SC 1 Rate IV Assessment

Bill Impacts and Potential Improvements

Consolidated Edison Company of New York

Case 22-E-0064

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I. Introduction

As agreed in the February 16, 2023 Joint Proposal in Case 22-E-0064, Consolidated Edison Company of New York, Inc. ("Con Edison" or the "Company") has completed an assessment of the demand-based rate SC1 Rate IV ("SC1R4" or "R4"). The Company conducted bill impact analyses for customers switching to SC1R4 from either the usage-based SC1 Rate I ("SC1R1" or "R1") or the time-of-use SC1 Rate III ("SC1R3" or "R3").

The following customer groups were included in the study: a control group (customers with no known ownership of end use technologies included in this assessment); customers who own an electric vehicle ("EV"); customers who have installed air-source heat pumps ("ASHP"); customers who have installed ground-source heat pumps ("GSHP"); and customers who have installed solar photovoltaic panels ("PV"). Customer groups that own each of these technologies have no other end-use technologies to the Company's knowledge.

The general finding in the study is that customers who can spread usage more evenly throughout the day (i.e., customers with higher load factors[1]) are most likely to benefit from switching to SC1R4. There is some positive correlation between load factors and usage—many high usage customers have higher load factors. Hence, high usage customers such as customers who have ground source heat pumps are also more likely to benefit from switching. Another insight gathered from the study is that PV customers under net metering are the least likely to benefit from the switch to SC1R4 due to the large fluctuation in billed usage throughout the day (i.e., lower load factors). The customer's ability to export power to the grid during the PV system's productive hours significantly reduces the customer's monthly kWh usage, but has little effect on the customer's kW demand.

Thus, the study finds that, on a 12-month average, the customer group with the greatest percentage of customers that saw bill savings with a switch from either R1 or R3 to R4 are heat pump customers. However, the percentage of savers is notably greater with a switch from R1 to R4 than the switch from R3 to R4. PV customers, on the other hand, have the smallest percentage of customers saving with the rate switch (either from R1 or R3) for a 12-month period.

Another result of the analysis is that the amount of savings with a switch to R4 from either R1 or R3 is dependent on the season. The greatest percentage of ASHP and GSHP customers (around 90% on average) save with a switch from R1 to R4 during the non-summer period (October through May). This percentage goes down considerably in the summer (June to September) to nearly half the non-summer levels. Meanwhile, except for PV customers, all groups in the samples have close to or over 90% of customers saving with a switch from R3 to R4 in the summer. The percentage of customers saving with this switch drops to near negligible levels in the non-summer period.

While this assessment does not make any rate design recommendations at this time, the information on bill impacts will be instrumental in future rate design discussions. At the end of the assessment, we discuss an alternative method of demand measurement and potential approaches to increase participation in R4 or demand-based rates in general.

[1] *Monthly Load Factor is defined as the customer's total usage for the month divided by the product of the peak demand for the month, the number of days in the month, and 24 hours per day. An average of monthly load factors is obtained by averaging the load factors of the relevant months (i.e. the 12-month average load factor is the average of monthly load factors for the 12 relevant months).*

II. Methodology

A. Analysis of Bill Impacts

The general approach to the bill impact analysis is to calculate the customers' average monthly bills under all three rate plans and see how the customer bill compares under SC1R4 relative to the other two rate plans. All rate components were considered in the analysis, including delivery, supply, and other[2] charges. The analysis also looked at supply and delivery bill impacts separately, as well as considered differences in seasonal bill impacts. For the seasonal bill impacts, the summer period was June through September and the non-summer period was October through May. The sampling methodology is discussed in further detail in the next section.

B. Overview of Sampling Methodology

Control Group. The Control group sample was obtained from customers included in the demand analysis study conducted for Case No. 19-E-0065. Customers that are known to own any of the end-use technologies included in this assessment are removed from the possible candidates to sample. The target sample size was 1,200 customers from all five boroughs of New York City (NYC)—Bronx, Brooklyn, Manhattan, Queens, and Staten Island—and from Westchester County. Due to missing data and other data quality issues, the sample size was reduced to 1,157.

End Use Technologies. Common among the residential customers sampled for each technology sub-group is that the customers have been known to adopt the technology and have AMI usage data for all 12 months of the relevant time frame (October 2022 through September 2023). Customers from all five boroughs of NYC and from Westchester County are included in the sample, unless otherwise stated. All non-PV customers that had zeroes in over 1% of the readings were excluded from the analyses. All PV customers that had zeroes in over 1% of the readings outside of the 10AM to 2PM time period—assumed to be the period when panels are most likely to generate enough to cause net usage to zero out—were excluded from the analysis. The following describes the sampling for each end-use technology sub-group.

EV Customers. Customers in this group have self-reported EV ownership. These customers most likely reported owning an EV to obtain the lower customer charge for SC1R3 in previous years (The lower customer charge for EV customers was removed effective August 2023). If customers do not report a change in ownership of the EV, they remain on record with the Company as owning EVs. Thus, the study only includes customers that have reported owning EVs from June 2020 through June 2022 to maximize the likelihood that these customers (1) still own the vehicles (assuming a 2-year lease for most vehicles) and (2) that they will have 12 months of AMI data. Customers who are known to own any other end use technology considered in this study were removed from the sample. This sample included 425 customers. Note that customer identification via self-reported ownership information creates concern in the analysis about selection bias. Given that a good portion of these customers voluntarily signed up for R3, these customers have potentially either adjusted their behavior to maximize the benefits of R3 or identified that R3 was favorable for them based on their consumption behavior.

[2] *For the purposes of this study, other charges include Billing, Payment, and Processing Charge; Systems Benefit Charges; Delivery Revenue Surcharge; Dynamic Load Management Surcharge; Value of Distributed Energy Resources Cost Recovery; Electric Vehicle Make Ready Surcharge; and Monthly Adjustment Clause.*

Heat Pump Customers. The customers in this sample are participants in the Company's Clean Heat Program and whose fossil fuel service was decommissioned. ASHP customers and GSHP customers were analyzed separately. Only Westchester customers were known to have GSHPs. Customers who are known to own any other end use technology considered in this study were removed from this sample. There were 1,220 customers included in the ASHP group and 18 customers included in the GSHP group.

PV Customers. Customers in this group are net metering customers that have PV panels installed for at least 12 months in the sample period. A random sample of customers within each borough was obtained to approximate the proportion of net metering customers. Customers who are known to own any other end use technology considered in this study were removed from the sample. This sample included 1,159 PV customers.

C. Bill Determinant Calculation

Relevant bill determinants in each of the rate classes in this study were calculated using actual customer usage data for the period beginning October 2022 and ending September 2023. All billing determinants were calculated consistent with the tariff. For SC1R4 this includes calculating daily demands on a rolling 60-minute basis using 15-minute interval data and obtaining monthly billable demands by averaging the top three daily demand observations for both peak and off-peak periods.

D. Bill Calculation

Delivery rates for all months used in the sample were calculated using the Rate Year 1 rates approved in Case No. 22-E-0065. A customer's supply rates are dependent on their location--NYC or Westchester (i.e., the two territories get different supply rates). Furthermore, while electric supply rates in practice vary on a billing cycle basis, the analysis assumes that all customers in the sample are on the same billing cycle—assumed to be the calendar month. Supply and all remaining rates are set at the actual rates that were in effect in the relevant period.

III. Summary Results

A. Total Bill Impacts

Table 1 provides an overview of the average monthly bill impacts based on 12 months of data for all customer groups in the study. On average, when customers switch from SC1R1 to SC1R4, over half of the customers in the Control, EV, ASHP, and GSHP will have no impact or decreased average monthly bills. GSHP customers have the greatest percentage of savers in the sample when switching from R1 to R4 at around 89%. The savers in the GSHP group have the highest average savings of $103 or 18% of the bill at SC1R1. Note also that GSHP customers have the highest average monthly usage among the customer groups at 1,942 kWh. In contrast, customers with PV have the smallest percentage of savers switching from R1 to R4 among the sample in each sub-group. Customers who own only PV had the lowest percentage of savers (~12%) and the lowest average monthly usage at 202 kWh. This is largely due to net metering, which results in a large reduction in total volumes, but only a small (if any) reduction in maximum demand.

Similarly, Control, ASHP, and GSHP customers have the highest percentage of savers switching from R3 to R4. EV customers, however, saw a considerable drop in the percentage of savers if switching from R3 to R4 compared to switching from R1 to R4 (see EV portion of Section II. B. on sampling methodology – most EV customers in the sample most likely reported EV ownership to the Company to confirm eligibility for the lower customer charge under R3 at the time). Across the board (except for the Control group), there would be a lower percentage of customers that will save if switching from R3 to R4 rather than switching from R1 to R4, with lower savings levels.

Table 1. Bill Impact Analysis Summary Results (12-Month Average)

End Use Technology	Control	EV	Air Source Heat Pump (ASHP)	Ground Source Heat Pump (GSHP)	PV
Sample Size	1157	425	1220	18	1159
Average Monthly Usage (kWh)	973	1108	867	1942	202
Percent of Customers with No Change or Decreased Bills from SC1R1 to SC1R4	58.3%	67.5%	80.1%	88.9%	12.3%
Percent of Customers with No Change or Decreased Bills from SC1R3 to SC1R4	63.4%	31.8%	65.5%	72.2%	8.3%
Average Monthly Bill SC1R1	$316	$344	$283	$564	$103
Average Monthly Bill SC1R3	$318	$305	$261	$525	$96
Average Monthly Bill SC1R4	$274	$317	$244	$469	$145
Average Monthly Savings SC1R1 to SC1R4*	$48 (15%)	$36 (10%)	$41 (14%)	$103 (18%)	$6 (6%)
Average Monthly Savings SC1R3 to SC1R4*	$50 (16%)	$14 (5%)	$23 (9%)	$68 (13%)	$4 (4%)
Average Monthly Increase SC1R1 to SC1R4**	$7 (2%)	$9 (3%)	$3 (1%)	$8 (1%)	$47 (45%)
Average Monthly Increase SC1R3 to SC1R4**	$6 (2%)	$26 (9%)	$6 (2%)	$11 (2%)	$53 (55%)

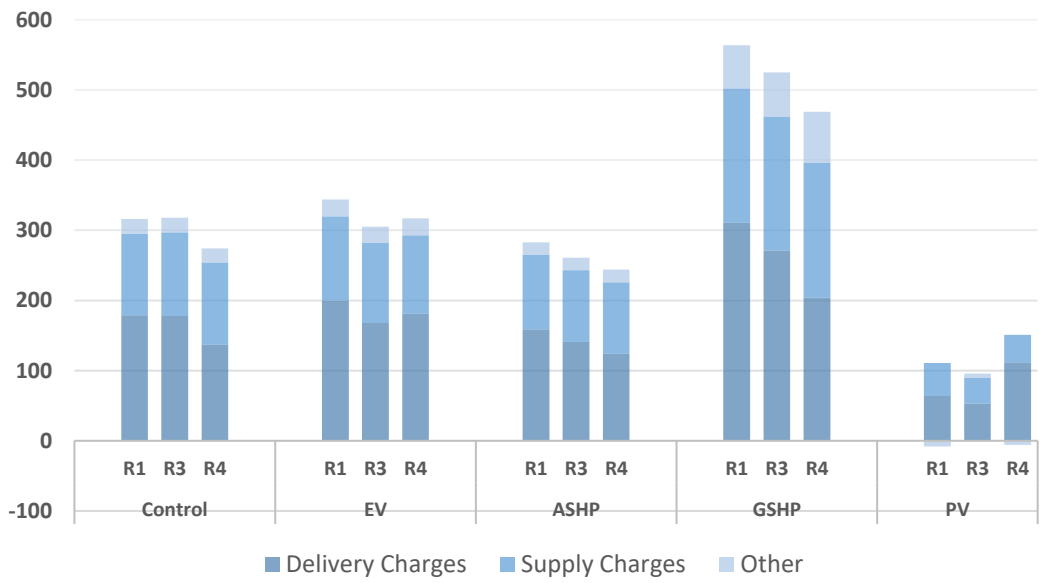
**For customers who showed average monthly bill savings.*

***For customers who showed average monthly bill increases*

Fig. 1 shows the composition of each customer group's average monthly bill priced out at R1, R3, and R4. It also shows the breakdown between delivery, supply, and other charges. On average, the total monthly bill is lowest on R4 for the Control, ASHP, and GSHP customers. The reduction in the bill is attributable to the reduction in average delivery charges. PV customers have the highest average bills on R4, again due primarily to poor

customer load factors which result in higher delivery charges on R4. Finally, EV customers experience a reduction in average monthly bill switching from R1 to R4, but have the lowest average bill on R3.

Figure 1. Average Monthly Bill Components ($) at Each Rate Class (12-Month Average)



The correlations in Table 2 below provide insights on the relationship between the 12-month average load factors (LF) and the percentage bill impacts of switching to R4 and between average monthly usage and these percentage bill impacts. For the most part, the customer groups with the greatest percentage of customers that would benefit from a switch to R4 from either R1 or R3 (Control, EV, ASHP, and GSHP), also had the greatest negative correlations between the 12-month average load factors and percentage bill impacts. That is, the higher that 12-month average load factor, the greater the average percentage savings. On the other hand, average monthly usage and percentage bill impact have a weaker negative correlation for most of the customer groups.

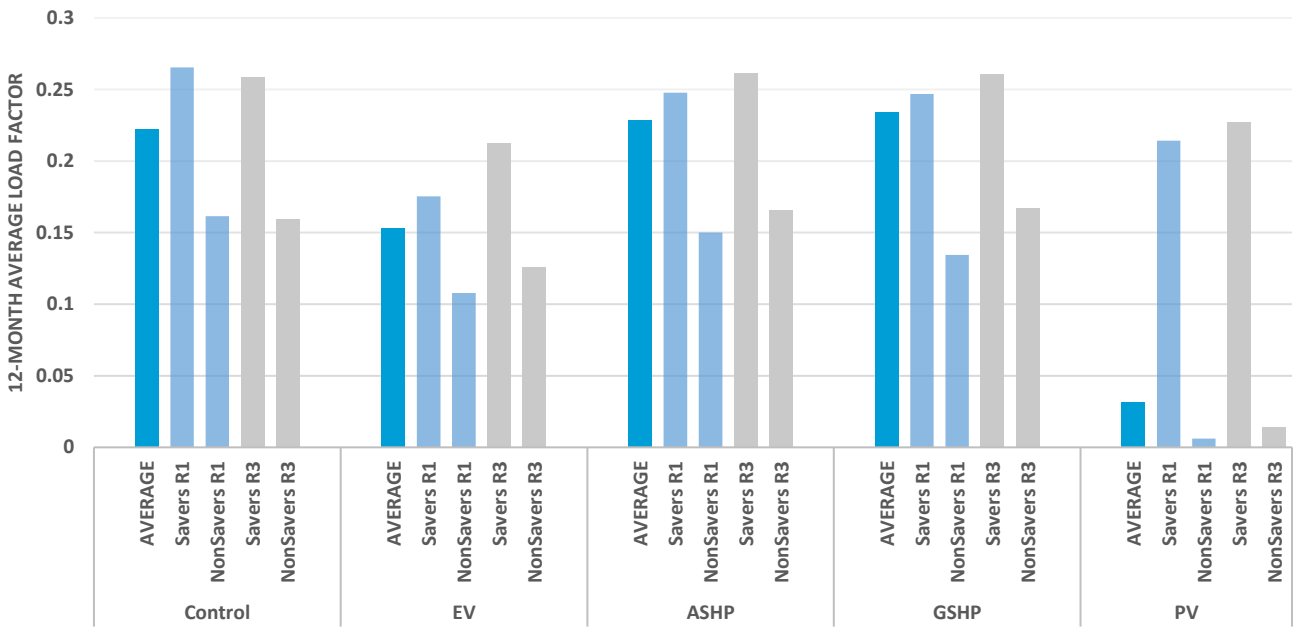
Table 2. Correlations: Load Factors, Usage, and Bill Impacts (12-Month Average)

	Control	EV	ASHP	GSHP	PV
Correlation - LF 12M Av & Bill Impact % R1 to R4	(0.81)	(0.65)	(0.77)	(0.83)	(0.55)
Correlation - LF 12M Av & Bill Impact % R3 to R4	(0.74)	(0.77)	(0.76)	(0.86)	(0.50)
Correlation - Av Monthly Usage & Bill Impact % R1 to R4	(0.33)	(0.49)	(0.57)	(0.44)	(0.61)
Correlation - Av Monthly Usage & Bill Impact % R3 to R4	(0.31)	(0.55)	(0.50)	(0.52)	(0.60)

Fig. 2 reinforces the observation that there is a correlation between customer load factors and bill savings when switching from either R1 or R3 to R4. For each customer group, the first bar shows the 12-month average monthly load factor for the entire customer group. The lighter blue bars show the average load factors for the R1 to R4 savers (those with reduced bills switching from R1 to R4) and for the R1 to R4 non-savers (those with increased bills switching from R1 to R4). The grey bars show the average load factors for the R3 to R4 savers and for the R3 to R4 non-savers. In general, savers in all customer groups have higher than average load factors and

the non-savers. Customers who own only heat pumps have the highest load factors. As noted above, they have the greatest percentage of customers that will save on their bills if they switch to R4.

Figure 2. Average 12-Month Load Factors Each Customer Group, the Savers, and NonSavers per Rate Class Switch



B. Summer Bill Impacts

Table 3 summarizes the average monthly bill impacts during the summer period (June through September) for all customer groups in the study. On average, there is a notable reduction in the percentage of customers that would save on their bills when switching from SC1R1 to SC1R4 in the summer compared to the 12-month average. GSHP customers still have the greatest percentage of savers in the sample at around 56% of the customers although notably lower than the 89% for the 12-month average. The savers in the GSHP group have the highest average savings of $68 or 13% of the bill at SC1R1. Note also that GSHP customers have the highest average monthly summer usage among the customer groups at 1,692 kWh. In contrast, customers with PV, have the smallest percentage of savers among the sample in each sub-group.

In the summer, Control, EV, ASHP, and GSHP customers see a jump in the percentage of savers from R3 to R4 compared to the 12-month average. This is to be expected due to R3's higher summer peak usage supply pricing due to recovery of capacity costs solely in summer peak periods (see Appendix on Rate Structures).

Table 3. Bill Impact Analysis Summary Results (Summer)

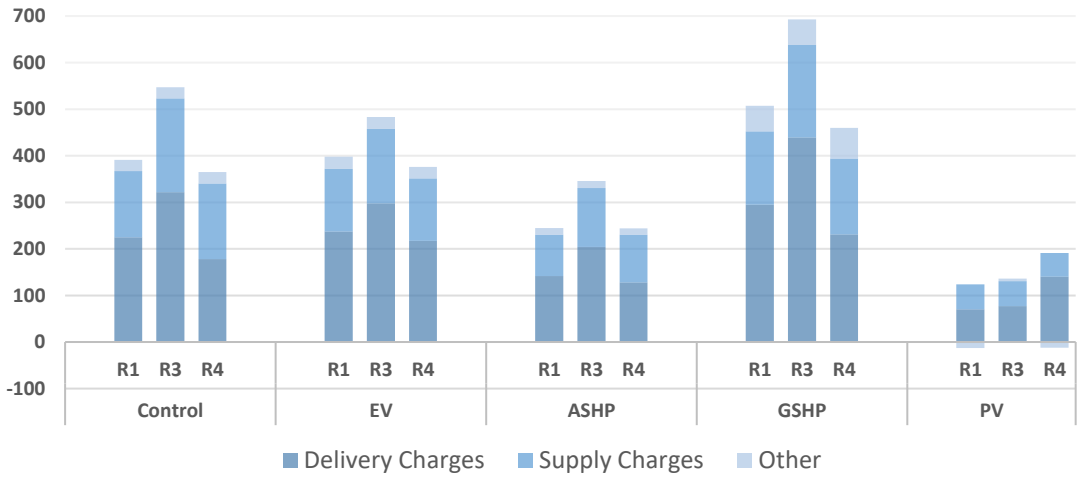
End Use Technology	Control	EV	ASHP	GSHP	PV
Sample Size	1157	425	1220	18	1159
Average Monthly Summer Usage (kWh)	1177	1251	714	1692	253
Percent of Customers with No Change or Decreased Summer Bills from SC1R1 to SC1R4	48.8%	58.1%	43.4%	55.6%	9.6%
Percent of Customers with No Change or Decreased Summer Bills from SC1R3 to SC1R4	94.1%	85.6%	94.7%	94.4%	20.0%
Average Monthly Summer Bill SC1R1	$391	$398	$245	$507	$111
Average Monthly Summer Bill SC1R3	$547	$483	$346	$693	$136
Average Monthly Summer Bill SC1R4	$365	$376	$244	$460	$179
Average Monthly Savings SC1R1 to SC1R4*	$42 (11%)	$38 (10%)	$13 (5%)	$68 (13%)	$5 (5%)
Average Monthly Savings SC1R3 to SC1R4*	$183 (33%)	$110 (23%)	$102 (29%)	$237 (34%)	$21 (15%)
Average Monthly Increase SC1R1 to SC1R4**	$15 (4%)	$17 (4%)	$13 (5%)	$21 (4%)	$73 (66%)
Average Monthly Increase SC1R3 to SC1R4**	$1 (0%)	$4 (1%)	$1 (0%)	$3 (0%)	$63 (46%)

**For customers who showed average monthly bill savings.*

***For customers who showed average monthly bill increases.*

Fig. 3 shows the composition of each customer group's average monthly summer bill under each rate (R1, R3, and R4). On average, the summer monthly bill is lowest on R4 for the Control, EV, ASHP, and GSHP customers. The reduction in the bill is largely attributable to the reduction in average delivery charges. PV customers have the highest average bills on R4 relative to their R1 or R3 bills, again due primarily to their lower load factors leading to a higher delivery portion of their bill under R4.

Figure 3. Average Monthly Bill Components ($) at Each Rate Class (Summer)



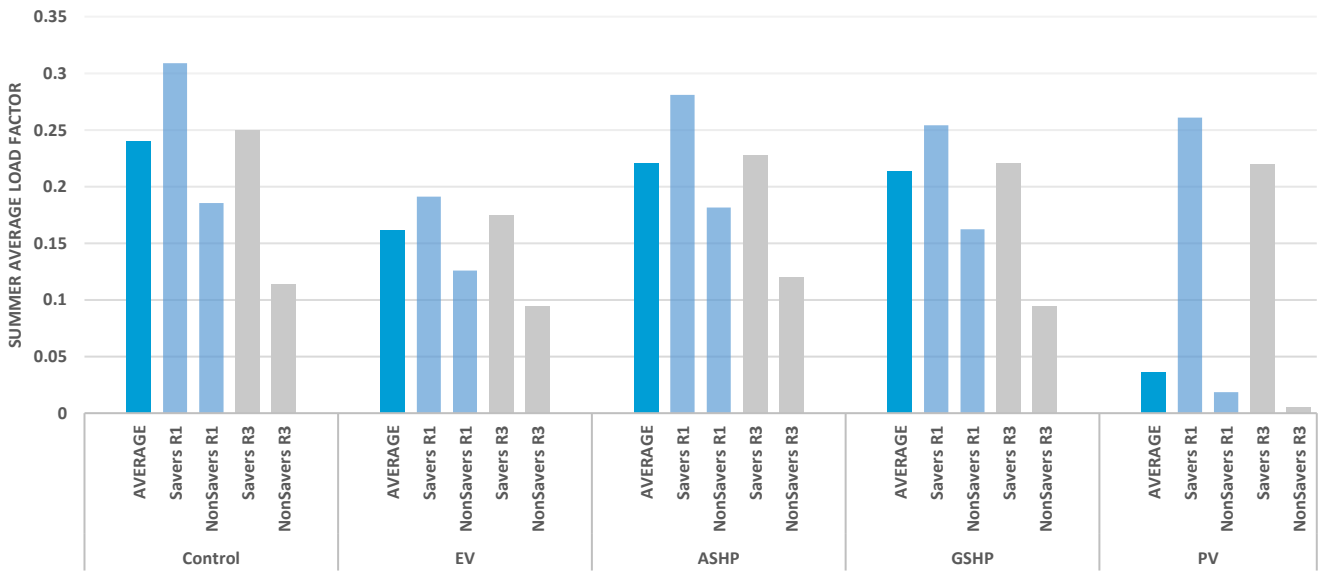
As Table 4 shows, during the summer period, the relatively larger negative correlations between load factors and the percentage bill impacts hold for Control, EV, ASHP, and GSHP customers, compared to the usage and percentage bill impact correlations. However, there is a general relative weakening in the negative correlations between the PV group's summer load factors and the percentage bill impacts, compared to the correlations between its 12-month average load factors and the percentage bill impacts. That is, there is a relatively stronger negative correlation in the summer between the PV group's usage and their percentage bill impacts.

Table 4. Correlations: Load Factors, Usage, and Bill Impacts (Summer)

	Control	EV	ASHP	GSHP	PV
Correlation - LF Summer Av & Bill Impact % R1 to R4	(0.80)	(0.59)	(0.73)	(0.83)	(0.40)
Correlation - LF Summer Av & Bill Impact % R3 to R4	(0.75)	(0.77)	(0.71)	(0.80)	(0.45)
Correlation - Av Monthly Summer Usage & Bill Impact % R1 to R4	(0.25)	(0.46)	(0.53)	(0.53)	(0.57)
Correlation - Av Monthly Summer Usage & Bill Impact % R3 to R4	(0.31)	(0.58)	(0.57)	(0.48)	(0.62)

Fig. 4 depicts the summer correlation between customer load factors and bill savings when switching from either R1 or R3 to R4. Consistently, savers in all customer groups in the summer also have higher than average load factors than the non-savers. In the summer, Control group customers have the highest load factors.

Figure 4. Average Summer Load Factors Each Customer Group, the Savers, and NonSavers per Rate Class Switch



C. Non-Summer Bill Impacts

For most of the customer groups, the percentage of non-summer savers switching from R1 to R4 increased relative to the percentage of savers over a 12-month period. On the contrary, customers switching from R3 to R4 in the non-summer period saw a significant drop in the percentage of savers. The level of savings was also reduced to near insignificant levels at 1% or less of their R3 bill. Fig. 5 does show that the average non-summer bill is lowest in R3 among all rate options across all customer groups.

Table 5. Bill Impact Analysis Summary Results (NonSummer)

End Use Technology	Control	EV	ASHP	GSHP	PV
Sample Size	1157	425	1220	18	1159
Average Monthly NonSummer Usage (kWh)	871	1037	944	2067	177
Percent of Customers with No Change or Decreased NonSummer Bills from SC1R1 to SC1R4	64.9%	69.2%	87.5%	94.4%	17.3%
Percent of Customers with No Change or Decreased NonSummer Bills from SC1R3 to SC1R4	3.7%	0.9%	8.7%	22.2%	1.6%
Average Monthly NonSummer Bill SC1R1	$278	$316	$302	$593	$100
Average Monthly NonSummer Bill SC1R3	$203	$216	$219	$441	$76
Average Monthly NonSummer Bill SC1R4	$229	$287	$244	$474	$128
Average Monthly Savings SC1R1 to SC1R4*	$54 (19%)	$38 (12%)	$60 (20%)	$125 (21%)	$8 (8%)
Average Monthly Savings SC1R3 to SC1R4*	$3 (1%)	$0 (0%)	$1 (0%)	$6 (1%)	$1 (1%)
Average Monthly Increase SC1R1 to SC1R4**	$5 (2%)	$8 (3%)	$2 (1%)	$6 (1%)	$37 (37%)
Average Monthly Increase SC1R3 to SC1R4**	$29 (14%)	$71 (33%)	$26 (12%)	$38 (9%)	$53 (70%)

**For customers who showed average monthly bill savings.*

***For customers who showed average monthly bill increases.*

Fig. 5 illustrates the breakdown among the charges in the average non-summer bill across rate classes and across customer groups. As mentioned above, R3 results in the lowest average bills across all customer groups in the non-summer period. Across the customer groups, the relative levels of the average bill are mostly attributable to the relative levels of delivery charges. In addition, however, the higher supply charges with R4 also contribute to the higher average R4 bill than the R3 bill for the Control, ASHP, and GSHP groups who have some of the highest average non-summer usage. The higher supply charges with R4 than with R3 are likely due to the lower peak supply pricing for R3 during the non-summer period.

Figure 5. Average Monthly Bill Components ($) at Each Rate Class (Non-Summer)

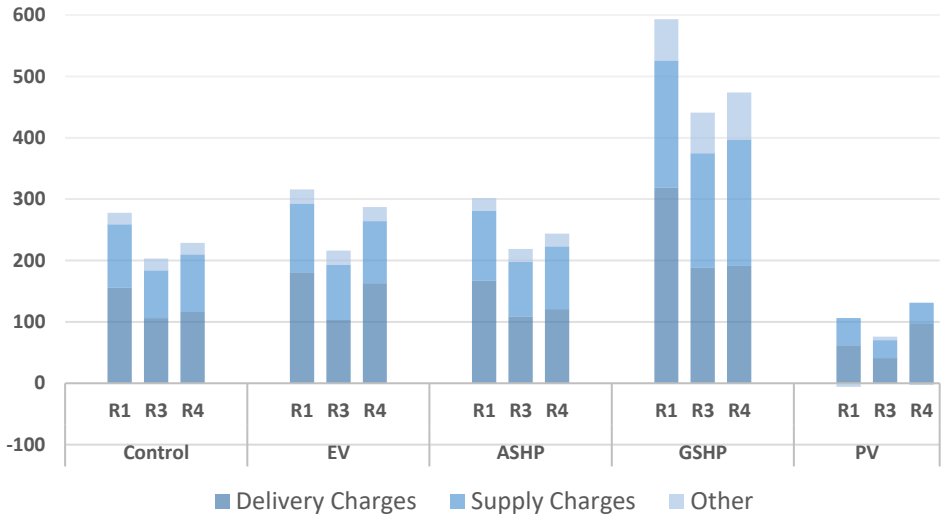


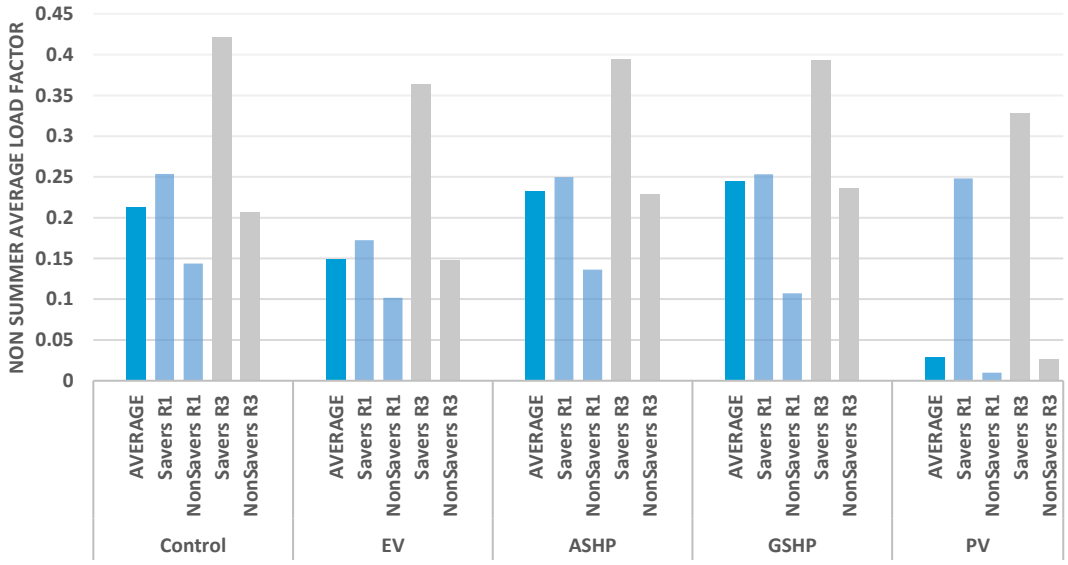
Table 6 shows that during the non-summer period, the relatively larger negative correlations between load factors and the percentage bill impacts hold for Control, EV, ASHP, and GSHP customers, compared to the usage and percentage bill impact correlations. Also, as in the summer, there is a relatively stronger negative correlation between the PV group's usage and their percentage bill impacts.

Table 6. Correlations: Load Factors, Usage, and Bill Impacts (Non-Summer)

	Control	EV	ASHP	GSHP	PV
Correlation - LF NonSummer Av & Bill Impact % R1 to R4	(0.81)	(0.67)	(0.80)	(0.78)	(0.47)
Correlation - LF NonSummer Av & Bill Impact % R3 to R4	(0.82)	(0.80)	(0.80)	(0.80)	(0.36)
Correlation - Av Monthly NonSummer Usage & Bill Impact % R1 to R4	(0.35)	(0.46)	(0.55)	(0.43)	(0.54)
Correlation - Av Monthly NonSummer Usage & Bill Impact % R3 to R4	(0.31)	(0.51)	(0.50)	(0.46)	(0.45)

Fig. 6 below shows a similar pattern of higher load factors in the non-summer for savers across the customer groups. Another notable observation from the chart, along with Table 5, is that despite the non-summer average load factors being only marginally different than the 12-month average load factors for the Control, ASHP, and GSHP savers with the switch from R1 to R4, the average monthly savings in the non-summer period are considerably higher than the 12-month average monthly savings. By contrast, a considerable increase in the load factor for the savers from the R3 to R4 switch in the non-summer compared to the switch in the 12-month average still results in negligible amounts of savings in the non-summer.

Figure 6. Average Non-Summer Load Factors Each Customer Group, the Savers, and NonSavers per Rate Class Switch



IV. Summary Results of Bill Impact Analysis: SC1 Rate I to SC1 Rate IV

Table 7 presents the breakdown of customer percentages that fall within dollar bill impact ranges when they switch from R1 to R4. For Control, EV, ASHP, and GSHP customer groups, the greatest percentage of these customers have savings between $20 and $100 a month on average and over half of these customers are either saving or not impacted by the rate switch on average.

PV customers, have the greatest percentage of customers experiencing increases of over $50 per month on average when they are switched over to R4 from R1.

Table 7. Percent of Customers in Group within Bill Impact Range ($) R1 to R4 (12-Month Average)

12-Month Average Bill Impacts of Switching from SC1R1 to SC1R4	Control	EV	ASHP	GSHP	PV
< ($100)	6.4%	10.6%	10.1%	38.9%	1.2%
($100) to ($50)	6.0%	14.8%	23.0%	27.8%	1.9%
($50) to ($20)	18.4%	22.6%	25.1%	16.7%	4.0%
($20) to ($5)	18.9%	13.9%	16.6%	0.0%	3.5%
($5) to $0	8.6%	5.6%	5.3%	5.6%	1.8%
$0 to $5	12.2%	4.7%	5.7%	0.0%	2.8%
$5 to $20	20.5%	11.8%	9.9%	5.6%	7.5%
$20 to $50	7.6%	10.8%	3.4%	0.0%	32.6%
$50 to $100	1.1%	3.5%	0.8%	0.0%	37.8%
> $100	0.3%	1.6%	0.1%	5.6%	6.9%

To provide information on the bill impacts relative to the size of customers' bills, Table 8 presents the impact ranges in terms of percent changes in the bill. In terms of percent bill impacts, GSHP customers have the greatest percentage savings on their bills with the switch from R1 to R4. The majority of GSHP customers have bill reductions of greater than 10% of their R1 bill. Meanwhile, the greatest percentage of customers saved between 10 and 20 percent of their R1 bills in the Control, EV, and ASHP groups. Also notable in the table is that a high percentage of PV customers have increases of over 20% of their R1 bill.

Table 8. Percent of Customers in Group within Bill Impact Range (%) R1 to R4 (12-Month Average)

12-Month Average Bill Impacts of Switching from SC1R1 to SC1R4	Control	EV	ASHP	GSHP	PV
< (20%)	8.6%	12.5%	20.2%	33.3%	2.7%
(20%) to (10%)	23.9%	25.2%	35.0%	44.4%	4.2%
(10%) to (5%)	13.1%	17.4%	14.3%	5.6%	2.2%
(5%) to 0%	12.9%	12.5%	10.6%	5.6%	3.2%
0% to 5%	12.9%	10.4%	7.5%	5.6%	4.1%
5% to 10%	8.7%	6.1%	3.8%	0.0%	3.2%
10% to 20%	10.5%	9.6%	5.2%	0.0%	5.3%
> 20%	9.5%	6.4%	3.4%	5.6%	75.0%

V. Summary Results of Bill Impact Analysis: SC1 Rate III to SC1 Rate IV

Table 9 presents the breakdown of customer percentages that fall within dollar bill impact ranges when they switch from R3 to R4. For Control, ASHP, and GSHP customer groups, the greatest percentage have savings between $20 and $100 per month on average, and over half of these customers have either no change or a reduction on their bills each month.

PV customers have the greatest percentage of customers whose bills increase by over $50 per month on average when they are switched over to R4 from R3.

Table 9. Percent of Customers in Group within Bill Impact Range ($) R3 to R4 (12-Month Average)

12-Month Average Bill Impacts of Switching from SC1R3 to SC1R4	Control	EV	ASHP	GSHP	PV
< ($100)	6.5%	3.8%	3.0%	22.2%	0.7%
($100) to ($50)	8.6%	6.4%	11.9%	27.8%	1.4%
($50) to ($20)	18.0%	10.1%	24.0%	22.2%	2.9%
($20) to ($5)	21.7%	8.5%	19.3%	0.0%	2.2%
($5) to $0	8.6%	3.1%	7.5%	0.0%	1.1%
$0 to $5	11.3%	4.7%	6.3%	5.6%	1.7%
$5 to $20	18.5%	12.9%	18.9%	5.6%	6.0%
$20 to $50	5.6%	31.8%	7.8%	11.1%	32.6%
$50 to $100	1.0%	16.2%	1.1%	0.0%	43.4%
> $100	0.3%	2.6%	0.3%	5.6%	8.0%

Table 10 shows the impact ranges in terms of percent changes in the bill, again to provide information on the bill impacts relative to the size of customers' bills. The greatest percentage of customers still saved between 10 and 20 percent of their R3 bills in the Control, ASHP, and GSHP groups. However, with the switch from R3 to R4, the percent bill savings seems to have been tempered compared to the percent bill savings with a switch from R1 to R4. Notice the significant reduction in the percentage of customers that save over 20% for EVs and both types of heat pumps customers compared to their levels in Table 8.

Table 10. Percent of Customers in Group within Bill Impact Range (%) R3 to R4 (12-Month Average)

12-Month Average Bill Impacts of Switching from SC1R3 to SC1R4	Control	EV	ASHP	GSHP	PV
< (20%)	9.9%	2.4%	3.0%	5.6%	1.5%
(20%) to (10%)	26.4%	9.9%	28.2%	38.9%	3.0%
(10%) to (5%)	14.6%	10.1%	18.8%	27.8%	1.6%
(5%) to 0%	12.4%	9.4%	15.5%	0.0%	2.2%
0% to 5%	11.7%	12.0%	10.3%	11.1%	2.9%
5% to 10%	6.7%	11.5%	9.9%	11.1%	2.4%
10% to 20%	10.6%	19.8%	8.5%	0.0%	5.2%
> 20%	7.6%	24.9%	5.7%	5.6%	81.2%

VI. Spotlight on Each Customer Group

VI.A. Control Group

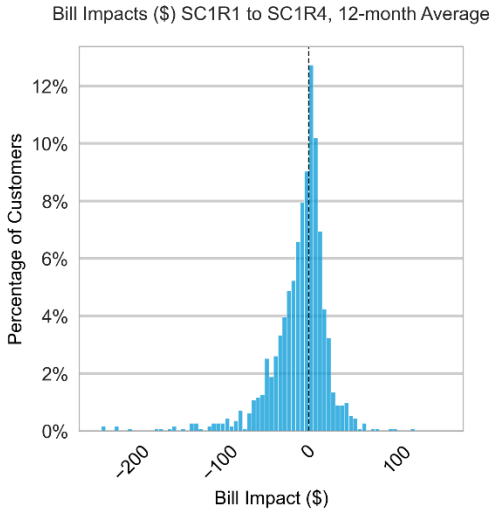
The Control group was a sample of 1,157 customers with an average monthly usage of 973 kWh. The smallest customer in the sample had an average monthly usage of 13 kWh and the largest customer had an average monthly usage of 24,731 kWh. The size diversity in this group of customers is expected due partly to the presence of religious customers in the residential service classification. The control group had a 12-month average monthly demand of 6.08 kW implied from their average load factors and average usage.

The average monthly usage in the summer for this customer group was 1,177 kWh. It is about 35% higher than the 871 kWh monthly average use in the non-summer period. The implied monthly demand in the summer is 6.8 kW. It is 20% higher than the 5.68 kW implied monthly average demand in the non-summer period.

VI.A.i. Bill Impacts – Control – SC1R1 to SC1R4

The figure below shows the percentage of Control group customers that fall within monthly average dollar bill impact ranges switching from R1 to R4 for the 12 months in the sample. The chart indicates that there is a greater percentage of customers that experienced a reduction in their average monthly bill based on 12 months in the sample. It also shows a left-skewed distribution: there is some percentage of customers that have average monthly savings that are greater than $100, while the increases in bills seem to have topped out at about $100 with a smaller percentage of customers.

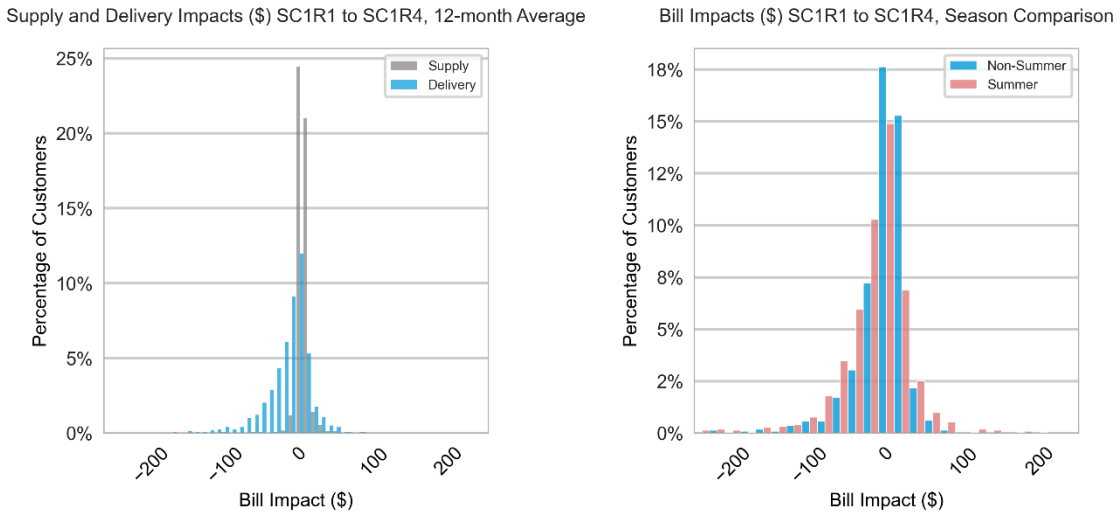
Figure 7. 12-Month Average Bill Impact (% and $) of Switching from R1 to R4 – Control



The left panel of Fig. 8 below shows the separate dollar impacts of delivery and supply charges with the switch between R1 and R4. The chart shows that most of the customers experienced a reduction in their average monthly bill mostly due to the reduction in delivery charges. On average, for the 12 months, most customers had very small supply charge impacts with the switch. Next, the panel on the right below shows the comparison

of the percentage of customers that fall within dollar bill impact ranges for the summer period and the non-summer period. For this group of customers, there is a slightly greater percentage of customers that benefit, on average, from switching to R4 in the non-summer period than in the summer.

Figure 8. Average Bill Impact ($) Composition (12-Month Average) and Seasonal Breakdown of Switching from R1 to R4– Control



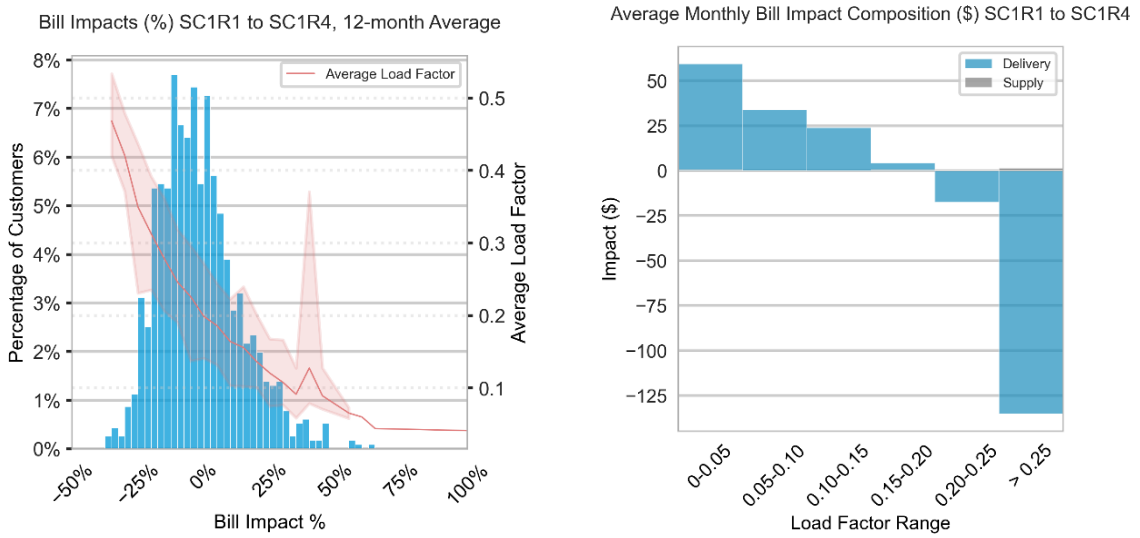
The charts in Fig. 9 illustrate the relationship between the average monthly load factors and the distribution of dollar bill impacts and the breakdown between delivery and supply impacts with the switch from R1 to R4. The left panel shows the percentage of customers that fall within the percentage bill impact ranges. This chart provides information on the magnitude of bill impact relative to the size of the customers' bills. The fact that this chart is skewed to the right (i.e., there is a small percentage of customers that have bill increases that are above 50% of their R1 bill, while the bill reductions seem to bottom out at about 38% of the R1 bill), while Fig. 7 above is skewed to the left indicates that there are is a small percentage of customers whose bills are relatively small but will disproportionately increase with the switch to R4.

The left panel also indicates, as expected, that customers with higher load factors (represented by the red line) are more likely to experience reduced bills with the switch. The pink area around the load factor line represents the 95% interval for the percentile ranges. For instance, customers who experienced no impact on average (0% bill impact) had an average monthly load factor of just above 0.2 (a point on the solid red line). The top of the pink band at 0% bill impact indicates that 97.5% of these customers had average monthly load factors that are less than 0.3 and the bottom of the pink band indicates that 2.5% of the customers who had 0% bill impact had average monthly load factors that are less than 0.15. The downward sloping red line indicates that on average, the higher a customer's load factor is, the more likely they are to have their bills reduced with a switch. However, the pink band's range indicates that a high load factor is not a guarantee that one would save changing over to R4. A notable example would be for customers that have increases of about 40% of their R1 bills, the top of the band is at a relatively high load factor of about 0.35.

For the Control group, on average, customers that have monthly load factors that are greater than 0.2 are more likely to save and customers with the largest monthly load factors also are more likely to see the highest percentage savings with a switch. In contrast, customers with average monthly load factors less than 0.2 are more likely to experience bill increases with the switch. They also have some of the largest increases in their bills. Next, the right panel of the figure illustrates the relationship between ranges of load factors and the

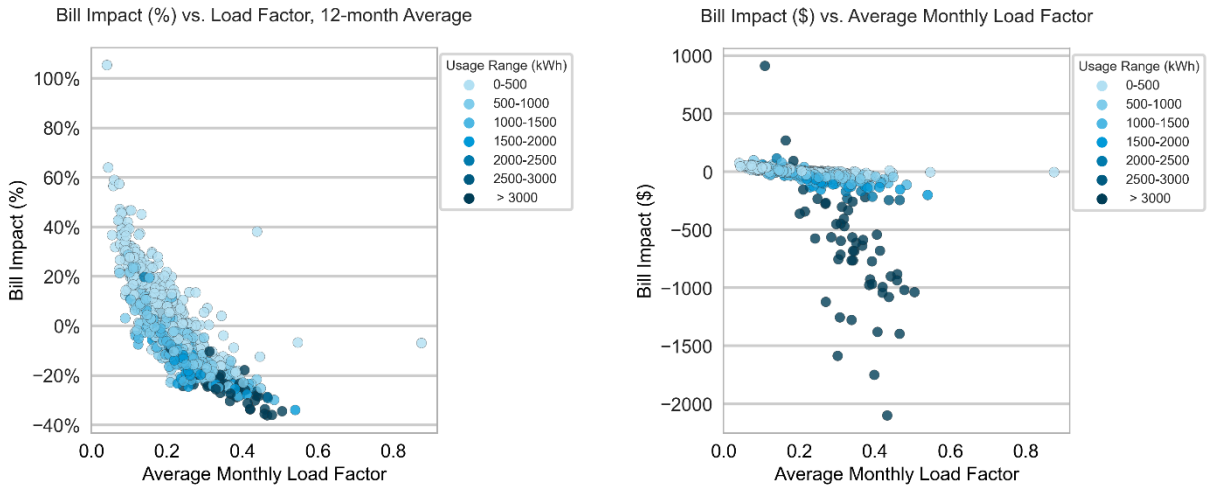
delivery vs. supply charge impacts. Since most of the bill impacts are actually attributable to the delivery charge impacts—supply charge impacts are negligible—it is not surprising to see that customers with load factors greater than 0.2 also saw the largest drops in their delivery charges by switching from R1 to R4.

Figure 9. Average Percentage Bill Impact Distribution (R1 to R4) and Composition Across Average Monthly Load Factor Ranges (12-Month Average) – Control



The charts in Fig. 10 demonstrate the relationship between average monthly load factors, average monthly usage, and bill impacts switching from R1 to R4. The left panel shows percentage bill impacts while the one on the right shows dollar bill impacts. Both charts show that there is some positive correlation (although not perfect) between load factors and usage levels. There is visibly a greater tendency to have more of the darker dots (high usage) towards higher load factors. However, there seems to be a stronger negative correlation between the load factor ranges and bill impacts than between the usage levels and bill impacts. There is a perceptible downward slope in the relationship between bill impact and average monthly load factor. However, while there is some trend where higher usage customers tend to experience bill reductions with the switch, that relationship is not as strong as evidenced by large customers, for instance, experiencing both spikes and drops in their average monthly bill. The left panel of Fig. 10 also reinforces the finding shown in Fig. 9 that customers who have, on average, load factors higher than the range 0.15 through 0.3 are most likely to save on their bills on R4.

Figure 10. Relationships Among Bill Impacts (R1 to R4), Average Usage Ranges (kWh), and Average Monthly Load Factors (12-Month Average) – Control

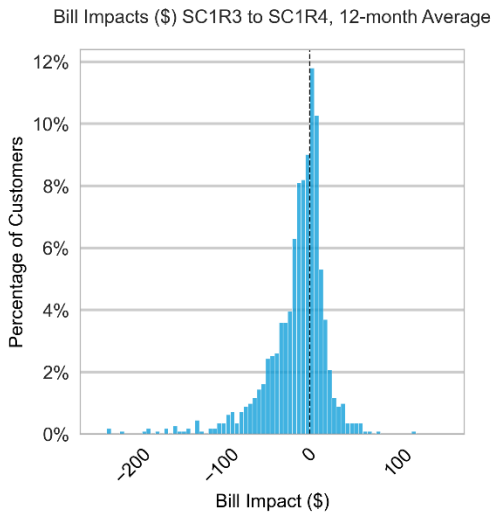


Bill Increase Outliers. Customers whose percentage bill increases are 3 standard deviations or more above the average percentage bill impact are considered outliers. For the Control group, there were 9 outliers who fall within this range--customers whose bill increases were greater than 45% of their SC1R1 bill. The average usage of these outliers was 221 kWh, 752 below the average monthly usage for the entire customer group. The average monthly load factor for the outliers based on 12-month data was notably lower at 0.07—0.15 (1.9 standard deviations) below the average monthly load factor for this entire customer group. To illustrate the difference between the average load curves of the outliers and the non-outliers, please see **Figure 47** in the Appendix.

VI.A.ii. Bill Impacts – Control – SC1R3 to SC1R4

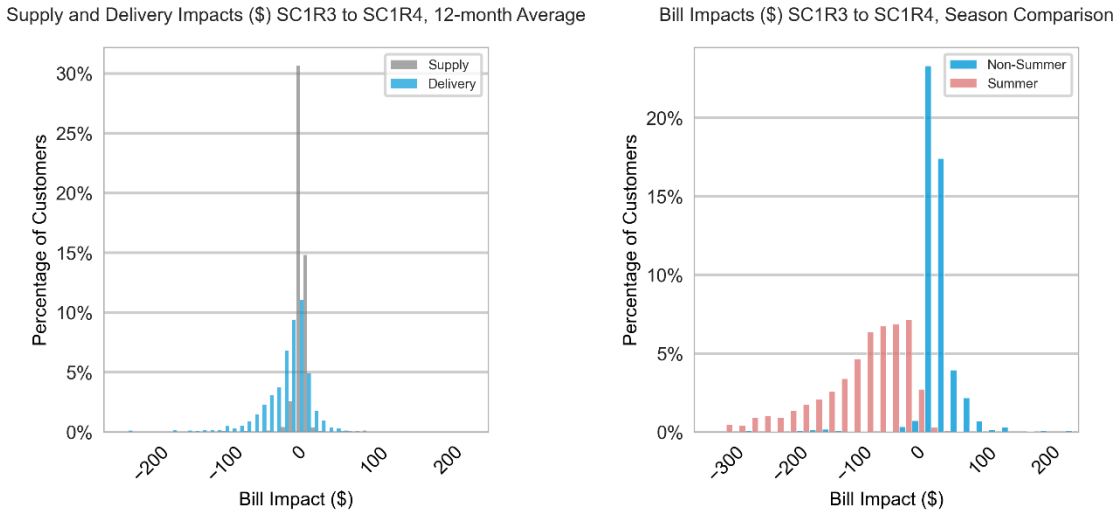
Fig. 11 below shows the percentage of Control group customers that fall within monthly average dollar bill impact ranges switching from R3 to R4 for the 12 months in the sample. The chart indicates that there is a greater percentage of customers that experienced a reduction in their average monthly bill based on 12 months in the sample. It also shows a left-skewed distribution: there is some percentage of customers that have average monthly savings that are greater than $100, while the increases in bills seem to have topped out at about $100 with a smaller percentage of customers.

Figure 11. 12-Month Average Bill Impact ($) of Switching from R3 to R4 – Control



The left panel of Fig. 12 below shows the separate dollar impacts of delivery and supply charges with the switch between R3 and R4. The chart shows that most of the customers experienced a reduction in their average monthly bill mostly due to the reduction in delivery charges. The greatest percentage of customers had zero impact in supply charges, on average. Next, the panel on the right below shows the comparison of the percentage of customers that fall within dollar bill impact ranges for the summer period and the non-summer period. For this group of customers, there is a significantly greater percentage of customers that benefit, on average, from switching from R3 to R4 in the summer than in the non-summer period. In fact, the majority of customers will experience savings in the summer, but will have their bills increase in the non-summer period if they switch from R3 to R4. Note again that R3 is a time-of-use rate with a considerable on-peak premium per kWh during the summer months relative to the non-summer period. This is due to the recovery of capacity costs solely in the summer peak period.

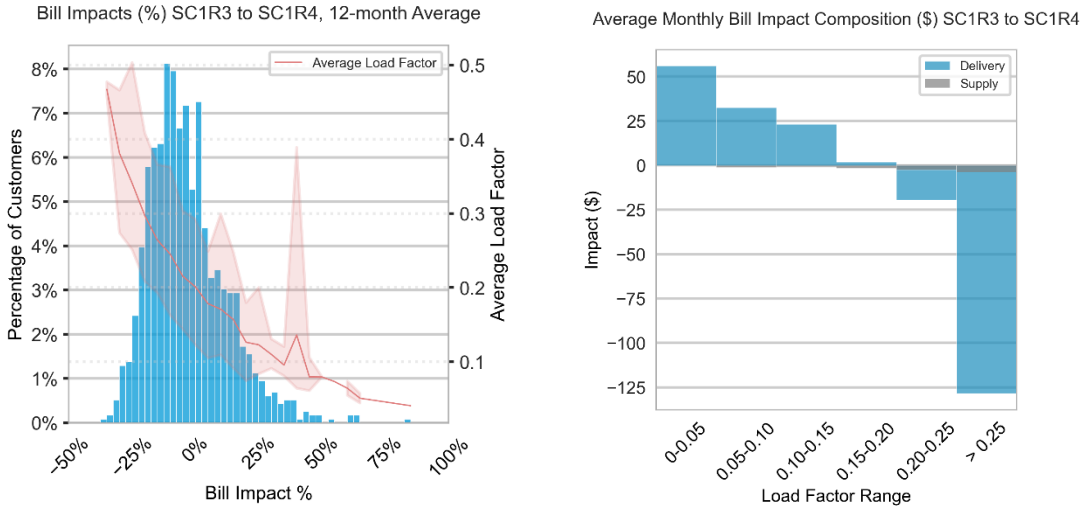
Figure 12. Average Bill Impact ($) Composition (12-Month Average) and Seasonal Breakdown of Switching from R3 to R4– Control



The left panel of Fig. 13 below shows that the majority of customers in the Control group will have percentage bill reductions when switching from R3 to R4. The percentage bill impact is also right skewed: there is a small percentage of customers whose bills increase by more than 50% of their R3 bills, while the largest reduction tops out at about 38% of the R3 bills. The chart also shows the negative correlation between average monthly load factor and percentage bill impact. Control group customers, on average, are more likely to have their bill reduced if their monthly average load factor is 0.2 or greater (the portion of the load factor line to the left of 0% bill impact). Those with the highest load factors are also more likely to experience the greatest percentage reductions in their bill compared to R3. The presence of the band, again, represents the 95% interval range for the average monthly load factor percentile. So, for instance, 97.5% of customers who had no change in their bills with the switch from R3 to R4 had load factors less than 0.3 and 2.5% of customers with no change in their bills had load factors less than 0.1.

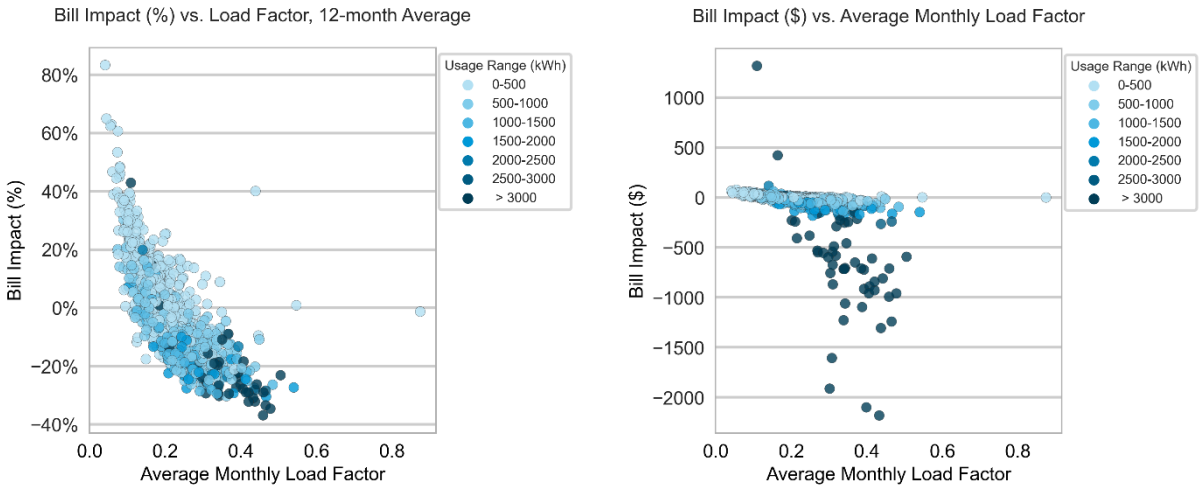
The right panel of Fig. 13 illustrates the relationship between the ranges of load factors and the delivery vs. supply charge impacts. Again, since delivery charge accounts for most of the bill impacts, it can be expected that customers with load factors greater than 0.2 saw the largest drops in their delivery charges by switching to R4. Although minimal, the savings in supply charges when they switch from R3 to R4 for customers with higher average load factors are slightly higher than for those with lower average load factors.

Figure 13. Average Percentage Bill Impact Distribution (R3 to R4) and Composition Across Average Monthly Load Factor Ranges (12-Month Average) – Control



Similar to the findings in R1 to R4 bill impacts, Fig. 14 shows there is a negative correlation between the R3 to R4 bill impact (in percent on the left panel, in dollars on the right panel) and average monthly load factor. Usage and bill impact also have a weaker negative correlation than the bill impact-load factor correlation as seen in the distribution of different usage range levels across all bill impact ranges. Fig. 14 (more obviously on the left panel) also reinforces the finding shown in Fig. 13 that customers who have, on average, load factors higher than the range 0.1 through 0.3 are most likely to save on their bills with a switch from R3 to R4.

Figure 14. Relationships Among Bill Impacts (R3 to R4), Average Usage Ranges (kWh), and Average Monthly Load Factors (12-Month Average) – Control



Bill Increase Outliers. Customers whose percentage bill increases are 3 standard deviations or more above the average percentage bill impact are considered outliers. For the Control group, there were 12 outliers who fall within this range--customers whose bill increases were greater than 43% of their SC1R3 bill. The average usage of these outliers was 243 kWh, 730 below the average monthly usage for the entire customer group. The average monthly load factor for the outliers based on 12-month data was notably lower at 0.07, 0.16 (2 standard deviations) below the average monthly load factor for this entire customer group. To illustrate the difference between the average load curves of the outliers and the non-outliers, please see **Figure 48** in the Appendix.

VI.B. Electric Vehicle Customers

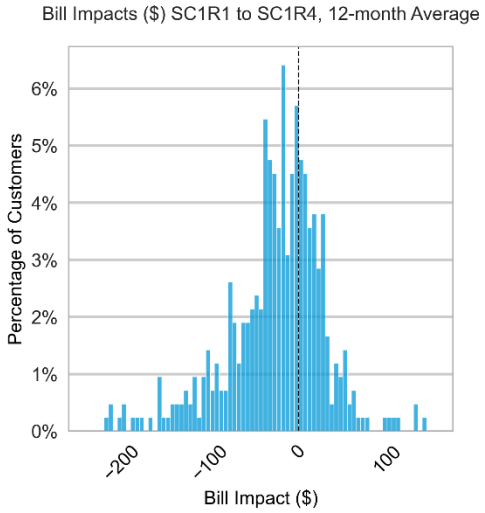
The EV group was a sample of 425 customers. The average monthly usage of the sample was 1,108 kWh, which is higher than the average monthly usage in the Control group. The smallest customer in the sample had an average monthly usage of 124 kWh and the largest customer had an average monthly usage of 3,863 kWh, which is a narrower range than the Control group. The EV customers had a 12-month implied average monthly demand of 10.04 kW.

The average monthly usage in the summer for this customer group was 1,251 kWh. It is about 21% higher than the monthly average use of 1,037 kWh in the non-summer period, less than the Control group's seasonal usage differential of 35%. The implied monthly demand in the summer is 10.75 kW. It is 11% higher than the implied monthly average demand of 9.65 kW in the non-summer period.

VI.B.i. Bill Impacts – EV – SC1R1 to SC1R4

For the EV group, 67.5% of customers saved on their bills switching from R1 to R4. Of those who had their bills reduced, average savings were roughly $36 or 10%. This is consistent with Fig. 15 below, which shows the majority of customers saw reduced bills switching from R1 to R4 with the distribution's greatest density being to the left of zero.

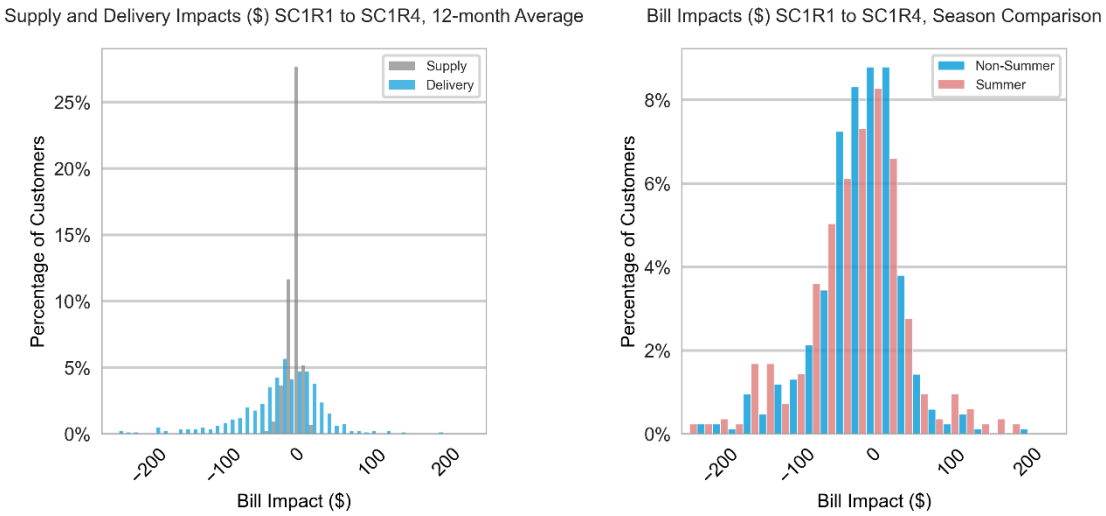
Figure 15. 12-Month Average Bill Impact ($) of Switching from R1 to R4 – EV



As shown in the left panel of Fig. 16 below, while switching from SC1 to SC4 implies changes to both supply and delivery costs for the EV group, the impact of the change in supply cost was much more modest than the change in delivery costs, consistent with findings in the control group. It is also apparent that a greater percentage of customers experience a reduction in delivery charges with the switch to R4.

Consistent with the control group and illustrated in the graph on the right of Fig. 16, neither R1 or R4 appears to be more beneficial for EV customers in one season over another.

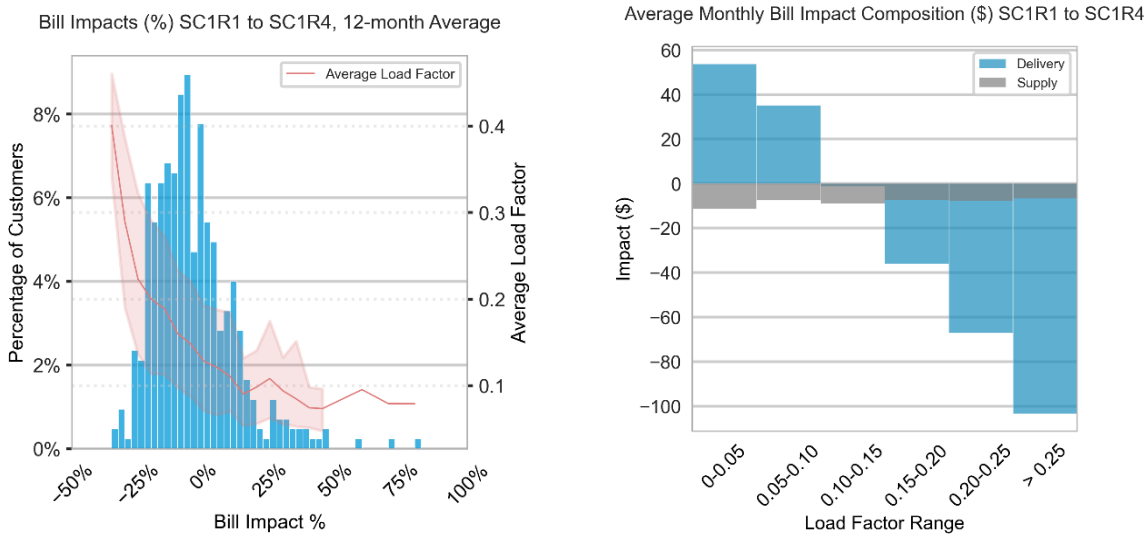
Figure 16. Average Bill Impact ($) Composition (12-Month Average) and Seasonal Breakdown of Switching from R1 to R4– EV



The left panel of Fig. 17 below shows that the majority of customers in the EV group will have percentage bill reductions from R1 to R4. The percentage bill impact is also right skewed: there is a small percentage of customers whose bills increase by more than 50% of their R1 bills, while the largest reduction is only about 38% of the R1 bills. The chart also shows the negative correlation between average monthly load factor and percentage bill impact, consistent with the findings in the Control group. EV customers, on average, are more likely to have their bill reduced if their monthly average load factor is ~0.15 or greater (the portion of the load factor line to the left of 0% bill impact). Those with the highest load factors are also more likely to experience the greatest percentage reductions in their bill compared to R1. The average load factor band shows that 97.5% of customers who had no change in their bills with the switch to R4 had load factors less than ~0.2 and 2.5% of customers with no change in their bills had load factors less than ~0.05. These load factor ranges are comparably lower than the load factor ranges for Control group customers. That is, EV customers have lower load factors associated with savings with a switch to R4 than the load factors for control group customers.

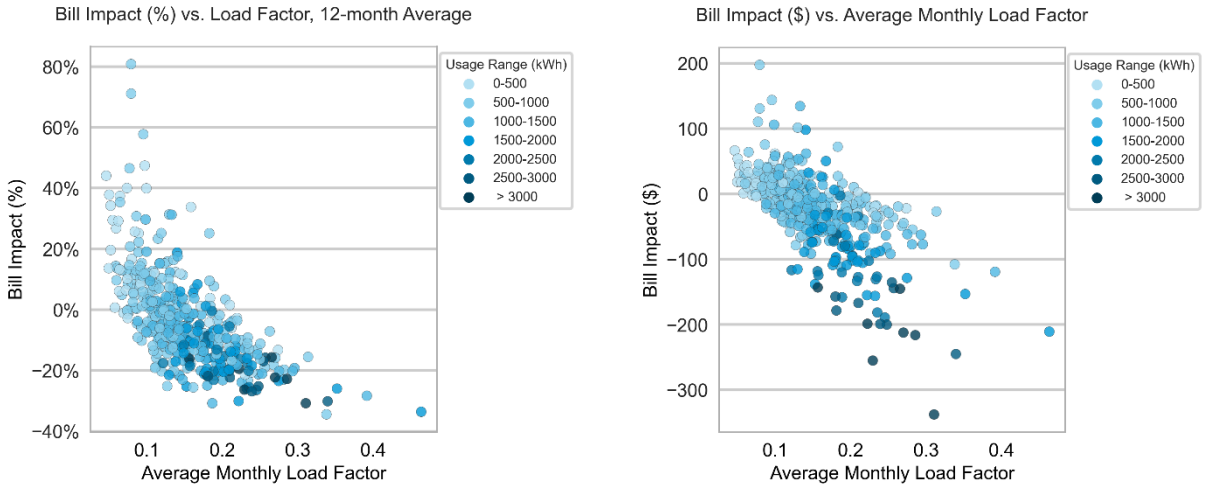
Moreover, the graph on the right of Fig. 17 shows the lack of savings in delivery charges to customers with low load factors with a switch to R4. It also shows how R4 supply costs are generally favorable over R1, regardless of load factor range.

Figure 17. Average Percentage Bill Impact Distribution (R1 to R4) and Composition Across Average Monthly Load Factor Ranges (12-Month Average) – EV



Similar to the control group findings, Fig. 18 shows there is a negative correlation between the bill impact (in percent on the left panel, in dollars on the right panel) and average monthly load factor. Usage and bill impact also have a weaker negative correlation than the bill impact-load factor correlation as shown by the different intensities of dot colors across all bill impact ranges.

Figure 18. Relationships Among Bill Impacts (R1 to R4), Average Usage Ranges (kWh), and Average Monthly Load Factors (12-Month Average) – EV

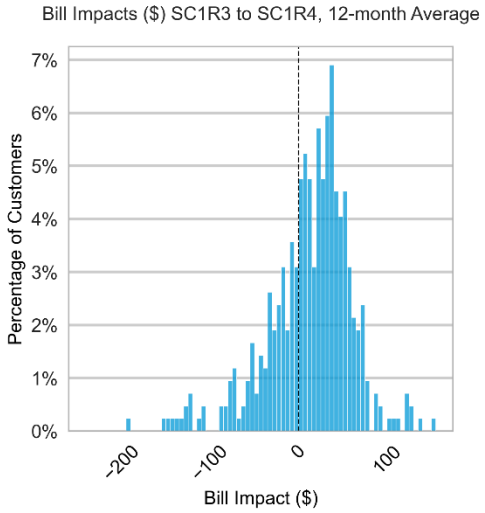


Bill Increase Outliers. Customers whose percentage bill increases are 3 standard deviations above the average percentage bill impact are considered outliers. For the EV group, there were 6 outliers who fall within this range--customers whose bill increases were greater than 43% of their SC1R1 bill. The average usage of these outliers was 604 kWh, 505 below the average monthly usage for the entire customer group. The average monthly load factor for the outliers based on 12-month data was notably lower at 0.08, 0.07 (1.2 standard deviations) below the average monthly load factor for this entire customer group.

VI.B.ii. Bill Impacts – EV – SC1R3 to SC1R4

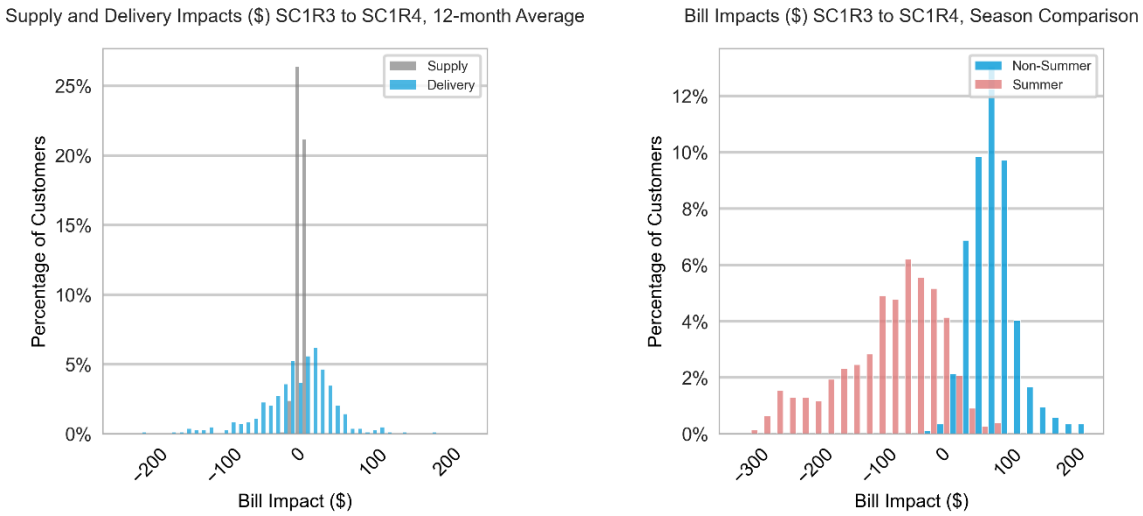
On average, only 31.8% of EV customers saved on their R4 bills compared to R3. For the remaining 68.2% of customers, the average monthly increase was about $26 or 9%. This is supported by Fig. 19 below which shows the greatest density of the distribution falls to the right of zero impact.

Figure 19. 12-Month Average Bill Impact ($) of Switching from R3 to R4 – EV



Similar to the findings in the control group, the change in supply costs for EV customers switching from R1 to R4 is much smaller than the change in delivery costs as the left panel of Fig. 20 shows. Majority of EV customers had supply charge impacts around zero (the bars are clustered around zero). On the other hand, the distribution of customers that experienced a change in delivery costs suggests an increase in the bill due to delivery charges for majority of EV customers on R4 compared to R3. Meanwhile, the right panel of Fig. 20 presents a substantial difference in the bill impacts switching from R3 to R4 based on the seasons. In the summer months, majority of EV customers save on R4 bills over R3. In contrast, during the non-summer months, majority of EV customers save on their bills on R4 versus R3. This is similar to the findings in the control group. Given that majority of these EV customers had higher bills overall on R4 than R3, the increases in the R4 bills in the non-summer months appear to outweigh the R4 bill savings in the summer months.

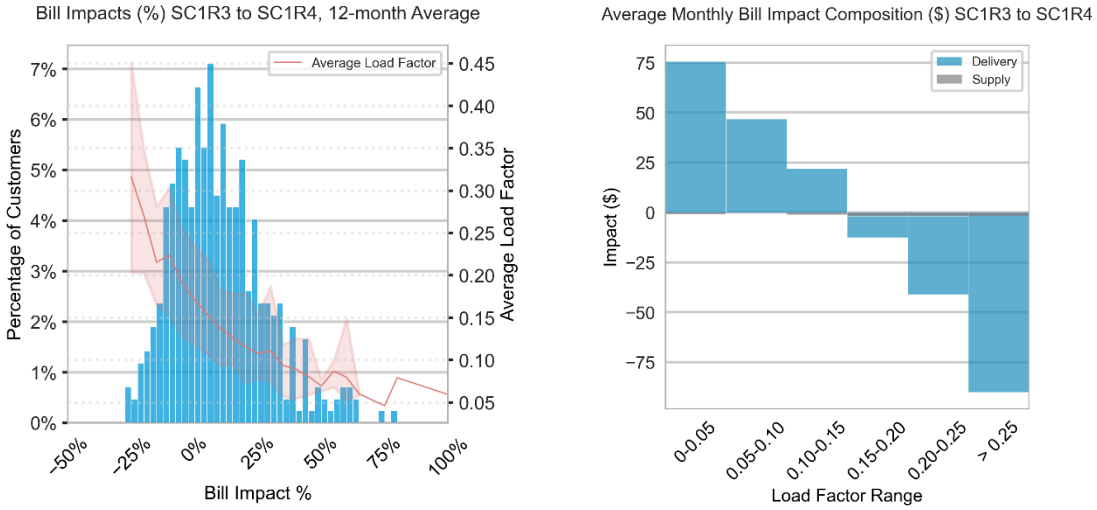
Figure 20. Average Bill Impact ($) Composition (12-Month Average) and Seasonal Breakdown of Switching from R3 to R4– EV



The left panel of Fig. 21 below shows that majority of the customers in the EV group will have percentage bill increases from R3 to R4. The percentage bill impact is also right skewed: there is a small percentage of customers whose bills increase by more than 50% of their R3 bills, while the largest reduction is only about 25% of the R3 bills. The chart also shows the negative correlation between average monthly load factor and percentage bill impact, consistent with the findings in the control group. EV customers, on average, are more likely to have their bill reduced if their monthly average load factor is ~0.17 or greater (the portion of the load factor line to the left of 0% bill impact). Those with the highest load factors are also more likely to experience the greatest percentage reductions in their bill compared to R3. The average load factor band shows that 97.5% of customers who had no change in their bills with the switch to R4 had load factors less than ~0.25 and 2.5% of customers with no change in their bills had load factors less than ~0.12. These load factor ranges are comparably lower than the load factor ranges for control group customers. That is, EV customers have lower load factors associated with savings with a switch to R4 than the load factors for control group customers.

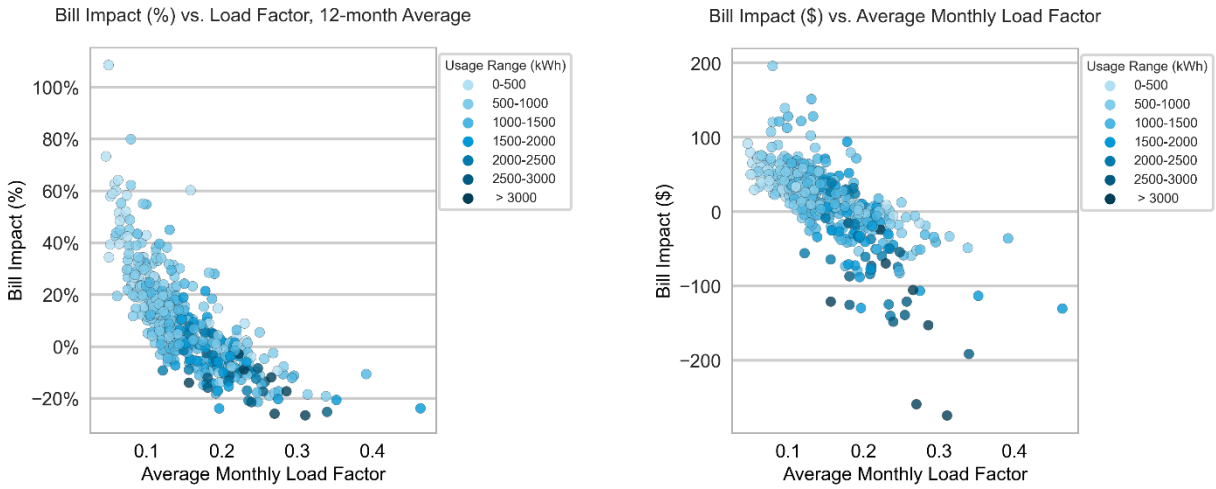
The graph on the right of Fig. 21 moreover stresses the lack of savings in delivery charges to customers with load factors less than 0.15 with a switch to R4. It also shows how R3 supply costs are minimally favorable over R4 for those with load factors higher than 0.15.

Figure 21. Average Percentage Bill Impact Distribution (R3 to R4) and Composition Across Average Monthly Load Factor Ranges (12-Month Average) – EV



Similar to the control group findings, Fig. 22 shows there is a negative correlation between the bill impact (in percent on the left panel, in dollars on the right panel) and average monthly load factor. Usage and bill impact also have a weaker negative correlation than the bill impact-load factor correlation as seen in the spattering of different usage range levels across all bill impact ranges.

Figure 22. Relationships Among Bill Impacts (R3 to R4), Average Usage Ranges (kWh), and Average Monthly Load Factors (12-Month Average) – EV



Customers whose percentage bill increases are 3 standard deviations above the average percentage bill impact are considered outliers. For the EV group, there were 3 outliers who fall within this range--customers whose bill increases were greater than 67% of their SC1R3 bill. The average usage of these outliers was 532 kWh, 577 below the average monthly usage for the entire customer group. The average monthly load factor for the outliers based on 12-month data was notably lower at 0.06, 0.09 (1.5 standard deviations) below the average monthly load factor for this entire customer group.

VI.C. ASHP Customers

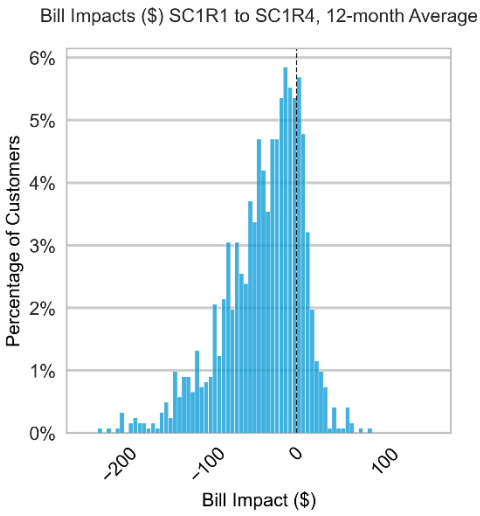
The ASHP group was a sample of 1,220. The average monthly usage of the sample was 867 kWh and their 12-month implied average monthly demand was 5.28 kW. The smallest customer had an average monthly usage of 52 kWh and the largest customer had an average monthly usage of 5,513 kWh.

The average monthly usage in the summer for this customer group was 714 kWh, which is about 24% lower than the monthly average use of 944 kWh in the non-summer period. The implied monthly demand in the summer is 4.49 kW. It is 21% lower than the implied monthly average demand of 5.65 kW in the non-summer period. As expected, heat pump customers have greater average usage in the non-summer period due to the heating requirement during these months.

VI.C.i. Bill Impacts – ASHP – SC1R1 to SC1R4

For the ASHP group, 80.1% of customers saved on their bills switching from R1 to R4. Of those who had their bills reduced, average savings were about $41 or 14%. This is consistent with Fig. 23 below, which shows that majority of customers saw bill savings switching from R1 to R4. Majority of customers are to the left of the no-impact line.

Figure 23. 12-Month Average Bill Impact ($) of Switching from R1 to R4 – ASHP

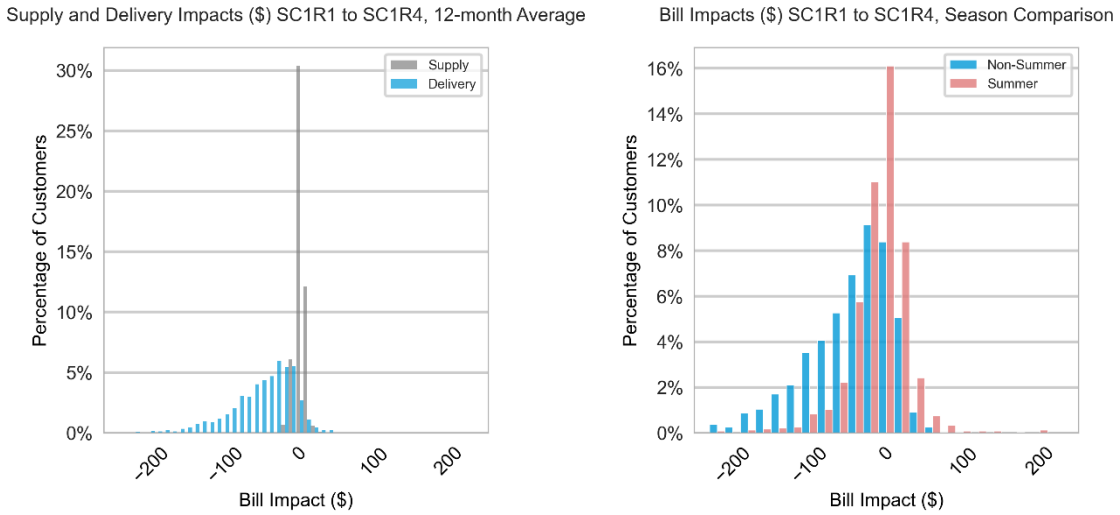


The left panel of Fig. 24 below shows that while switching from R1 to R4 implies changes to both supply and delivery costs, the impact of the change in supply cost was much more modest than the change in delivery costs. It is also apparent that a greater percentage of customers experience a reduction in delivery charges with the switch to R4. The chart implies that most of the change in total bill is attributable to the change in delivery charges.

Summer and non-summer differences were apparent as well. As shown in the right panel of Fig. 24, ASHP customers tended to see greater bill savings in R4 when compared to R1 in the non-summer months over the summer. A greater percentage of customers saved a greater amount in dollar terms in the non-summer months

as indicated by the blue bars going past $200 average monthly savings. A much smaller percentage of customers save at most $200 in the summer months, as shown by the orange bars.

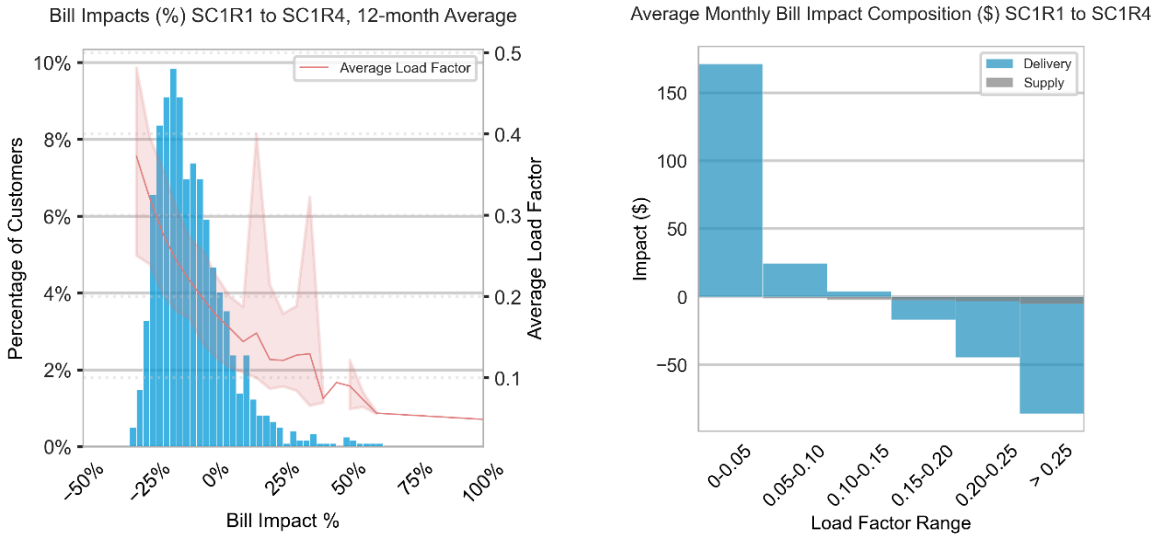
Figure 24. Average Bill Impact ($) Composition (12-Month Average) and Seasonal Breakdown of Switching from R1 to R4– ASHP



The left panel of Fig. 25 below shows that majority of the customers in the ASHP group will have percentage bill reductions from R1 to R4. The percentage bill impact is also right skewed: there is a small percentage of customers whose bills increase by more than 50% of their R1 bills, while the largest reduction is less than ~35% of the R1 bills. As expected, the left panel also suggests a negative correlation between load factor and the bill impacts from switching to R4. This is consistent with all the technologies. What is notable, however is the high percentage of customers that fall within the bill savings range (left of 0% bill impact) with a load factor greater than ~0.2 on average. The average load factor band shows that 97.5% of customers who had no change in their bills with the switch to R4 had load factors less than ~0.25 and 2.5% of customers with no change in their bills had load factors less than ~0.15. Again, of interest are the customers who see high percentage bill increases despite having high load factors. For instance, there are particularly tall load range bands around the 10% and around the 35% bill impact ranges.

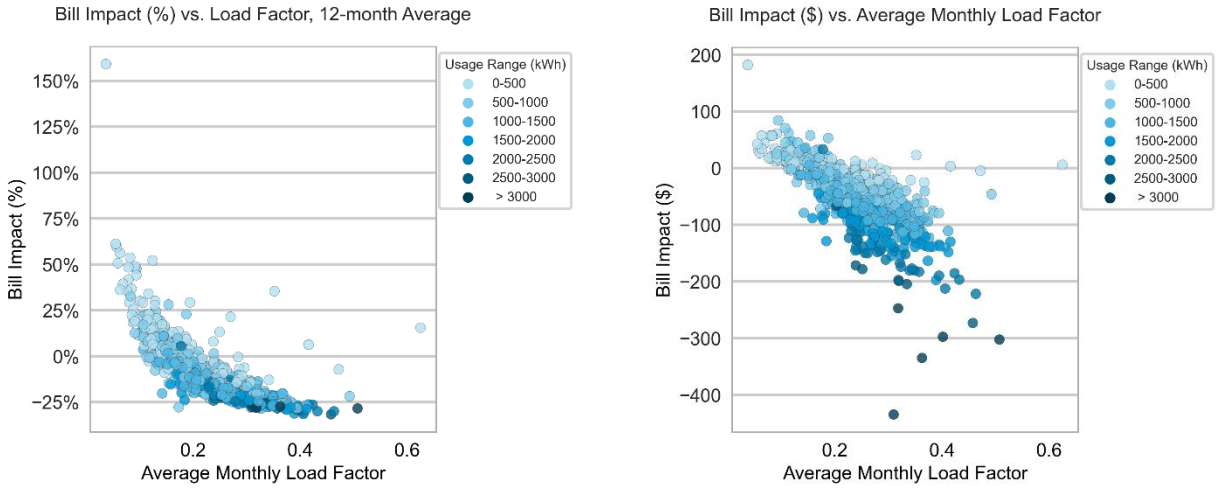
The graph on the right of Fig. 25 depicts the lack of savings in delivery charges to customers with low load factors with a switch to R4—customers with the lowest load factors experience the greatest increases in their delivery charges. It also shows how R4 supply costs are minimally favorable over R1 for those with average load factors greater than 0.15.

Figure 25. Average Percentage Bill Impact Distribution (R1 to R4) and Composition Across Average Monthly Load Factor Ranges (12-Month Average) – ASHP



Similar to the control group and EV findings, Fig. 26 shows there is a negative correlation between the bill impact (in percent on the left panel, in dollars on the right panel) and average monthly load factor. Consistent with the findings on the left panel of Fig. 25, most customers with average load factors greater than ~0.15 will fall below the zero-percent bill impact range. Usage and bill impact also have a weaker negative correlation than the bill impact-load factor correlation as seen in the spattering of different usage range levels across all bill impact ranges. There are actually smaller usage customers that saw bill reductions as long as they had relatively higher average load factors.

Figure 26. Relationships Among Bill Impacts (R1 to R4), Average Usage Ranges (kWh), and Average Monthly Load Factors (12-Month Average) – ASHP



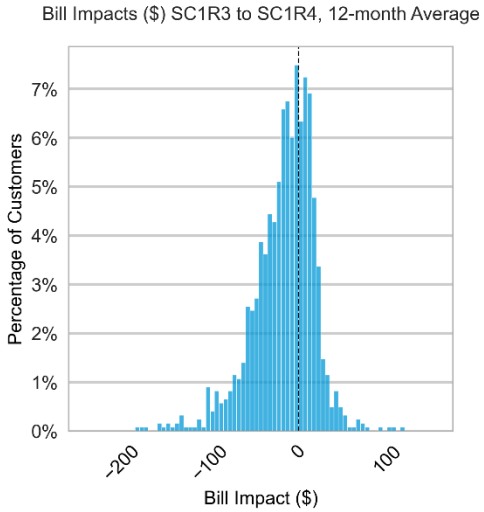
<u>*Bill Increase Outliers*</u>. Customers whose percentage bill increases are 3 standard deviations above the average percentage bill impact are considered outliers. For the ASHP group, there were 18 outliers who fall within this range--customers whose bill increases were greater than 33% of their SC1R1 bill. The average usage of these

outliers was 213 kWh, 655 below the average monthly usage for the entire customer group. The average monthly load factor for the outliers based on 12-month data was notably lower at 0.09, 0.13 (1.9 standard deviations) below the average monthly load factor for this entire customer group.

VI.C.ii. Bill Impacts – ASHP – SC1R3 to SC1R4

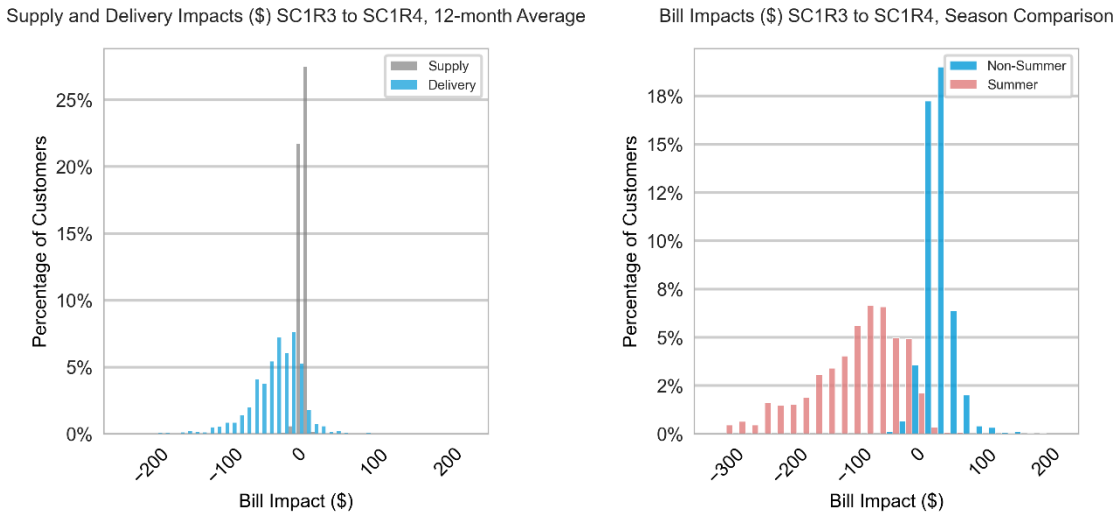
While on average a majority of ASHP customers at 65.5% of the sample still see bill reductions from R4 compared to R3, that proportion of customers is considerably lower than the customers that save on their R4 bills compared to R1. As shown in Fig. 27, majority of the customers fall to the left of the no-impact line, but at a lesser extent than seen in Fig. 23 previously.

Figure 27. 12-Month Average Bill Impact ($) of Switching from R3 to R4 – ASHP



Similar to the findings in the prior customer groups and expressed in the left panel of Fig. 28, most customers saw a substantially smaller change in supply costs than in delivery costs. Due to this, much of the change in the total bill with the rate switch is attributable to the change in delivery charges. Particularly, majority of the customers had decreased delivery charges which led to decreased total bills on R4 versus R3. Furthermore, the right panel of Fig. 28 shows that ASHP customers significantly save more on their bills in the summer on R4 when compared to R3. By contrast, ASHP customers tend to do have lower bills on R3 in the non-summer period on average. The blue bars falling mostly to the bill increase ranges demonstrates the higher R4 bills than R3 bills during these months. It seems, though, that the summer savings have greater weight in the 12-month average than the bill increases in the non-summer months given that majority of the ASHP customers see savings when switching from R3 to R4 in the 12-month average bill impacts.

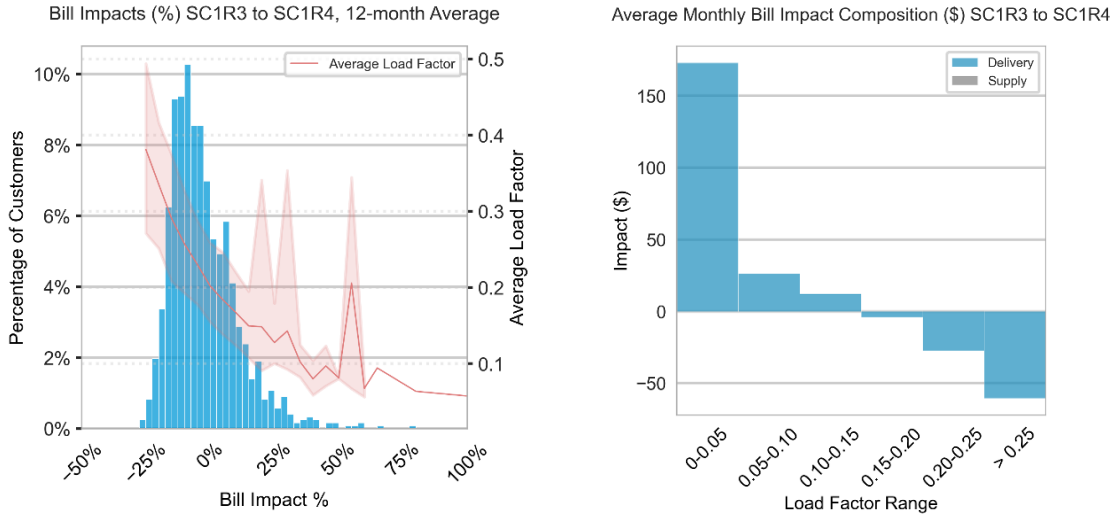
Figure 28. Average Bill Impact ($) Composition (12-Month Average) and Seasonal Breakdown of Switching from R3 to R4 – ASHP



The left panel of Fig. 29 below shows that majority of the customers in the ASHP group will have percentage bill reductions from R3 to R4 with most customers clustered to the left of the zero-percent bill impact range. The percentage bill impact is also right skewed: there is a small percentage of customers whose bills increase by more than 50% of their R3 bills, while the largest reduction is only about 25% of the R3 bills. The chart also shows the negative correlation between average monthly load factor and percentage bill impact, consistent with the findings in the prior customer groups. ASHP customers, on average, are more likely to have their bill reduced if their monthly average load factor is above ~0.2 (the portion of the load factor line to the left of zero-percent bill impact). Those with the highest load factors are also more likely to experience the greatest percentage reductions in their bill compared to R3. The average load factor band shows that 97.5% of customers who had no change in their bills with the switch to R4 had load factors less than ~0.3 and 2.5% of customers with no change in their bills had load factors less than ~0.15. These load factor ranges are comparable to the load factor ranges for control group customers.

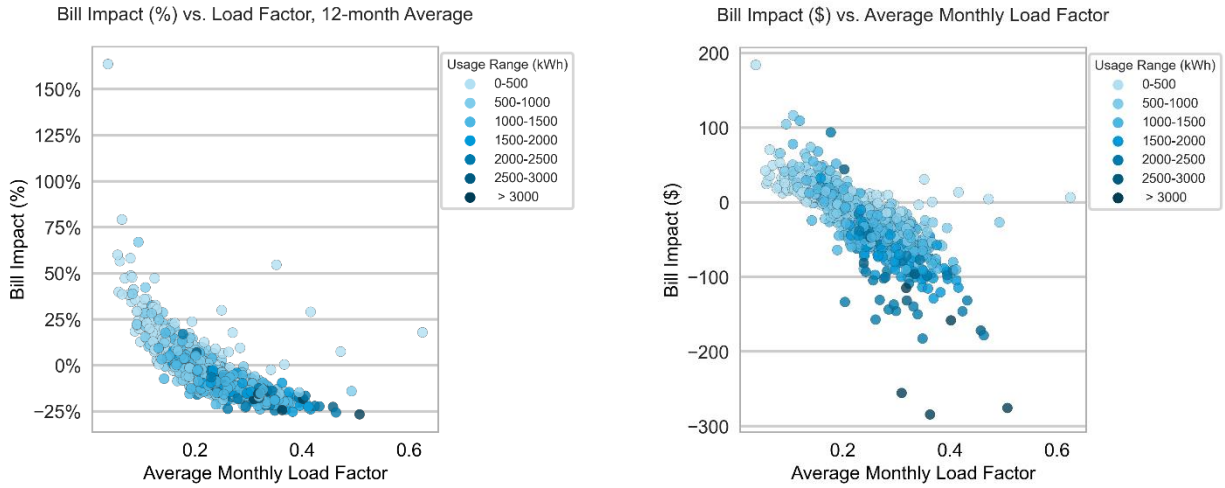
The right panel of Fig. 29 moreover stresses the lack of savings in delivery charges to customers with load factors less than 0.15 with a switch to R4. It also shows that R3 supply costs are comparable to R4 supply costs, regardless of the customers' average load factor. The graph also emphasizes that customers with the lowest average load factors see a significantly higher bill on R4 than on R3, due mostly to increases in their delivery charges.

Figure 29. Average Percentage Bill Impact Distribution (R3 to R4) and Composition Across Average Monthly Load Factor Ranges (12-Month Average) – ASHP



Similar to the control group and EV findings, Fig. 30 shows there is a negative correlation between the bill impact (in percent on the left panel, in dollars on the right panel) and average monthly load factor. Consistent with the findings on the left panel of Fig. 29, most customers with average load factors greater than ~0.15 will most likely fall below the zero-percent bill impact range. Usage and bill impact also have a weaker negative correlation than the bill impact-load factor correlation as seen in the spattering of different usage range levels across all bill impact ranges. There are actually smaller usage customers that saw bill reductions as long as they had relatively higher average load factors.

Figure 30. Relationships Among Bill Impacts (R3 to R4), Average Usage Ranges (kWh), and Average Monthly Load Factors (12-Month Average) – ASHP



Bill Increase Outliers. Customers whose percentage bill increases are 3 standard deviations above the average percentage bill impact are considered outliers. For the ASHP group, there were 15 outliers who fall within this range--customers whose bill increases were greater than 39% of their SC1R3 bill. The average usage of these outliers was 271 kWh, 596 below the average monthly usage for the entire customer group. The average

monthly load factor for the outliers based on 12-month data was notably lower at 0.1, 0.13 (1.9 standard deviations) below the average monthly load factor for this entire customer group.

VI.D. GSHP Customers

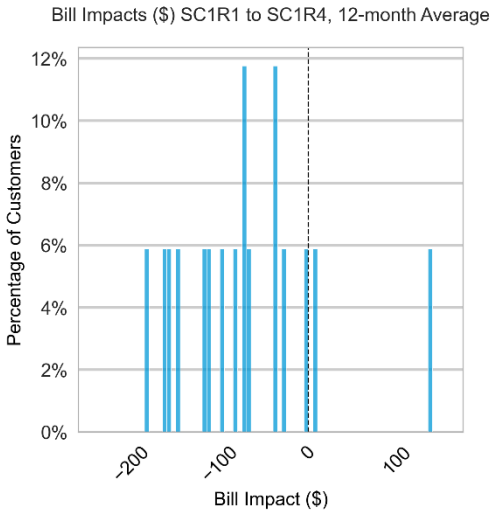
The GSHP group was a sample of 18 customers. The average monthly usage of the sample was 1,942 kWh. The smallest average usage was 828 kWh and the largest customer had an average monthly usage of 5,404 kWh. These customers had a 12-month implied average monthly demand of 11.5 kW.

The average monthly usage in the summer for this customer group was 1,692 kWh. It is about 18% lower than the monthly average use of 2,067 in the non-summer period. The implied monthly demand in the summer is 11.01 kW, 6% lower than the implied monthly average demand of 11.72 kW in the non-summer period.

VI.D.i. Bill Impacts – GSHP – SC1R1 to SC1R4

For the GSHP group, 88.9% of customers saved on their bills switching from R1 to R4. Of those who had their bills reduced, average savings were about $103 or 18%. This level of savings is the highest both in terms of dollar and in terms of percentage of R1 bills among all customer groups considered in this assessment. Fig. 31 below shows that the greatest percentage of customers are to the left of the no-impact line with average savings going all the way to $200 a month.

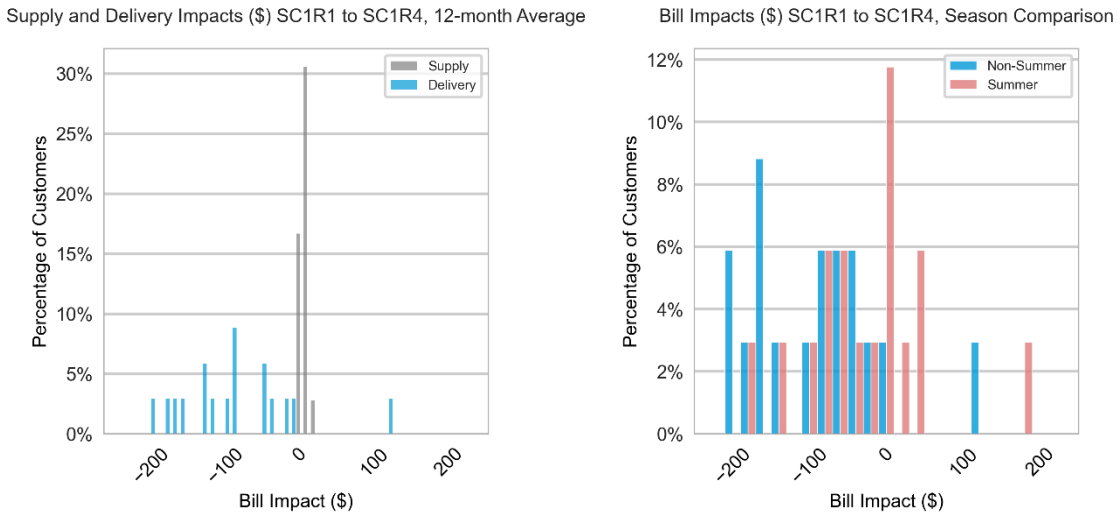
Figure 31. 12-Month Average Bill Impact ($) of Switching from R1 to R4 – GSHP



The left panel of Fig. 32 below implies that changes in the total bill from R1 to R4 are mostly attributable to changes in delivery costs. Supply charge impacts are minimal for most customers in the group. It is also apparent that a greater percentage of customers experience a reduction in delivery charges with the switch to R4.

Summer and non-summer differences were apparent as well. As shown in the right panel of Fig. 32, GSHP customers tended to see greater bill savings in R4 when compared to R1 in the non-summer months over the summer. A greater percentage of customers saved a greater amount in dollar terms in the non-summer months as indicated by the blue bars going to around $200 average monthly savings. A much smaller percentage of customers save at most $200 in the summer months, as shown by the orange bars. Some customers even have their bills increase considerably in the summer with R4.

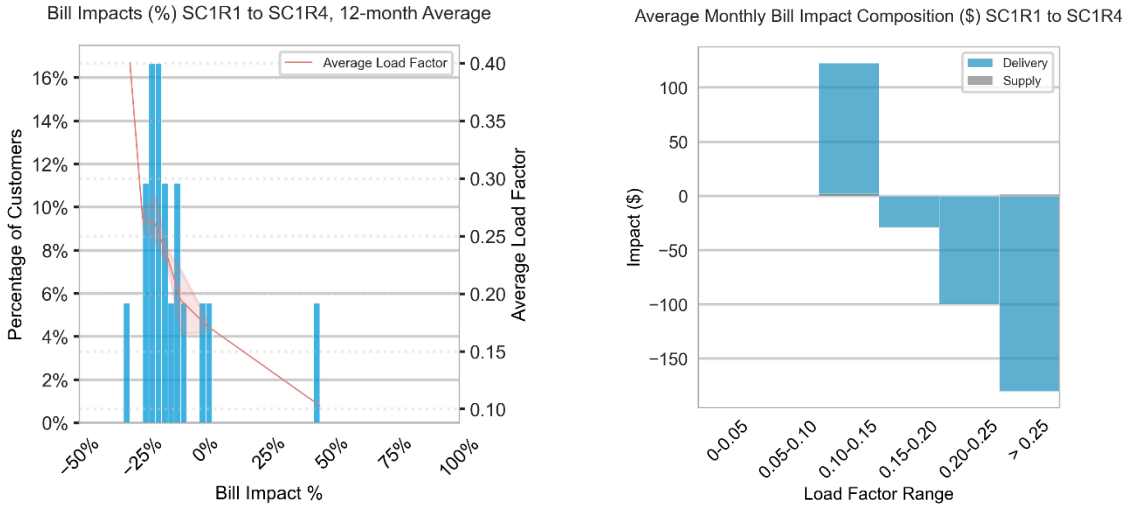
Figure 32. Average Bill Impact ($) Composition (12-Month Average) and Seasonal Breakdown of Switching from R1 to R4 – GSHP



The left panel of Fig. 33 below shows that majority of the customers in the GSHP group will have percentage bill reductions from R1 to R4. The percentage bill impact is also right skewed: there is a small percentage of customers whose bills increase by close to 50% of their R1 bills, while the largest reduction is less than ~30% of the R1 bills. As expected, the left panel also suggests a negative correlation between load factor and the bill impacts from switching to R4, consistent with the prior findings. What is notable, however is the high percentage of customers that fall within the bill savings range (left of 0% bill impact) with a load factor greater than ~0.175 on average. The average load factor band shows that 97.5% of customers who had no change in their bills with the switch to R4 had load factors less than ~0.18 and 2.5% of customers with no change in their bills had load factors less than ~0.16.

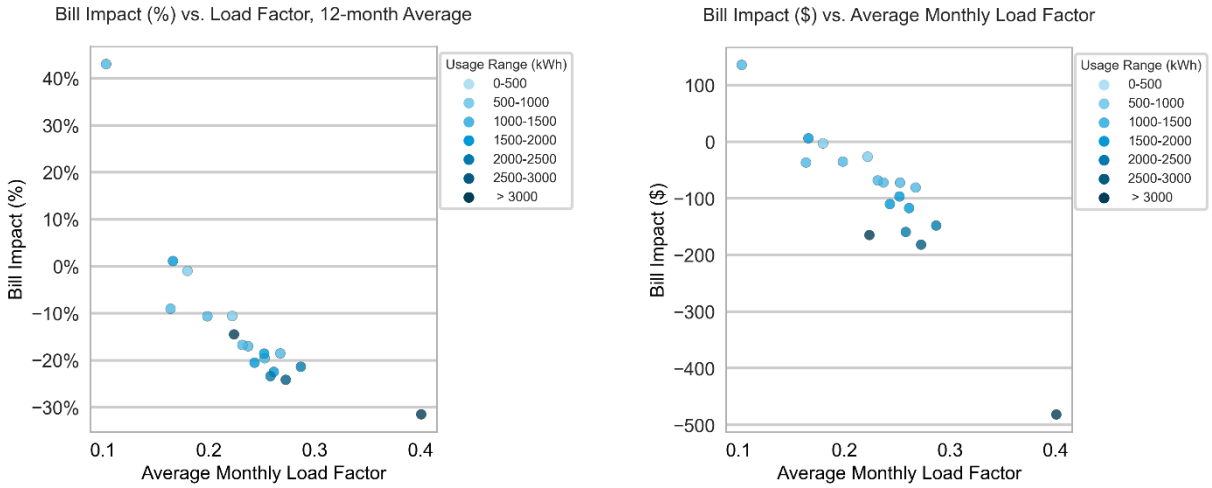
The graph on the right of Fig. 33 demonstrates the lack of savings in delivery charges to customers with average load factors less than 0.15 with a switch to R4—customers with the lowest load factors experience the greatest increases in their delivery charges. It also shows how R4 supply costs are comparable to R1 supply costs, given the minute supply charge impacts with the switch to R4, regardless of the customers' average load factor.

Figure 33. Average Percentage Bill Impact Distribution (R1 to R4) and Composition Across Average Monthly Load Factor Ranges (12-Month Average) – GSHP



Even with a very limited sample of only 18 customers, Fig. 34 also shows there is a negative correlation between the bill impact (in percent on the left panel, in dollars on the right panel) and average monthly load factor. Consistent with the findings on the left panel of Fig. 33, most customers with average load factors greater than about ~0.2 will fall below the zero-percent bill impact range. Usage and bill impact also have a weaker negative correlation than the bill impact-load factor correlation as seen in the diversity of usage range levels (represented by the color intensity of the dots) across all bill impact ranges. There are actually smaller usage customers that saw bill reductions as long as they had relatively higher average load factors.

Figure 34. Relationships Among Bill Impacts (R1 to R4), Average Usage Ranges (kWh), and Average Monthly Load Factors (12-Month Average) – GSHP



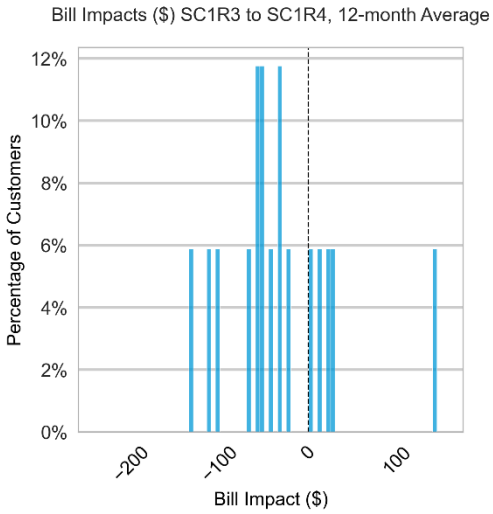
<u>*Bill Increase Outliers*</u>. Customers whose percentage bill increases are 3 standard deviations above the average percentage bill impact are considered outliers. For the GSHP group, there was one outlier that fell within this range—the customer's bill increased more than 35% of their SC1R1 bill. The average usage of this outlier was 1060 kWh, 882 below the average monthly usage for the entire customer group. The average monthly load

factor for the customer based on 12-month data was notably lower at 0.1, 0.13 (2.1 standard deviations) below the average monthly load factor for this entire customer group.

VI.D.ii. Bill Impacts – GSHP – SC1R3 to SC1R4

For the GSHP group, 72.2% of customers saved on their bills switching from R3 to R4. Of those who had their bills reduced, average savings were about $68 or 13%. This level of savings is the highest both in terms of dollar and in terms of percentage of R3 bills among all customer groups considered in this assessment. Fig. 35 below shows that the greatest percentage of customers are to the left of the no-impact line. Note, however, that the percentage of customers saving on their bills from R3 to R4 is noticeably less than the percentage of customers saving from R1 to R4. The average savings level was also $35 less with the R3 to R4 switch than with the R1 to R4 switch. In fact, compared to Fig. 31 where savings tops out at ~$200 a month, the average savings only goes to ~$150 a month in Fig. 35.

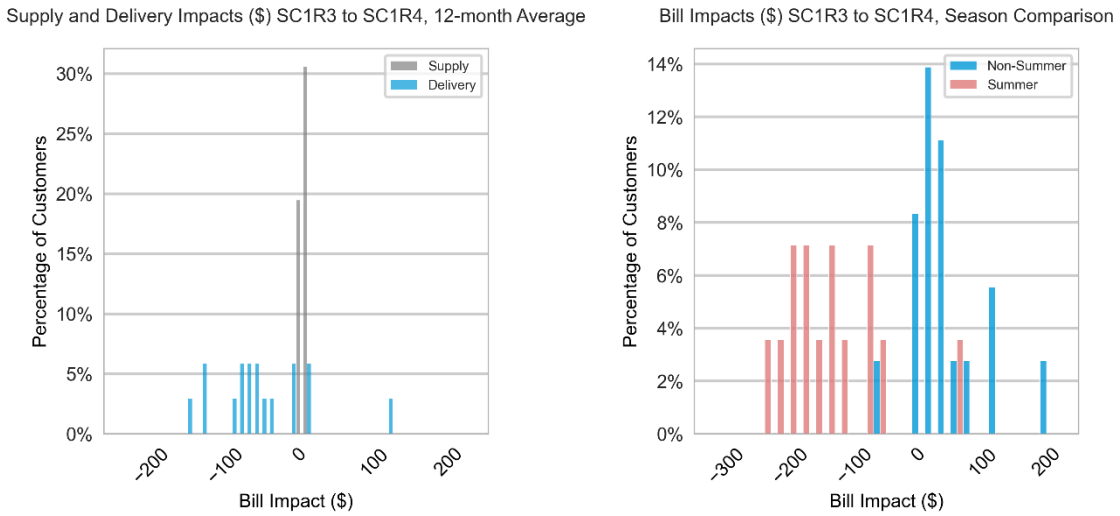
Figure 35. 12-Month Average Bill Impact ($) of Switching from R3 to R4 – GSHP



The left panel of Fig. 36 below implies that changes in the total bill from R3 to R4 are mostly attributable to changes in delivery costs. Supply charge impacts are minimal for most customers in the group. It is also apparent that a greater percentage of customers experience a reduction in delivery charges with the switch to R4. Again, although most customers see savings in their delivery charges with the switch from R3 to R4, these savings levels are less than the savings levels seen in the switch from R1 to R4.

Summer and non-summer differences were apparent as well. As shown in the right panel of Fig. 36, GSHP customers tended to see greater bill savings in R4 when compared to R3 in the summer months over the non-summer period. A greater percentage of customers saved a greater amount in dollar terms in the summer as indicated by the orange bars going to beyond $200 average monthly savings. On the contrary, in the non-summer period, most customers experience increases in their bills if they switch to R4 from R3. It seems that these heating customers save more with a TOU rate, R3, during the months that include the heating season.

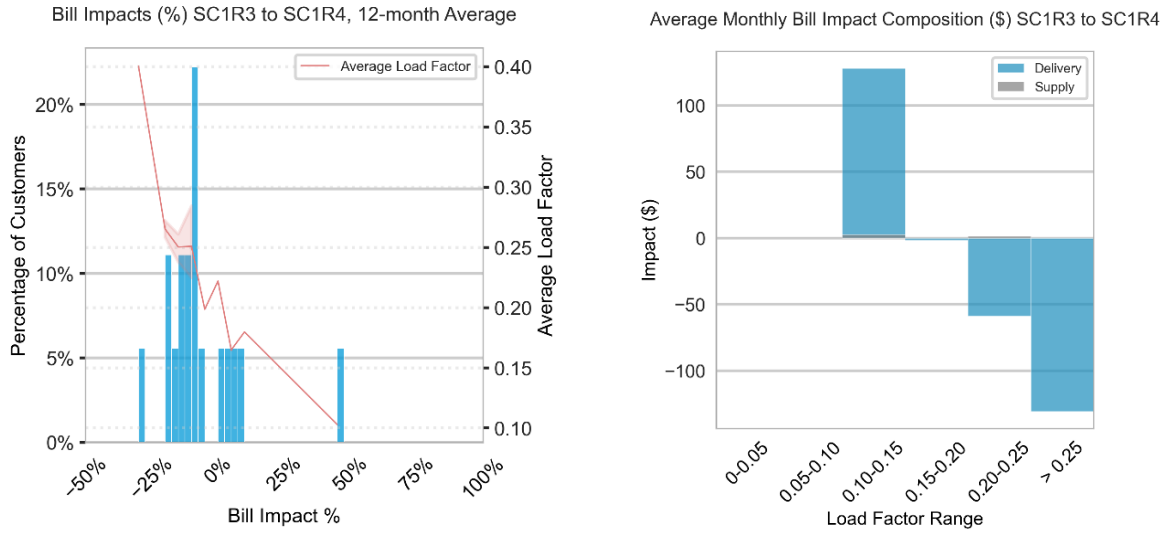
Figure 36. Average Bill Impact ($) Composition (12-Month Average) and Seasonal Breakdown of Switching from R3 to R4 – GSHP



The left panel of Fig. 37 below shows that majority of the customers in the GSHP group will have percentage bill reductions from R3 to R4. The percentage bill impact is also right skewed: there is a small percentage of customers whose bills increase by close to 50% of their R3 bills, while the largest reduction is less than ~25% of the R3 bills. As expected, the left panel also suggests a negative correlation between load factor and the bill impacts from switching to R4, consistent with the prior findings. Most customers fall within the bill savings range (left of 0% bill impact) with a load factor greater than ~0.17 on average. Due to the small sample size, there are load factor levels in the chart that have no band around the levels.

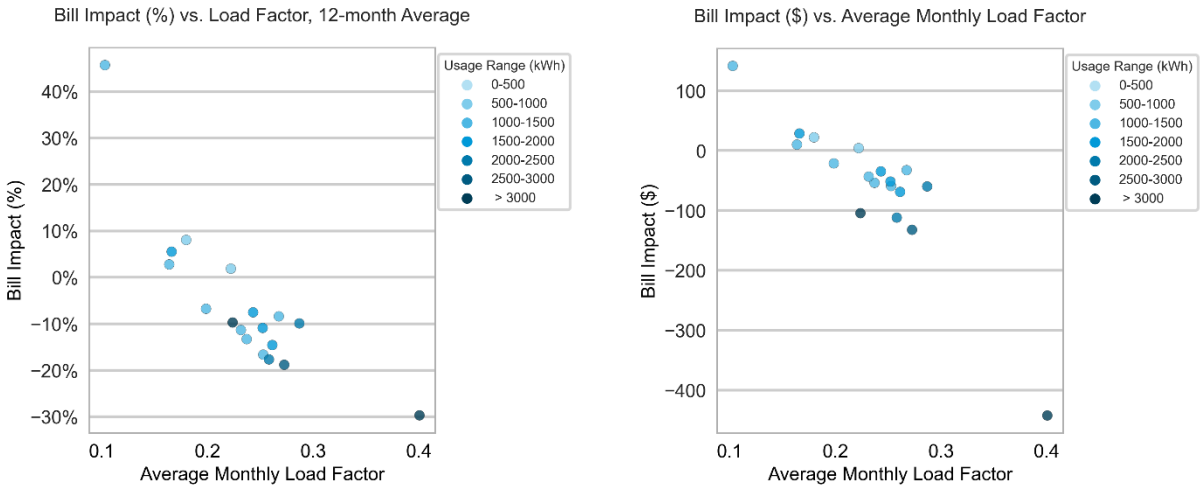
The graph on the right of Fig. 37 demonstrates the lack of savings in delivery charges to customers with average load factors less than 0.15 with a switch to R4—customers with the lowest load factors experience the greatest increases in their delivery charges. It also shows how R4 supply costs are comparable to R1 supply costs, given the negligible supply charge impacts with the switch to R4, regardless of the customers' average load factor.

Figure 37. Average Percentage Bill Impact Distribution (R3 to R4) and Composition Across Average Monthly Load Factor Ranges (12-Month Average) – GSHP



Again, even with a very limited sample of only 18 customers, Fig. 38 displays the negative correlation between the bill impact (in percent on the left panel, in dollars on the right panel) and average monthly load factor. Consistent with the findings on the left panel of Fig. 37, most customers with average load factors greater than about ~0.2 will fall below the zero-percent bill impact range. Usage and bill impact also have a weaker negative correlation than the bill impact-load factor correlation as seen in the diversity of usage range levels (represented by the color intensity of the dots) across all bill impact ranges. There are actually smaller usage customers that saw bill reductions as long as they had relatively higher average load factors.

Figure 38. Relationships Among Bill Impacts (R3 to R4), Average Usage Ranges (kWh), and Average Monthly Load Factors (12-Month Average) – GSHP



<u>*Bill Increase Outliers*</u>. Customers whose percentage bill increases are 3 standard deviations above the average percentage bill impact are considered outliers. For the GSHP group, there was one outlier that fell within this range—the customer's bill increased more than 42% of their SC1R3 bill. The average usage of the outlier was

1060 kWh, 882 below the average monthly usage for the entire customer group. The average monthly load factor for the this customer based on 12-month data was notably lower at 0.1, 0.13 (2.1 standard deviations) below the average monthly load factor for this entire customer group.

VI.E. PV Customers

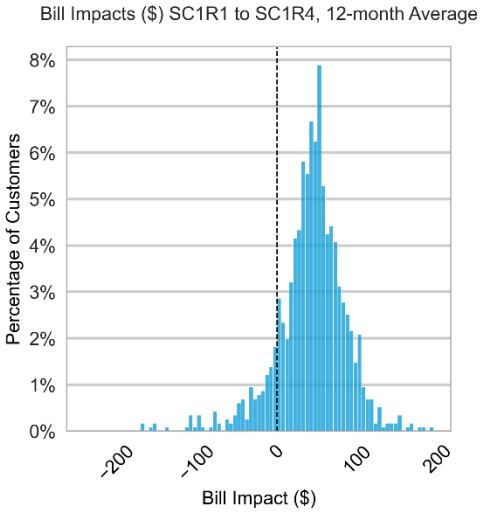
The PV group was a sample of 1,159. The average monthly usage of the sample was 202 kWh, which is lower than the average use of the other groups studied because of the ability of these customers to net their energy use. The smallest average usage was (3,070) kWh (customer is a net exporter of power) and the largest customer had an average monthly usage of 6,390 kWh. These customers had a 12-month implied average monthly demand of 8.85 kW.

The average monthly usage in the summer for this customer group was 254 kWh. It is about 44% higher than the monthly average use of 177 kWh in the non-summer period. The implied monthly demand in the summer is 9.65 kW, 16% higher than the implied monthly average demand of 8.35 kW in the non-summer period.

VI.E.i. Bill Impacts – Solar – SC1R1 to SC1R4

For the PV group, only 12.3% of customers saved on their bills switching from R1 to R4. Of those who had their bills reduced, average savings were minimal at $6 or 6%. This is consistent with Fig. 39 below, which shows that majority of customers are to the right of zero. That is, majority of the customers have their bills increase on R4 compared to R1.

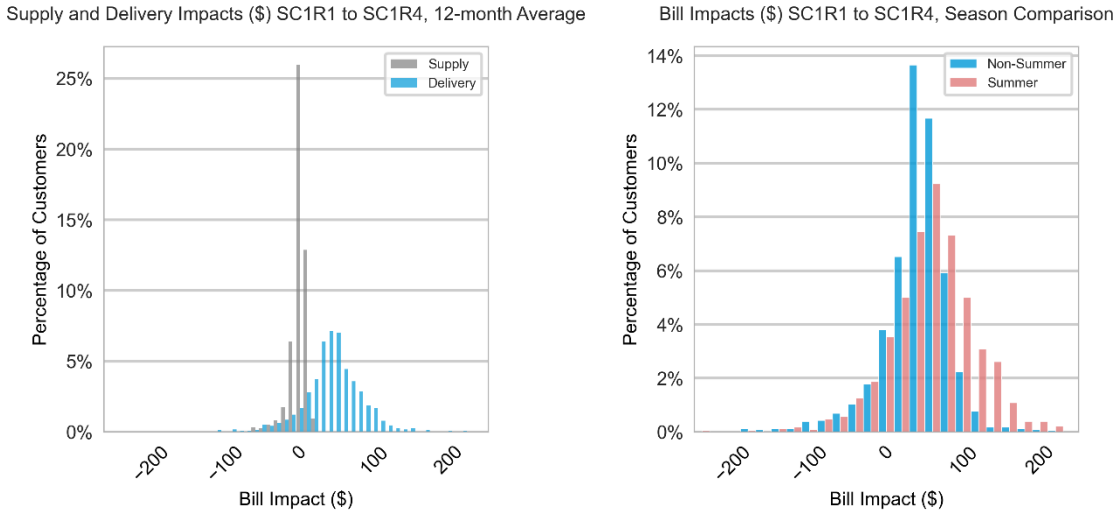
Figure 39. 12-Month Average Bill Impact ($) of Switching from R1 to R4 – Solar



The left panel of Fig. 40 below shows that while switching from R1 to R4 implies changes to both supply and delivery costs, the supply charge impact was much less than the delivery charge impact. There are modest decreases in the supply charges for some customers. But it is apparent that a greater percentage of customers experience an increase in delivery charges with the switch to R4. This can be expected because a PV net metering customer is able to reduce the delivery portion of their bill through the energy they export. Since R4 delivery charges are purely demand based, with no volumetric component, the PV net metering customers are no longer receiving that benefit from netting through the base delivery charge.The chart implies that most of the change in total bill is attributable to the change in delivery charges.

The right panel of Fig. 40 also shows moderate differences between the summer and non-summer impacts. The increases for most PV customers with the switch to R4 seems to be capped at around $100 on average. In the summer, a greater percentage of customers see their bills hike up by up to about $200 with the switch.

Figure 40. Average Bill Impact ($) Composition (12-Month Average) and Seasonal Breakdown of Switching from R1 to R4 – Solar

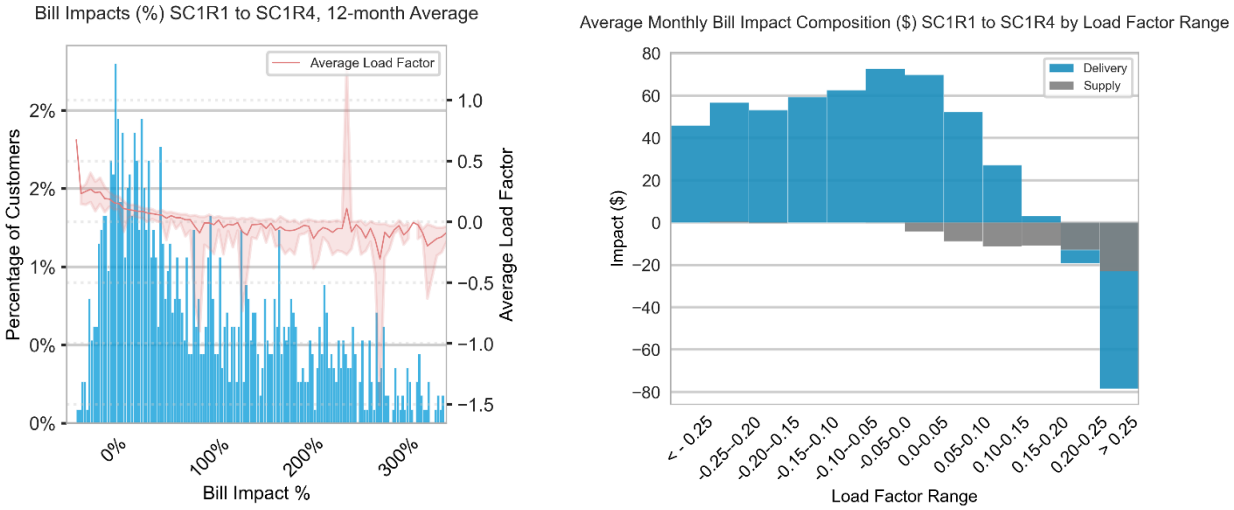


The left panel of Fig. 41 below shows that majority of the customers in the PV group will have percentage bill increases from R1 to R4. The percentage bill impact is also right skewed: The mode of the distribution is found around the zero-percentage impact, but smaller percentages of customers experience extremely high percentage increases on their bills with the switch. As expected, the left panel also suggests a negative correlation between load factor and the bill impacts from switching to R4. This is consistent with all the technologies. Another notable finding for the PV customers is that a disproportionately large percentage of these customers on average have lower load factors than the Control group. Majority of the Control group customers have average monthly load factors above ~0.2, while a significantly large majority of PV customers have load factors fall below ~0.2. With the lower average load factors, PV customers also saw the largest bill increases with R4 at up to over 400% of their R1 bill.

The average load factor band for PV customers shows that 97.5% of customers who had no change in their bills with the switch to R4 had load factors less than ~0.25 and 2.5% of customers with no change in their bills had load factors less than ~0.15. Again, of interest are the customers who see high percentage bill increases despite having high load factors. For instance, there are particularly tall load range bands around the 250% bill impact.

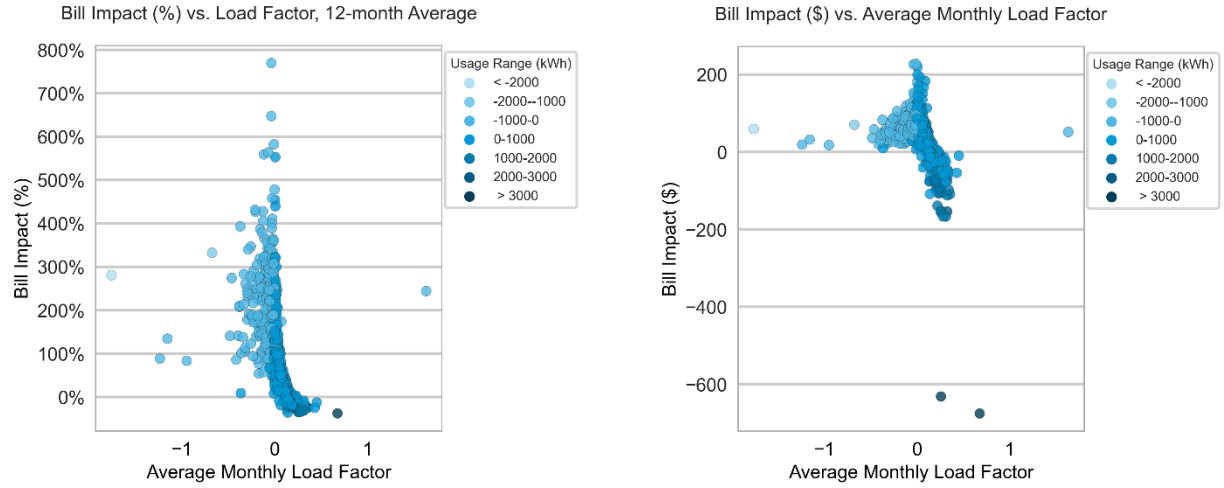
The graph on the right of Fig. 41 depicts the lack of savings in delivery charges to customers with low load factors with a switch to R4. On average, substantial delivery charge savings are experienced only by those highest average monthly load factors (over 0.25). It is noteworthy, however, that customers that have positive average load factors saw savings on their R4 supply charges. PV customers are most likely able to avoid peak supply charges during the panels' productive hours. Thus, the substantially lower off-peak supply charges on R4 as compared to the all-hours supply charges on R1 results in overall supply charge savings on R4 for these customers.

Figure 41. Average Percentage Bill Impact Distribution (R1 to R4) and Composition Across Average Monthly Load Factor Ranges (12-Month Average) – Solar



Despite the different load factor ranges for PV customers (i.e., the presence of negative load factors), Fig. 42 still shows that there is a negative correlation between the bill impact (in percent on the left panel, in dollars on the right panel) and average monthly load factor. Consistent with the findings on the left panel of Fig. 41, most PV customers have relatively low load factors—most points in the chart are clustered around zero average monthly load factor or found to the left of it. Along with these low load factors, most of these points are found above the zero-bill impact ranges. Usage and bill impact also have a weaker negative correlation than the bill impact-load factor correlation as seen in the spattering of different usage range levels across all bill impact ranges. There are actually smaller usage customers that saw bill reductions as long as they had relatively higher average load factors.

Figure 42. Relationships Among Bill Impacts (R1 to R4), Average Usage Ranges (kWh), and Average Monthly Load Factors (12-Month Average) – Solar

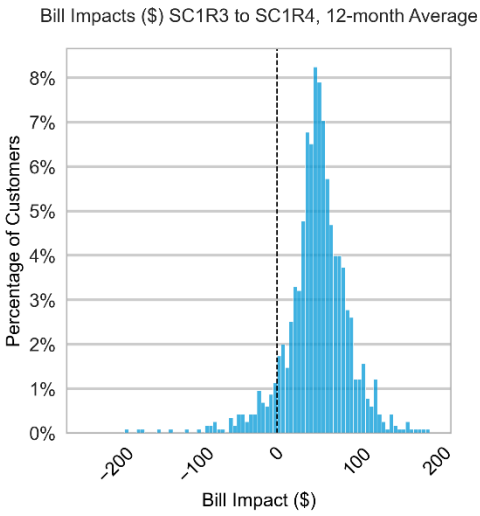


Bill Increase Outliers. Customers whose percentage bill increases are 3 standard deviations above the average percentage bill impact are considered outliers. For the PV group, there were 11 outliers who fall within this range--customers whose bill increases were greater than 431% of their SC1R1 bill. The average usage of these outliers was (183) kWh (the customer was a net exporter of power to the Company), 385 below the average monthly usage for the entire customer group. The average monthly load factor for the outliers based on 12-month data was lower at -0.05, 0.08 (0.5 standard deviations) below the average monthly load factor for this entire customer group.

VI.E.ii. Bill Impacts – Solar – SC1R3 to SC1R4

For PV customers, only 3.6% saved switching from R3 to R4. This is an even smaller percentage than those customers who benefited from R4 when compared to R1. Of those who saw reduced bills, average savings were only $4 or 4% of a customer's bill. As shown in Fig. 43 below, a significant majority of the PV customers are to the right of zero impact. That is, most of these customers saw average increases in their bills with the switch from R3 to R4.

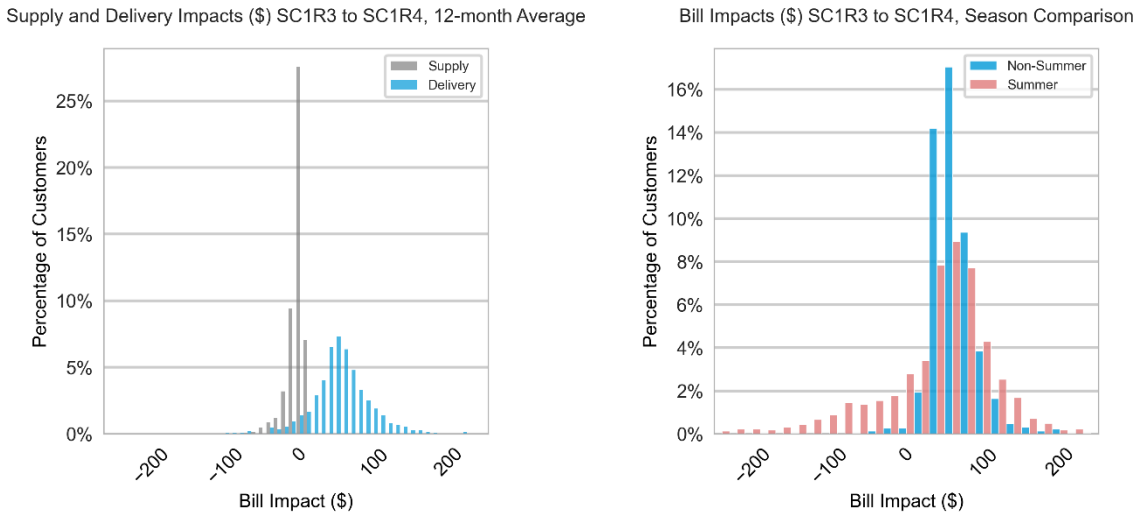
Figure 43. 12-Month Average Bill Impact ($) of Switching from R3 to R4 – Solar



The right panel of Fig. 44 below shows that R4 supply charges are somewhat lower than R1 supply charges on average—a large percentage of customers saw either no change in or reductions in supply charges with R4. However, delivery costs are clearly higher under R4 than R3 for majority of the PV customers. The greatest percentage of these PV customers saw their R4 average delivery charges increase in the vicinity of ~$50.

In a seasonal comparison of PV customer bills under R3 and R4, while majority of customers saw increased bills under R4 in both periods, there is a small percentage of customers who saved on R4 bills during the summer months over R3. Meanwhile, there is a negligible percentage of PV customers who saw bill savings in the non-summer months.

Figure 44. Average Bill Impact ($) Composition (12-Month Average) and Seasonal Breakdown of Switching from R3 to R4 – Solar

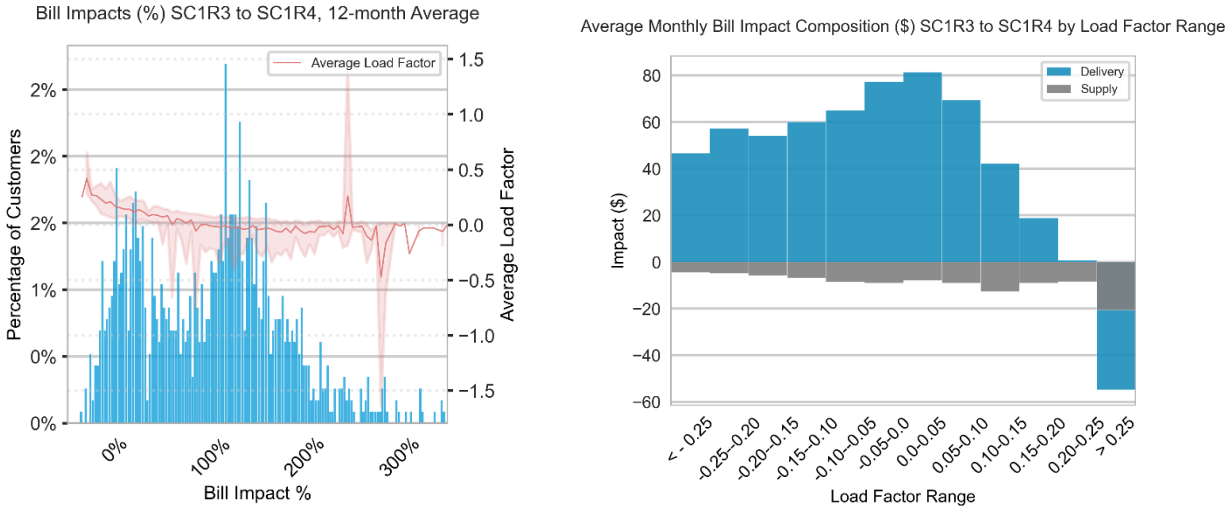


The left panel of Fig. 45 below shows that majority of the customers in the PV group will have percentage bill increases from R3 to R4. The percentage bill impact is also right skewed: The mode of the distribution is found around the zero-percentage impact, but smaller percentages of customers experience extremely high percentage increases on their bills with the switch. As expected, the left panel also suggests a negative correlation between load factor and the bill impacts from switching to R4, consistent with all the technologies. As mentioned in the prior section, with the lower average load factors, PV customers saw the largest bill increases with R4 at up to over 350% of their R3 bill. Another observation is the increase in the percentage of customers having over 100% bill increases with the R3 to R4 switch compared with the R1 to R4 switch. The change in distribution of percentage bill impacts between the two scenarios resulted in the increase in the average monthly bill increase with the switch to R4 to $53 (55% of the R3 bill) from $47 (45% of the R1 bill).

The chart also suggests that customers who have an average monthly load factor of ~0.25 are more likely to see bill increases from R3 to R4. This average load factor level is slightly higher than the minimum average load factor that makes PV customers more likely to save on their R4 bills switching from R1. The average load factor band for PV customers shows that 97.5% of customers who had no change in their bills with the switch to R4 had load factors less than ~0.4 and 2.5% of customers with no change in their bills had load factors less than ~0.10. Again, of interest are the customers who see high percentage bill increases despite having high load factors. For instance, there are particularly tall load range bands around the 250% bill impact.

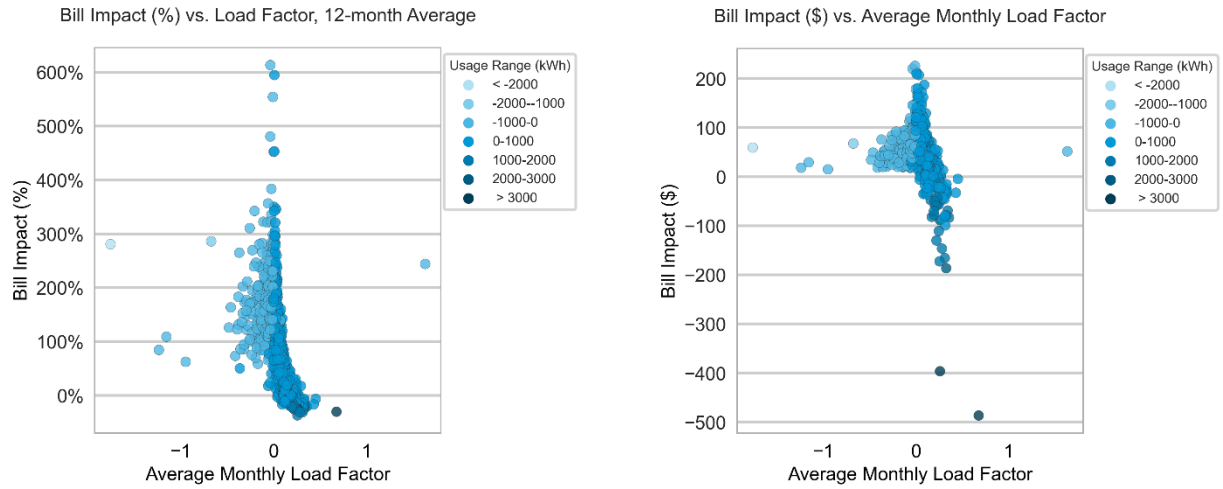
The graph on the right of Fig. 45 depicts the lack of savings in delivery charges to customers with relatively low load factors with a switch to R4. On average, substantial delivery charge savings are experienced only by those highest average monthly load factors (over 0.25). It is noteworthy, however, that customers saw savings on their R4 supply charges versus their R3 supply charges, regardless of their average load factor. PV customers are most likely able to avoid peak supply charges during the panels' productive hours. Thus, the marginally lower off-peak supply charges on R4 as compared to those for R3 contributes to the overall supply charge savings on R4 for these customers. The bigger impact, however, is most likely due to the capacity charges recovered during the summer super-peak period under R3 that these customers would not be subject to under R4.

Figure 45. Average Percentage Bill Impact Distribution (R3 to R4) and Composition Across Average Monthly Load Factor Ranges (12-Month Average) – Solar



Despite the different load factor ranges for PV customers (i.e., the presence of negative load factors), Fig. 46 still shows that there is a negative correlation between the bill impact (in percent on the left panel, in dollars on the right panel) and average monthly load factor. Consistent with the findings on the left panel of Fig. 46, most PV customers have relatively low load factors—most points in the chart are clustered around zero average monthly load factor or found to the left of it. Along with these low load factors, most of these points are found above the zero-bill impact ranges. Usage and bill impact also have a weaker negative correlation than the bill impact-load factor correlation as seen in the spattering of different usage range levels across all bill impact ranges. There are smaller usage customers that saw bill reductions as long as they had relatively higher average load factors.

Figure 46. Relationships Among Bill Impacts (R3 to R4), Average Usage Ranges (kWh), and Average Monthly Load Factors (12-Month Average) – Solar



Bill Increase Outliers. Customers whose percentage bill increases are 3 standard deviations above the average percentage bill impact are considered outliers. For the PV group, there were 9 outliers who fall within this range—customers whose bill increases were greater than 350% of their SC1R1 bill. The average usage of these outliers was (89) kWh (they were net exporters of power to the Company), 291 below the average monthly usage for the entire customer group. The average monthly load factor for the outliers based on 12-month data was slightly lower at -0.02, 0.05 (0.3 standard deviations) below the average monthly load factor for this entire customer group.

VII. Recommendations for Potential Improvements

In addition to evaluating the impacts of R4 on customers with various technologies, the Company agreed to assess R4 for potential improvements. As discussed below, the Company has explored: the potential for a change in its method of demand measurement for R4 customers; and how the findings of its Innovative Pricing Pilot and Select Pricing Program could contribute to improved customer education and outreach for R4 customers.

VII.A. Demand Measurement

One of the ways in which R4 could possibly be improved is by switching from *rolling* to *clock hour* demand measurement. Currently, the customer's billable demand for the relevant time period (peak/off-peak) under R4 is the average of the three highest maximum daily demands occurring in each time period for the billing period. The highest maximum daily demand is the highest 60-minute load measured for the relevant time period. The 60-minute loads are measured on a rolling basis from 15-minute interval readings. That is, four successive 15-minute interval load readings are summed up every 15-minutes, as long as all intervals are within the same time period. This results in about 90 60-minute load observations per customer per day. By contrast, calculating a 60-minute load reading every clock hour would result in only 24 load observations per customer per day.

There are two benefits to using clock hour over rolling demand for the customer. The first is that clock hour demand is a much simpler concept. Customers are familiar with kWh. Demand, measured in kWs, is a customer's kWh usage over a one-hour period. It therefore might make intuitive sense to customers that there would be 24 demand observations in a day. Switching the demand measurement to clock-hour may improve the understandability of demand-based rates, both for customers and other stakeholders (e.g. contractors or developers for end use technologies).

The second benefit to measuring demand by clock hour is that it inherently reduces the billable demand, possibly reducing the volatility in demand measurement. To illustrate, see Table 11 which shows the 15-minute readings for a hypothetical customer from 11:15AM to 2:00PM. This hypothetical customer's usage spikes to 5 kWh for two 15-minute intervals crossing over two clock hours. With the rolling demand measurement, both intervals are included in a 60-minute load measurement three times. In this example, the maximum demand for the period shown is 12 kW with the rolling calculation. With the clock-hour demand measurement, each 15-minute interval is only included in one 60-minute load measurement, resulting in a maximum demand of 8 kW in this example. Therefore, when the three highest demand observations are averaged over the month to calculate the billable demand for R4, the maximum three observations under the clock hour calculation must be less than or equal to the maximum observations under the rolling calculation. With demands measured on a clock hour basis, a customer is less likely to see volatility in their billable demands.

Table 11. Example – Rolling vs. Clock Hour Demand Calculation

	Usage (kWh)	Rolling Demand (kW)	Clock Hour Demand (kW)
11:15	1		
11:30	1		
11:45	1		
12:00	5	8	8
12:15	5	12	
12:30	1	12	
12:45	1	12	
13:00	1	8	8
13:15	1	4	
13:30	1	4	
13:45	1	4	
14:00	1	4	4

Table 12 shows the 12-month average peak and off-peak demand across all customers in each group's sample if billable demand is calculated on a rolling basis. As a measure of variability in billable demand month to month, the standard deviation measures for the peak and the off-peak demands averaged over all customers in the sample are also shown for each customer group. Table 13, on the other hand, shows the same information if billable demand was calculated on a clock hour basis.

Table 12. 12-Month Average and Standard Deviation of Peak and Off Peak Demand – Rolling Basis

Rolling Demand Statistics (kW)	Control	EV	ASHP	GSHP	PV
12 Mo Average Peak - Rolling Demand	3.68	4.23	3.25	7.19	2.80
12 Mo St. Dev. Peak - Rolling Demand	7.93	2.47	1.71	3.62	1.60
12 Mo Average Off-Peak - Rolling Demand	4.09	8.90	3.79	8.37	3.20
12 Mo St. Dev. Off-Peak - Rolling Demand	9.00	3.61	2.09	3.70	1.97

Table 13. 12-Month Average and Standard Deviation of Peak and Off Peak Demand – Clock Hour Basis

Clock Hour Demand Statistics (kW)	Control	EV	ASHP	GSHP	PV
12 Mo Average Peak - Clock Hour Demand	3.61	4.19	3.19	7.06	2.77
12 Mo St. Dev. Peak - Clock Hour Demand	7.80	2.45	1.69	3.68	1.60
12 Mo Average Off-Peak - Clock Hour Demand	3.93	8.76	3.33	7.98	3.00
12 Mo St. Dev. Off-Peak - Clock Hour Demand	8.80	3.58	1.93	3.54	1.89

Table 14 shows that across all customer groups, both peak and off-peak billable demands are reduced when calculated on a clock hour basis versus a rolling basis. Not only are billable demands reduced, but the variability of billable demand is also tempered as evidenced by the reduction in the calculated standard deviation for both peak and off-peak demands across all customer groups. The effect is largest during off-peak hours, which shows the average demand decreasing between 1.6% and 12. 1%, compared to 0.9% and 1.9% during peak hours.

Table 14. Percentage Change in 12-Month Average and Standard Deviation of Peak and Off Peak Demand from Rolling to Clock Hour Basis

Clock Hour vs Rolling Demand Statistics (kW)	Control	EV	ASHP	GSHP	PV
Percentage Chg 12 Mo Average Peak DD	-1.9%	-0.9%	-1.8%	-1.8%	-1.1%
Percentage Chg 12 Mo St. Dev. Peak	-1.6%	-0.8%	-1.2%	1.7%	0.0%
Percentage Chg 12 Mo Average Off-Peak	-3.9%	-1.6%	-12.1%	-4.7%	-6.3%
Percentage Chge 12 Mo St. Dev. Off-Peak	-2.2%	-0.8%	-7.7%	-4.3%	-4.1%

With a reduction in the forecasted billable demand calculated on a clock hour basis, delivery rates should also be increased to enable the Company to recover the class revenue requirement. Such a change in delivery rates would require additional analysis beyond the scope of this study, but that analysis could be done in the future to estimate the potential bill impacts of a change to clock hour demand measurement. Such an exercise would provide insight on the bill impact of both the compensatory rate increase and the change in the billable demand calculation. While a change to clock hour demand measurement would decrease some customers' bills and increase others, a reduction in the volatility of billable demand should lead to more stable bills on average.

Note, however, that the implementation costs associated with a change to clock hour demand measurement are yet to be determined.

VII.B. Increasing Participation in the Rate

This section will discuss a two-part approach to improving participation in demand-based rates: (1) focusing on customers who have *current* usage patterns (load shapes, rather than usage levels) that will make them most likely to save with a rate switch and (2) focusing on customers who have the ability to *change* their usage patterns to make them likely to save with a rate switch. Both recommendations require further exploration to choose the appropriate methodology for customer usage pattern determination if they will benefit from R4. The usage patterns could depend on the customers' characteristics such as location, building features (single family home versus apartment), ability to work from home, and other pertinent features to be determined with further study. This type of analysis might now be possible with AMI data more readily available. The cost, of course, will be time, information technology resources, and manpower needed to process massive amounts of data to be able to create usage profiles around which demand-based rates could be designed.

One of the lessons learned in the Company's Innovative Pricing Pilot (IPP) is that customers who benefit from switching to a rate plan are likely to stay on that rate. As determined in this study, it is possible to identify customers that are likely to benefit from R4. This study focused on the bill impacts of customers segmented according to end use technologies that they own. However, the Company could market the rate to customers based on their usage patterns, rather than the end use technology they own. As this study shows, there are customers in the Control group that would save by switching to R4. By attracting the likely savers into R4, customers that do make the switch are likely to stay on the rate.

The challenge, however, is attracting those likely savers to R4. Demand based rates for residential customers are a relatively new development made possible by AMI implementation and understanding by the general public is still limited. Therefore, in addition to technical improvements for R4, customer outreach and education tools could be improved to increase participation.

Con Edison has already started the process of developing its marketing strategy for R4 and has rolled out several customer recruitment efforts. In September 2023, the Company conducted a focus group consisting of 24 customers to understand the experience of participants in the Company's Clean Heat program who replaced their existing fossil fuel heating equipment with ASHP or GSHP. In the focus group, the participants were asked about R4, because demand-based rates are generally favorable for heat pump customers with high load factors. Participants were shown information about the rate on the website. Based on the feedback from these customers, the Company could improve the clarity of available information. The Company could also provide other user-friendly digital tools to help customers understand the bill impact of switching to another rate and other pertinent information. In the third quarter of 2023, the Company began exploratory work around a suite of rate products that would provide customers with rate recommendations based on energy consumption patterns (including evaluation of impacts of clean energy products such as heat pumps and EVs) and tools to compare bills under different rate options, among other capabilities.

As acceptance and participation in demand-based rates increase, the Company can start marketing the rates to customers that have the ability to *change* their current usage patterns (adjust their load factors) so that they are most likely to save on their bills with a rate switch. One of the major challenges to such an effort is identifying customers that have that ability to alter their usage patterns. The Company will probably have to rely on self-identification in this case, so customer education and targeted marketing are crucial. The Company could further develop educational tools so that customers are able to make an informed decision to switch to

demand-based rates and be made aware that they could have the capability to change their usage patterns to benefit from specific rates.

APPENDIX

SC1 Rates – Delivery

	Season	SC1 Rate I	SC1 Rate III	SC1 Rate IV
Customer Charge ($/month)	All year	18	18	28
Delivery Charges: Volumetric (c/kWh)	Summer (June-Sept.)	First 250 kWh: 14.116 Over 250 kWh: 16.228	Peak: 30.88 Off-Peak: 2.18	
	Non-Summer	14.116	Peak: 11.43 Off-Peak: 2.18	
Delivery Charges: Demand ($/kW)	Summer (June-Sept.)	N/A	N/A	Peak: 21.75 Off-Peak: 6.41
	Non-Summer	N/A	N/A	Peak: 16.73 Off-Peak: 6.41
Peak Definition	All year		8 AM – midnight all days including holidays	Noon-8 PM on weekdays except holidays
Additional Charges and Adjustments	Same volumetric charges apply to all SC1 rates above. Monthly Adjustment Clause ("MAC"), Billing and Payment Processing ("BPP") Charge, System Benefits Charge ("SBC"), Dynamic Load Management ("DLM") Surcharge, Delivery Revenue Surcharge, Value of Distributed Energy Resources ("VDER") Cost Recovery, Tax Sur-credit			

SC1 Rates – Supply

	Season	SC1 Rate I	SC1 Rate III	SC1 Rate IV
Market Supply Charge (MSC): Volumetric	Summer (June-Sept.)	Not TOU	Peak Off-peak Super-peak	Peak Off-peak
	Non-Summer	Not TOU	Peak Off-peak	Peak Off-peak
Peak Definition	All year		8 AM – midnight all days including holidays	Noon-8 PM on weekdays except holidays
Super-peak Definition	Summer		2PM-6PM on weekdays	
Additional Charges and Adjustments	MSC I, MSC II, CESS, MFC.			

Illustration of Load Curve Differences: Bill Increase Outliers vs. Non-Outliers

Figure 47. Hourly Load as Percentage of Daily Maximum Demand - Average of All Accounts, 2023 July 28, Control (R1 to R4 Bill Impact Outliers vs. Non-Outliers)

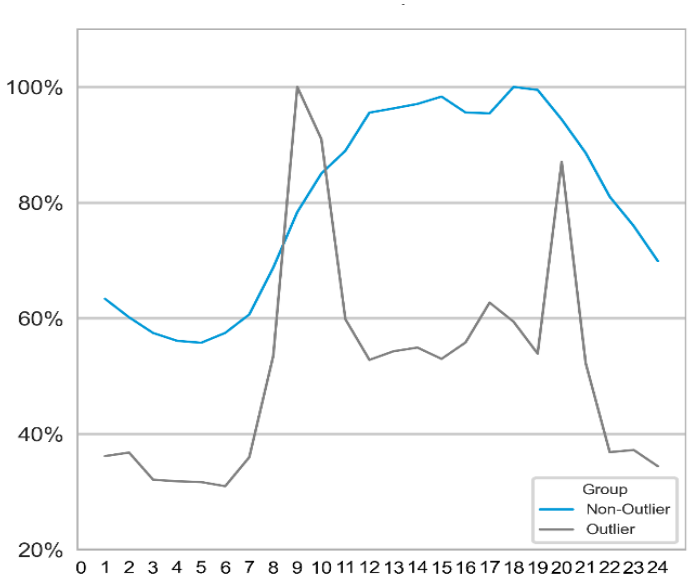
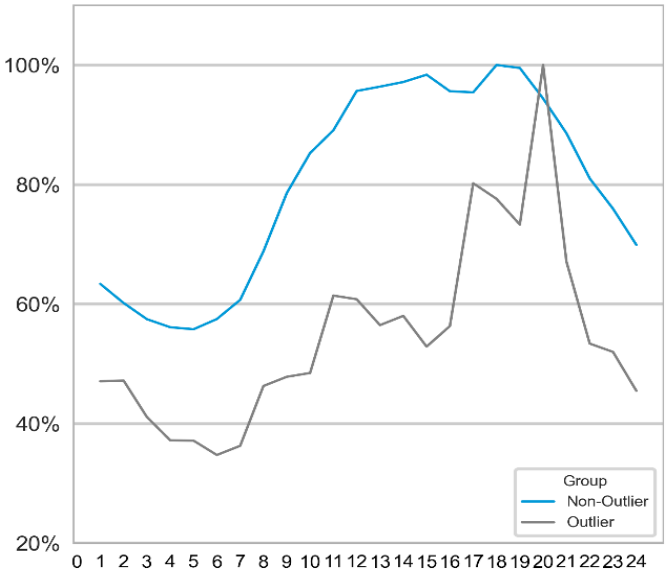


Fig. 47 above illustrates the difference between the average load curves of customers that are considered outliers in the Control Group – those whose bills increased by over 45% switching from R1 to R4 -- and the non-outliers (all other customers). Each point on a curve in the figure is the group's average hourly load taken as a percentage of the group's average peak demand for the company's NYISO peak day for summer 2023, July 28th. The curves indicate that the peak hour for outliers was at 9 A.M., while that for the non-outliers was at 6 P.M. The curve for the non-outliers is clearly flatter: each point on the curve, on average, is closer to the peak than that for the outliers. The points on the curve for the outliers have greater variability in the distance from the peak hour load. The difference in these curves illustrates the statistically lower load factor for the outliers. These customers do not have usage that is relatively evenly spread out throughout the day.

Figure 48. Hourly Load as Percentage of Daily Maximum Demand - Average of All Accounts, 2023 July 28, Control (R3 to R4 Bill Impact Outliers vs. Non-Outliers)



Similarly, Fig. 48 above shows the difference between the average load curves of customers that are considered outliers in the Control Group – those whose bills increased by over 43% switching from R3 to R4 -- and the non-outliers (all other customers). The curves indicate that the peak hour for outliers was at 8 P.M., while that for the non-outliers was at 6 P.M. Again, the curve for the non-outliers has points being closer to the peak on average than the curve for the outliers. Like Fig. 47, the differences in these curves illustrate that customers who have less evenly spread-out usage (lower load factors) during the day are more likely to experience extreme bill increases with a switch to the demand-based rate, R4.