

*Annual Energy and Emissions Intensity (“EEI”)Metrics Report*  
*Pursuant to WAC 480-109-300*  
*June 1, 2017*

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# **Energy and Emissions Intensity Metrics Report**

## **Pursuant to WAC 480-109-300**

### **Section 1: Executive Summary**

Per the requirements of WAC 480-109-300, Puget Sound Energy (“PSE”) 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<sub>2</sub>) emissions measured in short tons
- Ratio of Annual CO<sub>2</sub> emissions to CO<sub>2</sub> 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<sub>2</sub> 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 2007) 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 (2016)**

Summarized in Table 1 and narrative below are PSE’s 2016 energy and intensity metrics

Utility :	Puget Sound Energy	
Reporting for year :	2016	<b>MWh per Capita</b>
Population Served :	2,466,653	<b>8.29</b>

*Energy Intensity Metrics*

	MWh at Meter	MWh Proportion	Customer Count	MWh per Customer
Residential Customers	10,245,326	50.1%	984,739	<b>10.4</b>
Commercial Customers	8,979,883	43.9%	137,997	<b>65.1</b>
Industrial Customers	1,223,214	6.0%		
Total Load Served	20,448,423			

*Emissions Intensity Metrics*

	Busbar MWh	Percent of Total Load	Short Tons CO <sub>2</sub>	
Known Resources Serving WA	18,455,004	81.6%	9,726,282	
Unknown Resources Serving WA	<b>4,166,129</b>	<b>18.4%</b>	<b>2,086,933</b>	<b>% of 1990 CO<sub>2</sub></b>
	2016 Tons CO <sub>2</sub>		<b>11,813,215</b>	<b>170.1%</b>

1990 Short Tons CO<sub>2</sub> **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<sub>2</sub> emissions measured in short tons from generation sources for the previous 10 years. Figure 1 also includes a 1990 emissions baseline.

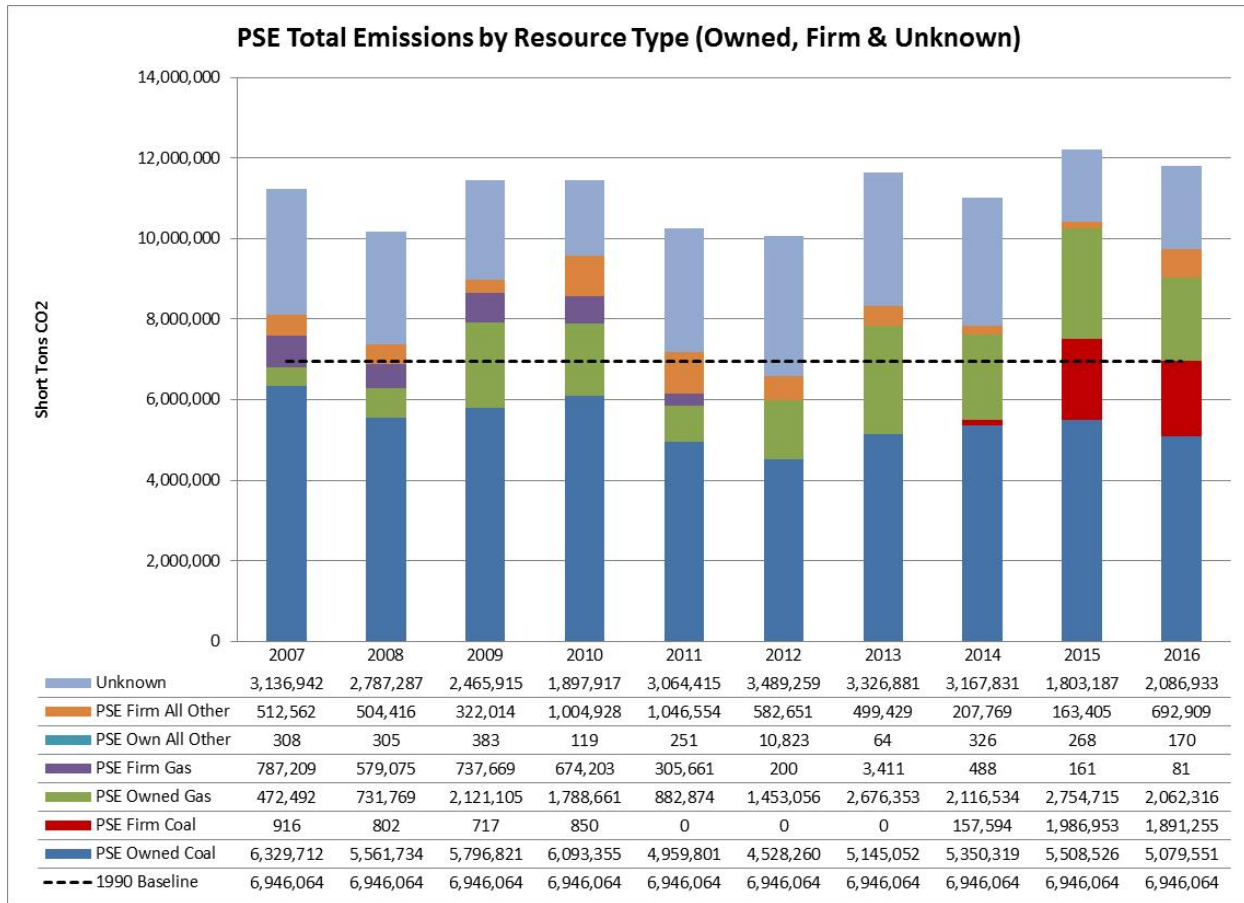


Figure 2 provides a comparison of the average MWh per residential customer, average MWh per commercial customer, and MWh per capita delivered in each of the years during the reporting period in PSE’s service territory.

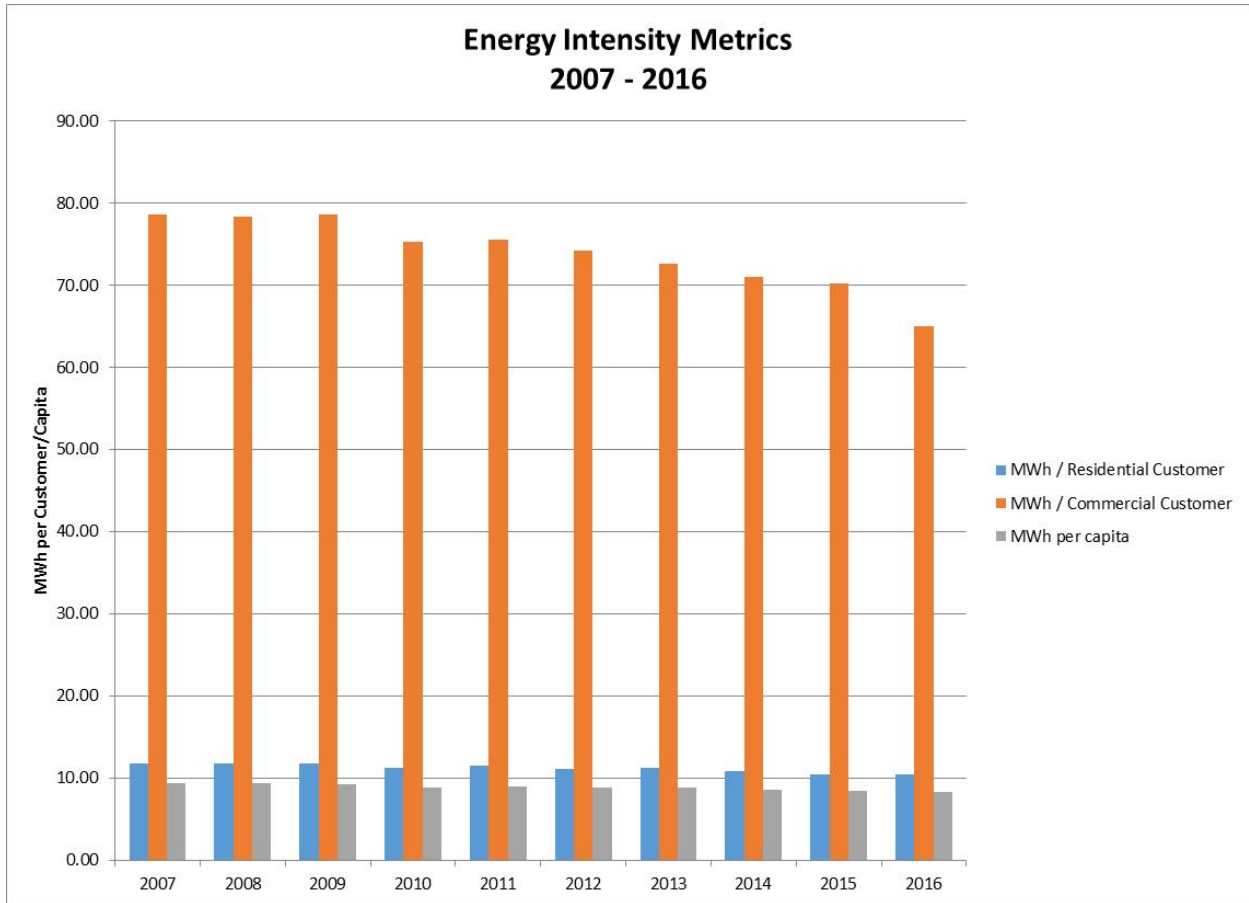


Figure 3 provides a comparison of the ratios of PSE’s annual CO<sub>2</sub> emissions from known sources for the reporting period compared to CO<sub>2</sub> emission in 1990.

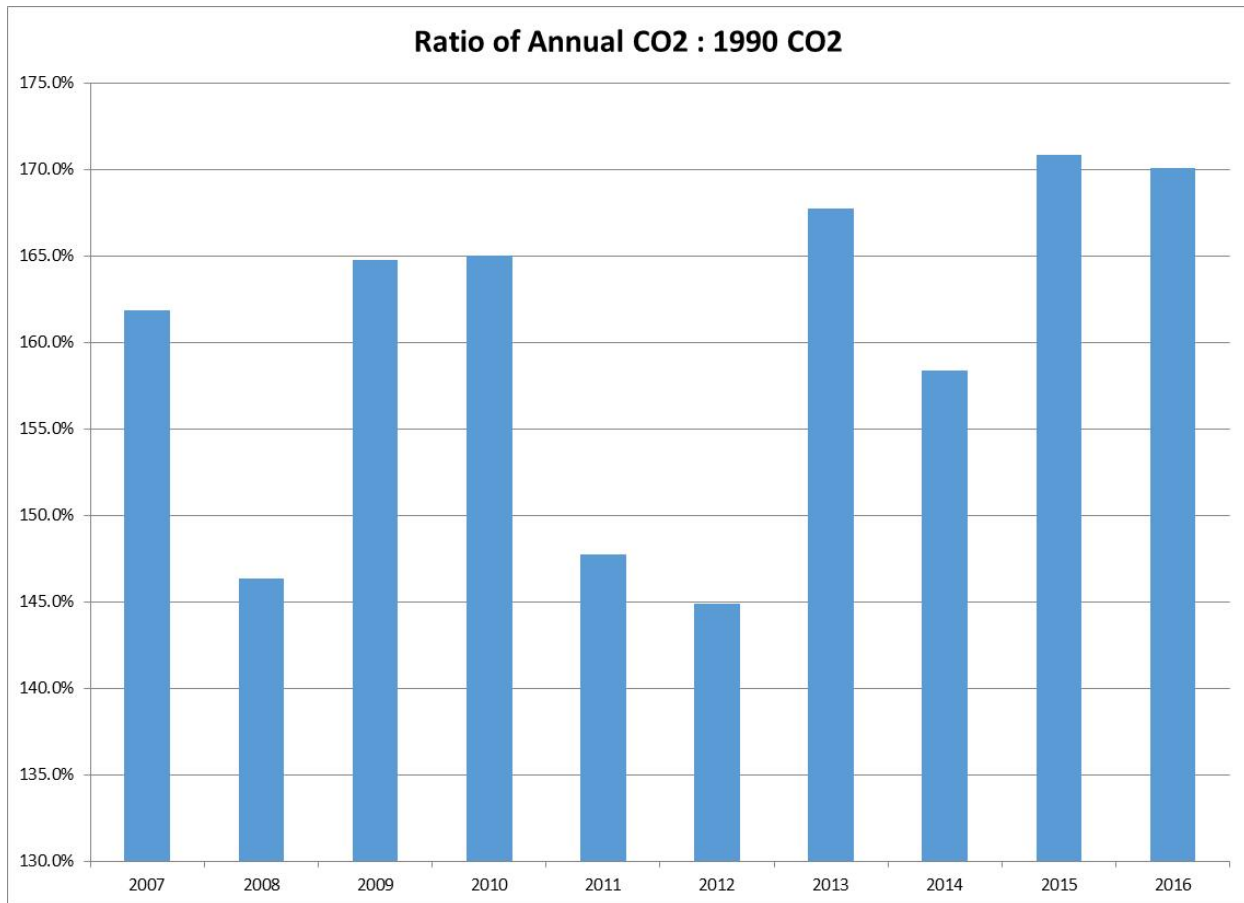
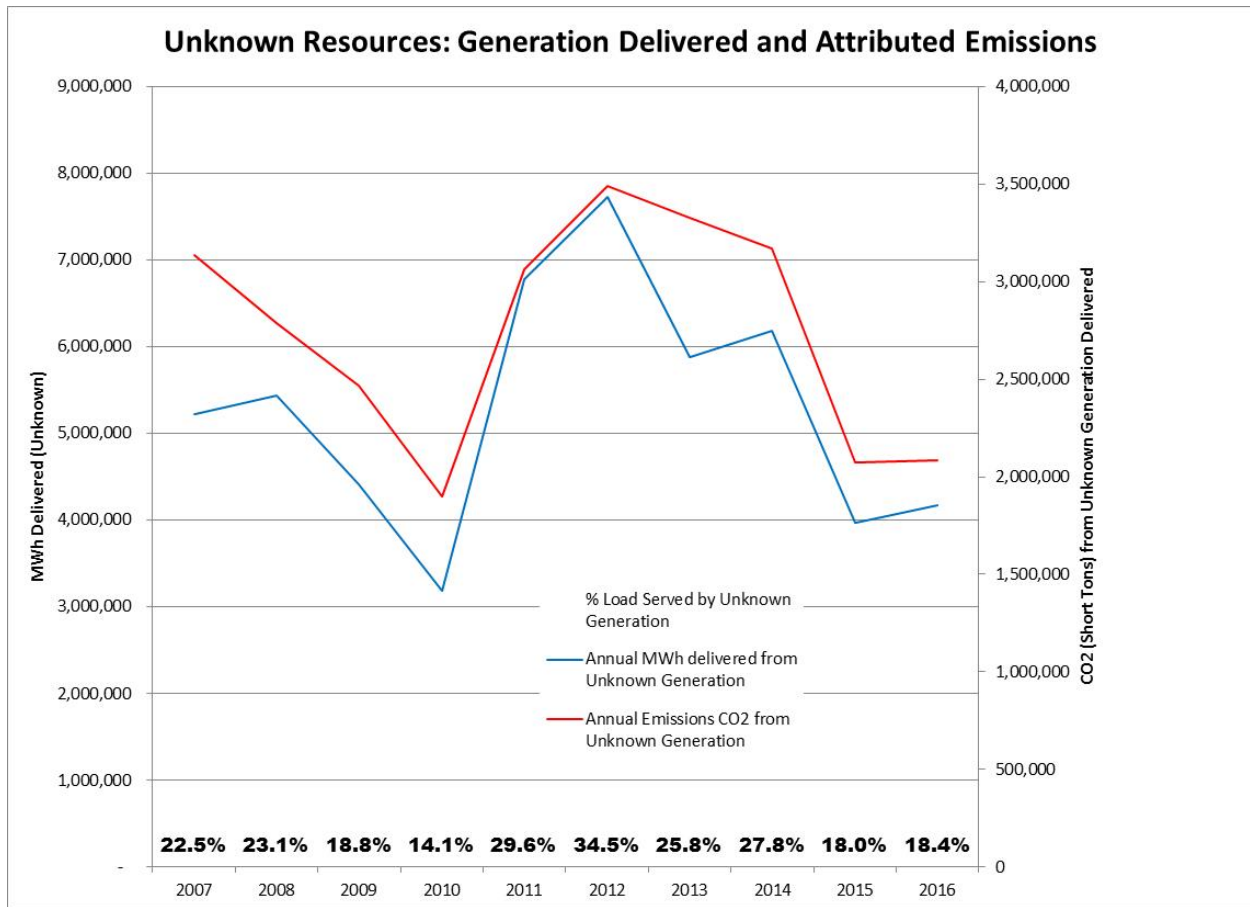


Figure 4 provides a 10-year comparison of generation delivered to PSE from unknown sources and the attributed emissions. Those metrics include annual CO<sub>2</sub> emissions (short tons), annual MWh delivered to retail customers, and the percentage of load served. As discussed in the executive summary, 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.

#### 2016 Results & Discussion

Overall, PSE’s CO<sub>2</sub> emissions intensity from total electricity delivered to customers decreased nearly six percent from 1,109 lb/MWh to 1,044 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 2016, 51.2 percent of electricity delivered to PSE customers was generated by the company, while 48.8 percent of electricity was purchased via firm contracts (30.4%) and non-firm contracts, i.e. spot market (18.4%). Of the CO<sub>2</sub> emissions associated with electric delivery, 60.5 percent were from

electricity generated by PSE and 39.5 percent were from purchased electricity (21.9 percent via firm contracts and 17.7 percent via non-firm contracts).

It's important to remember that CO<sub>2</sub> 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<sub>2</sub> per megawatt hour (lb/MWh) of electricity produced. For instance, about 39.1 percent of the electricity generated by PSE came from coal combustion, but this fuel source represented about 71.1 percent of the CO<sub>2</sub> 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 28.9 percent of the CO<sub>2</sub> emissions from electricity generated by PSE. Renewable power accounted for 25 percent of the electricity generated by PSE, and produced zero CO<sub>2</sub> emissions. Similar trends are seen when the previous 10 years (2007 to 2016) are averaged.

Compared to 2015, total electricity delivered to customers in 2016 was up by three percent but total emissions were down by three percent. This trend is largely due to PSE dispatching less of its owned thermal generation as more purchased energy was being delivered into PSE's system. In addition, emissions from PSE's owned generating sources were down in 2016 for several reasons including: more efficient dispatch of PSE's coal-based Colstrip Generating Station (emissions down 8%); less coal deliveries from Centralia (emissions down 5%); less PSE gas generation due to project outages (emissions down 25%); and more deliveries of low- or zero-emitting purchased firm energy (up 21%). The combination of more efficient dispatch of Colstrip and less gas generation due to project outages resulted in a five percent decrease in CO<sub>2</sub> emission intensity from 1,297 lb/MWh to 1,234 lb/MWh.

In 2016, PSE purchases of electricity delivered to customers made up for less thermal generation from the company's owned units. Firm deliveries were up by 21 percent and unspecified deliveries (i.e. spot market) were up by 17 percent. Firm thermal purchases come from four contracted sources. Three of the sources (BC Hydro, BPA WNP#3, and Centralia Coal) are assigned a system emissions rate due to a market option in the contract structure. The fourth contracted source, Klamath Falls combustion turbine, is assigned an emission rate based on EIA heat input and generation. Firm contract purchased electricity increased GHG emissions intensity two percent from 737 lb/MWh to 752 lb/MWh. The increase in unspecified purchased electricity resulted in an increase in higher emissions even though a lower Commerce emission factor was used (1,002 lb/MWh in 2016 versus 1,046 lb/MWh in 2015).

### *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<sub>2</sub> emissions and power production, i.e., pounds CO<sub>2</sub>/kWh.

For example, about 39.1 percent of the electricity generated by PSE came from coal combustion, which has a high CO<sub>2</sub> emission intensity compared to natural gas and oil combustion sources. Of CO<sub>2</sub> emissions from electricity generated by PSE (direct emissions), about 71.1 percent were from coal-combustion generation. It is the high CO<sub>2</sub> emission intensity of coal-combustion generation that made the overall CO<sub>2</sub> emission intensity of PSE's electric operations high.

Another example highlighting this trend occurs in purchased electricity. Roughly 66.4 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<sub>2</sub> 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 2016**

<i>Resource Category</i>	<i>MWh Total (2016)</i>	<i>% PSE Only (All Owned)</i>	<i>% PSE Only Thermal</i>	<i>% of Total</i>	<i>Short Ton Total (2016)</i>	<i>% PSE Only (All Owned)</i>	<i>% PSE Only Thermal</i>	<i>% of Total</i>
PSE Owned Coal	4,529,179	39.1%	52.2%	20.0%	5,079,551	71.1%	71.1%	43.0%
PSE Firm Coal	1,568,805			6.9%	1,891,255			16.0%
PSE Owned Gas	4,152,008	35.9%	47.8%	18.4%	2,062,316	28.9%	28.9%	17.5%
PSE Firm Gas	200			0.0%	81			0.0%
PSE Own All Other	2,896,420	25.0%		12.8%	170	0.0%		0.0%
PSE Firm All Other	5,308,391			23.5%	692,909			5.9%
Unspecified	4,166,129			18.4%	2,086,933			17.7%
<b>Total</b>	<b>22,621,132</b>				<b>11,813,215</b>			
PSE Only Total	11,577,608			51.2%	7,142,038			60.5%
Firm Total	6,877,396			30.4%	2,584,245			21.9%
Unspecified Total	4,166,129			18.4%	2,086,933			17.7%

**Total Energy Delivered & Total Emissions 2007 - 2016**

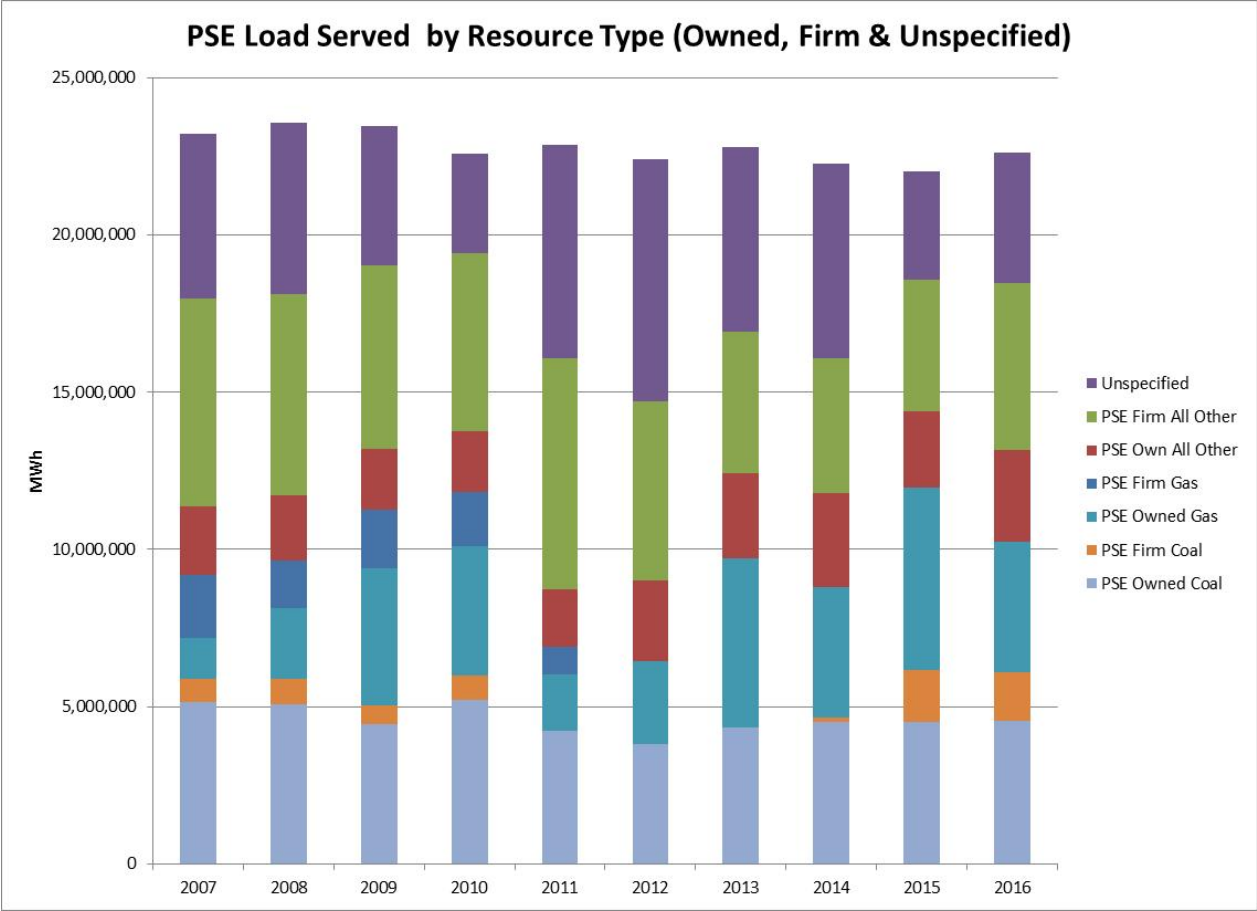
<i>Resource Category</i>	<i>MWh Total (2007-2016)</i>	<i>% PSE Only (All Owned)</i>	<i>% PSE Only Thermal</i>	<i>% of Total</i>	<i>Short Ton Total (2007-2016)</i>	<i>% PSE Only (All Owned)</i>	<i>% PSE Only Thermal</i>	<i>% of Total</i>
PSE Owned Coal	45,759,659	43.5%	56.0%	20.1%	54,353,131	76.1%	76.1%	48.8%
PSE Firm Coal	6,273,108			2.8%	4,039,087			3.6%
PSE Owned Gas	35,979,216	34.2%	44.0%	15.8%	17,059,876	23.9%	23.9%	15.3%
PSE Firm Gas	7,956,051			3.5%	3,088,159			2.8%
PSE Own All Other	23,540,793	22.4%		10.3%	13,016	0.0%		0.0%
PSE Firm All Other	55,857,093			24.5%	5,536,635			5.0%
Unspecified	52,438,481			23.0%	27,226,568			24.5%
<b>Total</b>	<b>227,804,400</b>				<b>111,316,472</b>			
PSE Only Total	105,279,667			46.2%	71,426,023			64.2%
Firm Total	70,086,252			30.8%	12,663,881			11.4%
Unspecified Total	52,438,481			23.0%	27,226,568			24.5%

**Comparison: 2016 v. 2015**

Source	2016 v. 2015					Comment / Observations
	Energy (MWh)	%	Emissions (Short Ton)	%	Intensity lb/MWh	
Total	590,284	3%	-404,000	-3%	-65	Total energy delivered up by 3% from the previous year, but total emissions down by 3% from the previous year, largely due to more efficient annual emission rate at Colstrip (emissions down 8%), less coal deliveries from Centralia (emissions down 5%), less PSE gas generation (emissions down 25%), and more low/zero-emitting firm deliveries (firm energy up 21%).
PSE Owned Coal	34,147	1%	-428,975	-8%	-208	Energy up slightly, but emissions down. This was due to a higher (i.e., inefficient) emission rate in 2015.
PSE Firm Coal	-82,372	-5%	-95,697	-5%	4	Energy and emissions were equally down by 5% from previous year.
PSE Owned Gas	-1,678,016	-29%	-692,399	-25%	48	Owned gas generation down by close to 30% from previous year. Goldendale (a baseload CCCT) was in outage much of the year due to an upgrade.
PSE Firm Gas	-200	-50%	-81	-50%	1	The Firm Gas category is a very small percentage of total energy deliveries, does not substantively add to total emissions and emissions intensity.
PSE Own All Other	474,462	16%	-98	-36%	0	This category is made up of most PSE-owned renewables (hydro, wind, solar). The emissions in this category come from small backup diesel generating power only. Renewable power was up approximately 15% from the previous year, which is why total energy is up.
PSE Firm All Other	1,124,586	21%	529,504	76%	183	Firm deliveries were up by 21% from the previous year to make up for less PSE thermal generation. Emissions are from four (4) firm contract sources. Three (3) are assigned a system rate due to contract structure (BC Hydro, BPA WNP#3 Exchange, Centralia Coal Market). Klamath Falls CT assigned emission rate based on EIA heat input and generation, however Klamath deliveries nominal.
Unspecified	717,677	17%	283,746	14%	-44	Deliveries up by 17% to make up for less PSE thermal generation.

**Comparison Continued: 2016 v. 2015**

Source	2016					2015				
	Energy MWh	%	Emissions Short Ton	%	Intensity lb/MWh	Energy MWh	%	Emissions Short Ton	%	Intensity lb/MWh
Total	22,621,132		11,813,215		1,044	22,030,848		12,217,216		1,109
PSE Owned Coal	4,529,179	20%	5,079,551	43%	2,243	4,495,032	20%	5,508,526	45%	2,451
PSE Firm Coal	1,568,805	7%	1,891,255	16%	2,411	1,651,177	7%	1,986,953	16%	2,407
PSE Owned Gas	4,152,008	18%	2,062,316	17%	993	5,830,024	26%	2,754,715	23%	945
PSE Firm Gas	200	0%	81	0%	807	400	0%	161	0%	806
PSE Own All Other	2,896,420	13%	170	0%	0	2,421,958	11%	268	0%	0
PSE Firm All Other	5,308,391	23%	692,909	6%	261	4,183,805	19%	163,405	1%	78
Unspecified	4,166,129	18%	2,086,933	18%	1,002	3,448,452	16%	1,803,187	15%	1,046
PSE Owned	11,577,608	51%	7,142,038	60%	1,234	12,747,014	58%	8,263,509	68%	1,297
Firm	6,877,396	30%	2,584,245	22%	752	5,835,382	26%	2,150,519	18%	737
Unspecified	4,166,129	18%	2,086,933	18%	1,002	3,448,452	16%	1,803,187	15%	1,046
All (Own, Firm, Unspecified)	22,621,132	100%	11,813,215	100%	1,044	22,030,848	100%	12,217,216	100%	1,109



*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 No. 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 2,411 pounds of carbon dioxide emissions per megawatt-hour (“lbs per CO<sub>2</sub>/MWh”, calculated). For power supplied by Centralia, PSE applied the WA Department of Commerce (“Commerce”) 2016 system rate, which is 1,002 lbs per CO<sub>2</sub>/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<sup>1</sup> and the Commission's Final Order<sup>2</sup> 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."<sup>3</sup>

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<sup>4</sup> 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 as 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 2.50. 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 2010-2014. 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>.

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<sup>1</sup> UE-131732 Proposed EE Metrics Workgroup Results – Final Report, August 7, 2015, (Report at 2-3).

<sup>2</sup> UE-131732, Final Order, General Order R-581: Order Adopting Rule Permanently, September, 10, 2015, (Order at 6 §17).

<sup>3</sup> UE-131732, Final Order, General Order R-581: Order Adopting Rule Permanently, September, 10, 2015, (Order at 6 §17).

<sup>4</sup> Federal Energy Regulatory Commission

The following table details the data and the calculation of the 2.50 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.

Line No.		Source	Skagit County, Washington	Pierce County, Washington	Island County, Washington	King County, Washington	Kitsap County, Washington	Kittitas County, Washington	Thurston County, Washington	Whatcom County, Washington
1	Households, 2011-2015	U.S. Census Bureau <a href="http://www.census.gov/quickfacts/table/PST045215/00">http://www.census.gov/quickfacts/table/PST045215/00</a>	45,841	303,586	33,125	819,651	97,739	16,953	102,631	79,767
2	Persons per household, 2011-2015	U.S. Census Bureau <a href="http://www.census.gov/quickfacts/table/PST045215/00">http://www.census.gov/quickfacts/table/PST045215/00</a>	2.56	2.65	2.33	2.45	2.54	2.34	2.52	2.53
3	Weight	(Line 1) X (Line 2)	117,353	804,503	77,181	2,008,145	248,257	39,670	258,630	201,811
4	Weighted person per household for Puget Sound Energy Service territory with Jefferson County	(Sum of Line 3) / (Sum of Line 1)	2.50							

## 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<sub>2</sub> 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<sub>2</sub> 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 CO<sub>2</sub>/MMBtu) = 21,343 short ton CO<sub>2</sub>

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<sub>2</sub> 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	0%	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 -

$$\text{Firm Facility Emission Rate}_{\text{year}} = ((\text{MMBtu heat input}) \times (\text{EF lb CO}_2/\text{MMBtu})) / \text{MWh net gen}$$

Step 2 -

$$\text{Firm Facility Claimed Emissions} = \text{Firm Facility Emission Rate}_{\text{year}} \text{ lb CO}_2/\text{MWh} \times \text{Purchased Power MWh}$$

### 3. Non-Firm Contract Purchases

PSE's emissions from non-firm contract purchased electricity were estimated using a lump sum of total non-firm contract purchased electricity and regional average emission factors from the department of Commerce.

#### Appendix 3: "Netting Out" Evaluation

At the request of the Commission, PSE conducted the following analysis. Results are shown below and all work papers are shown in Attachment B.

WUTC's requested approach:

1. "Net out" sales and purchases with each non-firm transaction partner
2. Apply the Commerce fuel mix figure to net purchases
3. Apply the utility's fleet average emissions intensity factor to sales
4. Include three test case years (PSE selected 2008, 2012 and 2016)

**Comparison of Emissions Using WUTC "Net Out" Methodology Recommendation**

	<b>2008</b>	<b>2012</b>	<b>2016</b>
<i>Rationale for selecting</i>	High emissions year in the NWPP	Low emissions year in the NWPP	Current reporting year
<b>CO2 Emission Rates</b>			
<i>Commerce Rate, lb/MWh</i>	1,024	903	1,002
<i>PSE Owned + Firm Rate, lb/MWh</i>	814	895	1,057
<b>Non-Firm Purchases &amp; Sales</b>			
<i>Unspecified Sales (MWh)</i>	-6,340,438	-7,143,982	-20,152,154
<i>Unspecified Purchases (MWh)</i>	11,781,860	14,870,988	24,318,283
<i>Net Delivered (MWh)</i>	5,441,422	7,727,006	4,166,129
<b>CO2 Emissions - Net Purchase &amp; Sales by Counterparty, then apply rates</b>			
<i>Short Tons</i>	2,808,760	3,492,881	1,967,454
<b>CO2 Emissions - Sum of all Purchase &amp; Sales x Commerce Rate</b>			
<i>Short Tons</i>	2,787,287	3,489,259	2,086,933
<b>Difference (Short Tons)</b>	<b>21,473</b>	<b>3,621</b>	<b>-119,479</b>
	0.8%	0.1%	-5.7%