Annual Energy and Emissions Intensity ("EEI") Metrics Report
Pursuant to WAC 480-109-300
June 1, 2018

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Energy and Emissions Intensity Metrics Report
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Section 1: Executive Summary

Per the requirements of WAC 480-109-300, Puget Sound Energy ("PSE" or the "Company") submits the following report outlining its energy and emissions intensity metrics for the previous 10 years ("reporting period"). This report includes the following metrics for all PSE generating resources serving Washington State customers:

- Average megawatt hours (aMWh) per residential customer
- Average megawatt hours (aMWh) per commercial customer
- Megawatt hours (MWh) per capita
- Annual carbon dioxide (CO_2) emissions measured in short tons
- Ratio of Annual CO_2 emissions to CO_2 emissions in 1990

PSE and the other utilities purchase a percentage of their energy to serve native load from the spot market. The generation sources from purchases made on the spot market are unknown. Therefore, this report also includes a subset of metrics for spot market purchases based on average emission rate factors provided by the Washington State Department of Commerce ("Commerce"). Those metrics include:

- Annual CO_2 emissions (short tons) from unknown generation sources
- Annual megawatt hours (MWh) delivered to retail customers from unknown generation sources
- Percentage of load served by unknown generation sources

In addition to the raw data included in Attachment A to this report, the tables and sections below provide trend analysis, narrative descriptions and graphics to help contextualize PSE's data and trends for the reporting period. Table 1 below summarizes PSE's greenhouse gas (GHG) emissions intensity and energy metrics for calendar year 2016. Summaries of the previous nine years in the reporting period are included in Attachment A to this report. Section 2 below provides a 10-year "lookback" analysis of the reporting period (to operating year 2008) of the metrics mentioned above, and benchmarks those metrics to a 1990 emissions baseline. Section 3 provides a discussion of the trends observed in the metrics and the broader regional market. Section 4 includes appendices that provide more detail on methodologies used in this report.

Table 1- Summary of Energy and Emissions Intensity Metrics (2017)

Summarized in Table 1 and narrative below are PSE's 2017 energy and intensity metrics. Staff requested in its compliance letter to PSE's 2017 EEI report that the Company explain the difference between "total load served" and the sum of "Busbar MWh" included in Table 1. The energy intensity metrics represent the metered sale of energy to customers (by class) as reported pursuant to the FERC Form-1 protocols, i.e. Total Load Served. Busbar energy tallies represent the total load PSE served (to Washington) that is generated and purchased, net of bilateral sales, as reported in PSE's Energy Accounting (EA) database, i.e. Busbar MWh.

Table 1. Summary Energy and Emissions Intensity Report

Utility :	Puget Sound Energy	
Reporting for Year :	2017	**MWh per Capita**
Population Served :	2,524,400	**8.41**

Energy Intensity Metrics

	MWh at Meter	MWh Proportion	Customer Count	**MWh per Customer**
Residential Customers	10,931,999	51.5%	1,003,984	**10.9**
Commercial Customers	9,089,842	42.8%	134,692	**67.5**
Industrial Customers	1,214,818	5.7%		
Total Load Served	21,236,659			

Emissions Intensity Metrics

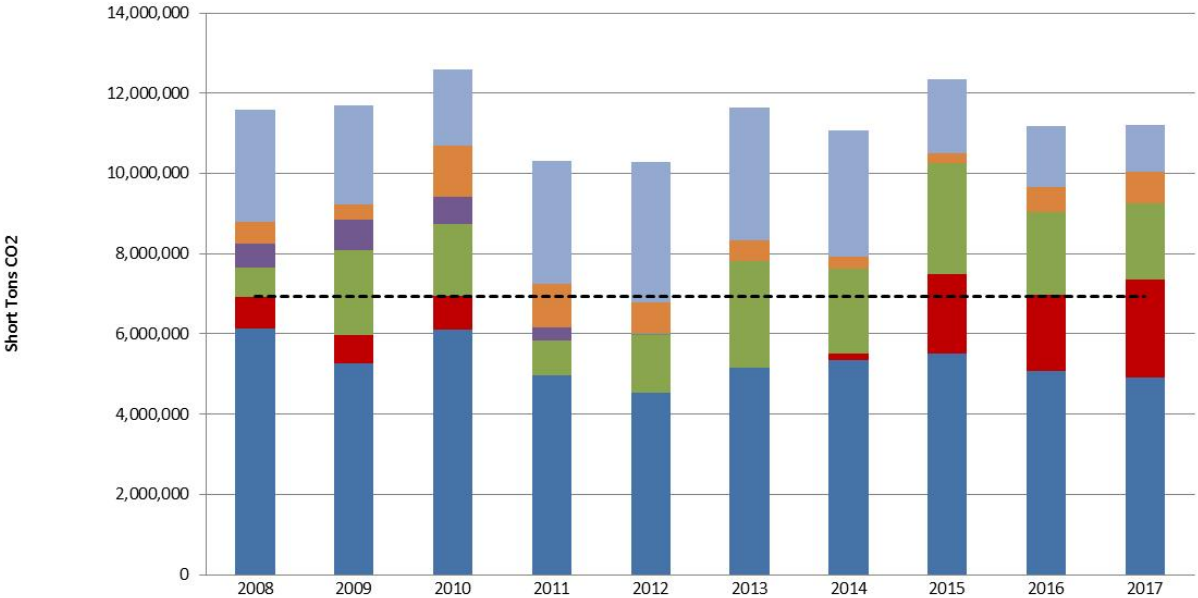
	Busbar MWh	Percent of Total Load	**Short Tons CO_2**	
Known Resources Serving WA	18,364,275	87.9%	10,029,376	
Unknown Resources Serving WA	2,534,323	**12.1%**	1,188,669	**% of 1990 CO_2**
		Total Short Tons (CO_2):	**11,218,045**	**161.5%**

1990 Short Tons CO_2	6,946,064

Section 2: Prior 10-year annual metrics for all generating resources serving Washington customers

Figure 1 provides a comparison of annual PSE CO_2 emissions measured in short tons from generation sources for the previous 10 years. Figure 1 also includes a 1990 emissions baseline.

Figure 1. PSE Total Emissions by Resource Type (Owned, Firm & Unknown)



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Unknown	2,787,287	2,465,915	1,897,917	3,064,415	3,489,259	3,326,881	3,138,202	1,851,819	1,537,614	1,188,669
PSE Firm All Other	548,109	397,766	1,285,615	1,097,367	790,139	499,429	302,577	252,050	619,004	766,337
PSE Own All Other	305	383	119	251	10,823	64	326	268	170	368
PSE Firm Gas	579,075	737,669	674,203	305,661	200	3,411	488	161	81	0
PSE Owned Gas	731,769	2,121,105	1,788,661	882,874	1,453,056	2,676,353	2,116,534	2,754,715	2,062,316	1,905,779
PSE Firm Coal	801,890	716,565	850,106	0	0	0	157,594	1,986,953	1,891,255	2,449,181
PSE Owned Coal	6,130,795	5,258,788	6,093,355	4,959,801	4,528,260	5,145,052	5,350,265	5,508,526	5,079,502	4,907,712
1990 Baseline	6,946,064	6,946,064	6,946,064	6,946,064	6,946,064	6,946,064	6,946,064	6,946,064	6,946,064	6,946,064

Figure 2 provides a comparison of the average MWh per residential customer, average MWh per commercial customer, and MWh per capita delivered in each of the years during the reporting period in PSE's service territory.

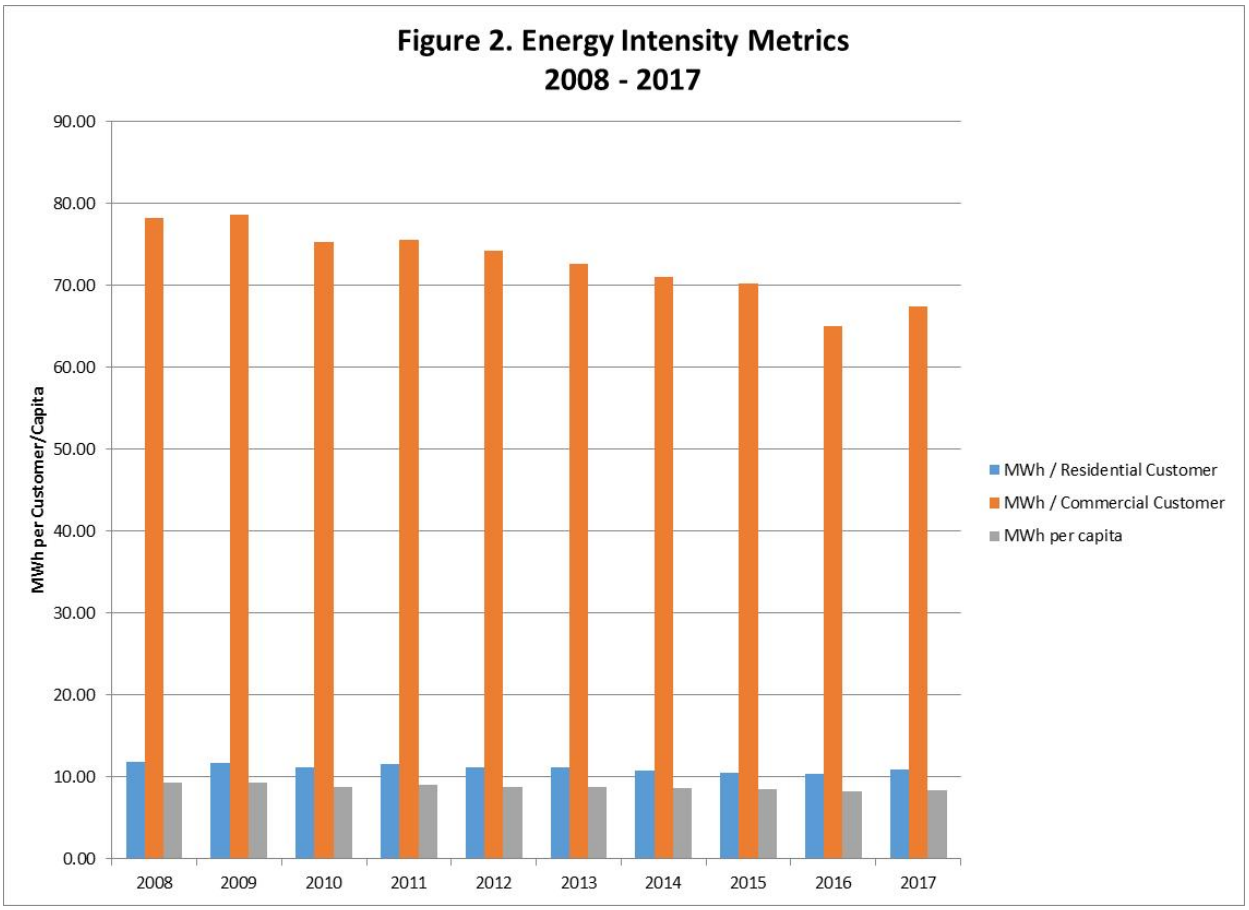


Figure 3 provides a comparison of the ratios of PSE's annual CO_2 emissions from known sources for the reporting period compared to CO_2 emission in 1990.

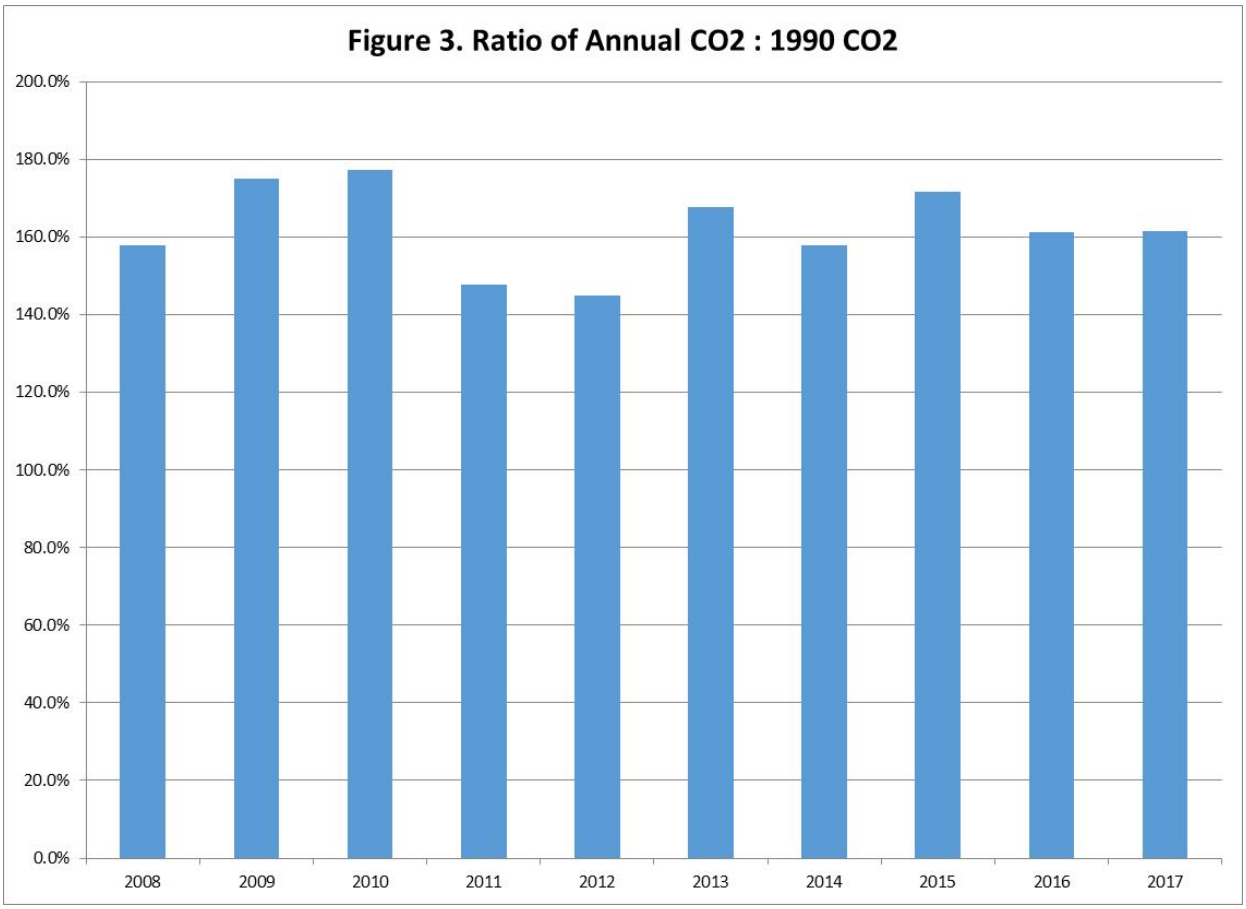
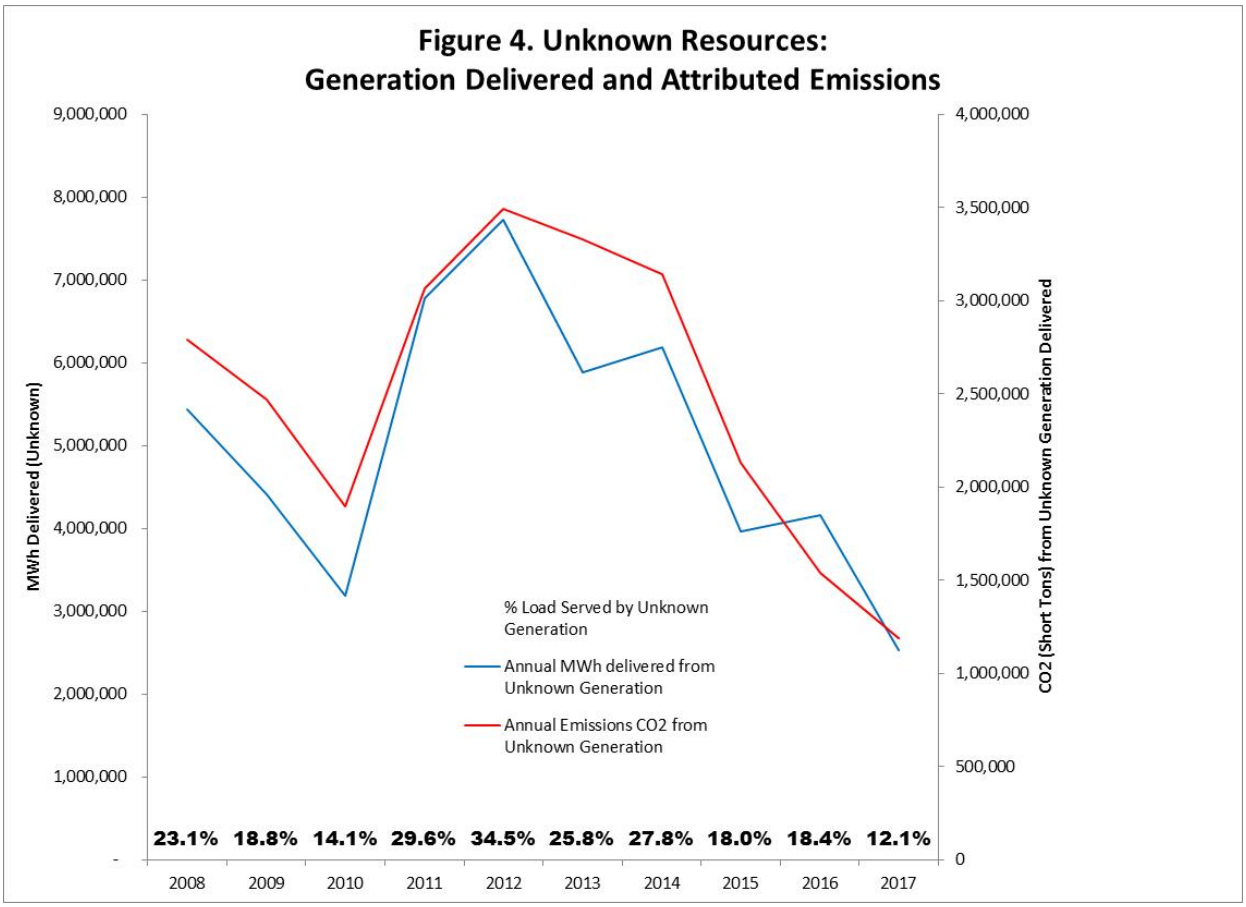


Figure 4 provides a 10-year comparison of generation delivered to PSE from unknown sources and the attributed emissions. Those metrics include annual CO_2 emissions (short tons), annual MWh delivered to retail customers, and the percentage of load served. As discussed in the executive summary, the generation sources and attributed emissions for spot market purchases are unknown, and therefore Commerce provided emissions factors for each of the previous 10 years in the reporting period.



Section 3: Trend analysis, narrative, findings and graphics

This section addresses the requirement in WAC 480-109-300(4) to include narrative text describing trends and an analysis of the likely causes of changes, or lack of changes, in the metrics.

Electric Supply

In 2017, PSE's electric power resources, which include company-owned or controlled resources as well as those under long-term contract, had a total capacity of approximately 4,737 megawatts (MW). PSE's historical peak load of approximately 4,912 MW occurred on December 10, 2009.

PSE purchases electric energy under long-term firm purchased power contracts with other utilities and marketers in the western interconnect. PSE is generally not obligated to make payments under these contracts unless power is delivered. PSE had seasonal energy and capacity exchange agreements with the Bonneville Power Administration ("BPA") for 44 aMW of

capacity which expired on July 1, 2017, with no provision to renew this agreement. PSE also has an agreement with Pacific Gas & Electric Company for 300 MW of capacity which currently has no set expiration.

Energy supply and demand across the Western Interconnection is maintained on a second-to-second basis, and PSE dispatches its resources based on market prices in the Interconnect. When the dispatch cost of a specific PSE-owned unit is lower than market price, the unit runs, and the net revenue credits back to customers to reduce rates. When the cost to run the PSE-owned unit is greater than market price, the units are not dispatched. Dispatch decisions are independent of the demand by PSE's customers. If PSE's customers need power when its units are uneconomic to run, PSE purchases the energy from wholesale markets – other utilities or registered power marketers that have energy to sell. In the case where PSE's generation is dispatched and there is a surplus above PSE's customers' needs, that surplus will be sold in the wholesale market (net revenue from such sales is credited back to customers through rates). This means whatever is happening to PSE's load is unrelated. The primary driver of generation dispatch is whether a generator's variable cost of dispatch is lower than market price.

PSE tracks its firm and non-firm power transactions in its Energy Accounting ("EA") database. Table 2 shows all firm energy transactions made in 2017. Table 2 includes the total dispatch of all of PSE-owned units. Emissions from PSE's units and from each firm purchase are calculated using the methodologies described in Appendix 2.1 and 2.2 respectively. For all firm BPA transactions and "non-unit-specific" purchases, PSE defaults to the Commerce emissions intensity metric pursuant to Staff instruction. PSE employed Staff's net-by-counterparty approach to calculate emissions from its non-firm (unspecified) power transactions. Details of these transactions are presented in Table 3 and the calculation methodology is described in Appendix 2.3. Staff requested in its compliance letter to PSE's 2017 EEI report that the Company explain how PSE determines whether a source is known or unknown. Staff correctly assumes that PSE classifies non-unit specific purchases as unknown sources. PSE also classifies firm deliveries from the BPA and BC Hydro systems as unknown resources because the system mix of energy behind the delivery can vary at any moment in time. PSE-owned resources and unit-specific firm deliveries are classified as known sources because their fuel source is known and reported in EIA databases as described in Appendix 2.1 and 2.2.

Table 2. PSE-Owned & Firm Resources Serving WA Customers

Resource	WA MWh	lbs CO_2/MWh	Short Tons CO_2	Type	Fuel
PSE-Owned Generation (NERC Generating Availability Data System - GADS)					
Lower Baker	313,112	0	0	PSE-Owned	Hydro
Snoqualmie Falls #1	60,898	0	0	PSE-Owned	Hydro

Snoqualmie Falls #2	135,067	0	0	PSE-Owned	Hydro
Upper Baker	355,744	0	0	PSE-Owned	Hydro
Colstrip 1 & 2	1,908,332	2,442	2,195,144	PSE-Owned	Coal
Colstrip 3 & 4	2,555,373	2,228	2,712,568	PSE-Owned	Coal
Crystal Mountain	396	1,859	368	PSE-Owned	Diesel
Encogen 1	69,342	1,046	36,267	PSE-Owned	Gas
Encogen 2	66,480	1,057	35,131	PSE-Owned	Gas
Encogen 3	69,378	1,064	36,907	PSE-Owned	Gas
Ferndale 1	383,068	1,005	192,552	PSE-Owned	Gas
Ferndale 2	381,873	1,015	193,842	PSE-Owned	Gas
Frederickson 1	18,492	2,370	21,910	PSE-Owned	Gas
Frederickson 2	11,360	4,744	26,943	PSE-Owned	Gas
Fredonia 1	44,480	1,893	42,092	PSE-Owned	Gas
Fredonia 2	45,384	1,927	43,727	PSE-Owned	Gas
Fredonia 3	16,508	1,244	10,272	PSE-Owned	Gas
Fredonia 4	17,880	1,216	10,870	PSE-Owned	Gas
Frederickson Unit 1	464,327	833	193,458	PSE-Owned	Gas
Goldendale	1,119,821	816	457,077	PSE-Owned	Gas
Mint Farm	915,875	857	392,321	PSE-Owned	Gas
Sumas	266,588	1,037	138,169	PSE-Owned	Gas
Whitehorn 2	7,643	3,937	15,043	PSE-Owned	Gas
Whitehorn 3	25,401	4,661	59,199	PSE-Owned	Gas
Hopkins Ridge (W184)	345,425	0	0	PSE-Owned	Wind
Lower Snake River	716,381	0	0	PSE-Owned	Wind
Wild Horse (W183)	612,984	0	0	PSE-Owned	Wind
Firm Deliveries (EA Database)					
3 Bar G Wind Turbine #3 LLC	25	0	0	Firm Unit-Specific	Wind
BC Hydro (Point Roberts)	21,210	1,004	10,647	Firm-Unknown	Hydro
Bio Energy Washington (BEW)	5	0	0	Firm Unit-Specific	Biogas
Black Creek Hydro Inc	11,718	0	0	Firm Unit-Specific	Hydro
Blocks Dairy Farm	1	0	0	Firm Unit-Specific	Biogas
BPA	7,000	1,004	3,514	Firm-Unknown	System
BPA Firm - WNP#3 Exchange	241,574	1,004	121,270	Firm-Unknown	System
CC Solar 1 and CC Solar 2	29	0	0	Firm Unit-Specific	Solar
Chelan PUD - RI & RR	2,315,054	0	0	Firm Unit-	Hydro

				Specific	
Chelan PUD - Rock Island Syst #2	-39,402	0	0	Firm Unit-Specific	Hydro
Chelan PUD - Rocky Reach	-81,794	0	0	Firm Unit-Specific	Hydro
Douglas PUD - Wells Project	1,111,775	0	0	Firm Unit-Specific	Hydro
Edaleen Dairy LLC	4,821	0	0	Firm Unit-Specific	Biogas
Farm Power Lynden LLC	4,648	0	0	Firm Unit-Specific	Biogas
Farm Power Rexville LLC	5,379	0	0	Firm Unit-Specific	Biogas
Grant PUD - Priest Rapids Project	49,501	0	0	Firm Unit-Specific	Hydro
Island Community Solar LLC	61	0	0	Firm Unit-Specific	Solar
Klondike Wind Power III	110,067	0	0	Firm Unit-Specific	Wind
Knudsen Wind Turbine #1	92	0	0	Firm Unit-Specific	Wind
Rainier Bio Gas	4,858	0	0	Firm Unit-Specific	Biogas
Skookumchuck Hydro	6,319	0	0	Firm Unit-Specific	Hydro
Smith Creek Hydro	126	0	0	Firm Unit-Specific	Hydro
Swauk Wind	9,505	0	0	Firm Unit-Specific	Wind
Transalta Centralia Generation LLC	2,070,958	2,365	2,449,181	Firm Unit-Specific	Coal
Transalta Centralia Generation LLC - Bookout Source Other Adjustment	1,256,783	1,004	630,905	Firm-Unknown	System
Van Dyk - S Holsteins	2,345	0	0	Firm Unit-Specific	Biogas
VanderHaak Dairy Digester	2,323	0	0	Firm Unit-Specific	Biogas
Electron Hydro, LLC	128,752	0	0	Firm Unit-Specific	Hydro
Emerald City Renewables	36,229	0	0	Firm Unit-Specific	Biogas
Ikea Solar	82	0	0	Firm Unit-Specific	Solar
Koma Kulshan Associates	42,817	0	0	Firm Unit-Specific	Hydro
Lake Washington -- Finn Hill	310	0	0	Firm Unit-Specific	Biogas
Nooksack	21,012	0	0	Firm Unit-Specific	Hydro
Sygitowicz Creek	986	0	0	Firm Unit-	Hydro

				Specific	
Twin Falls Hydro	77,849	0	0	Firm Unit-Specific	Hydro
Weeks Falls	13,647	0	0	Firm Unit-Specific	Hydro

Total:	18,364,275	10,029,376
Firm Total:	7,436,665	3,215,518
Firm Renewable Total:	3,839,140	
% Firm Renewable:	52%	

Table 3. Unknown Resources Serving WA Customers

Resource	Net-by-Counterparty MWh	Fuel Mix lbs CO_2/MWh	Short Tons CO_2
Firm Deliveries (EA Database)			
Avista Corp. WWP Division	55,283	1,004	27,752
Avista Nichols Pump	21,065	1,004	10,574
Black Hills Power	-2,600	1,092	-1,420
BP Energy Co.	217,861	1,004	109,366
BPA	98,054	1,004	49,223
BPA - CA Wind Integration	22,037	1,004	11,062
BPA - NWPP Reserve Sharing Energy	159	1,004	80
BPA - PTP Transactions	86,309	1,004	43,327
BPA - SCD Hourly NF	17,365	1,004	8,717
BPA - Spin Reserv Requirement	38,849	1,004	19,502
BPA IS - Hourly Non-Firm	8,707	1,004	4,371
British Columbia Transmission Corp	409	1,004	205
CAISO EESC Load Undistributed Costs	33,125	1,004	16,629
CAISO PRSC Undistributed Costs	-8,713	1,092	-4,758
California ISO	23,659	1,004	11,877
Calpine Energy Services	-252,611	1,092	-137,960
Cargill Power Markets	157,955	1,004	79,293
Chelan County PUD #1	-52,667	1,092	-28,763
Citigroup Energy Inc	312,832	1,004	157,042
Clark Public Utilities	-2,830	1,092	-1,546
Clatskanie PUD	-7,310	1,092	-3,992
Colstrip - Energy Imbalance Market	105,631	1,004	53,027
Conoco, Inc.	-8,000	1,092	-4,369

Deviation	-25,311	1,092	-13,823
Douglas County PUD #1	212,117	1,004	106,483
Douglas PUD - Wells Project	20,574	1,004	10,328
EDF Trading NA LLC	475,784	1,004	238,844
Encogen	1,723	1,004	865
Energy Keepers Inc.	60	1,004	30
ENMAX Energy Marketing, Inc.	-296	1,092	-162
Eugene Water & Electric	-63,712	1,092	-34,795
Exelon Generation Co LLC	149,950	1,004	75,275
Ferndale Co-Generation	70,221	1,004	35,251
Freddie #1	214	1,004	108
Fredonia - Energy Imbalance Market	8,211	1,004	4,122
Fredrickson 1 & 2	6,813	1,004	3,420
Goldendale	-40,989	0	0
Grant County PUD #2	-4	1,092	-2
GRIDFORCE ENERGY MANAGEMENT, LLC.	-202	1,092	-110
Iberdrola Renewables (PPM Energy)	731,570	1,004	367,248
Idaho Power Company	-40,797	1,092	-22,281
J. Aron & Company	30,000	1,004	15,060
Lower Baker	2,626	1,004	1,318
MID-C for Energy Imbalance Market	110,531	1,004	55,486
Mint Farm	-16,758	0	0
Morgan Stanley CG	513,602	1,004	257,828
Natur Ener USA	-211	1,092	-115
Nevada Power Company	-16	1,092	-9
NextEra Energy Power Marketing	4,000	1,004	2,008
Northwestern Energy	-15,807	1,092	-8,633
Okanogan PUD	26,026	1,004	13,065
Pacific Gas & Elec - Exchange	0	1,092	
Pacificorp	-237,749	1,092	-129,843
Portland General Electric	-133,050	1,092	-72,663
Powerex Corp.	-1,371,536	1,092	-749,044
Public Service of Colorado	130,513	1,004	65,518
Rainbow Energy Marketing	-2,638	1,092	-1,441
Sacramento Municipal	139	1,004	70
Seattle City Light Marketing	132,196	1,004	66,362
Shell Energy (Coral Pwr)	-73,192	1,092	-39,973
Snohomish County PUD #1	12,341	1,004	6,195
Snoqualmie-Energy Imbalance Market	1,788	1,004	898
Sumas	24,529	1,004	12,313
Tacoma Power	30,313	1,004	15,217

Talen Energy (PPL Energy Plus)	221,765	1,004	111,326
Tenaska Power Services Co.	-3,000	1,092	-1,638
The Energy Authority	788,491	1,004	395,822
TransAlta Energy Marketing	-271,727	1,092	-148,400
TransCanada Energy Sales Ltd	-46,100	1,092	-25,177
Turlock Irrigation District	8,325	1,004	4,179
Upper Baker	68,798	1,004	34,537
Vitol Inc.	226,338	1,004	113,622
Whitehorn 2&3	13,715	1,004	6,885
Wild Horse (W183)	-6,495	0	0
Williams Power Company	-3,928	1,092	-2,145

Columbia River Energy Supply Contracts

During 2017, approximately 16.1% of PSE's energy supply requirement was obtained through long-term contracts with three Washington Public Utility Districts (PUDs) that own and operate hydroelectric projects on the Columbia River (Mid-Columbia). PSE's portion of the power output of the PUDs' projects is shown in Table 4.

Table 4. Columbia River Electric Energy Supply Contracts

Project	Contract Expiration	Percent of Output (PSE Share)	MW Capacity (PSE Share, approx.)
Rock Island Project (Chelan County PUD)	2031	25%	156
Rocky Reach Project (Chelan County PUD)	2031	25%	325
Wells Project (Douglas County PUD)	2028	29.9%	251
Priest Rapids Development (Grant County PUD)	2052	0.6%	6
Wanapum Development (Grant County PUD)	2052	0.6%	7

Energy Imbalance Market (EIM)

Staff requested in its compliance letter to PSE's 2017 EEI report that the Company clarify how its participation in the Energy Imbalance Market ("EIM"), operated by the California Independent System Operator ("CAISO"), is represented in this EEI report. For several reasons described below, it would be premature to make any assumptions in this report regarding the emissions impact to PSE from participation in the EIM because there is simply not enough information available from the market operator at this time to make any reasonable conclusions.

PSE joined the EIM in October 2016 and has realized significant financial and operational benefits from participation in this real-time energy imbalance trading market operated by the CAISO that automatically finds the lowest-cost energy to serve intra-hour incremental changes across a wide geographic area of the western United States. PSE is reliant upon the CAISO market model's identification of sources and sinks in the EIM and, therefore, must look to CAISO to calculate any state-specific emissions impacts of the EIM. At the current time, CAISO calculates and publishes GHG emission impacts across the entire EIM footprint, but does not calculate state-specific or utility-specific emissions impacts for EIM participants. CAISO's calculation of emissions is based on "avoided renewable curtailments" across the entire EIM footprint and it assumes that those avoided renewable curtailments displace generation from a resource with a default emissions rate of 0.428 metric tons CO2/MWh. Currently, CAISO's model cannot provide PSE with the information necessary to make its own state- or utility-specific emissions impact calculation. CAISO only calculates the sink point for generators dispatched to the state of California, and this calculation is not based on physical dispatch, but is based on a least-cost dispatch run by the market model.

CAISO has an ongoing stakeholder process that seeks to update its market model to provide increased accuracy and accounting of dispatch volumes into the California cap-and-trade system and potential future GHG pricing regimes. PSE is participating in that process. More information is available about the CAISO EIM, its emissions and benefit calculations/assumptions, and ongoing stakeholder initiatives at www.westerneim.com.

2017 Carbon Dioxide Emissions - Results & Discussion

Overall, PSE's CO_2 emissions intensity from total electricity delivered to customers increased by eight percent from 989 lb/MWh to 1,074 lb/MWh. As shown throughout this report, PSE delivers electricity to customers from a combination of sources that the company owns and purchases from other providers via firm contracts or the spot market. In 2017, 52.3 percent of electricity delivered to PSE customers was generated by the company, while 47.9 percent of electricity was purchased via firm contracts (35.6%) and non-firm contracts, i.e. spot market (12.1%). Of the CO_2 emissions associated with electric delivery, 60.7 percent were from electricity generated by PSE and 39.3 percent were from purchased electricity (28.7 percent via firm contracts and 10.6 percent via non-firm contracts).

It's important to remember that CO_2 emissions vary based on the fuel source or technology used to generate the electricity. Some sources are more emissions intense than others. "Intensity" is the relationship between emissions and production, and utilities can measure that intensity using a metric called pounds of CO_2 per megawatt hour (lb/MWh) of electricity produced. For instance, about 40.8 percent of the electricity generated by PSE came from coal combustion, but this fuel source represented about 72.0 percent of the CO_2 emissions from electricity generated by PSE. Natural gas accounted for 35.9 percent of the electricity generated

by PSE, however this fuel source represented only 28.0 percent of the CO_2 emissions from electricity generated by PSE. Renewable power accounted for 23.2 percent of the electricity generated by PSE, and produced zero CO_2 emissions.

Compared to 2016, total electricity delivered to customers in 2017 was down by 7.6 percent, and total emissions were down by 0.3 percent. This trend is largely due to PSE dispatching less of its owned generation (coal, gas and renewable) with more purchased energy being delivered into PSE's system under firm contract, but less from the spot market. In addition, emissions from PSE's owned generating sources were down in 2017 for several reasons including: marginally less dispatch of PSE's coal-based Colstrip Generating Station (emissions down 3.4%); more deliveries from firm contracted resources (emission up 29.5%); less PSE gas generation (emissions down 7.6%); and less deliveries of purchased unspecified energy (emissions down 22.7%).

In 2017, PSE purchases of electricity delivered to customers made up for less thermal generation from the company's owned units. Firm deliveries were up by 8.1 percent and unspecified deliveries (i.e. spot market) were down by 39.2 percent. Firm thermal purchases come from four contracted sources: BC Hydro, BPA, BPA WNP#3, and Centralia ("Market & Coal"). Firm deliveries from BC Hydro, BPA, BPA WNP#3, and "Centralia Market" are assigned a system emissions rate due to a market option in the contract structure. Firm deliveries from "Centralia Coal" are assigned a calculated rate pursuant to the methodology described below under *Centralia Coal Transition Power* and in Appendix 2. While unspecified purchased electricity decreased by 39.2 percent, emissions from unspecified purchased electricity only decreased by 22.7 percent because a higher emission factor was used for the NWPP (1,004 lb/MWh in 2017 versus 895 lb/MWh in 2016) and for PSE-Firm PPA deliveries (1,092 lb/MWh in 2017 versus 1,046 lb/MWh in 2016.

Trends Discussion

An interesting trend to note is that the relative amount of GHG emissions from the electricity sources did not align with the amount of power produced from each electricity source. This is due to several factors related to the intensity of emissions from each source. Again, emission intensity is the relationship between CO_2 emissions and power production, i.e., pounds CO_2/kWh.

For example, about 40.8 percent of the electricity generated by PSE came from coal combustion, which has a high CO_2 emission intensity compared to natural gas and oil combustion sources. Of CO_2 emissions from electricity generated by PSE (direct emissions), about 72.0 percent were from coal-combustion generation. It is the high CO_2 emission intensity of coal-combustion generation that made the overall CO_2 emission intensity of PSE's electric operations high.

Another example highlighting this trend occurs in purchased electricity. Roughly 52 percent of firm contract electricity purchased by PSE came from renewable plants in the Pacific Northwest (mostly hydroelectric), while the remaining purchases were sourced from thermal plants. Since hydroelectric generation is considered a non-GHG emitting source, almost all of the CO_2 emissions generated from firm contract purchased electricity come from coal and natural gas generated electric operations.

A third example relates to how emissions are calculated for electricity purchased by PSE on the spot market (i.e. non-firm contracted purchases of electricity). Again, these purchases are sourced from different utilities and non-utilities via the "grid" system of electric distribution, which makes the source of energy difficult to track and measure. Therefore, regional average emission factors were used to estimate non-firm contract purchased electricity. For instance, electricity purchased by a utility from an energy trader could have been purchased by the energy trader from a hydroelectric facility near the utility's operational territory, or from a utility generating electricity using coal outside the utility's operational territory. The emissions associated with the generation are not clearly known because they could be significantly different for each source. Therefore, the emissions associated with non-firm contract purchased electricity were calculated using regional average emission factors provided by Commerce that generally reflect the suite of generation sources that produced the purchased electricity.

Total Energy Delivered & Total Emissions 2017

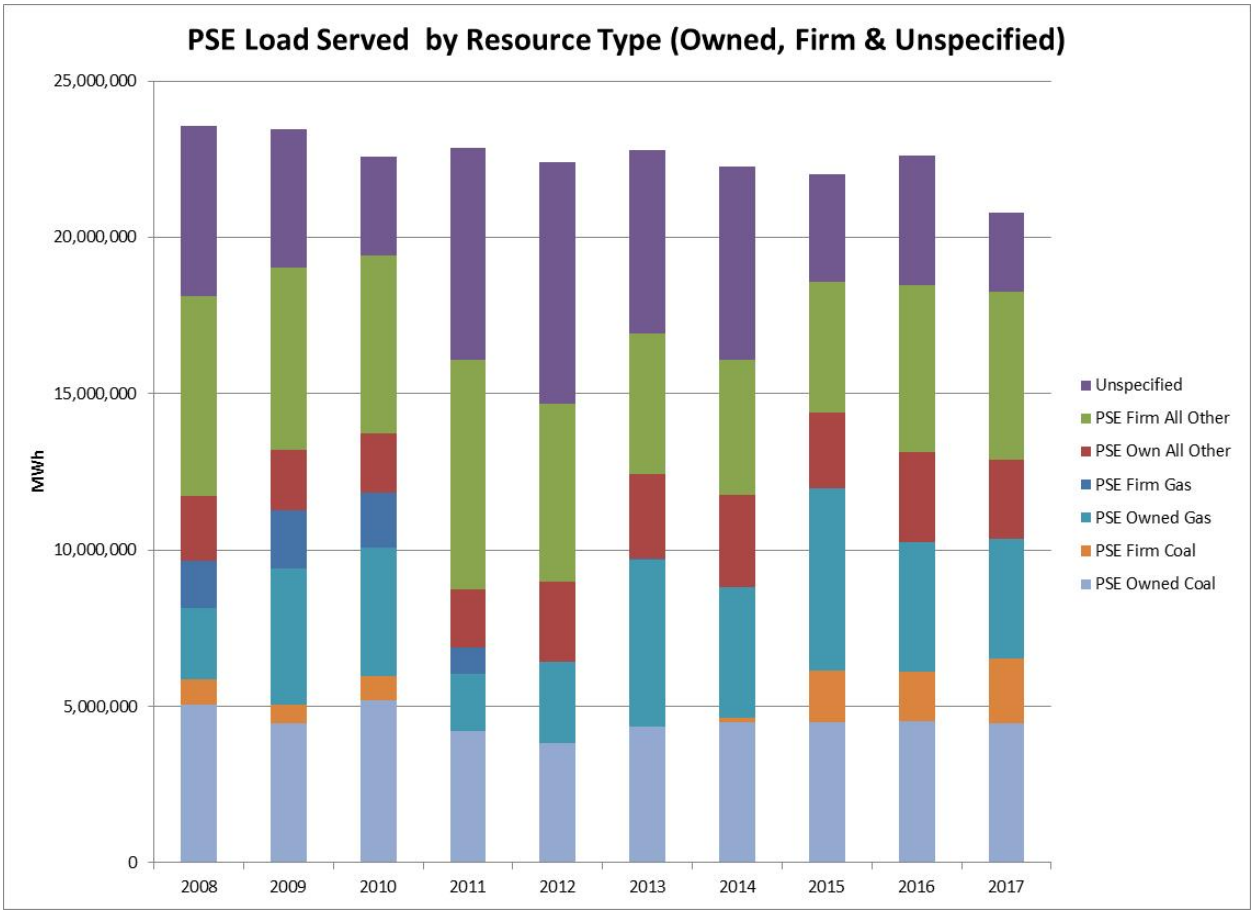
Resource Category	*MWh Total*	*% PSE Only (All Owned)*	*% PSE Only Thermal*	*% of Total*	*Short Ton Total*	*% PSE Only (All Owned)*	*% PSE Only Thermal*	*% of Total*
PSE Owned Coal	4,463,705	40.8%	53.2%	21.4%	4,907,712	72.0%	72.0%	43.7%
PSE Owned Gas	3,923,898	35.9%	46.8%	18.8%	1,905,779	28.0%	28.0%	17.0%
PSE Own All Other	2,540,007	23.2%		12.2%	368	0.0%		0.0%
Firm Coal	2,070,958			9.9%	2,449,181			21.8%
Firm Gas	0			0.0%	0			0.0%
Firm All Other (Renewable)	5,365,707			25.7%	766,337			6.8%
Unspecified	2,534,323			12.1%	1,188,669			10.6%
Total	20,898,598				11,218,045			
PSE Own Plus Firm PPA	18,364,275				10,029,376			
PSE Only Total	10,927,610			52.3%	6,813,858			60.7%
Firm Total	7,436,665			35.6%	3,215,518			28.7%
Unspecfied Total	2,534,323			12.1%	1,188,669			10.6%

Comparison: 2017 v. 2016

	2017 v. 2016				
Source	*Energy (MWh)*	*%*	*Emissions (Short Ton)*	*%*	*Intensity lb/MWh*
Total	-1,722,534	-7.6%	28,104	0.3%	84
PSE Owned Coal	-65,474	-1.4%	-171,790	-3.4%	-44
Firm Coal	502,153	32.0%	557,926	29.5%	-46
PSE Owned Gas	-228,111	-5.5%	-156,537	-7.6%	-22
Firm Gas	-200	-100.0%	-81	-100.0%	-807
PSE Own All Other	-356,413	-12.3%	198	116.2%	0
Firm All Other (Renew	57,316	1.1%	147,333	23.8%	52
All PSE Generation	-649,998	-5.6%	-328,130	-4.6%	13
All Firm	559,269	8.1%	705,178	28.1%	135
Unspecified	-1,631,806	-39.2%	-348,945	-22.7%	200

Comparison Continued: 2017 v. 2016

	2017					2016				
	Energy		*Emissions*		*Intensity*	*Energy*		*Emissions*		*Intensity*
Source	*MWh*	*%*	*Short Ton*	*%*	*lb/MWh*	*MWh*	*%*	*Short Ton*	*%*	*lb/MWh*
Total	20,898,598		11,218,045		1,074	22,621,132		11,189,942		989
PSE Owned Coal	4,463,705	21.4%	4,907,712	43.7%	2,199	4,529,179	20.0%	5,079,502	45.4%	2,243
Firm Coal	2,070,958	9.9%	2,449,181	21.8%	2,365	1,568,805	6.9%	1,891,255	16.9%	2,411
PSE Owned Gas	3,923,898	18.8%	1,905,779	17.0%	971	4,152,008	18.4%	2,062,316	18.4%	993
Firm Gas	0	0.0%	0	0.0%	0	200	0.0%	81	0.0%	807
PSE Own All Other	2,540,007	12.2%	368	0.0%	0	2,896,420	12.8%	170	0.0%	0
Firm All Other (Renewable)	5,365,707	25.7%	766,337	6.8%	286	5,308,391	23.5%	619,004	5.5%	233
Unspecified	2,534,323	12.1%	1,188,669	10.6%	938	4,166,129	18.4%	1,537,614	13.7%	738
PSE Own Plus Firm PPA	18,364,275		10,029,376		1,092	18,455,004		9,652,328		1,046
PSE Owned	10,927,610	52.3%	6,813,858	60.7%	1,247	11,577,608	51.2%	7,141,988	63.8%	1,234
Firm	7,436,665	35.6%	3,215,518	28.7%	865	6,877,396	30.4%	2,510,340	22.4%	730
Unspecified	2,534,323	12.1%	1,188,669	10.6%	938	4,166,129	18.4%	1,537,614	13.7%	738
All (Own, Firm, Unspecified)	20,898,598	100.0%	11,218,045	100.0%	1,074	22,621,132	100.0%	11,189,942	100.0%	989



Centralia Coal Transition Power

It is important to distinguish between emissions from PSE's owned thermal resources above and the contract PSE signed with TransAlta for coal transition power from the Centralia

power station ("Centralia"). In this report, PSE incorporates a breakdown of power and emissions from Centralia and differentiates Centralia generation and Centralia supply, which is power purchased by the owner of Centralia (i.e. TransAlta), and supplied to PSE. PSE's report will apply different emissions factors for power supplied versus generated from Centralia in order to more accurately reflect known sources of emissions.

PSE reports the difference between supplied and generated power each year from Centralia in its Annual Report of Energy Delivery to PSE from TransAlta-Centralia Transition Coal in Docket UE-121373 ("Coal Transition Report"). PSE's sources of Centralia generation and supply in this report are consistent with its Coal Transition Report. For power generated from Centralia coal, PSE applied the assigned emissions factor of 2,365 pounds of carbon dioxide emissions per megawatt-hour ("lbs per CO_2/MWh", calculated). For power supplied by Centralia, PSE applied the WA Department of Commerce ("Commerce") 2017 system rate, which is 1,004 lbs per CO_2/MWh. PSE determined the Commerce system rate was reasonable because it provides consistency given the uncertainty of sources purchased by TransAlta from other Balancing Authority Areas. PSE plans to use this same methodology to differentiate Centralia generation and supply in this report for the duration of the Centralia coal transition contract.

Population Data

PSE tracks customers served by class of service but does not track the number of *people* (population) served. Therefore, population data in this report is estimated based upon methodology agreed to by PSE, UTC Staff, and the other utilities. Total service area population for this report was estimated by multiplying the total residential customers in PSE's service area by the average household size (AHS) of occupied homes, using data from the most recent five-year estimates (2010-2014) from the U.S. Census Bureau's American Community Survey (ACS).

Unspecified Market Purchases

Included in this report is energy that PSE has purchased from the spot market associated with the corresponding generation year where the actual generating unit is unknown (unspecified). As stipulated in this rule, PSE uses a net system mix emissions rate for these spot market purchases where the energy source is unknown (WAC 480-109-300(3)). The net system mix emissions rates for PSE and the other utilities during the reporting period has been calculated and provided by Commerce.

Appendices

Appendix 1: Estimation of PSE Service Territory Population

This appendix documents how PSE estimated the population within its service territory to meet the reporting requirement of WAC 480-109-300(2)(c): Megawatt-hours per capita. The estimated population for each reporting year is the product of PSE residential customer count for the year multiplied by the weighted average of household size of the counties that PSE provides electric service. The methodology is consistent with the preferred Per Capita Methodology described in the UTC Staff's final report[1] and the Commission's Final Order[2] on the estimation of population in an electric utility service territory. As prescribed in the Commission's Final Order paragraph 17, "To produce the reports required by WAC 480-109-300(2)(c), the utilities should use the methodology agreed upon by stakeholders and described in the final report and this order." [3]

PSE's customer information system is the ultimate source of the annual residential customer count data which represents the number of households within PSE service territory. These customer count data are as reported in PSE's FERC[4] financial reporting Form No. 1: Annual Report of Major Electric Utilities, Licensees and Others. Not all residents in a multi-family or mixed-use commercial and residential building are included in PSE's residential customer count at this time. PSE does not have reliable data to make a separate adjustment to account for the persons residing in master-metered residential buildings.

The average household size used in PSE's WAC 480-109-300: Energy and emissions intensity metrics is 2.51. This is the overall average number of persons per household for PSE's service territory weighted by the population size for each of the counties for 2012-2016. The source of the five-year average of county-level data is the United States Census Bureau's *American Communities Survey*, which can be accessed using the Bureau's web-based application QuickFacts at http://www.census.gov/quickfacts/table/PST045215/00.

[1] UE-131732 Proposed EE Metrics Workgroup Results – Final Report, August 7, 2015, (Report at2-3).
[2] UE-131732, Final Order, General Order R-581: Order Adopting Rule Permanently, September, 10, 2015, (Order at 6 §17).
[3] UE-131732, Final Order, General Order R-581: Order Adopting Rule Permanently, September, 10, 2015, (Order at 6 §17).
[4] Federal Energy Regulatory Commission

The following table details the data and the calculation of the2.51 persons average household size that used in the determination of PSE service territory population for WAC 480-109-300(2)(c): Megawatt-hours per capita.

	Skagit County, Washington	Pierce County, Washington	Island County, Washington	King County, Washington	Kitsap County, Washington	Kittitas County, Washington	Whatcom County, Washington	Thurston County, Washington
Population estimates, July 1, 2017, (V2017)	125,619	876,764	83,159	2,188,649	266,414	46,205	216,800	275,222
Households, 2012-2016	46,108	307,106	33,388	831,995	98,250	17,164	81,019	103,468
Persons per household, 2012-2016	2.57	2.66	2.34	2.46	2.55	2.35	2.52	2.54

Appendix 2: Emissions Reporting Methodology

1. Owned Thermal Resources

PSE wholly owns three dual-fuel combustion turbine generation facilities (Frederickson, Fredonia, and Whitehorn), five natural gas combined cycle generation facilities (Encogen, Goldendale, Mint Farm, Ferndale and Sumas), and one internal diesel combustion generation facility (Crystal Mountain). Also, PSE partially owns one coal-combustion generation facility (Colstrip) and one natural gas combined cycle generation facility (Freddy 1).

PSE's CO_2 emissions from electric operations are calculated using the EPA GHG Mandatory Reporting Rule Subparts C and D (Tiers 2 & 4) calculation methodologies. Utilizing Subparts C & D, carbon dioxide mass is calculated based on the amount of fuel consumed by each generation facility.

Thermal facilities utilizing the Subpart C method include Frederickson, Fredonia Units 1 & 2 and Whitehorn. Annual CO_2 mass emissions using Subpart C are calculated with these plant measurements: 1) fuel heat content (HHV), 2) the amount of fuel burned (volume) and, 3) a default specific emission factor. An example calculation is provided below.

Example = Volume gas x fuel heat content HHV x EF =

(334,172,000 scf natural gas measured) x (0.0010920 MMBtu/scf measured) x (53.06 kg CO2/MMBtu) = 21,343 short ton CO2

Thermal facilities utilizing the Subpart D method include Encogen, Goldendale, Mint Farm, Ferndale, Sumas, Fredonia Units 3 & 4, Freddy 1 and Colstrip. This method utilizes direct continuous emissions measurement systems (CEMS) as prescribed in Part 75 of the EPA Acid Rain Program. Stack gas and flow measurements are measured continuously, and this data is used in prescribed equations (via the CEMS system) to determine total CO_2 mass. Part 75 also includes certification and QA/QC requirements to ensure that data validity is confirmed at the beginning of a monitoring program.

PSE Units and Applicable GHG Measurement Program

Unit	Unit ID	Unit Type	PSE Share	Fuel Type	Acid Rain Program	EPA Subpart C & D Tier
Colstrip Unit 1	1	Coal	50%	Coal	Yes	4
Colstrip Unit 2	2	Coal	50%	Coal	Yes	4
Colstrip Unit 3	3	Coal	25%	Coal	Yes	4
Colstrip Unit 4	4	Coal	25%	Coal	Yes	4
Encogen 1	CT1	Natural gas cogeneration	100%	Natural Gas	Yes	4
Encogen 2	CT2	Natural gas cogeneration		Natural Gas	Yes	4
Encogen 3	CT3	Natural gas cogeneration		Natural Gas	Yes	4
Ferndale 1	CT-1A	Natural gas combined cycle	100%	Natural Gas	Yes	4
Ferndale 2	CT-1B	Natural gas combined cycle	100%	Natural Gas	Yes	4
Frederickson Unit 1	F1CT	Natural gas combined cycle	49.85%	Natural Gas	Yes	4
Fredonia 1	CT1	Dual-fuel combustion turbines	100%	Natural Gas	No	2
Fredonia 1	CT1	Dual-fuel combustion turbines		Distillate Fuel Oil No. 2	No	2
Fredonia 2	CT2	Dual-fuel combustion turbines		Natural Gas	No	2
Fredonia 2	CT2	Dual-fuel combustion turbines		Distillate Fuel Oil No. 2	No	2
Fredonia 3	CT3	Dual-fuel combustion turbines	100%	Natural Gas	Yes	4
Fredonia 4	CT4	Dual-fuel combustion turbines		Natural Gas	Yes	4
Frederickson 1	CT1	Dual-fuel combustion turbines	100%	Natural Gas	No	2
Frederickson 1	CT1	Dual-fuel combustion turbines		Distillate Fuel Oil No. 2	No	2
Frederickson 2	CT2	Dual-fuel combustion turbines		Natural Gas	No	2
Frederickson 2	CT2	Dual-fuel combustion turbines		Distillate Fuel Oil No. 2	No	2
Goldendale	CT-1	Natural gas combined cycle	100%	Natural Gas	Yes	4
Mint Farm	CTG1	Natural gas combined cycle	100%	Natural Gas	Yes	4
Sumas	CT-1	Natural gas cogeneration	100%	Natural Gas	Yes	4
Whitehorn 2	CT2	Dual-fuel combustion turbines	100%	Natural Gas	No	2
Whitehorn 2	CT2	Dual-fuel combustion turbines		Distillate Fuel Oil No. 2	No	2
Whitehorn 3	CT3	Dual-fuel combustion turbines		Natural Gas	No	2
Whitehorn 3	CT3	Dual-fuel combustion turbines		Distillate Fuel Oil No. 2	No	2

2. Firm Contract Purchases

PSE's firm contract purchased electricity were calculated using the amount of electricity purchased, broken down by the electricity generation technology (e.g., coal, natural gas, or petroleum), and emission factors applicable to each generation source. The emission factors for each specified thermal source was calculated using the following steps:

1. Obtain annual plant generation and heat rate (EIA-923, https://www.eia.gov/electricity/data/eia923/)
2. Obtain fossil fuel emission factors from EPA (EPA Clean Power Plan Technical Support Document, pp. 41-50)
3. Calculate total CO2 mass using the following equation:

Step 1 -

Firm Facility Emission Rate$_{year}$ = ((MMBtu heat input) x (EF lb CO2/MMBtu)) / MWh net gen

Step 2 -

Firm Facility Claimed Emissions = Firm Facility Emission Rate$_{year}$ lb CO2/MWh x Purchased Power MWh

3. Non-Firm Contract Purchases

PSE's emissions from non-firm contract purchased electricity were estimated using the net-by-counterparty methodology for purchases and sales of non-firm contract purchased electricity pursuant to the Staff directive described below:

> *" 3. Unknown Sources – Purchase and sales reporting methodology: After several rounds of discussion last year and after reviewing analysis performed by the utilities, Staff believes the appropriate methodology for reporting purchases and sales is the net-by-counterparty approach:*
> *(a) for each transaction partner whose generation is from an unknown resource, subtract the total annual sales to this party from the total annual purchases from this party;*
> *(b) if the result is positive, apply the Department of Commerce fuel mix emissions intensity factor to calculate emissions associated with the net purchase;*
> *(c) if the result is negative, apply an aggregate, fleet-wide emissions intensity factor for the utility's known sources to calculate emissions associated with the net sale.*
> *Staff understands that this approach has largely been implemented by PSE in prior reports. Staff contends that the net-by-counterparty approach represents an optimal balance among the three competing priorities of accuracy, consistency, and burden on company and commission resources."*

4. Non-Firm Purchases in the EIM

1. For non-PSE units, PSE applies the net-by-counterparty calculus described in 3) above

2. For PSE units, PSE applied the Commerce rate if the end-of-year net generation (by plant) is greater than zero which means that PSE was a net purchaser from CAISO. If end-of-year net generation (by plant) is less than zero, then PSE had excess generation and assigned a "zero" emission rate because emissions are accounted for under "generation." This approach ensures PSE is not double-counting emissions.