UE 335 / PGE / 1100
Riter – Lucas

BEFORE THE PUBLIC UTILITY COMMISSION

OF THE STATE OF OREGON

UE 335

Load Forecast

PORTLAND GENERAL ELECTRIC COMPANY

Direct Testimony and Exhibits of

Amber Riter
Alison Lucas

February 15, 2018

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I. Introduction and Summary

Q. Please state your names and positions with Portland General Electric Company (PGE).

A. My name is Amber M. Riter. I am an Economist and the Principle Load Forecasting Analyst at PGE.

My name is Alison Lucas. I am a Senior Load Forecasting Analyst at PGE.

We are responsible for developing PGE's energy deliveries forecast. Our qualifications appear at the end of this testimony.

Q. What is the purpose of your testimony?

A. Our testimony presents PGE's 2019 test year energy and customer forecast.[1]

Q. What load forecast related request does PGE make of the Public Utility Commission of Oregon (Commission) in this proceeding?

A. We request the Commission: 1) accept PGE's methodology including modeling changes described in this testimony and the use of a trended weather normal assumption; 2) accept, as a preliminary matter, our forecast of energy deliveries recognizing that updates will be made throughout the course of this proceeding, and 3) set a schedule in this proceeding allowing for periodic updates of the energy delivery forecast for 2019.

Q. Does PGE intend to update its 2019 forecast during this case?

A. Yes, we intend to update the test-year forecast as we have in prior cases. Updates will include model re-estimation to: 1) incorporate more current load and economic data as they become available; 2) refresh the forward-looking inputs, including the economic outlook for Oregon; and 3) incorporate the most current operational information in large customers' usage forecasts.

[1] We use the terms "energy deliveries" and "load forecast" interchangeably in this testimony.

Q. Please describe PGE's delivery forecast.

A. PGE's 2019 test year energy forecast is for energy deliveries of 19,041 thousand megawatt-hours (MWh), on a cycle-month (billing) basis, including deliveries to customers who opted out of PGE cost-of-service rates for direct access under Schedules 485 and 489. The forecast reflects current expected economic conditions for Oregon in 2019, as well as operational changes among PGE's largest customers and savings from incremental energy efficiency (EE) programs that are implemented by the Energy Trust of Oregon (ETO).

Q. How does the 2019 forecast compare to recent historical demand?

A. Similar to the energy delivery trends of recent years, the 2019 forecast reflects stronger growth in deliveries to industrial (primary voltage service) customers relative to lower growth anticipated in the residential and commercial customer classes. Industrial deliveries growth is related to high-tech expansion and new data centers. Although higher than in other customer classes, the rate of growth in deliveries to industrial customers has slowed as initial phases in a large high-tech construction project are completed.

Table 1 below summarizes the MWh delivery forecast in annual percentage changes by voltage service customer class on a weather adjusted, billing cycle basis from 2015 through 2019.

Table 1

Percent Change in MWh Delivery from Preceding Year: 2015-2019

Voltage Service Class	2015	2016	2017	2018 (E)	2019 (E)
Residential	-0.7%	0.5%	-1.4%	0.2%	-0.1%
General Service[2]	0.1%	-1.4%	0.6%	-0.8%	-1.4%
Transmission	4.2%	-56.2%	-2.7%	-38.9%	0.0%
Primary	7.0%	1.5%	3.8%	1.4%	1.7%
Total	1.2%	-2.6%	0.4%	-0.7%	-0.2%

[2] General Service is the summation of Secondary Voltage and Miscellaneous Schedules.

Q. How has PGE's load forecast performed compared to industry standard?

A. While forecasts are always subject to uncertainty, PGE's load forecast has performed very well over the years. Table 2 displays PGE's load forecast variance, compared to industry averages, measured in mean absolute percentage error (MAPE), as reported in Itron's annual load forecasting benchmark survey.

Table 2

Comparison of PGE Forecast Error to Itron Benchmark Survey

	2011		2012		2013		2014		2015		2016	
	Survey	PGE	Survey	PGE	Survey	PGE	Survey	PGE	Survey	PGE	Survey	PGE
Residential	1.7%	-0.5%	1.5%	0.0%	1.7%	0.3%	1.5%	1.2%	1.9%	1.5%	1.7%	0.1%
Commercial	1.7%	-0.4%	2.0%	-1.4%	2.1%	-1.9%	1.3%	0.6%	1.6%	0.8%	1.8%	-2.0%
Industrial	3.2%	-0.7%	3.2%	-4.5%	4.4%	-8.8%	3.4%	-0.5%	3.0%	2.8%	3.3%	-2.7%
System	NA	-0.5%	1.6%	-1.5%	1.5%	-2.5%	1.3%	0.6%	1.9%	1.5%	1.6%	-1.4%

II. Forecast Methodology and Process

Q. Please summarize the process you use to develop the retail energy deliveries forecast.

A. We use monthly time-series regression models to estimate the residential, commercial and manufacturing sectors, based on the relationship between energy deliveries and weather variables, economic variables, and seasonal control variables. The most current forecasted explanatory variables are applied to the coefficients from the regression models to develop the energy deliveries forecast.

Q. How do you group customers in your forecast models?

A. We forecast demand (MWh delivery) for residential, commercial, manufacturing customers and energy served under miscellaneous rate schedules (See Exhibit 1101). For residential customers, we model both customer counts and usage per customer for seven segments based on dwelling type and space heating type. We group commercial and manufacturing customers into eleven commercial and seven manufacturing groups according to the North American Industrial Classification System (NAICS) definition of business segments.[3] Commercial customers typically are businesses providing services, such as retail and wholesale establishments, schools, hospitals, government, and financial institutions. Manufacturing customers include producers of paper, lumber, steel, machinery, micro-processors, solar panels, and transportation equipment.

Q. How do you forecast the gross loads delivered to the PGE system?

A. This process involves three steps: 1) aggregated cycle-based NAICS sector MWh deliveries are converted into voltage service levels using ratios based on historical data; 2) cycle-based energy deliveries are converted to calendar-based deliveries using cycle-to-calendar ratios;

[3] https://www.census.gov/eos/www/naics/.

and 3) transmission and distribution (line) losses are added to deliveries at the meter to obtain the bus bar energy (MWh or MWa) required to meet the aggregated end users' demand. For the 2019 test year, we apply line loss factors as established in PGE's 2015 general rate case (Docket No. UE 283).

Q. Are these models new or different from previous PGE energy delivery models?

A. The forecast models and process remain fundamentally the same as those used in previous filings with the Commission. However, there are some updates in model specifications, specifically with respect to reexamination of the underlying structure of historical data series and relationships to weather and economic drivers.

Q. What changes have been made to model specifications?

A. In Docket No. UE 319, PGE agreed to conduct further analysis of non-stationarity in its load forecast regression models. PGE tested for deterministic trends and breakpoints and found that most of the sector energy deliveries time series do not show evidence of a unit root after accounting for those trends and breakpoints. Instead, most series are stationary or trend stationary. As a result of this analysis, trend variables and breakpoints are included in the regression equations where appropriate. Additionally, PGE has maintained "flat" forecasts for any series that showed evidence of unit root non-stationarity. PGE's Load Forecast work papers contain the testing results that support choice of model structure for each of PGE's regression models.

Q. Have any other changes been made to PGE's documentation of its forecasting process?

A. Yes, PGE has documented a series of testing procedures for each of its regression-based forecasts as evidence to support choice of model structure and variables. These tests include: univariate analysis of each series to understand the underlying structure of the

series, including trends, breaks, and outliers; scatter plots of each energy deliveries variable to temperature to inform the choice of weather variables, specifically related to the set points used for heating and cooling degree days; and out-of-sample testing comparing updated model specifications to prior forecast model run. Furthermore, PGE has revised its supplemental process work papers with the focus of providing clear and useful documentation of its forecasting process.

Q. Did you make any adjustments for incremental EE to the forecast?

A. Yes. We adjusted the forecast to account for the impact of PGE's incremental EE programs funded through Schedule 109 Incremental EE Funding, enabled by Senate Bill 838 (SB 838), as forecasted by the ETO, and updated in November of 2017. Since EE trends, including SB 1149[4] measures, are assumed to be captured implicitly in the forecast model, no explicit adjustments are made for SB 1149 savings. The incremental EE program levels reflect the increased funding for EE programs under SB 838, starting in November 2017, the first month of the forecast.

Q. Has PGE made any changes to its EE adjustment since UE 319?

A. No, PGE has not changed its approach to the EE adjustment. In UE 319, Commission Staff recommended an alternative approach citing concern with the incremental versus embedded nature of SB 838 savings. PGE recognizes that as time passes since the issuance of SB 838 in 2007, the level of embedded savings becomes less clear. While PGE is interested in investigating alternative approaches, at this time we believe our current adjustment mechanism performs well and is both appropriate and necessary for the development of PGE's energy deliveries forecast.

[4] Oregon Senate Bill 1149 established the 3% public purpose charge to fund and encourage energy conservation.

Q. What is the impact of incremental EE programs savings on the forecast?

A. We estimate a total of 300.6 thousand MWh or 1.6% savings from these programs in the 2019 test year based on the EE savings starting in November 2017 and accumulating through December 2019. PGE Exhibit 1102 shows the forecast adjusted for incremental EE savings and PGE Exhibit 1103 shows the savings from the incremental EE programs that are included in PGE's delivery forecast.

III. Input Assumptions

Q. What sources of information do you use to forecast energy deliveries?

A. PGE relies on the Oregon Department of Administrative Services' Office of Economic Analysis (OEA) for the Oregon economic forecast. OEA's December 2017 employment forecasts were used to develop the forecast for this proceeding. In addition, customers who are large energy users provide us with specific operational information, direct inputs and, if available, forecasts of energy use through correspondence with PGE's Business Customer Group. PGE's Corporate Finance Group performs credit-risk analysis for these large customers, providing additional credit-risk and financial performance information on our large customers.

Q. How current are the data you use to estimate the model?

A. The models estimated for use in this proceeding are based on energy data through the October 2017 billing cycle and customer connects data through August 2017.

Q. What assumption did you make regarding weather variables in the forecast?

A. The test-year forecast is based on a trended normal weather assumption to capture gradual warming observed in the Portland area over the last 40 years. The normal weather series is estimated using monthly degree day data from 1941 to 2016, with a simple average from 1941 to 1975 and a linear trend fit to data from 1976 to 2016.

Q. Is the assumption regarding weather variables used in the forecast different from that used in prior PGE forecasts?

A. Yes. Since Docket No. UE 180, PGE has used a 15-year moving average to represent normal weather conditions. PGE first proposed use of the trended weather assumption in UE 319 and described the approach in detail in its direct testimony for the case. While

OPUC Staff stated interest in a more sophisticated approach to the 15-year average weather input assumption,[5] Parties stipulated that PGE should use 15-year average weather in the final forecast as adopted by Order No. 17-511.

Q. Why is PGE proposing the trended weather forecast assumption again?

A. PGE strives for an expected mid-point load forecast; that is, a "50/50" load forecast where there is a 50% chance that the actual outcome falls short of or exceeds the forecast. To achieve this, forecast assumptions must also be based on an expected mid-point, where it is equally likely that the outcome falls short of or exceeds the assumption. In the case of a persistent warming trend, as experienced in the Pacific Northwest, a moving average approach contains a cold bias[6] and does not achieve a 50/50 forecast. PGE proposes the trended weather approach to better approximate a 50/50 forecast for expected weather.

Q. What are the primary impacts of this weather assumption on PGE's load forecast results?

A. Using the trended weather assumption decreases PGE's annual energy deliveries forecast by approximately 49.1 thousand MWh's, or 0.3%, in 2019 compared to the use of a 15-year normal weather assumption. Within this total change is a seasonal shift in PGE's energy deliveries, primarily in the residential customer forecast, decreasing deliveries in the heating months, and increasing deliveries in the cooling season.

Q. How does the change in weather assumption impact PGE's Decoupling Mechanism?

A. PGE Exhibit 1200 outlines a decoupling mechanism that is based on actual (rather than weather adjusted) energy deliveries. In the context of this updated approach, the weather

[5] See UE 319 Staff/700 Kaufman.
[6] A cold bias in the weather assumptions means that we systematically underestimate average temperature.

adjustment itself is not relevant to the calculation of the decoupling adjustment. Use of an unbiased assumption to describe normal weather, theoretically, reduces price volatility that might be created given an embedded bias towards cooler weather.

Q. Has a similar trended weather approach been used in other utility electric load forecasts?

A. While other utilities have proposed a similar approach, PGE is not aware of any other regulated utility using a trended weather assumption in its energy deliveries forecast for rate making proceedings. However, the Energy Information Administration's Annual Energy Outlook uses trended weather assumptions that reflect regional warming.[7] PGE recognizes that this is an innovative approach and believes capturing a warming trend is appropriate in the context of the energy deliveries forecast, particularly in the long term.

[7] https://www.eia.gov/outlooks/aeo/assumptions/pdf/residential.pdf , p31.
https://www.eia.gov/outlooks/aeo/assumptions/pdf/commercial.pdf , p43.

IV. Forecast Results

Q. What are the key results of PGE's residential sector forecast?

A. For the 2019 test year, we forecast deliveries of 7,506 thousand MWh to 781,152 residential customers. Declines in residential use per customer, driven by incremental EE programs, are offset by customer growth of 1.3% in 2019 for annual residential energy deliveries decrease of -0.1% over 2018. The residential forecast includes residential outdoor area lighting energy. PGE Exhibit 1104 shows the forecast of building permits, new connects, and customer counts. PGE Exhibit 1105 displays the forecast of kWh use per customer and deliveries to residential customers in detail.

Q. What are the key results of PGE's commercial sector forecast?

A. For the 2019 test year, we forecast deliveries of 6,800 thousand MWh to NAICS-based commercial customers, a 1.5% decrease over forecasted 2018 energy deliveries of 6,903 thousand MWh. Declining energy deliveries to the commercial NAICS groups reflect savings from incremental EE programs larger than those projected in the residential sector, impacting the NAICS-based commercial sector by -2.6% for 2019. PGE's Exhibit 1106 contains the detailed forecast of deliveries to commercial consumers.

Q. What are the key results of PGE's manufacturing sector forecast?

A. For the test year 2019, we forecast deliveries of 4,605 thousand MWh to NAICS-based manufacturing customers, 1.5% higher than forecasted 2018 deliveries, following growth of 4.2% in 2017 and a decline of 2.3% in 2018. The manufacturing forecast reflects continued expansion by high-tech and related companies in our service territory. Manufacturing sector deliveries can show large swings from year to year due to specific individual company operations and industry conditions. For example, the closure of two large paper customers,

one at the end of 2015 and one at the end of 2017, significantly impacted PGE's energy deliveries growth rates. PGE Exhibit 1107 presents the detailed delivery forecast of the manufacturing sector.

Q. What are the key results of PGE's miscellaneous rate schedules forecast?

A. Deliveries to miscellaneous rate schedules account for approximately 1% of total retail deliveries in 2018. PGE Exhibit 1108 displays the miscellaneous schedules' forecast

Q. Did you make a separate forecast of delivery to Rate Schedule 485/489 customers?

A. Yes. PGE separates the delivery of energy to customers who chose service under Schedule 485/489 (direct access) by 2017 year-end from the energy delivery forecast to customers served under PGE cost-of-service (COS) rates, including variable-price (market power) customers. Schedule 485/489 is the only service under which we forecast customers to receive direct access service in 2019. We prorate the COS and Schedule 485/489 deliveries by applying these customers' respective historical shares of service level or revenue class energy to the forecast. PGE Exhibit 1110 shows the forecast of deliveries in 2019 to PGE COS customers and direct access (Schedule 485/489) customers.

V. Forecast Uncertainty

Q. Is the forecast subject to uncertainty?

A. Yes. The MWh delivery forecast we submit in this filing is our "expected" or mid-point estimate, but is subject to uncertainty. As such, it is a 50/50 "point" forecast, a 50% chance that the actual outcome falls short of or exceeds the forecast. As with any forecast, actual conditions may differ from what we assumed or anticipated in the forecast, resulting in a different outcome.

As mentioned with respect to the proposed trended weather approach, the accuracy of a forecast depends not only on the model specification, but also on the accuracy of the independent variables driving the forecast. In our model, the independent variables include weather variables and the economic forecast drivers. In addition, the model includes assumptions surrounding implementation of EE programs, key customers' operational decisions, new customers' entry or existing customers' exit, and the absence of unforeseen natural disasters, wars or geopolitical turmoil. The accuracy of our forecast will be impacted by the extent to which actual outcomes of these variables differ from our assumptions.

Q. How do you address uncertainty in your forecast?

A. PGE aims to reduce uncertainty by using the most current information available in its forecast models. PGE's input assumptions, such as employment forecasts, weather data, and actual load, are refreshed in each forecast. PGE tracks forecast performance on a monthly basis and updates its forecast multiple times in any given year to include the most recent historical trends, billing data, and input assumptions available. We expect to include a June update and a September update as the final forecast for setting 2019 rates.

VI. Qualifications

Q. Ms. Riter, please describe your qualifications.

A. I received my Bachelor of Arts in Economics from New Mexico State University and my Master of Arts in Economics from The University of New Mexico. I have been working as an Economist in energy deliveries forecasting for the past 8 years. Prior to joining PGE in 2014, I worked at PNM Resources, the parent company of Public Service Company of New Mexico (PNM) and Texas New Mexico Power (TNMP), performing load forecasting and load research analysis.

Q. Ms. Lucas, please describe your qualifications.

A. I received my Bachelor of Arts in Physics from Colgate University. I have been working as a data analyst in various capacities for the past 11 years. Prior to joining PGE in 2016, I worked at DNV GL using high resolution meteorological and wind turbine performance data to forecast wind farm energy production. Prior to that, I worked for IBM as a management consultant to federal agencies.

Q. Does this conclude your testimony?

A. Yes.

List of Exhibits

PGE Exhibit	Description
1101	Energy Deliveries Forecast by Market Segment and Service Level
1102	Energy Deliveries Forecast after EE adjustments
1103	Forecast of Incremental Energy Efficiency Savings
1104	Residential Building Permits, New Connects, Vacancy Rates and Customer Count History
1105	Forecast of Residential Use per Customer
1106	Commercial Energy Deliveries Forecast
1107	Manufacturing Deliveries Forecast by NAICS Sector
1108	Forecast of Energy Deliveries to Misc. Rate Schedules
1109	Total Delivery and Demand Forecasts
1110	Forecast of 2019 Deliveries to Cost of Service and Direct Access Customers
1111	Trended Weather HDD and CDD Comparison

Energy Deliveries Forecast (Base) by Market Segment and Service Level

(at average weather)

Base (not adjusted) Forecast [1]

	(in thousand MWh)					% Change [2]				
	2015	**2016**	**2017**	**2018**	**2019**	**2015**	**2016**	**2017**	**2018**	**2019**
Schedule 7	7,563	7,600	7,495	7,547	7,587	-0.7%	0.5%	-1.4%	0.7%	0.5%
Residential Lighting	3	3	3	3	3	-33.6%	-2.2%	-0.8%	-0.5%	0.0%
Total Residential	7,567	7,604	7,498	7,550	7,591	-0.7%	0.5%	-1.4%	0.7%	0.5%
Commercial [3]	6,988	6,920	6,913	6,975	6,979	0.0%	-1.0%	-0.1%	0.9%	0.1%
Manufacturing [3]	4,907	4,458	4,649	4,555	4,643	6.0%	-9.1%	4.3%	-2.0%	1.9%
Miscellaneous Customers	190	166	156	155	155	-1.4%	-12.8%	-6.1%	0.0%	-0.4%
Secondary Voltage	7,320	7,239	7,291	7,313	7,322	0.1%	-1.1%	0.7%	0.3%	0.1%
Total General Service	7,510	7,405	7,447	7,468	7,477	0.1%	-1.4%	0.6%	0.3%	0.1%
Primary Voltage Service	3,700	3,756	3,898	3,964	4,047	7.0%	1.5%	3.8%	1.7%	2.1%
Transmission Voltage Service	874	382	372	227	227	4.2%	-56.2%	-2.7%	-38.9%	0.0%
Total Retail [4]	19,651	19,147	19,215	19,209	19,341	1.2%	-2.6%	0.4%	0.0%	0.7%

1 SDEC17B_W75

2 Calculated from rounded numbers

3 By NAICS grouping

4 Total Retail equals Total Residential + Commercial + Manufacturing + Miscellaneous. Also equals Total Residential + Total General + Primary Voltage Service + Transmission Service, totals may not foot due to rounding.

Energy Deliveries Forecast (Energy Efficiency Adjusted) by Market Segment and Service Level

(at average weather)

Net of Incremental Energy Efficiency [1]

	(in thousand MWh)					% Change [2]				
	2015	**2016**	**2017**	**2018**	**2019**	**2015**	**2016**	**2017**	**2018**	**2019**
Schedule 7	7,563	7,600	7,495	7,507	7,503	-0.7%	0.5%	-1.4%	0.2%	-0.1%
Residential Lighting	3	3	3	3	3	-33.6%	-2.2%	-0.8%	-0.5%	0.0%
Total Residential	7,567	7,604	7,498	7,510	7,506	-0.7%	0.5%	-1.4%	0.2%	-0.1%
Commercial [3]	6,988	6,920	6,913	6,903	6,800	0.0%	-1.0%	-0.1%	-0.1%	-1.5%
Manufacturing [3]	4,907	4,458	4,649	4,539	4,605	6.0%	-9.1%	4.3%	-2.4%	1.5%
Miscellaneous Customers	190	166	156	155	155	-1.4%	-12.8%	-6.1%	0.0%	-0.4%
Secondary Voltage	7,320	7,239	7,291	7,235	7,132	0.1%	-1.1%	0.7%	-0.8%	-1.4%
Total General Service	7,510	7,405	7,447	7,391	7,287	0.1%	-1.4%	0.6%	-0.8%	-1.4%
Primary Voltage Service	3,700	3,756	3,898	3,953	4,021	7.0%	1.5%	3.8%	1.4%	1.7%
Transmission Voltage Service	874	382	372	227	227	4.2%	-56.2%	-2.7%	-38.9%	0.0%
Total Retail [4]	19,651	19,147	19,215	19,081	19,040	1.2%	-2.6%	0.4%	-0.7%	-0.2%

1 SDEC16E_W75

2 Calculated from rounded numbers

3 By NAICS grouping

4 Total Retail equals Total Residential + Commercial + Manufacturing + Miscellaneous. Also equals Total Residential + Total General + Primary Voltage Service + Transmission Service, totals may not foot due to rounding.

Forecast of Incremental Energy Efficiency (EE) Savings

(in thousand MWh)

	2018	2019
Base (B) Forecast	19,209	19,341
Incremental EE Savings [1]	(128)	(301)
Post-EE Forecast (E) [2]	19,081	19,040

1 Energy Trust of Oregon (ETO) annual savings deployment forecast.

2 Totals and differences may not foot due to rounding.

Residential Building Permits, New Connects, Vacancy Rates and Customer Counts History and Forecast

	2015	2016	2017 [1, 2]	2018 [2]	2019 [2]
Building Permits [3]					
Single-Family	9,999	10,629	10,472	10,931	11,531
Multi-Family	6,371	8,082	8,129	9,329	9,828
New Connects					
Single-Family	4,480	5,410	4,730	5,610	5,922
Multi-Family	3,965	4,713	5,392	5,590	4,939
Mobile Home	64	111	97	60	60
Other	41	32	11	24	24
Total Residential Connects	8,550	10,266	10,230	11,284	10,945
Commercial Connects	1,935	1,858	2,252	2,419	2,407
Total New Connects	10,485	12,124	12,482	13,703	13,352
Residential Customer Counts					
Single-Family Heat	109,572	110,374	110,910	111,209	111,565
Single-Family Non-Heat	354,075	358,731	363,094	366,992	371,496
Multiple-Family Heat	180,880	184,326	187,825	191,495	195,045
Multiple-Family Non-Heat	58,743	59,641	60,972	62,489	64,018
Mobile Home Heat	30,417	30,501	30,609	30,517	30,328
Mobile Home Non-Heat	3,908	3,932	3,935	3,915	3,897
Other	4,872	4,883	4,866	4,831	4,802
Total Number of Accounts [4]	742,467	752,388	762,211	771,448	781,152

1 Includes actuals through December 2017, except for connects which include actuals through November 2017 and forecast for December 2017

2 Forecasted values are identical for base and energy efficiency forecast

3 Oregon building permits

4 Includes vacant accounts

Forecast of Residential Use per Customer and Ultimate Deliveries

(at average weather)

Net of Incremental Energy Efficiency [1]

Use per Customer (kWh)	2015 [2]	2016 [2]	2017 [2]	2018	2019
Single-Family Heat	14,808	14,813	14,378	13,971	13,721
Single-Family Non-Heat	10,112	10,010	9,849	9,890	9,820
Multiple-Family Heat	8,220	8,090	7,740	7,636	7,512
Multiple-Family Non-Heat	6,004	5,959	5,875	5,912	5,880
Mobile Home Heat	14,028	14,167	13,694	13,171	12,979
Mobile Home Non-Heat	10,722	10,914	10,525	10,358	10,287
Other	10,703	10,827	10,536	10,207	10,092
Average Use per Customer	10,187	10,102	9,833	9,731	9,604
Ultimate Deliveries (millions of kWh)					
Single-Family Heat	1,623	1,635	1,595	1,554	1,531
Single-Family Non-Heat	3,580	3,591	3,576	3,630	3,648
Multiple-Family Heat	1,487	1,491	1,454	1,462	1,465
Multiple-Family Non-Heat	353	355	358	369	376
Mobile Home Heat	427	432	419	402	394
Mobile Home Non-Heat	42	43	41	41	40
Other	52	53	51	49	48
Schedule 6 & 7 Deliveries	7,563	7,600	7,495	7,507	7,503
Residential Lighting	3	3	3	3	3
Total Residential Deliveries	7,567	7,604	7,498	7,510	7,506

1 SDEC17E_W75

2 Weather-adjusted

Commercial Energy Deliveries Forecast by NAICS Sector

(at average weather)

Net of Incremental Energy Efficiency

						% Change [1]				
	2015 [2]	2016 [2]	2017 [2]	2018	2019	2015	2016	2017	2018	2019
Food Stores	456	431	421	412	398	-2.0%	-5.5%	-2.3%	-2.1%	-3.5%
Govt. & Education	998	969	984	971	957	0.3%	-3.0%	1.6%	-1.4%	-1.4%
Health Services	729	721	718	731	727	-0.3%	-1.2%	-0.3%	1.7%	-0.5%
Lodging	105	107	106	103	102	0.9%	1.5%	-0.7%	-2.6%	-1.8%
Misc. Commercial	640	665	712	705	699	0.1%	4.0%	7.0%	-0.9%	-0.8%
Department Stores/Malls	350	343	332	338	334	-0.3%	-2.1%	-3.0%	1.7%	-1.1%
Office & F.I.R.E. [3]	1018	993	954	963	945	-3.1%	-2.5%	-3.9%	0.9%	-1.9%
Other Services	834	863	867	864	855	3.8%	3.5%	0.5%	-0.4%	-1.0%
Other Trade	727	720	713	710	692	0.5%	-1.0%	-0.9%	-0.4%	-2.6%
Restaurants	481	480	481	487	486	0.5%	-0.2%	0.1%	1.4%	-0.3%
Trans., Comm. & Utility	649	629	629	619	606	-0.5%	-3.1%	0.0%	-1.6%	-2.1%
Total Commercial	6,988	6,920	6,918	6,903	6,800	-0.1%	-1.0%	0.0%	-0.2%	-1.5%

1 Calculated using rounded-numbers

2 Weather-adjusted

3 Finance, Insurance, and Real Estate

Manufacturing Deliveries Forecast by NAICS Sector

(at average weather)

Net of Incremental Energy Efficiency

	(in thousand MWh)					% Change [1]				
	2015 [2]	2016 [2]	2017 [2]	2018	2019	2015	2016	2017	2018	2019
Food & Kindred Products	247	257	268	269	269	4.8%	3.9%	4.3%	0.1%	0.1%
High Tech	2,368	2,459	2,588	2,650	2,732	10.6%	3.8%	5.2%	2.4%	3.1%
Lumber & Wood	95	93	101	97	96	-2.8%	-2.9%	8.5%	-4.0%	-0.7%
Metal Manufacturing and Fab	478	450	445	439	436	-2.9%	-5.9%	-1.1%	-1.5%	-0.6%
Other Manufacturing	737	712	767	748	736	-1.7%	-3.4%	7.7%	-2.5%	-1.6%
Paper & Allied Products	788	313	297	158	158	10.7%	-60.2%	-5.1%	-46.8%	-0.1%
Transportation Equipment	191	173	178	179	178	3.5%	-9.6%	2.9%	0.4%	-0.2%
Total Manufacturing	4,907	4,458	4,644	4,539	4,605	6.3%	-9.1%	4.2%	-2.3%	1.5%

1 Calculated using rounded-numbers

2 Weather-adjusted

Forecast of Energy Deliveries to Miscellaneous Rate Schedules

Net of Incremental Energy Efficiency

	(in thousand MWh)					% Change [1]				
	2015	2016	2017	2018 [2]	2019 [2]	2015	2016	2017	2017	2018
Residential										
Outdoor Area Lighting (15R) [3]	3	3	3	3	3	-33.6%	-2.2%	-0.8%	-0.5%	0.0%
Secondary (Commercial)										
Outdoor Area Lighting (15C) [4]	13	13	13	13	12	-9.0%	-1.8%	-2.0%	-2.4%	-1.9%
Farm Irrigation et al. [5]	92	80	79	85	86	15.6%	-13.4%	-0.7%	7.7%	1.3%
Street and Other Lighting [6]	84	73	63	58	56	-14.2%	-13.9%	-12.7%	-9.2%	-2.7%
Total Miscellaneous Commercial	190	166	156	155	155	-1.4%	-12.8%	-6.1%	0.0%	-0.4%
All Miscellaneous Schedules [7]	193	169	159	159	158	-2.3%	-12.6%	-6.0%	0.0%	-0.4%

1 Calculated from rounded numbers

2 Identical for non-price, price-effect and post-EE forecasts

3 Existing Schedule 15R

4 Existing Schedule 15C

5 Existing Schedules 47 & 49

6 Existing Schedules 91, 92 & 93, and Schedule 95 beginning in 2013. Rate schedule 93 moved to Rate Schedule 38 in 2014.

7 Equals line 2 + line 7

Total Delivery and Demand Forecast

Net of Incremental Energy Efficiency [4]

	Million kWh [1]	Average MW [2]	Peak MW [3]
2010	18,893	2,274	3,582
2011	19,138	2,334	3,555
2012	19,248	2,312	3,597
2013	19,265	2,346	3,869
2014	19,420	2,329	3,866
2015	19,651	2,344	3,914
2016	19,147	2,287	3,726
2017	19,215	2,389	3,976
2018	19,081	2,318	3,613
2019	19,040	2,313	3,610

1 Cycle-month basis, at end-user meters, weather adjusted; includes actual deliveries through 2017

2 Calendar basis, at the bus bar, actual through 2017, not adjusted for weather.

3 Coincidental annual system peak at bus bar; includes actual through 2017, not adjusted for weather.

4 2018 and 2019 are the incremental EE adjusted forecast.

Forecast of 2019 Deliveries to Cost of Service and Direct Access Customers

Net of Incremental Energy Efficiency

(in thousand MWh)

	Cost of Service [1]	Direct Access [2]	Total Delivery [3]
Residential	7,506	0	7,506
Secondary	6,652	579	7,231
Primary	2,816	1,205	4,021
Transmission	58	169	227
Lighting	56	0	56
Total Retail [3]	17,088	1,953	19,041

1 Includes economic replacement VPO deliveries

2 Schedule 485/489 deliveries

3 Totals may not add due to rounding.

Trended Weather HDD and CDD Comparison

2019 Weather Variables

	Based on Trended Approach		Based on 15-Year Avg. (2002-2016)	
Billing Month	HDD65	CDD65	HDD65	CDD65
January	753.5	0.0	775.4	0.0
February	639.0	0.0	664.5	0.0
March	557.8	0.0	573.6	0.0
April	409.7	0.2	438.1	0.5
May	272.7	7.3	297.3	7.1
June	137.3	36.2	153.8	31.8
July	46.8	115.5	43.7	108.2
August	11.7	195.7	4.3	178.3
September	22.6	173.9	19.3	149.1
October	103.3	44.1	122.0	36.9
November	322.8	1.4	342.4	1.9
December	642.1	0.0	660.4	0.0
Annual	3,919.4	574.3	4,094.8	513.9

Trended Weather Approach Resources

Livezey, Robert E. et al. "Estimation and Extrapolation of Climate Normals and Climatic Trends." Journal of Applied Meteorology and Climatology, vol. 46, 2007, pp. 1759-1776, http://journals.ametsoc.org/doi/pdf/10.1175/2007JAMC1666.1. Accessed Nov. 2016.

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Wilks, Daniel S. and Robert E. Livezey. "Performance of Alternative "Normals" for Tracking Climate Changes, Using Homogenized and Nonhomogenized Seasonal U.S. Surface Temperatures." Journal of Applied Meteorology and Climatology, vol. 52, 2013, pp. 1677-1687, http://journals.ametsoc.org/doi/pdf/10.1175/JAMC-D-13-026.1. Accessed Nov. 2016.