Grid-Related Costs Associated with EV Charging

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Program Background

Maryland Senate Bill 179

Goals

- Increase reliability & efficiency of the electric distribution system
- Lower electricity use at time of high demand (peak)

Incentives

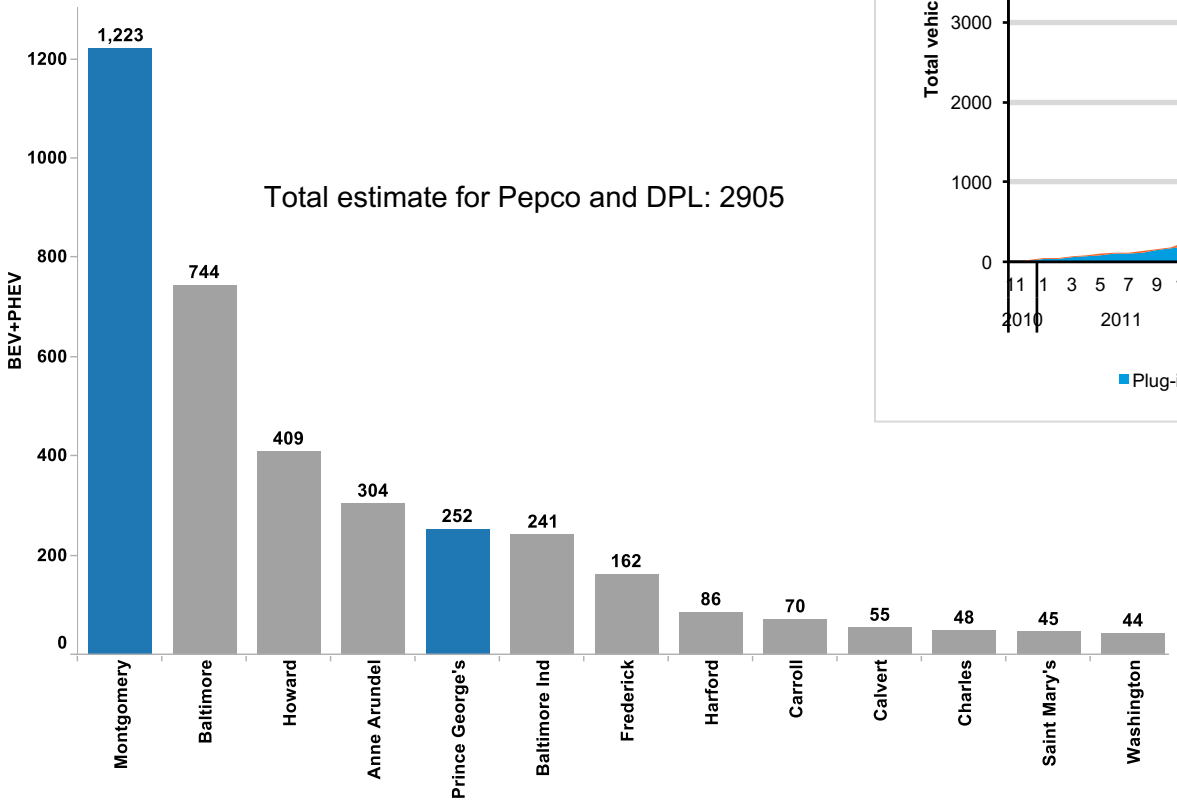
- ✓ **TOU Pricing**
- ➢ Credits on Distribution Charges
- ✓ **Rebates on the Costs of Charging Systems**
- ✓ **Demand Response Programs**
- ➢ Other Programs as approved

Maryland PSC CN 9261

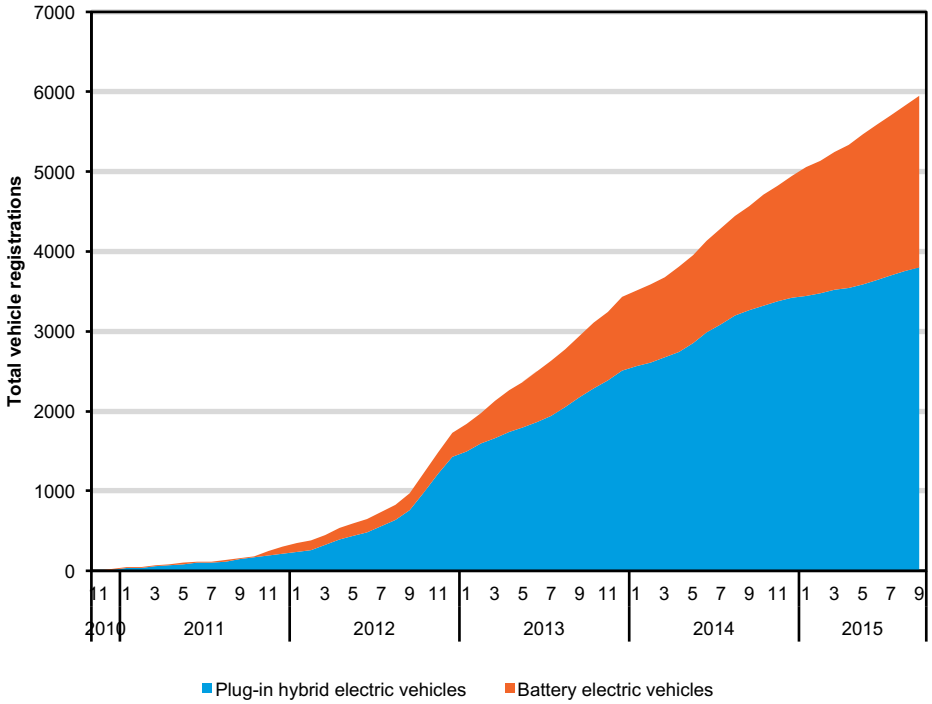
- Created a Working Group with major stakeholders
- Issued the Final Report (Feb 13, 2012)
- Focused on reliability and promoting “off peak” charging
- Developed consensus for desirable elements of a pilot (Pilot Framework)
- Program launched on December 2013 and an Interim Report provided in 2014
- Commission approved extending the program through December 2015

Pilot Components: Background

Electric Vehicles in Maryland



Total estimate for Pepco and DPL: 2905



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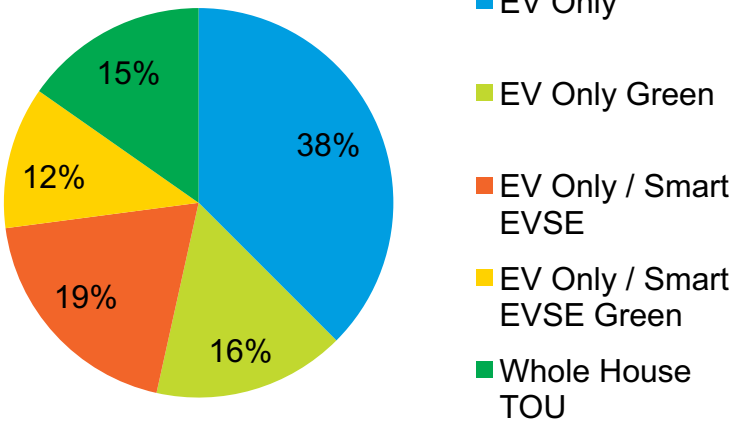
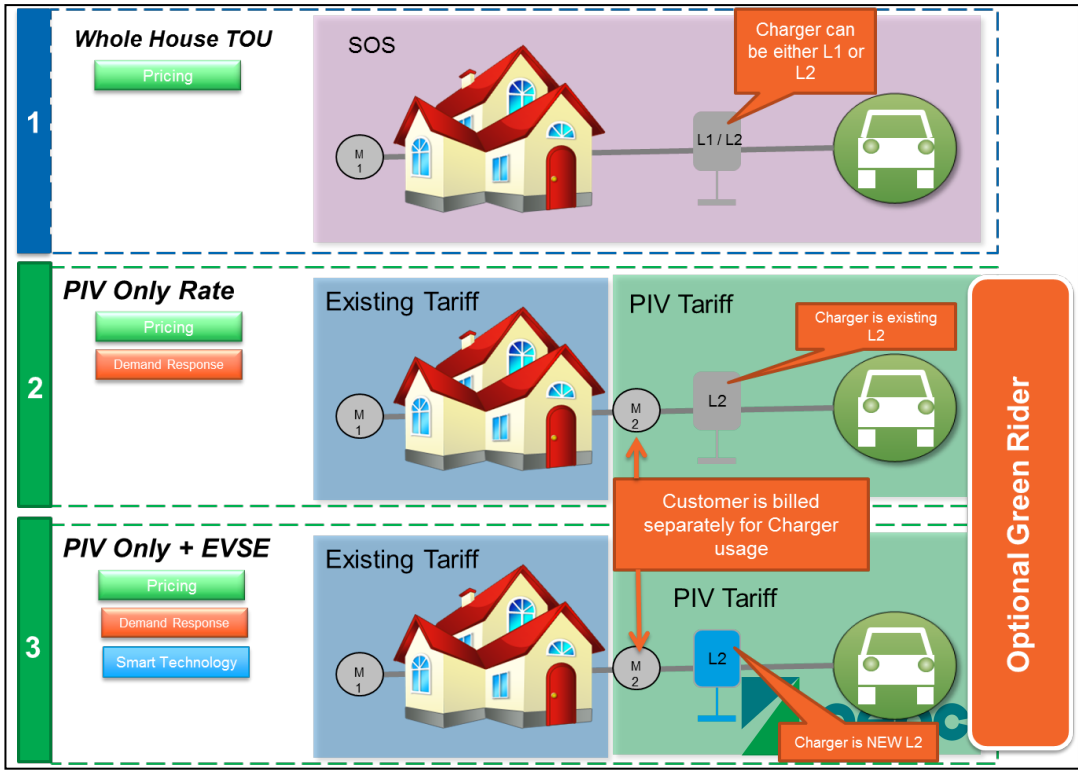
MD EV Pilot Program Details

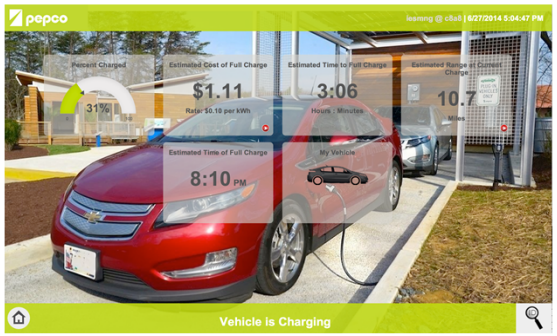
Completed 12/31/15

- Established through MD Legislation for Demand Response
- Demonstrated Passive and Active control for EV Charging
- Over 90% of the customers charged off-peak
- Included installation of 50 smart chargers
- Performed active EVSE control in concert with Demand Response events
- EPRI compiled and published results

154 Total Participants

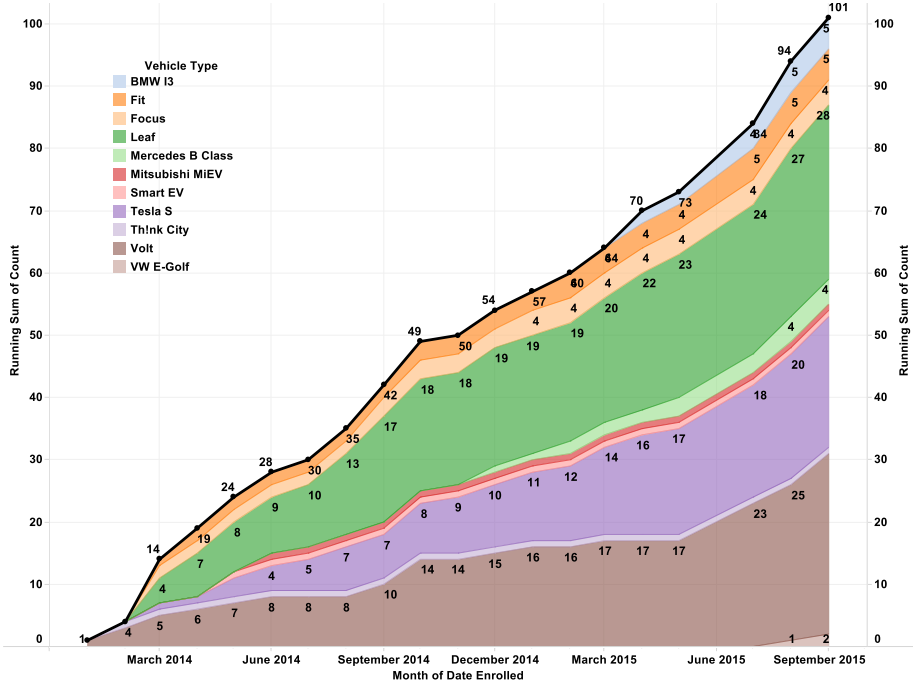


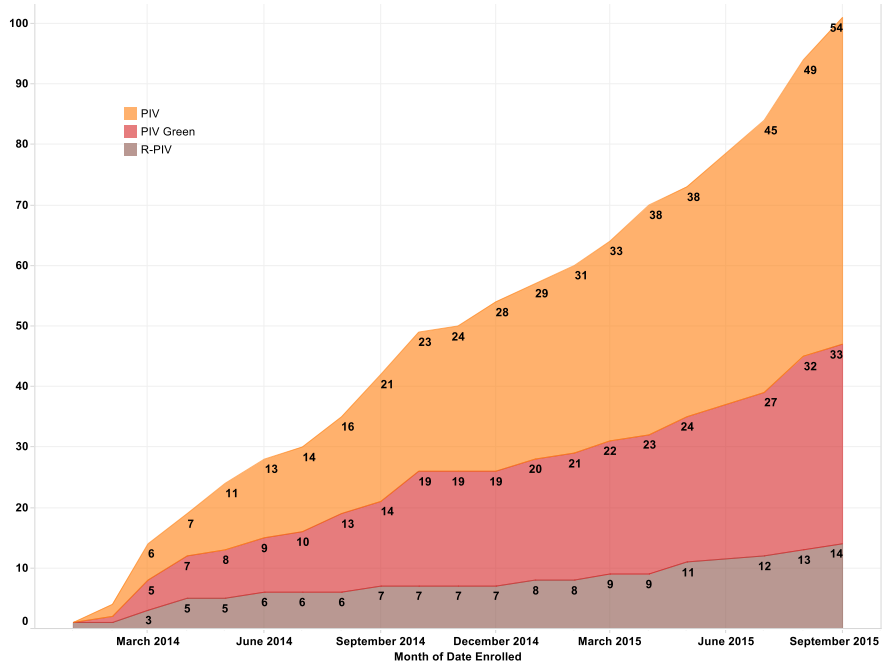




Pilot Participants

Enrollment over time, by rate





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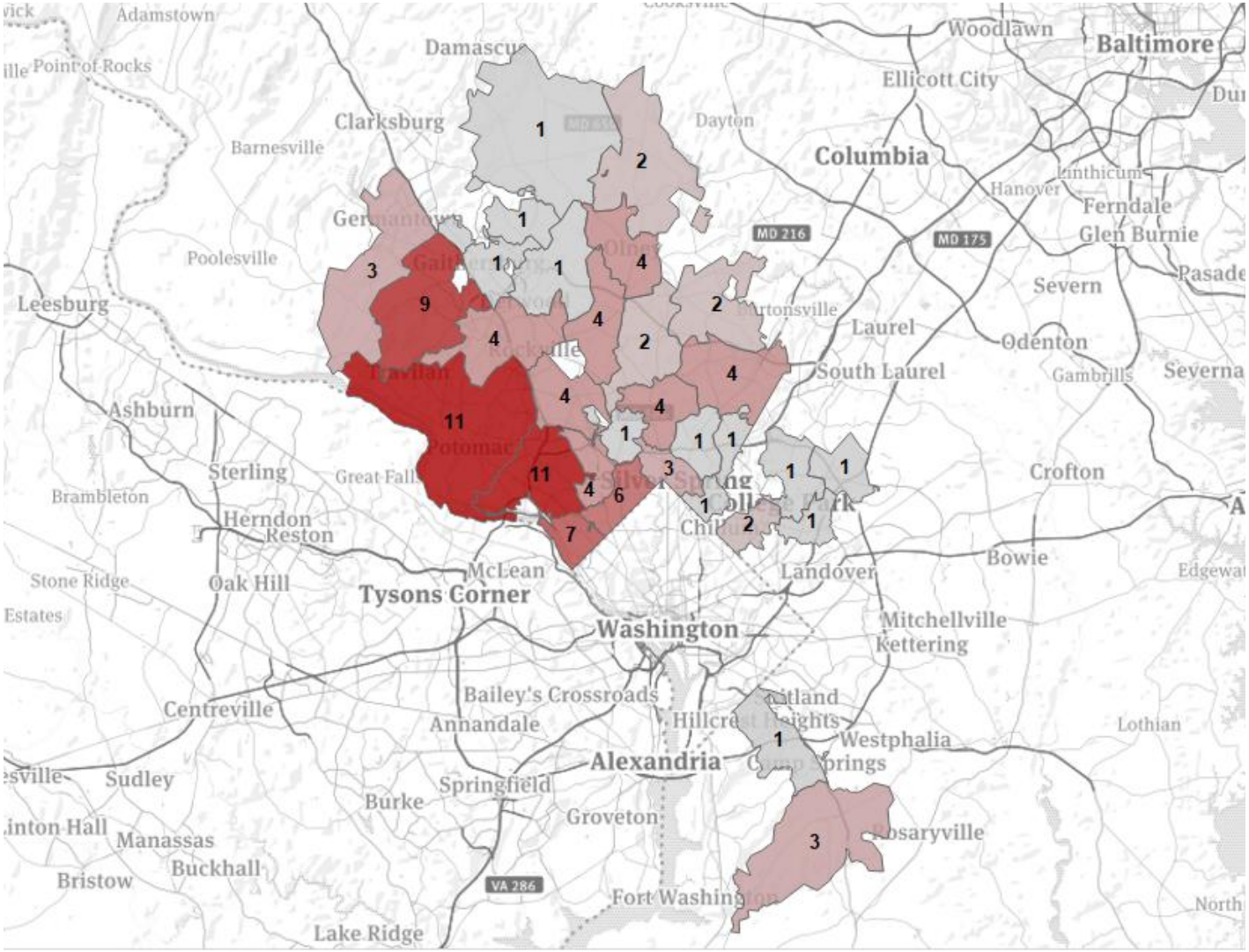
Pilot Participants

Location by zip code



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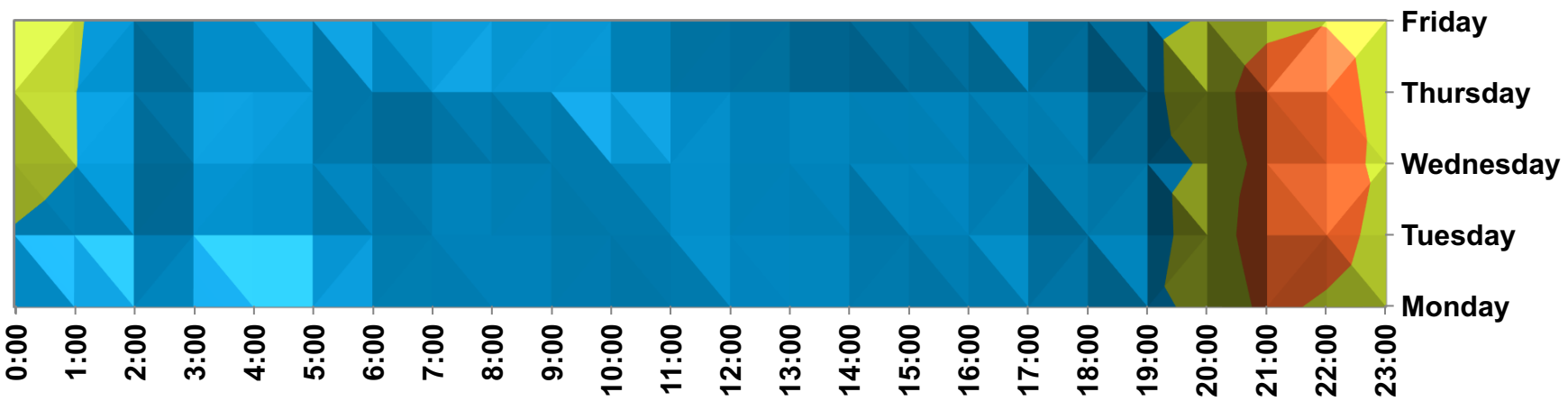
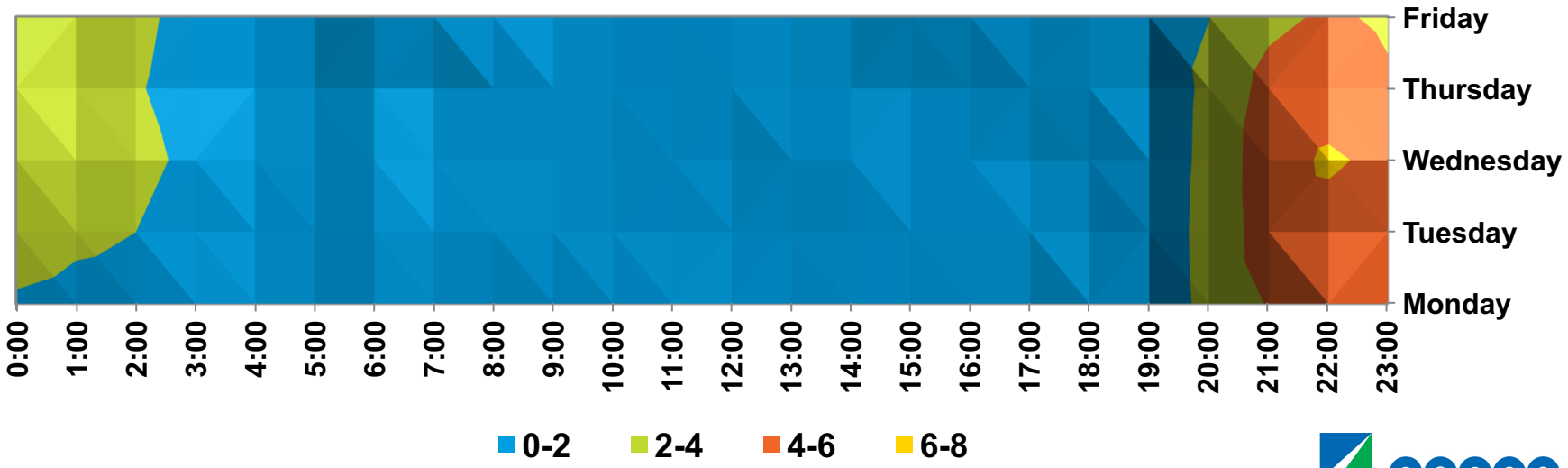
Results: Charging Behavior

Average Weekly Load Shapes

PIV Green (kW)



PIV (kW)



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A Smart EVSE Installation

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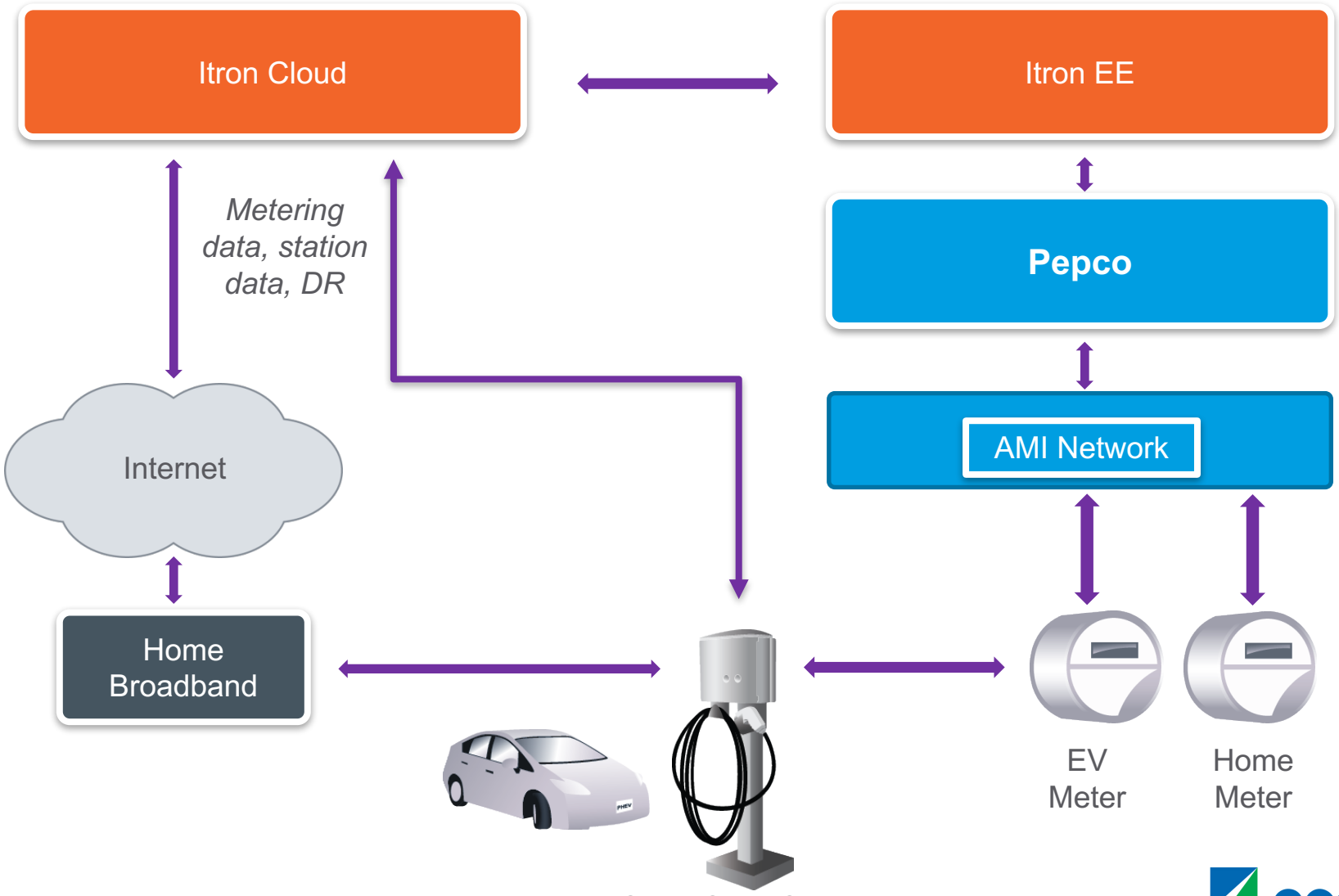
Smart Charging Architecture



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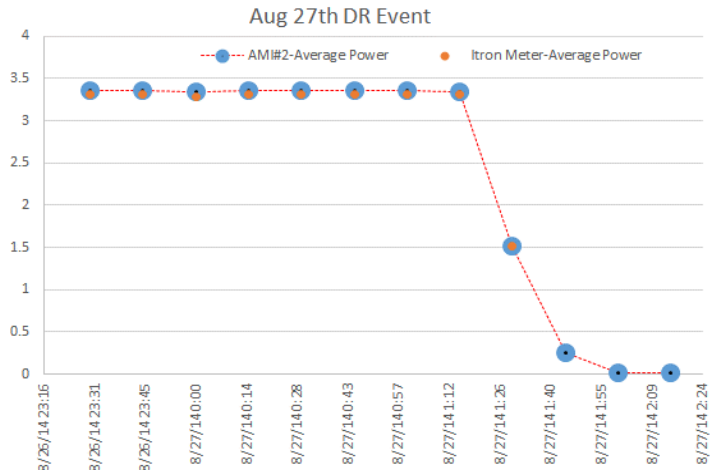
Results: Charging Behavior

Demand Response

Demand Response logistics:

- **Email the morning of the event**
- **Options:**
  1. **Not charge during the event**
  2. **Charge at level 1, peak charge rates apply**
  3. **'Opt out': Charge at level 2, peak charge rates apl**



Date	Time	Number of meter that received the DR event signal	Number of people charging during the event	Number Opted Out	Number of customers with reduced load
8/27/2014	2:00 PM-6:00 PM	9	2	1	1
9/2/2014	2:00 PM-6:00 PM	9			
7/21/2015	2:00 PM-6:00 PM	8			
8/3/2015	2:00 PM-6:00 PM	8	1		1
8/17/2015	2:00 PM-6:00 PM	9			
9/9/2015	2:00 PM-6:00 PM	10			
9/25/2015	2:00 PM-3:00 PM	11			

Results: Cost

Total Program Savings

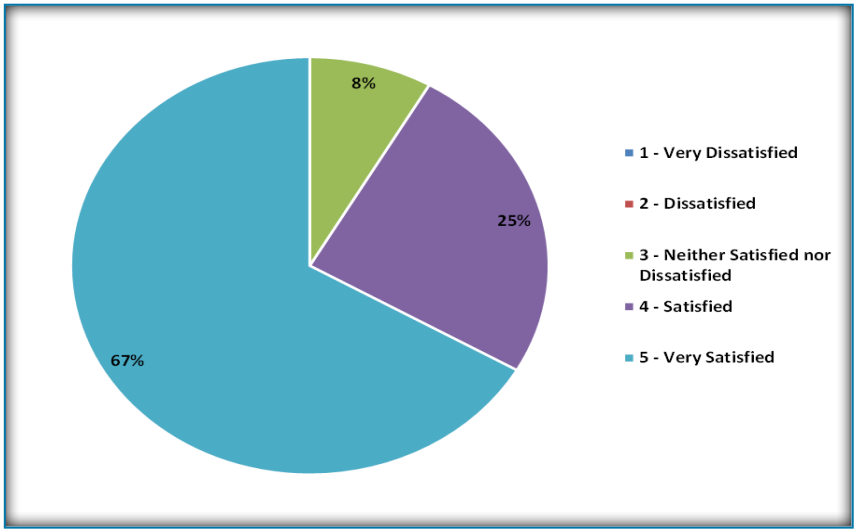
Aggregated Customer Savings							
Vehicle	Rate type	Total kWh	Energy Cost ($) Off Peak	Energy Cost ($) Peak	Total Energy Cost ($) (Peak & Off Peak)	If SOS* rate was used	Savings ($): SOS rates-Peak & Off Peak
Volt	PIV	19,235	$1,275.86	$327.61	$1,603.47	$2,321.27	$717.80
	PIVGreen	21,021	$1,638.15	$587.61	$2,225.76	$2,520.27	$294.52
Tesla	PIV	32,956	$2,348.90	$213.54	$2,562.44	$3,988.45	$1,426.00
	PIVGreen	23,869	$2,076.10	$177.96	$2,254.06	$2,843.76	$589.70
Leaf	PIV	30,607	$2,022.54	$518.62	$2,541.16	$3,662.92	$1,121.76
	PIVGreen	16,621	$1,381.80	$281.83	$1,663.63	$1,994.95	$331.32
Other	PIV	18,379	$1,182.75	$414.40	$1,597.14	$2,221.52	$624.38
	PIVGreen	13,852	$1,142.01	$259.82	$1,401.83	$1,666.68	$264.84
Aggregate	PIV	101,177	$6,830.05	$1,474.17	$8,304.22	$12,194.16	$3,889.94
	PIVGreen	75,362	$6,238.06	$1,307.21	$7,545.28	$9,025.66	$1,480.38
	TOTAL	176,539	$13,068.11	$2,781.38	$15,849.49	$21,219.81	$5,370.32

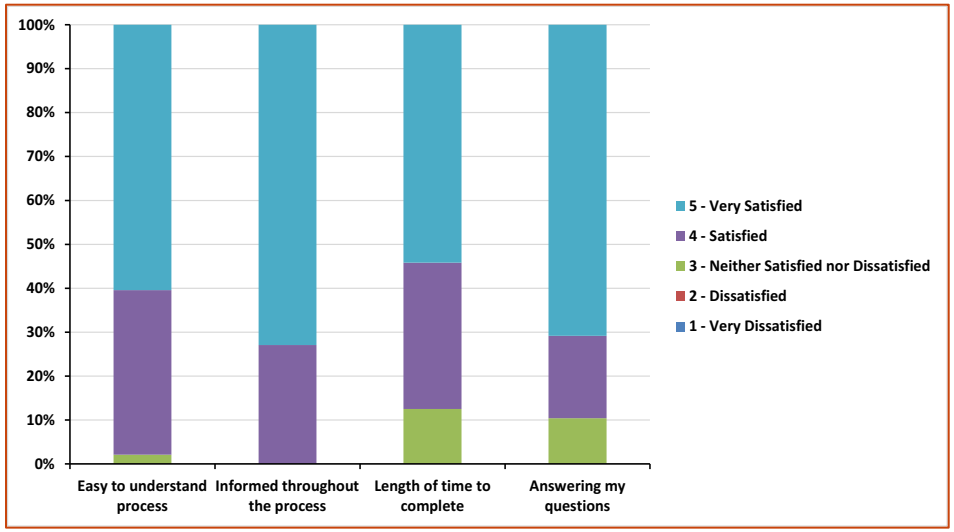
Results: Cost

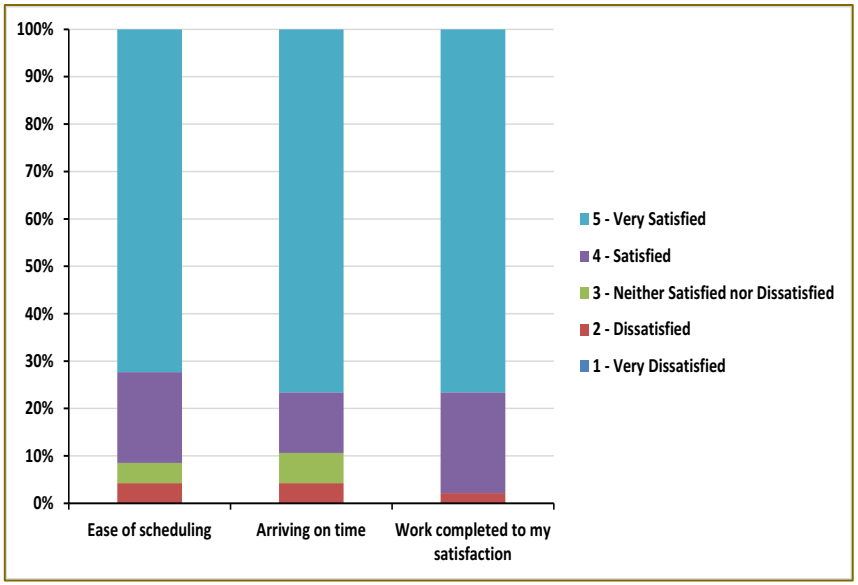
Average Monthly Savings

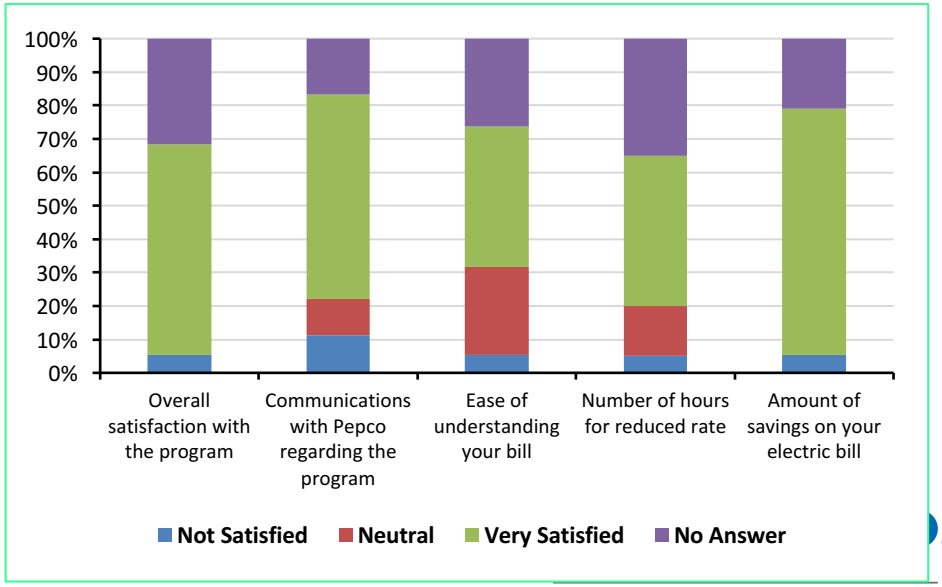
Average Monthly Energy Savings							
Vehicle	Rate type	Total kWh	Energy Cost ($) Off Peak	Energy Cost ($) Peak	Total Energy Cost ($) (Peak & Off Peak)	If SOS* rate was used	Savings ($): SOS rates- Peak & Off Peak
Volt	PIV	189	$14.08	$3.60	$17.68	$25.81	$8.13
	PIVGreen	203	$17.51	$5.84	$23.35	$27.66	$4.30
Tesla	PIV	272	$21.28	$2.52	$23.80	$37.04	$13.24
	PIVGreen	288	$28.40	$0.89	$29.29	$39.27	$9.98
Leaf	PIV	187	$13.52	$4.44	$17.96	$25.50	$7.54
	PIVGreen	187	$16.72	$4.23	$20.95	$25.55	$4.60
Other	PIV	159	$11.72	$3.24	$14.96	$21.65	$6.69
	PIVGreen	204	$18.15	$4.68	$22.82	$27.77	$4.94
Average	PIV	202	$15.15	$3.45	$18.60	$27.50	$8.90
	PIVGreen	221	$20.20	$3.91	$24.10	$30.06	$5.96
	Total Average	211	$17.67	$3.68	$21.35	$28.78	$7.43

Customer Feedback



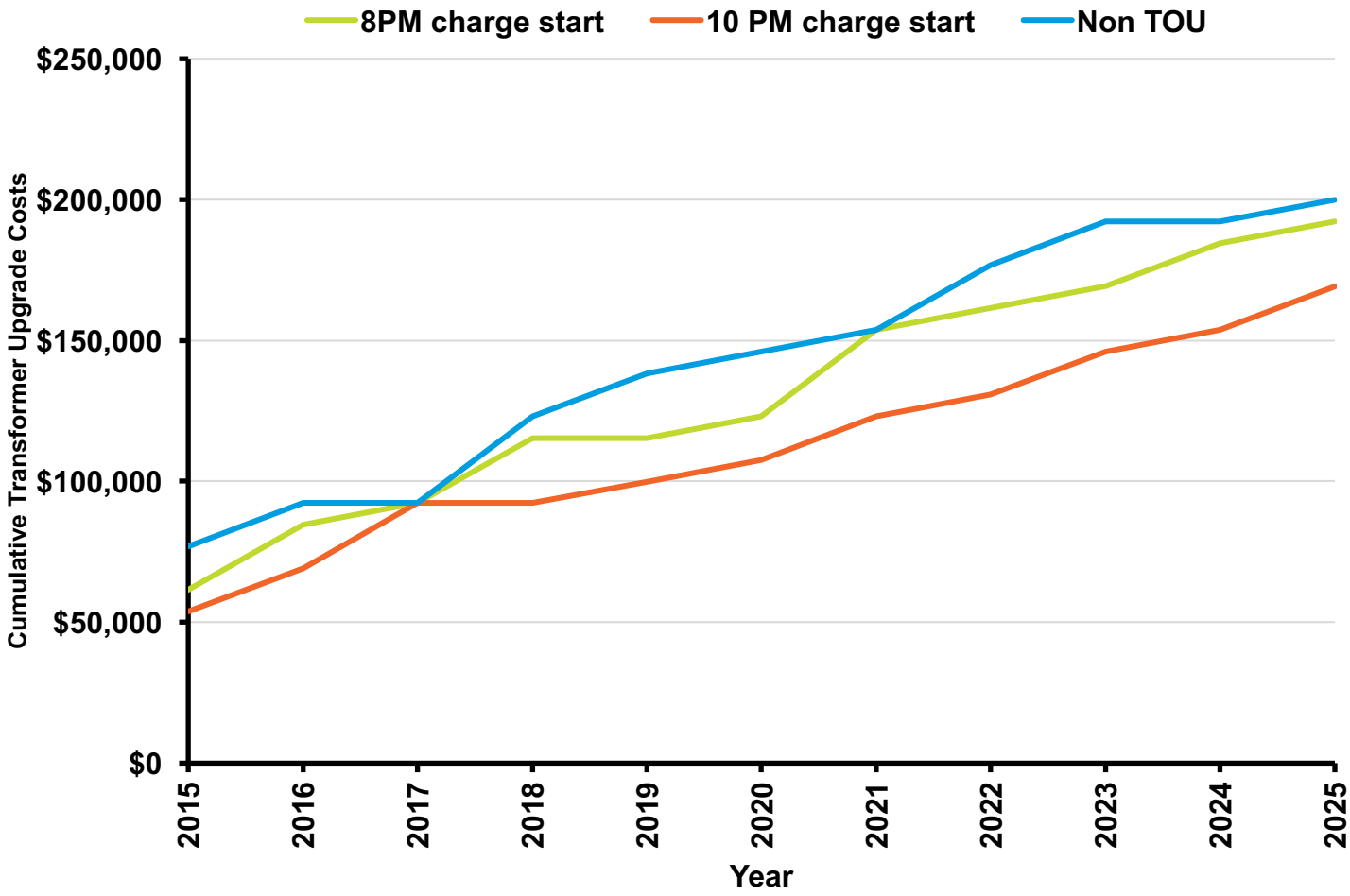






Results: Grid Impact

Hotspotter: Cumulative Upgrade Costs for 3 scenarios



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Results - Summary

- Customers took advantage of the off-peak rates
- Customers did not charge every day. When they charge, the State of Charge (SOS) is not zero
- Average kWh/day changes according to seasons, weekday/weekend and customers
- Customers were satisfied with the quality of the program
- Vehicles charged 0.87 times per day at an average 8.36 kWh
- Embedded meters with smart EVSE are within Maryland 2% standards. Further data verification will be needed
- Average installation cost for PIV Customers with Smart EVSE was $4,069
- Average installation cost for second AMI Meter for PIV Customers was $2,395
- During Energy Peak days (7), demand can be effectively reduced by controlling the smart EVSE level of charge while giving the customer “Opt Out” options
- Transformer loading analysis shows potential system impact by 2025

Next Steps

- Currently evaluating technology to streamline the installation and reduce costs associated with metering the PIV rate
  - Once complete, the Company will seek to establish the PIV and R-PIV tariffs as permanent offerings for MD Customers

- Continuing to leverage AMI data to provide a more detailed understanding of the potential grid impacts associated with EV Charging

- Considering additional opportunities to support EV markets in MD
  - DC Fast Charging
  - Commercial Level 2 Chargers and tariff
  - Incentives
    - Tracking premises
    - Charger Installations