CHAPTER 2
LOAD FORECAST

NorthWestern's 2015 Forecast of Customer Loads

Peak Demand Forecast

Peak demand drives and defines the need for capacity resources, establishes resource adequacy benchmarks, and comprises a key planning variable in the 2015 Plan. The analysis of peak demand is prepared by the Energy Supply group in coordination with NorthWestern's Load Research Department using historical hourly load data for the retail customer rate classes. Energy Supply analyzes this data for patterns of use, peak demand, and sensitivity to weather. NorthWestern's loads exhibit dual-peaks, meaning that maximum annual peak demand has occurred in both winter and summer. Actual peak demand for winter and summer, including line losses, is presented in Table 2-1 for the period 2002–2014. The annual peak load forecast presented in Table 2-2, is a 1 in 2 forecast, meaning that there is a 50% probability that forecast peak will be less than actual peak load, and a 50% probability that the forecast peak will be greater than actual peak load. The forecast of peak demand is presented with and without the estimated impacts of DSM measures as noted in the title of each of the tables.

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Table 2-1 Historical Peak Demand

	Historical Peak Demand (MW)		
	Year	Winter	Summer
Actual	**2002**	892	958
	2003	912	1078
	2004	1096	1000
	2005	1096	1026
	2006	1085	1122
	2007	1100	1177
	2008	1165	1071
	2009	1225	1059
	2010	1219	1045
	2011	1139	1091
	2012	1106	1133
	2013	1074	1162
	2014	1272	1115
2002-2014 CAGR		3.00%	1.27%

Table 2-2 Peak Demand 1 in 2

	1 in 2 Peak Demand Forecast Excluding DSM (MW)		
	Year	Winter	Summer
Forecast	**2016**	1224	1154
	2017	1244	1177
	2018	1264	1200
	2019	1285	1222
	2020	1305	1245
	2021	1325	1267
	2022	1344	1289
	2023	1363	1310
	2024	1382	1333
	2025	1390	1344
	2026	1398	1356
	2027	1405	1368
	2028	1413	1379
	2029	1423	1393
	2030	1433	1406
	2031	1443	1420
	2032	1453	1434
	2033	1463	1448
	2034	1473	1462
	2035	1484	1477
2016-2035 CAGR		1.02%	1.31%

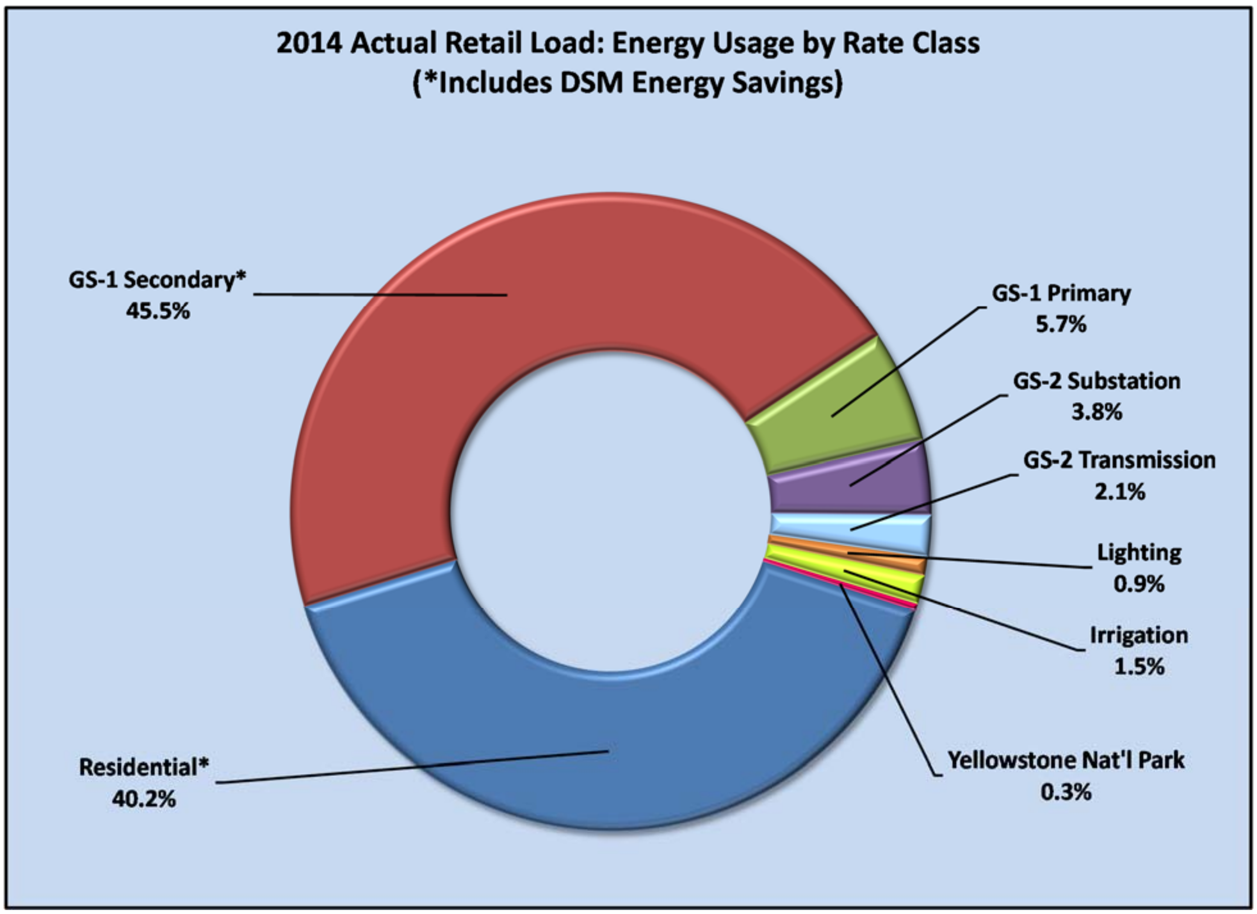
	Peak Demand DSM Savings Forecast (MW)		
	Year	Winter	Summer
Forecast	**2016**	40	38
	2017	50	48
	2018	60	58
	2019	69	66
	2020	79	76
	2021	89	86
	2022	99	95
	2023	109	104
	2024	118	114
	2025	118	114
	2026	118	114
	2027	118	114
	2028	118	114
	2029	118	114
	2030	118	114
	2031	118	114
	2032	118	114
	2033	118	114
	2034	118	114
	2035	118	114
2016-2035 CAGR		5.85%	5.95%

	1 in 2 Peak Demand Forecast Including DSM (MW)		
	Year	Winter	Summer
Forecast	**2016**	1184	1116
	2017	1195	1129
	2018	1205	1143
	2019	1216	1156
	2020	1226	1169
	2021	1236	1181
	2022	1246	1194
	2023	1254	1206
	2024	1263	1219
	2025	1272	1231
	2026	1280	1242
	2027	1287	1254
	2028	1295	1265
	2029	1304	1279
	2030	1314	1292
	2031	1324	1306
	2032	1335	1320
	2033	1345	1334
	2034	1355	1348
	2035	1365	1363
2016-2035 CAGR		0.75%	1.06%

Energy Usage and Needs

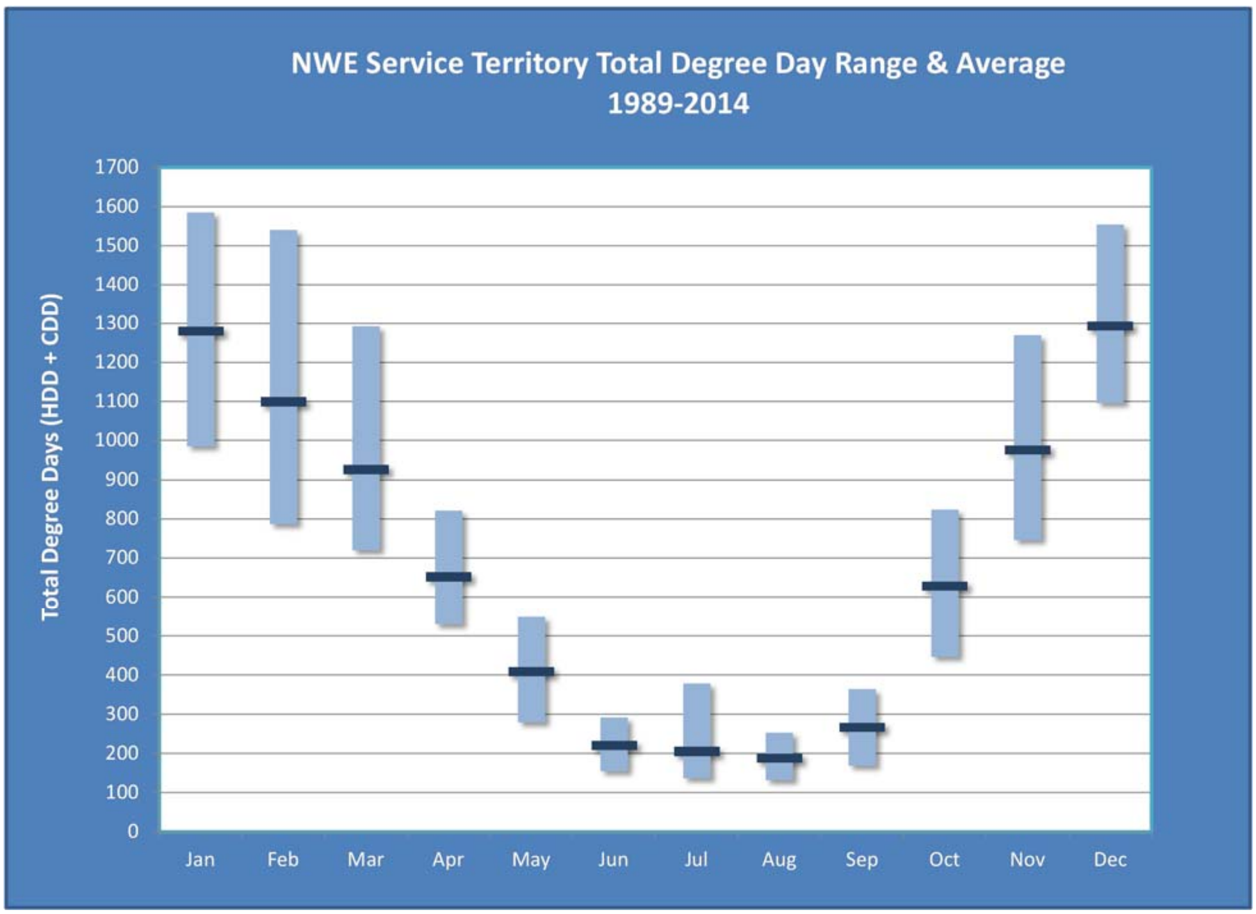
NorthWestern develops its 20-year long-term energy forecast using a regression model with two explanatory variables: a forecast of customer count and degree days. Residential and GS-1 Secondary (small commercial) rate classes represent approximately 85% of the total energy load-serving obligation (see Figure 2-1) so much of the energy usage and peak demand forecasting work focuses on these customer classes. Additionally, these two classes of retail customers are weather sensitive and respond quickly and predictably to temperature changes.

Figure 2-1 2014 Actual Retail Load Energy Usage by Rate Class



Weather is normalized by using average historical total degree days per year, heating degree days ("HDD") plus cooling degree days ("CDD"). Degree days are calculated according to the average daily temperature compared to 65° (Fahrenheit). If 65° minus the average daily temperature equals a positive value, the value is recorded as HDD; if a negative value is derived, the value is recorded as CDD. Figure 2-2 illustrates the monthly average and total range in weather variability in terms of degree days that have been recorded in the NorthWestern Montana service territory since 1989.

Figure 2-2 NorthWestern Service Territory Total Degree Day Range and Average 1989-2014



Other variables that may impact customer loads, such as economic conditions and DSM activity, are not included in the forecast. Several economic business cycles could occur over the course of the 20-year planning horizon, but NorthWestern has no practical way or predicting and measuring such cycles. However, the use of a long-term historical average annual growth rate, which does include the impacts of several economic business cycles, is incorporated in the long-term load forecast.

NorthWestern acquires about 1% of retail sales, or 6 aMW, of energy efficiency each year through its DSM programs. Over time, accumulated DSM reduces NorthWestern's load-serving obligation significantly and acts to dampen load growth that would otherwise occur. Figure 2-3 below provides the long-term load-serving obligation projection (blue) and expected DSM energy efficiency savings (gray) over the planning horizon; the stacked components illustrate what the load-serving obligation would otherwise be without the energy-reducing benefit of DSM.

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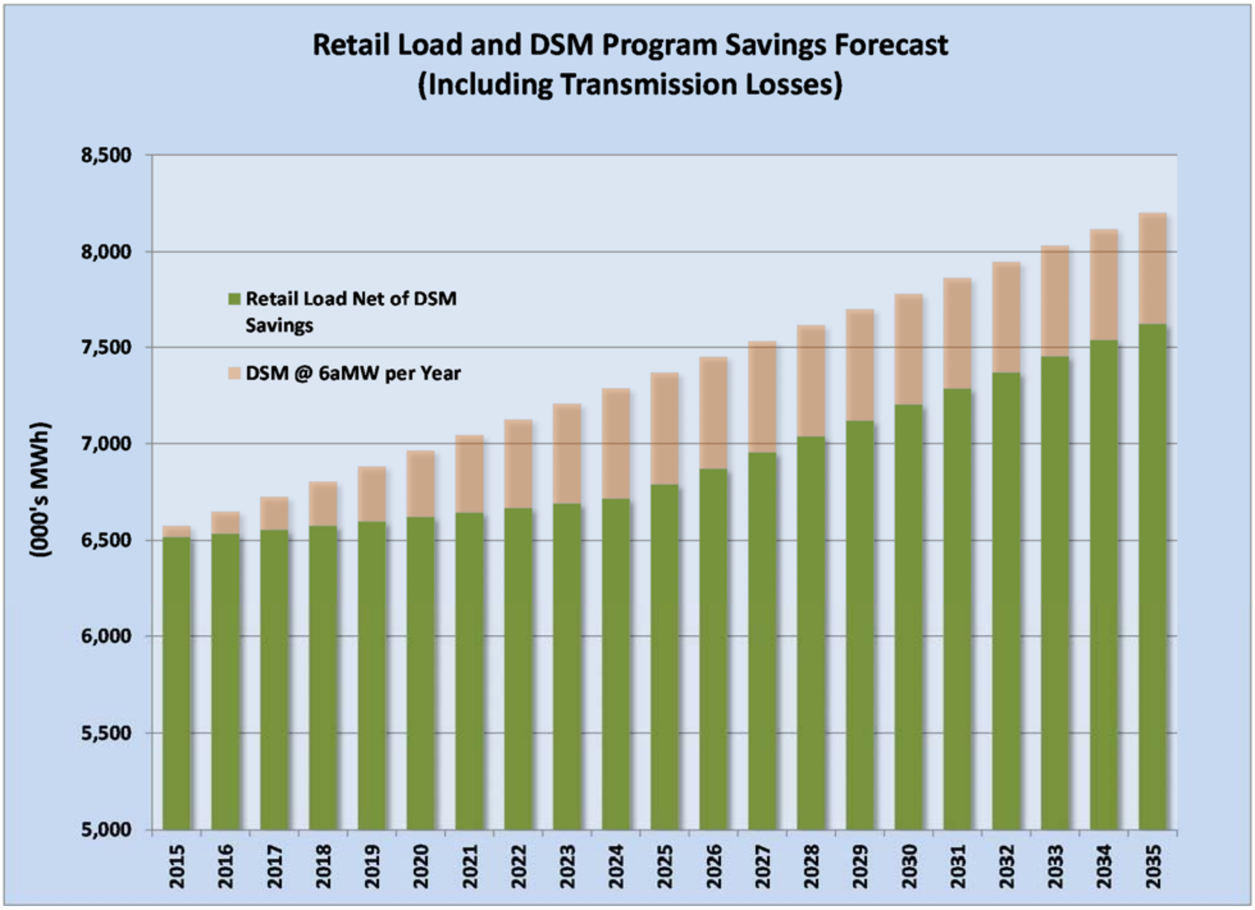
Figure 2-3 Retail Load and DSM Program Savings Forecast



DSM is an important long-term component in NorthWestern's supply stack. Currently, the long-term projected average annual growth rate of load is 1.1% per year excluding DSM and 0.8% net of DSM energy savings. The compounding growth of energy savings measures can be observed from 2016 through 2024. Based on the DSM acquisition assessment conducted in 2009, NorthWestern anticipates procuring approximately 750,000 fewer megawatt-hours ("MWh") per year by 2024 than it would otherwise have needed to procure without the energy savings from DSM program measures. DSM programs are discussed further in Chapter 3.

Customer Forecast

Residential and GS-1 Secondary (small commercial) customers make up 85% of NorthWestern Energy's load-serving obligation but they make up 98% of the Company's electric customers or accounts. The primary driver of the customer forecast is the projected population in NorthWestern's service territory, which is comprised of 37 of Montana's 56 counties. The State of Montana's Census and Economic Information Center publishes Montana's population forecast on its website and NorthWestern uses this in its forecasting work. The forecast is constructed using an independent econometric model developed by Regional Economic Models, Inc. that provides county population projections through 2060. As shown in Table 2-3, actual and expected population growth for the state of Montana and NorthWestern's service territory is about the same – approximately 1%. Total Accounts are expected to grow at about a 1.3% annual rate, greater than population growth because of total new connects in residential single and multi-family housing units and commercial buildings.

Table 2-3 Actual and Expected Population Growth

Year	Montana Population	*Annual Growth Rate*	NWE Srvc Territory Population	*Annual Growth Rate*	NWE Total Accounts	*Annual Growth Rate*	NWE Residential Accounts	*Annual Growth Rate*	NWE GS1-Secondary Accounts	*Annual Growth Rate*
2000	903,293		705,330		292,437		235,784		49,759	
2005	934,801	*0.7%*	731,505	*0.7%*	315,755	*1.5%*	253,124	*1.4%*	55,491	*2.2%*
2010	990,575	*1.2%*	774,891	*1.2%*	338,804	*1.4%*	270,571	*1.3%*	60,872	*1.9%*
2015	1,033,902	*0.9%*	807,496	*0.8%*	357,897	*1.1%*	286,311	*1.1%*	64,183	*1.1%*
2020	1,087,097	*1.0%*	848,406	*1.0%*	381,736	*1.3%*	304,800	*1.3%*	69,533	*1.6%*
2025	1,143,030	*1.0%*	891,388	*1.0%*	406,685	*1.3%*	324,206	*1.2%*	75,076	*1.5%*
2030	1,201,841	*1.0%*	936,547	*1.0%*	432,453	*1.2%*	344,454	*1.2%*	80,596	*1.4%*
2035	1,263,677	*1.0%*	983,995	*1.0%*	459,108	*1.2%*	365,556	*1.2%*	86,149	*1.3%*

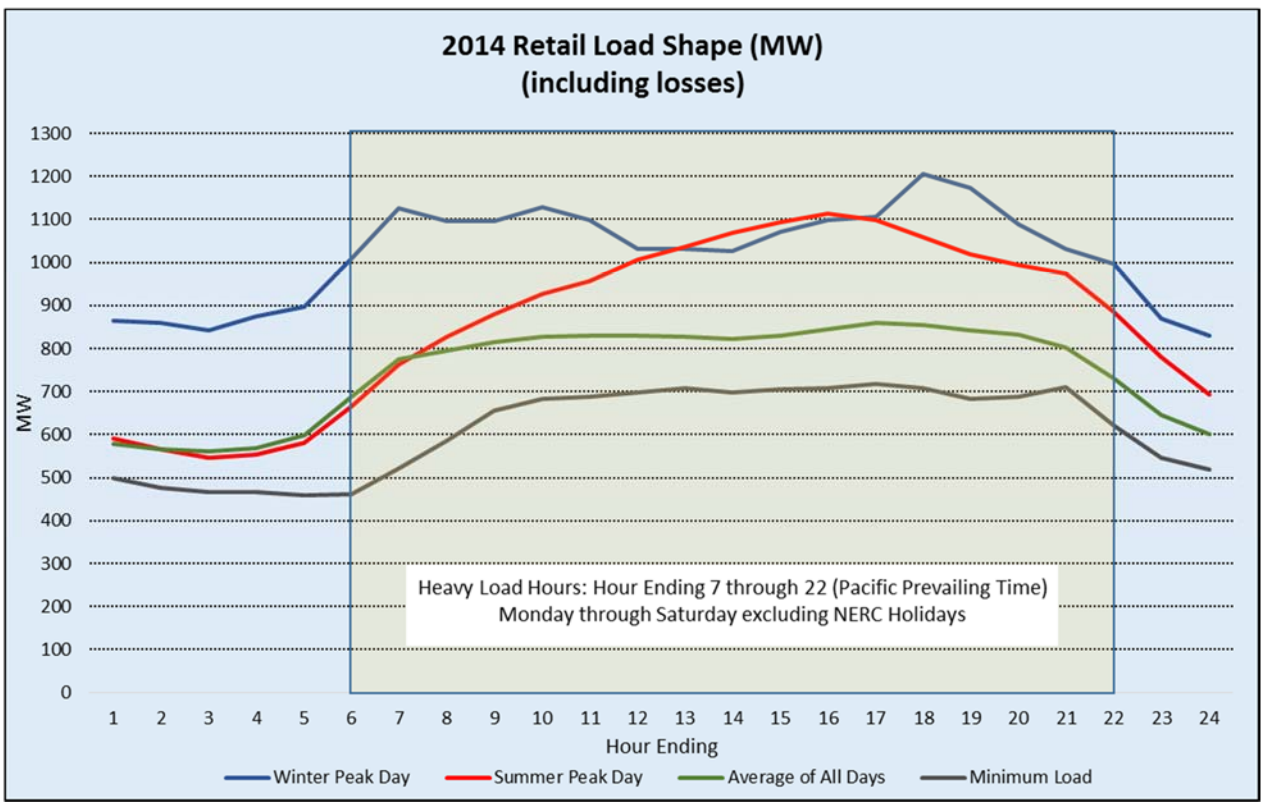
In addition to the information presented on peak demand and load forecasting in this chapter, supporting data and load analysis can be found in Volume 2, Chapter 2.

Retail Load Shape

The retail load shape is driven primarily by the energy consumption patterns from two rate classes: residential and GS-1 secondary. The pattern of retail consumption is seasonal and weather sensitive according to changes in outside air temperatures which span a range from over 100 degrees Fahrenheit to double digit negative values in a typical year.

Figure 2-4 illustrates the range of hourly retail load including losses for 2014. The blue and red lines show the peak winter and summer load days while the black line illustrates a minimum load day from May. The green line was created by averaging the hourly load values for individual hours of the day.

Figure 2-4 2014 Retail Load Shape



The gray shaded area represents HL hours defined as hour ending 6 – 22 on Monday through Saturday (Pacific Prevailing Time ("PPT")) and excluding NERC holidays. Remaining hours are defined as LL hours.

From the load-serving perspective it is critically important to account for load changes in order to reliably meet load by matching resource accordingly. Reviewing the winter peak day shown in Figure 2-4, loads varied from approximately 830 MW to a maximum of 1,200 MW – a range of approximately 370 MW. In the summer the range of load is much greater where the minimum load of roughly 550 MW doubles to 1,100 MW over a 24-hour period.

Energy Load – Balance

NorthWestern's load-serving obligation requires that Energy Supply acquire resources sufficient to achieve a balance between loads and resources. Load-resource balance is achieved when resources equal loads. The amount and timing of resource acquisitions is determined by comparing the existing supply portfolio to forecast need. Additionally, differences in need between heavy-load and light-load (also referred to as on- and off-peak) periods must also be considered. Simply averaging or ignoring these differences would not balance either load-serving period and would likely lead to energy deficits during HL hours and energy surpluses during LL hours.

Figures 2-5 and 2-6 illustrate NorthWestern's HL and LL load-resource balance over the next 10 years using forecast loads and existing resources. Each figure is compiled using monthly load values and reflects the seasonality of loads, resulting in a "spiky" appearance. The red line represents loads, while NorthWestern's existing resources are shown as a resource stack. Comparing forecast loads to the existing resource stack in each figure indicates the volume of resource needed to meet forecast loads.

The resource stack in each figure is constructed using average annual energy production for each existing resource. Existing wind resources are shown in the resource stack at their average annual energy production, which is equal to about 38% of generation at full capacity (also known as capacity factor). However, in any one hour cumulative wind may vary between 0% and 91% of total installed capacity. The area between the dotted lines in each figure represents the variability in wind that may occur from hour to hour (wind variability band). This band of variability represents uncertainty that NorthWestern must manage when procuring resources to serve loads.

Several conclusions can be drawn from Figures 2-5 and 2-6. First, NorthWestern has some ongoing need for resources that produce, or can be called on to produce, during HL hours. Second, NorthWestern has no need for resources that produce during LL hours. This category of resources generally includes must-take resources like non-curtailable intermittent wind. NorthWestern's wind at 0% and wind at 91% have been included in the figures (black dashed lines) to graphically portray the potential swing in wind resources that NorthWestern must be able to deal with in any one hour. The potential swing in wind production from hour to hour requires flexible, or ramping, resources. NorthWestern has modeled this need and presents the results of that analysis in Chapter 12.

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Figure 2-5 Current plus Market 5-Year HL MWh

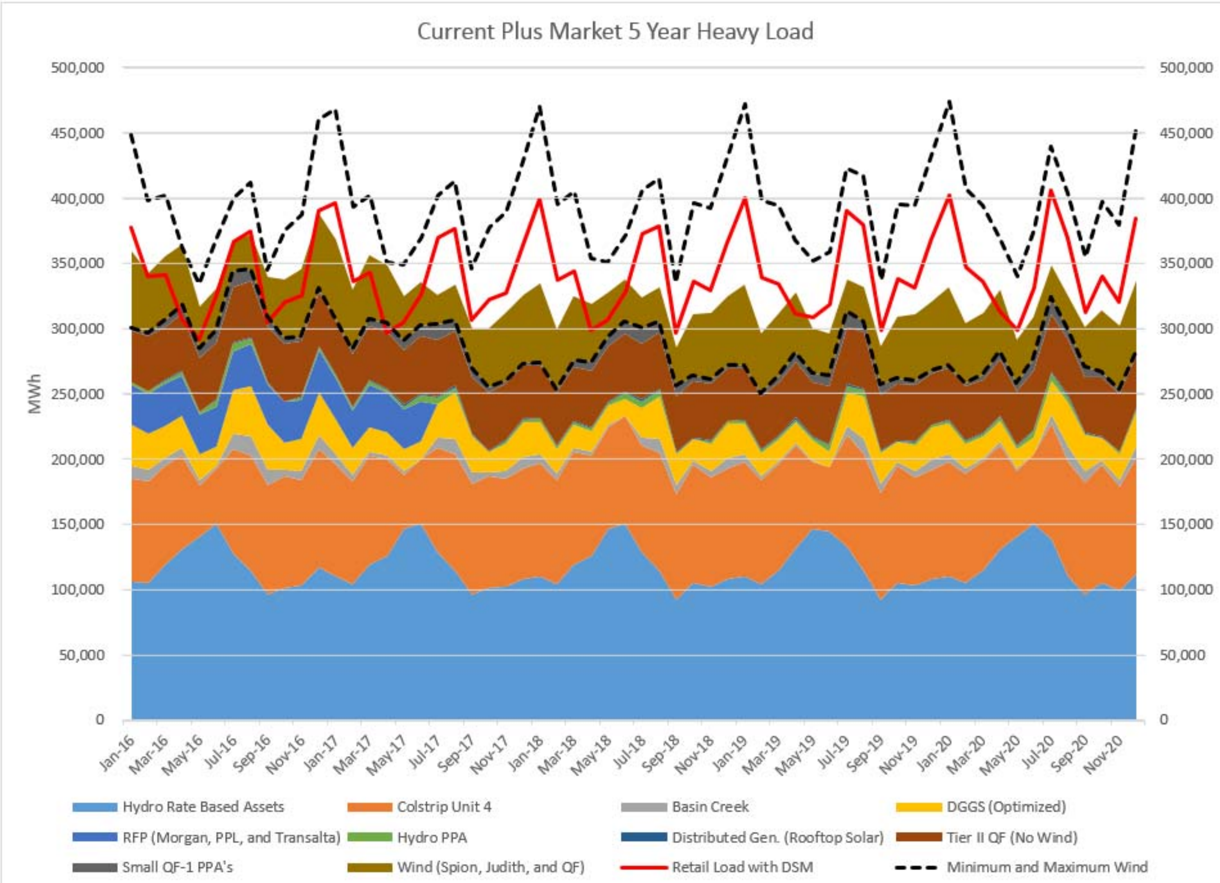

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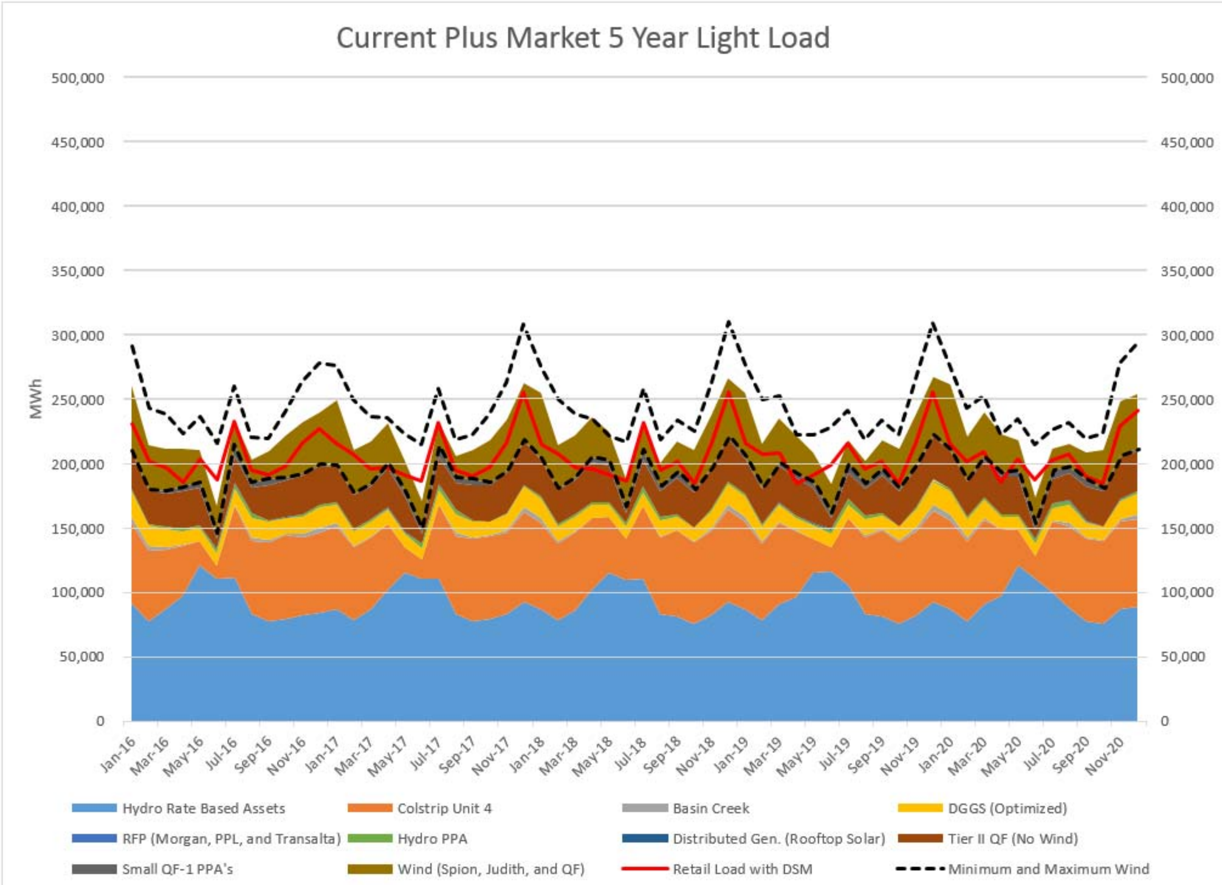
Figure 2-6 Current plus Market 5-Year LL MWh



Conclusion

NorthWestern is short on the physical capacity needed to meet peak loads and has some need for additional heavy load hour resources, but has little to no need for additional light load hour resources. Therefore, NorthWestern's first priority resource need is for dispatchable peaking resources and, on a much lower priority, some need for dispatchable heavy load hour resources. Specifically, NorthWestern has little to no need for additional intermittent renewable resources like wind, except to meet Renewable Portfolio Standards ("RPS") as required by law.

NorthWestern’s resource needs assessment, combined with its current portfolio of resources, drives the selection of resources as presented in Chapter 12. Other factors driving resource selection are the integration of system operations (presented in Chapter 10) and ancillary services (Chapter 11).