Before the North Dakota Public Service Commission
State of North Dakota

In the Matter of the Application of Otter Tail Power Company
For Authority to Increase Rates for Electric Utility
Service in North Dakota

Case No. PU-17-

Exhibit___

ENERGY SALES FORECAST

Direct Testimony and Schedules of

BRIAN H. DRAXTEN

**PUBLIC DOCUMENT – NOT PUBLIC (OR PRIVILEGED)
DATA HAS BEEN EXCISED**

November 2, 2017

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Prefiled Direct Testimony and Schedules of Brian Draxten (redacted) - Volume 2C
Otter Tail Power Company

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ATTACHED SCHEDULES

NOTE: The data files used to create the sales forecast and revenue forecast are voluminous and have been provided on accompanying disks.

I. INTRODUCTION AND QUALIFICATIONS

Q. PLEASE STATE YOUR NAME AND OCCUPATION.

A. My name is Brian H. Draxten. I am employed by Otter Tail Power Company (OTP) as its Manager, Resource Planning.

Q. PLEASE SUMMARIZE YOUR QUALIFICATIONS AND EXPERIENCE.

A. I have worked for OTP for 36 years in various positions, including as a Rates Analyst, Manager of Market Research, and Manager of Budget. I have served in my current position as Manager of Resource Planning since January 2008. In that position, I am responsible for the Load Forecasting and Resource Planning functions at OTP. I oversee the development of the retail sales forecast, the related demand forecast, and the resource plan. I also manage the related analyses for these processes.

I have a Bachelor of Arts degree in accounting with a minor in business finance from Moorhead State University in Moorhead, Minnesota. A copy of my resume is included as Exhibit ___ (BHD-1), Schedule 1.

II. PURPOSE AND OVERVIEW OF DIRECT TESTIMONY

Q. WHAT IS THE PURPOSE OF YOUR DIRECT TESTIMONY?

A. I will discuss OTP's energy forecasting process, including the 2018 Test Year forecast customer count and energy sales to be used in setting rates in this proceeding.

Q. PLEASE PROVIDE A BRIEF OVERVIEW OF YOUR DIRECT TESTIMONY.

A. OTP is forecasting 1,810 gigawatt hours (GWh) of North Dakota sales in the 2018 Test Year. The class-by-class 2018 Test Year sales are shown in Table 1 below.

Table 1
2018 Test Year Forecasted Sales

Class	kWh	Percent of Total Sales
Residential	613,950,110	33.9%
Farms	39,840,654	2.2%
Small Commercial	267,760,078	14.8%
Large Commercial	858,966,988	47.5%
Other Public Authority	16,459,056	0.9%
Streetlighting	12,795,273	0.7%
Total	1,809,772,159	
Unclassified	3,874,985	

The 2018 Test Year sales are 2.5 percent higher than sales from OTP's 2008 Rate Case (Case No. PU-08-862), which equates to approximately 0.25 percent annual average growth over the 10-year period.[1] OTP witness Mr. Bruce G. Gerhardson discusses the impact of the relatively small change between the 2007 Test Year sales and the 2018 Test Year sales in his Direct Testimony.

Q. HOW IS YOUR DIRECT TESTIMONY ORGANIZED?

A. In Section III, I discuss trends in OTP's North Dakota sales and our forecasting methodology. In Section IV, I discuss our class-by-class forecasts. Section V contains my conclusion.

[1] OTP's 2008 Rate Case used a 2008 historical Test Year and sales were based on 2007 actual (not weather normalized) sales with one adjustment for a large industrial customer coming online in 2008. This resulted in 2007 Test Year sales of 1,766 GWh.

III. CUSTOMER SALES AND FORECASTS

A. Sales Trends

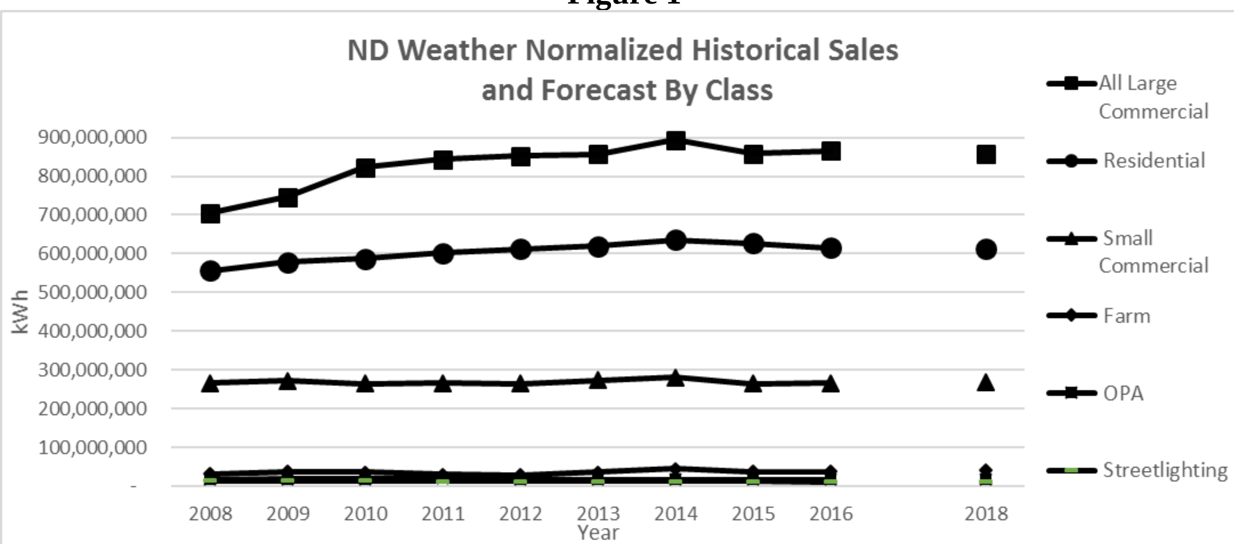
Q. PLEASE DESCRIBE THE RECENT TRENDS IN OTP'S NORTH DAKOTA SALES.

A. As noted in Figure 1 below, OTP's North Dakota Sales are basically flat since 2015. The average annual growth rate between 2008 actual weather normalized sales and the 2018 Test Year forecast is 1.02 percent.

Q. IS THE PATTERN OF RELATIVELY FLAT SALES CONSISTENT ACROSS ALL CLASSES?

A. Yes. As demonstrated in Figure 1, all classes show minimal growth from 2016 levels, and all classes except Large Commercial[2] have seen little to no growth from 2008 levels.

Figure 1



[2] As noted above, the 2007 Test Year included one adjustment for a large industrial customer coming online in 2008. It took several years for that customer's sales to materialize, which is the largest driver of the increase in Large Commercial sales between 2008 and 2010. The customer's sales have remained relatively consistent from 2010 forward, though at levels that are significantly lower than those assumed in the 2008 Rate Case.

Q. WHAT FACTORS ARE CONTRIBUTING TO OTP'S RELATIVELY FLAT SALES?

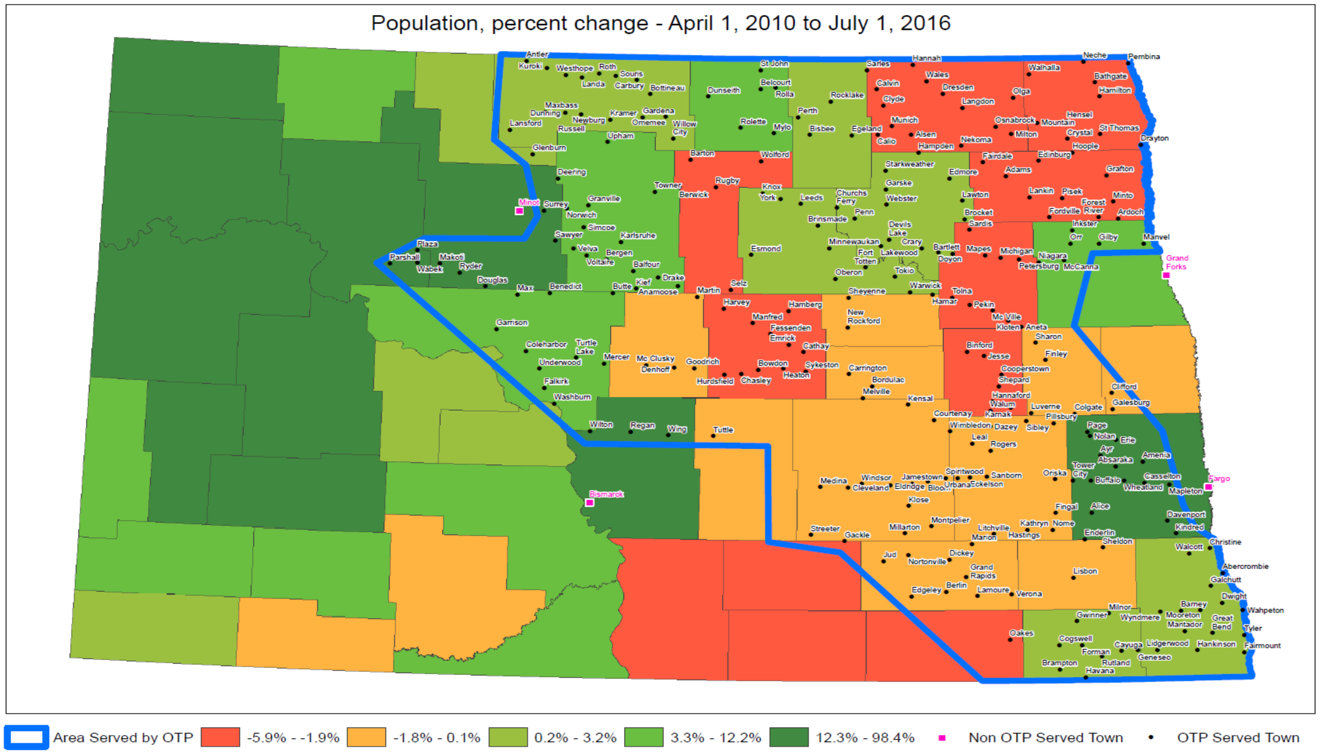
A. One factor is little to no customer growth. OTP's North Dakota customer count has grown by less than 0.25 percent annually since the 2008 Rate Case. Another factor contributing to the flat sales is the agriculture industry. Recent dry years and low crop prices have decreased sales to farm customers and to commercial and industrial customers in related agricultural industries.

Q. HAVE THE AREAS SERVED BY OTP GROWN SINCE OTP'S LAST RATE CASE?

A. No. North Dakota's population has grown significantly, with total population growing by 12.7 percent between 2010 and 2016.[3] That growth, however, has been concentrated in the western portion of the State that is not served by OTP. Many of the counties served by OTP have actually experienced population *loss* over the last several years. This can be seen in Figure 2 below, which is a reproduction of Exhibit ___ (BHD-1), Schedule 2.

[3] https://www.census.gov/quickfacts/fact/dashboard/ND/PST120216.

Figure 2
North Dakota 2010-2016 Population Change by County[4]



Q ARE THESE TRENDS EXPECTED TO CONTINUE INTO THE FUTURE?

A. Yes. Population projections developed by the North Dakota Census Office in January 2016 forecast that the trend of western population growth outpacing eastern population growth is expected to continue into the future.[5]

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[4] https://www.census.gov/quickfacts/fact/map/ND/PST120216.
[5] North Dakota Census Office Population Projections of the State, Regions and Counties 2016 (Jan. 19, 2016), *available at* https://www.commerce.nd.gov/uploads/8/2016PopulationsProjectionsFinal.docx.

Q. ARE 2018 TEST YEAR CUSTOMER COUNTS CONSISTENT WITH THESE POPULATION FIGURES?

A. Yes. Customer counts for the 2018 Test Year sales forecast are consistent with the historical trends of little to no population growth in the areas served by OTP. Table 2 below shows the class-level growth in customer counts from 2016 actuals.

Table 2
Comparison of 2018 Test Year Customer Count to 2016 Actuals

Year	2016	2018	% Change
Residential	45,892	45,851	-0.09%
Farm	1,001	1,005	0.40%
Small Commercial	10,518	10,472	-0.44%
Large Commercial	981	973	-0.82%
Other Public Authority	287	290	1.05%
Streetlighting	203	203	0.00%
Unclassified	77	79	2.60%

Q. IS THE RELATIVELY LITTLE GROWTH ASSOCIATED WITH THE 2018 TEST YEAR SALES FORECAST CONSISTENT WITH REGIONAL AND NATIONAL TRENDS?

A. Yes. Midcontinent Independent System Operator, Inc. (MISO) is using a 0.5 percent baseline 20-year energy growth rate for the midpoint assumption in the 2018 MISO Transmission Expansion Planning study.[6] The U.S. Energy Information Administration similarly projects growth in electricity use will remain relatively low into the future based on a variety of factors:

> In recent history, the growth in electricity demand has slowed as older equipment was replaced with newer, more efficient stock, as efficiency standards were implemented and technology change occurred, particularly in lighting and other appliances. The demographic and economic factors

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[6] *See* MISO MTEP18 Futures, Planning Advisory Committee, p. 13 (June 14, 2017), *available at* https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/PAC/2017/20170614/20170614%20PAC%20Item%2002a%20MTEP18%20Futures.pdf.

driving this trend included slowing population growth and a shifting economy toward less energy-intensive industries.[7]

Thus, OTP's experience of almost no sales growth and forecast of relatively little growth in the 2018 Test Year is consistent with regional and national expectations.

B. **Methodology and Inputs**

Q. PLEASE SUMMARIZE OTP'S SALES FORECAST METHODOLOGY.

A. OTP forecasts both a class customer count and a class Use per Customer (UPC). The class customer count is multiplied by the class UPC to arrive at the class kilowatt hour (kWh) sales forecast. OTP uses multiple econometric models to create forecasts for each class of customers. Weather data, economic data, customer counts, and historical usage are all inputs to the models. For each class, multiple economic variables are tested and those that have a statistical relevance to the model are used. When all models are complete, they are compared to actual historic data for reasonableness. Additional detail regarding our customer and sales forecast procedure is included in Exhibit ___ (BHD), Schedule 3.

Q. DOES OTP USE THIS FORECASTING METHODOLOGY FOR ALL CLASSES?

A. Generally, yes, though OTP does manually forecast sales to several of our largest customers. The manual forecasts involve discussions with individual customers to obtain their expected future energy usage as well as our own assessment of various economic, regulatory, legislative factors, and specific industry trends.

In North Dakota, we manually forecast sales for pipeline pumping customers, ethanol producers, and certain large manufacturers. We also manually forecast sales to oil pipeline pumping customers in Minnesota. South Dakota has no manually forecasted customers.

[7] U.S. Energy Information Administration, Annual Energy Outlook 2017, p. 76, *available at* https://www.eia.gov/outlooks/aeo/pdf/0383(2017).pdf.

Q. WHAT IS THE BASIS FOR THE 2018 TEST YEAR SALES FORECAST?

A. The 2018 Test Year sales forecast was completed in July 2017. The historical data used to develop the forecast runs through May 2017.

Q. WHAT IS THE SOURCE OF HISTORICAL CUSTOMER COUNTS AND ENERGY USAGE DATA?

A. Historical customer counts and usage data for the sales forecast are from our Customer Information System (CIS). This dataset is internally referred to as "CIS/A". We have had this dataset in place since the early 1990s. This dataset applies billing corrections in the month that the actual bill occurred, as opposed to including the corrections in the month that they are made within CIS. This dataset more accurately reflects actual usage during the applicable timeframe. The historical customer counts are used to forecast customer counts, while historical usage is used in the UPC forecast.

Q. DOES OTP USE ECONOMIC DATA IN ITS FORECAST?

A. Yes. OTP used economic data for North Dakota, Minnesota, and South Dakota purchased from Woods and Poole Economics. This data is at a county level. OTP serves a large service territory and in some instances, OTP serves only a small percentage of the population in any given county. To prevent interference from counties where OTP only serves a small percentage of the total county population, economic data from any county where OTP serves less than 10 percent of the population of the county is excluded.

Q. HOW IS ECONOMIC DATA USED IN THE SALES FORECAST PROCESS?

A. Economic data is generally used to forecast customer counts. It is not used in the UPC forecasts because economic growth does not have a significant impact on usage and what little growth that may occur as a result of economic growth is offset by the improvement in energy efficiencies of equipment and household products.

Q. PLEASE DESCRIBE HOW WEATHER DATA IS USED IN THE SALES FORECAST.

A. Weather data is the primary driver used in the UPC forecasts. OTP uses 20 years of historical weather data paired with 20 years of usage data to develop a relationship between weather and UPC. This relationship is used in the UPC model to predict future UPC.

OTP also uses "normal" weather to determine what historic sales would have been during a normal weather year. By applying "normal" weather to historical data, OTP is able to remove most of the effects of non-normal weather on historical sales during those years. Similarly, the 2018 Test Year sales forecast is based on a normal weather year.

Q. HOW DOES OTP CALCULATE NORMAL WEATHER?

A. OTP serves an extremely large geographic foot print, covering over 70,000 square miles. OTP uses data provided by the weather division of Schneider Electric (www.schneider-electric.com). They capture weather measurements from fourteen weather stations situated throughout OTP's service area. Schneider Electric goes through multiple data "cleansing" processes to ensure the data is correct and missing values are filled.

OTP has North Dakota customers near eight of these weather stations, and these stations are used in the North Dakota weather normalization process. OTP uses data from these eight weather stations to calculate daily average Heating Degree Days (HDD) and Cooling Degree Days (CDD) for North Dakota. HDD and CDD are measurements designed to reflect the energy needed to heat or cool a building. It is derived from measurements of outside air temperature. The heating and cooling requirements for a given structure at a specific location are considered to be directly proportional to the number of HDD and CDD at that location. The daily average temperature is compared to a base temperature to determine HDD and CDD. The base temperature used in OTP's weather normalization was 55 degrees Fahrenheit for HDD and 65 degrees Fahrenheit for CDD. These are calculated for each month and are then averaged over a 20-year period to create normalized HDD and CDD.

Q. HOW DOES OTP DETERMINE WHICH DATA INPUTS ARE STATISTICALLY RELEVANT IN ITS FORECAST MODELS?

A. Various independent variables were used in the creation of the models. Generally, variables with a t-statistic value of the absolute value of 2 or greater are considered good predictor variables, and OTP attempted to only select variables that met this criterion. Some exceptions do exist – for example, some monthly binary variables do not meet this criterion for some of the months but were still used in the model because there are enough weather differences month-to-month to warrant the inclusion of these variables.

In addition to monthly binary variables, other binary variables are used in the models. While OTP uses a large amount of historical data to better predict future sales, recent trends in usage patterns may be much different than usage patterns earlier in the 20-year period. For example, there is a clear change in usage patterns of some classes starting around 2014 due to extreme weather and economic issues related to commercial customers. Both the number of customers and usage patterns often change during periods of economic change, and binary variables help reflect that change.

OTP also uses other statistical tests (the R-squared, Mean Absolute Percent Error (MAPE), and the Durbin Watson Statistic) to check the reasonableness of the models. Each model has also been reviewed graphically by various areas within OTP, compared to historical data, and found to be reasonable.

IV. 2018 TEST YEAR CLASS SALES FORECASTS

A. Residential

Q. WHAT ARE THE MAIN VARIABLES IN FORECASTING RESIDENTIAL CLASS SALES?

A. North Dakota Residential class sales are the product of forecasted customer count and UPC for the Residential class. Forecasted customer count is primarily a function of the number of households and the historical population. Residential class UPC is driven mostly by weather and historical UPC.

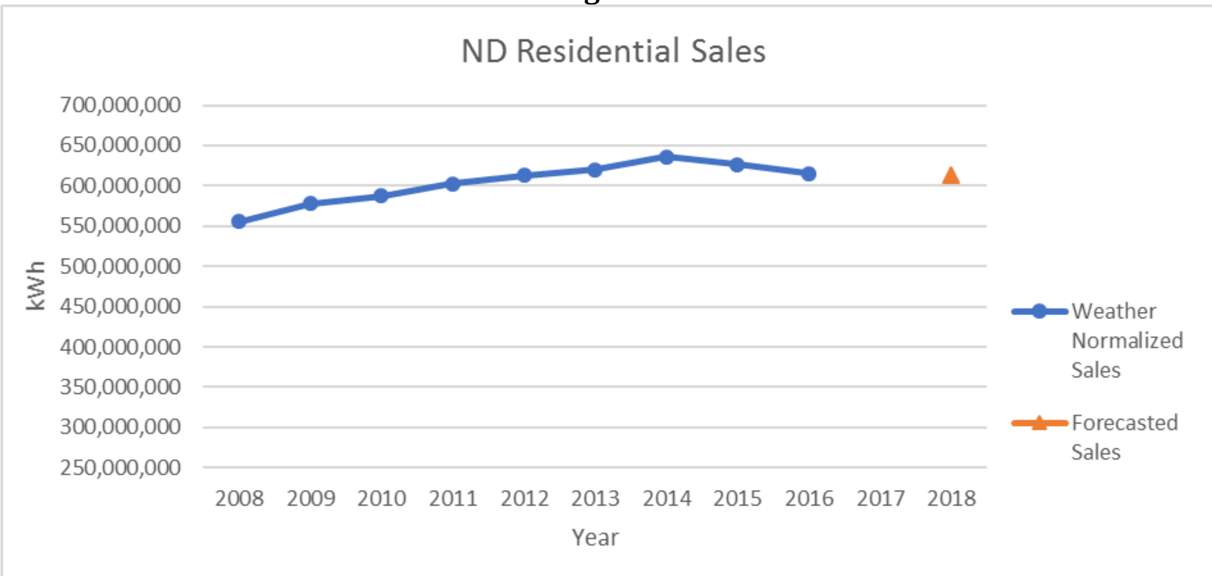
Q. PLEASE DISCUSS HOW WEATHER IMPACTS THE FORECAST OF RESIDENTIAL CLASS SALES.

A. This class is extremely weather-sensitive, so weather is an important predictor of sales. The objective in forecasting this class is to forecast it as though it is a "normal" weather year – neither extremely warm nor extremely cold. OTP does have a significant number of electric heating customers, so this class has more seasonal deviation than most other classes.

Q. HOW DO 2018 TEST YEAR RESIDENTIAL CLASS SALES COMPARE WITH RECENT ACTUAL, WEATHER NORMALIZED RESIDENTIAL CLASS SALES?

A. The 2018 Test Year Residential sales are 0.16 percent lower than actual 2016 weather normalized Residential sales. This is generally consistent with the recent past. Between the years of 2007 and 2014, this class was growing at a rate of 1.89 percent. Growth ended in 2015, with sales decreasing by 1.51 percent in 2015 and by 1.85 percent in 2016. While customer counts were up very slightly in 2015 and 2016, the growth in customer count was not enough to counter a decrease in UPC, which was likely related to energy efficiency seen in household appliances, electronics, and LED lighting. Figure 3 shows weather normalized historical sales and forecasted sales for the Residential class.

Figure 3



B. **Farms**

Q. WHAT ARE THE MAIN VARIABLES IN FORECASTING FARM CLASS SALES?

A. North Dakota Farm class sales are the product of forecasted customer count and UPC for the Farm class. OTP has found the number of households to be a significant predictor of Farm customer counts. Farm class UPC is mainly driven by weather.

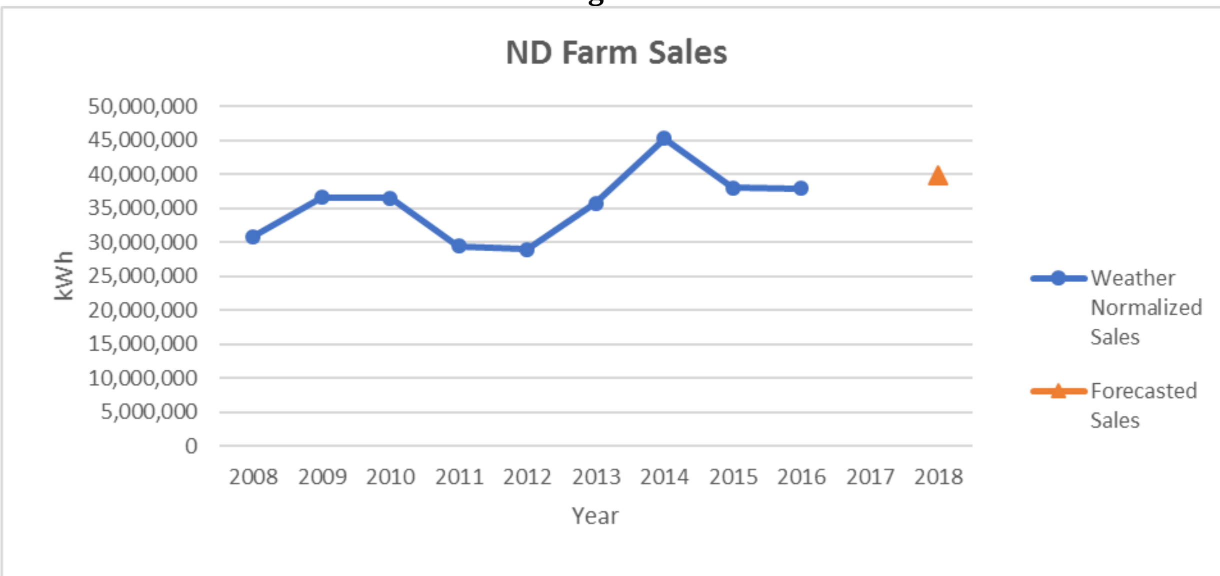
Q. PLEASE DISCUSS HOW WEATHER IMPACTS THE FORECAST OF FARM CLASS SALES.

A. Much of the Farm class load is grain drying. When and whether grain might require drying is difficult to predict and is largely dependent on precipitation levels. Grain drying sometimes occurs in August, September, October, or November – or not at all.

Q. HOW DO 2018 TEST YEAR FARM CLASS SALES COMPARE WITH RECENT ACTUAL, WEATHER NORMALIZED FARM CLASS SALES?

A. We forecast 2018 Test Year Farm class sales to be 5.2 percent greater than actual 2016 weather normalized Farm class sales, echoing the steady growth that has occurred in this class since 1997. As shown in the figure below, recent sales to the Farm class have been quite variable: for example, in 2014, sales grew by 26.73 percent from the prior year, while in 2015, sales fell by 16.06 percent. The 2018 Test Year forecast is consistent with the longer-term (since 1997) upward trend in sales for this class. Farm class sales since 2008 are shown in Figure 4 below:

Figure 4



C. **Small Commercial**

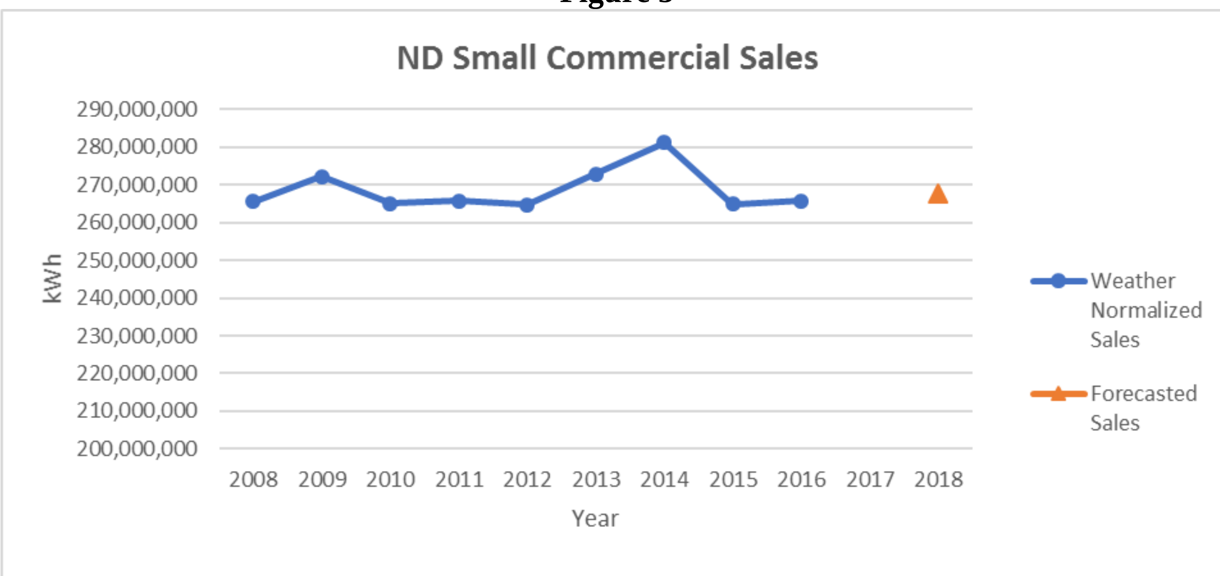
Q. WHAT ARE THE MAIN VARIABLES IN SMALL COMMERCIAL CLASS SALES?

A. North Dakota Small Commercial class sales are the product of forecasted customer count and UPC for the Small Commercial class. Gross Regional Product is the main predictor of customer count in this class. The main driver of UPC is weather. A downturn in the agricultural economy and a spike in propane prices for the winter of 2013-14 also had significant impacts on this customer class. See a more detailed discussion of these factors in the Large Commercial customer class below.

Q. HOW DO 2018 TEST YEAR SMALL COMMERCIAL CLASS SALES COMPARE WITH RECENT ACTUAL, WEATHER NORMALIZED SMALL COMMERCIAL CLASS SALES?

A. OTP forecasts 2018 Test Year sales for this class to be 0.78 percent higher than actual 2016 weather normalized Small Commercial class sales. The slight increase in 2018 Test Year sales is due to an increase in UPC. The 2018 Test Year Small Commercial sales are generally consistent with sales to this class since 2010.[8] Small Commercial class sales since 2008 are shown in Figure 5 below:

Figure 5



D. **Large Commercial**

Q. WHAT ARE THE MAIN VARIABLES IN LARGE COMMERCIAL CLASS SALES?

A. Except for a few manually forecasted customers, North Dakota Large Commercial class sales are the product of forecasted customer count and UPC. The Large Commercial Class

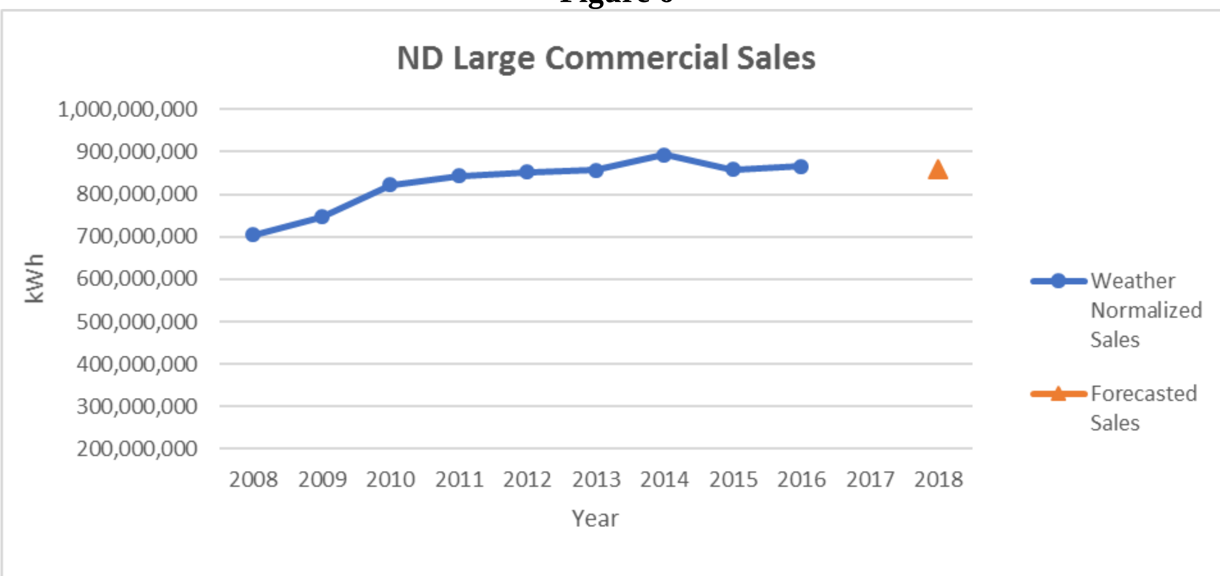
[8] OTP experienced extreme weather in 2013 and 2014. OTP's internal research indicates that this extreme weather is the reason 2013 and 2014 Small Commercial sales are above the 2010-2016 trendline.

customer count model is based on historical customer counts. The UPC model uses weather and historical sales to forecast the UPC.

Q. HOW DO 2018 TEST YEAR LARGE COMMERCIAL CLASS SALES COMPARE WITH RECENT ACTUAL, WEATHER NORMALIZED LARGE COMMERCIAL CLASS SALES?

A. The 2018 Test Year Large Commercial class sales are 0.75 percent lower than actual 2016 weather normalized Large Commercial class sales. Large Commercial class sales since 2008 are shown in Figure 6 below:

Figure 6



Q. PLEASE EXPLAIN HOW CHANGES IN CUSTOMER COUNT CAN AFFECT SALES TO THIS CLASS.

A. Given these are very large customers, slight changes in customer count or adding one or two very large customers can dramatically affect the total sales to this class. For example, in 1999, seven customers were added to this class, one being a very large customer (much larger than the class average). This caused actual 1999 weather normalized Large Commercial sales to grow by approximately 7 percent from actual 1998 weather normalized Large Commercial sales. Similarly, a large ethanol operator began taking service from OTP in late 2008 and ramped up production over the next two years. The addition of this operator was the primary driver of OTP's actual, weather normalized Large Commercial sales increasing by 9 percent in 2009 and 9 percent again in 2010.

Q. HAS OTP PERFORMED ANY OUTREACH TO BETTER UNDERSTAND ITS SALES TO LARGE COMMERCIAL CUSTOMERS?

A. Yes. OTP conducted an informal survey of North Dakota Large Commercial customers last year to try to better understand the decrease in sales between 2014 and 2015. The informal survey indicated that some former customers that left the system went out of business and are not likely to return. We were also told by customers that the agricultural economy is down, and this has affected production in some areas. Additionally, propane prices spiked during the winter of 2013-14. Between 2008 and 2013, propane prices were generally in the $1.50-$2.00 per gallon range. During the 2013-14 winter, prices went as high as $4.50 per gallon. Starting in 2015, prices dropped generally to $1.00-$1.50 per gallon. This significant price increase had the effect of customers switching some of their heating and processing load to electricity in 2014. As propane prices returned to lower rates, the customer load followed. OTP feels that after this one-year downturn in sales in 2015, Large Commercial sales will be generally consistent with the long-term trend.

E. **Other Public Authority**

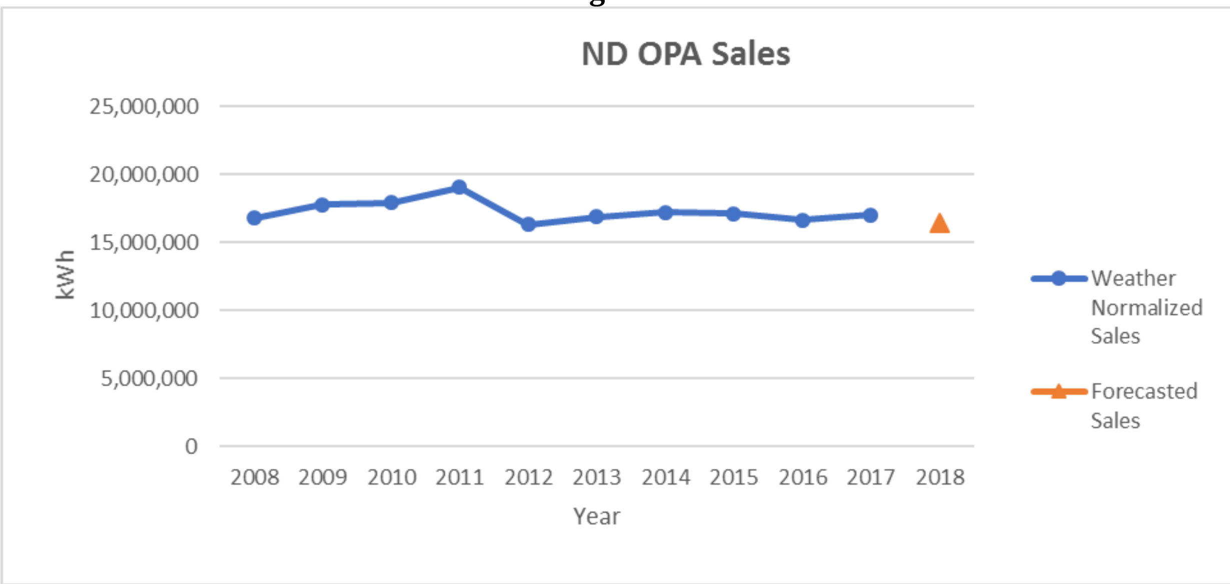
Q. WHAT ARE THE MAIN VARIABLES IN OTHER PUBLIC AUTHORITY (OPA) CLASS SALES?

A. North Dakota OPA class sales are the product of forecasted customer count and UPC for the OPA class. Weather is the only significant forecasting variable used in the UPC model for this class. Economic factors seem to have little or no impact on this class of customers, so none are included in the customer count model as they are in most other models.

Q. HOW DO 2018 TEST YEAR OPA CLASS SALES COMPARE WITH RECENT ACTUAL, WEATHER NORMALIZED OPA CLASS SALES?

A. OTP expects no sales growth in this class in 2018, mostly due to slightly declining UPC. Figure 7 shows historical weather normalized sales and the 2018 Test Year forecasted sales for the OPA Class.

Figure 7



F. **Street Lighting**

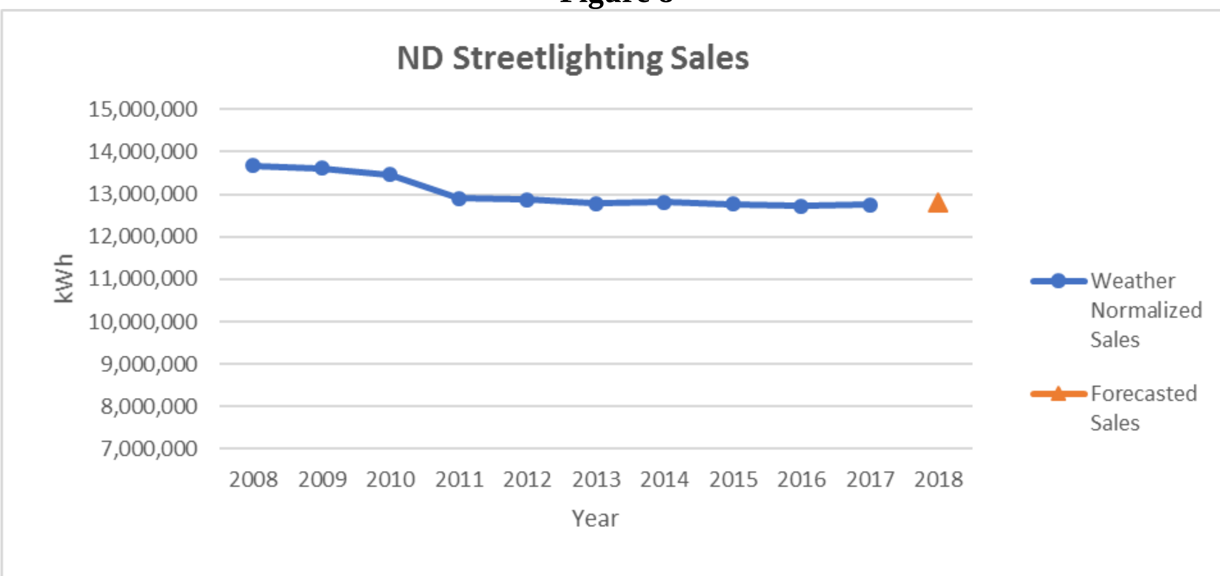
Q. WHAT ARE THE MAIN VARIABLES IN STREET LIGHTING CLASS SALES?

A. North Dakota Street Lighting class sales are the product of forecasted customer count and UPC for the Street Lighting class. The primary economic variable used to forecast the customer count for this class is total population. Unlike UPC models in other classes, weather is not a factor used to predict street lighting sales; lighting needs do not change due to hot or cold weather.

Q. HOW DO 2018 TEST YEAR STREET LIGHTING CLASS SALES COMPARE WITH RECENT ACTUAL, WEATHER NORMALIZED STREET LIGHTING CLASS SALES?

A. We forecast 2018 Test Year Street Lighting class sales to be 0.63 percent higher than actual 2016 weather normalized Street Lighting class sales. Again, this small rate of growth is typical to what we have seen over the past 20 years, and an improvement over recent (since 2008) past. Figure 8 details the historical weather normalized sales and 2018 sales forecast for this class.

Figure 8



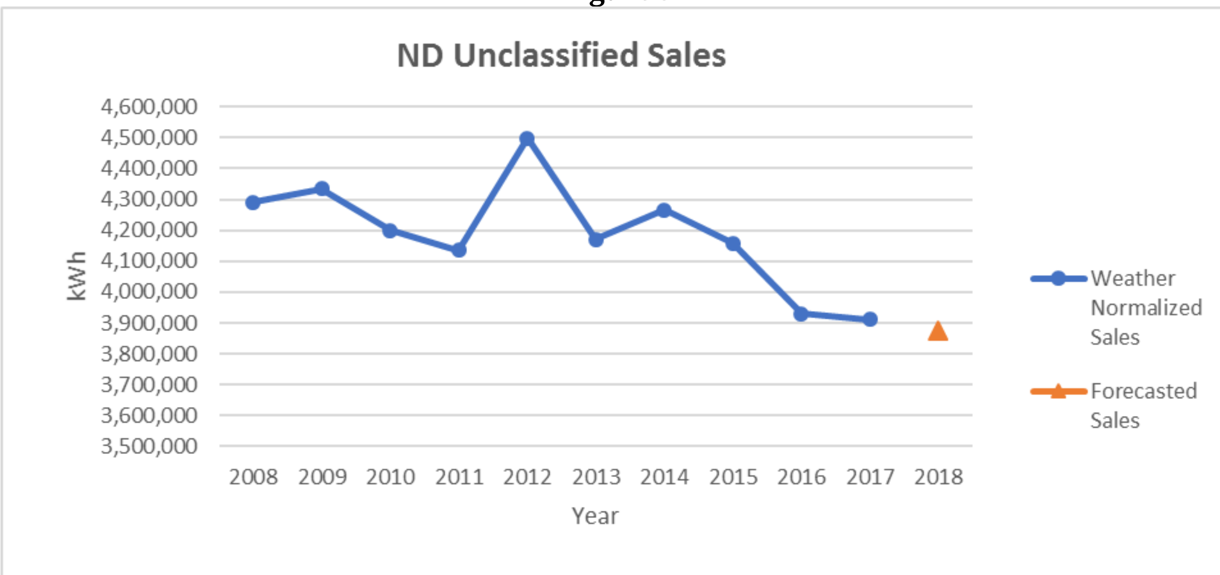
Q. DO YOU ANTICIPATE STRUCTURAL CHANGES TO THIS CLASS IN THE FUTURE?

A. Yes. We expect to see this load decrease in the future as LED lighting becomes more common. OTP witness Mr. David G. Prazak discusses LED lighting in his Direct Testimony.Unclassified

Q. WHAT ARE UNCLASSIFIED SALES?

A. This class is made up of company use accounts such as office and crew buildings, fleet service buildings, and our General Office. It is mainly OTP's own use of electricity. It makes up less than 0.21 percent of our total kWh sales in North Dakota. Figure 9 shows the historical weather normalized sales and 2018 Test Year sales forecast for this class.

Figure 9



V. CONCLUSION

Q. PLEASE SUMMARIZE YOUR DIRECT TESTIMONY.

A. In my Direct Testimony, I have discussed the forecast methodology used to develop the 2018 Test Year sales forecast. I have discussed the development of both the customer count forecast and sales forecast and have supplied the data used in those calculations.

The forecast provided in this case is a reasonable estimate of the expected customer counts and kWh sales for the 2018 Test Year, and OTP requests that they be adopted for the purpose of determining the revenue requirements and final rates in this proceeding.

Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes, it does.

BRIAN H. DRAXTEN

EMPLOYMENT

2008 – PRESENT Otter Tail Power Company Fergus Falls, MN
Manager, Resource Planning

2002 – 2008 Otter Tail Power Company Fergus Falls, MN
Manager, Budget / Forecast

1997 – 2002 Otter Tail Power Company Fergus Falls, MN
Manager, Market and Load Research

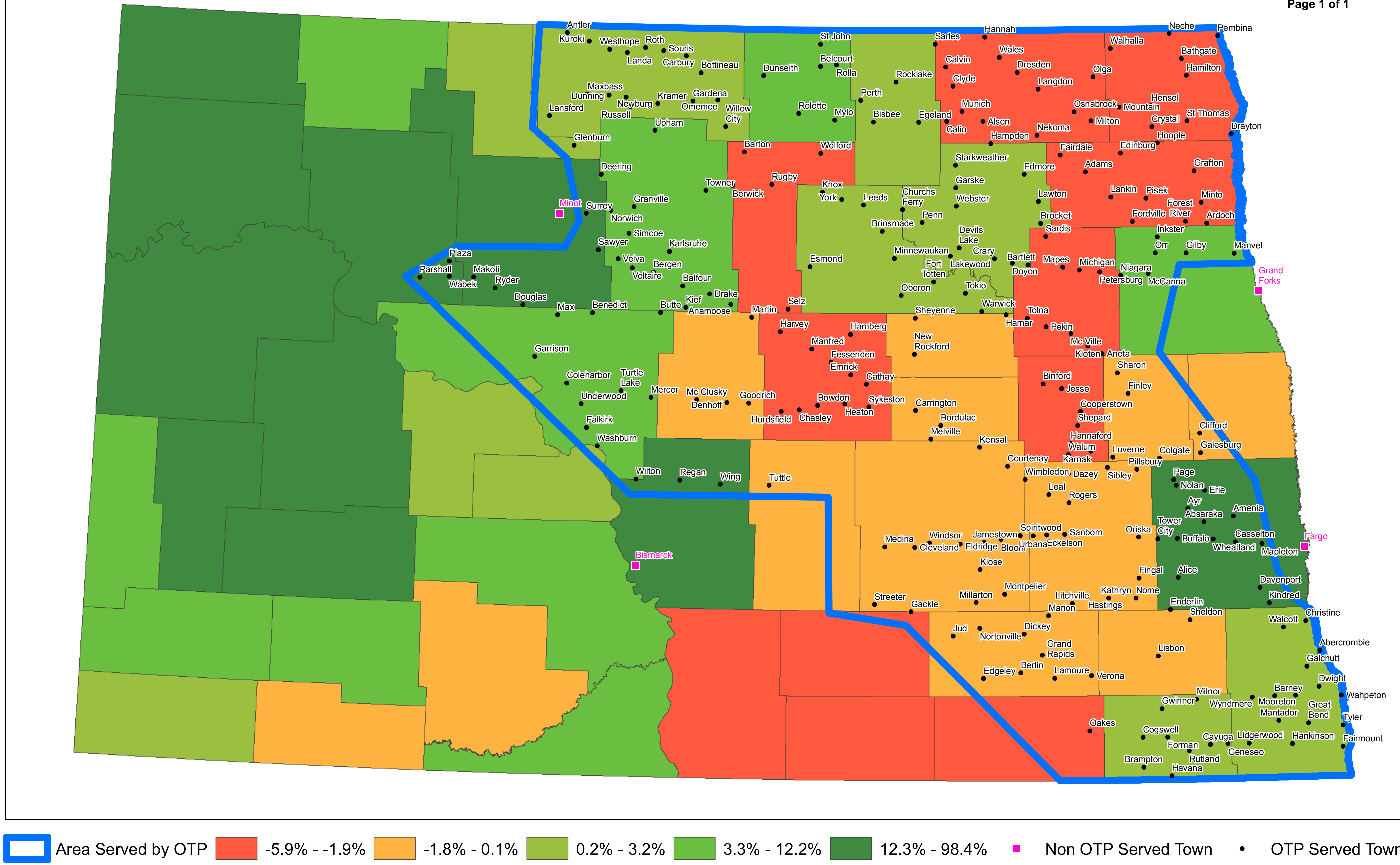
1995 – 1997 Otter Tail Power Company Fergus Falls, MN
Administrator, Market Research

1981 – 1995 Otter Tail Power Company Fergus Falls, MN
Rate Analyst, Rate Department

EDUCATION

- Bachelor of Arts — Moorhead State University
  - Accounting
  - Business Finance

Population, percent change - April 1, 2010 to July 1, 2016



Schedule 3

Brian H. Draxten

INTRODUCTION

Section A of this filing provides an overview of the process Otter Tail Power Company (OTP) uses to develop its Sales Forecast. This overview includes the methodologies employed to develop the forecasts for various classes of customers. Section B provides an overview of the processes OTP uses to develop various pricing and billing determinants to develop its Revenue Forecast. This section also provides an overview of a workbook model that combines the Sales Forecast (section A) and the pricing and billing determinant information (section B). The workbook generates the 2018 forecast test year Revenue Forecast.

A. SALES FORECAST

1. OVERVIEW

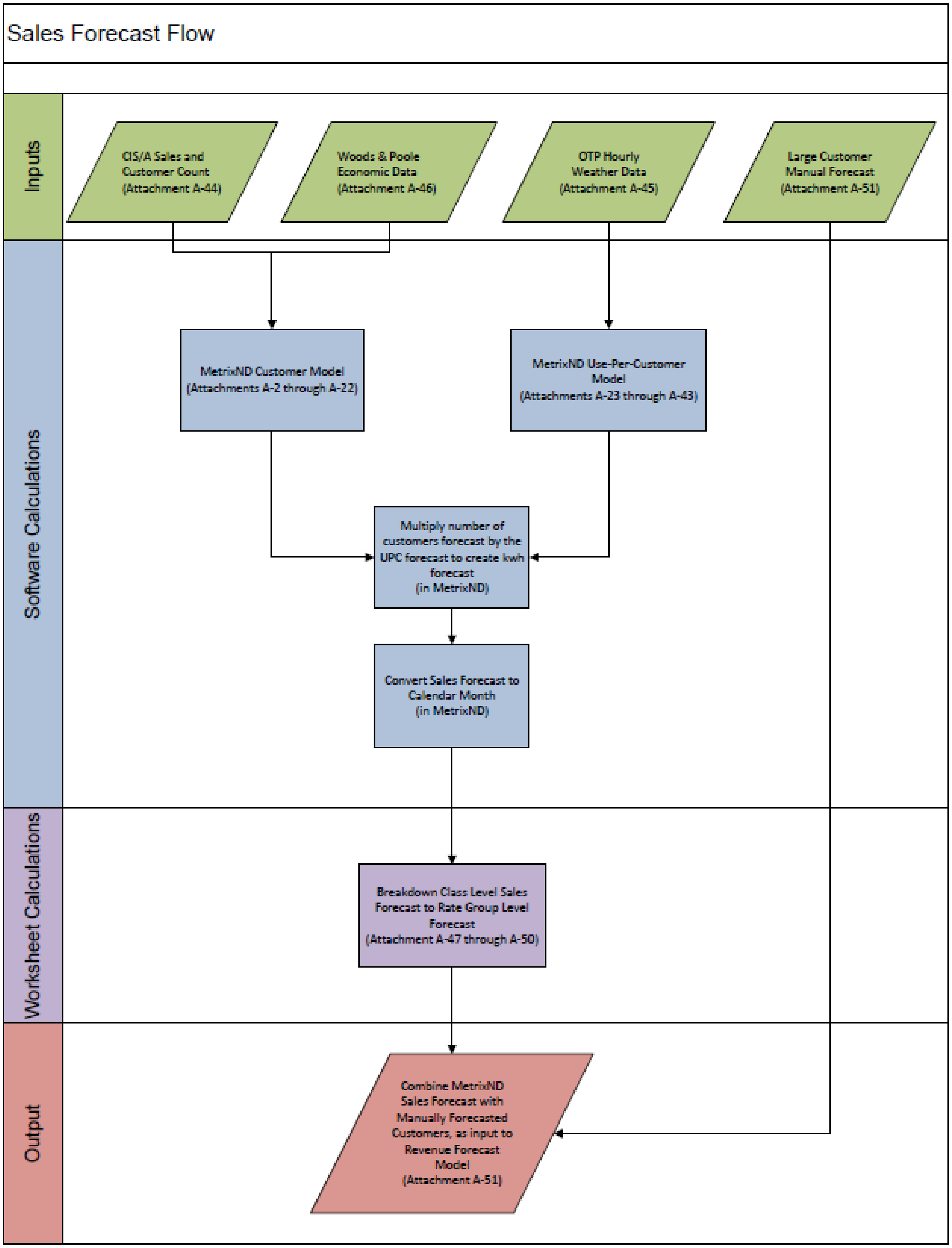
Section A is a description of the process used to develop OTP's 2018 Test Year forecast for energy sales. The forecast uses actual sales history through May 2017. The model used by OTP to produce the forecast is MetrixND® (MetrixND). The files produced in MetrixND are easily exportable to Microsoft Excel.

Along with this document are numerous workbooks that provide all regression models, results, and data used to create those test year forecasts.

SALES MODEL DESCRIPTION

The following flowchart is the process OTP follows to create its Sales Forecast.

Sales Forecast Flow Chart



a) Customer Model

The Customer Models, designed in MextrixND, forecast monthly customer counts, by state and by class, based on historical customer counts, economic indicators, and various binary variables. The economic data is 2017 vintage and from Woods and Poole. The variables most often used are Number of Households and Gross Regional Product.

The table in *Attachment A1 Independent Variables.xlsx* shows the variables that are included in each customer model.

The following attachments contain all Customer Model and statistical information.

- *Attachment A2 ND ResCust.xlsx*
- *Attachment A3 ND FarmCust.xlsx*
- *Attachment A4 ND SComCust.xlsx*
- *Attachment A5 ND LComCust.xlsx*
- *Attachment A6 ND OPACust.xlsx*
- *Attachment A7 ND SltCust.xlsx*
- *Attachment A8 ND UnclCust.xlsx*
- *Attachment A9 MN ResCust.xlsx*
- *Attachment A10 MN FarmCust.xlsx*
- *Attachment A11 MN SComCust.xlsx*
- *Attachment A12 MN LComCust.xlsx*
- *Attachment A13 MN OPACust.xlsx*
- *Attachment A14 MN SltCust.xlsx*
- *Attachment A15 MN UnclCust.xlsx*
- *Attachment A16 SD ResCust.xlsx*
- *Attachment A17 SD FarmCust.xlsx*
- *Attachment A18 SD SComCust.xlsx*
- *Attachment A19 SD LComCust.xlsx*
- *Attachment A20 SD OPACust.xlsx*
- *Attachment A21 SD SltCust.xlsx*
- *Attachment A22 SD UnclCust.xlsx*

b) Use-Per-Customer (UPC) Model

The Use-Per-Customer (UPC) Models, also designed in MetrixND, forecast estimated monthly UPC as a function of historical usage, weather conditions, and binary variables. Weather conditions are represented using monthly Heating Degree Days (HDD) and Cooling Degree Days (CDD) (definitions to follow), with a base of 65 degrees for cooling and 55 degrees for heating. In some cases, binary variables are included in the equation to account for events in the historical period.

Generally, OTP does not use economic indicators in the UPC Models because economic growth does not have a significant impact on usage. What little growth that may occur is offset by the improvement in energy efficiencies of household products.

The table in *Attachment A1 Independent Variables.xlsx* shows the variables that are included in each UPC model.

The following attachments contain all UPC Model and statistical information.

- *Attachment A23 ND ResUPC.xlsx*
- *Attachment A24 ND FarmUPC.xlsx*
- *Attachment A25 ND SComUPC.xlsx*
- *Attachment A26 ND LComUPC.xlsx*
- *Attachment A27 ND OPAUPC.xlsx*
- *Attachment A28 ND SltUPC.xlsx*
- *Attachment A29 ND UnclUPC.xlsx*
- *Attachment A30 MN ResUPC.xlsx*
- *Attachment A31 MN FarmUPC.xlsx*
- *Attachment A32 MN SComUPC.xlsx*
- *Attachment A33 MN LComUPC.xlsx*
- *Attachment A34 MN OPAUPC.xlsx*
- *Attachment A35 MN SltUPC.xlsx*
- *Attachment A36 MN UnclUPC.xlsx*
- *Attachment A37 SD ResUPC.xlsx*
- *Attachment A38 SD FarmUPC.xlsx*
- *Attachment A39 SD SComUPC.xlsx*
- *Attachment A40 SD LComUPC.xlsx*
- *Attachment A41 SD OPAUPC.xlsx*
- *Attachment A42 SD SltUPC.xlsx*
- *Attachment A43 SD UnclUPC.xlsx*

2. MODEL INPUTS

a) Sales and Customer Count Historical Data

Data: *Attachment A44 Sales and Cust Counts.xlsx*

Adjustments Made:

Monthly kWh data was graphed and values were checked for errors due to meters not being billed, being billed twice in one month, etc. As described in detail below, any bill adjustments are applied to the month in which the error occurred. In most cases the corrections are found and downloaded during the next monthly update.

Detailed Information:

Historical kWh data and the number of customers are read from SAS CIS/A data sets. The SAS data sets are created from extracts of OTP's CIS, which are downloaded the first day of each month for the prior month. These datasets are also updated monthly for billing adjustments to appropriately reflect actual usage and billing impacts in the month of the original bill. Any changes made in OTP's CIS are included in the CIS/A download, and the adjustments are made to the month the error occurred (as opposed to the month the adjustment was made). For example, if a customer has a bill adjustment made to their July bill, but the need for the adjustment was not determined or made in the CIS until December, the adjustment in the CIS/A data set would adjust the July bill, not the December bill.

From the CIS/A data set, the data is written into a totalized SAS dataset called cisa_s_allyrs. This dataset is input to both the Sales Forecast and the Revenue Forecast. In the Sales Forecast, the data is downloaded to the workbook referenced in this section (*Attachment A44 Sales and Cust Counts.xlsx*). Each record in the dataset is assigned to one of seven classes used in the forecast, by state (tab kWh). All customer counts and kWhs are divided into one of the following worksheets (tabs), one for each state and class:

- MNRes
- NDRes
- SDRes
- MNFarm
- NDFarm
- SDFarm
- MNScom
- NDScom
- SDScom
- MNLcom
- NDLcom
- SDLcom
- MNOPA
- NDOPA
- SDOPA
- MNSlt
- NDSlt
- SDSlt
- MNUncl
- NDUncl
- SDUncl

The variable UPC is created by dividing the monthly kWh by the monthly number of customers.

b) Otter Tail Power Company's Weather Data

Data: *Attachment A45 HDD CDD.xlsx*

Adjustments Made:

OTP graphs hourly monitoring station temperatures each month after downloading the data. Any missing or obviously bad temperatures are corrected based on temperatures from other nearby monitoring points or by judgment when necessary.

Detailed Information:

OTP uses 20 years of historical weather in its 2018 Sales Forecast. This weather was collected from 1997-2017, from 14 monitoring stations throughout Minnesota, North Dakota and South Dakota. OTP's service territory is broken up into 14 geographic divisions. There is one weather station in each of OTP's 14 divisions, so that the weather across OTP's entire service territory is well represented.

The UPC forecast uses HDD and CDD as inputs – values calculated from dry bulb temperatures in the weather data referenced above. The following is a definition of Heating and Cooling Degree Days from The National Oceanic and Atmospheric Administration (NOAA) (www.noaa.gov):

> Degree days are the difference between the daily temperature mean and 55°F (heating) 65°F (cooling). If the temperature mean is above 65°F, we subtract 65 from the mean and the result is Cooling Degree Days. If the temperature mean is below 55°F, we subtract the mean from 55 and the result is Heating Degree Days.

For each weather station, an average dry bulb temperature is calculated for each day. The HDD are then calculated by subtracting the average daily temperature from 55 degrees (the base). For example, if the average temperature for the day is 30 degrees, the HDD for that day is 25 (55-30). CDD are calculated by subtracting 65 (the base) from the average daily temperature. For example, if the average daily temperature is 70 degrees, the CDD for that day is 5 (70-65).

Table 1 lists each worksheet in *Attachment A45 HDD CDD.xlsx*, and its description/purpose. A brief overview of the HDD and CDD calculation follows.

Table 1

HDD CDD By Division	
Worksheets	**Description**
FergusFallsHourlyDB	Hourly Dry Bulb/HDD/CDD for Fergus Falls Division
DevilsLakeHourlyDB	Hourly Dry Bulb/HDD/CDD for Devils Lake Division
JamestownHourlyDB	Hourly Dry Bulb/HDD/CDD for Jamestown Division
MorrisHourlyDB	Hourly Dry Bulb/HDD/CDD for Morris Division
OakesHourlyDB	Hourly Dry Bulb/HDD/CDD for Oakes Division
WahpetonHourlyDB	Hourly Dry Bulb/HDD/CDD for Wahpeton Division
LangdonHourlyDB	Hourly Dry Bulb/HDD/CDD for Langdon Division
RugbyHourlyDB	Hourly Dry Bulb/HDD/CDD for Rugby Division
CanbyHourlyDB	Hourly Dry Bulb/HDD/CDD for Canby Division
BemidjiHourlyDB	Hourly Dry Bulb/HDD/CDD for Bemidji Division
CrookstonHourlyDB	Hourly Dry Bulb/HDD/CDD for Crookston Division
HallockHourlyDB	Hourly Dry Bulb/HDD/CDD for Hallock Division
GarrisonHourlyDB	Hourly Dry Bulb/HDD/CDD for Garrison Division
MilbankHourlyDB	Hourly Dry Bulb/HDD/CDD for Milbank Division
MNDailyAvgDB	MN Daily Average HDD and CDD, weighted by station
NDDailyAvgDB	ND Daily Average HDD and CDD, weighted by station
SDDailyAvgDB	SD Daily Average HDD and CDD
MNMeterSchedule	MN - Calculates Average HDD and CDD by individual billing cycle
NDMeterSchedule	ND - Calculates Average HDD and CDD by individual billing cycle
SDMeterSchedule	SD - Calculates Average HDD and CDD by individual billing cycle
MNMonthlyBilling	MN - Combines individual cycles into billing month HDD and CDD
NDMonthlyBilling	ND - Combines individual cycles into billing month HDD and CDD
SDMonthlyBilling	SD - Combines individual cycles into billing month HDD and CDD
MNBillingNormal	MN - Combines 20 years of billing month HDD & CDD to create Normal HDD & CDD
NDBillingNormal	ND - Combines 20 years of billing month HDD & CDD to create Normal HDD & CDD
SDBillingNormal	SD - Combines 20 years of billing month HDD & CDD to create Normal HDD & CDD
MNMonthlyCalendar	MN - Combines calendar month HDD and CDD
NDMonthlyCalendar	ND - Combines calendar month HDD and CDD
SDMonthlyCalendar	SD - Combines calendar month HDD and CDD
MNCalendarNormal	MN - Combines 20 years of calendar month HDD & CDD to create normal HDD & CDD
NDCalendarNormal	ND - Combines 20 years of calendar month HDD & CDD to create normal HDD & CDD
SDCalendarNormal	SD - Combines 20 years of calendar month HDD & CDD to create normal HDD & CDD

To determine the HDD and CDD for North Dakota, the weather stations in or near North Dakota are weighted by weather-sensitive sales and summed.

ND Daily Heating Degree Days=
[(Station 1 Sales/ND Weather-Sensitive Sales) * Station 1 HDD]+
[(Station 2 Sales/ND Weather-Sensitive Sales) * Station 2 HDD]+
…
[(Station 8 Sales/ND Weather-Sensitive Sales) * Station 8 HDD]

ND Daily Cooling Degree Days=
[(Station 1 Sales/ND Weather-Sensitive Sales) * Station 1 CDD]+
[(Station 2 Sales/ND Weather-Sensitive Sales) * Station 2 CDD]+
…
[(Station 8 Sales/ND Weather-Sensitive Sales) * Station 8 CDD]

This process is repeated for Minnesota and South Dakota.

OTP creates HDD and CDD based on billing month weather and calendar month weather. The process is as follows:

1. *Billing Month HDD and CDD:*
   Daily HDD and CDD are next added by billing cycle to determine the HDD and CDD for each cycle and month. Once we have a HDD and CDD value for each cycle and month, all the cycles are combined into one billing month, averaging the cycle HDD and the cycle CDD. A HDD value and a CDD value for each billing month have now been created.

   Next, we calculate Normal Billing HDD and CDD. They are calculated by averaging 20 years of monthly billing HDD and CDD.

2. *Calendar Month HDD and CDD:*
   Daily HDD and CDD are added by calendar month to calculate the HDD and CDD for each calendar month.

   Normal Calendar HDD and CDD are next calculated. These values are used in the Sales Forecast. They are calculated by averaging 20 years of monthly Calendar HDD and CDD.

OTP's Sales Forecast uses weather normalization principally to compare the Sales Forecast to weather normalized historical data. HDD and CDD are used in all models with the exception of Streetlighting. All of OTP's other customer classes have some level of weather sensitivity.

c) Woods & Poole Economics, Inc.

Data: *Attachment A46 Woods and Poole Data.xlsx*

Adjustments Made: None

Detailed Information:

In its 2018 Sales Forecast, OTP uses economic data from Woods & Poole Economics, Inc. Woods & Poole's database contains economic and demographic data through the year 2050. OTP downloads this information by county to use in its Customer Model.

The Sales Forecast uses the following variables from Woods & Poole:

- *Number of Households*
- *Gross Regional Product*
- *Total Employment*
- *Total Population*
- *Farm Earnings*
- *Farm Employment*
- *Persons Per Household*

OTP does not serve the entire load in the counties within its service territory. This is especially problematic when OTP does not serve a large city that has a significant impact on the economy of the county. Some examples are Fargo, Moorhead, Grand Forks and Minot. OTP does not serve these larger cities, but it does serve small communities surrounding these larger ones. To reflect this, OTP used econometric data only from counties where OTP serves at least 10 percent of the population of the county. County population data is downloaded from www.census.gov. The percentage of the population served by OTP in each county was determined by dividing the sum of populations of towns served by OTP in each county by the population of the county. Counties with a percentage of less than 10 percent were not included. Town populations were obtained from an internal database of towns served. The data is then summed to the state level and graphed as a reasonability check. Annual Woods & Poole data is converted from annual data to monthly data by interpolating between annual values with a flat line.

As OTP serves three states with economic differences, using econometric models makes it possible to utilize the different economic data for each state and determine whether particular variables are drivers for each state.

3. CALENDAR MONTH CALCULATION

Because historical usage data is, in its purest form, in billing month format, OTP creates all models using billing month data. After creating billing month sales models, these models are adapted to calendar month. As weather generally only affects UPC, not the number of customers, the calendar month conversion is only applied to the UPC Model. To create the calendar month UPC forecast, the calendar month HDD and CDD (from *Attachment A45 HDD CDD By Division.xlsx*) are substituted for the billing month HDD and CDD resulting in a calendar month UPC forecast.

4. BINARY VARIABLES

All models that make up the Sales Forecast utilize binary variables. Monthly binary variables that account for seasonal differences are the most commonly used variables. Annual binary variables are used to account for the deviations in growth or consumption that are not expected in the test year. For example, the Residential Customer Model uses annual binary variables to account for the gradual change in growth rates that occurred before and after the 2008 recession. Other binary variables are utilized as necessary to improve the fit of the model and statistical significance of the economic and weather variables.

5. USE OF SALES FORECAST IN REVENUE FORECAST

As noted earlier, OTP develops Sales Forecasts for each class within each jurisdiction. However, to develop an accurate Revenue Forecast, the Sales Forecast within each class needs to be allocated to a more detailed Rate Group level[1]. In this manner, OTP can apply appropriate billing determinants to compute the forecasted revenues.

To allocate the Sales Forecast to each Rate Group, each meter from the CIS/A data set is first placed into one of 41 Rate Groups. These Rate Groups are created using a Revenue Class/Rate Code combination. For example, there is a Rate Group for Residential Water Heating, another for Small Commercial Water Heating, etc. (see full description of these Rate Groups in Revenue Forecast Model description – *Attachment B1 Rate Group Mapping.xlsx).*

In general, CIS/A data for each state/year/month/revenue class/rate code is combined into Rate Group definitions, by state/year/month. The percentage of each Rate Group in the class is calculated for each state/year/month, and a two-year average of these percentages is computed.

See *Attachment A47 Res Sales to Rate Group.xlsx* as an example of this process. The worksheets contained in this spreadsheet are found in Table 2:

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[1] OTP has 41 Rate Groups that are created using a Revenue Class/Rate Code (level pricing is applied at) combination. See *Attachment B1 Rate Group Mapping.xlsx* for a complete listing of the Rate Groups and how the Classes, Rate Groups, Revenue Class and Rate Codes all fit together.

Table 2

Residential Sales to Rate Group

Worksheet	Description
MN_Res **ND_Res** **SD_Res**	**Contains Sales by Rate Group,** **by State,** **Year and Month**
MN_Res_Ratio_2yr_Avg **ND_Res_Ratio_2yr_Avg** **SD_Res_Ratio_2yr_Avg**	**Calculates Percentage of Sales** **by Rate Group,** **by State, Year and Month**

This same process is followed for each of the following classes: Residential, Farm, Small Commercial, and Large Commercial. This process is not necessary for the Pipelines, Malting, OPA, Streetlighting, and Unclassified Classes as the class and the Rate Group are the same.

These monthly percentages are then applied to the Sales Forecast to allocate sales to the Rate Group level. The Sales Forecast at Rate Group level is a key input into the Revenue Forecast Model for pricing.

The following attachments create the Sales Forecast by Rate Group:

- *Attachment A47 Res Sales to Rate Group.xlsx*
- *Attachment A48 Farm Sales to Rate Group.xlsx*
- *Attachment A49 SCom Sales to Rate Group.xlsx*
- *Attachment A50 LCom Sales to Rate Group.xlsx*

The output of the Revenue Forecast is found in *Attachment A51 Sales Forecast to Revenue Forecast.xlsx*. This workbook contains five worksheets. The first, titled *Input to Revenue Forecast*, contains the majority of the data that goes into the Revenue Model. The next two worksheets, *Manual Pipe & Malt* and *Manual – Other* contain the manually forecasted customers. The data within these worksheets goes into the Revenue Model as well, to be priced separately (*Attachment B11 Revenue Model.xlsx*). The fourth worksheet, *Unclassified*, contains data that is not normally priced, as it includes mostly company use sales. Finally, the last worksheet, *Total* contains all the previous worksheets' sales totaled, to present the entire Sales Forecast as a whole.

B. REVENUE FORECAST

1. OVERVIEW

OTP produces its Revenue Model in the financial modeling software program, Utilities International, which easily exports to Microsoft Excel. OTP has chosen to provide this data in Excel format allowing transparency to its model.

Within this section, section B, is a description of the process used to develop OTP's Revenue Forecast. The forecast uses up to 5 years of historical customer data from CIS/A and a workbook containing OTP's current rate code prices. There are also four SAS programs and numerous Excel workbooks attached that provide the inputs and a transparent view of our Revenue Model.

OTP developed its Revenue Forecast[2] by applying various composite pricing to the applicable billing determinants[3] derived from the Sales Forecast. OTP uses actual historical billing determinants to develop composite pricing, demand ratios, ratcheted demand[4] ratios, and forecasted meter counts. The demand and ratcheted demand ratios are multiplied by the Sales Forecast to acquire the demand and ratcheted demand for each Rate Group[5]. Once all the billing determinants at the Rate Group level are computed, they are multiplied by the corresponding composite pricing to compute revenues for each Rate Group. Subsequently, OTP rolls up the Rate

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[2] OTP forecasts retail revenue excluding small power producers.
[3] Billing Determinants are units needed for billing, OTP's billing determinants used in the Revenue Forecast include sales (kWh), demand (kW), ratcheted demand (ratcheted kW), and meter count.
[4] Ratcheted demand is the maximum demand over the last 12 months, primarily used for calculating the facilities demand.
[5] OTP has 41 Rate Groups that are created using a Revenue Class/Rate Code (level pricing is applied at) combination. See *Attachment B1 Rate Group Mapping.xlsx* for a complete listing of the Rate Groups and how the Classes, Rate Groups, Revenue Class and Rate Codes all fit together.

Group level revenues to their respective Cost of Service Class level revenues by state. The Cost of Service Classes are as follows.

- Residential
- Farms
- General Service
- Large General Servic
- Irrigation
- Outdoor Lighting
- Other Public Authority (OPA)
- Controlled Service Water Heating
- Controlled Service Interruptible
- Controlled Services Deferred

Section B of this document will cover the information needed to develop the North Dakota Revenue Forecast.

2. REVENUE FORECAST DESCRIPTION

The following flowcharts describe the process OTP follows to create its Revenue Forecast. The remainder of section B of this document is laid out in three main sections; Inputs, Revenue Model, and Excel Revenue Calculation Model.

Inputs: This section explains how each input to the Revenue Model is calculated. The initial sections of each input can be read alone or you can use the SAS sections as a companion to the SAS program, which are attached in pdf format.

Revenue Model: This section is a description of OTP's Revenue Model and is the link between the inputs and the final Revenue Forecast results.

Excel Revenue Calculation Model: This section is a detailed description of the Excel document that calculates the Revenue Forecast. It details the items in each worksheet and how the worksheets are linked.

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[PROTECTED DATA BEGINS…

…PROTECTED DATA ENDS]

Revenue Forecast Flow Chart

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…PROTECTED DATA ENDS]

[PROTECTED DATA BEGINS…

…PROTECTED DATA ENDS]

[6] Calendar month sales are used to compute the Revenue Forecast

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…PROTECTED DATA ENDS]

[PROTECTED DATA BEGINS…

…PROTECTED DATA ENDS]

[PROTECTED DATA BEGINS…

…PROTECTED DATA ENDS]

[7] We need to drill down to the meter number for this because it is possible for a customer to have multiple TOU/TOD rates, however for each rate sequence (ex. 0611, 0613, 0615) the meter number is the same followed by a suffix – which for this program's purposes is excluded.

[PROTECTED DATA BEGINS…

…PROTECTED DATA BEGINS]

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[8] Only the maximum TOU/TOD Rate Code for the ratcheted kW are included to avoid overriding the non-maximum ratcheted kW being set to zero, see page 23, section (4) Time of Use/Time of Day (TOU/TOD) Rates.

[PROTECTED DATA BEGINS…

…PROTECTED DATA ENDS]

[PROTECTED DATA BEGINS…

…PROTECTED DATA ENDS]

[PROTECTED DATA BEGINS…

…PROTECTED DATA ENDS]

[PROTECTED DATA BEGINS…

…PROTECTED DATA ENDS]

[PROTECTED DATA BEGINS…

…PROTECTED DATA ENDS]

[PROTECTED DATA BEGINS…

…PROTECTED DATA ENDS]

[9] 730 is the number of hours in the average year divided by 12 to get the average number of hours in a month.
[10] This is not a "true" ratchet as the value may be pulled from a future month.

[PROTECTED DATA BEGINS…

…PROTECTED DATA ENDS]

[11] At this time the customer charge includes both the customer charge and the annual seasonal charge.

[PROTECTED DATA BEGINS…

…PROTECTED DATA ENDS]

[PROTECTED DATA BEGINS…

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[PROTECTED DATA BEGINS…

…PROTECTED DATA BEGINS]

[PROTECTED DATA BEGINS…

...PROTECTED DATA ENDS]

CONCLUSION

The forecast provided in this filing is a reasonable estimate of the expected sales and projected revenues under existing rates for the 2018 Test Year. OTP recommends that they be adopted for the purpose of determining the revenue requirements and final rates in this proceeding.