationship between opportunity export volume and average price is evident in **Figure 7.11**. When opportunity sales volumes are low, for example due to low water supplies in 2003/04, a higher proportion of those sales occur during higher priced periods, resulting in a relatively higher average price. Conversely, when water conditions are well above average such as was experienced in recent years, more opportunity sales occur during lower valued periods and the resulting average price is relatively lower. With respect to dependable sales, the signing of new major contracts can influence the average price of dependable sales. The sharp increase in

average dependable price that occurred in 2015/16 was largely attributed to the commencement of a new long term sale in 2015.

Figure 7.11 Opportunity and Dependable Export Volumes and Average Prices



Long-Term Sales – New Agreements and Sales under Negotiation

Manitoba Hydro has a number of signed long-term power sales agreements, several of which are linked to Keeyask and the new 500 kV interconnection to the US.

Xcel Energy Power Sale Agreements

On May 27, 2010, Manitoba Hydro and Xcel Energy entered into three agreements providing for (i) the sale to Northern States Power of 375 megawatts of system power in the summer seasons and 325 megawatts of system power in the winter seasons for May 2015 through April 2025, (ii) the sale to Northern States Power of 125 megawatts of

system power for May 2021 through April 2025 conditional on the construction by Manitoba Hydro of a major new hydro-electric generating facility, (iii) a 350 megawatt agreement with Northern States Power where capacity and energy is exported from Manitoba in the summer months and capacity and energy (if required by Manitoba Hydro) is returned to Manitoba in the winter months for the period May 2015 through April 2025.

Minnesota Power

On May 19, 2011 Manitoba Hydro and Minnesota Power entered into two agreements providing for (i) a 250 MW System Power Sale Agreement to Minnesota Power from June 2020 to May 2035, and (ii) an Energy Exchange Agreement to provide Manitoba Hydro with firm transmission service to import energy during the period June 2020 to May 2035. The 250 MW System Power Sale Agreement is conditional upon the construction of major new hydro-electric generating facilities and new transmission in Manitoba and the US.

On July 30, 2014, Manitoba Hydro and Minnesota Power signed two additional agreements: (i) a 133 MW Energy Sale to commence when the new 500kV transmission line is placed in service in approximately June, 2020 and continues until 2040, and (ii) a 2014 Energy Exchange Agreement to commence when the new 500kV transmission line is placed in-service and continues until 2040. These agreements provide Manitoba Hydro the right to export or import up to 133 MWh per hour of energy to or from Minnesota Power at Manitoba Hydro's sole discretion on the new 500 kV interconnection.

Wisconsin Public Service

On May 19, 2011, Manitoba Hydro and Wisconsin Public Service entered a contract providing for the sale of 100 MW of System Power during the period June 2021 to May 2027, dependent on the construction of Keeyask.

On February 26, 2014 Wisconsin Public Service and Manitoba Hydro entered into the following agreements:

(a) A 108 MW System Power Sale Agreement for the five year period June 2016 through May 2021. The capacity and dependable energy supporting this agreement do not require the construction of any new generation or transmission facilities.
(b) A 200 MW Energy Purchase Agreement for the period June 2020 through May 2036. The agreement is conditional upon the construction of the new 500 kV interconnection to the US, and will use 200 MW of the 698 MW of additional import capability provided by the transmission line.
(c) An 8 MW Energy Sale Agreement for the period June 2023 through May 2029. The 8 MW Energy Sale Agreement in conjunction with the 100 MW System Power Sale Agreement signed on May 19, 2011 for the same period uses all of the existing 108 MW of firm transmission service that is available between Manitoba Hydro and Wisconsin Public Service.

SaskPower

On January 29, 2016 Manitoba Hydro and SaskPower entered into an agreement providing for the sale of 100 MW of system power to SaskPower from June, 2020 through May, 2040. The 100 MW System Power Sale Agreement is conditional upon the construction of a new 230 kV transmission interconnection between Manitoba and Saskatchewan.

7.7 WATER CONDITIONS

Precipitation

Precipitation across the Nelson-Churchill basin was above average in 2016/17. Precipitation was near average for April through June and transitioned to above normal in July with significant rain events occurring over the Saskatchewan and Churchill River basins. Precipitation in September and October was well above average across the system, exceeding the 85th percentile for this period. Soil moisture conditions were well above average heading into winter as a result of the fall rains, a favourable condition for runoff in the spring of 2017. System-wide snowpack was slightly above average.

Inflows

As shown in **Figure 7.12** on the following page, annual inflows to the Manitoba Hydro system were well above average in 2015/16. Annual inflows for 2016/17 were above upper decile of historic flows since 1912 marking the thirteenth consecutive year of average or above average inflows, and the longest wet cycle on record. The previous record was five years. As indicated in **Figure 7.12**, the hydrologic record shows a history of long periods of above average conditions followed by similarly long periods of below average conditions. Although it is not possible to predict when there will be a transition to below average conditions, it is clear from the record that the transition can be relatively abrupt (for example 1997/98 to 1998/99) and that multi-year wet periods are typically followed by multi-year dry periods.

Figure 7.12 Historical Water Supply

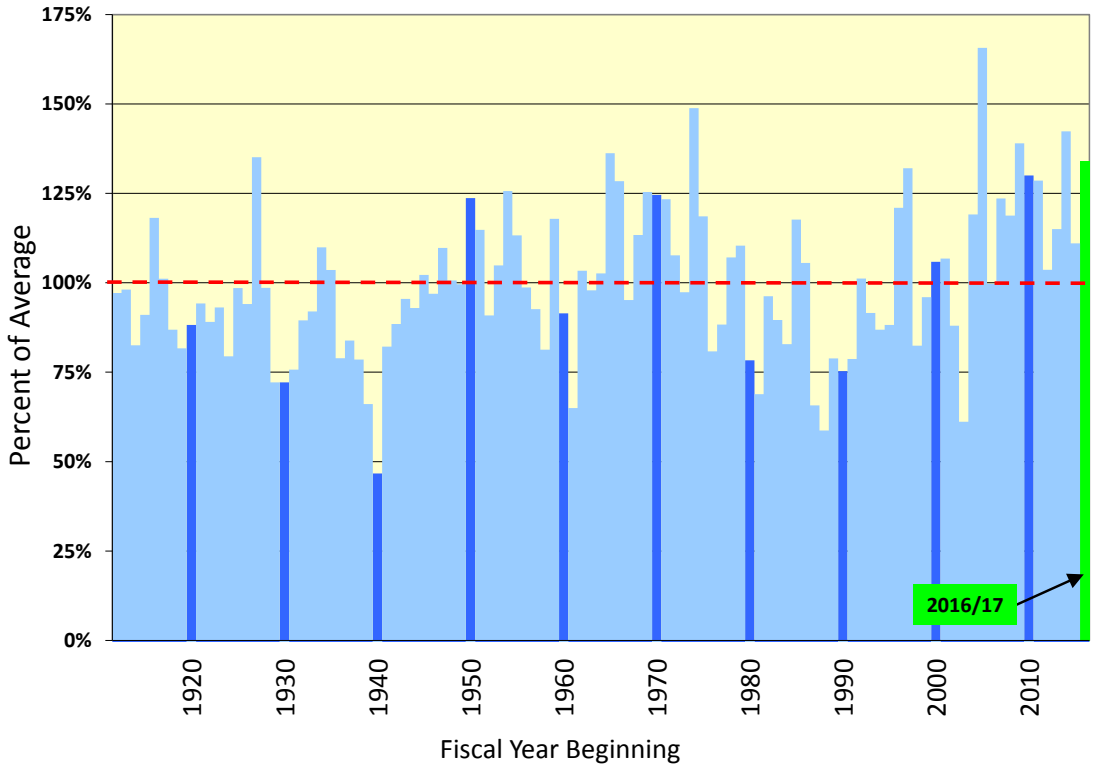
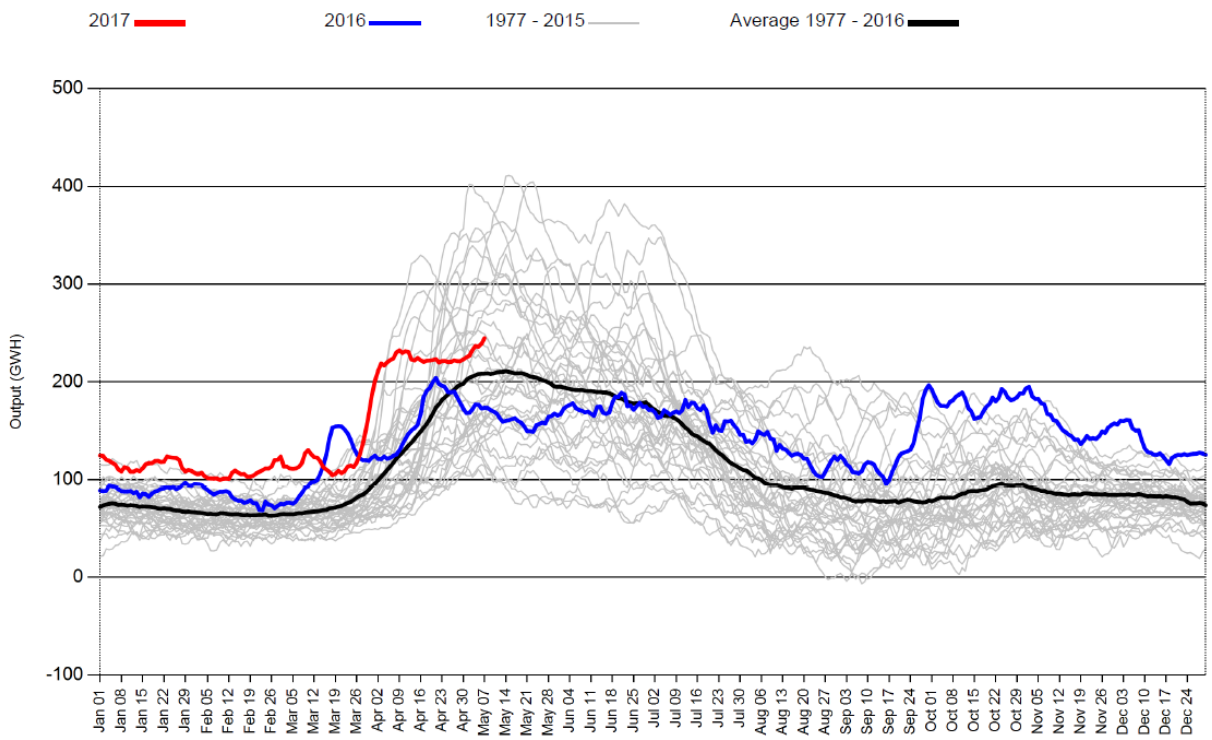


Figure 7.13 below shows historical daily inflows beginning in 1977, with inflows for 2016 and 2017 and the average shown as highlighted. Of note are the near record high inflows experienced since mid-September 2016 as a result of widespread rains falling across most of the basin which sustained inflows through the winter.

Figure 7.13 Daily Hydraulic Energy from Inflow

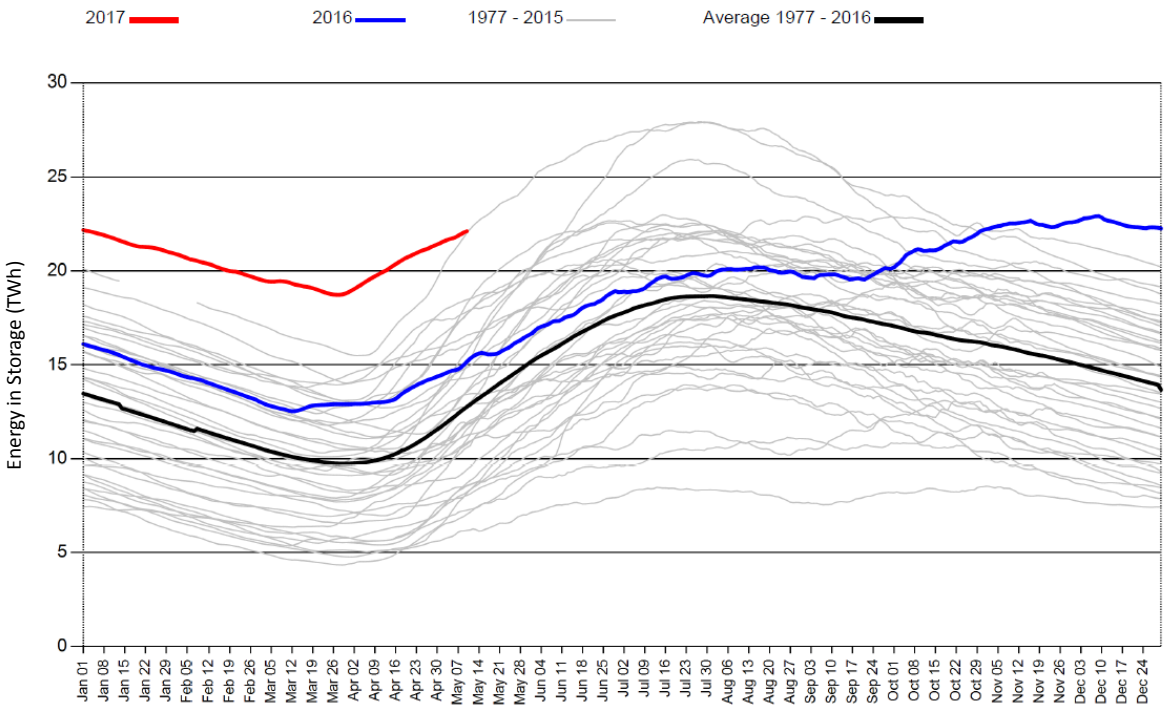


Energy in Reservoir Storage

Figure 7.14 on the following page shows historical daily energy in reservoir storage beginning in 1977, with values for 2016 and 2017 and the average shown as highlighted. This indicator is for the major reservoirs in Manitoba Hydro's watersheds including reservoirs regulated by other agencies whose operations affect the flows at Manitoba Hydro's generating stations.

As 2015/16 was an above average water year, more water in reservoir storage was carried forward into 2016/17 than average. This situation combined with record high inflows in the fall of 2016 resulted in reservoir storage levels at record highs through winter 2016/17. Although above average storage is generally favourable for hydraulic generation, with this record high storage condition, Manitoba Hydro is forced to spill a significant portion of this water in order to comply with regulatory limits on its major reservoirs.

Figure 7.14 Total Energy in Reservoir Storage



Reservoir Operations

Overall reservoir operations in the 2016/17 were driven by normal inflow conditions in the first quarter and then focused on flood management by September. Cedar Lake and Churchill River Diversion (CRD) releases were below average early in the year in order to recover storage while inflows were below average. Outflows from Cedar Lake and the CRD were increased to above average levels by July as reservoirs were close to full and precipitation in the basins supplying these reservoirs had transitioned from dry to very wet. For 2016/17, Lake Winnipeg outflows were above average because levels were in the upper decile range in the spring and inflows increased to above average by June, resulting in Lake Winnipeg levels eventually reaching record high winter levels. Lake Winnipeg outflows and CRD flows were maximized through the winter in order to maximize Nelson River generation. With current Lake Winnipeg levels, Manitoba Hydro expects to continue maximum Lake Winnipeg outflow operations through June 2017. Much of this water will be spilled at the Nelson River generating stations.

Total Hydraulic Generation

Figure 7.15 below shows the forecast hydraulic generation for the 2016/17 outlook based on expected inflows as at February 2017, as reflected in MH16.

For 2017/18 the main driver for hydraulic generation will be future precipitation, which is highly uncertain. A favourable factor will be the record high storage carry-over from 2016/17, primarily in Lake Winnipeg. **Figure 7.15** shows the forecast hydraulic generation for 2017/18 as well as a range reflecting various levels of uncertainty in inflows. The forecast hydraulic generation is the average hydraulic generation from a simulation using the 104 year flow record (1912/13 through 2015/16), all in conjunction with expected reservoir starting levels. In terms of the financial impact in 2017/18, the range of flow-related costs and revenues is $96M favourable with highest flows, and $166M unfavorable with lowest flows on record.

Use of a full simulation of historic flows for the second year of the forecast is a departure from previous methodology where in year two of the forecast median inflows to reservoirs were assumed. The year two forecast is now produced in a similar manner as years three and later and reflects the possibility of the full range of historic inflow conditions. This change better reflects expected revenues and costs that are affected by water supply.

Figure 7.15 Actual and Forecast Total Hydraulic Generation