

**EXH. CD-4
DOCKETS UE-22 ___/UG-22 ___
2022 PSE GENERAL RATE CASE
WITNESS: DR. CHHANDITA DAS**

**BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION**

**WASHINGTON UTILITIES AND
TRANSPORTATION COMMISSION,**

Complainant,

v.

PUGET SOUND ENERGY,

Respondent.

**Docket UE-22 ___
Docket UG-22 ___**

**THIRD EXHIBIT (NONCONFIDENTIAL) TO THE
PREFILED DIRECT TESTIMONY OF**

DR. CHHANDITA DAS

ON BEHALF OF PUGET SOUND ENERGY

JANUARY 31, 2022

Class Hourly Load Profile for Net Meter Customers

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1 INTRODUCTION

1.1 Background

This document gives an overview of PSE’s net meter customers’ loads. At the end of June 2021 there were 9,752 active net meter device locations.¹ Most of these are Schedule 7 - residential (94%) followed by Schedule 8 & 24 - small general service (6%), as shown in Table I:

Table 1: Net Meter Customer Count by Rate Class

Rate Class	Population (Device Location Count)	Sample (Device Location Count)
8 & 24 (commercial)	583 (6%)	67
7	9139 (94%)	186
24 Industrial	2 (0.02%)	
25 (commercial)	27 (0.28%)	
29	1 (0.01%)	
Total	9,752	253

Table 2 shows the technologies used by these net meter customers to produce energy. As expected, most of the net meter customers are solar PV (99.5%); Wind, Hybrid: Solar and Micro-Hydro make up the remaining 0.5%. Further, only about 4% of these devices have batteries to store extra productions for consumption during non-generating hours.

Table 2: Generation Technology by Rate Class²

Rate Class	Hybrid: Solar	Micro Hydro	Solar PV	Wind	Total	Batteries
7	12	4	9,056	22	9,094	393
8 & 24 (commercial)	1	1	567	4	573	23
24 Industrial			2		2	
25 (commercial)	1	1	24		26	1
29			1		1	
Total	14	6	9,650	26	9,696	417

Based on the population counts and sampling coverages, this study estimates net meter load profiles for only Schedule 7 (residential) and Schedule 8 & 24 (small general service) – commercial class. The load profiles were estimated using the net meter customer sample, which was established via the sample design and deployment study performed in 2017.³ The data from the test year were used for these 2017 sampled units, which are still active. However, because the net meter customer population almost doubled since 2017, this study does not use the stratifications defined in the sample design. Rather, this study post-stratifies the sample based on the status of the current population and expand the sample based on the post-stratification class weights as described in the Load Research Report provided as Exh. CD-3.

Table 3 shows the breakdown of annual sales by customer types for Schedules 7 and 8 & 24 – commercial (C) class. PSE does not publish official billing data by different customer types; therefore,

¹ Since this analysis uses data from different sources, this count might be different from the number of net meter device locations registered with the PSE system.

² The generation technology information was not available for all customers hence this count is smaller than in Table 1.

³ The historical data analyzed and the statistical analyses and validation performed for 2017 sample design and selection are discussed in 2017 Net Meter Class Load Research Sample Design and Deployment report, which is submitted as Exh. CD-6.

this breakdown is calculated by determining the proportion of net meter and non-net meter customers' usage in the total estimated use and then applying such ratios to the actual official class billed total.⁴ The net meter customers account for less than 0.5% of all sales for residential customers and less than 0.05% for all commercial small general service customers' total sales.

Table 3: Population Count⁵ and Consumption⁶ by Net Meter Rate Class

Rate Class	No. of Accounts	Total Annual kWh Use	Avg. kWh use per account	% of Total kWh Sales
7 - Net Meter	9,105	54,894,856	6,029	0.40%
7 - Non-net Meter	1,044,922	11,216,505,662	10,734	81.25%
8 & 24 (Commercial) - Net Meter	578	5,537,837	9,581	0.04%
8 & 24 (Commercial) - Non-net Meter	125,965	2,527,404,941	20,064	18.31%
Total	1,180,570	13,804,343,296	11,693	100%

2 NET METER RATE CLASS LOAD PROFILES

2.1 Residential Class (Schedule 7)

Residential class load profile is the sum of net meter customers' hourly load profiles and non-net meter customers' hourly load profiles. Both types of load profiles were estimated using the same methodology as discussed in the Load Research Report (Exh. CD-3). As shown in Table 3, most of the residential class are non-net meter customers. Net meter customers make less than 1% of all residential customers. In this section PSE presents a detailed summary of the net-meter and non-net meter customers' loads.

Figure 1 below presents the hourly load profile for the non-net meter residential customers. The figure displays the EnergyPrint to the left of a more standard two-dimensional x-y plot. The vertical form of the EnergyPrint displays time on the x-axis, day of the year on the y-axis and the magnitude of the load on the z-axis. The magnitude of load is displayed as a color gradient with low levels of load in the black-blue spectrum and high levels of load in the yellow-white spectrum. Since most of the residential customers are non-net meter, the total non-net meter profile is very similar to the total class load with the dominance of the winter load and bi-modal peaks occurring in the morning and early evening periods.

⁴ Net meter and non-net meter customer classes are not separate tariff rate classes. They are treated as separate rate classes here only for analytical purpose.

⁵ "No. of Accounts" = average of monthly account counts for the test period ranging from July 2020 to June 2021.

⁶ "Total Annual kWh Use" = annual delivered energy sales (billed & unbilled) for the test period from July 2020 to June 2021.

Figure 1: Residential Class Non Net Meter Total Load

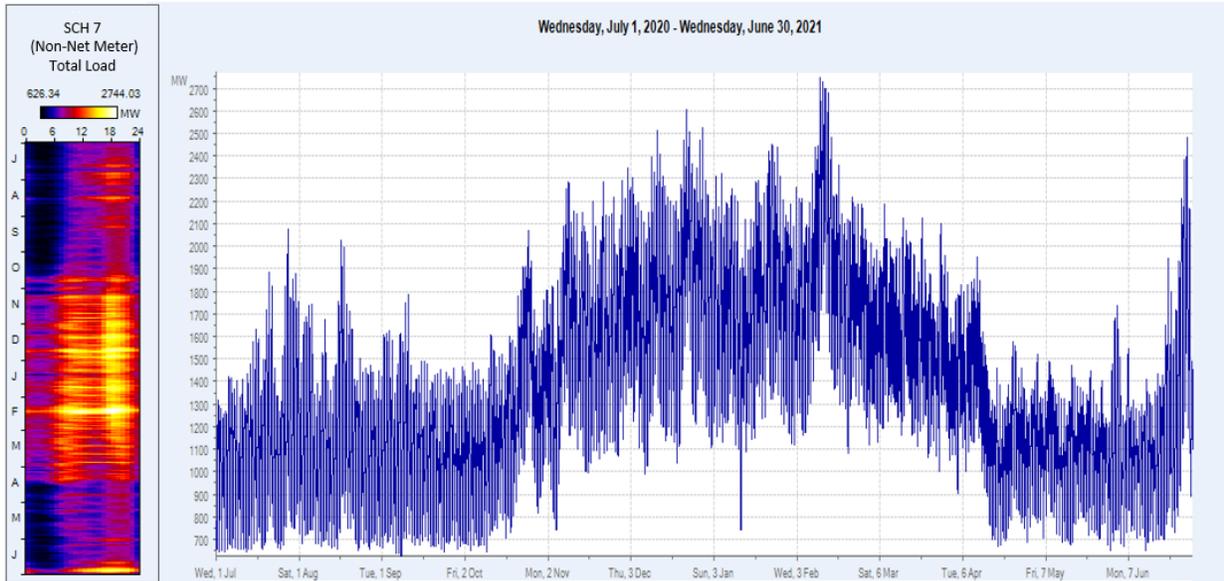


Figure 2 below presents the hourly load profile for the net meter residential customers. The higher negative load during the summer months are consistent with high productions in the warmer months.

Figure 2: Residential Class Net Meter Total Load

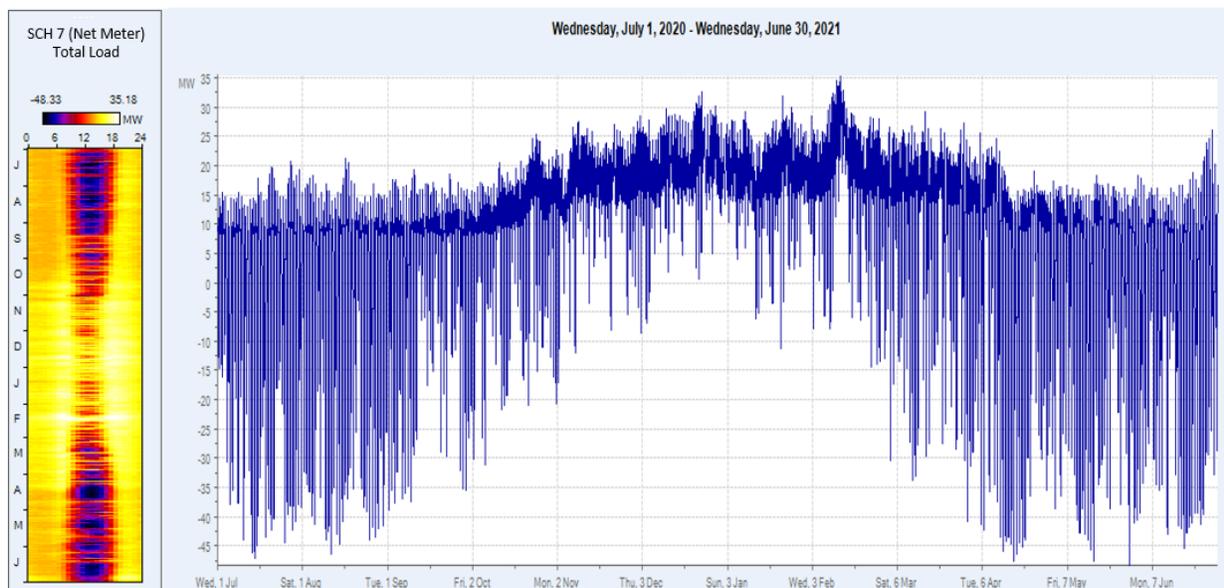


Table 4 below shows the monthly total load, average load, and average demand by customer types. The total monthly load for non-net meter customers varies from 775,589 MW in September 2020 to 1,324,034 MW in December 2020. The total monthly load for net meter customers varies from -456 MW in May 2021 to 14,331 MW in December 2020. The annual average load for a net meter customer is 6.9 MWH, about 60% of the non-net meter customers' annual average load of 11.6 MWH.

Table 4: Total Load Summary by Customer Types

Month	Non Net Meter Monthly Energy Use (kWh)	Net Meter Monthly Energy Use (kWh)	Non Net Meter Avg. Load (kWh)	Net Meter Avg. Load (kWh)	Non Net Meter Avg. Demand (kW)	Net Meter Avg. Demand (kW)
July-20	835,864,197	(1,607,964)	812	(176)	1,123,473	(2,161)
August-20	838,843,836	(1,471,566)	814	(161)	1,248,280	(2,190)
September-20	775,589,248	2,175,969	751	238	1,042,459	2,925
October-20	900,973,504	6,505,383	871	711	1,251,352	9,035
November-20	1,130,061,086	11,311,189	1,090	1,237	1,518,899	15,203
December-20	1,324,034,144	14,330,741	1,276	1,570	1,838,936	19,904
January-21	1,280,025,577	13,313,403	1,232	1,459	1,720,464	17,894
February-21	1,231,037,260	12,122,650	1,184	1,326	1,654,620	16,294
March-21	1,174,203,307	7,587,525	1,129	831	1,630,838	10,538
April-21	894,215,812	957,815	859	105	1,201,903	1,287
May-21	808,189,790	(456,446)	776	(50)	1,122,486	(634)
June-21	869,755,680	(1,027,118)	834	(112)	1,169,026	(1,381)
Annual	12,062,793,440	63,741,582	11,629	6,974	1,377,031	7,276

Table 5 below shows the demand at the system peak for both types of residential customers. Non-net meter customers' demand was 2,674.7 MW at the time of system peak on February 12, 2021 at 6 PM. The corresponding demand for net meter customers was 33.4 MW. At the monthly system peak, average demand for net meter customers are lower than the average demand for non-net meter customers during the summer months and higher during the winter months. In other words, an average net meter customer uses more energy than an average non-net meter customer during winter months, but during summer months when the generation picks up, their usages are lower.

The non-net meter peak demands are coincident to the system peak, with an annual average coincidence factor of 97%. On the other hand, the net meter customers' peak demands are fairly coincident to the system peak during winter months, but during the summer months coincident factors are close to zero or negative due to higher returned energy.

Table 5: Class Demand at System Peak by Customer Types

Date of System Peak	Time of System Peak	Non Net Meters Peak Demand (kW)	Net Meters Peak Demand (kW)	Non Net Meters Avg. Demand (kW)	Net Meters Avg. Demand (kW)	Non Net Meters Coincidence Factor	Net Meters Coincidence Factor
Monday, July 27, 2020	18:00	2,023,403	(2,587)	1.96	(0.28)	98%	-12%
Monday, August 17, 2020	18:00	1,978,674	106	1.92	0.01	98%	0%
Thursday, September 10, 2020	18:00	1,754,188	7,798	1.70	0.85	98%	40%
Monday, October 26, 2020	9:00	1,817,193	23,344	1.76	2.55	88%	92%
Monday, November 9, 2020	9:00	2,032,594	23,462	1.96	2.57	89%	85%
Wednesday, December 23, 2020	18:00	2,560,030	31,802	2.47	3.48	98%	97%
Tuesday, January 26, 2021	18:00	2,440,428	26,879	2.35	2.95	100%	84%
Friday, February 12, 2021	18:00	2,674,696	33,383	2.57	3.65	97%	95%
Tuesday, March 16, 2021	9:00	2,005,822	22,567	1.93	2.47	92%	77%
Monday, April 5, 2021	9:00	1,829,363	15,626	1.76	1.71	94%	61%
Friday, May 7, 2021	10:00	1,310,851	956	1.26	0.10	86%	5%
Monday, June 28, 2021	17:00	2,427,589	(5,625)	2.33	(0.61)	98%	-22%
		2,674,696	33,383	2.58	3.65	97%	94.9%

Table 6 below shows class peak demand, date, and time for both net meter and non-net meter customers. Non-net meter customer behavior is similar to the whole residential class with same class peak date and time. The residential non-net meter class peak and the total class peak occurred at 7 PM on February 11, 2021. The non-net meter class peak was 2,744 MW, which was 99% of the total class peak. Net meter customers' peak was on February 13, 2021 at 9 AM, with 35.1 MW net load.

Average non-coincident peak demand is higher for net meter customers than for non-net meter customers in all months, with annual average peak demand of 3.85 kW for net meter customers compared to 2.65 kW average peak demand for the non-net meter customers. During class peaks, net meter customers consume more energy on average than non-net meter customer.

Table 6: Class Peak Demand Summary by Customer Types

Non Net Meters				Net Meters			
Date of Class Peak	Time of Class Peak	Peak Demand (kW)	Avg. Peak Demand (kW)	Date of Class Peak	Time of Class Peak	Peak Demand (kW)	Avg. Peak Demand (kW)
Monday, July 27, 2020	19:00	2,075,273	2.02	July 27, 2020	21:00	20,740	2.27
Sunday, August 16, 2020	20:00	2,026,614	1.97	August 16, 2020	21:00	21,312	2.33
Thursday, September 10, 2020	19:00	1,786,128	1.73	September 10, 2020	20:00	19,369	2.12
Sunday, October 25, 2020	20:00	2,070,685	2.00	October 25, 2020	8:00	25,456	2.78
Sunday, November 29, 2020	18:00	2,291,824	2.21	November 9, 2020	18:00	27,616	3.02
Wednesday, December 23, 2020	19:00	2,602,223	2.51	December 24, 2020	18:00	32,723	3.58
Sunday, January 24, 2021	19:00	2,450,797	2.36	January 23, 2021	8:00	32,005	3.51
Thursday, February 11, 2021	19:00	2,744,028	2.64	February 13, 2021	9:00	35,175	3.85
Sunday, March 7, 2021	19:00	2,185,320	2.10	March 16, 2021	8:00	29,229	3.20
Sunday, April 11, 2021	9:00	1,951,242	1.87	April 5, 2021	8:00	25,480	2.79
Monday, May 3, 2021	20:00	1,520,476	1.46	May 17, 2021	20:00	18,396	2.01
Monday, June 28, 2021	19:00	2,483,188	2.38	June 28, 2021	21:00	26,106	2.85
Annual		2,744,028	2.65	Annual		35,175	3.85

Table 7 below shows the date and time when the net meter customers' demand was at the minimum, indicating when the net meter customers were returning maximum energy to the grid. The minimum demand (maximum productions) times are mostly in the afternoon at 1 PM or 2 PM, which is expected because this is the time when the sun is typically at peak and production is at the maximum. As expected, the negative demands (net productions) are higher in the warmer months than in the winter months. The production pattern follows the sun exposure because most net meters in PSE jurisdiction are solar PVs. The class minimum demand date and timing do not coincide with system minimum date and timing, which is informative for system planning purposes. The residential net meter customers' minimum load was on May 29, 2021 at 2 PM with -48.3 MW of net load (returned load of 50.86 MW).

Table 7: Minimum Demand for Net Meter Customers

Date of Class Minimum	Time of Class Minimum	Minimum Demand (kW)	Avg. Minimum Demand (kW)	Date of System Minimum	Time of System Minimum
July 14, 2020	14:00	(46,999)	(5.14)	July 5, 2020	6:00
August 11, 2020	14:00	(46,306)	(5.06)	August 30, 2020	4:00
September 1, 2020	14:00	(38,939)	(4.26)	September 8, 2020	4:00
October 6, 2020	14:00	(31,101)	(3.40)	October 4, 2020	4:00
November 1, 2020	13:00	(20,819)	(2.28)	November 5, 2020	3:00
December 2, 2020	13:00	(8,649)	(0.95)	December 20, 2020	4:00
January 22, 2021	13:00	(11,291)	(1.24)	January 13, 2021	3:00
February 24, 2021	13:00	(14,390)	(1.57)	February 22, 2021	3:00
March 31, 2021	14:00	(40,936)	(4.48)	March 28, 2021	3:00
April 17, 2021	14:00	(47,547)	(5.21)	April 19, 2021	3:00
May 29, 2021	14:00	(48,329)	(5.29)	May 31, 2021	4:00
June 18, 2021	14:00	(45,311)	(4.95)	June 20, 2021	6:00
Annual		(48,329)	(5.29)		

2.2 Small General Service Class - Commercial (Schedule 8 & 24)

For Small General Service class, load profiles are estimated for the commercial (C) customers only. As Table I shows, for small general service - industrial class, there were only two locations with net meters; hence, not suitable for estimating separate net meter load profiles. On the other hand, Schedule 8 & 24 – commercial (C) class had a substantial number of device locations with net meters. Therefore, it was possible to estimate separate load profiles. This section discusses summary characteristics of the net-meter and non-net meter customers loads for commercial rate class.

Figure 3 below presents the hourly load profile for schedule 8 & 24 (C) non-net meter customers. The figure displays the EnergyPrint to the left of a more standard two-dimensional x-y plot. The vertical form of the EnergyPrint displays time on the x-axis, day of the year on the y-axis and the magnitude of the load on the z-axis. The magnitude of load is displayed as a color gradient with low levels of load in the black-blue spectrum and high levels of load in the yellow-white spectrum. Since most of the Schedule 8 & 24 customers are commercial customers (>99%), their load profile is very similar to the total class load with the dominance of the winter load and daily peaks occurring in the early to late mornings. The Schedule 8 & 24 (C) non-net meter class peak 542.3 MW occurred at 8 AM on February 10, 2021.

Figure 3: Small General Service (Commercial) Non-Net Meter Total Load

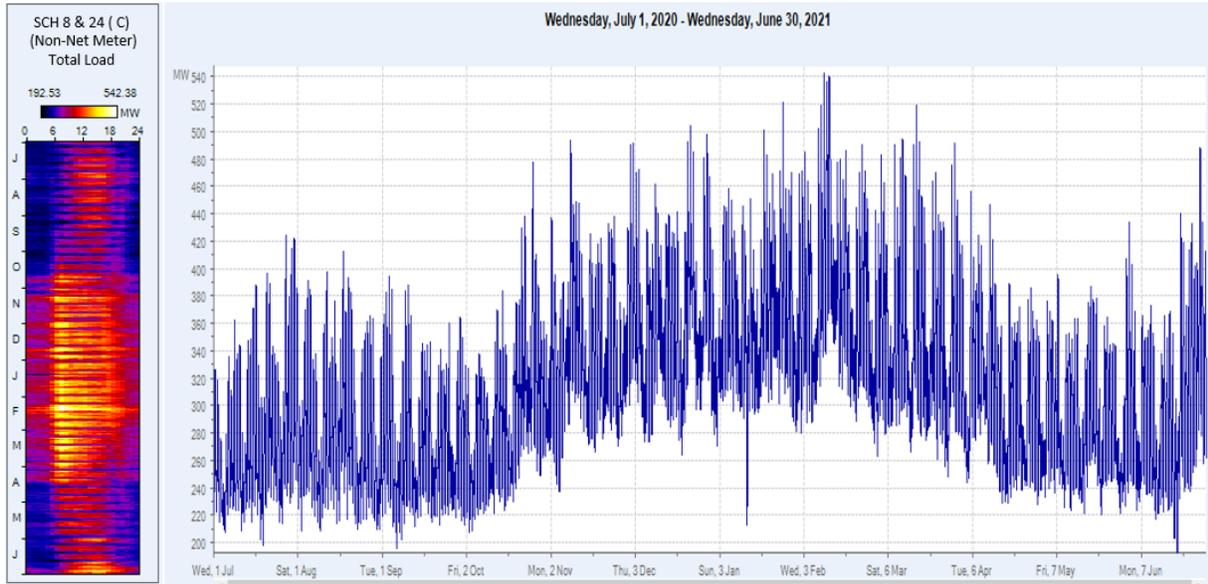


Figure 4 below presents the hourly load profile for schedule 8 & 24 (C) net meter customers. The higher negative load during the days of the summer months indicate higher productions for the warmer months.

Figure 4: Small General Service (Commercial) Net Meter Total Load

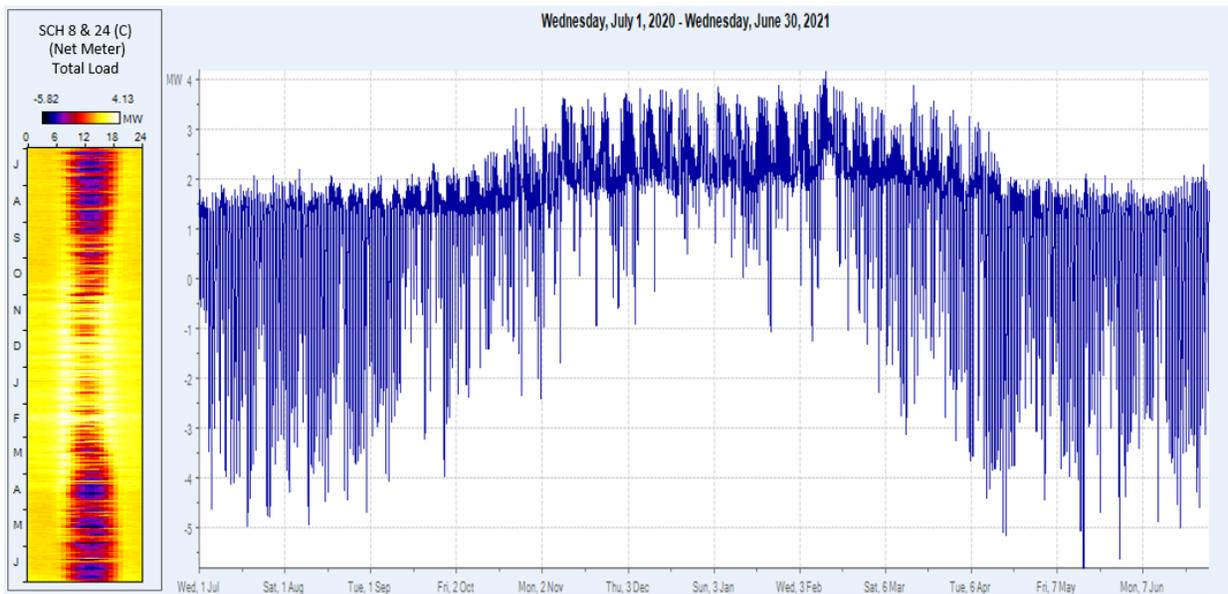


Table 8 below shows the monthly total load, average load, and average demand by customer types for Schedule 8 & 24 (C) class. The total monthly load for non-net meter customers varies from 192,554 MW in September 2020, to 267,181 MW in December 2020. The total monthly load for net meter customers varies from 49.2 MW in June 2021 to 1,735.6 MW in December 2020. The annual average load for a net meter customer is 16.5 MWH, about 72% of non-net meter customers' annual average load of 22.9 MWH.

Table 8: Total Load Summary by Customer Types

Month	Non Net Meter Monthly Energy Use (kWh)	Net Meter Monthly Energy Use (kWh)	Non Net Meter Avg. Load (kWh)	Net Meter Avg. Load (kWh)	Non Net Meter Avg. Demand (kW)	Net Meter Avg. Demand (kW)
July-20	204,095,719	67,408	1,716	116	274,322	91
August-20	204,612,562	119,846	1,718	207	304,483	178
September-20	192,554,725	517,365	1,613	895	258,810	695
October-20	215,277,526	958,097	1,803	1,658	298,997	1,331
November-20	242,311,127	1,437,065	2,027	2,478	325,687	1,932
December-20	267,181,647	1,735,575	2,233	3,013	371,086	2,411
January-21	265,648,225	1,649,776	2,219	2,849	357,054	2,217
February-21	251,515,483	1,510,373	2,096	2,613	338,058	2,030
March-21	255,129,607	1,083,298	2,124	1,871	354,347	1,505
April-21	218,331,689	324,059	1,814	559	293,457	436
May-21	211,504,872	94,522	1,754	163	293,757	131
June-21	214,209,348	49,231	1,776	85	287,916	66
Annual	2,742,372,529	9,546,615	22,895	16,488	313,056	1,090

Table 9 below shows the peak demand at the system peak for the both types of customers. Non-net meter customers' demand was 461.3 MW at the time of system peak on February 12, 2021 at 6 PM. The corresponding demand for net meter customers was 3.7 MW. Similar to residential customer class, at the system peak, average demand for the net meter customers is lower than the non-net meter customers during the summer months and higher during the winter months. That is, at the system peak, net meter customers use more energy than the non-net meter customers during winter months but less energy during warmer months, when generation is higher.

Coincidence factors are greater than 85% for all 12 months for the non-net meter customers. Net meter customers have a high coincidence factor during winter months, but during the summer the coincidence factors are almost zero or negative.

Table 9: Class Demand at System Peak by Customer Types

Date of System Peak	Time of System Peak	Non Net Meters Peak Demand (kW)	Net Meters Peak Demand (kW)	Non Net Meters Avg. Demand (kW)	Net Meters Avg. Demand (kW)	Non Net Meters Coincidence Factor	Net Meters Coincidence Factor
Monday, July 27, 2020	18:00	370,474	(274)	3.12	-0.47	87%	-13%
Monday, August 17, 2020	18:00	357,114	187	3.00	0.32	87%	9%
Thursday, September 10, 2020	18:00	348,309	1,062	2.92	1.84	88%	46%
Monday, October 26, 2020	9:00	477,204	3,434	4.00	5.94	100%	100%
Monday, November 9, 2020	9:00	474,188	3,265	3.97	5.63	96%	88%
Wednesday, December 23, 2020	18:00	423,807	3,207	3.54	5.57	84%	84%
Tuesday, January 26, 2021	18:00	400,549	3,405	3.35	5.88	77%	88%
Friday, February 12, 2021	18:00	461,327	3,729	3.85	6.45	85%	90%
Tuesday, March 16, 2021	9:00	497,861	3,104	4.14	5.36	96%	80%
Monday, April 5, 2021	9:00	441,910	2,275	3.67	3.92	97%	70%
Friday, May 7, 2021	10:00	370,863	589	3.08	1.02	94%	28%
Monday, June 28, 2021	17:00	488,157	(847)	4.05	-1.47	100%	-37%
		461,327	3,729	3.85	6.44	85%	90%

Table 10 below shows class peak demand, date, and time for both net meter and non-net meter customers. Non-net meter customer behavior is similar to the whole class with same class peak date and time. Non-net meter customer peak was on February 10, 2021 with 542.3 MW of load, which was 96% of total peak class load. Net meter customer peak was on February 12, 2021 at 9 AM with 4.1 MW of net load.

Average non-coincident peak demand for net meter customers is higher than non-net meter customers in almost all months except in June (2021) and July (2020). The annual average non-coincident peak demand for net meter customers is 7.15 kW, about 60% higher than the annual average peak demand of 4.52 kW for the non-net meter customers. Again, like the residential class, during class peaks net meter customers consume more energy on average than non-net meter customers.

Table 10: Class Peak Demand Summary by Customer Types

Non Net Meters				Net Meters			
Date of Class Peak	Time of Class Peak	Peak Demand (kW)	Avg. Peak Demand (kW)	Date of Class Peak	Time of Class Peak	Peak Demand (kW)	Avg. Peak Demand (kW)
Monday, July 27, 2020	14:00	424,456	3.57	July 27, 2020	21:00	2,053	3.53
Monday, August 17, 2020	16:00	412,309	3.46	August 6, 2020	9:00	2,180	3.76
Thursday, September 3, 2020	16:00	393,774	3.30	September 23, 2020	18:00	2,306	3.99
Monday, October 26, 2020	9:00	477,204	4.00	October 26, 2020	9:00	3,434	5.94
Monday, November 9, 2020	7:00	493,704	4.13	November 24, 2020	15:00	3,708	6.39
Wednesday, December 23, 2020	8:00	503,866	4.21	December 7, 2020	9:00	3,799	6.60
Tuesday, January 26, 2021	8:00	521,427	4.36	January 26, 2021	8:00	3,853	6.66
Wednesday, February 10, 2021	8:00	542,381	4.52	February 12, 2021	9:00	4,134	7.15
Tuesday, March 16, 2021	8:00	518,604	4.32	March 16, 2021	8:00	3,872	6.69
Monday, April 5, 2021	8:00	455,811	3.79	April 5, 2021	8:00	3,246	5.60
Friday, May 7, 2021	11:00	395,148	3.28	May 17, 2021	8:00	2,097	3.62
Monday, June 28, 2021	15:00	488,356	4.05	June 28, 2021	21:00	2,266	3.92
Annual		542,381	4.52	Annual		4,134	7.15

Table 11 below shows the date and time when the net meter customers' demand was at the minimum, indicating when the net meter customers returned maximum energy to the grid. The monthly minimum demand (maximum productions) times are mostly in the afternoon at 1 PM or 2 PM, which is expected because that is when the sun is typically at peak. As expected, the negative demands (net productions) are higher in the warmer months than in the winter months. The minimum net load was on May 16, 2021 at 2 PM, with -5.8 MW of net load with a returned energy of 6.03 MW. The date and time when the class load was at its minimum do not coincide with the minimum system demand date and time.

Table 11: Minimum Demand for Net Meter Customers

Date of Class Minimum	Time of Class Minimum	Minimum Demand (kW)	Avg. Minimum Demand (kW)	Date of System Minimum	Time of System Minimum
July 18, 2020	13:00	(4,986)	(8.57)	July 5, 2020	6:00
August 9, 2020	14:00	(4,960)	(8.55)	August 30, 2020	4:00
September 7, 2020	14:00	(4,069)	(7.04)	September 8, 2020	4:00
October 6, 2020	14:00	(2,377)	(4.11)	October 4, 2020	4:00
November 1, 2020	13:00	(2,423)	(4.18)	November 5, 2020	3:00
December 5, 2020	13:00	(916)	(1.59)	December 20, 2020	4:00
January 23, 2021	13:00	(1,060)	(1.83)	January 13, 2021	3:00
February 27, 2021	13:00	(1,311)	(2.27)	February 22, 2021	3:00
March 31, 2021	14:00	(3,264)	(5.64)	March 28, 2021	3:00
April 18, 2021	14:00	(5,162)	(8.90)	April 19, 2021	3:00
May 16, 2021	14:00	(5,822)	(10.04)	May 31, 2021	4:00
June 20, 2021	14:00	(5,018)	(8.68)	June 20, 2021	6:00
Annual		(5,822)	(10.04)		