Annual Energy and Emissions Intensity Metrics Report
Pursuant to WAC 480-109-300
Revised December 23, 2016

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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_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 2015. 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 2006) 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- 2015 Report – Summary of Energy and Emissions Intensity Metrics

Utility :	Puget Sound Energy	
Reporting for year :	2015	**MWh per Capita**
Population Served :	**2,418,979**	**8.48**

Energy Intensity Metrics

	MWh at Meter	MWh Proportion	Customer Count	**MWh per Customer**
Residential Customers	10,164,709	49.6%	970,830	**10.5**
Commercial Customers	9,087,102	44.3%	129,347	**70.3**
Industrial Customers	1,257,958	6.1%		
Total Load Served	20,509,769			

Emissions Intensity Metrics

	Busbar MWh	Percent of Total Load	**Short Tons CO_2**	
Known Resources Serving WA	18,582,396	84.3%	10,414,028	
Unknown Resources Serving WA	**3,448,452**	**15.7%**	**1,200,541**	**% of 1990 CO_2**
	2015	Tons CO_2	**11,614,569**	**167.2%**

1990 Short Tons CO_2	6,946,064

Summarized in Table 1 above and narrative form below are PSE's 2015 energy and intensity metrics.

10.5	Average MWh per residential customer
70.3	Average MWh per commercial customer
8.48	MWh per capita
11,614,569	Annual CO_2 emissions (short tons)
167.2%	Ratio of Annual CO_2 emissions to CO_2 emissions in 1990
1,200,541	Annual CO_2 emissions (short tons) from unknown generation sources
3,448,452	Annual MWh delivered to retail customers from unknown generation sources
15.7%	Percentage of load served by unknown generation sources

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 known generation sources for the previous 10 years. Figure 1 also includes a 1990 emissions baseline and a 10 year trend showing PSE's population served. Further discussion on PSE's methodology to calculate population is provided in Appendix 1.

Figure 1

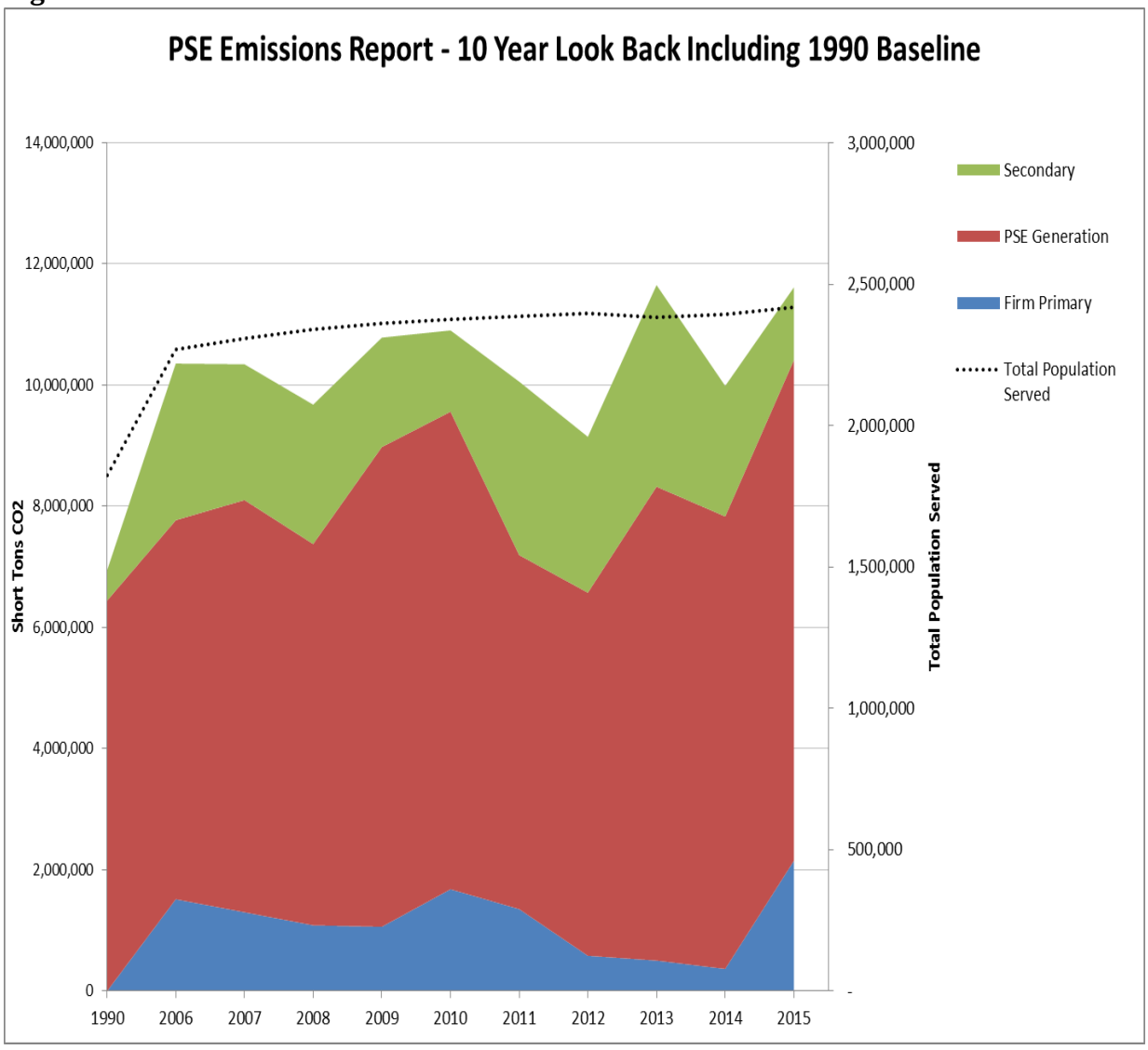


Figure 2 provides a comparison of the average MWh per residential customer, average MWh per commercial customer, and MWh per capita delivered in each of the years during the reporting period in PSE's service territory.

Figure 2

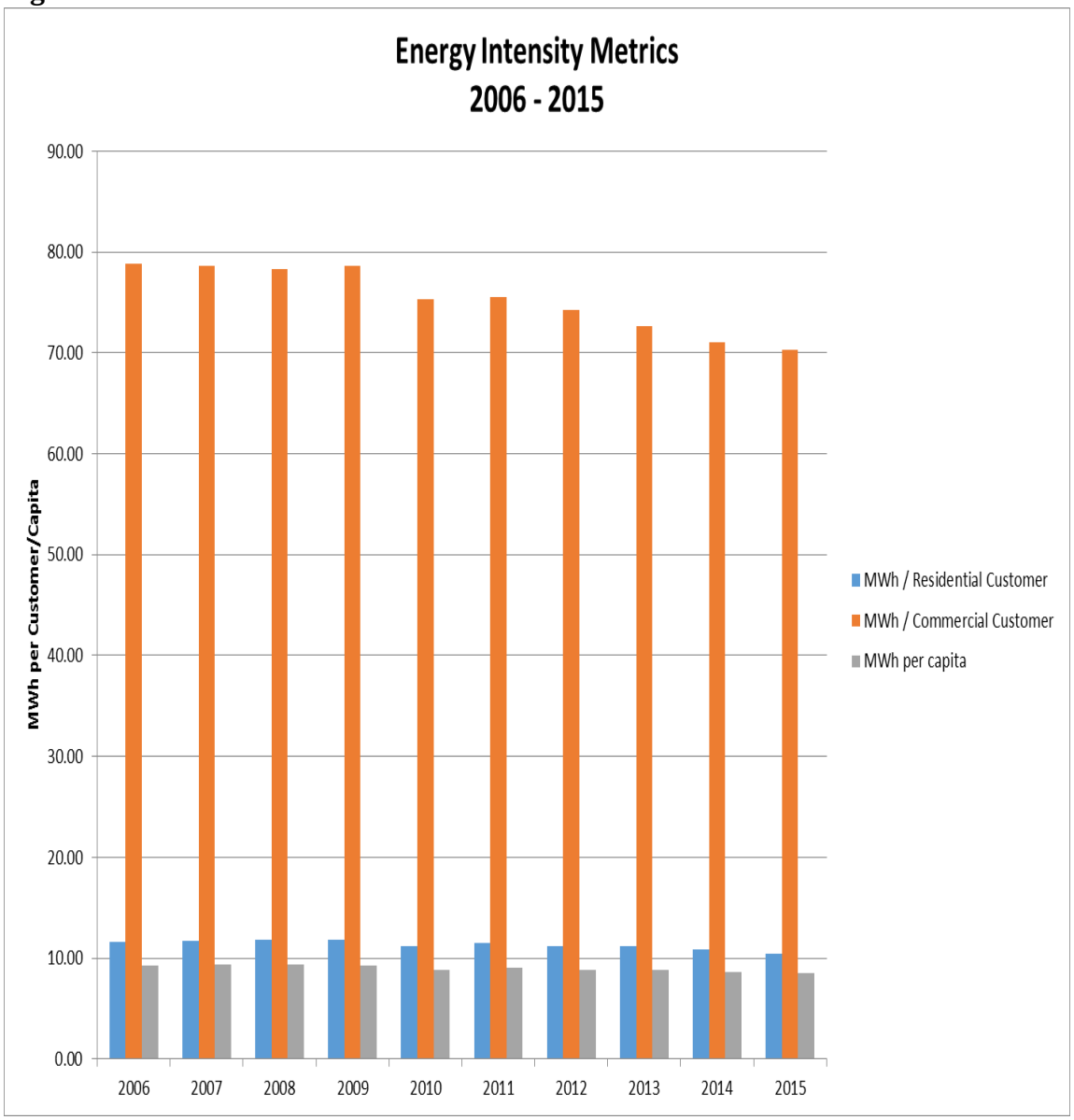


Figure 3 provides a comparison of the ratios of PSE's annual CO_2 emissions from known sources for the reporting period compared to CO_2 emission in 1990

Figure 3

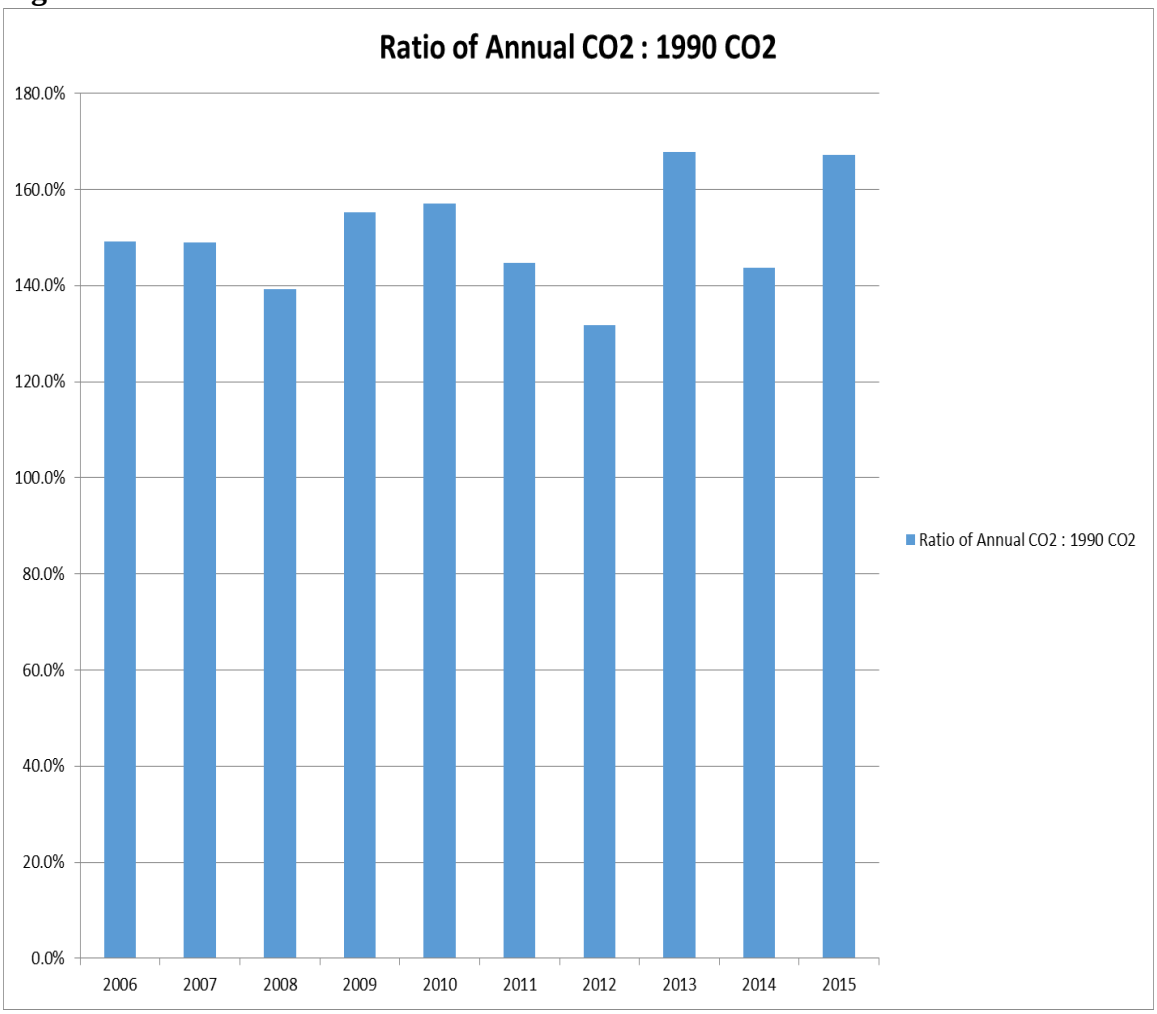
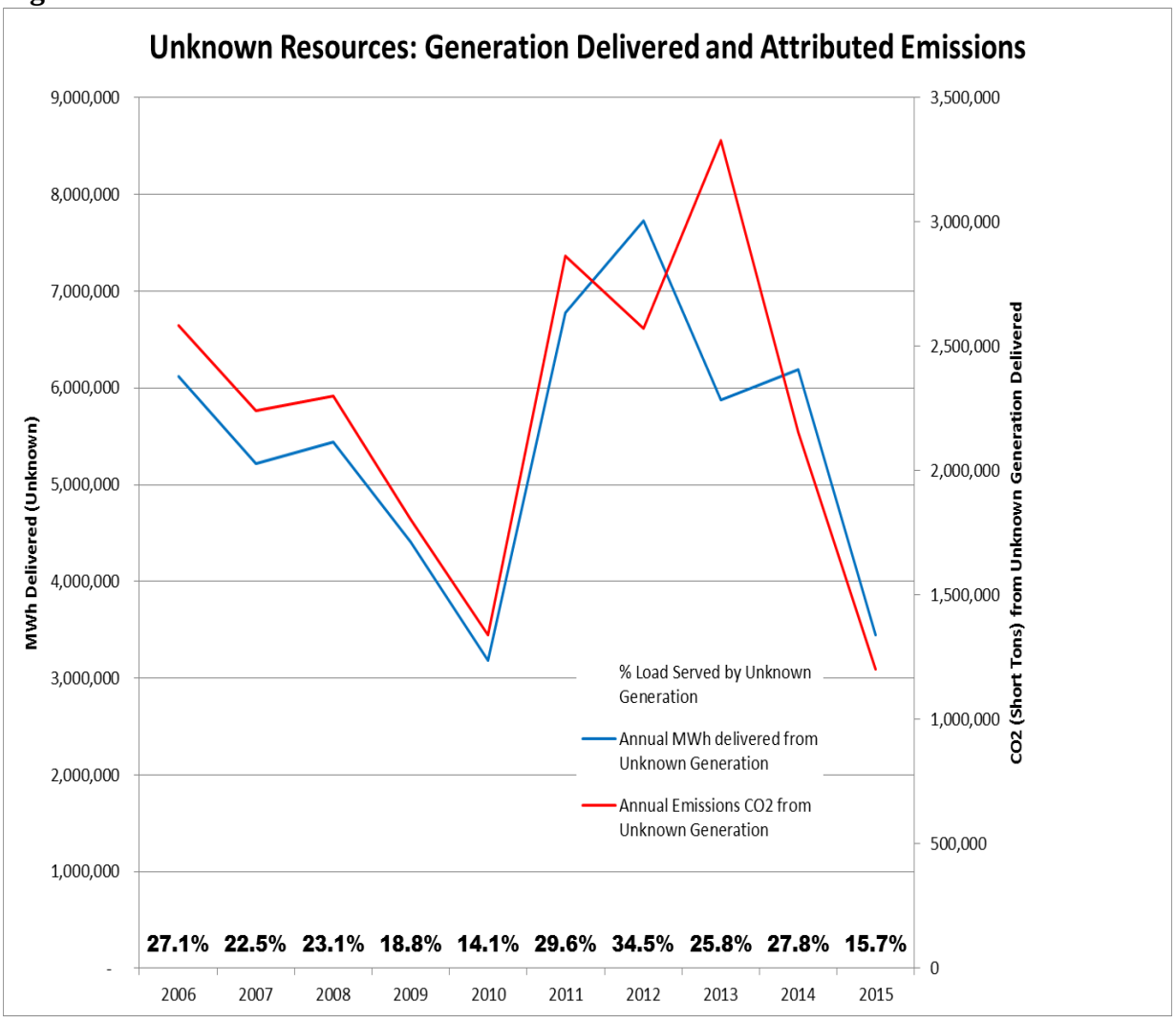


Figure 4 provides a 10-year comparison of generation delivered to PSE from unknown sources and the attributed emissions. Those metrics include annual CO_2 emissions (short tons), annual MWh delivered to retail customers, and the percentage of load served. As discussed in the executive summary, the generation 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. PSE is unclear of the methodology used by Commerce to calculate those emissions factors. Nonetheless, they are included in PSE's analysis in Attachment A and Figure 4 below. For comparison purposes only, PSE has included in Appendix 2 a similar analysis to Figure 4 but calculates emissions factors using publically available source data from the Northwest Power Pool eGrid tool and the Fuel Mix Disclosure reports from Commerce. PSE's analysis in Appendix 2 compares the impacts of using the different emissions factors from both sources.

Figure 4



Section 3: Trend analysis, narrative, findings and graphics

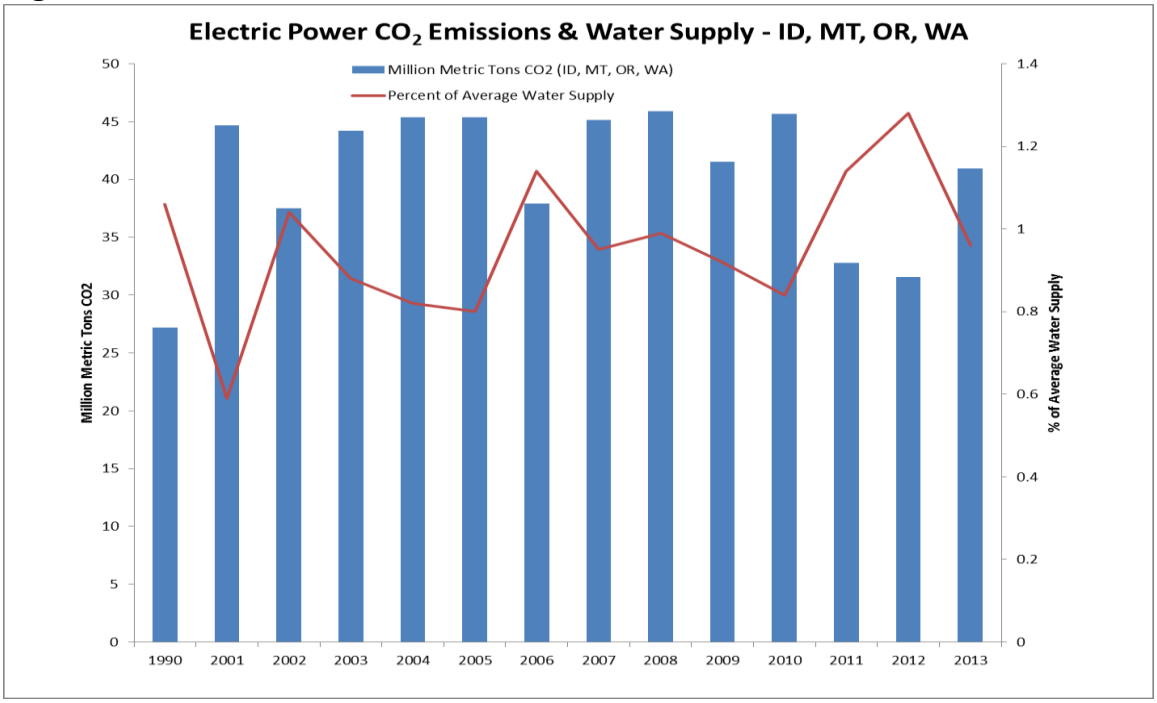
This section addresses the requirement in WAC 480-109-300(4) to include narrative text describing trends and an analysis of the likely causes of changes, or lack of changes, in the metrics.

PSE's Emissions Follow Northwest Fluctuations

In the Northwest, electric power emissions fluctuate significantly each year, and are inversely correlated to water supply. High water supply leads to increased hydroelectric generation which, all other factors held constant, reduces the need to operate coal and natural gas units. This results in lower overall emissions. This point is illustrated below in Figure 5, where total CO_2 emissions (from power generation in the Northwest) are plotted against water supply as a percent of average (right hand axis). Note that during high water years CO_2 emissions decline.

Hydroelectric generation is not the only driver of Northwest emissions. Looking at Figure 5, 2001 emissions are slightly lower than 2008 emissions even though 2001 was a lower water year. This rise in emissions was in part due to increased demand for Northwest electricity, both inside and outside of the region. In 2008 the Northwest produced over 25% more electricity than in 2001. Although much of the increased demand was met by hydroelectricity, some of the extra power was produced with natural gas, which increased total emissions. (*Note - Figure 5 does not include calendar years 2014 and 2015 because regional emissions data were not available as of this filing*)

Figure 5.



PSE emissions follow these same trends. From 2006 to 2013 PSE's emissions match the northwest trend lines shown in Figure 5. This is illustrated in PSE's emissions and generation summaries illustrated below in Figures 6, 7, 8, 9 and 10. PSE compared 2006 to 2013 to regional data because as noted above, regional emissions data for 2014 and 2015 were not available as of the filing deadline of this report.

Figure 6.

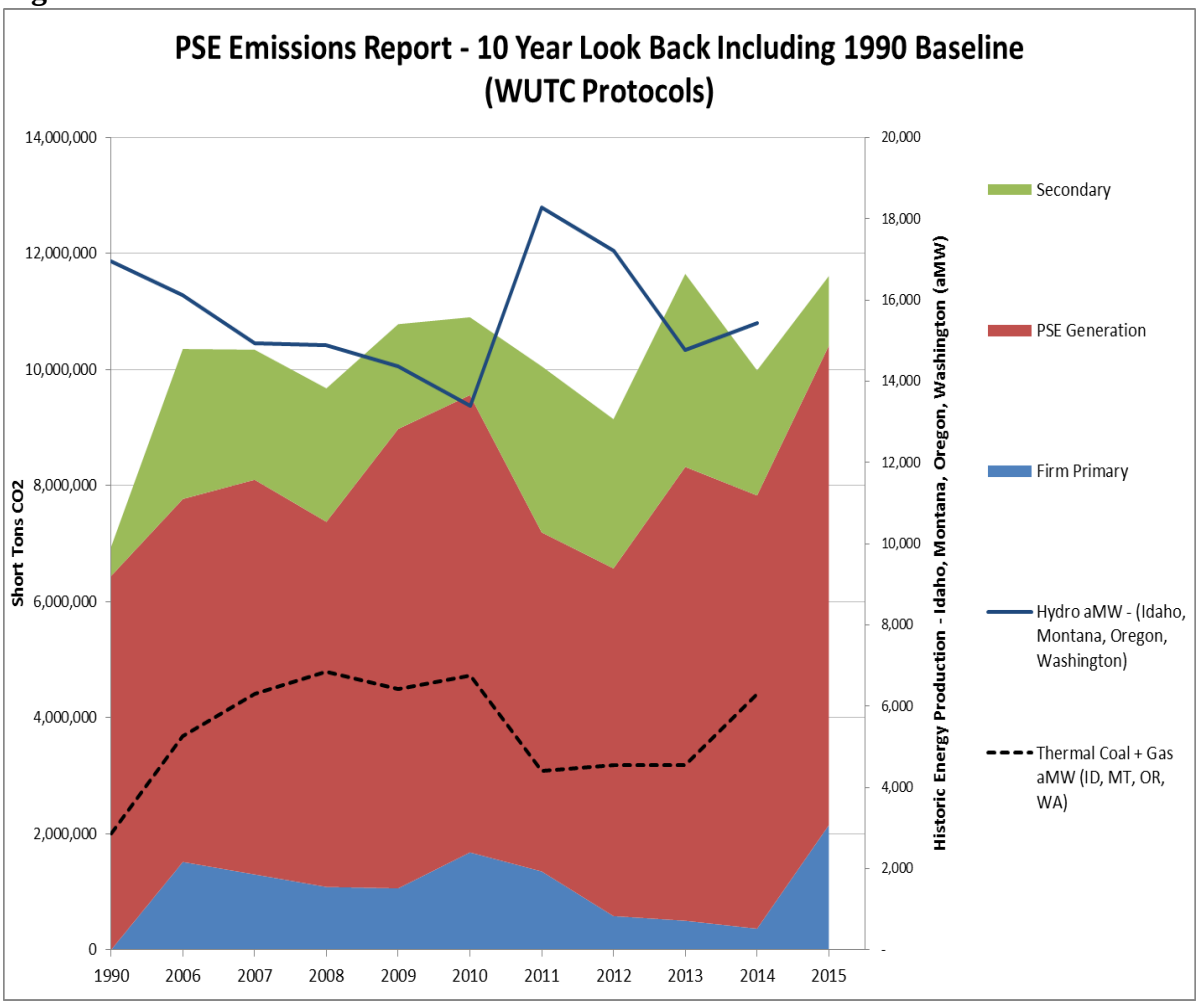


Figure 7.

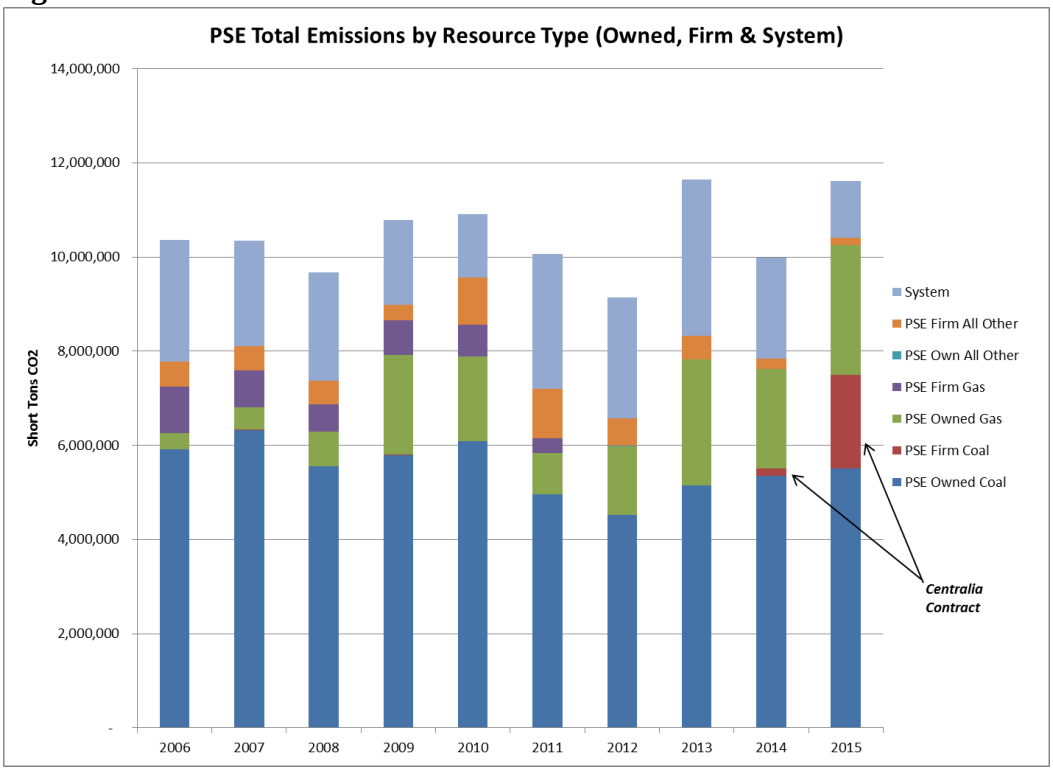
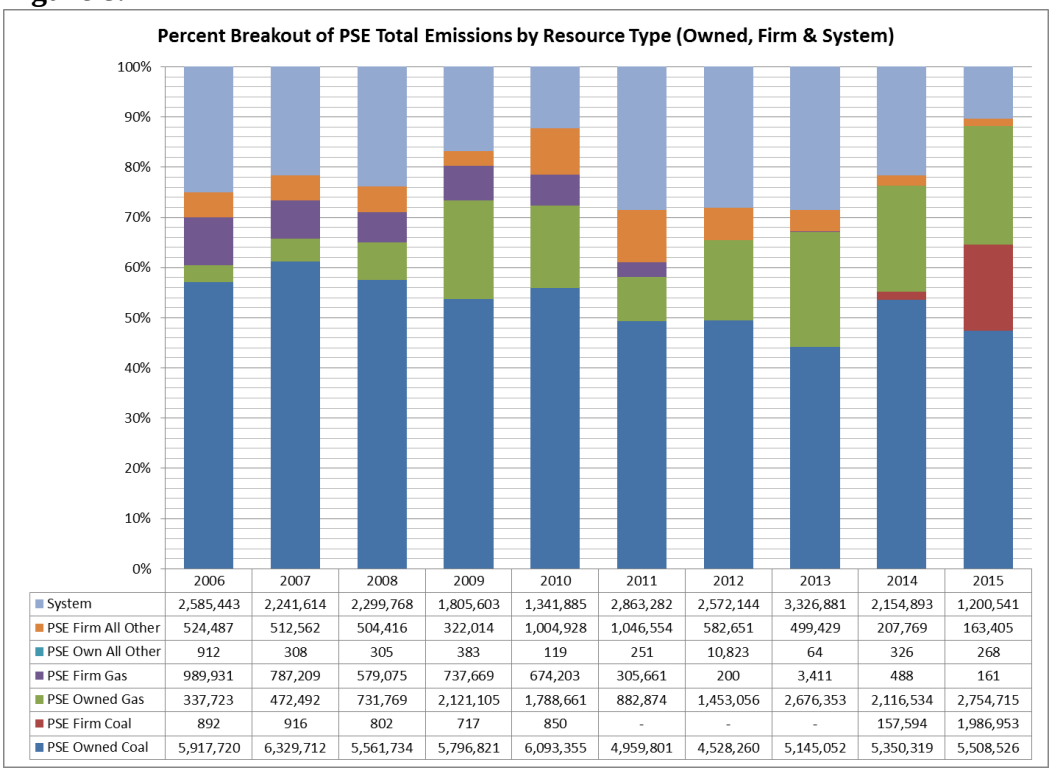


Figure 8.



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
System	2,585,443	2,241,614	2,299,768	1,805,603	1,341,885	2,863,282	2,572,144	3,326,881	2,154,893	1,200,541
PSE Firm All Other	524,487	512,562	504,416	322,014	1,004,928	1,046,554	582,651	499,429	207,769	163,405
PSE Own All Other	912	308	305	383	119	251	10,823	64	326	268
PSE Firm Gas	989,931	787,209	579,075	737,669	674,203	305,661	200	3,411	488	161
PSE Owned Gas	337,723	472,492	731,769	2,121,105	1,788,661	882,874	1,453,056	2,676,353	2,116,534	2,754,715
PSE Firm Coal	892	916	802	717	850	-	-	-	157,594	1,986,953
PSE Owned Coal	5,917,720	6,329,712	5,561,734	5,796,821	6,093,355	4,959,801	4,528,260	5,145,052	5,350,319	5,508,526

Figure 9.

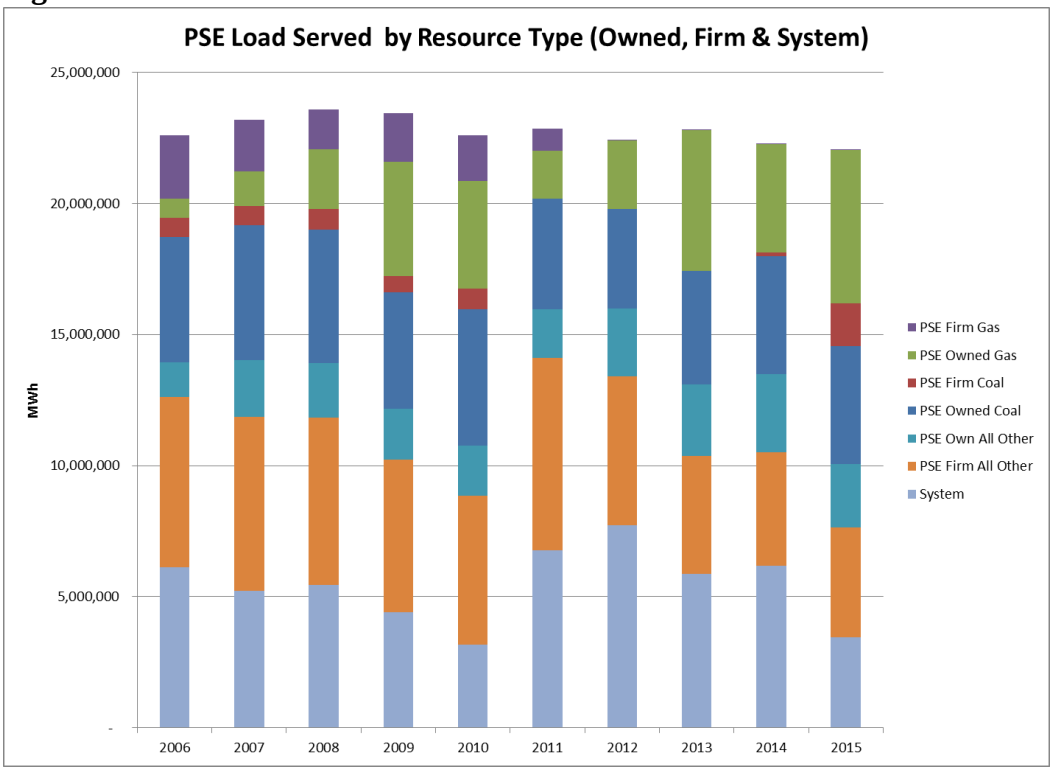
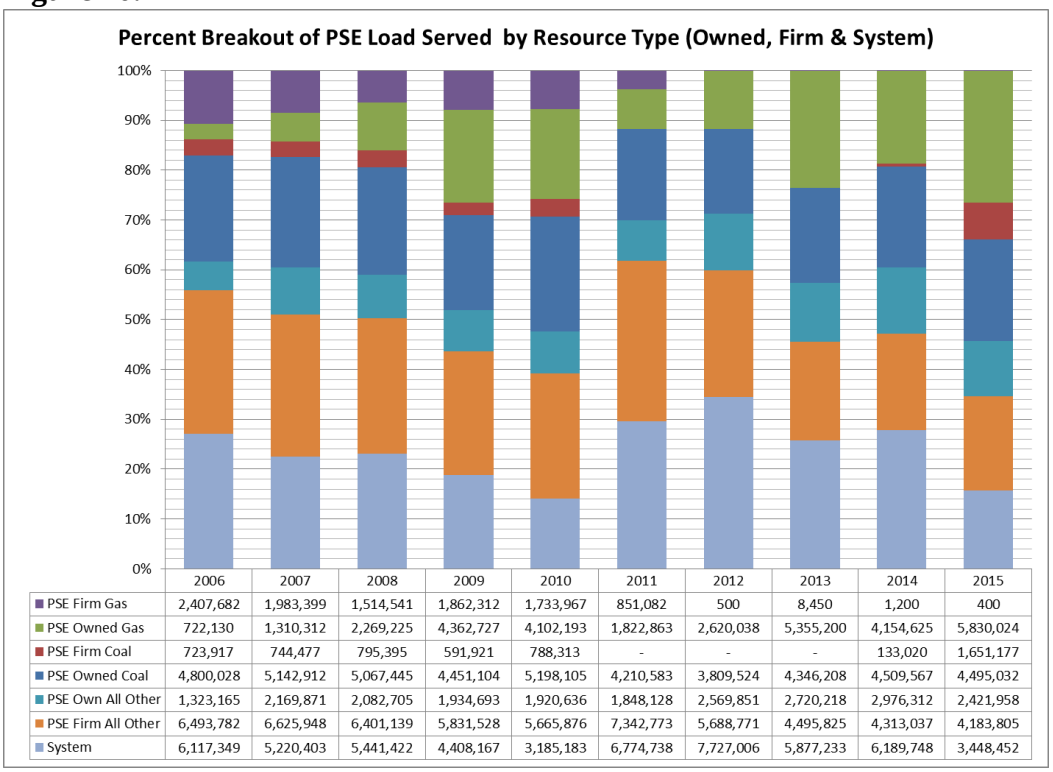


Figure 10.



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
PSE Firm Gas	2,407,682	1,983,399	1,514,541	1,862,312	1,733,967	851,082	500	8,450	1,200	400
PSE Owned Gas	722,130	1,310,312	2,269,225	4,362,727	4,102,193	1,822,863	2,620,038	5,355,200	4,154,625	5,830,024
PSE Firm Coal	723,917	744,477	795,395	591,921	788,313	-	-	-	133,020	1,651,177
PSE Owned Coal	4,800,028	5,142,912	5,067,445	4,451,104	5,198,105	4,210,583	3,809,524	4,346,208	4,509,567	4,495,032
PSE Own All Other	1,323,165	2,169,871	2,082,705	1,934,693	1,920,636	1,848,128	2,569,851	2,720,218	2,976,312	2,421,958
PSE Firm All Other	6,493,782	6,625,948	6,401,139	5,831,528	5,665,876	7,342,773	5,688,771	4,495,825	4,313,037	4,183,805
System	6,117,349	5,220,403	5,441,422	4,408,167	3,185,183	6,774,738	7,727,006	5,877,233	6,189,748	3,448,452

PSE Thermal Fleet

Between 2006 and 2015, 60% of the thermal electricity PSE generated came from the Colstrip station, which has a high GHG emission intensity compared to natural gas. Of the CO_2 emissions from thermal electricity generated by PSE during that time (Colstrip plus the entire owned and firm gas fleet), 74% of emissions were from coal-combustion. This factors heavily in the total emissions attributed to owned and firm purchases shown in Figures 6 and 7 above.

PSE Thermal Fleet Capacity 1990 to Current, MW

	1990	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Coal												
Centralia Coal	98											
Colstrip	677	677	677	677	677	677	677	677	677	677	677	677
Simple Cycle Gas												
Frederickson	154	154	154	154	154	154	154	154	154	154	154	154
Fredonia	230	230	230	230	230	230	230	230	230	230	230	230
Whitehorn 2 and 3	154	154	154	154	154	154	154	154	154	154	154	154
Combined Cycle Gas												
Encogen		183	183	183	183	183	183	183	183	183	183	183
Frederickson Power		134	134	134	134	134	134	134	134	134	134	134
Fredonia 3 & 4		114	114	114	114	114	114	114	114	114	114	114
Goldendale Generating			254	254	254	254	254	254	254	254	254	254
Mint Farm Generation					306	306	306	306	306	306	306	306
Sumas Energy 1				133	133	133	133	133	133	133	133	133
Tenaska Ferndale Cogen								286	286	286	286	286
Total Coal	775	677	677	677	677	677	677	677	677	677	677	677
Total Gas	538	969	1,223	1,356	1,662	1,662	1,662	1,948	1,948	1,948	1,948	1,948
Total Thermal	1,313	1,646	1,900	2,033	2,339	2,339	2,339	2,625	2,625	2,625	2,625	2,625

Centralia Coal Transition Power

It is important to distinguish between emissions from PSE's thermal fleet 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 (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 2,407 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") 2015 system rate, which is 1,046 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.

Emission Rate Correlation

PSE used regional average emission factors (based on Northwest Power Pool data) to estimate emissions from secondary purchases of electricity. It is difficult to track the source and type of electricity purchased on a non-firm contract from different utilities and non-utilities via the grid. For instance, electricity purchased by a utility from an energy trader could have been purchased by an 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 that generally reflect the suite of generation sources that produced the purchased electricity. However, similar to the total emission and regional hydropower supply corollary, the average emissions rates in the Northwest Power Pool and the Western Electricity Coordinating Council ("WECC") are also strongly influenced by hydropower supply. In years of high hydropower supply, emission rate averages are slightly "diluted" by the large number of non-emitting MWh that factor into the rate equation. Conversely, in years of low hydro, thermal resources are dispatched more frequently WECC-wide, adding CO_2 pounds to the numerator of the rate equation, resulting in a higher rate average. For example, note in the table below that 2005, 2009, 2010 and 2013 were lower than average hydro supply years which resulted in higher than average regional emission rate averages.

Year	Commerce NWPP CO2 Emission Rate (lb/MWh)	eGrid NWPP CO2 Emission Rate (lb/MWh)	eGrid WECC CO2 Emission Rate (lb/MWh)	Percent of Average Water Supply	Hydro Supply	Thermal Rate
2015	NA	NA	NA	NA		
2014	696	NA	NA	NA		
2013	1,132	NA	NA	96%	Slight low	High
2012	NA	666	879	128%	High	Low
2011	NA	NA	NA	114%	High	NA
2010	NA	843	952	84%	Low	High
2009	NA	819	953	92%	Low	High
2008	NA	NA	NA	99%	Normal	NA
2007	NA	859	994	95%	Slight Low	High
2006	NA	NA	NA	114%	High	NA
2005	NA	902	1,033	80%	Very low	Very high

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). PSE's population data methodology is described in greater detail in Appendix 1.

Spot 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. 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. However, in this first report only, Commerce noted it is not able to provide the net system mix emission rate for 2015 due to technical difficulties with their new system for tracking and compiling data. To fill this gap for 2015, Commerce staff will calculate and provide each utility a 10-year weighted average net system mix emissions rate for the period 2005 through 2014 as a proxy for the 2015 net system mix emissions rate. In future reports, Commerce has indicted it will be able to provide the utilities with the net system mix emission rates for the full 10-year reporting period. In addition, PSE was unclear on the methodology used by Commerce to calculate emissions factors from unknown resources. Therefore, PSE provides an analysis in Appendix 2 comparing emissions from unknown resources using the emissions factors provided by Commerce versus emissions factors developed using available data and methodologies from the Northwest Power Pool eGrid tool and Commerce Fuel Mix Disclosure reports.

Section 4: 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 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 2.49. 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.

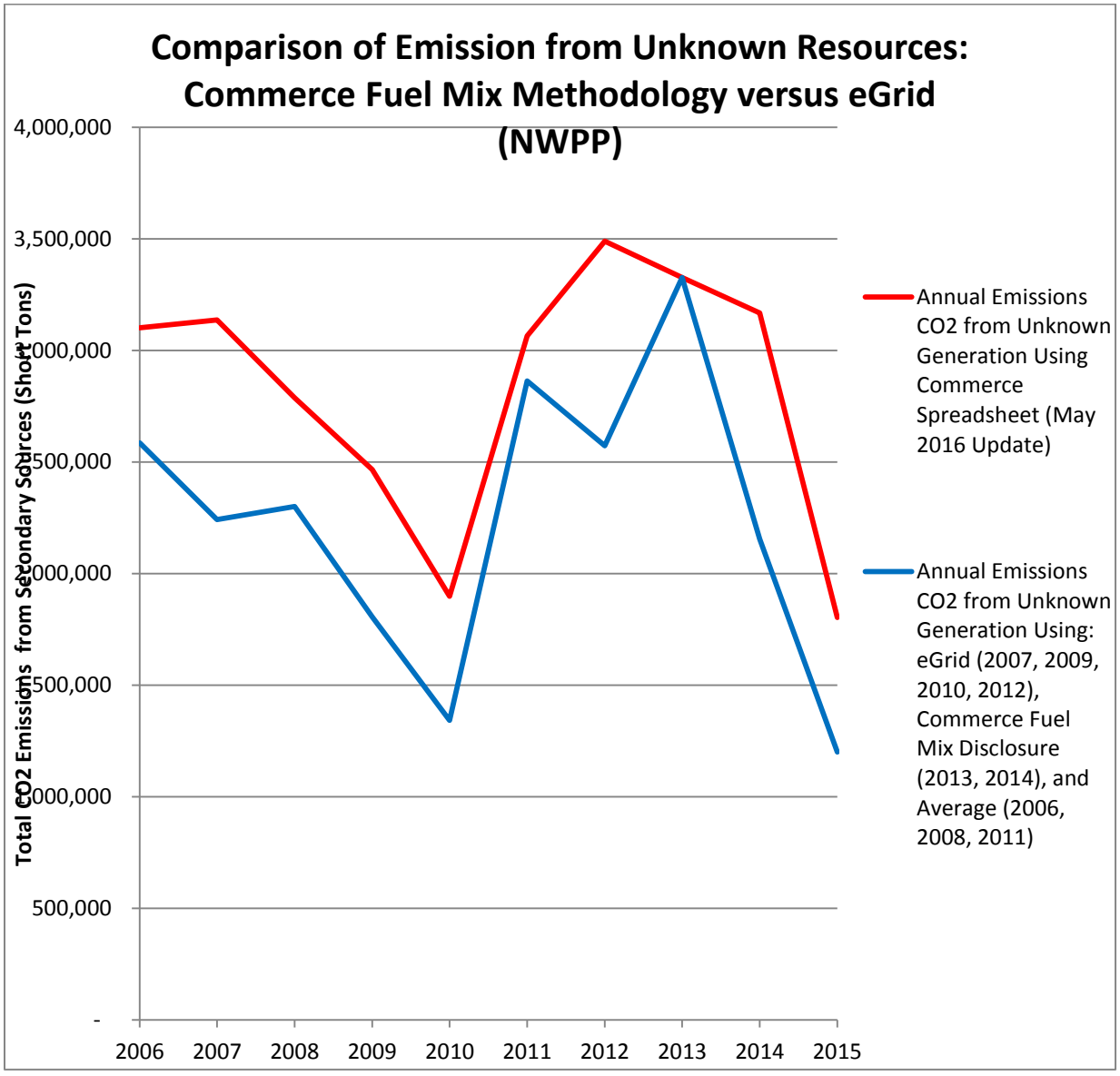
[1] UE-131732 Proposed EE Metrics Workgroup Results – Final Report, August 7, 2015, (Report at2-3).
[2] UE-131732, Final Order, General Order R-581: Order Adopting Rule Permanently, September, 10, 2015, (Order at 6 §17).
[3] UE-131732, Final Order, General Order R-581: Order Adopting Rule Permanently,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

The following table details the data and the calculation of the 2.49 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	Kittitas County, Washington	Kitsap County, Washington	King County, Washington	Jefferson County, Washington	Island County, Washington	Pierce County, Washington	Skagit County, Washington	Whatcom County, Washington	Thurston County, Washington
1	Households, 2010-2014	U.S. Census Bureau http://www.census.gov/quickfacts/table/PST045215/00	16,753	97,993	808,729	13,535	32,820	301,364	45,309	79,837	101,530
2	Persons per household, 2010-2014	U.S. Census Bureau http://www.census.gov/quickfacts/table/PST045215/00	2.34	2.51	2.44	2.15	2.35	2.64	2.57	2.50	2.52
3	Weight	(Line 1) X (Line 2)	39,202	245,962	1,973,299	29,100	77,127	795,601	116,444	199,593	255,856
4	Weighted person per household for Puget Sound Energy Service terrotory with Jefferson County	(Sum of Line 3) / (Sum of Line 1)	**2.49**								
5	Weighted person per household for Puget Sound Energy Service terrotory with Jefferson County	(Sum of Line 3 excluding Jefferson County) / (Sum of Line 1 excluding Jefferson County)	**2.49**								

Appendix 2: Comparison of Emissions from Unknown Sources using different methodologies

As discussed above, generation sources and attributed emissions for spot market purchases are unknown, and therefore the WA Department of Commerce provided emissions factors for each of the previous 10 years. PSE is unclear of the methodology used by the WA Department of Commerce to calculate those emissions factors. Nonetheless, they are included in PSE's analysis in Attachment A and Figure 4 above. For comparison purposes only, PSE conducted a similar analysis to Figure 4 above but calculates the emissions factors using publically available source data from the Northwest Power Pool eGrid tool and Fuel Mix Disclosure reports from the WA Department of Commerce. PSE's analysis below compares the impacts of using the different emissions factors from both sources.



Attachment A