2018
ELECTRIC LOAD FORECAST

MARKET FORECAST & LOAD RESEARCH

NOVEMBER 2018

Manitoba Hydro

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EXECUTIVE SUMMARY

Overview

The Gross Firm Energy in Manitoba is forecast to grow from a weather adjusted value of 25,870 GWh in 2017/18 to 28,627 GWh in 2027/28. This represents an average growth of 276 GWh or 1.0% per year for 10 years. By 2037/38, Gross Firm Energy is forecast to be 32,363 GWh, representing a growth rate of 325 GWh or 1.1% per year.

Gross Total Peak is forecast to grow at a similar pace, from an adjusted value of 4,751 MW in 2017/18 to 5,320 MW in 2027/28, growing 57 MW or 1.1% a year for the next 10 years. By 2037/38, Gross Total Peak is forecast to be 6,035 MW, representing a growth rate of 64 MW or 1.2% per year.

Growth is expected in all sectors with the Residential Basic, General Service Mass Market and General Service Top Consumers sectors forecast to grow annually by 1.2%, 1.5% and 0.2% respectively, over the next 20 years. During the last 10 years, Gross Firm Energy has grown 198 GWh or 0.8% per year. This 10 year period encompasses the 2009 global economic downturn that slowed growth and also reflects the influence of Manitoba Hydro's Demand Side Management activities.

The primary driver of energy growth in Manitoba is the population and the secondary driver is the economy. The population of Manitoba has grown from 1,191,000 people in 2007/08 to 1,342,000 people in 2017/18, averaging 1.2% growth per year. Manitoba's population is forecast to grow to 1,650,000 by 2037/38, averaging 1.1% per year. Real Manitoba Gross Domestic Product (GDP) is expected to grow 1.8% in 2018/19 and average 1.7% annually for the next 20 years. Canada and US Real GDP is forecast to grow 2.1% and 2.6% respectively in 2018/19 and average 1.9% and 2.1% annually for the next 20 years.

Three main components represent the majority of Manitoba's electricity use:

i. **Residential Basic** is forecast to grow at an average of 1.2% per year over the next 20 years. Customer growth, mimicking population growth, is growing 1.1% per year. Average use per customer is increasing, adding 0.15% per year. This is primarily due to the increased use of electric space heating, electric water heating and miscellaneous end uses in dwellings.

ii. **General Service Mass Market** is forecast to grow at an average of 1.5% per year, which is higher than the historic growth of 1.1% per year over the past 10 years. The growth is primarily due to the economic growth in Manitoba.

iii. **General Service Top Consumers** is forecast to grow at an average of 0.2% per year, which is higher than the 0.1% decline per year experienced during the past 10 years. It is less than the 3.1% growth per year during the prior 10 years. The 20 year historical growth of the Top Consumers has been 1.5% per year.

Table 1 – Gross Energy and Peak

Gross Firm Energy and Gross Total Peak History and Forecast 2007/08 - 2037/38					
	Gross Firm Energy		Gross Total Peak		Load Factor
Fiscal Year	(GWh)	Growth (%)	(MW)	Growth (%)	(%)
2007/08	24,122		4,304		64.0%
2008/09	24,417	1.2%	4,509	4.8%	61.8%
2009/10	23,412	-4.1%	4,393	-2.6%	60.8%
2010/11	23,892	2.1%	4,286	-2.4%	63.6%
2011/12	23,605	-1.2%	4,367	1.9%	61.7%
2012/13	24,750	4.9%	4,559	4.4%	62.0%
2013/14	25,625	3.5%	4,743	4.0%	61.7%
2014/15	25,505	-0.5%	4,713	-0.6%	61.8%
2015/16	24,665	-3.3%	4,479	-5.0%	62.9%
2016/17	25,227	2.3%	4,822	7.7%	59.7%
2017/18	25,742	2.0%	4,755	-1.4%	61.8%
2017/18 Wadj	25,870	0.5%	4,751	-0.1%	62.2%
10 Year Avg Gr.	198	0.8%	43	0.9%	
2018/19	25,935	0.3%	4,815	1.4%	61.5%
2019/20	26,237	1.2%	4,863	1.0%	61.6%
2020/21	26,528	1.1%	4,918	1.1%	61.6%
2021/22	26,759	0.9%	4,965	0.9%	61.5%
2022/23	27,018	1.0%	5,015	1.0%	61.5%
2023/24	27,357	1.3%	5,079	1.3%	61.5%
2024/25	27,691	1.2%	5,143	1.3%	61.5%
2025/26	28,001	1.1%	5,202	1.1%	61.5%
2026/27	28,329	1.2%	5,264	1.2%	61.4%
2027/28	28,627	1.1%	5,320	1.1%	61.4%
10 Year Avg Gr.	276	1.0%	57	1.1%	
2028/29	28,951	1.1%	5,381	1.2%	61.4%
2029/30	29,287	1.2%	5,445	1.2%	61.4%
2030/31	29,630	1.2%	5,511	1.2%	61.4%
2031/32	29,991	1.2%	5,580	1.3%	61.4%
2032/33	30,367	1.3%	5,652	1.3%	61.3%
2033/34	30,733	1.2%	5,722	1.2%	61.3%
2034/35	31,106	1.2%	5,794	1.3%	61.3%
2035/36	31,492	1.2%	5,869	1.3%	61.3%
2036/37	31,904	1.3%	5,948	1.4%	61.2%
2037/38	32,363	1.4%	6,035	1.5%	61.2%
20 Year Avg Gr.	325	1.1%	64	1.2%	

Change between the 2017 and 2018 Forecast

The Gross Firm Energy Forecast starts 144 GWh (0.6%) lower in 2018/19 and by 2036/37 is 445 GWh (1.4%) higher than the 2017 Forecast. This is an increase of just over 1 year of load growth by 2036/37. (1 year of load growth = approximately 325 GWh).

The Gross Total Peak is 137 MW higher in 2036/37 than presented under the 2017 Forecast primarily attributable to an increase in the energy forecast but a reduced energy forecast in the Top Consumers sector which results in a lower load factor and higher peak impact. This is an increase of just over 2 years of load growth. (1 year of load growth = approximately 64 MW).

Table 2 – Change in Energy and Peak

Gross Firm Energy and Gross Total Peak Change from Previous Forecast 2018/19 - 2037/38						
	Gross Firm Energy			Gross Total Peak		
Fiscal Year	2018 Forecast (GWh)	2017 Forecast (GWh)	Change (GWh)	2018 Forecast (MW)	2017 Forecast (MW)	Change (MW)
2017/18 Act	25,742			4,755		
Weather Adj.	128			-4		
2017/18 Wadj	25,870	26,065	(195)	4,751	4,767	(16)
2018/19	25,935	26,080	(144)	4,815	4,789	26
2019/20	26,237	26,369	(132)	4,863	4,845	18
2020/21	26,528	26,483	45	4,918	4,868	51
2021/22	26,759	26,459	299	4,965	4,870	95
2022/23	27,018	26,453	565	5,015	4,871	143
2023/24	27,357	26,453	903	5,079	4,875	204
2024/25	27,691	26,519	1,171	5,143	4,890	253
2025/26	28,001	26,639	1,362	5,202	4,913	289
2026/27	28,329	26,892	1,437	5,264	4,958	306
2027/28	28,627	27,241	1,386	5,320	5,022	298
10 Year	276	118		57	26	
Avg Gr.	1.0%	0.4%		1.1%	0.5%	
2028/29	28,951	27,650	1,301	5,381	5,098	284
2029/30	29,287	28,084	1,202	5,445	5,179	267
2030/31	29,630	28,529	1,101	5,511	5,262	249
2031/32	29,991	28,995	997	5,580	5,349	232
2032/33	30,367	29,469	898	5,652	5,438	215
2033/34	30,733	29,942	791	5,722	5,526	196
2034/35	31,106	30,427	679	5,794	5,617	177
2035/36	31,492	30,929	563	5,869	5,711	157
2036/37	31,904	31,459	445	5,948	5,811	137
19 Year	318	284	34	63	55	8
Avg Gr.	1.1%	1.0%	0.1%	1.2%	1.0%	0.1%

The decrease in 2018/19 of 144 GWh is mainly attributable to changes in the Top Consumers short term operating plans.

By 2036/37, the 2018 Forecast is 445 GWh higher than previously assumed in the 2017 Forecast. The difference is attributable to the following:

Residential Basic (+210 GWh)

- Primarily higher due to an decrease in the forecast of electric price

General Service Mass Market (+371 GWh)

- Primarily higher due to an increase in the average use forecast

General Service Top Consumer (-178 GWh)

- Primarily lower due to adjustments in customer short term plans and updates to the longer term growth forecast (PLIL)

Other sales and losses (+42 GWh)

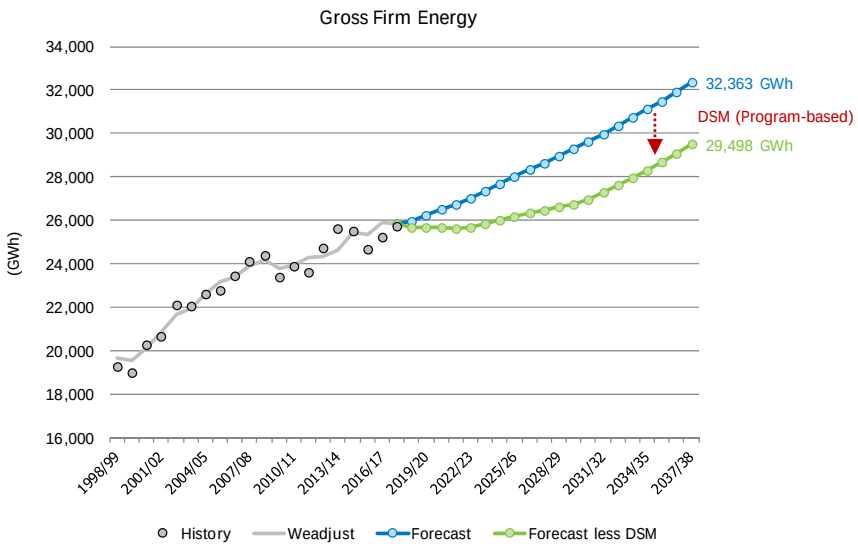
- Increases in other sales and losses

Program-based Demand Side Management (DSM)

Through its Demand Side Management (DSM) initiative, Manitoba Hydro develops and implements cost-effective energy conservation and alternative energy programs. These programs provide Manitoba customers with environmentally friendly initiatives that aim to reduce customer's energy consumption. The 2018 electric load forecast reflects future DSM savings associated with existing Provincial building codes and improved equipment efficiency standards and regulations (Codes and Standards). This is the only effect of DSM initiatives that is specifically accounted for within the forecast. DSM savings arising from future program-based offerings incremental to the above mentioned Codes and Standards are not reflected in this forecast. They are accounted for separately in Manitoba Hydro's DSM Plan and Power Resource Plan.

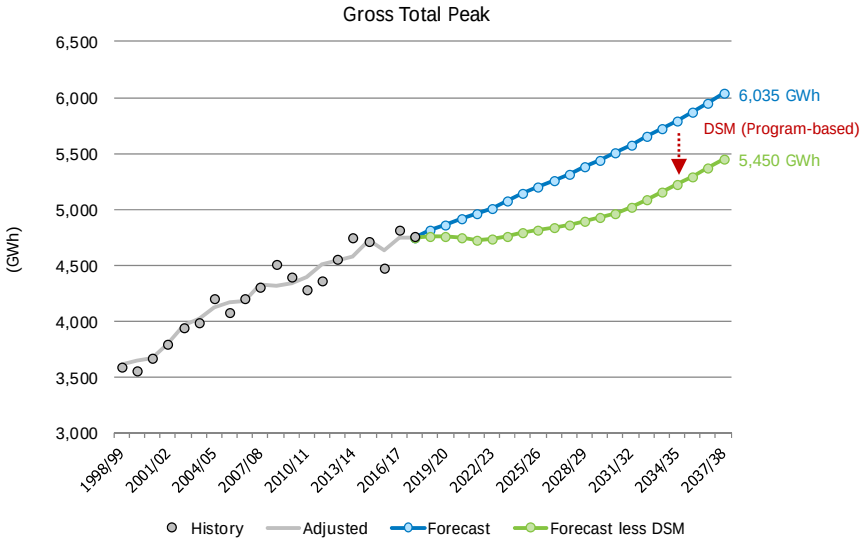
Although not explicitly included in this forecast, the program-based DSM has a significant impact on the projected future load growth expected in Manitoba. Program-based DSM reduces the Gross Firm Energy in 2037/38 from 32,363 GWh to 29,498 GWh, lowering the average growth of 325 GWh or 1.1% per year to an average growth of 181 GWh or 0.7% per year.

Figure 1 – Gross Firm Energy



Program-based DSM reduces the Gross Total Peak in 2037/38 from 6,035 MW to 5,450 29,498 GWh, lowering the average growth of 64 MW or 1.2% per year to an average growth of 35 GWh or 0.7% per year.

Figure 2 – Gross Total Peak



The following table outlines the impacts of incorporating program-based Demand Side Management activity:

Table 3 – Impacts of Demand Side Management

Gross Firm Energy and Gross Total Peak Impacts of Demand Side Management 2018/19 - 2037/38						
	Gross Firm Energy (GWh)			Gross Total Peak (MW)		
Fiscal Year	Forecast	DSM (Program Based)	Forecast less DSM	Forecast	DSM (Program Based)	Forecast less DSM
2017/18 Wadj	25,870		25,870	4,751		4,751
2018/19	25,935	(285)	25,651	4,815	(53)	4,762
2019/20	26,237	(541)	25,696	4,863	(99)	4,763
2020/21	26,528	(861)	25,667	4,918	(169)	4,749
2021/22	26,759	(1,158)	25,601	4,965	(238)	4,727
2022/23	27,018	(1,341)	25,677	5,015	(283)	4,732
2023/24	27,357	(1,509)	25,847	5,079	(319)	4,760
2024/25	27,691	(1,666)	26,024	5,143	(352)	4,790
2025/26	28,001	(1,829)	26,172	5,202	(386)	4,816
2026/27	28,329	(1,998)	26,331	5,264	(421)	4,843
2027/28	28,627	(2,173)	26,454	5,320	(455)	4,866
10 Year Avg Gr.	276		58	57		11
Avg Gr.	1.0%		0.2%	1.1%		0.2%
2028/29	28,951	(2,345)	26,607	5,381	(487)	4,894
2029/30	29,287	(2,525)	26,762	5,445	(521)	4,924
2030/31	29,630	(2,697)	26,933	5,511	(552)	4,959
2031/32	29,991	(2,717)	27,274	5,580	(557)	5,024
2032/33	30,367	(2,742)	27,625	5,652	(561)	5,091
2033/34	30,733	(2,766)	27,967	5,722	(566)	5,156
2034/35	31,106	(2,791)	28,314	5,794	(571)	5,223
2035/36	31,492	(2,815)	28,677	5,869	(576)	5,293
2036/37	31,904	(2,839)	29,064	5,948	(580)	5,368
2037/38	32,363	(2,865)	29,498	6,035	(585)	5,450
20 Year Avg Gr.	325		181	64		35
Avg Gr.	1.1%		0.7%	1.2%		0.7%

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INTRODUCTION

This document is prepared annually as Manitoba Hydro's forecast of its future load requirements for its service area. The service area consists of the entire province of Manitoba (99.85% of sales), as well as two resale customers that supply energy to Creighton, Saskatchewan (0.12% of sales) and the Northwest Angle, Minnesota (0.03% of sales). Exports of power to other utilities are not included.

This information provided serves several purposes. Short term forecasts of sales by billing month within rate groups are needed to forecast revenue for rate design and accounting. Short term forecasts of energy and peak is needed for system operations. Long term forecasts of energy and peak are required by power planning to determine long term supply requirements.

A "customer" in this document refers to a metered electrical service. Unmetered services, such as flat rate water heating and sentinel rentals are not defined as customers. Street lighting group a number of services at the municipal and lighting type category and are each defined as one customer. A customer is not equivalent to a building structure. One building can have multiple electric services and may count as more than one customer. Likewise, multiple buildings may have only one service and will count as only one customer.

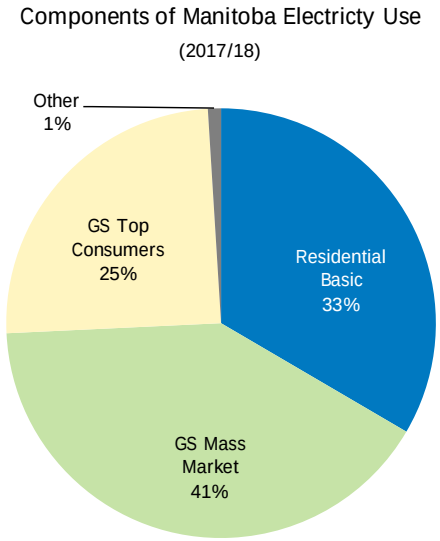
Electric consumption is read at the meter level in units of kilowatt-hours (kWh). This document reports electric use in terms of gigawatt-hours (GWh). One GWh equals one million kWh, which is approximately the energy of 100 typical residential dwellings not using electricity for heating. A residential dwelling not using electricity for heating uses approximately 10,000 kWh per year.

The highest load requirement during a time period is defined as the peak load. It is given in terms of megawatts (MW). One MW equals one thousand kilowatts (kW). A typical residential dwelling not using electricity for heating would use a maximum of about 2.5 kW sometime during the year. However, dwellings will not all be at their maximum use at the same hour. The use of all dwellings at any specific hour is defined as the coincident load. The coincident peak is the load at the hour of Manitoba's system peak. A typical dwelling not using electricity for heating would use about 1.6 kW at the coincident peak. Therefore 1.0 MW is approximately the coincident peak requirement of 600 typical dwellings not using electricity for heating.

Components of Manitoba's Electricity Use – 2017/18

General Consumers Sales (also referred to as Total Sales) includes the energy supplied to all of Manitoba Hydro's individually billed customers. During the 2017/18 fiscal year, Manitoba Hydro averaged 576,937 General Consumers Sales customers who consumed 22,573 GWh.

Figure 3 – Components of Manitoba Electricity Use



The major groups include:

i. **Residential Basic**, with 486,317 customers, who used 7,547 GWh or 33.4% of Total Sales are mostly residential structures that include single-family dwellings, multi-family dwellings and individually metered apartment suites.

ii. **General Service Mass Market**, with 68,105 customers who used 9,213 GWh or 40.8% of Total Sales are small to large Commercial and Industrial customers.

iii. **General Service Top Consumers**, with 26 customers who used 5,592 GWh or 24.8% of Total Sales are the 10 high-usage companies (some count as multiple customers) that are forecast individually.

In addition to the above major groups, there are four remaining group of customers who used 221 GWh or 1.0% of Total Sales:

i. Seasonal customers are those billed twice a year rather than on a monthly basis.

ii. Diesel customers are from four remote communities not connected to the integrated grid system.

iii. Flat Rate Water Heating customers.

iv. Area and Roadway Lighting sector which includes electricity sales for the Sentinel Lighting and Street Lighting groups.

Note: Over 50,000 of these services related to Flat Rate Water Heating and Area and Roadway Lighting do not count as customers.

Manitoba Load at Common Bus is the total load metered at all the substations in the province that supplies Manitoba Hydro's non-Diesel customers and includes Distribution Losses and Construction Power. In 2017/18, Common Bus was 23,799 GWh or about 5.4% more than Total Sales.

Gross Firm Energy is the total load needed to be generated for domestic firm load requirements on the Integrated System excluding Diesel customers. It includes Transmission Losses and Station Service. Some customers are on non-firm contracts (Surplus Energy Program), and their load is not included as part of Manitoba Hydro's generation requirement. In 2017/18, Gross Firm Energy was 25,742 GWh or about 14.0% over Total Sales.

Table 4 – Components of Manitoba Electric Use

Components of Manitoba Electricity Use 2017/18 (Customers, Actual Consumption and Average Use)				
Forecast Group	Cust/Serv	GWh	% of Sales	kWh/cust
Residential Basic	486,317	7,547	33.4%	15,519
Residential Diesel	587	8	0.0%	13,494
Residential Seasonal	19,507	65	0.3%	3,348
Residential Flat Rate Water Heating	3,129 *	16	0.1%	5,065
Total Residential	506,411	7,636	33.8%	
GS Mass Market	68,105	9,213	40.8%	135,273
GS Top Consumers	26	5,592	24.8%	215,084,080
GS Diesel	180	6	0.0%	31,285
GS Seasonal	957	5	0.0%	5,289
GS Flat Rate Water Heat	338 *	5	0.0%	16,287
GS Surplus Energy Program	31	28	0.1%	903,105
Total General Service	69,298	14,849	65.8%	
Sentinal Flat Rate	20,904 *	12	0.1%	565
Sentinal Rental	26,135 *	-	0.0%	-
Street Lighting	1,228	76	0.3%	62,123
Total Lighting	1,228	88	0.4%	
Total General Consumer Sales	576,937	22,573	100.0%	
Less Diesel Sales		(14)	-0.1%	
Distribution Losses		1,155	5.1%	
Construction Power		84	0.4%	
Manitoba Load at Common Bus		23,799	105.4%	
Transmission Losses		1,846	8.2%	
Less Non-Firm Energy		(28)	-0.1%	
Station Service		125	0.6%	
Gross Firm Energy		25,742	114.0%	

* Flat rate and rental services do not count as customers

FORECAST OVERVIEW

General Consumers Customer Forecast

In 2017/18, Manitoba Hydro had an average of 576,937 General Consumer Sales customers. These were made up of 486,317 Residential Basic customers, 68,105 General Service Mass Market customers, 26 General Service Top Consumers customers and 31 Surplus Energy Program (SEP), i.e. non-firm, customers, with the remaining customers being Diesel, Seasonal and Area and Roadway Lighting.

During the last 10 years, Residential Basic customers have grown at an average of 5,417 (1.2%) per year. Manitoba Hydro's Forecast of Key Economic and Financial Indicators provide the forecast of Residential Basic customers which is incorporated in the load forecast. Residential Basic customers are forecast to grow 5,968 (1.2%) customers per year over the next 10 years and 5,658 (1.1%) customers per year over the next 20 years.

General Service Mass Market customers have grown 425 (0.6%) per year over the last 10 years. The sector is forecast to grow 489 (0.7%) per year over the next 10 years and 490 (0.7%) per year over the next 20 years.

Residential Seasonal customers, mainly cottages with lower average energy use, experienced a reduction of customers over the past 10 years as higher energy consuming seasonal customers are transferred to the Residential Basic sector. The sector is forecast to decrease at 131 customers annually over the next 10 years and 133 customers annually over the next 20 years due to the continued transfer of higher usage seasonal customers to the Residential Basic sector.

Area and Roadway Lighting customers have grown 9 (0.7%) per year over the last 10 years. The sector is expected to grow at 6 (0.4%) customers annually over the next 10 years and 5 (0.4%) customers annually over the next 20 years.

Table 5 – General Consumers Sales Customers

General Consumer Sales (Average Customers) History and Forecast 2007/08 - 2037/38										
Fiscal	Residential			General Service					Lighting	Total
Year	Basic	Diesel	Seas	Mass Mkt	Top Cons	Diesel	Seas	SEP		Custs
2007/08	432,144	531	20,437	63,855	26	175	798	27	1,142	519,135
2008/09	437,263	540	20,648	64,140	26	178	818	24	1,175	524,811
2009/10	441,710	539	20,839	64,758	26	177	830	24	1,191	530,095
2010/11	445,882	550	20,950	65,193	26	176	842	24	1,184	534,828
2011/12	450,748	568	20,844	65,546	32	174	847	26	1,155	539,939
2012/13	456,130	577	20,731	65,974	31	175	850	28	1,164	545,660
2013/14	462,274	583	20,757	66,569	31	179	861	28	1,157	552,438
2014/15	468,499	583	20,626	67,042	30	183	872	28	1,196	559,060
2015/16	474,153	583	20,176	67,395	32	184	882	30	1,208	564,643
2016/17	480,365	586	19,707	67,676	26	181	923	30	1,218	570,712
2017/18	486,317	587	19,507	68,105	26	180	957	31	1,228	576,937
10 Year	5,417	6	-93	425	0	0	16	0	9	5,780
Avg Gr.	1.2%	1.0%	-0.5%	0.6%	0.0%	0.3%	1.8%	1.4%	0.7%	1.1%
2018/19	492,559	591	19,412	68,632	26	181	968	31	1,239	583,638
2019/20	498,806	592	19,277	69,112	26	180	983	31	1,244	590,251
2020/21	505,050	594	19,142	69,588	26	181	998	31	1,249	596,859
2021/22	511,061	597	19,007	70,066	26	181	1013	31	1,254	603,235
2022/23	516,880	599	18,872	70,560	26	181	1028	31	1,259	609,436
2023/24	522,680	602	18,737	71,062	26	181	1043	31	1,264	615,625
2024/25	528,523	604	18,602	71,547	26	182	1058	31	1,269	621,842
2025/26	534,372	607	18,467	72,027	26	182	1073	31	1,274	628,059
2026/27	540,200	609	18,332	72,510	26	182	1088	31	1,279	634,257
2027/28	545,999	612	18,197	72,996	26	183	1103	31	1,284	640,430
10 Year	5,968	2	-131	489	0	0	15	0	6	6,349
Avg Gr.	1.2%	0.4%	-0.7%	0.7%	0.0%	0.2%	1.4%	0.1%	0.4%	1.0%
2028/29	551,703	614	18,062	73,483	26	183	1118	31	1,289	646,509
2029/30	557,284	617	17,927	73,968	26	183	1133	31	1,294	652,462
2030/31	562,778	619	17,792	74,454	26	184	1148	31	1,299	658,330
2031/32	568,206	622	17,657	74,941	26	184	1163	31	1,304	664,134
2032/33	573,599	624	17,522	75,432	26	184	1178	31	1,309	669,904
2033/34	578,968	627	17,387	75,926	26	185	1193	31	1,314	675,656
2034/35	584,285	629	17,252	76,422	26	185	1208	31	1,319	681,356
2035/36	589,492	632	17,117	76,918	26	185	1223	31	1,324	686,947
2036/37	594,550	634	16,982	77,412	26	186	1238	31	1,329	692,388
2037/38	599,469	637	16,847	77,906	26	186	1253	31	1,334	697,689
20 Year	5,658	2	-133	490	0	0	15	0	5	6,038
Avg Gr.	1.1%	0.4%	-0.7%	0.7%	0.0%	0.2%	1.4%	0.0%	0.4%	1.0%

General Consumers Sales Forecast

During 2017/18, Total General Consumer Sales was 22,573 GWh. The fiscal billing year (using weather from March 16, 2017 to March 15, 2018) was significantly warmer than normal producing a weather adjustment for the year of +165 GWh. The resulting weather adjusted Total Sales value was 22,738 GWh.

Over the last 10 years, Total Sales have grown at 182 GWh (0.8%) per year. The growth was 1.4% per year in Residential Basic and 1.1% per year in General Service Mass Market, and a decline of 0.1% in General Service Top Consumers due to the economic downturn in 2009 and the loss of one Top Consumer customer. The historical growth also reflects the effect of past Demand Side Management (DSM) initiatives.

Sales are forecast to grow at 235 GWh (1.0%) per year over the next 10 years and 281 GWh (1.1%) per year over the next 20 years before accounting for future market-based DSM programs.

Most of the growth is forecast to occur in General Service Mass Market, at 166 GWh (1.5%) per year over the next 20 years, followed by Residential Basic at 103 GWh (1.2%) per year and Top Consumers at 13 GWh (0.2%) per year. Starting in 2016/17, seven of the smallest Top Consumers, totaling 404 GWh, were moved to General Service Mass Market for forecasting purposes. The historical growth rates for the General Service Mass Market and Top Consumers are adjusted to reflect the migration between both sectors.

Table 6 – General Consumer Sales Energy

General Consumer Sales (GWh) History and Forecast 2007/08 - 2037/38												
Fiscal	Residential				General Service						Lighting	Total
Year	Basic	Diesel	Seas	FRWH	Mass Mkt	Top Cons	Diesel	Seas	FRWH	SEP		Sales
2007/08	6,736	7	68	27	8,006	6,075	5	4	9	24	101	21,061
2008/09	6,847	7	74	25	8,049	6,065	5	5	8	22	102	21,210
2009/10	6,786	7	81	24	7,985	5,461	6	5	8	20	102	20,486
2010/11	6,952	8	77	23	8,258	5,324	5	5	8	24	103	20,786
2011/12	6,818	8	83	22	8,162	5,531	5	5	8	25	103	20,771
2012/13	7,223	8	81	21	8,434	5,560	5	5	7	28	103	21,477
2013/14	7,767	9	92	20	8,839	5,461	5	5	7	29	104	22,338
2014/15	7,658	9	102	19	8,771	5,750	6	6	6	27	104	22,458
2015/16	7,074	8	81	18	8,442	5,886	6	5	6	25	104	21,654
2016/17	7,158	9	66	17	8,956	5,685	6	5	6	26	92	22,025
2017/18	7,547	8	65	16	9,213	5,592	6	5	5	28	88	22,573
Weather Adj.	94	0	0	0	72	0	0	0	0	-1	0	165
2017/18 Wadj	7,641	8	65	16	9,284	5,592	6	5	5	27	88	22,738
10 Year Wadj	100	0	0	-1	174	-8	0	0	0	0	-1	182
Avg Gr.	1.4%	1.5%	-0.5%	-5.2%	1.1%	-0.1%	1.0%	1.2%	-4.4%	1.4%	-1.3%	0.8%
2018/19	7,714	8	71	15	9,468	5,250	6	5	5	28	72	22,642
2019/20	7,798	8	71	14	9,605	5,306	6	5	5	28	72	22,917
2020/21	7,891	8	70	14	9,750	5,351	6	5	5	28	72	23,199
2021/22	7,975	8	70	13	9,896	5,343	6	5	4	28	72	23,420
2022/23	8,049	8	70	12	10,077	5,343	6	5	4	28	72	23,675
2023/24	8,145	8	69	12	10,246	5,377	6	5	4	28	72	23,972
2024/25	8,245	8	69	11	10,406	5,412	6	6	4	28	72	24,265
2025/26	8,347	8	69	11	10,546	5,443	6	6	4	28	72	24,537
2026/27	8,441	8	69	10	10,710	5,474	6	6	3	28	72	24,826
2027/28	8,511	8	68	9	10,870	5,506	6	6	3	28	72	25,087
10 Year	87	0	0	-1	159	-9	0	0	0	0	-2	235
Avg Gr.	1.1%	0.4%	0.4%	-5.0%	1.6%	-0.2%	0.2%	1.3%	-5.0%	0.3%	-2.0%	1.0%
2028/29	8,597	8	68	9	11,040	5,537	6	6	3	28	72	25,373
2029/30	8,697	8	68	9	11,202	5,569	6	6	3	28	72	25,667
2030/31	8,802	8	67	8	11,366	5,601	6	6	3	28	72	25,967
2031/32	8,922	8	67	8	11,532	5,633	6	6	3	28	72	26,284
2032/33	9,045	8	67	7	11,707	5,665	6	6	3	28	72	26,613
2033/34	9,164	8	66	7	11,876	5,698	6	6	2	28	72	26,933
2034/35	9,286	8	66	7	12,048	5,731	6	6	2	28	72	27,259
2035/36	9,418	9	66	6	12,221	5,763	6	6	2	28	72	27,597
2036/37	9,560	9	65	6	12,407	5,797	6	6	2	28	72	27,957
2037/38	9,705	9	65	6	12,599	5,862	6	6	2	28	72	28,360
20 Year	103	0	0	-1	166	13	0	0	0	0	-1	281
Avg Gr.	1.2%	0.4%	0.0%	-5.0%	1.5%	0.2%	0.2%	1.2%	-5.0%	0.1%	-1.0%	1.1%

Manitoba Energy Forecast

The weather adjusted actual Gross Firm Energy was 25,870 GWh in 2017/18. Gross Firm Energy has grown 198 GWh (0.8%) per year for the past 10 years. This historical growth reflects the effect of past Demand Side Management (DSM) initiatives. Gross Firm Energy is forecast to grow to 32,363 GWh by 2037/38 at an average of 325 GWh (1.1%) per year. This does not reflect future market-based DSM programs.

Distribution Losses, which are the difference between Manitoba Hydro's substations and the customers' meters, have a wide variance from year to year. The differences have ranged between 3.5% and 5.5% of Total Sales. It is forecast to be between 4.8% and 4.9% of Sales for the entire forecast.

Transmission Losses, which are the difference between the generators and the substations, are forecast to be approximately 9.0% of Total Sales throughout the entire forecast period.

Distribution Losses and Transmission Losses, totaling almost 14%, need to be added to Total Sales to estimate Gross Firm Energy. The 14% value should be used to estimate load at generation when only load at the customer's meter is known. For example, to convert Power Smart program savings from the customer meter to generation. The exception is for large General Service customers who own their own transformation and incur minimal Distribution Losses. For these customers, a 10% value should be used.

Table 7 – Components of Manitoba Energy

Manitoba Firm Energy (GWh) History and Forecast 2007/08 - 2037/38										
Fiscal Year	General Consumer Sales less Diesel	Dist. Losses	Dist. Loss %	Const. Power	Manitoba Load at Common Bus	Trans. Losses	Trans. Loss %	Less Non Firm Energy	Station Service	Gross Firm Energy
2007/08	21,049	940	4.5%	47	22,036	1,949	9.3%	24	161	24,122
2008/09	21,198	1,052	5.0%	56	22,305	1,979	9.3%	22	154	24,417
2009/10	20,473	813	4.0%	75	21,361	1,934	9.4%	20	137	23,412
2010/11	20,773	947	4.6%	85	21,806	1,977	9.5%	25	134	23,892
2011/12	20,757	736	3.5%	67	21,560	1,939	9.3%	25	131	23,605
2012/13	21,463	1,184	5.5%	59	22,706	1,936	9.0%	28	136	24,750
2013/14	22,324	1,205	5.4%	12	23,541	1,969	8.8%	29	144	25,625
2014/15	22,443	992	4.4%	15	23,450	1,949	8.7%	26	132	25,505
2015/16	21,640	791	3.7%	28	22,460	2,107	9.7%	25	123	24,665
2016/17	22,010	1,043	4.7%	62	23,115	2,014	9.2%	26	123	25,227
2017/18	22,560	1,155	5.1%	84	23,799	1,846	8.2%	28	125	25,742
Weather Adj.	165	-48		0	117	10		-1	0	128
2017/18 Wadj	22,725	1,108	4.9%	84	23,916	1,856	8.2%	27	125	25,870
10 Year Wadj	182	24		4	210	-9		0	-4	198
Avg Gr.	0.8%	2.5%		6.0%	0.9%	-0.5%		1.4%	-2.5%	0.8%
2018/19	22,628	1,097	4.8%	87	23,812	2,028	9.0%	28	123	25,935
2019/20	22,904	1,109	4.8%	77	24,090	2,051	9.0%	28	123	26,237
2020/21	23,185	1,122	4.8%	51	24,358	2,074	8.9%	28	123	26,528
2021/22	23,406	1,135	4.8%	30	24,571	2,092	8.9%	28	123	26,759
2022/23	23,661	1,149	4.9%	0	24,810	2,113	8.9%	28	123	27,018
2023/24	23,958	1,164	4.9%	0	25,122	2,139	8.9%	28	123	27,357
2024/25	24,252	1,178	4.9%	0	25,430	2,165	8.9%	28	123	27,691
2025/26	24,524	1,192	4.9%	0	25,715	2,190	8.9%	28	123	28,001
2026/27	24,812	1,206	4.9%	0	26,018	2,216	8.9%	28	123	28,329
2027/28	25,073	1,219	4.9%	0	26,292	2,239	8.9%	28	123	28,627
10 Year	235	11		-8	238	38		0	0	276
Avg Gr.	1.0%	1.0%		-100.0%	1.0%	1.9%		0.3%	-0.1%	1.0%
2028/29	25,359	1,233	4.9%	0	26,592	2,264	8.9%	28	123	28,951
2029/30	25,653	1,248	4.9%	0	26,900	2,291	8.9%	28	123	29,287
2030/31	25,953	1,263	4.9%	0	27,217	2,318	8.9%	28	123	29,630
2031/32	26,270	1,280	4.9%	0	27,550	2,346	8.9%	28	123	29,991
2032/33	26,599	1,297	4.9%	0	27,896	2,375	8.9%	28	123	30,367
2033/34	26,919	1,314	4.9%	0	28,233	2,404	8.9%	28	123	30,733
2034/35	27,245	1,332	4.9%	0	28,577	2,433	8.9%	28	123	31,106
2035/36	27,582	1,350	4.9%	0	28,933	2,464	8.9%	28	123	31,492
2036/37	27,942	1,370	4.9%	0	29,312	2,496	8.9%	28	123	31,904
2037/38	28,345	1,390	4.9%	0	29,736	2,532	8.9%	28	123	32,363
20 Year	281	14		-4	291	34		0	0	325
Avg Gr.	1.1%	1.1%		-100.0%	1.1%	1.6%		0.2%	-0.1%	1.1%

Comparison of the 2017 Forecast to Actuals

Comparison of the 2017 Forecast to the 2017/18 Weather Adjusted Actuals

The weather adjusted General Consumer Sales for 2017/18 was 22,738 GWh which was 332 GWh higher than the 2017 Forecast of 22,407 GWh after incorporating the Demand Side Management (DSM) program savings achieved in 2017/18.

The weather adjusted Residential Basic sector was 107 GWh higher than the 2017 Forecast and the weather adjusted General Service Mass Market sector was 166 GWh higher than forecast.

In 2017/18, the Top Consumers sector consumed 5,592 GWh which was 71 GWh higher than the 2017 Forecast of 5,522 GWh. The difference is primarily due to an increase in production within the Metals & Forestry sector.

Distribution Losses were 66 GWh higher than forecast and transmission losses were 181 GWh lower than forecast.

Overall, the weather adjusted Gross Firm Energy for 2017/18 was 25,870 GWh which was 194 GWh higher than the 2017 Forecast of 25,676 GWh. The normalized Gross Total Peak for 2017/18 was 4,751 MW which was 43 MW higher than the 2017 Forecast of 4,708 MW.

Table 8 – 2017/18 Forecast to Actual

2017 Forecast Compared to Weather Adjusted Actuals 2017/18 Energy (GWh) and Peak (MW)					
Forecast Group	Actuals	Weather Adjustment	Wthr Adj Actuals	2017 Forecast less DSM	WA Actuals less Forecast
Residential Basic	7,547	94	7,641	7,534	107
Residential Diesel	8	-	8	9	(1)
Residential Seasonal	65	-	65	73	(8)
Residential Flat Rate Water Heating	16	-	16	16	(0)
Total Residential	7,636	94	7,730	7,632	98
GS Mass Market	9,213	72	9,284	9,119	166
GS Top Consumers	5,592	-	5,592	5,522	71
GS Diesel	6	-	6	6	(1)
GS Seasonal	5	-	5	5	(0)
GS Flat Rate Water Heat	5	-	5	5	0
GS Surplus Energy Program	28	(1)	27	26	1
Total General Service	14,849	71	14,920	14,683	237
Sentinal Flat Rate	12	-	12	12	(0)
Sentinal Rental	-	-	-	-	-
Street Lighting	76	-	76	80	(4)
Total Lighting	88	-	88	92	(4)
Total General Consumer Sales	22,573	165	22,738	22,407	332
Less Diesel Sales	(14)	-	(14)	(15)	2
Distribution Losses	1,155	(48)	1,108	1,042	66
Construction Power	84	-	84	105	(21)
Manitoba Load at Common Bus	23,799	117	23,916	23,538	378
Transmission Losses	1,846	10	1,856	2,037	(181)
Less Non-Firm Energy	(28)	1	(27)	(26)	(1)
Station Service	125	-	125	126	(1)
Gross Firm Energy (GWh)	25,742	128	25,870	25,676	194
Gross Total Peak (MW)	4,755	(4)	4,751	4,708	43

Changes between the 2017 and 2018 Forecasts

Changes between the 2017 and 2018 Residential Basic Forecast

The 2018 Residential Basic Forecast starts 43 GWh higher compared to the 2017 Forecast. This is primarily due to the 2017/18 weather adjusted actual energy use being higher than forecast. The difference between forecasts increases to 615 GWh in 2027/28, primarily due to the change in the electric price forecast. By 2036/37, the difference between forecasts decreases to 210 GWh as the forecast of electric price reaches similar levels to those included in the 2017 Forecast.

Figure 4 – Change of Res Basic Forecast

Comparison of 2017 to 2018 Forecast

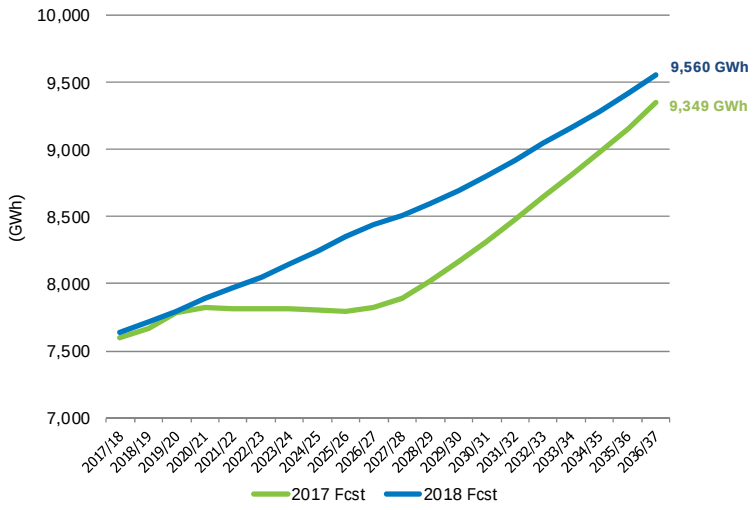


Table 9 – Change of Res Basic Forecast

Change of Residential Basic Forecast (GWh) Comparison of 2017 to 2018 Forecast				
Fiscal Year	2017 Fcst	2018 Fcst	Change	%
2017/18	7,594	7,641	47	0.6%
2018/19	7,671	7,714	43	0.6%
2019/20	7,780	7,798	19	0.2%
2020/21	7,826	7,891	65	0.8%
2021/22	7,814	7,975	161	2.1%
2022/23	7,815	8,049	235	3.0%
2023/24	7,811	8,145	334	4.3%
2024/25	7,807	8,245	438	5.6%
2025/26	7,797	8,347	550	7.1%
2026/27	7,821	8,441	620	7.9%
2027/28	7,895	8,511	615	7.8%
2028/29	8,020	8,597	577	7.2%
2029/30	8,162	8,697	534	6.5%
2030/31	8,311	8,802	492	5.9%
2031/32	8,474	8,922	448	5.3%
2032/33	8,643	9,045	402	4.7%
2033/34	8,808	9,164	356	4.0%
2034/35	8,977	9,286	309	3.4%
2035/36	9,158	9,418	260	2.8%
2036/37	**9,349**	**9,560**	**210**	**2.2%**

Major changes and energy impacts		
2036/37		
Decrease in the customer forecast of approx. 1,287 customers		
Customer forecast change	(21)	GWh
Increase in the forecast of Consumer Price Index	35	GWh
Decrease in the forecast of household income	(111)	GWh
Decrease in the short term forecast of electric price	255	GWh
Change in the starting point, which includes achieved DSM	(131)	GWh
Change in electric heat saturation	185	GWh
Change in model parameters	(72)	GWh
Average Use forecast change	161	GWh
Net effect of Natural Conservation and Codes & Standards	48	GWh
Increase in the forecast of electric vehicles	22	GWh
Other forecast change	70	GWh
Total Change	**210**	**GWh**

Changes between the 2017 and 2018 General Service Mass Market Forecast

The 2018 General Service Mass Market (GSMM) Forecast starts 36 GWh higher compared to the 2017 Forecast. The difference between forecasts increases to 563 GWh in 2027/28, primarily due to the change in the electric price forecast. By 2036/37, the difference between forecasts decreases to 371 GWh as the forecast of electric price reaches similar levels to those included in the 2017 Forecast. 371 GWh represents approximately 1.1 years of system load increase.

Figure 5 – Change of GS Mass Market Forecast

Comparison of 2017 to 2018 Forecast

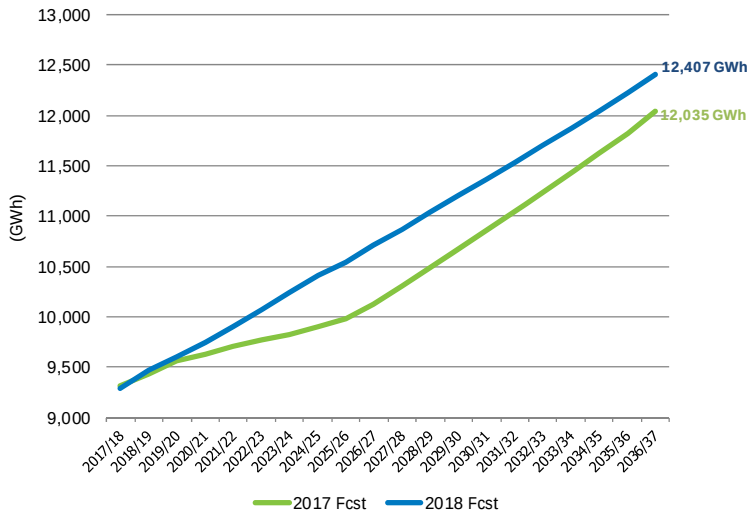


Table 10 – Change of GS Mass Market Forecast

Change of GS Mass Market Forecast (GWh) Comparison of 2017 to 2018 Forecast				
Fiscal Year	2017 Fcst	2018 Fcst	Change	%
2017/18	9,310	9,284	(25)	-0.3%
2018/19	9,432	9,468	36	0.4%
2019/20	9,557	9,605	48	0.5%
2020/21	9,622	9,750	127	1.3%
2021/22	9,703	9,896	193	2.0%
2022/23	9,773	10,077	305	3.1%
2023/24	9,820	10,246	426	4.3%
2024/25	9,899	10,406	507	5.1%
2025/26	9,982	10,546	563	5.6%
2026/27	10,128	10,710	581	5.7%
2027/28	10,307	10,870	563	5.5%
2028/29	10,488	11,040	551	5.3%
2029/30	10,671	11,202	531	5.0%
2030/31	10,857	11,366	510	4.7%
2031/32	11,045	11,532	487	4.4%
2032/33	11,235	11,707	472	4.2%
2033/34	11,427	11,876	449	3.9%
2034/35	11,623	12,048	425	3.7%
2035/36	11,822	12,221	399	3.4%
2036/37	**12,035**	**12,407**	**371**	**3.1%**

Major changes and energy impacts		
2036/37		
Increase in the customer forecast of approx. 104 customers		
Customer forecast change	11	GWh
Increase in the forecast of real GDP	118	GWh
Decrease in the short term forecast of electric price	162	GWh
Change in the starting point, which includes achieved DSM	109	GWh
Change in model parameters	(116)	GWh
Average Use forecast change	273	GWh
Net effect of Codes & Standards	95	GWh
Decrease in the forecast of electric vehicles	(8)	GWh
Other forecast change	87	GWh
Total Change	**371**	**GWh**

Changes between the 2017 and 2018 General Service Top Consumers Forecast

The 2018 GS Top Consumers Forecast is lower in the first five years (short term) based on updates sourced from industry news and publications, company prospectuses, and Manitoba Hydro's Key and Major Account Advisors. In addition, changes to the key economic variables within the Potential Large Industrial Loads (PLIL) model further contribute to the difference between forecasts to be 178 GWh lower by 2036/37.

Figure 6 – Change of GS Top Consumer Forecast

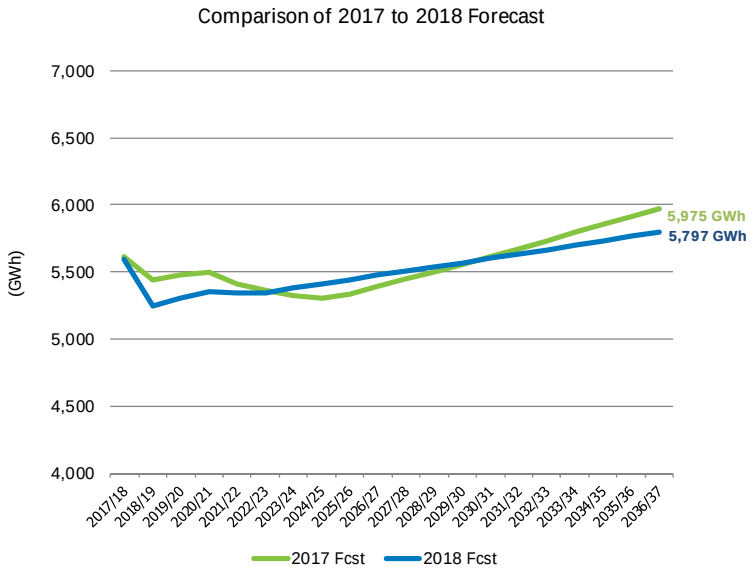


Table 11 – Change of GS Top Consumer Forecast

Change of Top Consumers Forecast (GWh) Comparison of 2017 to 2018 Forecast				
Fiscal Year	2017 Fcst	2018 Fcst	Change	%
2017/18	5,615	5,592	(23)	-0.4%
2018/19	5,440	5,250	(190)	-3.5%
2019/20	5,475	5,306	(169)	-3.1%
2020/21	5,502	5,351	(151)	-2.7%
2021/22	5,409	5,343	(66)	-1.2%
2022/23	5,365	5,343	(22)	-0.4%
2023/24	5,319	5,377	58	1.1%
2024/25	5,302	5,412	110	2.1%
2025/26	5,334	5,443	109	2.0%
2026/27	5,389	5,474	85	1.6%
2027/28	5,445	5,506	61	1.1%
2028/29	5,501	5,537	36	0.7%
2029/30	5,558	5,569	11	0.2%
2030/31	5,616	5,601	(15)	-0.3%
2031/32	5,674	5,633	(41)	-0.7%
2032/33	5,733	5,665	(68)	-1.2%
2033/34	5,792	5,698	(94)	-1.6%
2034/35	5,853	5,731	(122)	-2.1%
2035/36	5,914	5,763	(151)	-2.6%
2036/37	**5,975**	**5,797**	**(178)**	**-3.0%**

Major changes and energy impacts		
2036/37		
Reduction to the forecast in the chemical/treatment sector	(95)	GWh
Update to the forecast in the petro/oil/natural gas sector	31	GWh
Additional update to the forecast in other sectors	(2)	GWh
Short Term forecast change (Yr 1-5)	(66)	GWh
Increase in the forecast of real GDP	10	GWh
Increase in the long term forecast of electric price	(144)	GWh
Change in the starting point, which includes achieved DSM	31	GWh
Change in model parameters	(9)	GWh
Long Term (PLIL) forecast change	(112)	GWh
Total Change	**(178)**	**GWh**

Changes between the 2017 and 2018 General Consumers Sales Forecast

The General Consumers Sales Forecast starts 132 GWh lower compared to the 2017 Forecast. By 2036/37, energy use is higher by 383 GWh compared to the 2017 Forecast.

Figure 7 – Change of General Consumer Sales Forecast

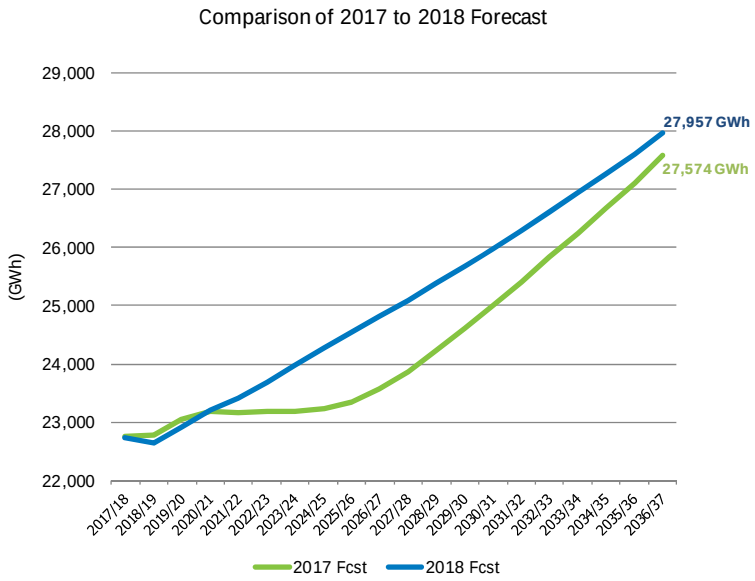


Table 12 – Change of General Consumer Sales Forecast

Change of General Consumer Sales Forecast (GWh) Comparison of 2017 to 2018 Forecast				
Fiscal Year	2017 Fcst	2018 Fcst	Change	%
2017/18	22,751	22,738	(13)	-0.1%
2018/19	22,773	22,642	(132)	-0.6%
2019/20	23,041	22,917	(124)	-0.5%
2020/21	23,179	23,199	20	0.1%
2021/22	23,153	23,420	267	1.2%
2022/23	23,179	23,675	496	2.1%
2023/24	23,176	23,972	796	3.4%
2024/25	23,232	24,265	1,033	4.4%
2025/26	23,337	24,537	1,201	5.1%
2026/27	23,561	24,826	1,265	5.4%
2027/28	23,869	25,087	1,218	5.1%
2028/29	24,229	25,373	1,144	4.7%
2029/30	24,611	25,667	1,056	4.3%
2030/31	25,002	25,967	965	3.9%
2031/32	25,411	26,284	873	3.4%
2032/33	25,828	26,613	785	3.0%
2033/34	26,243	26,933	690	2.6%
2034/35	26,669	27,259	591	2.2%
2035/36	27,109	27,597	487	1.8%
2036/37	**27,574**	**27,957**	**383**	**1.4%**

Major changes and energy impacts		
2036/37		
Primarily higher due to a decrease in the short term fcst. of electric price		
Resdiential Basic change	210	GWh
Primarily higher due to an increase in the average use forecast		
General Service Mass Market change	371	GWh
Primarily lower due to adjustments in customer short term plans and updates to the longer term growth forecast (PLIL)		
General Service Top Consumer change	(178)	GWh
Increase in other sales & losses		
Other sales and losses change	(20)	GWh
Total Change	**383**	**GWh**

Changes between the 2017 and 2018 Gross Firm Energy Forecast

The Gross Firm Energy Forecast starts 144 GWh lower compared to the 2017 Forecast. By 2036/37, energy use is higher by 445 GWh compared to the 2017 Forecast. This is equivalent to an increase of 1.4 years of system load growth. (1 year of load growth = approximately 325 GWh).

Figure 8 – Change of Energy Forecast

Comparison of 2017 to 2018 Forecast

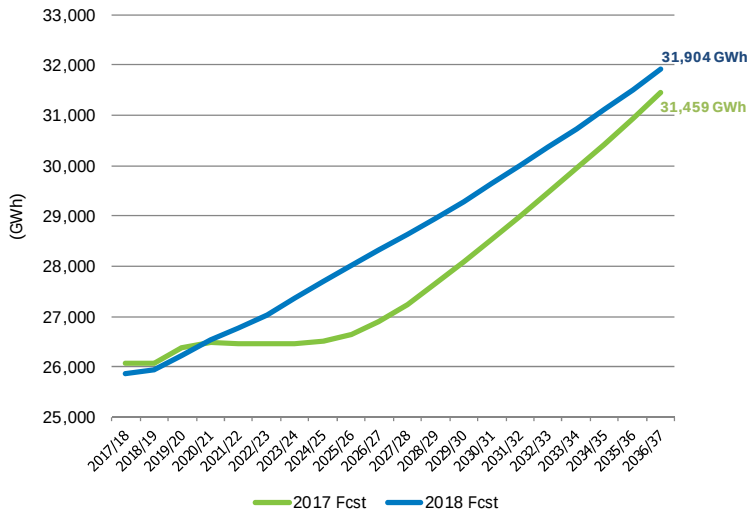


Table 13 – Change of Energy Forecast

Change of Gross Firm Energy Forecast (GWh) Comparison of 2017 to 2018 Forecast				
Fiscal Year	2017 Fcst	2018 Fcst	Change	%
2017/18	26,065	25,870	(195)	-0.7%
2018/19	26,080	25,935	(144)	-0.6%
2019/20	26,369	26,237	(132)	-0.5%
2020/21	26,483	26,528	45	0.2%
2021/22	26,459	26,759	299	1.1%
2022/23	26,453	27,018	565	2.1%
2023/24	26,453	27,357	903	3.4%
2024/25	26,519	27,691	1,171	4.4%
2025/26	26,639	28,001	1,362	5.1%
2026/27	26,892	28,329	1,437	5.3%
2027/28	27,241	28,627	1,386	5.1%
2028/29	27,650	28,951	1,301	4.7%
2029/30	28,084	29,287	1,202	4.3%
2030/31	28,529	29,630	1,101	3.9%
2031/32	28,995	29,991	997	3.4%
2032/33	29,469	30,367	898	3.0%
2033/34	29,942	30,733	791	2.6%
2034/35	30,427	31,106	679	2.2%
2035/36	30,929	31,492	563	1.8%
2036/37	**31,459**	**31,904**	**445**	**1.4%**

Major changes and energy impacts			
2036/37			
Primarily higher due to a decrease in the short term fcst. of electric price			
Resdiential Basic change	210	GWh	
Primarily higher due to an increase in the average use forecast			
General Service Mass Market change	371	GWh	
Primarily lower due to adjustments in customer short term plans and updates to the longer term growth forecast (PLIL)			
General Service Top Consumer change	(178)	GWh	
Increase in other sales & losses			
Other sales and losses change	42	GWh	
Total Change	**445**	**GWh**	

Changes between the 2017 and 2018 Gross Total Peak Forecast

The Gross Total Peak Forecast is higher by 137 MW by 2036/37 compared to the 2017 Forecast. The Peak Forecast is primarily based on the Gross Firm Energy Forecast, and as such the changes in energy impact the peak. Also contributing to the increase in gross total peak is a decrease in peak load factor from 61.8% in the 2017 Forecast to 61.2% in the 2018 Forecast. The load factor decrease is due to the reduced energy forecast of the Top Consumers sector, which has a high coincidence load factor of 91%.

The increase in peak in 2036/37 amounts to 137 MW, which is an increase of over 2.1 years of system load growth. (1 year of load growth = approximately 64 MW).

Figure 9 – Change of Peak Forecast

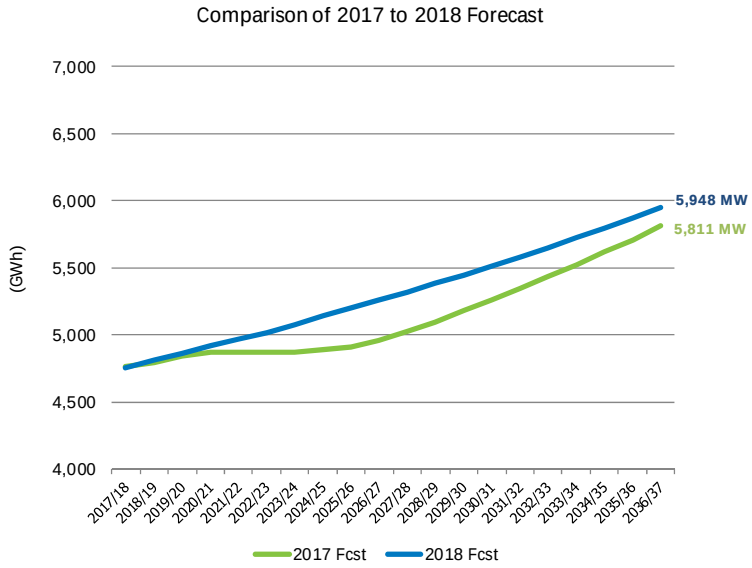


Table 14 – Change of Peak Forecast

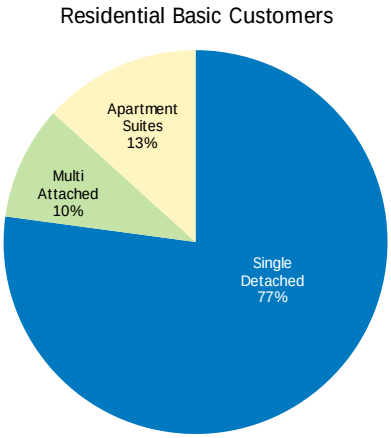
Change of Gross Total Peak (MW) Comparison of 2017 to 2018 Forecast				
Fiscal Year	2017 Fcst	2018 Fcst	Change	%
2017/18	4,767	4,751	(16)	-0.3%
2018/19	4,789	4,815	26	0.5%
2019/20	4,845	4,863	18	0.4%
2020/21	4,868	4,918	51	1.0%
2021/22	4,870	4,965	95	2.0%
2022/23	4,871	5,015	143	2.9%
2023/24	4,875	5,079	204	4.2%
2024/25	4,890	5,143	253	5.2%
2025/26	4,913	5,202	289	5.9%
2026/27	4,958	5,264	306	6.2%
2027/28	5,022	5,320	298	5.9%
2028/29	5,098	5,381	284	5.6%
2029/30	5,179	5,445	267	5.2%
2030/31	5,262	5,511	249	4.7%
2031/32	5,349	5,580	232	4.3%
2032/33	5,438	5,652	215	3.9%
2033/34	5,526	5,722	196	3.5%
2034/35	5,617	5,794	177	3.2%
2035/36	5,711	5,869	157	2.8%
2036/37	**5,811**	**5,948**	**137**	**2.4%**

FORECAST DETAILS

Residential Basic

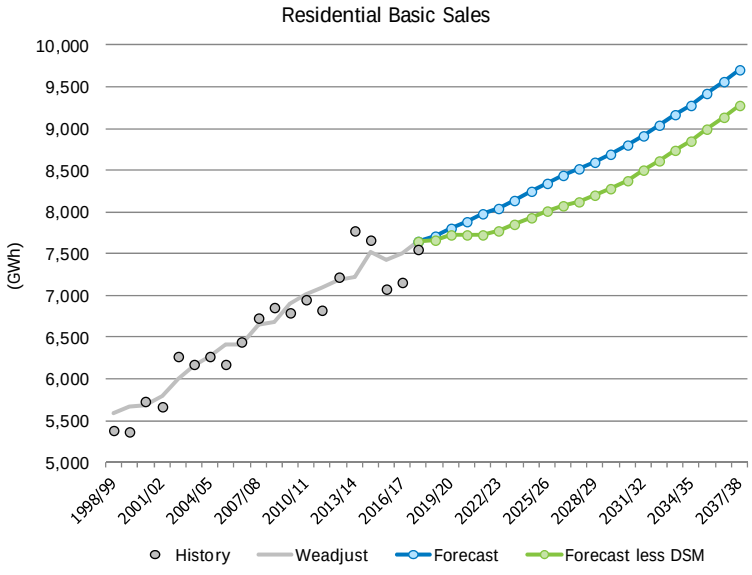
In 2017/18, there were 486,317 Residential Basic customers. Of these customers, 77% were single detached, 10% were multi-attached, and 13% were individually metered apartment suites. The majority of customers (54%) are in Winnipeg where natural gas is available, 29% are in natural gas available areas outside Winnipeg, and 17% are in areas where natural gas is not available.

Figure 10 – Residential Basic Customers



Residential Basic has grown 108 GWh (1.7%) per year for the past 20 years and 100 GWh per year (1.4%) for the past 10 years reflecting the effect of past Demand Side Management (DSM) initiatives. This sector is forecast to grow 87 GWh (1.1%) per year for the next 10 years and 103 GWh (1.2%) per year for the next 20 years, before future program-based DSM initiatives. Including program-based DSM, the sector is forecast to grow 82 GWh (1.0%) over the next 20 years. The primary driver of Residential Basic growth is population, which is forecast to grow 1.0% per year over the next 20 years.

Figure 11 – Residential Basic Sales



The following table outlines historical and forecast details including the impacts of program based Demand Side Management activity:

Table 15 – Residential Sales

Residential Basic Sales (GWh)			
Historical / Weather Adjustment			
Fiscal Year	Sales	Weather Adjust	Adjusted Sales
1998/99	5,384	197	5,580
1999/00	5,364	297	5,661
2000/01	5,737	(47)	5,690
2001/02	5,674	120	5,794
2002/03	6,266	(274)	5,992
2003/04	6,170	(10)	6,160
2004/05	6,275	2	6,276
2005/06	6,171	243	6,413
2006/07	6,443	(30)	6,413
2007/08	6,736	(90)	6,646
2008/09	6,847	(165)	6,682
2009/10	6,786	121	6,907
2010/11	6,952	63	7,015
2011/12	6,818	281	7,099
2012/13	7,223	(31)	7,192
2013/14	7,767	(554)	7,213
2014/15	7,658	(135)	7,523
2015/16	7,074	348	7,422
2016/17	7,158	344	7,503
2017/18	7,547	94	7,641
Forecast / Forecast less DSM			
Fiscal Year	Forecast	DSM (Program based)	Forecast less DSM
2018/19	7,714	(44)	7,670
2019/20	7,798	(80)	7,719
2020/21	7,891	(159)	7,732
2021/22	7,975	(242)	7,733
2022/23	8,049	(270)	7,779
2023/24	8,145	(299)	7,846
2024/25	8,245	(318)	7,927
2025/26	8,347	(338)	8,008
2026/27	8,441	(361)	8,080
2027/28	8,511	(382)	8,129
2028/29	8,597	(395)	8,202
2029/30	8,697	(410)	8,286
2030/31	8,802	(426)	8,376
2031/32	8,922	(424)	8,497
2032/33	9,045	(427)	8,618
2033/34	9,164	(428)	8,736
2034/35	9,286	(429)	8,856
2035/36	9,418	(429)	8,989
2036/37	9,560	(429)	9,130
2037/38	9,705	(431)	9,275

Table 16 – Residential Basic Sales

Residential Basic Sales History and Forecast 2017/18 - 2037/38											
Fiscal Year	Electric Heat Billed (1)			Non Electric Heat Billed (2)			Total Basic			% Elec Space Heat (3)	% Elec Water Heat (4)
	Custs	GWh	kWh/cust	Custs	GWh	kWh/cust	Custs	GWh	kWh/cust		
2017/18	191,907	4,461	23,247	294,410	3,086	10,481	486,317	7,547	15,519	39.5%	49.7%
2018/19	195,481	4,523	23,140	297,078	3,190	10,739	492,559	7,714	15,661	39.7%	50.1%
2019/20	198,899	4,570	22,977	299,907	3,228	10,764	498,806	7,798	15,634	39.9%	50.5%
2020/21	202,159	4,617	22,840	302,891	3,274	10,808	505,050	7,891	15,624	40.0%	50.8%
2021/22	205,180	4,658	22,703	305,880	3,316	10,842	511,061	7,975	15,604	40.1%	51.1%
2022/23	207,990	4,693	22,565	308,890	3,356	10,865	516,880	8,049	15,573	40.2%	51.3%
2023/24	210,722	4,736	22,473	311,958	3,409	10,929	522,680	8,145	15,583	40.3%	51.5%
2024/25	213,428	4,779	22,392	315,095	3,466	10,999	528,523	8,245	15,600	40.4%	51.7%
2025/26	216,110	4,823	22,318	318,262	3,523	11,071	534,372	8,347	15,620	40.4%	51.8%
2026/27	218,756	4,864	22,234	321,444	3,577	11,128	540,200	8,441	15,625	40.5%	52.0%
2027/28	221,377	4,894	22,109	324,622	3,616	11,140	545,999	8,511	15,587	40.5%	52.2%
2028/29	223,933	4,931	22,022	327,770	3,665	11,182	551,703	8,597	15,582	40.6%	52.3%
2029/30	226,425	4,974	21,967	330,859	3,723	11,252	557,284	8,697	15,605	40.6%	52.5%
2030/31	228,858	5,018	21,927	333,919	3,784	11,332	562,778	8,802	15,641	40.7%	52.6%
2031/32	231,252	5,068	21,916	336,954	3,854	11,437	568,206	8,922	15,702	40.7%	52.8%
2032/33	233,616	5,119	21,913	339,983	3,926	11,547	573,599	9,045	15,769	40.7%	52.9%
2033/34	235,957	5,168	21,904	343,010	3,995	11,648	578,968	9,164	15,828	40.8%	53.1%
2034/35	238,265	5,219	21,903	346,019	4,067	11,754	584,285	9,286	15,893	40.8%	53.2%
2035/36	240,521	5,273	21,925	348,971	4,145	11,877	589,492	9,418	15,977	40.8%	53.3%
2036/37	242,709	5,331	21,966	351,842	4,228	12,017	594,550	9,560	16,079	40.8%	53.4%
2037/38	244,833	5,352	21,860	354,637	4,353	12,276	599,469	9,705	16,190	40.8%	53.5%

Notes:

(1) Electric Heat Billed is defined as customers who have electric space heating included with the electric bill.

(2) Non Electric Heat Billed is defined as customers who do not have electric space heating included with the electric bill.

(3) % Electric Space Heat represents the proportion of Total Res. Basic customers who are Electric Heat Billed.

(4) % Electric Water Heat represents the proportion of Total Res. Basic customers who have Electric Water Heaters.

2017/18 GWh and kWh/cust values are not weather adjusted

The average use (kWh/customer) for Electric Heat Billed customers is decreasing as individually metered apartment suites are making up a higher proportion of the growth. The average use for Non Electric Heat Billed customers is increasing mainly due to increased use of electric water heating and miscellaneous end uses in dwellings.

Residential Diesel, Seasonal, and Flat Rate Water Heating

Residential Diesel

There were 587 Residential Diesel customers that used 8 GWh in 2017/18 averaging 13,494 kWh per year per customer. Customers are only allowed 60 amp services which will not allow for electric space heating. Space heating in the four diesel communities is mainly provided by fuel oil. The number of customers is expected to grow to 637 and usage is expected to increase 0.4% a year to 9 GWh by 2037/38. The assumption is that the communities will continue to be separate from the Integrated System.

Residential Seasonal

There were 19,507 Residential Seasonal customers that used 65 GWh in 2017/18, averaging 3,348 kWh per year per customer. The number of customers is expected decrease to 16,847 customers by 2037/38 due to transfers of higher using seasonal customers into the Residential Basic sector. Seasonal customers are billed only twice a year due to low usage, typically being a seasonal residence or cottage. The usage of Residential Seasonal customers is expected to decrease 0.02% a year to 65 GWh in 2037/38.

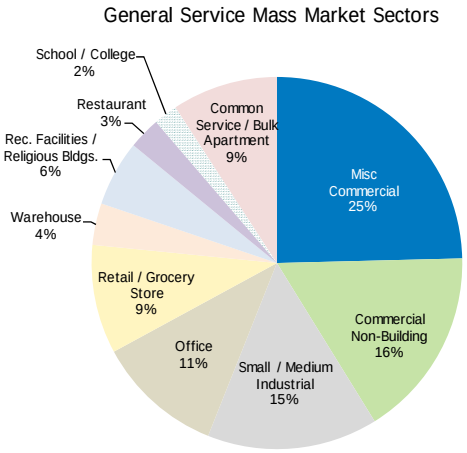
Residential Flat Rate Water Heating

Residential Water Heating is a flat rate unmetered service. This service has not been available to new customers since November 12, 1969. There were 3,129 remaining services in 2017/18. The number of services and usage is expected to decrease 5.0% per year throughout the forecast period. Usage was 16 GWh in 2017/18 and that will decrease to 6 GWh by 2037/38.

General Service Mass Market

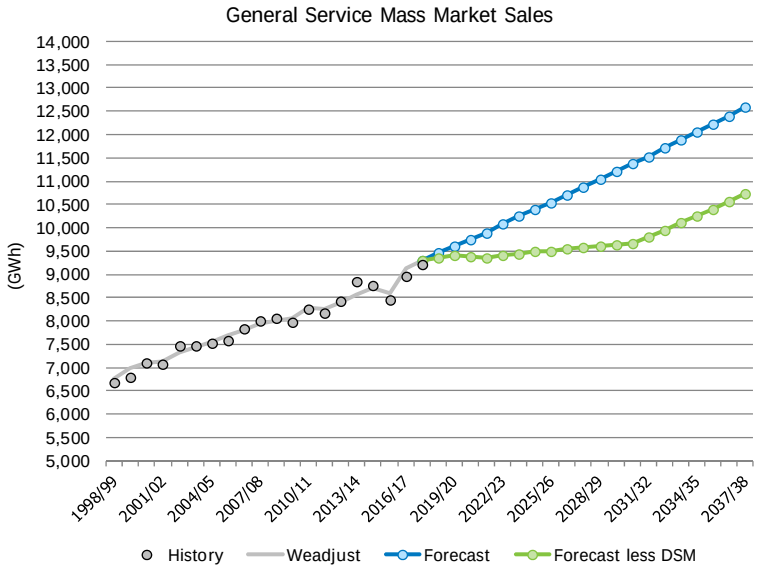
General Service Mass Market includes all Commercial and Industrial customers, excluding the General Service Top Consumers. There were 68,079 General Service Mass Market customers in 2017/18. Approximately 15% are Industrial and 85% are Commercial.

Figure 12 – General Service Mass Market Customers



GS Mass Market has grown 111 GWh (1.4%) per year for the past 20 years and 93 GWh per year (1.1%) for the past 10 years. This historical growth reflects the effect of past Demand Side Management (DSM) initiatives and includes the seven Top Consumers, totaling 404 GWh in 2015/16, who were moved into the Mass Market sector. The Mass Market Sector is forecast to grow 159 GWh (1.6%) per year for the next 10 years and 166 GWh (1.5%) per year for the next 20 years before program-based DSM initiatives. Including program-based DSM, the sector is forecast to grow 73 GWh (0.7%) over the next 20 years. The primary drivers for growth in the GS Mass Market are the population and the economy. Changes in the number of residential customers and the Manitoba Gross Domestic Product (GDP) are reflected in the GS Mass Market's electricity use.

Figure 13 – General Service Mass Market Sales



The following table outlines historical and forecast details including the impacts of program based Demand Side Management activity:

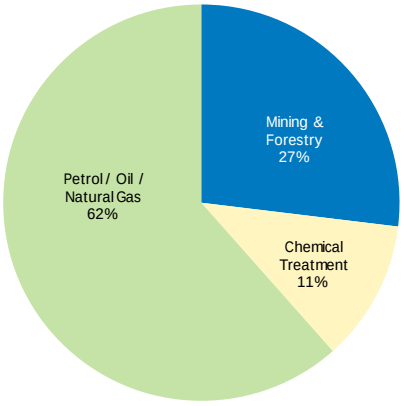
Table 17 – General Service Mass Market

General Service Mass Market (GWh)			
Historical / Weather Adjustment			
Fiscal Year	Sales	Weather Adjust	Adjusted Sales
1998/99	6,668	102	6,770
1999/00	6,796	180	6,976
2000/01	7,110	(2)	7,107
2001/02	7,084	44	7,128
2002/03	7,467	(143)	7,324
2003/04	7,460	(22)	7,437
2004/05	7,516	35	7,550
2005/06	7,587	109	7,696
2006/07	7,839	(47)	7,792
2007/08	8,006	(55)	7,951
2008/09	8,049	(52)	7,996
2009/10	7,985	86	8,070
2010/11	8,258	33	8,291
2011/12	8,162	94	8,257
2012/13	8,434	(46)	8,388
2013/14	8,839	(272)	8,566
2014/15	8,771	(64)	8,708
2015/16	8,442	159	8,601
2016/17	8,956	173	9,130
2017/18	9,213	72	9,284
Forecast / Forecast less DSM			
Fiscal Year	Forecast	DSM (Program based)	Forecast less DSM
2018/19	9,468	(103)	9,365
2019/20	9,605	(194)	9,410
2020/21	9,750	(366)	9,384
2021/22	9,896	(546)	9,350
2022/23	10,077	(678)	9,400
2023/24	10,246	(797)	9,449
2024/25	10,406	(916)	9,489
2025/26	10,546	(1,039)	9,506
2026/27	10,710	(1,166)	9,544
2027/28	10,870	(1,299)	9,571
2028/29	11,040	(1,437)	9,602
2029/30	11,202	(1,581)	9,621
2030/31	11,366	(1,716)	9,650
2031/32	11,532	(1,736)	9,796
2032/33	11,707	(1,755)	9,951
2033/34	11,876	(1,776)	10,101
2034/35	12,048	(1,796)	10,252
2035/36	12,221	(1,817)	10,404
2036/37	12,407	(1,838)	10,568
2037/38	12,599	(1,860)	10,740

General Service Top Consumers

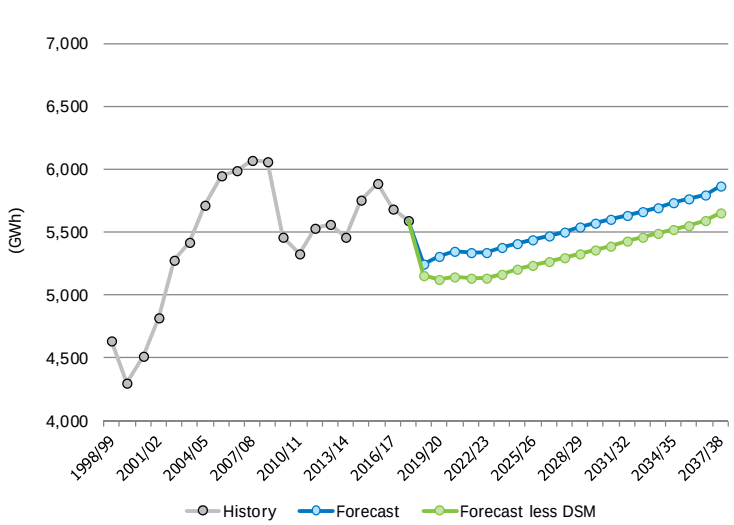
General Service Top Consumers represent the top energy consuming operations in Manitoba accounting for 25% of all General Consumers Sales. GS Top Consumers include 10 distinct companies that count as 26 customers in the Mining & Forestry, Chemical Treatment, Petrol/Oil/Natural Gas sectors.

Figure 14 – General Service Top Consumer Sectors



GS Top Consumers increased 72 GWh (1.5%) per year over the past 20 years and decreased 8 GWh per year (-0.1%) over the past 10 years. The decrease was due to the economic downturn experienced from 2008 to 2011 and the loss of one Top Consumer. The historical growth rates also reflect the shift of the seven smallest Top Consumers to the GS Mass Market Sector, totaling 404 GWh in 2015/16. These were moved because their usage patterns more closely mimic customers within the GS Mass Market sector. The Top Consumers sector is now forecast to decline at an average of 9 GWh (-0.2%) per year for the next 10 years but grow an average of 13 GWh (0.2%) per year for the next 20 years. Including program-based DSM, the sector is forecast to grow 3 GWh (0.1%) over the next 20 years. Short term reductions are expected in the Petro/Oil/Natural Gas and Chemical Treatment sectors

Figure 15 – General Service Top Consumers Sales



The following table outlines historical and forecast details including the impacts of program based Demand Side Management activity:

Table 18 – General Service Top Consumers

General Service Top Consumers (GWh) Historical / Forecast / Fcst. With PLIL / Fcst. Less DSM							
Fiscal Year	Sales	Fiscal Year	Individual	PLIL	Total	DSM (Program based)	Forecast less DSM
1998/99	4,632	2018/19	5,250	0	5,250	(90)	5,160
1999/00	4,299	2019/20	5,306	0	5,306	(180)	5,126
2000/01	4,515	2020/21	5,351	0	5,351	(208)	5,143
2001/02	4,818	2021/22	5,343	0	5,343	(208)	5,135
2002/03	5,282	2022/23	5,343	0	5,343	(208)	5,135
2003/04	5,423	2023/24	5,343	34	5,377	(208)	5,169
2004/05	5,714	2024/25	5,343	69	5,412	(208)	5,204
2005/06	5,948	2025/26	5,343	100	5,443	(208)	5,235
2006/07	5,989	2026/27	5,343	131	5,474	(208)	5,266
2007/08	6,075	2027/28	5,343	163	5,506	(208)	5,298
2008/09	6,065	2028/29	5,343	194	5,537	(208)	5,329
2009/10	5,461	2029/30	5,343	226	5,569	(208)	5,361
2010/11	5,324	2030/31	5,343	258	5,601	(208)	5,393
2011/12	5,531	2031/32	5,343	290	5,633	(208)	5,425
2012/13	5,560	2032/33	5,343	322	5,665	(208)	5,457
2013/14	5,461	2033/34	5,343	355	5,698	(208)	5,490
2014/15	5,750	2034/35	5,343	388	5,731	(208)	5,523
2015/16	5,886	2035/36	5,343	420	5,763	(208)	5,555
2016/17	5,685	2036/37	5,343	454	5,797	(208)	5,589
2017/18	5,592	2037/38	5,343	519	5,862	(208)	5,654

For the short term, General Service Top Consumers are forecast individually. Expected increases and decreases from customer's current and upcoming operating and expansion plans are compiled for the first five years of the forecast but exclude longer term plans that are uncommitted and subject to change.

For the long term, the growth of existing Top Consumers is forecast together econometrically. The econometric long term Top Consumer forecast is referred to as Potential Large Industrial Loads (PLIL). PLIL is based on the historic growth and/or retraction of the ten companies that comprise the Top Consumers as well as one former Top Consumers customer that closed in 2009. These are large companies that both drive and help define the local, national and international economies. The historical data used for modeling PLIL includes company expansions, production increases and reductions due to planned and unplanned shutdowns, cutbacks and labor disruptions. Therefore, the long term forecast implicitly includes the same expectations.

Historical growth of the Top Consumer sector is modeled using Gross Domestic Product (GDP) and electricity price as independent variables. The historic correlation between GDP, price and Top Consumer growth has been very strong and is expected to continue in the future. Future projections of GDP and price are used to forecast the long term future increase in Top Consumer growth starting from the sixth year of the forecast.

The sum of the individual company forecasts is expected to decline from 5,592 GWh in 2017/18 to 5,343 GWh in 2022/23. After 2022/23, the individual forecasts for these customers are held constant and longer term growth is considered to be included in PLIL.

PLIL is added starting in year six of the forecast. The econometric forecast for PLIL is based on an expected annual Manitoba/Canada/U.S. real GDP growth rate of 1.9%, leading to a forecast growth of 0.2% annually. Historically, the real GDP growth rate over the past 20 years was 2.3%, the Top Consumers sector growth averaged 1.5% annually.

The Top Consumers sector is expected to decline 249 GWh in the first five years based on individual customer short term plans, and then growth 519 GWh in years 6 to 20 for PLIL.

General Service Diesel, Seasonal, and Flat Rate Water Heating

General Service Diesel

In 2017/18, there were 180 General Service Diesel Full Cost customers using 6 GWh. The General Service Diesel sector is forecast to use 6 GWh by 2037/38.

General Service Seasonal

In 2017/18, there were 957 General Service Seasonal customers using 5 GWh. The General Service Seasonal sector is expected to grow to 6 GWh by 2037/38.

General Service Flat Rate Water Heating

General Service Water Heating is a flat rate unmetered service that has not been available to new customers since November 12, 1969. There were 338 remaining services in 2017/18. The number of services is expected to decrease 5.0% per year throughout the forecast period. Consumption was 5 GWh in 2017/18 and that is forecast to decrease to 2 GWh by 2037/38.

General Service Surplus Energy Program

Participants in the Surplus Energy Program (SEP) consumed 28 GWh in 2017/18 and are expected to use 28 GWh in 2018/19 and for the remainder of the forecast period. This energy is considered to be “interruptible” and thus “non-firm”. The energy used by these customers is included in Sales, but it is excluded from the Gross Firm Energy forecast.

Plug-In Electric Vehicles

This forecast includes an estimate of the future adoption of Plug-In Electric Vehicles in the Manitoba Hydro service area. This is made up of two types:

i. **Plug-In Hybrid Electric Vehicles (PHEVs)** run on an electric battery but use an internal combustion engine (ICE) or gasoline powered generator to extend the driving range when the battery charge runs low. An example is the Chevrolet Volt. As of March 1, 2018 there were 133 PHEVs registered in Manitoba.

ii. **Plug-in Electric Vehicles (PEVs)** run only on electric battery power. Pure electric plug-in vehicles include the Nissan Leaf, the Tesla, Mitsubishi MiEV, and New Flyer Xcelsior transit bus. As of March 1, 2018 there were 144 PEVs registered in Manitoba.

The forecast of electric vehicles does not include non-plug-in Hybrid Electric Vehicles (HEVs). These vehicles, such as the non-plug-in Toyota Prius, have an internal combustion engine (ICE) as well as a battery and electric motor to drive the wheels. The HEV battery is charged with power from the ICE and through regenerative breaking. It is not charged by plugging in and therefore does not affect electricity consumption in Manitoba. As of March 1, 2018 and after 18 years in the market, there were only 5,065 HEVs registered in Manitoba, representing 0.6% of all registered road motor vehicles.

In Canada, 47,800 plug-in electric vehicles were registered as on December 31, 2017 according to FleetCarma, making up 0.195% of total 24.5 million road motor vehicle registrations. In Manitoba, as of fiscal year ending 2018, there were 277 plug-in vehicles making up 0.03% of total road motor vehicle registrations. About 96% of all plug-in electric vehicles in Canada are registered in three provinces: Quebec (43%), Ontario (35%), and British Columbia (18%).

The Electric Vehicle Forecast

As of March 1st, 2018, there were a total of 277 plug-in electric vehicles, including five electric buses, registered in Manitoba with the Manitoba Public Insurance Corporation. Last year's 2017 Load Forecast predicted a total of 278 plug-in vehicles to be registered in Manitoba at fiscal year ending 2018. The latest electric vehicle forecast is adjusted to incorporate actual registrations recorded in fiscal year ending 2018.

Table 18 details the Manitoba actual and forecasted number of new vehicles per year, the total number of vehicles each year, as well as the corresponding numbers for Plug-In Electric Vehicles. The forecast incorporates passenger as well as commercial category vehicles such as Sport Utility Vehicles (SUVs), light and heavy duty trucks, and transit buses. Pull-trailers, farm equipment, motor boats and motor cycles are not included in the count. A passenger PEV consumes approximately 3,100 kWh annually, similar to the use of one residential electric hot water tank. An electric transit bus consumes 87,500 kWh annually. That is the equivalent use of three electrically heated single detached dwellings. The number of new PEVs is expected to slowly increase until it reaches about 1.1% of new vehicle sales or 800 units in 2027/28 and 10.0% of new vehicle sales or 8,975 units in 2037/38. The total number of PEVs on the road is forecasted to be 0.3% of total vehicle registrations or 3,821 units in 2027/28 increasing to 2.8% of total road motor vehicle registrations or 40,704 units by 2037/38.

Total energy use for PEVs in Manitoba is forecasted to be 15 GWh in 2027/28 and 146 GWh by 2037/38. Peak usage coincident to Manitoba Hydro's system peak is forecasted to be 1.8 MW in 2027/28 and 18.3 MW in 2037/38.

Figure 16 – Plug-in Electric Vehicles

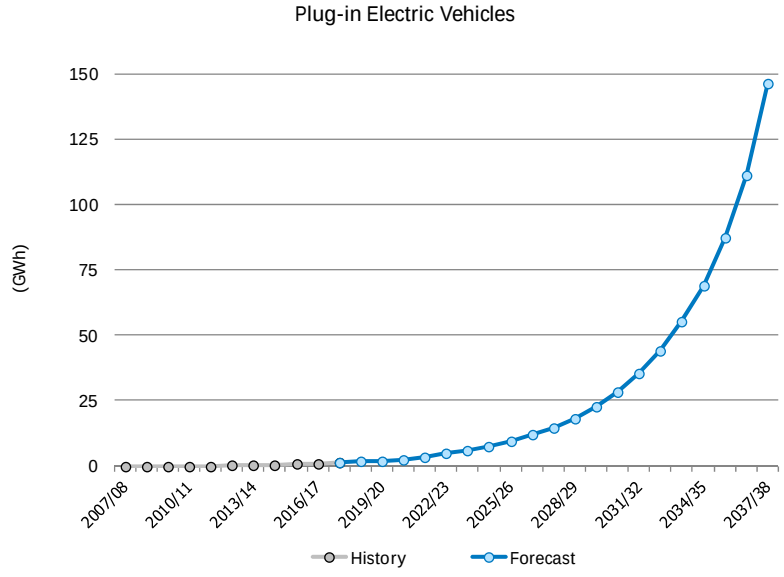


Table 19 – Plug-in Electric Vehicles

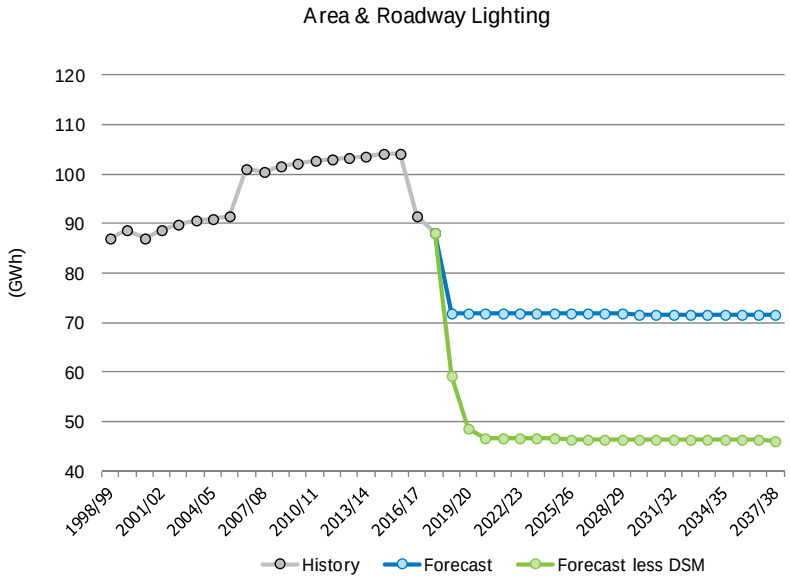
Plug-in Electric Vehicle Forecast History and Forecast 2007/08 - 2037/38								
Fiscal Year	New Vehicles Purchased	New PEV Purchased	New PEV %	Total Vehicles	Total PEV	Total % PEV	Cumul Total PEV GWh	Cumul Total PEV MW
2007/08	48,117	0	0.0%	675,685	0	0.0%	0	0.0
2008/09	45,832	0	0.0%	692,379	0	0.0%	0	0.0
2009/10	44,666	0	0.0%	703,989	0	0.0%	0	0.0
2010/11	46,475	1	0.0%	750,230	1	0.0%	0	0.0
2011/12	49,352	8	0.0%	766,267	9	0.0%	0	0.0
2012/13	52,448	28	0.1%	784,885	37	0.0%	0	0.0
2013/14	56,209	33	0.1%	797,383	70	0.0%	0	0.0
2014/15	58,376	32	0.1%	810,163	102	0.0%	1	0.1
2015/16	58,365	42	0.1%	857,029	144	0.0%	1	0.1
2016/17	58,359	60	0.1%	883,836	204	0.0%	1	0.1
2017/18	66,919	73	0.1%	896,133	277	0.03%	1	0.2
2018/19	60,640	104	0.2%	917,911	381	0.0%	2	0.2
2019/20	62,129	131	0.2%	940,223	512	0.1%	2	0.3
2020/21	63,616	164	0.3%	963,070	677	0.1%	3	0.3
2021/22	65,083	209	0.3%	986,443	886	0.1%	4	0.4
2022/23	66,554	261	0.4%	1,010,345	1,147	0.1%	5	0.6
2023/24	68,049	326	0.5%	1,034,783	1,472	0.1%	6	0.8
2024/25	69,564	407	0.6%	1,059,766	1,878	0.2%	8	1.0
2025/26	71,094	510	0.7%	1,085,298	2,386	0.2%	10	1.2
2026/27	72,637	638	0.9%	1,111,384	3,023	0.3%	12	1.5
2027/28	74,193	800	1.1%	1,138,029	3,821	0.3%	15	1.8
2028/29	75,744	1,005	1.3%	1,165,231	4,822	0.4%	18	2.3
2029/30	77,297	1,263	1.6%	1,192,991	6,082	0.5%	23	2.8
2030/31	78,856	1,592	2.0%	1,221,311	7,670	0.6%	28	3.5
2031/32	80,423	2,011	2.5%	1,250,193	9,676	0.8%	35	4.4
2032/33	82,001	2,549	3.1%	1,279,642	12,219	1.0%	44	5.5
2033/34	83,592	3,242	3.9%	1,309,663	15,454	1.2%	55	6.9
2034/35	85,187	4,142	4.9%	1,340,256	19,587	1.5%	69	8.6
2035/36	86,776	5,318	6.1%	1,371,420	24,893	1.8%	87	10.9
2036/37	88,357	6,867	7.8%	1,403,152	31,746	2.3%	111	13.9
2037/38	89,934	8,975	10.0%	1,435,450	40,704	2.8%	146	18.3

Area & Roadway Lighting

The Area and Roadway Lighting sector represents 0.4% of all sales within Manitoba. This sector includes electricity sales for the Sentinel Lighting and Street Lighting rate groups. Sentinel Lighting is an outdoor lighting service where units are available either as rentals to an existing metered service or on an unmetered, flat rate basis. Street Lighting includes all public roadway lighting in Manitoba. In 2006, a readjustment of the rate classes moved some flat rate General Service meters into the Lighting sector and starting in 2016, the street lighting LED conversion program decreased energy consumption. Only Street Lights count as customers.

For 2018/19, the Area and Roadway Lighting sector was further reduced by 16 GWh to reflect additional street lighting LED conversions. Excluding the effect of future Demand Side Management (DSM) initiatives expected to occur, the Area and Roadway Lighting sector is forecast to remain constant at 72 GWh throughout the entire forecast period.

Figure 17 - Area & Roadway Lighting



The following table outlines historical and forecast details including the impacts of program based Demand Side Management activity:

Table 20 - Area & Roadway Lighting

Area & Roadway Lighting (GWh)			
Historical / Weather Adjustment			
Fiscal Year	Sales	Weather Adjust	Adjusted Sales
1998/99	87	0	87
1999/00	89	0	89
2000/01	87	0	87
2001/02	89	0	89
2002/03	90	0	90
2003/04	91	0	91
2004/05	91	0	91
2005/06	91	0	91
2006/07	101	0	101
2007/08	101	0	101
2008/09	102	0	102
2009/10	102	0	102
2010/11	103	0	103
2011/12	103	0	103
2012/13	103	0	103
2013/14	104	0	104
2014/15	104	0	104
2015/16	104	0	104
2016/17	92	0	92
2017/18	88	0	88
Forecast / Forecast less DSM			
Fiscal Year	Forecast	DSM (Program based)	Forecast less DSM
2018/19	72	(13)	59
2019/20	72	(23)	49
2020/21	72	(25)	47
2021/22	72	(25)	47
2022/23	72	(25)	47
2023/24	72	(25)	47
2024/25	72	(25)	47
2025/26	72	(25)	47
2026/27	72	(25)	47
2027/28	72	(25)	47
2028/29	72	(25)	47
2029/30	72	(25)	46
2030/31	72	(25)	46
2031/32	72	(25)	46
2032/33	72	(25)	46
2033/34	72	(25)	46
2034/35	72	(25)	46
2035/36	72	(25)	46
2036/37	72	(25)	46
2037/38	72	(25)	46

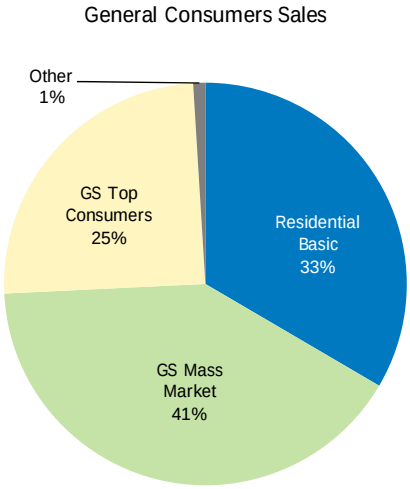
Table 21 – Area & Roadway Lighting

Area & Roadway Lighting History and Forecast 2007/08 - 2037/38								
Fiscal	Sentinal Flat Rates		Sentinal Rentals		Street Lighting		Total Lighting	
Year	(Services)	(GWh)	(Services)	(GWh)	(Custs)	(GWh)	(Custs)	(GWh)
2007/08	18,947	11	24,272	0	1,142	90	1,142	101
2008/09	19,228	11	24,542	0	1,175	91	1,175	102
2009/10	19,539	11	24,886	0	1,191	91	1,191	102
2010/11	19,835	11	25,216	0	1,184	92	1,184	103
2011/12	20,033	11	25,427	0	1,155	91	1,155	103
2012/13	20,238	12	25,613	0	1,164	92	1,164	103
2013/14	20,399	12	25,764	0	1,157	92	1,157	104
2014/15	20,495	12	25,853	0	1,196	92	1,196	104
2015/16	20,643	12	25,960	0	1,208	92	1,208	104
2016/17	20,818	12	26,093	0	1,218	80	1,218	92
2017/18	20,904	12	26,135	0	1,228	76	1,228	88
2018/19	20,993	12	26,177	0	1,239	60	1,239	72
2019/20	21,129	12	26,281	0	1,244	60	1,244	72
2020/21	21,265	12	26,385	0	1,249	60	1,249	72
2021/22	21,401	12	26,489	0	1,254	60	1,254	72
2022/23	21,537	12	26,593	0	1,259	60	1,259	72
2023/24	21,673	12	26,697	0	1,264	60	1,264	72
2024/25	21,809	12	26,801	0	1,269	59	1,269	72
2025/26	21,945	12	26,905	0	1,274	59	1,274	72
2026/27	22,081	13	27,009	0	1,279	59	1,279	72
2027/28	22,217	13	27,113	0	1,284	59	1,284	72
2028/29	22,353	13	27,217	0	1,289	59	1,289	72
2029/30	22,489	13	27,321	0	1,294	59	1,294	72
2030/31	22,625	13	27,425	0	1,299	59	1,299	72
2031/32	22,761	13	27,529	0	1,304	59	1,304	72
2032/33	22,897	13	27,633	0	1,309	59	1,309	72
2033/34	23,033	13	27,737	0	1,314	59	1,314	72
2034/35	23,169	13	27,841	0	1,319	59	1,319	72
2035/36	23,305	13	27,945	0	1,324	58	1,324	72
2036/37	23,441	13	28,049	0	1,329	58	1,329	72
2037/38	23,577	13	28,153	0	1,334	58	1,334	72

Total General Consumer Sales

General Consumers Sales includes sales to all of Manitoba Hydro's individually billed customers, but excludes export sales. This includes the total of all sales from the Residential, General Service and Lighting sectors. The General Service sector makes up about two-thirds, the Residential sector makes up about one-third and the remaining sectors are only 0.4% of all sales.

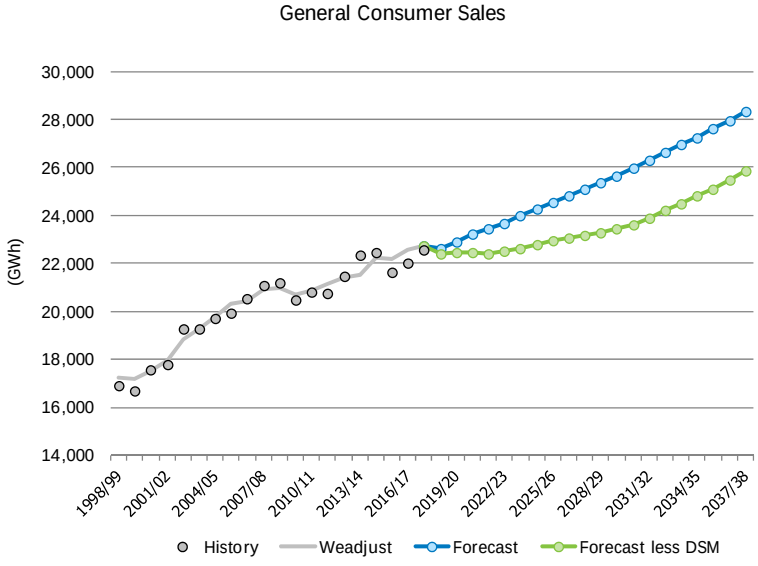
Figure 18 – General Consumers Sales



Note: Other category includes seasonal, flat rate water heating, area & roadway lighting, construction power and station service.

Weather adjusted General Consumers Sales has grown 290 GWh (1.5%) per year for the past 20 years and 182 GWh (0.8%) per year over the past 10 years. This historical growth includes the effect of past Demand Side Management (DSM) initiatives. Sales are forecast to grow 235 GWh (1.0%) per year for the next 10 years and 281 GWh (1.1%) per year for the next 20 years before program-based DSM initiatives. Including program-based DSM, the forecast is expected to grow 155 GWh (0.6%) over the next 20 years.

Figure 19 – General Consumers Sales



The following table outlines historical and forecast details including the impacts of program based Demand Side Management activity:

Table 22 – General Consumers Sales

General Consumers Sales (GWh) Historical / Weather Adjustment			
Fiscal Year	Sales	Weather Adjust	Adjusted Sales
1998/99	16,929	300	17,228
1999/00	16,696	479	17,175
2000/01	17,590	(51)	17,539
2001/02	17,805	166	17,970
2002/03	19,246	(418)	18,829
2003/04	19,280	(32)	19,248
2004/05	19,735	35	19,770
2005/06	19,935	353	20,287
2006/07	20,510	(76)	20,433
2007/08	21,061	(145)	20,917
2008/09	21,210	(219)	20,991
2009/10	20,486	207	20,693
2010/11	20,786	96	20,883
2011/12	20,771	378	21,148
2012/13	21,477	(76)	21,400
2013/14	22,338	(830)	21,508
2014/15	22,458	(199)	22,258
2015/16	21,654	509	22,163
2016/17	22,025	519	22,544
2017/18	22,573	165	22,738
Forecast / Forecast less DSM			
Fiscal Year	Forecast	DSM (Program based)	Forecast less DSM
2018/19	22,642	(250)	22,392
2019/20	22,917	(477)	22,440
2020/21	23,199	(758)	22,441
2021/22	23,420	(1,020)	22,400
2022/23	23,675	(1,181)	22,494
2023/24	23,972	(1,329)	22,643
2024/25	24,265	(1,467)	22,798
2025/26	24,537	(1,610)	22,927
2026/27	24,826	(1,760)	23,066
2027/28	25,087	(1,914)	23,173
2028/29	25,373	(2,065)	23,308
2029/30	25,667	(2,224)	23,443
2030/31	25,967	(2,375)	23,592
2031/32	26,284	(2,393)	23,891
2032/33	26,613	(2,415)	24,198
2033/34	26,933	(2,436)	24,497
2034/35	27,259	(2,459)	24,801
2035/36	27,597	(2,479)	25,118
2036/37	27,957	(2,501)	25,456
2037/38	28,360	(2,523)	25,836

Diesel Sales

There are four communities served by diesel generation in Manitoba: Brochet, Lac Brochet, Tadoule Lake and Shamattawa. Sales within these communities are included in General Consumers Sales, but are not part of the Integrated System, and are thus not part of Common Bus or Gross Firm Load.

Between 1997 and 1999, eleven communities previously served by diesel generation were connected to the Integrated System resulting in the drop in overall diesel sales. The four sites that were to remain diesel were converted from 15 amp service to 60 amp service between 1991 and 2001 causing the increase in those years.

Diesel customers do not have electric heat, which requires a minimum 200 amp service; therefore there is no weather effect.

Figure 20 – Diesel Sales

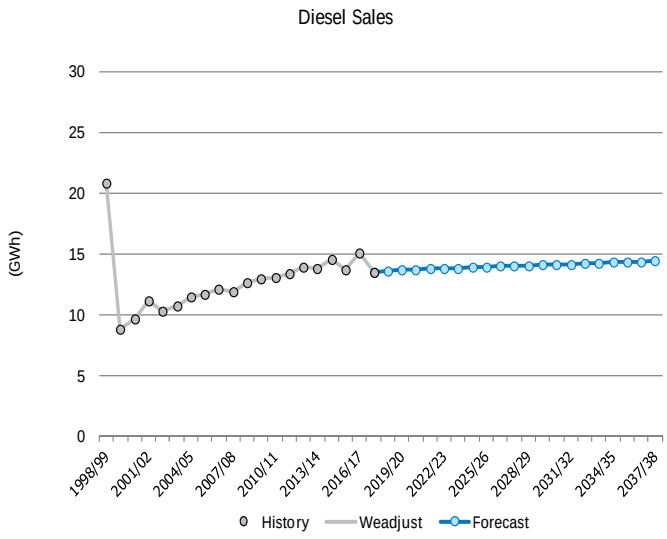


Table 23 – Diesel Sales

Diesel Sales (GWh) Historical / Weather Adjustment			
Fiscal Year	Sales	Weather Adjust	Adjusted Sales
1998/99	21	0	21
1999/00	9	0	9
2000/01	10	0	10
2001/02	11	0	11
2002/03	10	0	10
2003/04	11	0	11
2004/05	12	0	12
2005/06	12	0	12
2006/07	12	0	12
2007/08	12	0	12
2008/09	13	0	13
2009/10	13	0	13
2010/11	13	0	13
2011/12	13	0	13
2012/13	14	0	14
2013/14	14	0	14
2014/15	15	0	15
2015/16	14	0	14
2016/17	15	0	15
2017/18	14	0	14
Forecast			
Fiscal Year			Forecast
2018/19			14
2019/20			14
2020/21			14
2021/22			14
2022/23			14
2023/24			14
2024/25			14
2025/26			14
2026/27			14
2027/28			14
2028/29			14
2029/30			14
2030/31			14
2031/32			14
2032/33			14
2033/34			14
2034/35			14
2035/36			14
2036/37			14
2037/38			14

Distribution Losses

Distribution Losses are made up of the power loss between the distribution substation (Manitoba Load at Common Bus less Construction) and the customer's meter (General Consumers Sales less Diesel), as well as all other differences between what was billed and what was metered. The other differences include:

1. The offset between cycle billing (General Consumers Sales) and actual calendar month usage (Common Bus).
2. Customer Accounting adjustments,
3. Inaccuracies associated with estimated billing (including flat rate estimates),
4. The metered but unbilled consumption of Manitoba Hydro offices, and
5. Energy lost due to theft.

Distribution Losses are forecast in 2018/19 to be 4.8% of the General Consumers Sales less Diesel and remain between 4.8% and 4.9% throughout the forecast.

Figure 21 – Distribution Losses

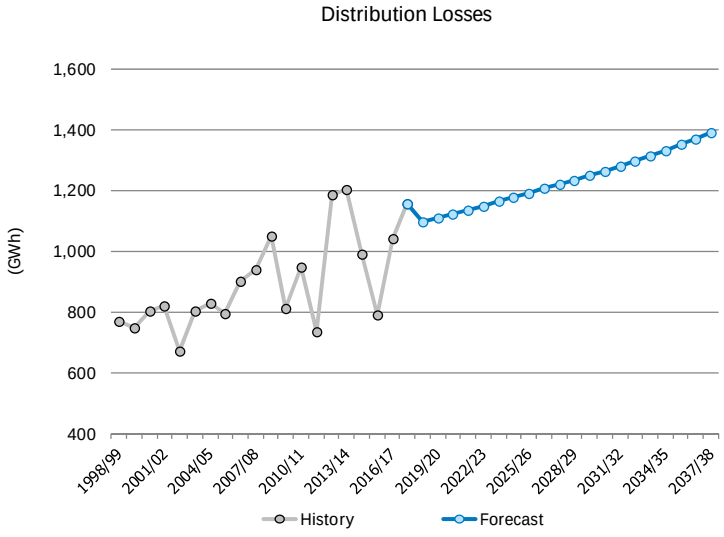


Table 24 – Distribution Losses

Distribution Losses (GWh) Historical / Percent of Sales			
Fiscal Year	Losses	Sales less Diesel	% Losses
1998/99	771	16,908	4.6%
1999/00	749	16,687	4.5%
2000/01	802	17,580	4.6%
2001/02	819	17,793	4.6%
2002/03	671	19,236	3.5%
2003/04	804	19,269	4.2%
2004/05	830	19,724	4.2%
2005/06	797	19,923	4.0%
2006/07	900	20,497	4.4%
2007/08	940	21,049	4.5%
2008/09	1,052	21,198	5.0%
2009/10	813	20,473	4.0%
2010/11	947	20,773	4.6%
2011/12	736	20,757	3.5%
2012/13	1,184	21,463	5.5%
2013/14	1,205	22,324	5.4%
2014/15	992	22,443	4.4%
2015/16	791	21,640	3.7%
2016/17	1,043	22,010	4.7%
2017/18	1,155	22,560	5.1%
Forecast / Percent of Sales			
Fiscal Year	Forecast Losses	Sales less Diesel	% Losses
2018/19	1,097	22,628	4.8%
2019/20	1,109	22,904	4.8%
2020/21	1,122	23,185	4.8%
2021/22	1,135	23,406	4.8%
2022/23	1,149	23,661	4.9%
2023/24	1,164	23,958	4.9%
2024/25	1,178	24,252	4.9%
2025/26	1,192	24,524	4.9%
2026/27	1,206	24,812	4.9%
2027/28	1,219	25,073	4.9%
2028/29	1,233	25,359	4.9%
2029/30	1,248	25,653	4.9%
2030/31	1,263	25,953	4.9%
2031/32	1,280	26,270	4.9%
2032/33	1,297	26,599	4.9%
2033/34	1,314	26,919	4.9%
2034/35	1,332	27,245	4.9%
2035/36	1,350	27,582	4.9%
2036/37	1,370	27,942	4.9%
2037/38	1,390	28,345	4.9%

Construction Power

Construction Power represents the energy used by Manitoba Hydro and its contractors in the construction of major capital works such as generating stations, converter stations and major transmission lines. Construction Power also includes Station Service until a plant is commissioned. Until 2013, about 48 GWh of heating load at the Gillam, Limestone and Kettle town sites was included in Construction Power. This energy is now included in Distribution Losses.

The Construction Power forecast includes (1) the Keeyask Generating Station and (2) the Keewatinohk Converter Station, started in January 2012 with expected completion in the spring of 2020.

Figure 22 – Construction Power

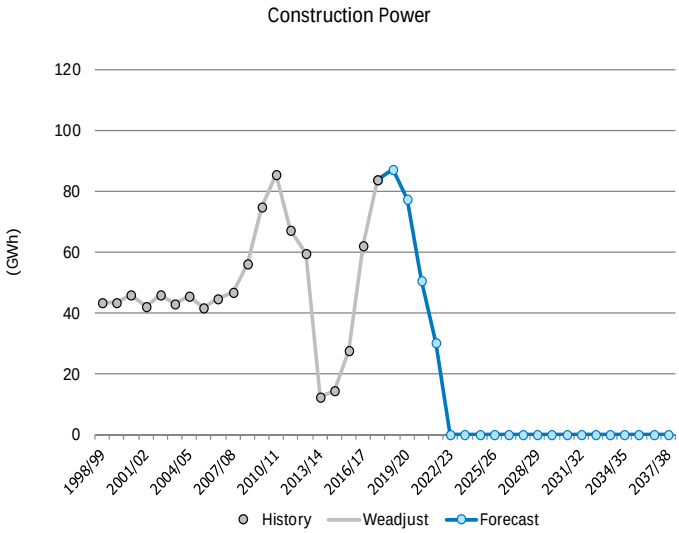


Table 25 – Construction Power

Construction Power (GWh) Historical / Weather Adjustment			
Fiscal Year	Usage	Weather Adjust	Adjusted Sales
1998/99	43	0	43
1999/00	43	0	43
2000/01	46	0	46
2001/02	42	0	42
2002/03	46	0	46
2003/04	43	0	43
2004/05	46	0	46
2005/06	42	0	42
2006/07	45	0	45
2007/08	47	0	47
2008/09	56	0	56
2009/10	75	0	75
2010/11	85	0	85
2011/12	67	0	67
2012/13	59	0	59
2013/14	12	0	12
2014/15	15	0	15
2015/16	28	0	28
2016/17	62	0	62
2017/18	84	0	84
Forecast			
Fiscal Year			Forecast
2018/19			87
2019/20			77
2020/21			51
2021/22			30
2022/23			0
2023/24			0
2024/25			0
2025/26			0
2026/27			0
2027/28			0
2028/29			0
2029/30			0
2030/31			0
2031/32			0
2032/33			0
2033/34			0
2034/35			0
2035/36			0
2036/37			0
2037/38			0

Manitoba Load at Common Bus

Manitoba Load at Common Bus is the total load measured from all the distribution points (i.e. substations) within Manitoba. It includes all energy supplied to General Consumers Sales customers, Construction Power plus associated Distribution Losses, but excludes Diesel customers, Transmission Losses and Station Service.

Common Bus is metered and totaled to correspond exactly to each calendar month. Weather adjustment is done on a calendar month basis.

Weather adjusted Common Bus has grown 308 GWh (1.5%) per year for the past 20 years and 210 GWh (0.9%) per year during the past 10 years reflecting the recent economic downturn. This historical growth also includes the effect of past Demand Side Management (DSM) initiatives. Common Bus is forecast to grow 238 GWh (1.0%) per year for the next 10 years and 291 GWh (1.1%) per year for the next 20 years before program-based DSM initiatives.

Figure 23 – Manitoba Load at Common Bus

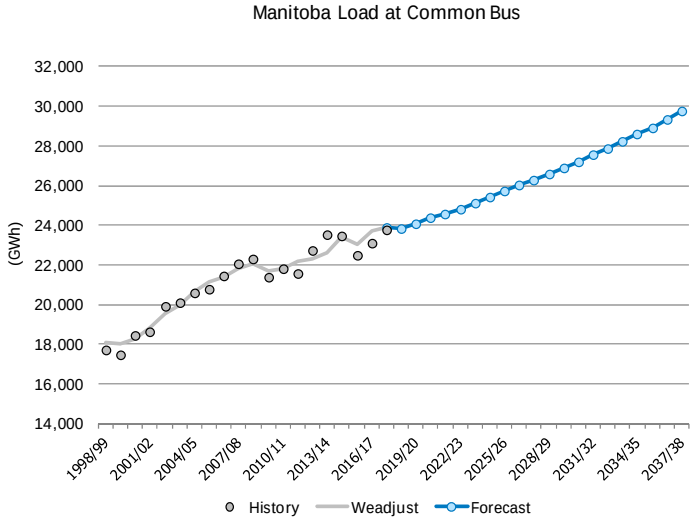


Table 26 – Manitoba Load at Common Bus

Manitoba Load at Common Bus Historical / Weather Adjustment			
Fiscal Year	Usage	Weather Adjust	Adjusted Sales
1998/99	17,722	336	18,059
1999/00	17,479	552	18,031
2000/01	18,428	(156)	18,272
2001/02	18,655	138	18,793
2002/03	19,953	(379)	19,573
2003/04	20,116	(130)	19,986
2004/05	20,600	28	20,627
2005/06	20,761	389	21,150
2006/07	21,442	(59)	21,383
2007/08	22,036	(219)	21,817
2008/09	22,305	(242)	22,064
2009/10	21,361	338	21,699
2010/11	21,806	39	21,844
2011/12	21,560	635	22,195
2012/13	22,706	(377)	22,329
2013/14	23,541	(947)	22,594
2014/15	23,450	(69)	23,381
2015/16	22,460	597	23,057
2016/17	23,115	609	23,724
2017/18	23,799	117	23,916
Forecast			
Fiscal Year			Forecast
2018/19			23,812
2019/20			24,090
2020/21			24,358
2021/22			24,571
2022/23			24,810
2023/24			25,122
2024/25			25,430
2025/26			25,715
2026/27			26,018
2027/28			26,292
2028/29			26,592
2029/30			26,900
2030/31			27,217
2031/32			27,550
2032/33			27,896
2033/34			28,233
2034/35			28,577
2035/36			28,933
2036/37			29,312
2037/38			29,736

Transmission Losses

Transmission Losses are the amount of energy lost while delivering power from the generation stations to all of the distribution substations that make up Common Bus. Transmission Losses only contains losses associated with supplying Manitoba customers. Losses attributable to exports and the gains attributable to imports are excluded. Transmission Losses are mostly losses on the High Voltage Direct Current (HVDC) lines, and are substantial because of the distance of transmission from northern generation to southern distribution points, but are much less than what AC losses would be over that distance. Transmission Losses vary year to year depending on water conditions, system configuration, outages and the magnitude of the load. High losses experienced in 2002/03 were due to two HVDC transformer failures.

Transmission Losses are forecast to be approximately 9.0% of the General Consumers Sales less Diesel Sales and do not reflect future efficiency gains from the commissioning of Bipole III as of July 2018.

Figure 24 – Transmission Losses

Table 27 – Transmission Losses

Transmission Losses (GWh) Historical / Weather Adjustment / Forecast			
Fiscal Year	Losses	Sales less Diesel	% Losses
1998/99	1,675	16,908	9.9%
1999/00	1,623	16,687	9.7%
2000/01	1,696	17,580	9.6%
2001/02	1,864	17,793	10.5%
2002/03	2,012	19,236	10.5%
2003/04	1,792	19,269	9.3%
2004/05	1,852	19,724	9.4%
2005/06	1,860	19,923	9.3%
2006/07	1,885	20,497	9.2%
2007/08	1,949	21,049	9.3%
2008/09	1,979	21,198	9.3%
2009/10	1,934	20,473	9.4%
2010/11	1,977	20,773	9.5%
2011/12	1,939	20,757	9.3%
2012/13	1,936	21,463	9.0%
2013/14	1,969	22,324	8.8%
2014/15	1,949	22,443	8.7%
2015/16	2,107	21,640	9.7%
2016/17	2,014	22,010	9.2%
2017/18	1,846	22,560	8.2%
Forecast / Percent of Sales			
Fiscal Year	Forecast Losses	Sales less Diesel	% Losses
2018/19	2,028	22,628	9.0%
2019/20	2,051	22,904	9.0%
2020/21	2,074	23,185	8.9%
2021/22	2,092	23,406	8.9%
2022/23	2,113	23,661	8.9%
2023/24	2,139	23,958	8.9%
2024/25	2,165	24,252	8.9%
2025/26	2,190	24,524	8.9%
2026/27	2,216	24,812	8.9%
2027/28	2,239	25,073	8.9%
2028/29	2,264	25,359	8.9%
2029/30	2,291	25,653	8.9%
2030/31	2,318	25,953	8.9%
2031/32	2,346	26,270	8.9%
2032/33	2,375	26,599	8.9%
2033/34	2,404	26,919	8.9%
2034/35	2,433	27,245	8.9%
2035/36	2,464	27,582	8.9%
2036/37	2,496	27,942	8.9%
2037/38	2,532	28,345	8.9%

Station Service

Station Service is the energy used by power plants to generate power and service their own load. Manitoba energy or peak without Station Service is referred to as “Net”, and with Station Service as “Gross”.

Station Service energy is forecast to be 123 GWh and Station Service peak is forecast to be 21 MW from 2018/19 to 2037/38.

Station Service for Keeyask and for future non-committed plants is excluded from this forecast.

Figure 25 - Station Service

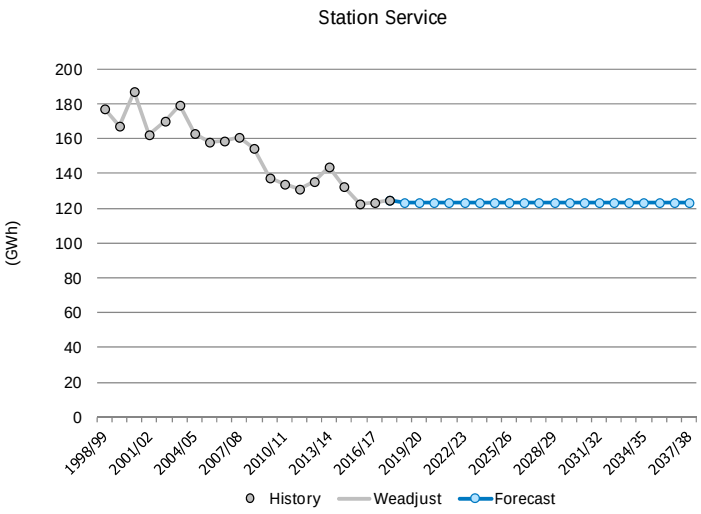


Table 28 - Station Service

Station Service (GWh) Historical / Weather Adjustment			
Fiscal Year	Usage	Weather Adjust	Adjusted Sales
1998/99	177	0	177
1999/00	167	0	167
2000/01	187	0	187
2001/02	162	0	162
2002/03	170	0	170
2003/04	179	0	179
2004/05	163	0	163
2005/06	158	0	158
2006/07	159	0	159
2007/08	161	0	161
2008/09	154	0	154
2009/10	137	0	137
2010/11	134	0	134
2011/12	131	0	131
2012/13	136	0	136
2013/14	144	0	144
2014/15	132	0	132
2015/16	123	0	123
2016/17	123	0	123
2017/18	125	0	125
Forecast			
Fiscal Year			Forecast
2018/19			123
2019/20			123
2020/21			123
2021/22			123
2022/23			123
2023/24			123
2024/25			123
2025/26			123
2026/27			123
2027/28			123
2028/29			123
2029/30			123
2030/31			123
2031/32			123
2032/33			123
2033/34			123
2034/35			123
2035/36			123
2036/37			123
2037/38			123

Table 29 – Monthly Station Service Energy

Monthly Station Service Energy (GWh) History and Forecast													
Fiscal Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total
2007/08	15.7	12.1	9.1	8.2	8.4	7.3	8.7	14.7	19.2	18.6	19.7	18.8	160.5
2008/09	13.8	9.4	7.5	9.5	10.4	7.1	10.6	15.1	20.1	20.4	14.9	15.5	154.2
2009/10	11.8	10.3	7.9	7.2	7.4	7.2	10.8	14.2	18.8	15.5	13.3	12.7	137.1
2010/11	10.2	9.9	7.3	6.7	7.2	7.4	9.5	12.9	16.4	17.1	14.4	15.0	134.1
2011/12	12.0	9.9	7.5	7.1	7.3	6.7	9.5	13.1	15.1	16.0	13.8	13.1	131.3
2012/13	11.0	9.4	7.7	7.0	6.7	6.4	11.4	14.3	16.2	16.6	13.7	15.2	135.5
2013/14	12.6	11.1	7.0	7.5	7.6	6.9	11.2	13.5	17.8	17.0	15.8	15.8	143.8
2014/15	12.1	9.6	7.7	7.5	7.2	7.0	8.9	13.2	14.4	16.1	15.0	13.7	132.4
2015/16	10.6	8.9	6.8	6.3	7.1	7.9	8.5	13.4	13.7	13.9	13.1	12.5	122.6
2016/17	11.3	8.6	7.0	6.9	8.0	6.9	10.2	10.5	15.6	13.3	12.2	12.6	123.1
2017/18	10.3	8.4	6.9	6.4	6.5	7.4	9.4	14.0	14.1	14.4	13.4	13.4	124.7
2018/19 - 2037/38	10.7	8.6	6.9	6.5	7.2	7.4	9.4	12.6	14.4	13.9	12.9	12.8	123.3

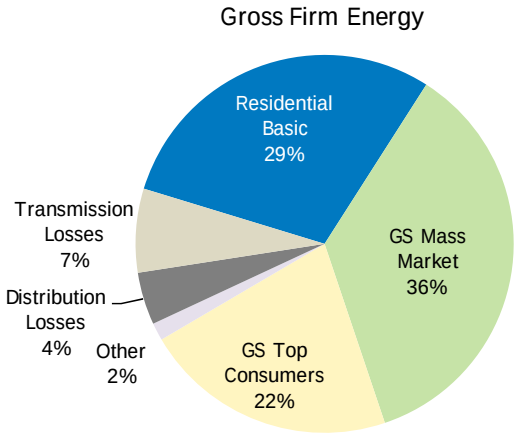
Table 30 – Monthly Station Service Peak

Monthly Station Service Peak (MW) History and Forecast													
Fiscal Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Annual
2017/18 Actual	16	12	9	8	9	11	15	23	21	21	21	18	23
2018/19 - 2037/38	17	12	10	10	8	12	13	21	20	21	21	19	21

Gross Firm Energy

Gross Firm Energy is the energy required to serve Manitoba Hydro's customers on the Integrated System. It excludes exports, interruptible (non-firm) loads, Diesel Sales and Station Service for Keeyask and non- committed plants.

Figure 26 - Gross Firm Energy

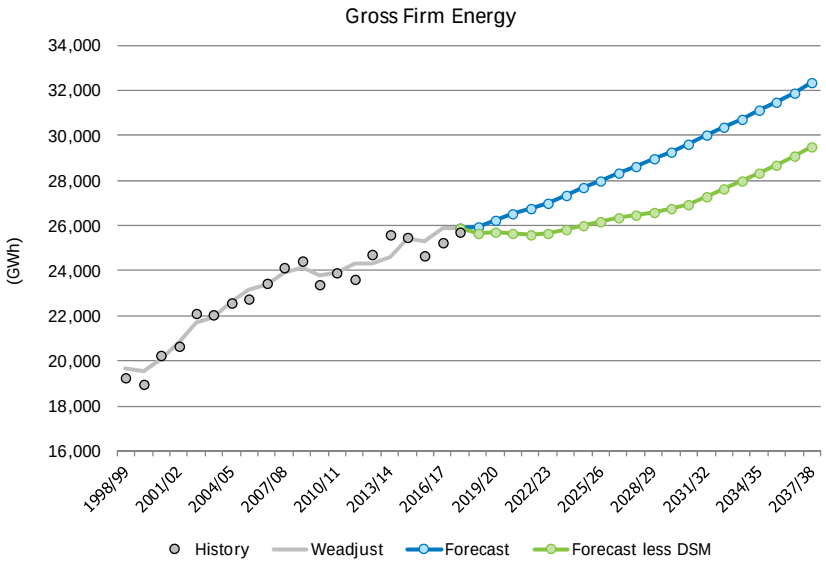


Note: Other category includes seasonal, flat rate water heating, area & roadway lighting, construction power and station service.

Gross Firm Energy has grown steadily during the past twenty years, except during the economic slowdown in the 1990's and more recently in 2009.

Weather adjusted Gross Firm Energy has grown 328 GWh (1.5%) per year for the past 20 years and 198 GWh (0.8%) per year during the past 10 years reflecting the recent 2008 global economic downturn. This historical growth includes the effect of past Demand Side Management (DSM) initiatives. Energy is forecast to grow 276 GWh (1.0%) per year for the next 10 years and 325 GWh (1.1%) per year for the next 20 years before program-based DSM initiatives. Including program-based DSM, the forecast is expected to grow 181 GWh (0.7%) over the next 20 years.

Figure 27 - Gross Firm Energy



The following table outlines historical and forecast details including the impacts of program based Demand Side Management activity:

Table 31 - Gross Firm Energy

Gross Firm Energy (GWh)			
Historical / Weather Adjustment			
Fiscal Year	Sales	Weather Adjust	Adjusted Sales
1998/99	19,273	367	19,639
1999/00	18,971	604	19,575
2000/01	20,262	(166)	20,096
2001/02	20,656	151	20,807
2002/03	22,110	(417)	21,694
2003/04	22,069	(144)	21,925
2004/05	22,589	31	22,620
2005/06	22,757	422	23,179
2006/07	23,464	(65)	23,399
2007/08	24,122	(236)	23,886
2008/09	24,417	(260)	24,156
2009/10	23,412	369	23,781
2010/11	23,892	44	23,937
2011/12	23,605	689	24,294
2012/13	24,750	(410)	24,339
2013/14	25,625	(1,020)	24,605
2014/15	25,505	(74)	25,431
2015/16	24,665	650	25,315
2016/17	25,227	663	25,890
2017/18	25,742	128	25,870
Forecast / Forecast less DSM			
Fiscal Year	Forecast	DSM (Program based)	Forecast less DSM
2018/19	25,935	(285)	25,651
2019/20	26,237	(541)	25,696
2020/21	26,528	(861)	25,667
2021/22	26,759	(1,158)	25,601
2022/23	27,018	(1,341)	25,677
2023/24	27,357	(1,509)	25,847
2024/25	27,691	(1,666)	26,024
2025/26	28,001	(1,829)	26,172
2026/27	28,329	(1,998)	26,331
2027/28	28,627	(2,173)	26,454
2028/29	28,951	(2,345)	26,607
2029/30	29,287	(2,525)	26,762
2030/31	29,630	(2,697)	26,933
2031/32	29,991	(2,717)	27,274
2032/33	30,367	(2,742)	27,625
2033/34	30,733	(2,766)	27,967
2034/35	31,106	(2,791)	28,314
2035/36	31,492	(2,815)	28,677
2036/37	31,904	(2,839)	29,064
2037/38	32,363	(2,865)	29,498

Table 32 – Monthly Gross Firm Energy

Monthly Gross Firm Energy (GWh) History and Forecast 2007/08 - 2037/38													
Fiscal Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total
2007/08	1,842	1,701	1,663	1,820	1,727	1,650	1,836	2,108	2,490	2,584	2,427	2,273	24,122
2008/09	1,881	1,737	1,662	1,730	1,787	1,681	1,874	2,154	2,652	2,702	2,226	2,331	24,417
2009/10	1,861	1,744	1,671	1,667	1,644	1,672	1,888	1,935	2,560	2,524	2,213	2,032	23,412
2010/11	1,699	1,692	1,611	1,716	1,698	1,638	1,778	2,129	2,563	2,682	2,322	2,364	23,892
2011/12	1,862	1,751	1,603	1,789	1,741	1,643	1,814	2,125	2,435	2,526	2,251	2,064	23,605
2012/13	1,802	1,698	1,688	1,869	1,727	1,606	1,941	2,265	2,665	2,766	2,342	2,383	24,750
2013/14	2,041	1,754	1,650	1,766	1,725	1,657	1,914	2,258	2,884	2,895	2,553	2,527	25,625
2014/15	2,048	1,837	1,690	1,788	1,778	1,703	1,909	2,424	2,638	2,770	2,581	2,339	25,505
2015/16	1,940	1,799	1,724	1,868	1,775	1,728	1,873	2,137	2,469	2,695	2,418	2,239	24,665
2016/17	2,007	1,741	1,726	1,826	1,809	1,720	1,986	2,093	2,754	2,740	2,350	2,472	25,227
2017/18	1,946	1,774	1,733	1,874	1,804	1,741	1,963	2,399	2,759	2,822	2,569	2,357	25,742
17/18 Wadj	1,983	1,828	1,747	1,933	1,876	1,755	2,007	2,309	2,692	2,886	2,498	2,357	25,870
2018/19	1,979	1,817	1,762	1,886	1,837	1,747	1,991	2,313	2,743	2,893	2,514	2,453	25,935
2019/20	2,002	1,838	1,783	1,910	1,861	1,768	2,014	2,339	2,773	2,925	2,542	2,480	26,237
2020/21	2,024	1,859	1,802	1,933	1,884	1,788	2,035	2,364	2,803	2,958	2,570	2,507	26,528
2021/22	2,041	1,875	1,818	1,950	1,901	1,803	2,053	2,385	2,828	2,984	2,592	2,527	26,759
2022/23	2,060	1,894	1,836	1,970	1,920	1,821	2,072	2,408	2,855	3,013	2,617	2,550	27,018
2023/24	2,086	1,917	1,859	1,995	1,944	1,844	2,098	2,439	2,891	3,052	2,650	2,582	27,357
2024/25	2,111	1,941	1,882	2,019	1,968	1,866	2,124	2,468	2,926	3,089	2,683	2,613	27,691
2025/26	2,135	1,962	1,903	2,042	1,990	1,887	2,147	2,496	2,959	3,124	2,713	2,642	28,001
2026/27	2,160	1,985	1,925	2,066	2,013	1,909	2,172	2,525	2,994	3,161	2,745	2,673	28,329
2027/28	2,183	2,006	1,946	2,088	2,034	1,929	2,195	2,552	3,025	3,194	2,774	2,701	28,627
2028/29	2,207	2,029	1,968	2,111	2,057	1,951	2,220	2,581	3,059	3,230	2,805	2,732	28,951
2029/30	2,233	2,052	1,991	2,136	2,081	1,974	2,245	2,611	3,095	3,268	2,838	2,764	29,287
2030/31	2,259	2,076	2,014	2,161	2,105	1,997	2,271	2,641	3,131	3,307	2,872	2,796	29,630
2031/32	2,286	2,101	2,038	2,187	2,131	2,021	2,299	2,674	3,170	3,348	2,907	2,830	29,991
2032/33	2,314	2,127	2,064	2,214	2,157	2,046	2,327	2,707	3,210	3,391	2,944	2,866	30,367
2033/34	2,342	2,152	2,088	2,240	2,183	2,070	2,355	2,740	3,249	3,433	2,980	2,900	30,733
2034/35	2,370	2,178	2,113	2,267	2,209	2,095	2,383	2,773	3,289	3,475	3,017	2,936	31,106
2035/36	2,399	2,205	2,139	2,295	2,236	2,120	2,412	2,808	3,331	3,519	3,055	2,972	31,492
2036/37	2,430	2,233	2,167	2,325	2,265	2,147	2,444	2,845	3,375	3,566	3,096	3,011	31,904
2037/38	2,465	2,265	2,198	2,358	2,297	2,178	2,479	2,886	3,424	3,618	3,141	3,055	32,363

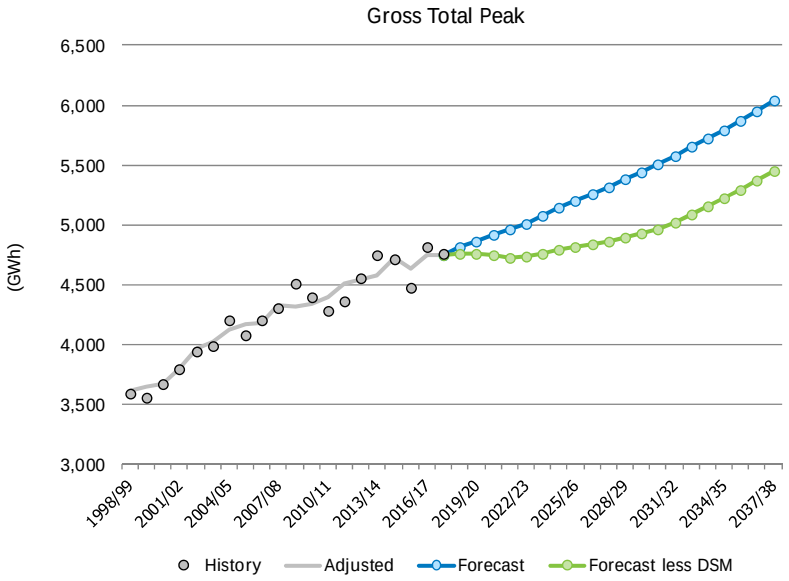
Gross Total Peak

Gross Total Peak is the maximum integrated average hourly load required to serve Manitoba Hydro's customers on the Integrated System. It excludes exports and Diesel Sales. It includes Station Service and Curtailable Loads.

Typically, the peak occurs on a very cold winter weekday either in the morning (often from 8 a.m. to 9 a.m.) or in the afternoon (from 5 p.m. to 6 p.m.). Electric heating is a main contributor to the peak on one of the coldest days, whereas the operation or lack thereof of large industrials often makes the difference as to the specific day and peak hour.

The adjusted Gross Total Peak has grown from 3,610 MW in 1998/99 to 4,751 MW in 2017/18 at an average growth of 60 MW or 1.5% per year. It is forecast to grow to 6,035 MW at 64 MW (1.2%) per year by 2037/38 years before program-based DSM initiatives. Including program-based DSM, the forecast is expected to grow 35 MW (0.7%) over the next 20 years.

Figure 28 - Gross Total Peak



The following table outlines historical and forecast details including the impacts of program based Demand Side Management activity:

Table 33 – Gross Total Peak

Gross Total Peak (MW)			
Historical / Weather Adjustment			
Fiscal Year	Peak	Adjustment	Adjusted Peak
1998/99	3,596	14	3,610
1999/00	3,555	90	3,645
2000/01	3,672	5	3,677
2001/02	3,797	(4)	3,793
2002/03	3,948	24	3,972
2003/04	3,994	31	4,025
2004/05	4,201	(72)	4,129
2005/06	4,085	84	4,169
2006/07	4,208	(26)	4,182
2007/08	4,304	21	4,325
2008/09	4,509	(195)	4,314
2009/10	4,393	(56)	4,336
2010/11	4,286	106	4,392
2011/12	4,367	146	4,514
2012/13	4,559	(13)	4,547
2013/14	4,743	(165)	4,578
2014/15	4,713	10	4,723
2015/16	4,479	155	4,634
2016/17	4,822	(71)	4,751
2017/18	4,755	(4)	4,751
Forecast / Forecast less DSM			
Fiscal Year	Forecast	DSM (Program based)	Forecast less DSM
2018/19	4,815	(53)	4,762
2019/20	4,863	(99)	4,763
2020/21	4,918	(169)	4,749
2021/22	4,965	(238)	4,727
2022/23	5,015	(283)	4,732
2023/24	5,079	(319)	4,760
2024/25	5,143	(352)	4,790
2025/26	5,202	(386)	4,816
2026/27	5,264	(421)	4,843
2027/28	5,320	(455)	4,866
2028/29	5,381	(487)	4,894
2029/30	5,445	(521)	4,924
2030/31	5,511	(552)	4,959
2031/32	5,580	(557)	5,024
2032/33	5,652	(561)	5,091
2033/34	5,722	(566)	5,156
2034/35	5,794	(571)	5,223
2035/36	5,869	(576)	5,293
2036/37	5,948	(580)	5,368
2037/38	6,035	(585)	5,450

Table 34 – Monthly Gross Total Peak

Monthly Gross Total Peak (MW) History and Forecast 2007/08 - 2037/38													
Fiscal Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Annual
2007/08	3,494	2,736	3,042	3,294	3,033	2,777	2,979	3,996	4,078	4,304	4,289	4,095	4,304
2008/09	3,221	2,893	2,952	2,920	3,110	2,726	3,159	3,804	4,427	4,509	4,196	4,223	4,509
2009/10	3,196	2,933	3,000	2,758	2,933	2,982	3,054	3,297	4,393	4,256	4,092	4,235	4,393
2010/11	2,905	2,843	2,805	2,991	3,163	2,709	3,056	3,927	4,195	4,286	4,250	4,169	4,286
2011/12	3,183	2,886	3,056	3,278	3,189	3,045	3,129	3,756	4,095	4,367	4,270	3,608	4,367
2012/13	3,328	2,775	3,161	3,260	3,253	2,870	3,312	4,087	4,410	4,559	4,543	4,013	4,559
2013/14	3,622	3,129	3,103	3,179	3,276	3,227	3,448	4,026	4,656	4,743	4,579	4,541	4,743
2014/15	3,754	2,955	2,967	3,094	3,190	2,938	3,382	4,391	4,532	4,713	4,573	4,390	4,713
2015/16	3,447	3,000	3,114	3,351	3,314	3,427	3,134	3,858	4,021	4,479	4,424	4,247	4,479
2016/17	3,663	2,934	3,103	3,333	3,132	2,958	3,228	3,622	4,616	4,822	4,469	4,435	4,822
2017/18	3,348	2,780	3,121	3,319	3,177	3,242	3,534	4,041	4,666	4,755	4,740	3,915	4,755
17/18 Norm	3,464	2,991	3,151	3,278	3,323	3,090	3,345	4,005	4,493	4,673	4,582	4,339	4,751
2018/19	3,511	3,031	3,193	3,322	3,368	3,132	3,391	4,059	4,554	4,736	4,644	4,398	4,815
2019/20	3,554	3,069	3,235	3,367	3,414	3,171	3,431	4,107	4,598	4,783	4,690	4,450	4,863
2020/21	3,592	3,103	3,270	3,407	3,455	3,207	3,468	4,152	4,650	4,838	4,743	4,496	4,918
2021/22	3,624	3,132	3,300	3,439	3,488	3,236	3,499	4,189	4,693	4,884	4,787	4,535	4,965
2022/23	3,660	3,163	3,335	3,476	3,526	3,270	3,534	4,232	4,740	4,933	4,834	4,577	5,015
2023/24	3,707	3,204	3,377	3,521	3,571	3,312	3,579	4,285	4,801	4,996	4,896	4,636	5,079
2024/25	3,753	3,243	3,419	3,565	3,616	3,353	3,623	4,339	4,861	5,059	4,957	4,693	5,143
2025/26	3,795	3,280	3,459	3,606	3,657	3,391	3,664	4,388	4,916	5,117	5,014	4,747	5,202
2026/27	3,841	3,319	3,500	3,649	3,702	3,432	3,708	4,440	4,975	5,178	5,075	4,804	5,264
2027/28	3,882	3,355	3,538	3,688	3,742	3,469	3,747	4,488	5,028	5,233	5,129	4,855	5,320
2028/29	3,927	3,393	3,579	3,731	3,785	3,509	3,790	4,539	5,085	5,294	5,188	4,911	5,381
2029/30	3,973	3,433	3,622	3,775	3,830	3,550	3,835	4,593	5,146	5,356	5,250	4,970	5,445
2030/31	4,020	3,474	3,665	3,821	3,876	3,593	3,880	4,648	5,207	5,421	5,313	5,029	5,511
2031/32	4,070	3,517	3,710	3,868	3,925	3,637	3,928	4,706	5,273	5,489	5,380	5,092	5,580
2032/33	4,121	3,561	3,758	3,917	3,975	3,683	3,978	4,766	5,340	5,560	5,449	5,158	5,652
2033/34	4,172	3,604	3,804	3,965	4,024	3,728	4,027	4,825	5,406	5,629	5,517	5,222	5,722
2034/35	4,223	3,648	3,851	4,014	4,074	3,774	4,076	4,884	5,474	5,699	5,586	5,287	5,794
2035/36	4,276	3,694	3,899	4,065	4,125	3,821	4,127	4,946	5,544	5,772	5,657	5,354	5,869
2036/37	4,333	3,742	3,951	4,119	4,180	3,871	4,182	5,013	5,619	5,851	5,734	5,426	5,948
2037/38	4,395	3,796	4,008	4,178	4,240	3,927	4,242	5,085	5,701	5,936	5,817	5,505	6,035

Peak load is measured and recorded differently than energy data. The system load at every hour is calculated by System Operations as:

Hourly Gross Total Peak (t)

= Hourly Total Generation (t)

- Hourly Metered Exports (t) + Hourly Metered Imports (t)

- Losses Associated with Exports (t) + Gains Associated with Imports (t)

+ Curtailments (t)

Losses for exports and gains for imports are only known on a monthly energy basis. The hourly value is obtained by using the ratio of exports/imports for the hour to the total exports/imports for the month and applying that to the total metered loss/gain for the month. The remaining difference between the balance of the load and Common Bus is taken as the Transmission Losses associated with Manitoba load.

Curtailments for individual customers are calculated as the difference between what the customer would have used if not curtailed versus what they actually used.

Annual Peak

The forecast annual peak is higher than the maximum of the monthly peaks. This is because the peak can occur in any one of the winter months. The same characteristic is apparent in historical peaks. The average historical annual peak is higher than the maximum of the highest average monthly peaks. For studies requiring yearly data, the annual peak should be used.

16 Hour Peak

The peaks in this document are integrated hourly peaks. For some studies and analysis of avoided cost or DSM savings, an estimate of the average peak during on-peak hours (from 6 a.m. to 10 p.m.) may be desired. To convert hourly peak to 16 hour peak, multiply the hourly peak in the associated month by the following percentages:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
94.4%	94.9%	95.8%	96.0%	96.3%	96.0%	96.6%	95.6%	95.8%	96.6%	95.6%	95.5%	94.8%

VARIABILITY AND ACCURACY

Weather Effect and Weather Adjustment

The weather effect is determined in any sector every year by regressing the previous two years of actual monthly energies against the actual HDD and CDD for the month. This results in a GWh per HDD effect and a GWh per CDD effect for that sector for that year.

Only sectors whose major variation is due to weather can have a weather effect estimated. Sectors that vary primarily due to industrial output levels or seasonal but non-weather reasons may yield false weather effects if estimated. Weather effects are not determined for the GS Top Consumers, Seasonal, Diesel, Water Heating and Lighting sectors.

For sectors where a weather effect is calculated, this document shows energy as the reported value and as a weather adjusted value. Forecasts are based on the weather adjusted values. The calculations are:

Weather Adjustment = HDD weather effect * (HDD actual - HDD normal) + CDD weather effect * (CDD actual - CDD normal)

Weather Adjusted Actual = Actual - Weather Adjustment

Following are the HDD and CDD weather effect factors by sector:

Weather Effect Factors by sector		
Sector	GWh/DDH	GWh/DDC
Residential Basic	0.6	1.1
GS Mass Market	0.3	1.0
General Consumers Sales	0.9	2.1
Gross Firm	1.2	2.7
	Winter @ -30°C MW/Deg	Summer @ 30°C MW/Deg
Gross Total Peak	49	112

Load Variability

Uncertainty is an inherent characteristic of forecasting. The load will vary both year to year and long term because of underlying changes in population growth, economic growth, changes in the operations of Top Consumers, and overall use patterns. An economic recession will slow energy growth and an economic boom will increase it. Cycles cannot be predicted in advance so some appropriate midpoint must be chosen as the forecast.

This forecast was created as Manitoba Hydro's best estimate of Manitoba's future energy requirement with an expectation of a 50% chance that actual growth will be higher than the forecast, and a 50% chance that actual growth will be lower than the forecast. This can also be called the P50 (50th Percentile) or Base Forecast.

To evaluate the potential for variation, historic load variability has been analyzed using a probabilistic-based approach. Doing this provides an estimate of the magnitude of the potential load variation from the forecast due to population, economy and other effects. 10% and 90% confidence bands (-/+ 1.28 standard deviations), also known as P10 and P90, were selected to be a proxy for the Low and High Load Forecast Scenarios for use in risk analysis studies. They are calculated as follows:

Load = Base Forecast -/+ 1.28 x Standard Deviation

For other probability points, substitute for the 1.28 the following numbers:

Prob	0.1%	2.5%	10.0%	20.0%	50.0%	80.0%	90.0%	97.5%	99.9%
Z(Prob)	-3.09	-1.96	-1.28	-0.84	0.00	0.84	1.28	1.96	3.09

This calculation gives the variability due to long term economic effects. It does not include variability due to weather which was removed through the use of weather adjusted load. The standard deviation of the weather variation has been found to be approximately 2% of both the energy and peak. Annual weather variations tend to be independent of the economy, so if a combined variance is desired, then the variance due to weather can be added to the variance without weather to derive an overall variance that includes weather.

The following four charts and tables summarize the variability for energy and peak. By 2037/38, the Load Forecast has an 80% probability of being accurate to within ± 1,743 GWh or ±5.5%. Due to the inherent variability of the load, this is the best level of accuracy possible.

The overall economic standard deviation in 2037/38 is 1,262 GWh or 3.9% of the forecast energy. Analyzed individually, the economic standard deviation of the Top Consumers sector is 1,305 GWh (22.3%), Residential is 487 GWh (5.0%) and Mass Market is also 474 GWh (3.8%), showing that the Top Consumers sector is the majority of the variance.

Figure 29 – Energy Variability

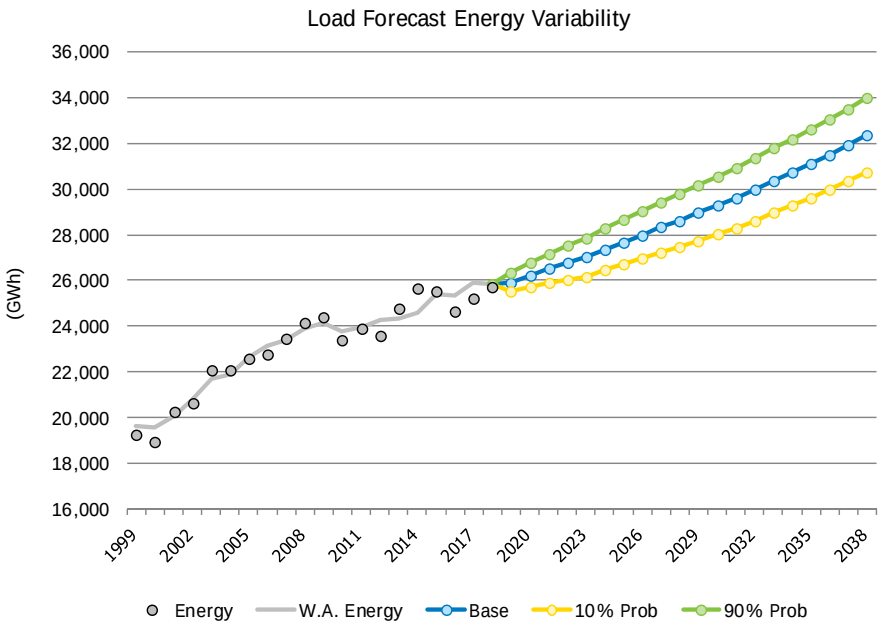


Table 35 – Energy Variability

Energy Variablility (GWh)				
Fiscal Year	Gross Firm Base Fcst	Long Term Economic Std Dev	10.0% Prob Point	90.0% Prob Point
2018/19	25,935	298	25,554	26,317
2019/20	26,237	417	25,702	26,772
2020/21	26,528	508	25,876	27,179
2021/22	26,759	584	26,010	27,508
2022/23	27,018	651	26,184	27,852
2023/24	27,357	711	26,446	28,267
2024/25	27,691	765	26,710	28,672
2025/26	28,001	816	26,955	29,047
2026/27	28,329	864	27,222	29,436
2027/28	28,627	908	27,463	29,791
2028/29	28,951	951	27,733	30,170
2029/30	29,287	991	28,017	30,556
2030/31	29,630	1,029	28,311	30,949
2031/32	29,991	1,066	28,625	31,358
2032/33	30,367	1,102	28,955	31,779
2033/34	30,733	1,136	29,277	32,189
2034/35	31,106	1,169	29,608	32,604
2035/36	31,492	1,201	29,953	33,031
2036/37	31,904	1,232	30,325	33,482
2037/38	32,363	1,262	30,746	33,980

Figure 30 – Peak Variability

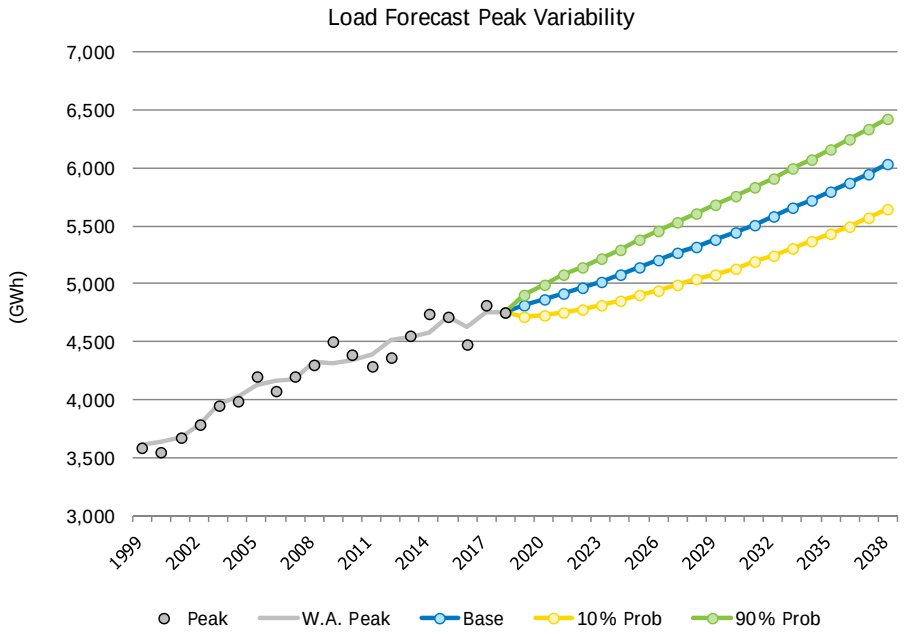


Table 36 – Peak Variability

Peak Variablility (MW)				
Fiscal Year	Gross Firm Base Fcst	Long Term Economic Std Dev	10.0% Prob Point	90.0% Prob Point
2018/19	4,815	72	4,723	4,908
2019/20	4,863	101	4,733	4,992
2020/21	4,918	123	4,760	5,076
2021/22	4,965	142	4,783	5,146
2022/23	5,015	158	4,812	5,217
2023/24	5,079	172	4,858	5,300
2024/25	5,143	186	4,905	5,381
2025/26	5,202	198	4,948	5,455
2026/27	5,264	209	4,996	5,532
2027/28	5,320	220	5,038	5,602
2028/29	5,381	231	5,086	5,677
2029/30	5,445	240	5,137	5,753
2030/31	5,511	250	5,191	5,831
2031/32	5,580	259	5,249	5,912
2032/33	5,652	267	5,310	5,995
2033/34	5,722	276	5,369	6,076
2034/35	5,794	284	5,431	6,157
2035/36	5,869	291	5,495	6,242
2036/37	5,948	299	5,565	6,331
2037/38	6,035	306	5,643	6,428

5 and 10 year Forecast Accuracy

Due to the load variation caused by population growth and economic growth, there is only a certain level of accuracy possible. Using the load variability estimates of the previous section, due to economic variability alone, there is only an 80% chance that a 5 year energy forecast will be within 3.2% of the actual, and an 80% chance that a 10 year energy forecast will be within 4.5% of the actual.

Recognizing this inherent uncertainty of the forecast, historic forecast variation has been tracked. The following four figures and tables compare previous load forecasts to actual results 5 and 10 years later.

The energy savings achieved under Manitoba Hydro's market-based DSM programs between the year the forecast was prepared and the year being forecast was subtracted first from the forecast value. The remaining difference is taken as an estimate of the accuracy of the forecast.

The following figures and tables may suggest cycles in the forecast made up of alternating periods of over-forecasting and under-forecasting. These are not so much due to a bias in the forecast as they are due to unexpected periods of recession or economic growth. Once one of these unexpected periods occur, the accuracy of the previous five 5-year forecasts for 5 years, and the accuracy of the previous ten 10-year forecasts for ten years will be affected thus causing periods of over- or under-forecasting.

Compensation for these periods of over and under-forecasting cannot be applied until after the events occur and only then can they be identified and quantified. The forecast assumes average expected economic conditions. When economic conditions are abnormal, the forecast will be high or low.

The weather adjusted Gross Firm Energy is shown in two separate columns in the Energy Accuracy table (Table 35) and they vary in each year due to the difference in weather normals used in each of the respected forecasts.

Figure 31 – Energy Accuracy

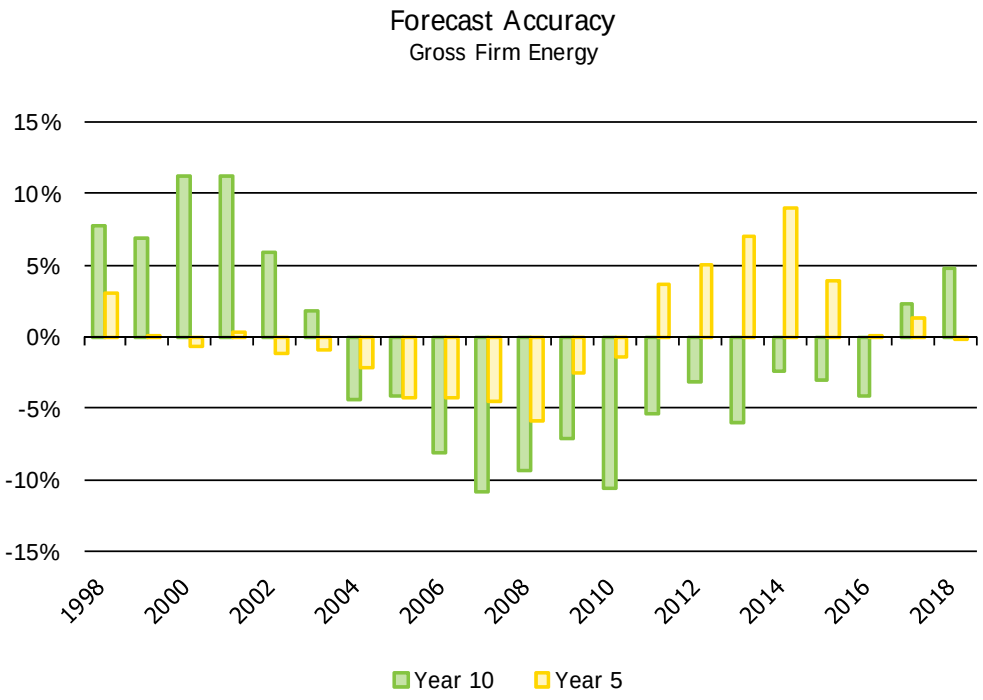


Table 37 – Energy Accuracy

Energy Accuracy (GWh)							
Fiscal Year	Actual Gross Firm Energy	Forecast Prepared 5 Years Previous	W.A. Gross Firm Energy	5 Year Percent Accuracy	Forecast Prepared 10 Years Previous	W.A. Gross Firm Energy	10 Year Percent Accuracy
1996/97	19,321	19,395	18,810	3.1%	20,174	18,716	7.8%
1997/98	19,014	19,455	19,429	0.1%	20,661	19,320	6.9%
1998/99	19,273	19,675	19,818	-0.7%	21,919	19,708	11.2%
1999/00	18,971	19,767	19,703	0.3%	21,833	19,629	11.2%
2000/01	20,262	20,018	20,241	-1.1%	21,300	20,103	6.0%
2001/02	20,656	20,783	20,980	-0.9%	21,364	20,979	1.8%
2002/03	22,110	21,395	21,861	-2.1%	20,916	21,868	-4.4%
2003/04	22,069	21,134	22,062	-4.2%	21,191	22,107	-4.1%
2004/05	22,589	21,693	22,664	-4.3%	20,870	22,714	-8.1%
2005/06	22,757	22,216	23,277	-4.6%	20,812	23,346	-10.9%
2006/07	23,464	22,107	23,489	-5.9%	21,395	23,595	-9.3%
2007/08	24,122	23,353	23,962	-2.5%	22,328	24,034	-7.1%
2008/09	24,417	23,926	24,259	-1.4%	21,756	24,320	-10.5%
2009/10	23,412	24,734	23,850	3.7%	22,611	23,892	-5.4%
2010/11	23,892	25,239	24,020	5.1%	23,299	24,071	-3.2%
2011/12	23,605	25,909	24,202	7.1%	22,924	24,376	-6.0%
2012/13	24,750	26,464	24,270	9.0%	23,844	24,433	-2.4%
2013/14	25,625	25,510	24,538	4.0%	23,936	24,696	-3.1%
2014/15	25,505	25,491	25,469	0.1%	24,455	25,508	-4.1%
2015/16	24,665	25,707	25,366	1.3%	25,999	25,405	2.3%
2016/17	25,227	25,902	25,936	-0.1%	26,984	25,747	4.8%

Figure 32 – Peak Accuracy

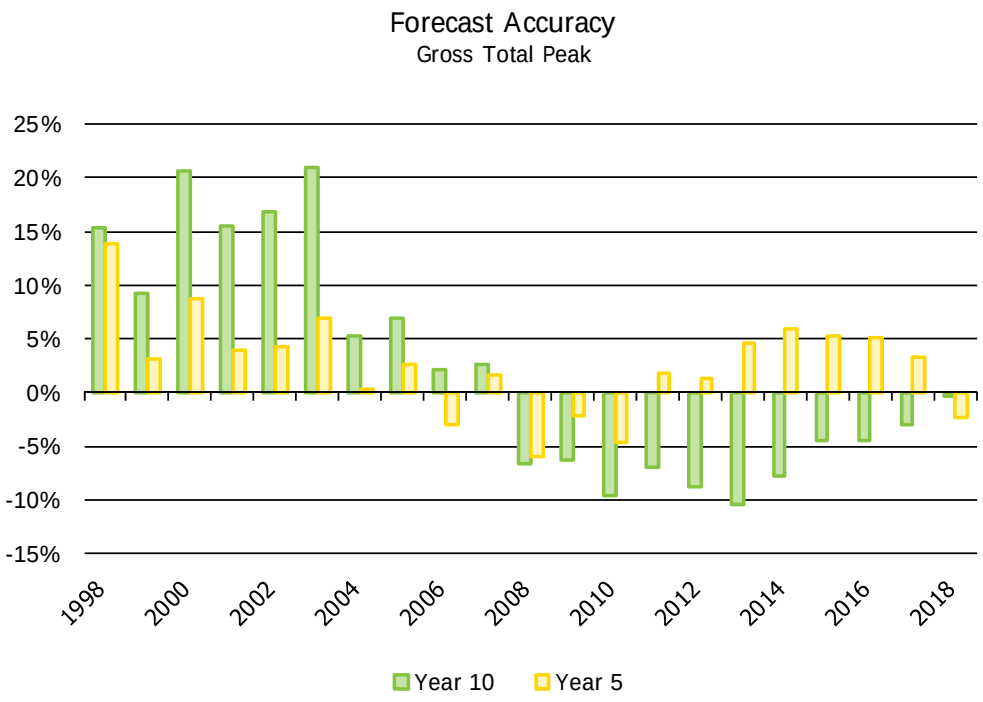


Table 38– Peak Accuracy

Peak Accuracy (MW)							
Fiscal Year	Actual Gross Total Peak	Forecast Prepared 5 Years Previous	Normalized Gross Total Peak	5 Year Percent Accuracy	Forecast Prepared 10 Years Previous	Normalized Gross Total Peak	10 Year Percent Accuracy
1996/97	3,444	3,906	3,432	13.8%	3,962	3,432	15.4%
1997/98	3,525	3,768	3,654	3.1%	3,990	3,654	9.2%
1998/99	3,596	3,703	3,404	8.8%	4,108	3,404	20.7%
1999/00	3,555	3,738	3,597	3.9%	4,152	3,597	15.4%
2000/01	3,672	3,758	3,603	4.3%	4,210	3,603	16.8%
2001/02	3,797	3,759	3,516	6.9%	4,251	3,516	20.9%
2002/03	3,948	3,801	3,790	0.3%	3,989	3,790	5.2%
2003/04	3,994	3,833	3,733	2.7%	3,990	3,733	6.9%
2004/05	4,201	3,817	3,936	-3.0%	4,023	3,936	2.2%
2005/06	4,085	3,860	3,799	1.6%	3,899	3,799	2.6%
2006/07	4,208	3,894	4,145	-6.0%	3,868	4,145	-6.7%
2007/08	4,304	4,097	4,191	-2.2%	3,927	4,191	-6.3%
2008/09	4,509	4,161	4,367	-4.7%	3,948	4,367	-9.6%
2009/10	4,393	4,371	4,295	1.8%	3,993	4,295	-7.0%
2010/11	4,286	4,398	4,344	1.2%	3,959	4,344	-8.9%
2011/12	4,367	4,606	4,403	4.6%	3,942	4,403	-10.5%
2012/13	4,559	4,705	4,441	5.9%	4,098	4,441	-7.7%
2013/14	4,743	4,523	4,296	5.3%	4,106	4,296	-4.4%
2014/15	4,713	4,658	4,430	5.2%	4,233	4,430	-4.4%
2015/16	4,479	4,735	4,588	3.2%	4,451	4,588	-3.0%
2016/17	4,822	4,616	4,726	-2.3%	4,708	4,726	-0.4%

LOAD SENSITIVITY AND EXTREME EVENTS

Manitoba Hydro examines the effect of possible events on the load. The information presented here provides planners with an understanding of what the potential scale of these individual events may have on the system load requirements.

The individual effects of each event can be included in scenario or sensitivity analysis if the need arises. Each change in assumption can be individually applied to the forecast as required to capture the annual energy and peak effect of the desired assumption in any given year. All values are listed at Generation and include transmission and distribution losses.

The sensitivities provide an estimate of what effect a change in assumption will have on the annual energy and peak over the 20 year forecast period.

Effects are summarized below, and the details of each effect follow.

Sensitivity of the Load to an Assumption Change

Change in 20 year average annual growth rate	Energy (GWh)	Peak (MW)
0.1% Increase/Decrease in Population	± 303	± 56
0.1% Increase/Decrease in Income	± 52	± 9
0.1% Increase/Decrease in GDP	± 178	± 33
0.1% Increase/Decrease in Electricity Price	∓137	∓25
Climate Change per Degree Celsius Warmer	+30	-49

Evaluation of Extreme Events	Energy (GWh)	Peak (MW)
All Natural Gas in Manitoba to Electricity	+ 16,000	+ 7,000
Increase/Decrease of One Very Large Industrial Customer	± 1,500	± 180
Maximum Potential Effect of Increased Online Shopping	- 775	- 143
Additional Load if 100% Electric Vehicle Saturation Rate	+ 12,124	+ 1,516
Illustrated Effect of Grid Parity (e.g. Solar Panels)	- 857	0

In context, one year of energy growth is 325 GWh and one year of peak growth is 64 MW.

Population / Economic / Price Changes

The population, economy and prices are the most significant drivers of the load in Manitoba. These effect of each driver based on the coefficients found in the models is summarized below.

Population: A one-time 1% increase in population (13,422 people) results in a 1% increase in the number of Residential Basic customers (4,863 customers representing 75 GWh) and a 0.32% change in the number of GS Mass Market customers (215 customers representing 59 GWh). The total effect on Manitoba Gross Firm Energy would be 152 GWh (0.59%) for any given year. Assuming a 0.1% change in the annual average population growth rate over the 20 year forecast period, the total effect would be a change of 303 GWh in the 20th year of the forecast.

Income: A one-time 1% increase in real income results in a 0.30% increase in Residential average use (47 kWh per customer and 23 GWh overall). On Manitoba Gross Firm Energy it is 26 GWh (0.10%). Assuming a 0.1% change in the annual average income growth rate over the 20 year forecast period, the total effect would be a change of 52 GWh in the 20th year of the forecast.

GDP: A one-time 1% increase in Manitoba GDP results in a 0.55% increase in GS Mass Market Small and Medium average use (564 kWh per customer totaling 38 GWh). A 1% increase in MB/Canada/US blended GDP results in 0.29% increase in GS Large Customer average use (18,754 kWh per customer totaling 6 GWh) and a 0.62% increase in Top Consumers use (35 GWh). The total effect of a 1% increase in GDP on Manitoba Gross Firm Energy is 89 GWh (0.34%). Assuming a 0.1% change in the annual average GDP growth rate over the 20 year forecast period, the total effect would be a change of 178 GWh in the 20th year of the forecast.

Electricity Price: A one-time 1% increase in real electricity price results in a 0.28% decrease in Residential average use (-43 kWh per customer totaling -21GWh). It will also result in a 0.13% decrease in GS Mass Market Small and Medium average use (-133 kWh per customer totaling -9 GWh), a 0.46% decrease in GS Mass Market Large average use (-29,747 kWh per customer totaling -10 GWh) and a 0.37% decrease in GS Top Consumers use (-21 GWh). The total effect of a 1% increase in real electricity price on Manitoba Gross Firm Energy is -68 GWh (-0.26%). Assuming a 0.1% change in the annual average price growth rate over the 20 year forecast period, the total effect would be a change of 137 GWh in the 20th year of the forecast.

Below is a summary of the 20 year impact to the forecast should a change of 0.1% to the annual growth rate for each of the economic assumption is assumed.

Change in 20 year average annual growth rate	Energy (GWh)	Peak (MW)
0.1% Increase/Decrease in Population	± 303	± 56
0.1% Increase/Decrease in Income	± 52	± 9
0.1% Increase/Decrease in GDP	± 178	± 33
0.1% Increase/Decrease in Electricity Price	∓137	∓25

Climate Change

The Intergovernmental Panel on Climate Change projects an increase in global temperature as a result of rising concentrations of greenhouse gases in the atmosphere. Changes to temperature and extreme events have the potential to influence future energy demands. This section quantifies the general effect caused by a 1°C increase in average daily temperature throughout the year.

In Manitoba Hydro's case, if Winnipeg experienced a uniform 1°C warming throughout the year, winter months would be subject to less heating while summer months would be subject to more cooling. Over 200 winter days, every degree Celsius of temperature rise above average conditions will result in an approximate decrease of 200 Heating Degree Days (HDD) per year, and a corresponding approximate increase of 100 Cooling Degree Days (CDD) per year over 100 summer days.

Applying the Weather effect for Manitoba Hydro at Generation gives:

Decrease of 200 HDD ➔ -240 GWh and -49 MW in the winter
Increase of 100 CDD ➔ +270 GWh and +112 MW in the summer

The resulting total effect of every one degree increase in temperature would be:

	Energy (GWh)	Peak (MW)
Climate Change per Degree Celsius Warmer	+30	-49

Conversion of all Natural Gas Use to Electricity

Currently, about 275,000 Residential and General Service customers use natural gas as a fuel for space heating, water heating, cooking, etc. Given possible future green initiatives that could implement carbon taxes on fossil fuels, a scenario to consider is the conversion of all natural gas used as a fuel to electricity. The maximum additional load required over the current forecast for 100% saturation is 16,000 GWh (44 years of load growth) and 7,000 MW (about 108 years of peak growth).

Assumptions exclude industries using natural gas as an ingredient, not as a fuel, and use a fuel efficiency averaging 82% and a load factor of 26%.

	Energy (GWh)	Peak (MW)
All Natural Gas in Manitoba to Electricity	+ 16,000	+ 7,000

Potential Changes in Load from Very Large Industrial Customers

Manitoba Hydro's largest customer currently uses in excess of 1,500 GWh annually and has a coincident peak load of about 180 MW. It is feasible that one or more customers of this size could decide to start up in Manitoba in the next 20 years.

Similarly, it is possible that one or more very large customers may discontinue operations in Manitoba. This could also be the equivalent of losing Manitoba Hydro's largest customer.

	Energy (GWh)	Peak (MW)
Increase/Decrease of One Very Large Industrial Customer	± 1,500	± 180

Maximum Potential Load Effect of Increased Online Shopping

Online shopping is a growing service offering by many retailers. It is possible that this trend could lead to fewer retail establishments if online shopping becomes pervasive. The potential load reduction of such a scenario will be the electricity use of about 5,800 General Service customers in the Retail sector who currently use about 680 GWh. At generation, this represents a potential total of 775 GWh and 143 MW (using a 62% load factor). This assumes that the structures used for retail are torn down or are refurbished with other businesses that would otherwise have built a new structure.

	Energy (GWh)	Peak (MW)
Maximum Potential Effect of Increased Online Shopping	- 775	- 143

Potential Load from High Adoption of Electric Vehicle Technology

This forecast includes the expected impact due to adoption of electric vehicles within Manitoba over the next twenty years. The specifics have been detailed in the Electric Vehicle Forecast section of this document.

It is possible that the current technological challenges will be solved, price will match those of internal combustion vehicles, and range anxiety will be alleviated. If or when these issues are resolved, it is possible that electric vehicles may eventually grow to be the dominant vehicle.

The maximum load required, if 100% of all new passenger and commercial vehicles purchased every year within the forecast period are Plug-In Electric Vehicles (PEVs), would be 12,270 GWh of energy and 1,534 MW of load. Currently, the forecast for electric vehicles load by 2037/38 is 146 GWh and 18 MW. Therefore the maximum additional load required over the current forecast for 100% saturation is 12,124 GWh (37 years of load growth) and 1,516 MW (about 24 years of peak growth).

	Energy (GWh)	Peak (MW)
Additional Load if 100% Electric Vehicle Saturation Rate	+ 12,124	+ 1,516

Illustrated Effect of Grid Parity

Grid Parity is when a customer will have an economic option to provide some or all of the electricity needs their home or business requires with an alternative energy source. Grid parity requires the self-generated kWh cost to be competitive with utility power when considering operating, maintenance costs and a reasonable amortization period for capital costs.

Solar photovoltaic installations are frequently referenced in discussions related to grid parity as costs continue to decline. Initial adoption rates may be gradual and may take years to mature. For illustrative purposes, the effect at utility generation if 100,000 residential (2 kW system) and 10,000 commercial (50 kW system) customers added solar panels would be:

	Energy (GWh)	Peak (MW)
Illustrated Effect of Grid Parity (e.g. Solar Panels)	- 857	0

ASSUMPTIONS

Economic Assumptions

Economic forecast assumptions are taken from the economic variables that become part of Manitoba Hydro's Forecast of Key Economic and Financial Indicators and Energy Price Forecast.

Residential Customers - The number of Residential Basic customers in Manitoba is forecast to increase by 1.3% or 6,242 units in 2018/19 and averages 1.1% per year over the forecast period. This compares to a historical average increase of 1.2% per year over the last ten years. Residential customers are used in the Residential and GS Mass Market customer forecasts.

Electricity and Natural Gas Prices - The electricity price forecast is based on the Consumer Price Index (CPI) and rate increase projections contained in the Integrated Financial Forecast. The nominal electricity price is forecast to increase annually by 3.6% in 2018/19, 3.7% from 2019/20 to 2035/36 and then reduce to a 2% for the remaining 2 years of the forecast. In real terms, this will translates to an annual increase of 1.5% in 2018/19, between 1.6% and 1.8% from 2019/20 to 2035/36 and then reduce to 0% for the remaining 2 years of the forecast. Manitoba Hydro views the natural gas price forecast as commercially sensitive information. Consistent with the Clean Environment Commission and Electric General Rate Application, this information will not be publicly disclosed. The ratio of natural gas price to electric price is used in the Residential Basic forecast.

Manitoba Disposable Income - Real Manitoba disposable income per Residential Basic customer grew on average 1.6% over the past 20 years and 1.5% over the past 10 years. It is forecast to grow 0.6% annually for the next 20 years. Manitoba disposable income is used in the Residential Basic forecast.

Gross Domestic Product (GDP) - Real economic growth in Manitoba averaged 2.3% annually for the past 20 years and 2.1% annually for the past 10 years. Real Manitoba GDP is expected to grow 1.8% in 2018/19 and average 1.7% annually for the next 20 years. Real economic growth in Canada averaged 2.4% annually for the past 20 years and 1.7% annually for the past 10 years. It is forecast to grow 2.1% in 2018/19 and average 1.9% annually for the next 20 years. Real economic growth in US averaged 2.2% annually for the past 20 years and 1.4% annually for the past 10 years. It is forecast to grow 2.6% in 2018/19 and average 2.1% annually for the next 20 years. GDP is used in the GS Mass Market and GS Top Consumer forecasts.

Price / Income / GDP Elasticity

The economic effects of price, income and GDP have been incorporated into the 2017 forecast. The elasticity of each has been estimated from econometric modeling. A summary of the elasticities found is:

	Price Elasticity	Real Income Elasticity	Real GDP Elasticity
Residential Basic	-0.33	0.31	-
GS Mass Mkt Small/Medium	-0.12	-	0.55
GS Mass Mkt Large	-0.43	-	0.30
GS Top Consumers	-0.34	-	0.62
Gross Firm Energy	-0.28	0.11	0.36

See the Methodology section for more details.

Normal Weather Assumptions

Historical weather adjusted actuals are the foundation of the underlying historical information used in the Residential Average Use and General Service Mass Market Average Use models. Manitoba Hydro forecasts with the assumption of normal weather. The process of adjusting annual historical usage to reflect the same weather pattern reduces the inherit variability caused by weather in the underlying data in each respective model.

Demand Side Management (DSM) in the Forecast

The base forecast reflects future DSM savings associated with existing Provincial building codes and improved equipment efficiency standards and regulations (Codes and Standards) and is the only effect of DSM initiatives that is specifically accounted for in the forecast. Savings due to DSM programs to date are embedded in the historical data that is the basis for this forecast with the current level of past achieved DSM savings is assumed to remain in place throughout the future. Future DSM savings arising from future DSM offerings and market engagement above the current level and incremental to the above mentioned Codes and Standards are not reflected in this forecast. They are accounted for separately in Manitoba Hydro's DSM Plan and Power Resource Plan. As a result, historical growth rates in this document are not directly comparable to future growth rates because the history includes the effect of past program-based DSM initiatives, but the forecast does not. For customers involved in Load Displacement and Alternative Energy initiatives, the forecast excludes the effect of the initiatives, and projects the load without the savings due to the initiatives.

Figure 33 – Gross Firm Energy (Net of DSM)

Although not explicitly included in the base forecast, the program-based DSM has a significant impact on the future load growth expected in Manitoba. Program-based DSM reduces the Gross Firm Energy in 2037/38 from 32,363 GWh to 29,498 GWh, lowering the average growth of 325 GWh or 1.1% per year to an average growth of 181 GWh or 0.7% per year.

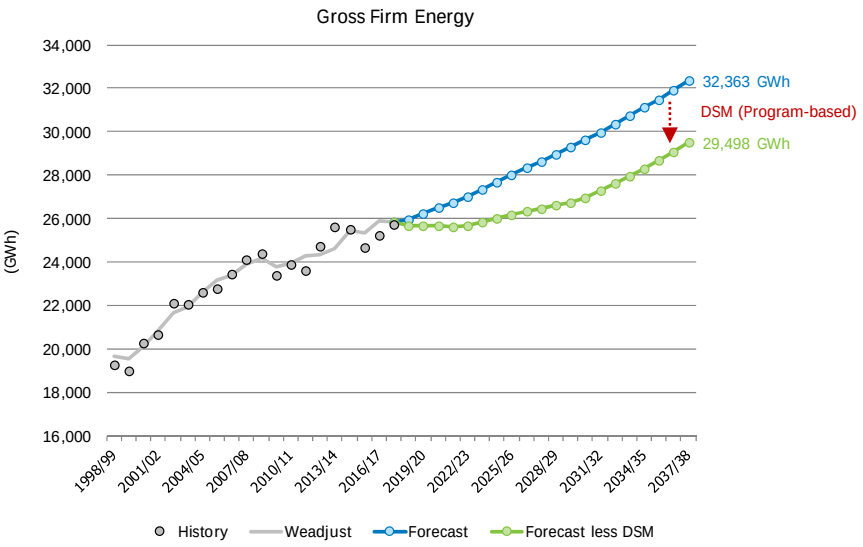
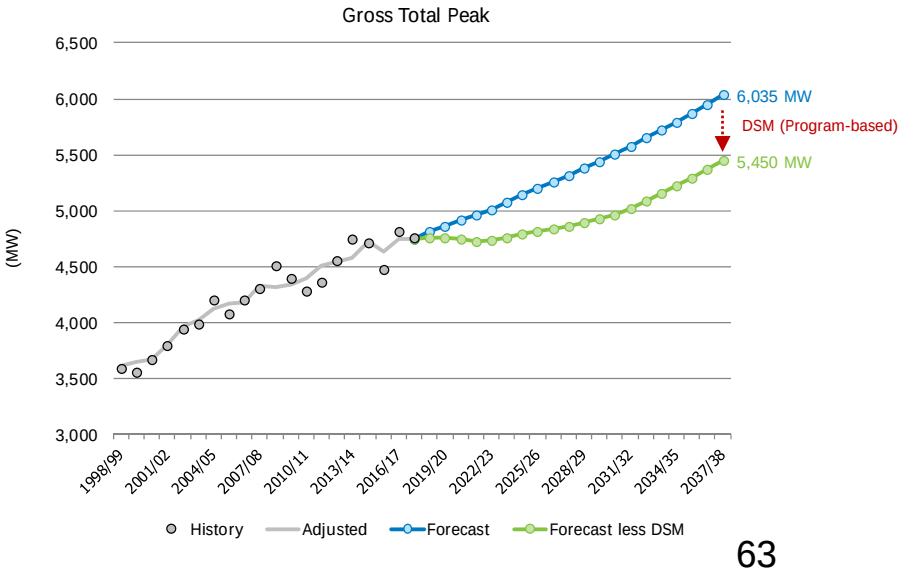


Figure 34 – Gross Total Peak (Net of DSM)

Program-based DSM reduces the Gross Total Peak in 2037/38 from 6,035 MW to 5,450 MW, lowering the average growth of 64 MW or 1.2% per year to an average growth of 35 MW or 0.7% per year.



METHODOLOGY

Residential Basic Methodology

Several different models and forecasts were used to determine the Residential Basic Model. These are the steps to produce the forecast:

i. **Forecast Residential Dwellings** - The forecast of Manitoba residential customers in Manitoba Hydro's Forecast of Key Economic and Financial Indicators was used for the total number of Residential Basic customers for the 2018/19 to 2037/38 period. The customer forecast was based on the average of several Manitoba population forecasts from various external agencies multiplied by a forecast of the people per residential customer ratio. The customer forecast was reduced by about 0.5% to account for customers with multiple services to obtain the forecast of individual dwellings.

ii. **Forecast Existing Dwellings** – Existing dwellings were broken down by dwelling type (single detached, multi attached, and Individually metered apartment suites) within each fuel region (Winnipeg, Gas Available outside Winnipeg and No Gas Available). The rate of change due to demolitions and type change (e.g. bulk apartments to individually metered) as well as customer switches of their space heating fuel were taken into account.

iii. **Historical Space Heating Systems** – The number of historical dwellings by type and region were each divided into nine space heating systems: Electric Forced Air Furnace, Electric Baseboard, Electric Ground Source Heat Pump, Electric Boiler, Gas High-Efficiency Furnace, Gas Mid-Efficiency Furnace, Gas Standard-Efficiency Furnace, Gas Boiler, and Other heat that is not billed for gas or electric. Percentages of each heat type in existing dwellings were based on the 2014 Residential Energy Use Survey.

iv. **Forecast of Space Heating Systems in New Dwellings** – Econometric equations were developed to forecast the number of electric space heating systems in new single detached and multi attached dwellings by region as follows:

Model: **Single Detached, Winnipeg**

Equation: Logit (Percentage of New Dwellings (t)) = -6.72 + 2.38 * T + 4.34 * PGEFF (lag(t))

Results:

Model R-Squared	Variable	Coefficient	t-stat
77.8%	Constant	-6.72	-13.45
	Trend	2.38	8.45
	PGEFF	4.34	6.03

Model: **Single Detached, Gas Available**

Equation: Logit (Percentage of New Dwellings (t)) = -2.06 + 1.49 * T + 2.89 * PGEFF (lag(t))

Results:

Model R-Squared	Variable	Coefficient	t-stat
92.2%	Constant	-2.06	-13.90
	Trend	1.49	10.86
	PGEFF	2.89	13.10

Model: **Multi Attached, Winnipeg**

Equation: Logit (Percentage of New Dwellings (t)) = -10.04 + 6.38 * T + 11.27 * PGEFF (lag(t))

Results:

Model R-Squared	Variable	Coefficient	t-stat
51.4%	Constant	-10.04	-4.96
	Trend	6.38	4.79
	PGEFF	11.27	3.88

Model: **Multi Attached, Gas Available**

Equation: Logit (Percentage of New Dwellings (t)) = -3.21 + 1.84 * T + 5.79 * PGEFF (lag(t))

Results:

Model R-Squared	Variable	Coefficient	t-stat
66.9%	Constant	-3.21	-5.62
	Trend	1.84	3.79
	PGEFF	5.79	7.07

Term definitions:

Logit - A log transformation of percentages used for saturation analysis
T - A trend variable capturing the effect of natural gas price changes
PGEFF - Ratio of the gas to electricity price for high efficiency furnaces
lag(t) - The weighted average (50%, 10%, 12%, 28%) of the 1,3, 4 and 5 year lags

The 2014 Residential Energy Use Survey was used to break the forecast of new electric heat dwellings and new non-electric-heat dwellings within single detached, multi attached and individually metered apartment suites across Winnipeg, Gas Available and No Gas Available areas into specific furnace types.

v. **Forecast of Space Heating Systems in Existing Dwellings** – The average age of heating systems in existing dwellings was determined from the 2014 Residential Energy Use Survey. The number of annual replacements was estimated using a Weibull distribution based on the average age of each furnace type. Fuel switching was estimated using survey respondents in older dwellings with newer heating systems and included saving estimates from the Heating Fuel Choice initiative.

vi. **Forecast of Water Heating Systems in New and Existing Dwellings** – Electric and natural gas water heater saturations and average age were estimated for dwellings with and without natural gas space heat using information from the 2014 Residential Energy Use Surveys. The number of annual replacements was forecast using a Weibull distribution based on the average age of water heaters and switches between fuels were taken into account when forecasting future numbers of water heaters. Saving estimates from the Heating Fuel Choice initiative were included.

vii. **Other End Uses** – Other major uses of residential electricity were forecast by dwelling type, including central air conditioning, major appliances, televisions and lighting using the saturation data from the 2014 Residential Energy Use Survey.

viii. **Determine Overall Average Use** – An econometric model was used to forecast the average annual electricity use per customer of the Residential Basic sector. The Average Use per customer without Demand Side Management (DSM) programs and Codes & Standards (C&S) savings was used as the dependent variable in the model. Historical data from 1992/93 to 2017/18 was modeled.

The resulting model and parameters are:

Model: **Overall Average Use**

Equation: Ln (Total Usage + DSM programs + C&S savings) / Customers

= 6.25 + 1.39 x Saturation – 0.33 x Ln (Price) + 0.31 x Ln (Income) + 0.01 x T(t)

Results:

Model R-Squared	Variable	Coefficient	t-stat
99.5%	Constant	6.25	6.77
	Saturation	1.39	2.16
	Price	-0.33	-5.50
	Income	0.31	3.33
	Trend	0.01	4.51

Term definitions:

Saturation - Electric Heat Customer Count / Total Res Basic Customer Count
Price - Manitoba Real Residential Electricity Price lagged 2.5 years
Income - Manitoba Real Income per Res Basic Customer
T - A trend variable capturing increases in electric use and house size

ix. **Appliance Use and Balancing** – Conditional Demand Analysis using the 2014 Residential Survey data combined with customer annual use from billing data was used to derive average annual energy use by type of heating system and appliance for existing and new dwellings. These average uses were multiplied by the number of each type of system and appliance to get the total energy use. This was balanced against Step 8 results to ensure reasonableness.

x. **Determine Total GWh used** – The forecast number of dwellings multiplied by the overall average use determined the GWh forecast. The forecast of energy savings from Codes and Standards as outlined in Manitoba Hydro's Power Smart Plan were subtracted. Additional energy savings due to the higher adoption of LED lights, and the future adoption of Electric Vehicles in the Residential sector were included. The end result was the forecast of Residential Basic customer total energy use. Excluded are savings attributable to future Demand Side Management initiatives.

General Service Mass Market Methodology

i. **General Service Mass Market Customer Forecast -** Econometric analysis of historical sales data was used to develop models to forecast the number of General Service Mass Market customers. Forecasts of Manitoba Gross Domestic Product (GDP) and Manitoba Hydro Residential Basic Customers were then input into the models to generate forecasts for the number of customers for each year of the forecast period. The number of Small Non-Demand, Small Demand and Medium customers was modeled using yearend historical customer data from 1985/86 to 2017/18.

The resulting model and parameters are as follows:

Model: **GS Mass Market Customer Forecast (Small ND, Small Demand and Medium)**

Equation: Number of Customers at yearend (t) = 35,877 + 0.21 x MGDP + 0.04 x RES

Results:

Model R-Squared	Variable	Coefficient	t-stat
	Constant	35,887	19.63
99.6%	MGDP	0.21	7.99
	RES	0.04	5.67

Term definitions:

MGDP - Manitoba Real Gross Domestic Product
RES - Year end number of Residential Basic Customers

General Service Mass Market customer growth was assigned to Small Non Demand, Small Demand and Medium classes by using their 3 year average use by class and allocating the customers appropriately.

The number of General Service Large customers was modeled using yearend historical customer data from 1989/90 to 2017/18. The resulting model and parameters are as follows:

Model: **GS Mass Market Customer Forecast (Large)**

Equation: Number of Customers at yearend (t) = -298 + 0.01 x CrGDP + 0.0011 x RES

Results:

Model R-Squared	Variable	Coefficient	t-stat
	Constant	-298	-6.48
98.8%	CrGDP	0.01	3.78
	RES	0.0011	6.93

Term definitions:

CrGDP - Manitoba / Canada / U.S. Blended Real Gross Domestic Product
RES - Year end number of Residential Basic Customers lagged 2 years

ii. **General Service Mass Market Average Use Forecast -** Historical Average Use per General Service customer was calculated after removing the effects of DSM and Codes & Standards. The average use of the combined Small Non-Demand (SND), Small Demand (SD) and Medium classes were forecast using an econometric regression model that included Electricity Price and Manitoba GDP. Historical data from 1989/90 to 2017/18 was used.

The resulting model and parameters are as follows:

Model: **GS Mass Market Average Use Forecast (Small ND, Small Demand and Medium)**

Equation: Ln Average Use per GS SND, SD and Medium

= 5.88 – 0.12 x Ln (Elec Price) + 0.55 x Ln (MGDP) + 0.04 x Dummy

Results:

Model R-Squared	Variable	Coefficient	t-stat
98.9%	Constant	5.88	18.94
	Elec Price	-0.12	-3.13
	MGDP	0.55	22.38
	Dummy	0.04	5.08

Term definitions:

Elec Price - SND, SD and Medium Average Real Electricity Price lagged 2 years
MGDP - Manitoba Real Gross Domestic Product
Dummy - "1" up to 2005/06 due to a billing system change causing a reclassification of customers in 2006/07

The Average Use for Large Mass Market customers was forecast in an econometric regression model that used Electricity Price and a blended Manitoba, Canadian, and U.S Real GDP as explanatory variables. Historical data from 1989/90 to 2017/18 was modeled.

The resulting model and parameters are as follows:

Model: **GS Mass Market Average Use Forecast (Large)**

Equation: Ln Average Use per GS Large

= 13.75 – 0.43 x Ln (Elec Price) + 0.30 x Ln (CrGDP) + 0.06 x Dummy

Results:

Model R-Squared	Variable	Coefficient	t-stat
96.6%	Constant	13.75	35.91
	Elec Price	-0.43	-5.79
	CrGDP	0.30	9.75
	Dummy	0.06	5.81

Term definitions:

Elec Price - GS Large Average Real Electricity Price lagged 2 years
CrGDP - Manitoba / Canada / U.S. Blended Real Gross Domestic Product
Dummy - Included from 1999/00 to 2005/06 to reflect the average use of the 750V-30kV group being higher for those years by about 250,000 kWh

The GS Mass Market Small, Medium and Large groups are further subdivided into rate groups that are based on customer's usage. If usage by an individual customer increases (or decreases) sufficiently then they are re-assigned to the appropriate rate group. This action results in the average use of each group to remain relatively stable. For the forecast, the average use of each rate group is held constant. The number of customers in each group is adjusted so that both the total number of customers and overall average use forecast by these models is achieved.

iii. **General Service Mass Market Total Use Forecast** - Total GWh for the General Service Mass Market sector was forecast by multiplying the forecast number of customers in each rate group by the forecast average use. The forecast of energy savings from Codes and Standards as outlined in Manitoba Hydro's Power Smart Plan were subtracted, and the future use of Electric Vehicles in the GS Mass Market sector was added.

General Service Top Consumers Methodology

There are 10 companies counting as 26 customers in the Top Consumers category, covering four industry sectors. Each customer is forecasted individually based on information collected on individual operating plans, including short-term expansion or contraction plans. The sources of information are derived from industry news and publications, company prospectuses, and from Manitoba Hydro's Key and Major Account Advisors. The information collected is used in the preparation of company specific short term forecasts for committed projects. The short- term plans are forecasted to occur within the first five years. For the long-term beyond year five, the energy in year six of each customer is held constant for the remainder of the forecast period.

To account for unexpected load increases or decreases for the current Top Consumers beyond year five, the Potential Large Industrial Loads (PLIL) category was created. PLIL is as an alternative to attempting long-term forecasts for individual Top Consumers. It is based on analyzing the historical changes in energy of the Top Consumers as a group rather than on focusing on individual customers. PLIL endeavors to account for long-term future growth or contraction, including unexpected major expansions, contractions, or potential loss of existing Top Consumer customers.

PLIL is forecast using an econometric model of Top Consumers historical energy activity from 1983/84 to 2017/18. During the historical period, 3 customers joined the Top Consumers sector and only the variations in operating activities were included in the analysis. The model fits the energy to the specific Top Consumers Electricity Price and to a blended Manitoba, Canadian, and U.S Real GDP.

The resulting model and parameters are as follows:

Model: **GS Top Consumer Forecast (PLIL)**

Equation: Ln Total Load = 3.35 – 0.34 x Ln (Top Price) + 0.62 x Ln (CrGDP)

Results:

Model R-Squared	Variable	Coefficient	t-stat
	Constant	3.35	4.43
89.9%	Top Price	-0.34	-2.05
	CrGDP	0.62	9.78

Term definitions:

Top Price - Manitoba Top Consumers Real Electricity Price lagged 1 year
CrGDP - Manitoba / Canada / U.S. Blended Real Gross Domestic Product

The forecasted growth from this model was used in years 6 through 20 as PLIL.

Electric Vehicles

The methodology for forecasting Electric Vehicles trends uses historical data supplied by Statistics Canada and Manitoba Public Insurance on automobile purchases and registrations per year in Manitoba. To help estimate future trends, appropriate assumptions from recent relevant literature were applied to Manitoba's situation. The forecast section on Electric Vehicles provides further details.

Other Sectors

Seasonal, Water Heating, Lighting

Most of the smaller sales sectors, including Seasonal, Flat Rate Water Heating and Area and Roadway Lighting were forecast by analysis of the changes in the number of customers or services and in changes in average use per customer or service. Growth rates were applied based on history and a best estimate as to what the future will bring.

Diesel

Each of the diesel generated supplied communities was individually forecast and included in the forecast under the assumption that these communities are not anticipated to be connected to the Integrated System during the forecast period.

Monthly Sales Allocations

Monthly percentages of customer growth through the year and GWh for each month of the year were averaged for the past three to five years. The most appropriate growths were applied to the forecasts of annual customers and GWh to get the monthly forecasts.

Monthly and Annual Gross Firm Energy and Gross Total Peak

The 5 year monthly percentage of Common Bus and Station Service are applied to their annual energy to calculate their monthly values. Transmission Losses are calculated using a 5 year average of their ratio to Common Bus. Monthly Common Bus, Transmission Losses and Station Service are added up to give the Monthly System Energy. Monthly Common Bus, Transmission Losses, Station Service and Gross Firm Energy are totaled to give the Annual Gross Firm Energy.

The Gross Total Peak is calculated from Load Factors applied to the forecast monthly Gross Total Energy. Prior to calculating the Load Factors, the Top Consumer energy and peak are subtracted because the Top Consumers have a higher average hourly energy relative to their peak value than the Residential and General Service Mass Market Customers. A 10 year historical average Load Factor is calculated for the remaining energy and is applied to the forecast monthly energy to get the peaks for the remaining energy. The Top Consumer peaks are added using a 92% Load Factor applied to the Top Consumer monthly energy.

The annual Gross Total Peak is calculated using the 3 winter months of December, January and February when the actual peak has typically occurred and applied a ratio from the January peak to be used as the annual peak.

Historical weather adjusted energy is used to calculate the annual Load Factor. The historical trend of the load factor increasing 0.08% per year is applied to the forecast in the winter months when the annual system peak occurs. The number of hours in each month is used to calculate monthly Load Factors.

Growth Rates

Annual GWh/year growth rates in this document are linear growth rates, calculated as: GWh growth / number of years.

Annual percentage growth rates in this document are compound growth rates calculated as: (final GWh / initial GWh) ^ (1 / number of years) – 1.

GLOSSARY OF TERMS

Area and Roadway Lighting sector - includes electricity sales for the Sentinel Lighting and Street Lighting rate groups.

Common Bus - is the total load measured from all the distribution points (i.e. substations) within Manitoba. It includes all energy supplied to General Consumers Sales customers, Construction Power plus associated Distribution Losses, but excludes Diesel customers, Transmission Losses and Station Service.

Customer – Most metered electrical services count as a customer. Unmetered services such as flat rate water heating and sentinel rental services do not count as a customer. Street lighting counts all the services grouped as a premise as one customer.

Codes and Standards – A Demand Side Management (DSM) initiative associated with existing Provincial building codes and improved equipment efficiency standards. This is the only DSM initiative that is specifically accounted for in the forecast.

Curtailable - is a load that can be curtailed on short notice. A discount is given for subscribing to this program. Curtailable loads can affect peak demand because some periods of curtailment may be at or near the system peak.

Gas Available Area – A city or town in Manitoba where customers have natural gas service available and can choose to heat their dwelling with either natural gas or electricity. Approximately 83% of Residential Basic customers, including the entire city of Winnipeg, have gas available.

General Consumers Sales - includes the energy supplied to all of Manitoba Hydro's individually billed customers. It excludes export sales.

General Service Mass Market - includes all Commercial and Industrial customers, excluding the Top Consumers group.

General Service Sector - made up of sales to Commercial and Industrial businesses served by Manitoba Hydro. This sector consists of five rate groups (Basic, Diesel, Seasonal, Flat Rate Water Heating and Surplus Energy Program).

General Service Top Consumers - is made up of the largest electricity users of Manitoba Hydro.

Gross Firm Energy - is the energy required to serve Manitoba Hydro's customers on the Integrated System. It excludes exports, interruptible (non-firm) loads and diesel customers.

Gross Total Peak - is the maximum integrated (i.e. average) hourly load required to serve Manitoba Hydro's customers on the Integrated System. It excludes exports and diesel customers. It includes curtailable loads.

GWh (gigawatt-hour) - The unit of energy primarily used in this document. One GWh equals one million kWh (kilowatt-hours), which is approximately equal to the energy of 100 typical dwellings not using electricity for heating, or 40 dwellings that use electricity for heating.

Integrated System - is the power grid that connects Manitoba Hydro's generation sources to its customers. All Manitoba Hydro's customers except diesel are on the Integrated System.

Interruptible (Non-Firm) Energy - includes all energy sold to Manitoba customers on a non-firm basis. Currently, the only rate group for this is the Surplus Energy Program (SEP).

kWh/cust (kilowatt-hours per customer) - The unit of energy primarily used in this document to represent the average use of one customer. The total usage in GWh of a group of customers is divided by the number of customers and then multiplied by one million.

Load Factor - is the ratio of the average hourly energy over a period, usually a year, divided by the energy used at a specific hour, usually the hour of system peak. A load factor of 25% means that the average energy is one-quarter of what is used at system peak. A load factor greater than 100% means that the average hourly energy is more than what is used at system peak. Given a specific energy, a lower load factor means a higher peak. The equation is:

Load Factor = (Total Energy / Hours) / (Energy over the hour of system peak)

Manitoba Load at Common Bus - is the total load measured from all the distribution points (i.e. substations) within Manitoba. It includes all energy supplied to General Consumers Sales customers plus associated Distribution Losses, but excludes diesel customers, Transmission Losses and Station Service.

MW (megawatt) - The unit of peak demand primarily used in this document. One MW is a million watts. One thousand MW of peak demand for one hour equals one GWh of energy. Alternatively, one MW for a thousand hours also equals one GWh of energy.

Net Firm Energy and Net Total Peak - are the same as Gross Firm Energy and Gross Total Peak except they exclude Station Service. The reporting of Manitoba Load in the Load Forecast used "Net" until 2008. It presented both until 2011. Starting with the 2012 forecast, only the "Gross" is presented. Net can be calculated when needed by subtracting Station Service from the Gross.

Residential Basic – is the primary residential customer group made up of single detached and multi attached dwellings as well as individually metered apartment suites.

Residential sector - made up of sales to residential customers for non-business operations. The Residential sector is comprised of four rate groups (Basic, Diesel, Seasonal, and Flat Rate Water Heating).

Station Service - is the energy used by power plants to generate power and service their own load.

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