

BGE Electric Vehicle Off Peak Charging Pilot

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Manger – Energy Efficient Programs

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BGE's Schedule EV Off Peak Pilot

BGE's Electric Vehicle (EV) Pilot Program included incentives for residential customers to charge electric vehicles during Off-Peak hours when the EV Rate and demand for energy are lower.

Voluntary Time-of-Use (TOU) Electric Rate for residential customers that have purchased or leased a Plug-in Electric Vehicle.

Whole house electric meter. No second meter dedicated to EV charging.

Smart Meter (AMI) or TOU Meter for interval energy usage tracking. Customers with Net Meters for renewables are not eligible.

BGE Standard Offer Service energy supply. Customers with a third party retail energy supplier are not eligible.

Customer participation in two EV Surveys to provide insights into EV charging behavior and EV Rate Pilot Program customer satisfaction.

Customers encouraged to participate in BGE's Peak Rewards and Smart Energy Rewards Programs.



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Pilot Overview

- Developed as outcome of PSC EV Working Group and approved in 2013, metrics approved in early 2014
- At time, BGE was initiating system wide conversion to Smart Meters, so rate and pilot design had to work with both legacy and AMI technology and systems
- Rate design refined the standard residential rate and reshaped the supply allocations to provide incentive to move load away from the on-peak hours
- Design was supply cost neutral for a customer with the average load profile between Schedule R and Schedule EV
- Legacy “intermediate” hours were included as “off-peak” hours to extend the charging window

Comparison of BGE R and EV Rates			
	<u>R</u>	<u>EV</u>	
Customer Charge	\$7.50	\$7.50	
Distribution Charge (per kWh)*	\$0.03287	\$0.03287	
Total SOS rate (per kWh)**:		<u>On</u>	<u>Off</u>
Jun. 1, 2015 - Sep. 30, 2015	\$0.09481	\$0.16650	\$0.05642
Oct. 1, 2015 - May 31, 2016	\$0.09345	\$0.19704	\$0.05757
Jun. 1, 2016 - Sep. 30, 2016	\$0.09180	\$0.16350	\$0.05342
Notes * Excludes Rider 10 and 25			
** Excludes Rider 8			



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EV Rate Metrics

Metric Category	Description
Eligible Customers	<ul style="list-style-type: none"> Customers in BGE Service Territory that own or lease Electric Vehicle(s) Eligible EV Customers for EV Rate Pilot Program – EV, BGE Supply (no Retail Energy Supplier), Smart Meter (AMI) or TOU meter (no Net Meter)
Customer Participation	<ul style="list-style-type: none"> Number of Enrollments Number of Opt-outs during program
Communications & Customer Care	<ul style="list-style-type: none"> Number of EV Rate Inquiries BGE.com EV page views EV Survey results
Energy Usage Profiles	<ul style="list-style-type: none"> EV Rate Participant & Non-Participant hourly energy usage during Peak and Non-Peak periods EV Rate Participant Energy usage comparison from Peak to Non-Peak periods before & after EV Rate Pilot Program EV customer energy usage comparisons and non-EV residential customers
Customer Satisfaction & Feedback	<ul style="list-style-type: none"> Customer EV charging behavior moving from Peak to Non-Peak periods Customer Satisfaction with EV Rate Pilot Program EV Customer Survey comments



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Pilot Findings

- The types of vehicles and driving range did not vary much between the overall EV population and Pilot participants
- The EV user population uses more energy than the typical BGE residential customer and Pilot participants demonstrated higher usage than the overall EV population
- Both EV customers and Pilot participants reported similar awareness of tools for programming, however, Pilot participants reported more frequent use of the tools
- Pilot participants demonstrated a shift in charging behavior and shift in demand to off=peak hours through the Pilot
- Most pilot participants shows a savings on their bills as compared to standard rates, with 25 of 30 showing savings
- Pilot participants demonstrated strong participation in BGE's Peak Rewards program and an awareness of ways to control their energy use
- Participants reported strong satisfaction with the EV rate with 91% of the participants reporting either "Extremely satisfied" or "Satisfied"

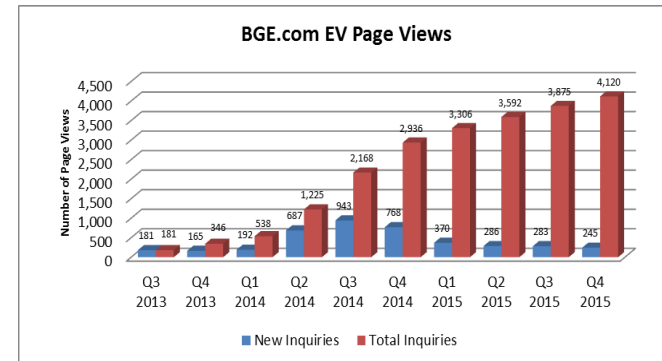
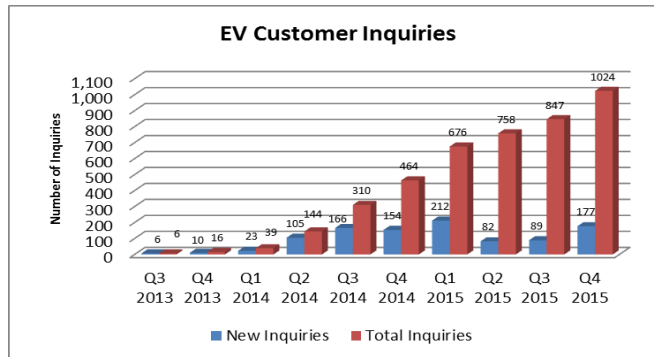
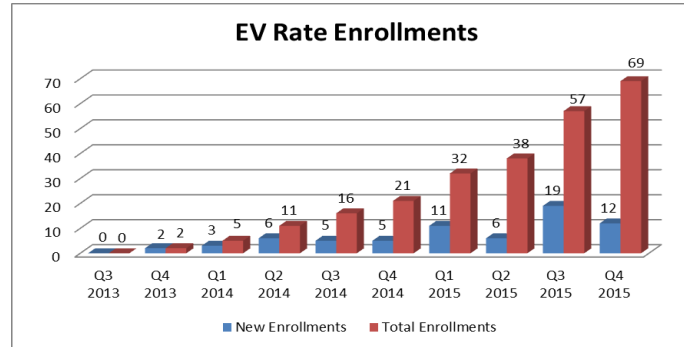


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EV Pilot Enrollments and Interest



- Count of BGE customers with EV's grew from 363 at the start of the pilot to 1734 at the time of the Pilot report.
- Pilot had 69 participants at time of the Report, out of 932 eligible customers.
- Ten customers had “unenrolled” over the pilot period due to moves, end of lease, conversion to net metering and not sure of savings.



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EV Participant Energy Use

Pilot participants showed a shift in energy use to off peak:

On Peak Energy Use		
	Pilot Participants	All residential
Summer 2014	50.7%	50.4%
Non-summer 2014	36.6%	38.1%
Summer 2015	43.4%	49.1%
Non-summer 2015	33.4%	37.1%
Difference (adjusted)	- 6% summer, - 2.3% non-summer	All residential showed a decrease of 1.3% summer and 0.9% non-summer which was adjusted from the EV Pilot analysis

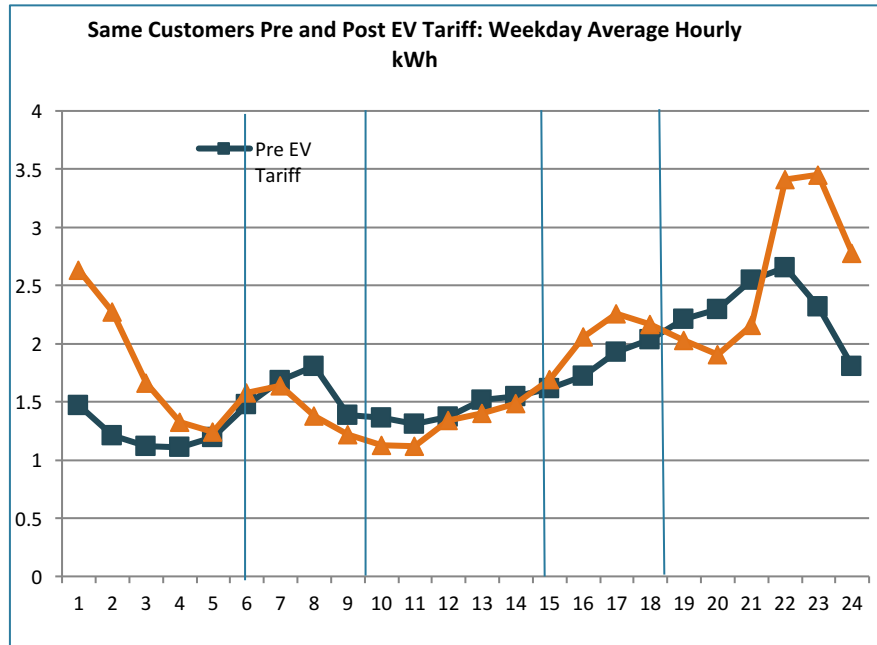


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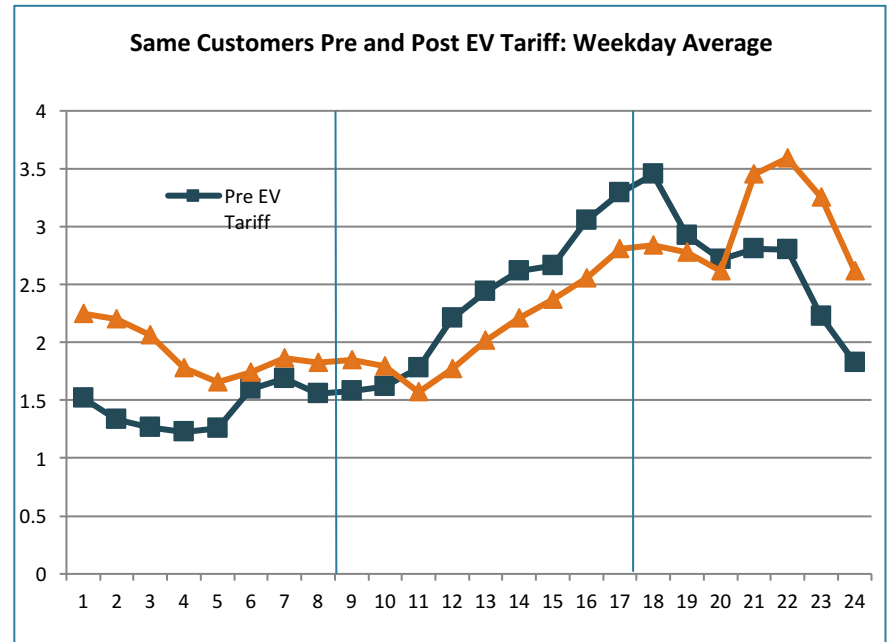
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EV Participant Energy Use Profiles



May 2014 compared to May 2015



August 2014 compared to August 2015

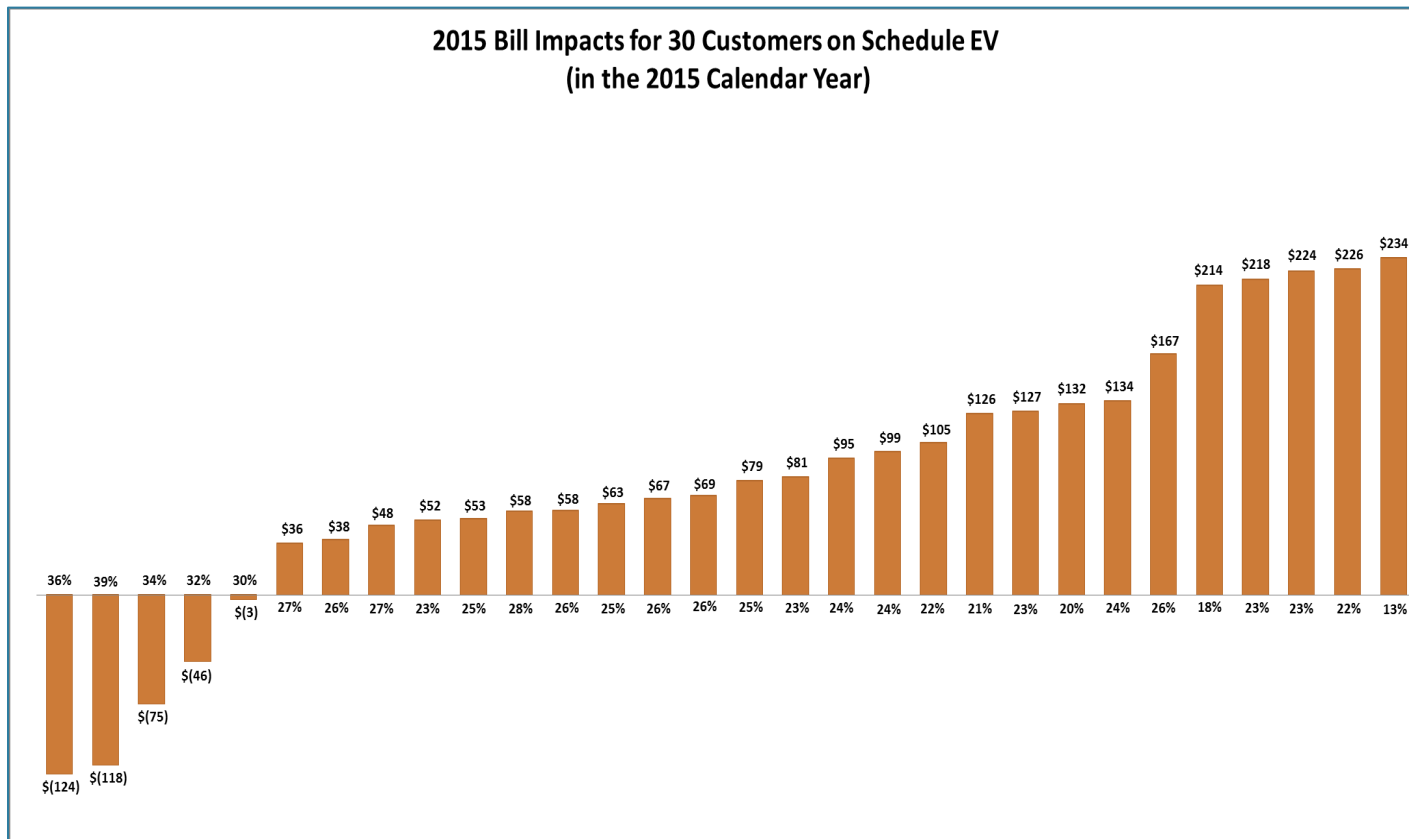


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EV Pilot Participant Bill Impacts



Average participants savings was \$81 for the year, with one customers saving \$234
“Savers” had about 22% on peak use vs. 33% or more for those that did not save.



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EV Survey Topics

Topic	Purpose
Plug-in Electric Vehicle Type	Different EV models may use more or less energy for a battery re-charge
Primary and Secondary EV charging locations	Understand primary and secondary charging locations for the customer
Type of Electric Vehicle Supply Equipment (EVSE)	Level 1 (120 Volts), Level 2 (240 Volts), or Custom to understand the capabilities available to the customer
Number of Week Day Miles driven	Miles driven are a key factor in the charging requirements and hours of charging required
Programmable Tools to manage EV charging	Understand awareness of availability and use of tools to manage charging
Time of day most likely to start EV charging	Compare reported charging behavior at start of enrollment, and again after period of participation
Time of day of other household energy usage	Assess customer awareness of TOU rates and when house hold uses most energy
Other ways customers manage energy costs	Understand customer awareness and use of other BGE Programs, energy conservation, and energy cost savings. Responses include: Programmable Thermostat, BGE Programs, Behavior Habits, Timers, etc.
Customer EV Behavior & EV Rate Satisfaction	Survey # 2 (Final): Has EV charging behavior changed; feedback on EV Rate Program Satisfaction; Would they recommend EV Rate; and perceptions of BGE with respect to "Green" Energy Solutions
Comments	Opportunity for additional comments from EV Customers on EV Rate Program.



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EV Survey Response Findings*

All BGE EV users were invited to participate in an on-line survey with questions on EV awareness and behaviors. Pilot participants were requested to participate in a second, follow-up survey, to assess any changes in reported perceptions or behaviors.

- Over 830 surveys were completed, with 317 determined to be BGE customers. Of the 317, 58 indicated they would be participating in the pilot and 55 pilot participants completed the second survey.
- EV Pilot participants had a larger share of all electric vehicles (58%) as compared to plug-in hybrids or EREVs as compared to all EV users (42%).
- Pilot participants reported strong awareness of times for charging and overall appliance use, and reported a shift in energy use behavior to off peak periods.
- Pilot participants reported similar awareness of EV related programmable tools at the initial survey when compared to all EV survey respondents. Pilot participants reported a significant increase in awareness (38 to 65%) and use (1 in 2) of these tool in the post pilot survey as compared to other EV users (1 in 3).
- Participants reported a strong interest in employing other ways to manage energy and costs
- Participants reported strong satisfaction with the EV rate with 91% of the participants reporting either “Extremely satisfied” or “Satisfied” and 73% of the pilot participants would recommend EV Rate Program to another EV Customer

(Details are in the appendix)*



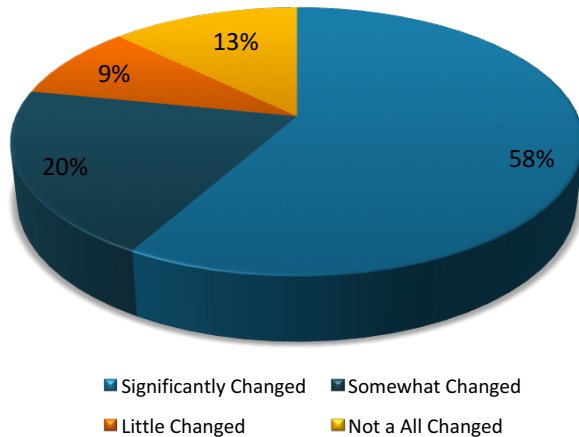
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Reported Impact on Charging Behavior

#2: Customer Behavior Changed on EV Rate



Selected customer quote:

"EV Rate Pilot program was like a hidden secret for me before buying my electric vehicle, ... Since I learned about this program a lot of things changed in our home for example my wife started doing laundry after peak hours, we also started almost always charging the car at nights, I would say about ninety percent of the time and we started conserving more energy in other areas as well. My hope is for BGE to keep this program open in future, because its incentivizes people..."



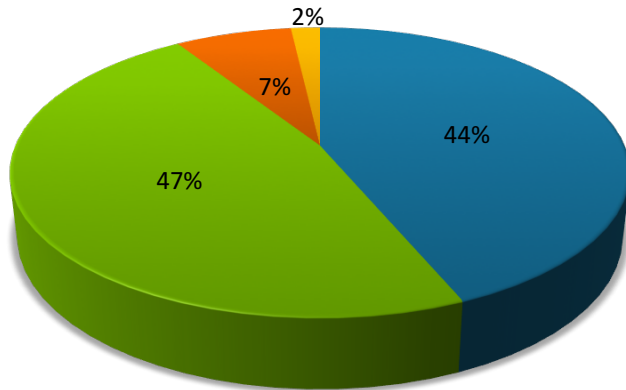
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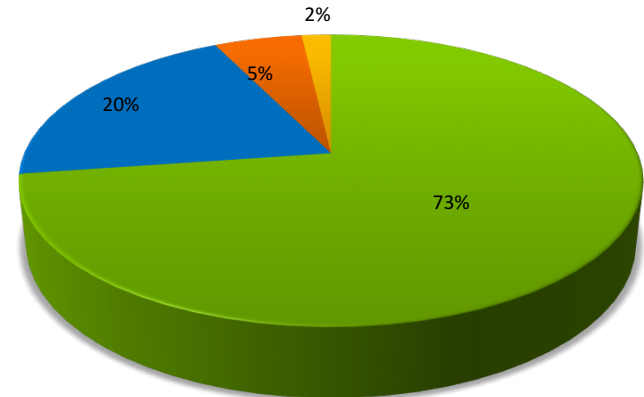
EV Rate Customer Satisfaction

#2: EV Rate Customer Satisfaction



■ Extremely Satisfied ■ Satisfied ■ Neither Satisfied nor dissatisfied ■ Extremely dissatisfied

#2: Recommend EV Rate



■ Extremely Likely ■ Likely ■ Neither Likely nor Unlikely ■ Extremely Unlikely

- Majority EV Rate Customers “Extremely Satisfied” or “Satisfied” with EV Rate Program
- 73% EV Rate Customers would recommend EV Rate Program to another EV Customer



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Takeaways and Next Steps

BGE's EV rate shows that TOU rates can incent a change in charging and energy use behavior.

Recognize there are further opportunities with enhancements and other options

- Strengthen education and supporting tools and provide targeted education for EV users and managing charging during Smart Energy Rewards Peak events
- Evaluate additional rate options and load management strategies specific to EV charging
 - EV Only Rate – could work with PSC Engineering, other utilities, EV Charging providers to develop strategies to reduce the need for a “second” meter or meter within the building.
 - Evaluate peak, non-peak periods as EV growth advances and system load profiles change
 - Open to supplier interest in providing EV specific rates that could leverage AMI capabilities
 - Consider other changes as technology and EV adoption advances to enable additional EV users to participate in incentives to help manage charging impacts and costs

The EV rate, along with targeted engagement with Smart Energy Manager and other demand management programs will help assure effective integration of EVs with the utility distribution grid and reduce the need for distribution system infrastructure upgrades and investments.



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Additional information:
Additional Survey Response Details



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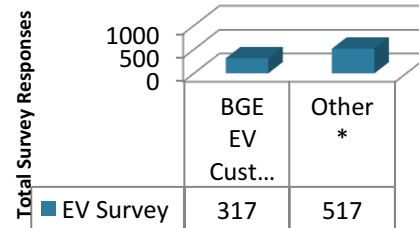
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Completed EV Surveys

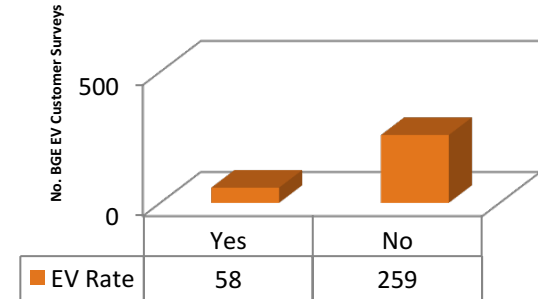
Two Surveys Conducted

- Any BGE Customer reporting they had an EV invited to participate in the survey
- EV Rate Participants self identified in survey and segmented for analysis (Initial Survey)
- Follow-up survey directed to EV Rate Participants (Survey 2)
- Had significant number of survey responses from non-BGE customers
- Of 317 initial respondents
 - 58 indicated they were or would be enrolling in the EV rate
 - 55 of those completed the follow-up survey, Survey 2

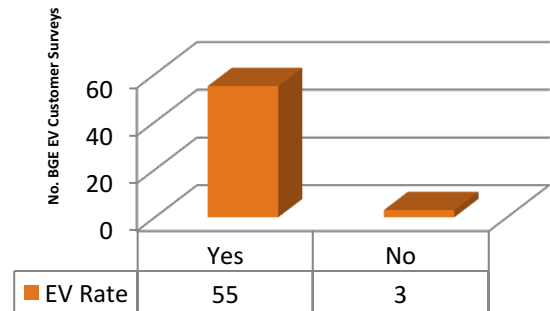
Survey #1 All EV Responses



Survey #1 EV Rate Participants



Survey #2 EV Rate Participants



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Electric Vehicle Type

BEV – Battery Electric Vehicle

- Nissan Leaf
- Mitsubishi “i” - MiEV
- Tesla Model S, X, Roadster
- Smart-For Two
- Honda FIT EV
- Toyota Rav4 EV
- Chevrolet Spark

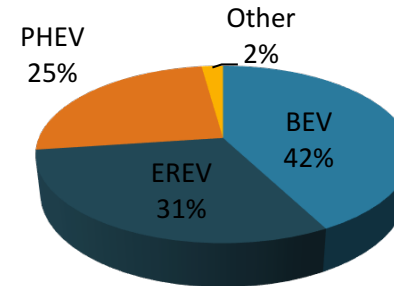
PHEV - Plug-in Hybrid Vehicle

- Toyota Prius Plug-in
- Ford Focus Electric, Fusion ENERGY, C-Max
- Honda Accord Plug-in

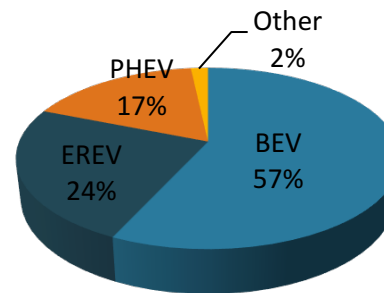
EREV – Electric Range Electric Vehicle

- Chevrolet Volt

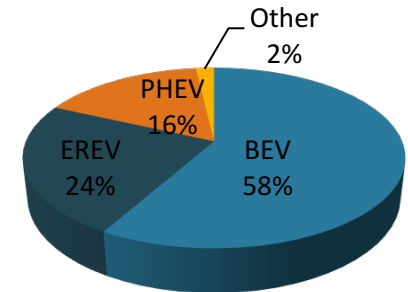
#1: EV Type – All EV Customers



#1: EV Type - EV Rate



#2: EV Type - EV Rate



- EV type provides insight on the Mileage Range on electric and Battery Capacity for re-charging or estimated energy usage.
- EV Customers and customers enrolled in the EV Rate primarily own or lease all-electric vehicles such as a Tesla or Nissan Leaf



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EV Charging Times – Most Likely to Charge EV

EV Rate – Time Periods

Summer

Peak: 10am – 8pm
Non-Peak: 8pm – 9am

Non-Summer

Peak: 7am – 11am;
5pm – 9pm
Non-Peak: 11am – 5pm;
9pm – 7am

Note: see current Schedule EV & Rider 1 for more accurate details



- EV Rate has more Non-Peak hours available at a lower rate for EV Charging

Survey # 1 – all EVs

Time of Use - EV	Responses	%
6:00 AM - 8:00 AM	5	2%
8:00 AM - 10:00 AM	3	1%
10:00 AM - 4:00 PM	12	4%
4:00 PM - 6:00 PM	35	11%
6:00 PM - 8:00 PM	82	26%
8:00 PM - 12:00 AM	96	30%
12:00 AM - 6:00 AM	84	26%

Survey # 1-EV Rate Participants

Time of Use - EV	Responses	%
6:00 AM - 8:00 AM	0	0%
8:00 AM - 10:00 AM	1	2%
10:00 AM - 4:00 PM	1	2%
4:00 PM - 6:00 PM	3	5%
6:00 PM - 8:00 PM	7	12%
8:00 PM - 12:00 AM	23	40%
12:00 AM - 6:00 AM	23	40%

Survey # 2-EV Rate Participants

Time of Use - EV	Responses	%
6:00 AM - 8:00 AM	0	0%
8:00 AM - 10:00 AM	1	2%
10:00 AM - 4:00 PM	1	2%
4:00 PM - 6:00 PM	2	4%
6:00 PM - 8:00 PM	7	13%
8:00 PM - 12:00 AM	26	47%
12:00 AM - 6:00 AM	18	33%

- EV Rate participants showed greater level of charging in the 8 pm to 6 am periods as compared to all EV users.



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Charging Times - Energy Usage for Other Household Appliances



Moving other household appliance energy usage to Non-Peak times may increase energy savings on EV Rate

Survey # 1 – all EVs

Time of Use - Other Household	Responses	%
6:00 AM - 8:00 AM	13	4%
8:00 AM - 10:00 AM	10	3%
10:00 AM - 4:00 PM	68	21%
4:00 PM - 6:00 PM	44	14%
6:00 PM - 8:00 PM	151	48%
8:00 PM - 12:00 AM	27	9%
12:00 AM - 6:00 AM	4	1%

Survey # 1 – EV Rate

Time of Use - Other Household	Responses	%
6:00 AM - 8:00 AM	3	5%
8:00 AM - 10:00 AM	3	5%
10:00 AM - 4:00 PM	10	17%
4:00 PM - 6:00 PM	8	14%
6:00 PM - 8:00 PM	30	52%
8:00 PM - 12:00 AM	4	7%
12:00 AM - 6:00 AM	0	0%

Survey # 2 – EV Rate

Time of Use - Other Household	Responses	%
6:00 AM - 8:00 AM	2	4%
8:00 AM - 10:00 AM	2	4%
10:00 AM - 4:00 PM	7	13%
4:00 PM - 6:00 PM	6	11%
6:00 PM - 8:00 PM	28	51%
8:00 PM - 12:00 AM	10	18%
12:00 AM - 6:00 AM	0	0%

- EV Customers reported highest energy usage vary during daytime hours, EV Rate participants reported shift to later hours in follow-up survey



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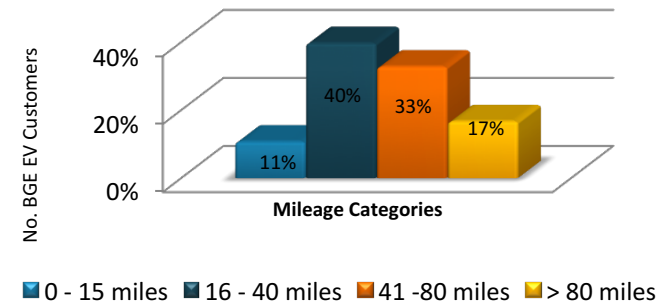
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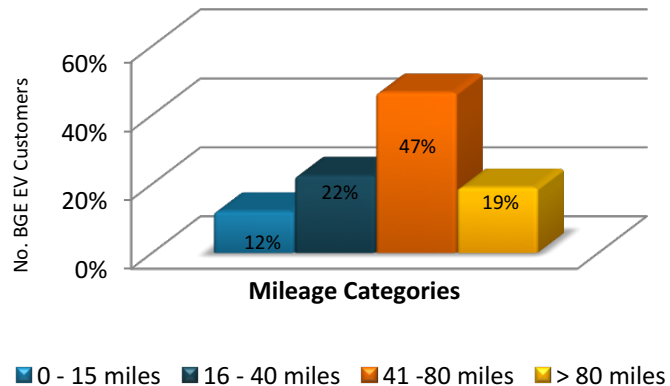
Weekday Miles Driven

Miles Driven and Vehicle Type are variables to determine the charge requirements

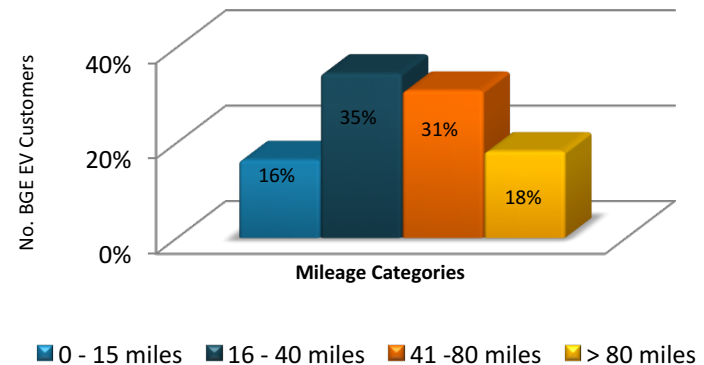
#1: Miles Driven – all EVs



#1: Miles Driven - EV Rate



#2: Miles Driven – EV Rate



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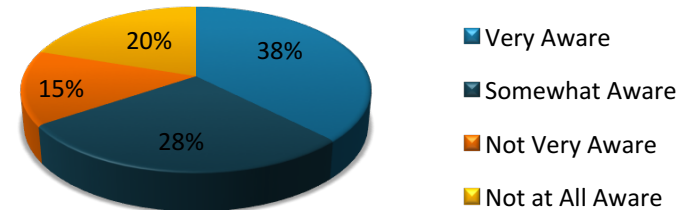
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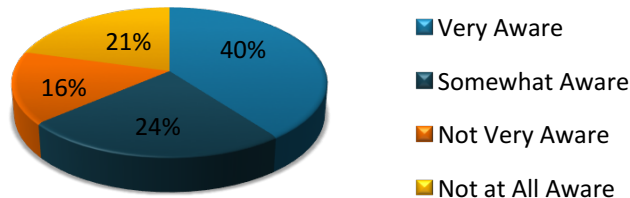
EV Programmable Tools

- EV Programmable Tools to manage Time of Use for EV Charging.
- Tools could include: EV touch screens, Mobile Device Apps, & Web sites.

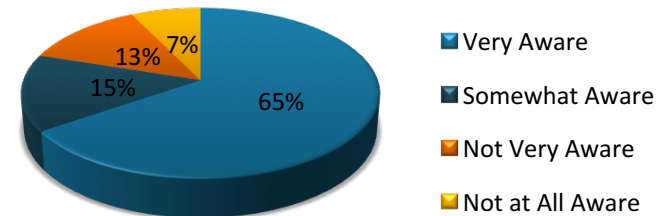
#1: EV Tools-all EVs



#1: EV Tools - EV Rate



#2: EV Tools – EV Rate



- EV customers are “Very Aware” of tools to manage charging
- EV Rate customers reported an increased awareness, 40% to 65%



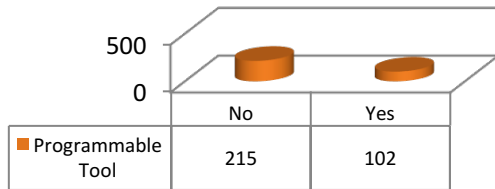
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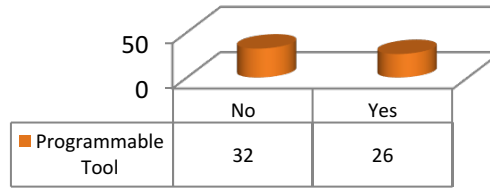
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EV Tool Usage & Type

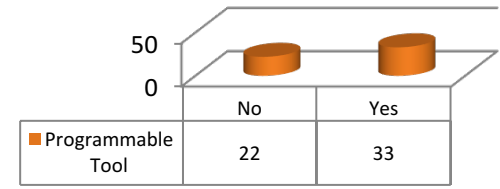
#1: Tool Usage – all EVs



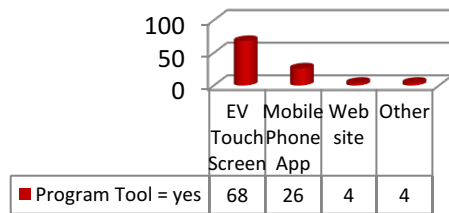
#1: Tool Usage - EV Rate



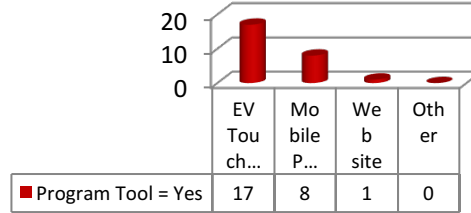
#2: Tool Usage – EV Rate



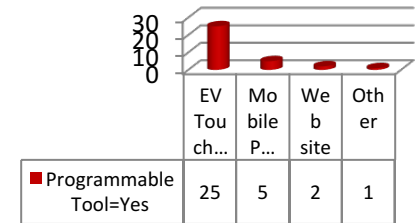
#1: Tool Type - all EVs



#1: Tool Type - EV Rate



#2: Tool Type - EV Rate



- About 1 in 3 EV customers use an EV Programmable Tool, primarily EV touch screen and a few mobile phone apps
- About 1 in 2 EV Rate customers use EV Programmable Tools, primarily EV touch screen and some mobile phone apps



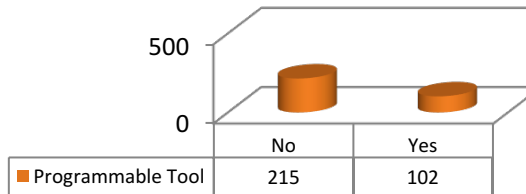
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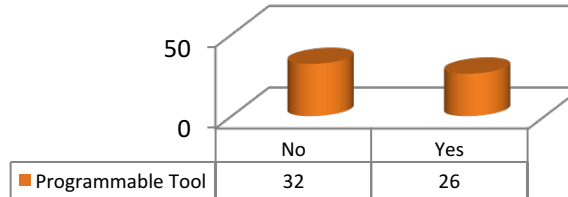
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Programmable Tool Usage

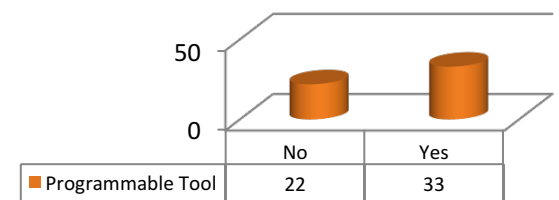
#1: Tool Usage – all EVs



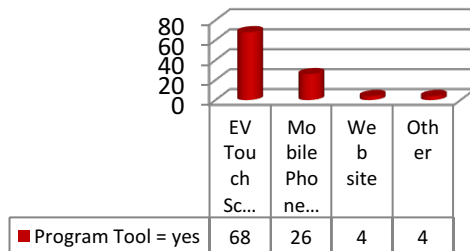
#1: Tool Usage - EV Rate



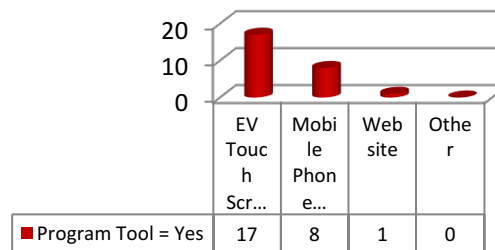
#2: Tool Usage – EV Rate



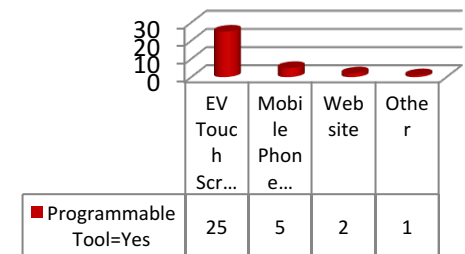
#1: Tool Type - all EVs



#1: Tool Type - EV Rate



#2: Tool Type - EV Rate



- About 1 in 2 EV Rate customers use a Programmable Tools, primarily EV touch screen and mobile phone apps as compared to 1 in 3 overall EV Customers



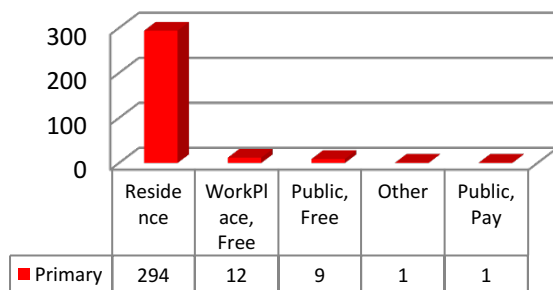
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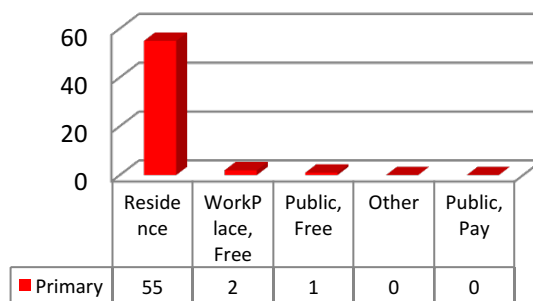
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Electric Vehicle Supply Equipment (EVSE) Charging Location

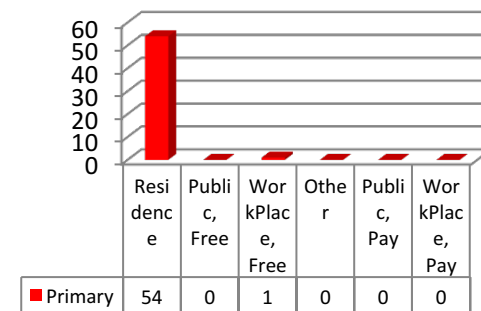
#1: Primary - all EVs



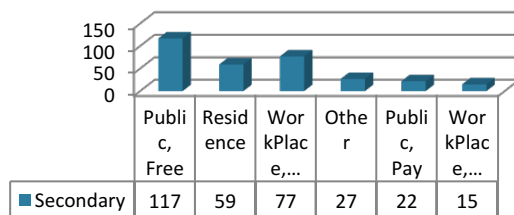
#1: Primary - EV Rate



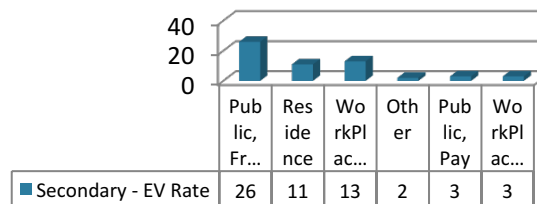
#2: Primary – EV Rate



#1: Secondary – all EVs



#1: Secondary - EV Rate



- At home charging is the most used location, followed by public (free) and workplace



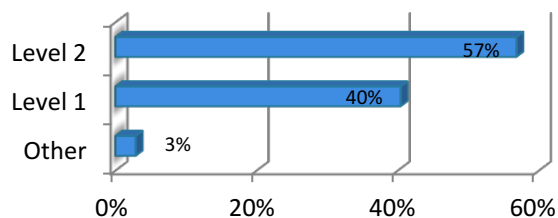
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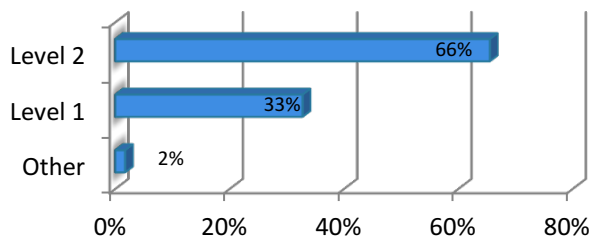
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Electric Vehicle Supply Equipment (EVSE) Charger Type

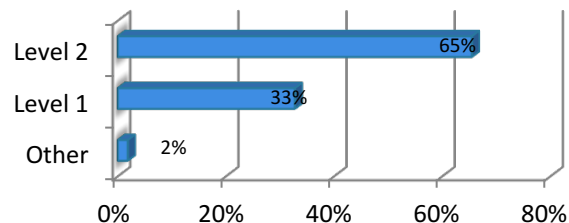
#1: Charging Equipment - all EVs



#1: Charging Equipment - EV Rate



#2: Charging Equipment - EV Rate



- EVSE charging type preference is Level 2 (240 Volt) for faster re-charging for EV and EV Rate customers.



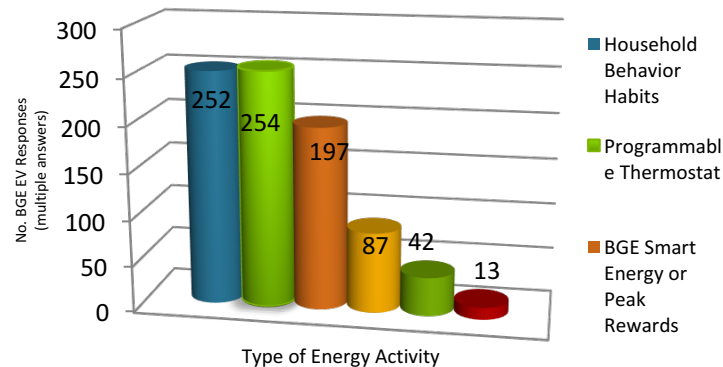
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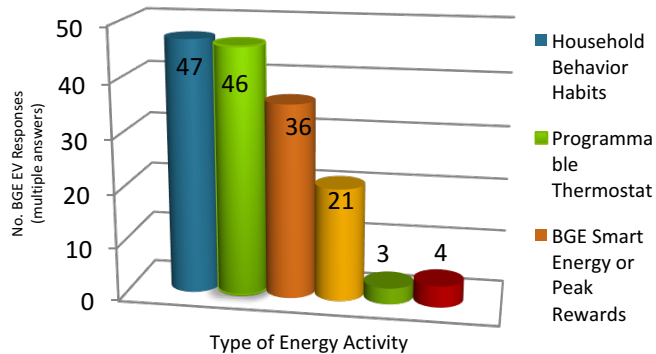
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Other Ways to Manage Energy Usage

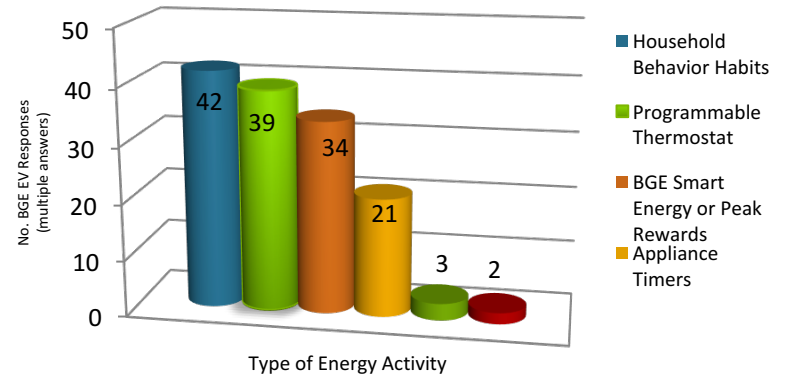
#1: Other Energy Saving Activities - all EVs



#1: Other Energy Saving Activities - EV Rate



#2: Other Energy Saving Activities – EV Rate



BGE EV Customers show strong interest in other BGE Programs and incorporating “other” ways to manage their energy usage and costs



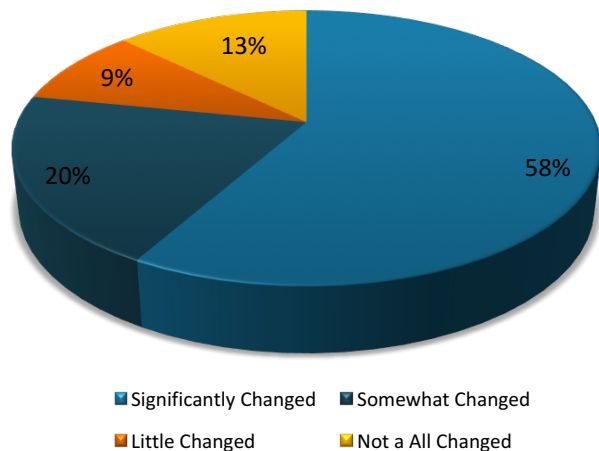
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EV Charging Behavior & Comments

#2: Customer Behavior Changed on EV Rate



I scheduled the charging to non-peak periods. I planned recharging to avoid peak periods.

More mindful of peak usage

Used the EV's charging scheduler to make sure it was always charging during the cheapest rate time.

Try to use appliances that use hot water or more electricity at non peak times.

I usually wait until the off-peak hours during weekdays for charging at home. We also defer other household electric use to off-peak (dishwasher, washing machine, dryer, etc.).

If it's cheaper, we try to use it.

We primarily charge at night

Charging now happens around midnight on weekdays. This is programmed in the vehicle to begin at 11pm when charging is needed.

Always wait until after 9pm before I start charging the car.

I just set my car to charge after 10PM

We were already using most of our energy during the off-peak hours, so having a car charging during that time just further boosted the benefits of how we use energy in our house.

I programmed the schedule into my car and always charged only during low peak hours with only some exceptions when I was very low. We also changed our household habits the best we could.

"EV Rate Pilot program was like a hidden secret for me before buying my electric vehicle, but thanks God Since I learned about this program a lot of things changed in our home for example my wife started doing laundry after peak hours, we also started almost always charging the car at nights, I would say about ninety percent of the time and we started conserving more energy in other areas as well. My hope is for BGE to keep this program open in future, because its incentivizes people..."



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