Annual Energy and Emissions Intensity ("EEI") Metrics Report
Pursuant to WAC 480-109-300
May 28, 2019

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Energy and Emissions Intensity (EEI) Metrics Report
Pursuant to WAC 480-109-300

Section 1: Executive Summary

Compared to last year's EEI report, Puget Sound Energy's (PSE's) CO_2 emissions intensity from total electricity delivered to customers increased from 1,014 lb/MWh to 1,043lb/MWh. This report provides the metrics, analyses, and descriptions behind that change and further demonstrates that 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.

Per the requirements of WAC 480-109-300, 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 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 2018. 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 2009) 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 (2018)

Summarized in Table 1 and narrative below are PSE's 2018 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 :	2018	**MWh per Capita**
Population Served :	2,521,470	**8.18**

Energy Intensity Metrics

	MWh at Meter	MWh Proportion	Customer Count	**MWh per Customer**
Residential Customers	10,497,389	50.9%	1,010,574	**10.4**
Commercial Customers	8,932,681	43.3%	128,845	**69.3**
Industrial Customers	1,189,828	5.8%		
Total Load Served	20,619,898			

Emissions Intensity Metrics

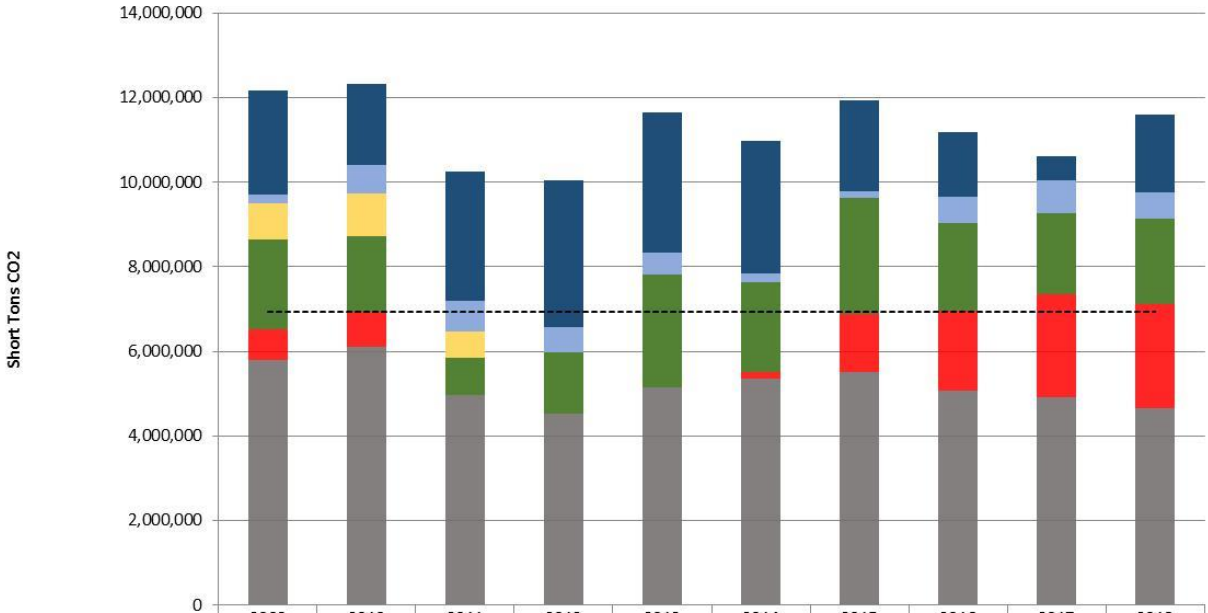
	Busbar MWh	Percent of Total Load	**Short Tons CO_2**	
Known Resources Serving WA	18,499,300	83.2%	9,763,449	
Unknown Resources Serving WA	3,726,897	**16.8%**	1,825,150	**% of 1990 CO_2**
	Total Short Tons (CO_2):		**11,588,599**	**166.8%**

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.

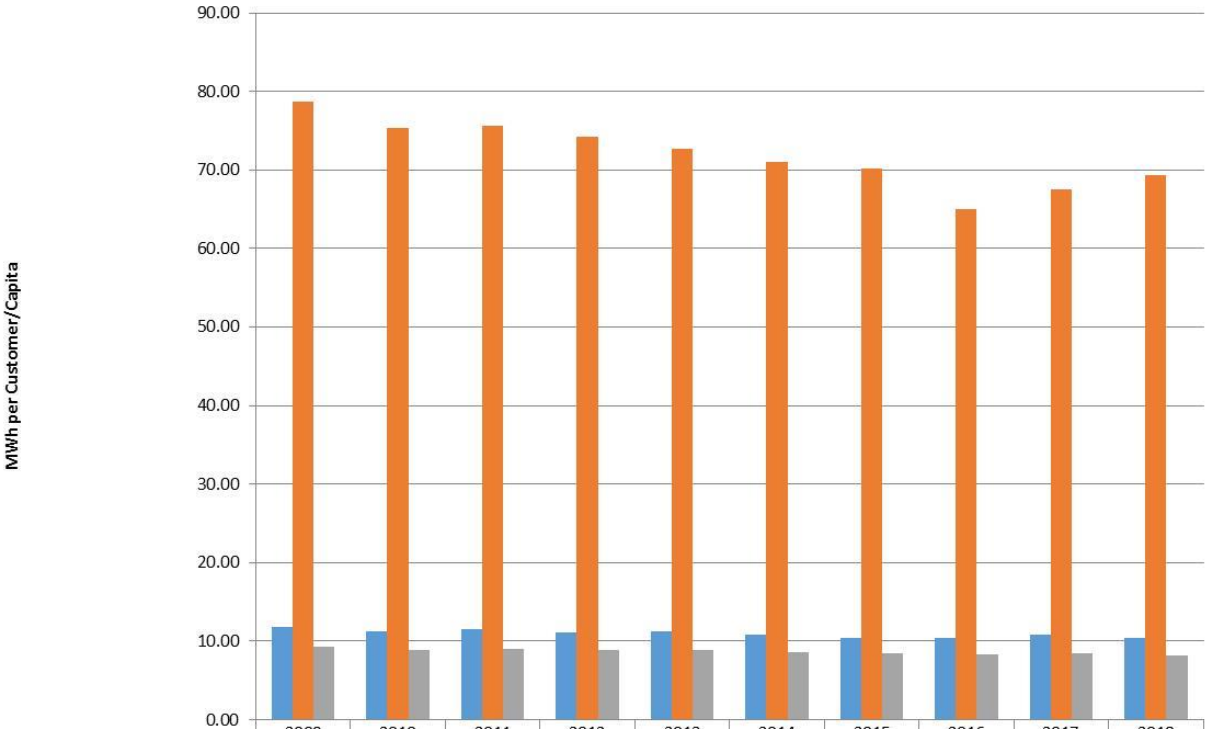
Figure 1. Total Emissions by Resource Type



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Market Unspecified	2,465,916	1,897,917	3,064,416	3,489,259	3,326,882	3,138,202	2,127,989	1,537,082	570,619	1,825,150
Firm Unspecified	207,143	677,387	723,369	581,922	499,429	207,769	163,405	619,004	766,337	628,393
Firm Gas	852,539	1,001,743	628,846	930	3,411	488	161	81	0	0
Owned Gas	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	2,010,104
Firm Coal	716,565	850,106	0	0	0	157,594	1,366,285	1,891,255	2,449,181	2,470,596
Owned Coal	5,796,821	6,093,355	4,959,801	4,528,260	5,145,052	5,350,319	5,508,526	5,079,551	4,907,712	4,654,288
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 2. Energy Intensity Metrics



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
MWh / Residential Customer	11.78	11.20	11.54	11.17	11.20	10.84	10.47	10.40	10.89	10.39
MWh / Commercial Customer	78.68	75.34	75.58	74.28	72.63	71.02	70.25	65.07	67.49	69.33
MWh per capita	9.28	8.86	9.03	8.82	8.82	8.64	8.48	8.29	8.41	8.18

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.

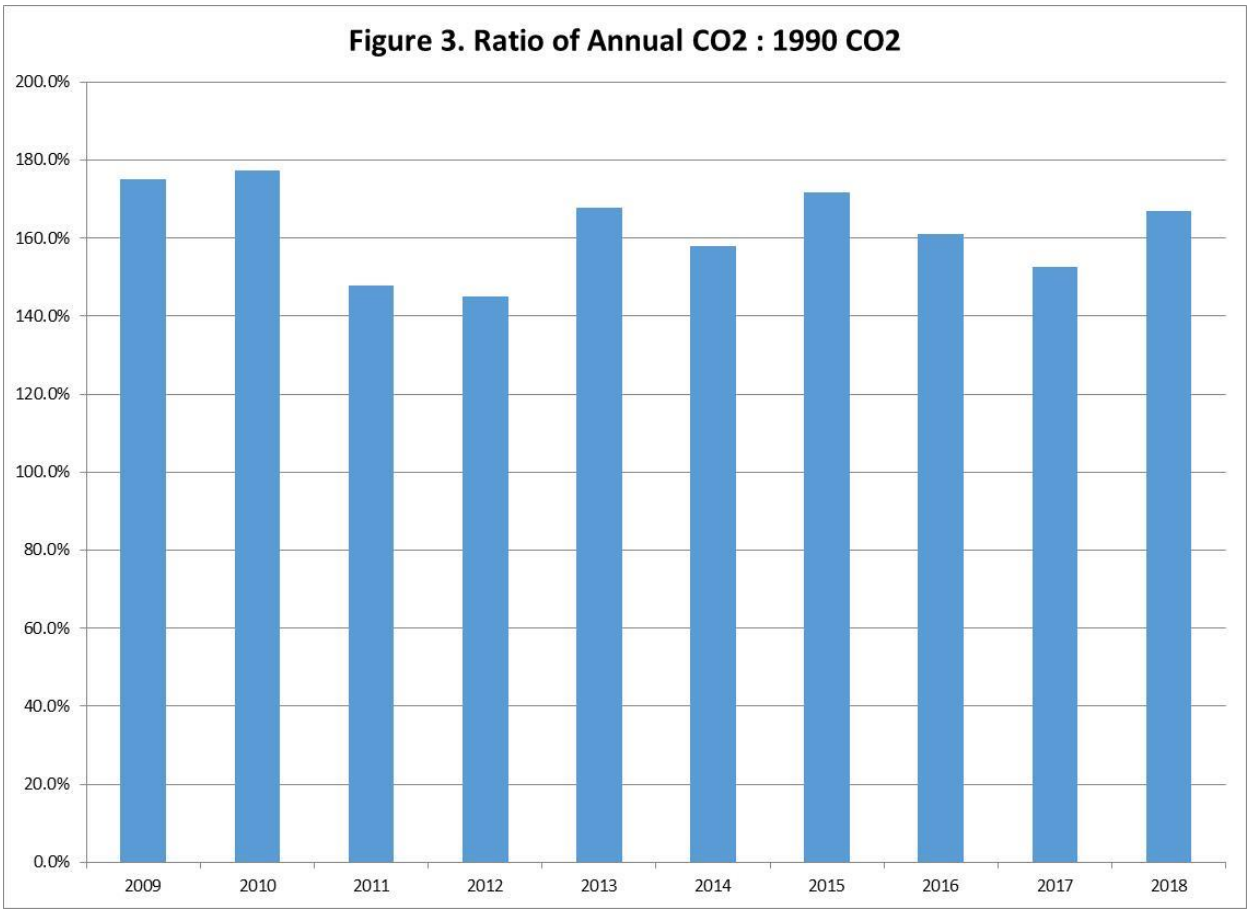
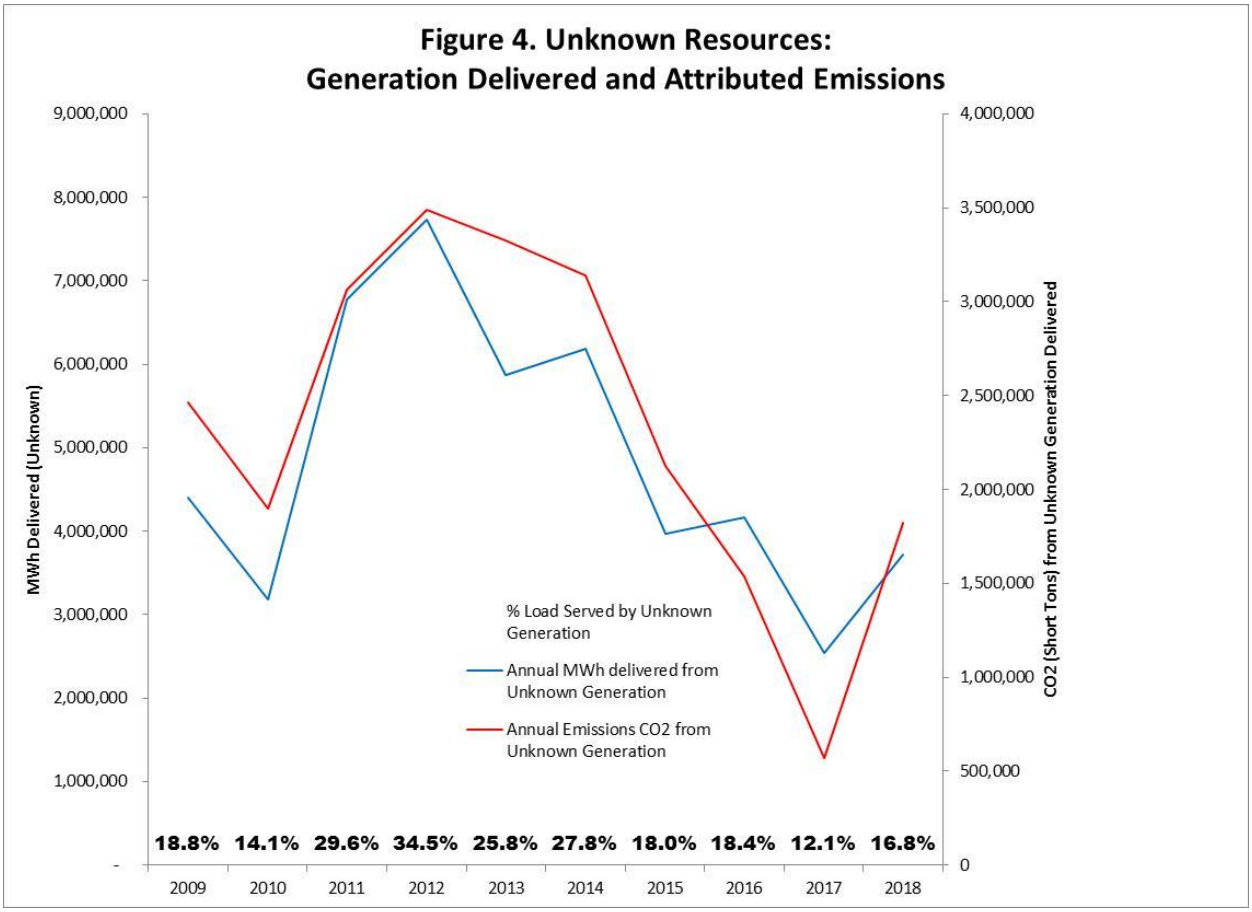


Figure 4 provides a 10-year comparison of generation delivered to PSE from unknown sources and the attributed emissions. Those metrics include annual CO_2 emissions (short tons), annual MWh delivered to retail customers, and the percentage of load served. As discussed in the executive summary, the generation 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 2018, 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 4,696 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.

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 2018. 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 commission staff instruction. PSE employed commission 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. Known Resources Serving WA Customers

Resource	WA MWh	Short Tons CO_2	Type	Fuel
Lower Baker	385,262	0	Own	Hydro
Snoqualmie Falls #1	68,320	0	Own	Hydro
Snoqualmie Falls #2	127,167	0	Own	Hydro
Upper Baker	333,791	0	Own	Hydro
Colstrip 1 & 2	1,767,119	2,026,961	Own	Coal
Colstrip 3 & 4	2,317,777	2,627,327	Own	Coal
Crystal Mountain	71	68	Own	Diesel
Encogen 1	66,696	34,193	Own	Gas

Encogen 2	68,504	36,142	Own	Gas
Encogen 3	67,908	35,877	Own	Gas
Ferndale 1	337,058	163,347	Own	Gas
Ferndale 2	338,338	169,793	Own	Gas
Frederickson 1	29,824	30,508	Own	Gas
Frederickson 2	12,958	14,644	Own	Gas
Fredonia 1	75,975	65,435	Own	Gas
Fredonia 2	48,859	40,447	Own	Gas
Fredonia 3	4,676	2,809	Own	Gas
Fredonia 4	4,973	3,038	Own	Gas
Frederickson Unit 1	353,717	148,267	Own	Gas
Goldendale	1,113,146	468,777	Own	Gas
Mint Farm	1,412,745	603,354	Own	Gas
Sumas	279,593	144,437	Own	Gas
Whitehorn 2	12,294	13,529	Own	Gas
Whitehorn 3	17,605	35,507	Own	Gas
Wild Horse (W183)	638,689	0	Own	Wind
Lower Snake River	882,777	0	Own	Wind
Hopkins Ridge (W184)	410,913	0	Own	Wind
Bio Energy Washington (BEW)	1	0	Firm	Biogas
Blocks Dairy Farm	23	0	Firm	Biogas
Edaleen Dairy LLC	4,701	0	Firm	Biogas
Emerald City Renewables	33,932	0	Firm	Biogas
Farm Power Lynden LLC	5,065	0	Firm	Biogas
Farm Power Rexville LLC	4,650	0	Firm	Biogas
Lake Washington -- Finn Hill	261	0	Firm	Biogas
Rainier Bio Gas	5,376	0	Firm	Biogas
Van Dyk - S Holsteins	992	0	Firm	Biogas
VanderHaak Dairy Digester	3,598	0	Firm	Biogas
Transalta Centralia Generation LLC	2,067,688	2,470,596	Firm	Coal
Black Creek Hydro Inc	11,824	0	Firm	Hydro
Chelan PUD - RI & RR	2,367,842	0	Firm	Hydro
Chelan PUD - Rock Island Syst #2	-39,039	0	Firm	Hydro
Chelan PUD - Rocky Reach	-81,380	0	Firm	Hydro
Douglas PUD - Wells Project	1,168,961	0	Firm	Hydro
Electron Hydro, LLC	136,215	0	Firm	Hydro
Grant PUD - Priest Rapids Project	52,318	0	Firm	Hydro
Koma Kulshan Associates	41,921	0	Firm	Hydro
Nooksack	22,251	0	Firm	Hydro
Skookumchuck Hydro	3,280	0	Firm	Hydro
Smith Creek Hydro	137	0	Firm	Hydro

Sygitowicz Creek	697	0	Firm	Hydro
Twin Falls Hydro	78,046	0	Firm	Hydro
Weeks Falls	14,576	0	Firm	Hydro
CC Solar 1 and CC Solar 2	29	0	Firm	Solar
Ikea Solar	64	0	Firm	Solar
Island Community Solar LLC	60	0	Firm	Solar
BC Hydro (Point Roberts)	19,966	9,747	Firm	System
BPA	7,000	3,417	Firm	System
Transalta Centralia Generation LLC - Bookout Source Other Adjustment	1,260,220	615,228	Firm	System
3 Bar G Wind Turbine #3 LLC	185	0	Firm	Wind
Klondike Wind Power III	119,259	0	Firm	Wind
Knudsen Wind Turbine #1	119	0	Firm	Wind
Swauk Wind	11,707	0	Firm	Wind

Total:	18,499,300	9,763,449
Firm Total:	7,322,547	3,098,989
Firm Renewable Total:	3,967,673	
% Firm Renewable:	54%	

Table 3. Unknown Resources Serving WA Customers

Resource	Net-by-Counterparty MWh	Fuel Mix lbs CO_2/MWh	Short Tons CO_2
Avista Corp. WWP Division	62,689	976	30,604
Avista Nichols Pump	28,488	976	13,908
Black Hills Power	-150	1,056	-79
Book Outs - EITF 03-11	0	1,056	0
BP Energy Co.	172,289	976	84,110
BPA	510,195	976	249,073
BPA - NWPP Reserve Sharing Energy	193	976	94
British Columbia Transmission Corp	-51	1,056	-27
Brookfield Energy Marketing	1,020	976	498
CAISO EESC Load Undistributed Costs	-741	1,056	-391
CAISO PRSC Undistributed Costs	2,326	976	1,135
California ISO	15,271	976	7,455
Calpine Energy Services	-89,436	1,056	-47,202
Chelan County PUD #1	33,534	976	16,371
Citigroup Energy Inc	674,887	976	329,474
Clatskanie PUD	-25,325	1,056	-13,366
Colstrip - Energy Imbalance Market	77,289	976	37,732
Conoco, Inc.	-77,891	1,056	-41,109

CP Energy Marketing (Epcor)	15,194	976	7,418
Deviation	-448,577	1,056	-236,747
Douglas County PUD #1	183,509	976	89,588
Douglas PUD - Wells Project	76,002	976	37,103
EDF Trading NA LLC	202,896	976	99,052
Encogen	-8,923	1,056	0
Energy Keepers Inc.	35,992	976	17,571
Eugene Water & Electric	-42,091	1,056	-22,215
Exelon Generation Co LLC	209,922	976	102,482
Ferndale Co-Generation	-16,088	1,056	0
Freddie #1	1,964	976	959
Fredonia - Energy Imbalance Market	13,348	976	6,517
Fredrickson 1 & 2	-6,410	1,056	0
Goldendale	-48,326	1,056	0
Grant County PUD #2	-9	1,056	-5
GRIDFORCE ENERGY MANAGEMENT, LLC.	-648	1,056	-342
Iberdrola Renewables (PPM Energy)	374,771	976	182,960
Idaho Power Company	-80,275	1,056	-42,367
Lower Baker	2,784	976	1,359
MID-C for Energy Imbalance Market	60,683	976	29,625
Mint Farm	-57,811	1,056	0
Morgan Stanley CG	-422,896	1,056	-223,194
Natur Ener USA	-152	1,056	-80
Nevada Power Company	-9	1,056	-5
NextEra Energy Power Marketing	370	976	181
Northwestern Energy	-28,629	1,056	-15,110
Okanogan PUD	25,476	976	12,437
Pacific Gas & Elec - Exchange	0	1,056	0
Pacificorp	-59,016	1,056	-31,147
Portland General Electric	104,861	976	51,192
Powerex Corp.	-347,614	1,056	-183,462
Public Service of Colorado	84,495	976	41,250
Rainbow Energy Marketing	6,248	976	3,050
Sacramento Municipal	-39	1,056	-21
Seattle City Light Marketing	49,071	976	23,956
Shell Energy (Coral Pwr)	163,879	976	80,004
Snohomish County PUD #1	21,665	976	10,577
Snoqualmie-Energy Imbalance Market	-143	1,056	-75
Sumas	1,311	976	640
Tacoma Power	39,893	976	19,475
Talen Energy (PPL Energy Plus)	106,084	976	51,789

Tenaska Power Services Co.	369	976	180
The Energy Authority	479,949	976	234,307
TransAlta Energy Marketing	1,271,332	976	620,653
TransCanada Energy Sales Ltd	-122,342	1,056	-64,569
Turlock Irrigation District	38,518	976	18,804
Upper Baker	14,871	976	7,260
Vitol Inc.	463,767	976	226,407
Western Area Power Association	3	976	1
Whitehorn 2&3	-5,098	1,056	0
Wild Horse (W183)	-10,701	1,056	0
Williams Power Company	-1,120	1,056	-591
Total:	**3,726,897**		**1,825,150**

Columbia River Energy Supply Contracts

During 2018, approximately 15.6 percent 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	25.3%	212
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 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.

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2018 Carbon Dioxide Emissions - Results & Discussion

Overall, PSE's CO_2 emissions intensity from total electricity delivered to customers increased from 1,014 lb/MWh to 1,043lb/MWh. . In 2018, 50.3 percent of electricity delivered to PSE customers was generated by the company, while 49.7 percent of electricity was purchased via firm contracts (32.9%) and non-firm contracts, i.e. spot market (16.8%). Of the CO_2 emissions associated with electric delivery, 57.5 percent were from electricity generated by PSE and 42.5 percent were from purchased electricity (26.7 percent via firm contracts and 15.7 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 36.5 percent of the electricity generated by PSE came from coal combustion, but this fuel source represented about 69.8 percent of the CO_2 emissions from electricity generated by PSE. Natural gas accounted for 38.0 percent of the electricity generated by PSE, however this fuel source represented only 30.2 percent of the CO_2 emissions from electricity generated by PSE. Renewable power accounted for 25.5 percent of the electricity generated by PSE, and produced zero CO_2 emissions.

Compared to 2017, total electricity delivered to customers in 2018 increased by 6.4 percent, and total emissions increased 9.3 percent. This trend is largely due to PSE purchasing and delivering more energy to customers from the spot market in response to better pricing as

described earlier. Energy delivered from PSE owned and firm resources were approximately the same as delivered in 2017. Emissions from unspecified sources increased because PSE made more spot market purchases in 2018 compared to 2017 and the emissions rate applied to spot market purchases increased based on the methodologies developed by Commerce and the UTC.

In 2018, firm deliveries decreased by 1.5percent and unspecified deliveries (i.e. spot market) increased by 47.1percent. Firm thermal purchases come from three contracted sources: BC Hydro, BPA, and Centralia ("Market & Coal"). Firm deliveries from BC Hydro, BPA, 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.

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 36.5 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 69.8 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 54percent 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.

2018 Summary of Total Energy Delivered, Total Emissions								
Source	MWh Total	MWh % of PSE All-owned Total	MWh % of PSE Thermal Only	MWh % of Total	Short Ton Total	Short Ton % of PSE All-owned Total	Short Ton % of PSE Thermal Only	Short Ton % of Total
PSE Owned Coal	4,084,896	36.5%	49.0%	18.4%	4,654,288	69.8%	69.8%	40.2%
PSE Owned Gas	4,244,938	38.0%	51.0%	19.1%	2,010,172	30.2%	30.2%	17.3%
PSE Owned Renewable	2,846,918	25.5%		12.8%	0	0.0%		0.0%
Firm Coal	2,067,688			9.3%	2,470,596			21.3%
Firm Renewable	3,967,673			17.9%	0			0.0%
Firm Unspecified	1,287,186			5.8%	628,393			5.4%
Unspecified	3,726,897			16.8%	1,825,150			15.7%
Total	22,226,197				11,588,599			
PSE Own plus Firm PPA	18,499,300				9,763,449			
Total PSE Only	11,176,753			50.3%	6,664,460			57.5%
Total Firm Only	7,322,547			32.9%	3,098,989			26.7%
Total Unspecified Only	3,726,897			16.8%	1,825,150			15.7%

Comparison to Previous Year

	2018					***2017***				
	Energy MWh	%	Emissions Short Ton	%	Intensity (lb/MWh)	Energy MWh	%	Emissions Short Ton	%	Intensity (lb/MWh)
PSE Owned Coal	4,084,896	18%	4,654,288	40%	2,279	4,463,705	21%	4,907,712	46%	2,199
Firm Coal	2,067,688	9%	2,470,596	21%	2,390	2,070,958	10%	2,449,181	23%	2,365
PSE Owned Gas	4,244,938	19%	2,010,172	17%	947	3,924,293	19%	1,906,147	18%	971
PSE Owned All Other	2,846,918	13%	0	0%	0	2,539,612	12%	0	0%	0
Firm All Other	5,254,859	24%	628,393	5%	239	5,365,707	26%	766,337	7%	286
Unspecified	3,726,897	17%	1,825,150	16%	979	2,534,323	12%	570,619	5%	450
PSE Owned Plus Firm PPA	18,499,300		9,763,449		1,056	18,364,275		10,029,376		1,092
PSE Owned	11,176,753	50%	6,664,460	58%	1,193	10,927,610	52%	6,813,858	64%	1,247
Firm	7,322,547	33%	3,098,989	27%	846	7,436,665	36%	3,215,518	30%	865
Unspecified	3,726,897	17%	1,825,150	16%	979	2,534,323	12%	570,619	5%	450
Total (Own, Firm Unspecified)	22,226,197		11,588,599		1,043	20,898,598		10,599,996		1,014

Comparison to Previous Year

	2018 v. 2017				
	Energy MWh	%	Emissions Short Ton	%	Intensity (lb/MWh)
PSE Owned Coal	-378,809	-8%	-253,424	-5%	80
Firm Coal	-3,270	0%	21,415	1%	24
PSE Owned Gas	320,645	8%	104,025	5%	-24
PSE Owned All Other	307,307	12%	0	0%	0
Firm All Other	-110,848	-2%	-137,944	-18%	-46
Unspecified	1,192,574	47%	1,254,531	220%	529
PSE Owned	249,143	2%	-149,399	-2%	-55
Firm	-114,118	-2%	-116,528	-4%	-18
Unspecified	1,192,574	47%	1,254,531	220%	529
Total (Own, Firm Unspecified)	1,327,599	6%	988,604	9%	28

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 2,390 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") 2018 system rate, which is 976 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 (2013-2017) 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 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.

	Skagit County, Washington	Pierce County, Washington	Island County, Washington	King County, Washington	Kitsap County, Washington	Kittitas County, Washington	Whatcom County, Washington	Thurston County, Washington
Families & Living Arrangements								
Households, 2013-2017	47,341	312,839	34,027	851,077	100,484	17,648	83,475	106,229
Persons per household, 2013-2017	2.53	2.64	2.3	2.45	2.51	2.34	2	3

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:
   - Apply net-by-counterparty calculus described in 3) above

2. For PSE units:
   - If end-of-year net (by plant) is greater than zero, then PSE was a net purchaser (from CAISO); assign Commerce rate. If end-of-year net (by plant) is less than zero, then PSE had excess generation.

- For excess generation from PSE units, will assign “zero” emission rate because emissions are accounted for under “Generation” (otherwise we’re double counting)