PSE PUGET SOUND ENERGY

Education and Outreach Pilot Program

Program Support for Market Transformation

Nationally, research shows that consumer familiarity with electric vehicles (EVs) is low (around 50%)[1], and those considering an EV purchase is only around 25%.[1,2] Locally, PSE's customer research shows that 70% of current EV drivers believe there is not enough publicly available information about EVs.[3] In addition, local dealerships are the front-line for providing customer's information, but have limited knowledge on EV options, benefits, charging, and incentives when selling EVs to shoppers.[4]

Education and outreach (E&O) represents an important component of PSE's overall EV portfolio offering to customers. PSE's E&O pilot program has the goals of providing the "next generation" of EV drivers with greater awareness and understanding of EVs and helping overcome barriers toward EV adoption. The pilot program is aimed at moving the market towards increased EV adoption, supports Governor Inslee's goal of 50,000 EVs on Washington's roadways by 2020,[5,6] and promotes a market growth trajectory beyond 2020.

Program Objectives

This pilot program is designed to accelerate consumer awareness of transportation electrification through education and outreach; a core component of PSE's portfolio strategy. Program objectives to support this strategy include:

1) Raise awareness of electric transportation options by using PSE's existing connection to customers to provide impartial information about electric transportation options, benefits, cost information, PSE program offerings, and other resources[7]
2) Increase knowledge of electric transportation through events where EVs can be experienced first-hand, and developing community partnership that provide resources to local partners such as auto dealerships, municipalities, and employers[8]
3) Support customers in making informed decisions about electric transportation options using tools and technical assistance

[1] Singer, M. "Consumer Views on Plug-In Electric Vehicles – National Benchmark Report." National Renewable Energy Laboratory. Jan 2016.
[2] "Electrifying insights: How automakers can drive electrified vehicle sales and profitability." McKinsey. Jan 2017.
[3] "Electric Vehicle Charger Incentive Program Report", Puget Sound Energy, April 2018.
[4] "Electric Vehicle (EV) Sales Experience and Best Practice Study", Ipsos RDA, Nov 2017.
[5] "Washington State Electric Vehicle Action Plan." Washington State Department of Transportation. 2015.
[6] "Transportation." Access Washington. 2018. https://www.governor.wa.gov/issues/issues/transportation.
[7] Study found that utilities can leverage the experience and outreach fostered through programs to educate customers and manage successful transportation electrification programs. Schefter, Kellen. "Accelerating Electric Vehicle Adoption". Edison Electric Institute. Feb 2018.
[8] "Electric Vehicle Charger Incentive Program Report", Puget Sound Energy, April 2018.

Program Summary

PSE proposes a pilot Education & Outreach program of two years, in order to accelerate transportation electrification while also supporting PSE's portfolio of EV program offerings. Research has shown that digital platforms are the primary method for engaging and interacting with utility customers.[9] PSE's program will place an emphasis on digital education and outreach resources, inclusive of an interactive website, but will also include traditional print and in-person channels. A summary of the pilot program's objective areas are outlined below.

Customer Awareness

PSE will develop digital and print resources and messaging designed to educate customers on transportation electrification options and considerations.[10] These will address misconceptions around EVs,[11] promote PSE's electric transportation programs, and make customers aware of other resources, such as state and federal tax credits.[12]

PSE's website will be a source of comprehensive information to assist in a customer's learning online by providing clear and easily accessible information.[13,14] PSE will expand its existing website in order to create a more interactive and informative experience for customers while also promoting program offerings.[15]

Outreach will include traditional advertising like radio and print, but will emphasize digital channels as car shoppers spend the majority of their time making decisions around vehicles while shopping online.[16,17] The program will develop and deploy content through methods like email newsletters, social media, and other digital media channels. PSE will also develop printed material to be used at events and to distribute to stakeholders like auto dealerships. These materials can serve as an information source to assist customers with EV and charging questions. In addition, print and digital materials will reference higher-touch resources like PSE's Energy Advisors.[18]

Customer awareness activities may include:

- Educational web content around incentives, charging options, and vehicles
- Developing collateral (flyers, one-pagers) that can be used at events, partner locations, and online
- Partnering with local auto dealerships to provide tutorials and informative materials

[9] "Customer Experience & Expectations." Smart Energy Consumer Collaborative. Dec 2017.
[10] From PSE's 2017 customer research, 70% of current EV drivers reported not having enough information about electric vehicles "PSE EV Customer Research." 2017.
[11] "Electrifying insights: How automakers can drive electrified vehicle sales and profitability." McKinsey. Jan 2017.
[12] "Alternative Fuel Vehicles and Plug-In Hybrids Washington State Tax Exemptions." Washington State Department of Licensing. 2018. http://www.dol.wa.gov/vehicleregistration/altfuelexemptions.html.
[13] Hall, D. and Lutsey, N. "Emerging Best Practices for Electric Vehicle Charging Infrastructure." The International Council on Clean Transportation, Oct 2017.
[14] Edison Electric Institute reported "electric companies' existing relationships with customers allow them to grow familiarity and interest in electric transportation." Schefter, Kellen. "Accelerating Electric Vehicle Adoption." Edison Electric Institute. Feb 2018.
[15] "Beyond the hype: What is the value of customer satisfaction to a regulated utility?" PricewaterhouseCoopers. 2015.
[16] "Beyond the hype: What is the value of customer satisfaction to a regulated utility?" PricewaterhouseCoopers. 2015.
[17] Industry study found that across all car shoppers, 61% of decision-making time is spent researching and shopping online "Car Buyer Journey 2018" Autotrader, Dealer.com, Kelley Blue Book, Cox Automotive, 2018.
[18] Industry study found that third party sites are the most used online sites during the car shopping experience. "Car Buyer Journey 2018" Autotrader, Dealer.com. Kelley Blue Book, Cox Automotive. 2018.

- Description of program offerings for residential, multi-family, and commercial customers
- Direct customer outreach on program offerings
- Targeted advertising and digital media campaigns
- Email marketing regarding PSE program offerings

Events & Community Partnership

A large component of the vehicle-buying process includes experiencing the vehicle firsthand, which is typically done through test drives at auto dealerships. Often car-buyers avoid the auto dealership until they are ready to purchase a specific vehicle.[19] Ride & Drive events are the opportunity to showcase EVs in a no-pressure environment, and allow customers to become familiar with an EV.[20] To determine if Ride & Drive events could be a valuable part of E&O programs, PSE conducted a successful Ride & Drive event in October 2017 where close to 100 test drives were conducted during the 5-hour event. PSE will continue offering this type of successful event format as long as customer interest remains high.

In addition to Ride & Drive events, PSE will participate in other community events, like National Drive Electric Week[21], to answer customer questions and promote resources. This will be a sustained effort since often purchasing/leasing a new vehicle can involve a long consideration period.[22]

Community partnership activities may include:

- Organizing Ride & Drive events throughout PSE's service territory
- Being present at local events to answer customer questions
- Partnering with municipalities as they plan and respond to local needs
- Following up with customer after events with any further questions

Tools & Technical Assistance

PSE is a valuable resource to customers as they make energy decisions, and EV programs will continue this interaction.[23] This will include developing online tools for customers to self-serve around EV decisions (such as EV calculators[24]), and provide other channels for customer inquiries, including phone and email. PSE conducted research with potential EV buyers, and found that these customers view EV events and tools as useful resources in decision-making.[25] In addition, many customers who are considering an EV purchase have limited knowledge about charging options.[26] PSE will work to address customer concern by using existing materials that are currently available, while also tailoring materials specific to PSE customers.

[19] "The consumer decision journey." McKinsey & Company. 2009.
[20] "Accelerating the Electric Vehicle Market: Potential Roles of Electric Utilities in the Northeast and Mid-Atlantic States." MJB&A. Mar 2017.
[21] "Drive Electric Week". https://driveelectricweek.org/
[22] Industry study found that in 2018, car shoppers spent on average 108 days in the market shopping for a car. "Car Buyer Journey 2018" Autotrader, Dealer.com, Kelley Blue Book, Cox Automotive, 2018.
[23] Study found that utilities can leverage the experience and outreach fostered through programs to educate customers and manage successful transportation electrification programs. Schefter, Kellen. "Accelerating Electric Vehicle Adoption". Edison Electric Institute. Feb 2018.
[24] PSE internal research and vendor quotes on EV calculators and tools. 2017.
[25] "2017 PSE EV Customer Research", 69% of EV Intenders are "Somewhat Interested" or "Extremely Interested" in EV Workshops.
[26] "2017 PSE EV Customer Research", 86% of EV Intenders have not researched and narrowed charging options, 2017.

PSE will also develop a training curriculum for its own employees, materials for auto dealerships, and resources for other partners. These materials are intended to inform customer-interfacing stakeholders so they can be knowledgeable and consistent in providing guidance to customers.[27] The materials will focus on providing information around the EV purchase decision and subsequent considerations (charging, etc) required for EV ownership.

Technical assistance activities may include:

- Developing online tools for customers to use for assessment purposes. This may include calculators, vehicle model comparison, and charging options/costs
- Developing training materials for PSE front-line employees (e.g. Energy Advisors) and internal staff to help answer customer questions
- Developing tailored tools and collateral for specific customers (e.g. residential vs commercial)
- Providing briefing materials for key stakeholders (i.e. dealers) in order to message consistent information to customers regarding EVs

Based on PSE's core program areas and target activities, Figure 1 details the number of customer impressions PSE anticipates to receive in the first year of the program.

Figure 1. Indicative Education & Outreach Pilot Program Activities & Impressions (Year 1)

	Tactics	Year 1 Estimated Impressions
Paid Media		
	Radio promotion	N/A
Digital		
	Search Engine Marketing (SEM)	2,000,000
	Website	48,000
	Email (newsletter)	3,000
	Social organic	40,000
	Social paid	300,000
Print		
	PSE fleet wrap	1,000,000
	Brochures	10,000
	PSE "The Voice" Distribution	3,000,000
Events		
	Ride & Drive event attendance	10,000
	Ride & Drive test drives	300
Other		
	Energy Advisor contact	1,000

[27] "Excellence in Consumer Engagement." Smart Energy Consumer Collaborative. 2011.

Program Schedule & Budget

Figure 2. Education & Outreach Pilot Program Projected Schedule

Education & Outreach Activity	Year 1	Year 2	Year 3
Website & Tool Development			
Develop/refresh outreach material			
Internal staff trainings			
Dealer/stakeholder training			
Ongoing customer outreach (Figure 1)			
Ride & Drive Events			
Market Surveys (baseline + recurring)			
Data Analysis & Reporting			

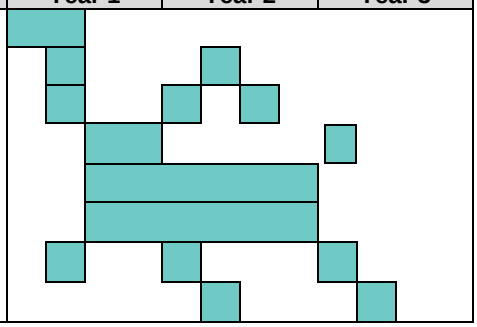

Figure 3. Education & Outreach Pilot Program Budget Projection

(in '000)	Year 1	Year 2	Year 3
Projected Capital Costs	$166.9	$0	$0
Projected Expenses	$679.8	$704.3	$66.8

PUGET SOUND ENERGY

Residential Charging & Off-Peak Pilot Program

Program Support for Market Transformation

PSE customers' electric vehicles (EVs) adoption continues to increase[1]. Based on PSE research, approximately 96% of PSE's current EV customers charging their vehicle at their place of residence,[2] typically during evening peak hours.[3] Given the contribution of residential charging to evening peak loads, mainstream adoption of EVs without diversity of charging times may drive a need for additional generation resources. PSE's most recent Integrated Resource Plan (IRP) showed that without changing the time at which vehicles are charged, by 2037 an additional 277 MW is needed to meet peak capacity needs and 44 MW more to meet renewable needs.[4] While research suggests that EV owners are eager to cooperate with utilities to reduce grid impacts when provided with information, the extent to which customers will shift charging behavior based on education or incentives is unclear as past research has focused on small populations of drivers.[5,6,7]

PSE's Residential Charging and Off-Peak pilot program seeks to test and identify effective education/incentive-based methods to encourage customers to charge off-peak at their homes to curtail the need for additional generation resources to support EV charging.

Program Objectives

1) Increase customer knowledge around off-peak charging benefits[8]
2) Determine appropriate technology and education/incentives to encourage customers to charge in off-peak times
3) Develop realistic estimates of peak load that can be feasibly moved to different times
4) Build a best practice toolkit for installation of charging in different homes, servicing, and ideal charging mix among other options (e.g. public, workplace)[9] in coordination with other programs in PSE's electrified transportation portfolio
5) Determine ability, plan, and optimal design to deploy an off-peak charging program at-scale

[1] WSDOT Hybrid Vehicle and Alternative Fuel Report, 2018.
[2] PSE found that 4% of drivers in service territory do not charge their vehicle at home, 70% use Level 2 home charging, and 26% use Level 1 home charging. "PlugInsights EV Driver Survey for PSE." PlugInsights. 2017.
[3] "Electric Vehicle Charger Incentive Program Report", Puget Sound Energy, 2018.
[4] "2017 PSE Integrated Resource Plan", Section 6 Electric Analysis, Scenarios and Sensitivities, 2017.
[5] "Demand Management Pilot for Plug-In Vehicle Charging in Maryland." Pepco. 2015.
[6] The PG&E and BMW partnership found that 70 of 100 participating cars were typically available to delay their charging by an hour if given a financial incentive. Kaufman, Leslie. "BMW Tests Electric Cars as Power Grid Stabilizers." Inside Climate News. Jun 28, 2017.
[7] Braintree Electric Light Department (BELD) provides participating EV drivers $8 per month for charging during off-peak hours. BELD focuses on increasing awareness of off-peak charging through marketing. Krysti Shallenberger, Krysti. "Do utilities need rate design for electric vehicle charging?" Utility Dive. Nov 15, 2017.
[8] "Customer Acceptance, Retention, and Response to Time-Based Rates from the Consumer Behavior Studies" DOE Smart Grid Investment Grant Program. Nov 2016.
[9] Rocky Mountain Institute reports there is "still very little data available to provide empirical evidence to prove one approach is better than another" for charging installation practices. From Gas to Grid." Rocky Mountain Institute. Sep 2017.

Program Summary

PSE's Residential Charging and Off-Peak pilot program will run for up to five years and provide EV owners with incentives charging during off-peak hours to reduce the impact of EVs on PSE's power supply and to determine the program design and technology solutions that can be scaled up to a large number of customers.

The Off-Peak Pilot will enroll approximately 550 residential customers and test strategies for shifting charging load using education and/or targeted incentives to encourage behavior change. In addition, this Pilot will test three different technologies for monitoring charging behavior (discussed in more detail below). Using lessons learned from this Pilot, in the future PSE plans to develop a larger program to a wider customer base to maximize the benefits of charging at different times.

The target customer enrollment numbers for the Pilot and subsequent programs are outlined in Figure 1 below.

Figure 1. Target Customer Enrollments and Charger Installations per Year

	Year 1	Year 2	Year 3	Year 4
Residential Customer Enrollment	500	0	0	0
Residential Charger Installation	300	200	0	0
Alternate Off-Peak Technology Enrollment / Installation	50	0	0	0

EV Off-Peak Pilot Description

The objectives of the EV Off-Peak Pilot are to (1) pilot an off-peak EV charging program that has the ability to scale and eventually be offered to all EV customers, (2) test incentive mechanisms for getting customers to change the time they charge, and (3) test different technologies for verifying off-peak charging behavior. PSE will implement this Pilot primarily using smart chargers, which PSE found through an assessment in 2017 to be the most appropriate technology to conduct a pilot with customers, detailed further in Appendix A.[10]

The EV Off-Peak Pilot will include approximately 550 customers; which consists of 500 smart chargers, and approximately 50 "alternate" technology methods like Open Vehicle Grid Integration Platform (OVGIP)[11] and vehicle telematics. Detailed descriptions of these technologies are included in Appendix A. The 50 customers in the alternate technology are smaller because of where the technology is in development; they are earlier stage and have not yet been proven at scale. Customers who qualify for a smart charger will receive a free smart charger and have 75% of the the installation paid for in exchange for participation in the Off-Peak Pilot, subject to a cap on the total cost contribution. Customers participating in the Pilot must own an EV and have access to a designated charging area. Customers who previously participated in PSE's $500 Level 2 rebate program are not eligible to participate in this Pilot. Customers participating in the Off-Peak Pilot will be eligible for different incentives based on

[10] "Electric Vehicle Charger Incentive Program Report", Puget Sound Energy, 2018.
[11] "Open Vehicle-Grid Integration Platform, General Overview." EPRI. July 2016.

their assigned “reinforcement” (or treatment) group (see Appendix B).

PSE recognizes that over time “off-peak” may be a dynamic timeframe and that overall customer offerings will change over time. PSE may also look at how renewables can be integrated into Off-Peak charging times. For this Off-Peak Pilot, the program will evaluate:

- Incentive and education methods for increasing and maintaining off-peak charging
- Technology effectiveness for tracking off-peak charging
- Program persistence of off-peak charging
- Impacts of residential charging patterns on system peaks, demand charges, and energy usage
- Technical and original equipment manufacturer (OEM) viability
- Participant experience and satisfaction with pilot

Off-Peak Mechanisms

The EV Off-Peak Pilot will test PSE’s ability to encourage off-peak charging through the use of incentives. PSE will use various mechanisms (monetary, education/information, etc.) to test whether customers shift the time they charge and the relative effectiveness of each incentive mechanism.

PSE considered the use of Time-of-Use (TOU) rates as a mechanism to shift EV charging behavior to off-peak hours, but decided to instead test customer incentives through the Pilot to minimize impact on customers from having to learn new rate schedules. While TOU mechanisms and EV-specific rates are strategies currently used by utilities to affect times at which customers charge EVs, PSE recognizes that TOU rates may impact customer satisfaction.[12] Further, the customer behavior learned through this pilot could be used to help with any future rate design, which could include TOU rates. PSE views incentives or rewards programs as a way to increase engagement with EV drivers while also encouraging off-peak charging.

PSE’s off-peak program has several important benefits, including: (1) the development of a more engaging customer experience, (2) the potential to work more directly with customers to shift behaviors (including the potential for two-way communication for improving grid operations), and (3) the ability to familiarize new EV drivers with charging patterns that avoid peak impacts.[13]

The program objectives, reinforcement groups, and sample size, is included in Appendix B.

Charging Verification

In 2017, PSE assessed various technology platforms that could be used for verifying charging behavior as part of an off-peak program. As a result, PSE proposes testing three technologies in the Pilot (these technologies are described in more detail in Appendix A):

1. Smart chargers[14]

[12] “Do utilities need rate design for electric vehicle charging?” Utility Dive. Nov 15 2017.
[13] “Do utilities need rate design for electric vehicle charging?” Utility Dive. Nov 15 2017.
[14] Wi-Fi/cell enabled charging stations with the ability to view and/or control charging events.

2. Open Vehicle Grid Integration Platform (OVGIP) platform
3. Telematics technologies

Smart Charger Technology

Based on an evaluation of the current state of these technologies, PSE believes that the "smart charger" technology is currently the most effective option for charging verification during a pilot.[15] Smart chargers are in-home chargers that provide several advanced features, including the ability to monitor and share EV charge event statistics with PSE via on online platform.[16] PSE already has experience with smart chargers to support its own vehicle fleet. In PSE's previous residential charging program, a few customers chose smart charger technology for their charger rebate. Since then, the number of available residential smart chargers has grown and the price point of those chargers has decreased significantly. The EV Off-Peak Pilot will include 500 participating customers using smart chargers.[17] Participating customers will receive a PSE-owned smart charger free of charge for the equipment and installation, and will allow them to charge their vehicle at their home and control their charging time via software.

Through a Request for Proposal (RFP) PSE intends to select at least two equipment manufacturers that meet specifications to demonstrate smart charging feasibility for the preliminary pilot. From PSE's experience and the program goals of encouraging market competitiveness, PSE believes that an RFP process will provide a more robust list of qualified vendors. Once PSE has demonstrated technical viability and customer acceptance, PSE will evaluate expanding to other hardware and software platforms. For a pilot of this scale, PSE will require vendors to provide visibility into customer charging patterns and charger usage (either via their software or integrated into existing PSE systems) and afford customers an excellent user experience. Understanding home charging behavior and investing in technology that cost-effectively provides data collection is essential as the number of EVs in PSE's service territory expands. PSE intends to integrate charging data into future programs as well, so software solutions must be able to meet the needs to both the pilot and a much larger number of customers.

In addition, PSE will conduct small-scale technology demonstrations with technologies like OVGIP and telematics technologies. These will likely be on the scale of 10-50 participants. The participation is smaller because these technologies are earlier in their development and it is unknown as to whether these technologies can scale to large numbers in terms of customer experience and cost.[18] By conducting a smaller pilot, PSE can determine whether these technologies can be scaled to a larger customer audience.

Customer Contribution

For program qualification, PSE plans to cover the cost of L2 home charging equipment to the customers. This cost is fixed, and in order the maintain program goals, PSE would like to have oversight on specified equipment. PSE will require that residential customers contribute part of the installation cost of equipment. PSE's program would cover 75% of the installation cost, up-to $2000. For example, if the overall installation cost is $1000, PSE would pay for $750 and the

[15] "Electric Vehicle Charger Incentive Program Report." Puget Sound Energy. 2018.
[16] This technology is further outlined in Appendix A.
[17] This sampling is further outlined in Appendix A.
[18] "Electric Vehicle Charger Incentive Program Report." Puget Sound Energy. 2018.

customer would be responsible for $250.

Larger Deployment of EV Off-Peak Program

Following the results of the Off-Peak Pilot and assessment of successful incentive mechanisms, PSE will launch a larger scale EV Off-Peak Program that will encourage customers to shift their charging load from evening peak to off-peak times. The objective of this program is to minimize energy use of EVs at peak times and provide PSE flexibility in shifting charging loads to off-peak periods. The details of this roll-out will be dependent on findings from the Pilot regarding technology verification and effectiveness of behavior change strategies.

The current program is scheduled to last for up to 4 years, but if early results from the program, technology evolution, or market evolution allow PSE to modify the program or increase it's scale prior to the end of 4 years, PSE will revisit the pilot design and propose changes.

Program Schedule & Budget

Figure 2. Residential Charging and Off-Peak Pilot Program Projected Schedule

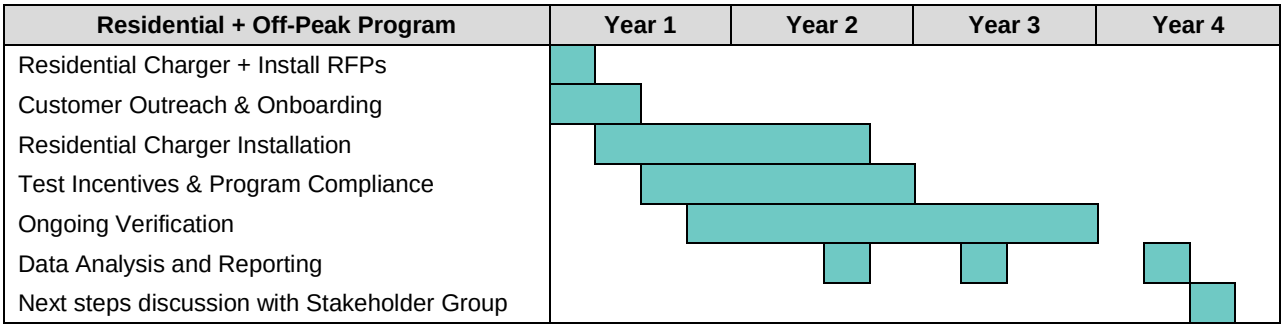

Figure 3. Residential Charging and Off-Peak Pilot Program Budget Projection

(in '000)	Year 1	Year 2	Year 3	Year 4
Projected Capital Costs	$1,803.6	$380.1	$40.4	$69.0
Projected Expenses	$683.4	$610.9	$591.4	$598.5

Residential Charging & Off-Peak Pilot Program – Appendix A

In 2017, PSE assessed various technology platforms that could be used for verifying changes in charging behavior during an EV off-peak program. PSE identified five approaches to measure and verify EV charging behavior. These included AMI/AMR load disaggregation, use of the Open Vehicle Grid Integration Platform (OVGIP), Vehicle Telemetry/Telematics, smart chargers, and Self-Report.[19] These approaches are discussed in more detail in this section, and are also the results from the 2018 "Electric Vehicle Charger Incentive Program Report" from PSE's previous rebate program

EV Charging from Meter Data Disaggregation

PSE tested if the increased electricity usage during EV charge events should be detectable in the meter data of a home or building.[20] Oracle's DataRaker team developed an algorithm to determine EV charge events using 15-minute automatic meter reading (AMR) data. The developed algorithm was only 60% accurate, even when compared to known charging patterns, which PSE determined was too low for an incentive-based compliance system. While PSE found that the DataRaker service and algorithm has not reached an adequate level of maturity for use in the pilot or full-scale program, it may prove useful in the future.

Open Vehicle Grid Integration Platform (OVGIP)

The Open Vehicle Grid Integration Platform (OVGIP) is a software application that enables EV and charging infrastructure management. Since its inception in late 2012, OVGIP has been a joint utility industry and automotive industry initiative led by the Electric Power Research Institute (EPRI). OVGIP offers several benefits, including the robust ability to detect charge events both at the home and at public charging stations and a no-installation and hassle-free user experience. PSE found that OVGIP is limited primarily by the development of an integrated and automated platform. PSE has had individual conversations with key auto manufacturers who are interested in participating in PSE's pilot program.

Vehicle Telemetry/Telematics

Vehicle telemetry involves the use of a physical device that plugs into a vehicle for monitoring a wide range of activities and statistics, including EV charge events. PSE has been in communication with FleetCarma, a manufacturer of vehicle telemetry devices for EVs. Like OVGIP, FleetCarma devices would be able to monitor charging activity both within the home and outside the home. Peer utilities using FleetCarma telematics have provided valuable operational information about the technology. There are a number of questions that need to be answered in the pilot, such as the cost to deploy this technology at scale.

Smart Chargers

Residential smart chargers are EV charging stations that provide several advanced features, including the ability to monitor and share EV charge event statistics with PSE via on online platform. Smart chargers are generally compatible with all popular EV brands, and have a

[19] "Electric Vehicle Charger Incentive Program Report." Puget Sound Energy. 2018.
[20] Chris, Chen, et al. "Method for detection of plug-in electric vehicle charging via interrogation of smart meter data." US Grant. 2017. https://patents.google.com/patent/US9156368.

robust data collection and transmission system. However, smart chargers are a fixed asset and limited to detecting charge events that occur at the customer's home. External charge events or charging at public stations by the customer will be undetectable. There is also a question of whether chargers will be a cost-effective technology platform at-scale.

Self-Report

In addition to the direct measurement methods mentioned above, PSE also considered self-reporting as an option to assess compliance with the EV off-peak program. Participants would be asked periodically about their charging behavior and their level of compliance. For this pilot program, this method is not planned as a customer reinforcement measure, but likely conducted through customer surveys for comparison.

Assessment Results

The table below summarizes PSE's overall assessment of the four direct-verification mechanisms. PSE assessed each verification pathway in terms of technology effectiveness, cost, scalability, and program risk.

Figure 4. Charging Verification Technology Assessment Matrix

	Technology Effectiveness How accurate is the technology pathway at detecting charging events?	Cost What are the up-front and on-going costs associated with this pathway?	Scalability How easily can this pathway scale to a full program?	Program Risk What risks exists with this pathway and what is the likelihood of potential mitigation strategies?	Other Considerations
AMR/AMI Meter Data	Needs further refinement for detection analysis accuracy	$ Low	Good; doesn't measure use outside residential charging.	Dependent on data analysis, which is currently not able to detect events at a satisfactory level	Improvements in algorithm detection may be made in next few years; continue to explore option
Car Telematics	Good	$$ Moderate to High; high upfront cost and subscription service charges.	Uncertain; Highly dependent on unit costs and vehicle compatibility.	Moderate risk, compatibility for different vehicles; data security.	Good for actively managed charging if PSE decides to implement this in the future. Cost is big consideration.
OVGIP	Good	$ Moderate, depends on incremental costs.	Dependent on participation of auto manufacturers and utilities; may be a risk going forward.	Moderate risk	Ongoing improvements in participation and platform development
Smart Chargers	Good, doesn't include use outside residence	$$ Moderate to High; high upfront cost and subscription service charges.	Moderate; dependent on cost and customer willingness to install technology.	Moderate risk, back-end software must be compliant with PSE systems.	Data compatibility/format may be different for vendors.

Legend
Not available
Positive assessment
Poor assessment
Neutral assessment

Residential Charging & Off-Peak Pilot Program – Appendix B

Appendix B outlines how the program will approach grouping, incentive structures, and a discussion on the target sample sizes.

Incentive Strategies

Each customer participating in the Residential and Off-Peak charging program will receive an incentive (or payment) for their participation. The timing and distribution of the incentive will vary dependent on the Reinforcement Group the customer is assigned to. All customers participating in the program will receive an incentive for participation. PSE has estimated this incentive to be $120 per year (or $10 per month).

This value of $120 is a starting amount to determine the customer response to the value; PSE may determine that the annual value needs to be changed if compliance is lower than expected. It was also determined from PSE's analysis that each EV driver will contribute approximately $156 annually in benefit from 2023-2027 by charging off-peak (the summation of capacity, transmission, distribution, demand costs). The $120 was estimated as a starting point for the pilot within the bounds of potential EV driver benefit in the future.

Reinforcement Groups

PSE seeks to understand the extent to which various incentive strategies help promote EV charging shifts to off-peak hours, and is proposing 5 reinforcement groups. Five groups were chosen in that the size of each group (approximately 100) would allow for a statistically significant sample. The five groups also allows for a change to be made on one variable (e.g. fixed vs sliding incentive) in order to compare method efficacy. Table 2 lists reinforcement groups that may be used. The reinforcement groups listed in Table 2 are designed to cover a spectrum of possible reinforcements, from "no reinforcement" through a flexible "sliding incentive" reinforcement. Groups 2 and 3 represent "education only" groups, which will test the hypothesis that providing information alone may be sufficient to induce charge shifting behavior. However, in order to prevent possible customer dissatisfaction that other reinforcement groups are being offered an incentive, PSE plans to have these "education only" groups receive payment in order to participate. It will be made clear that incentives are not tied to compliance with any type of program requirements.

Groups 4 and 5 are two variations of incentive reinforcement: the first is an "all or none" incentive in which a customer must comply with the program terms each month in order to receive the full incentive. Non-compliance means the customer will not receive any incentive for that month. The second incentive option is a more flexible approach, which pays customers for each day that they do not charge during peak time.

Figure 5. Potential Off-Peak Pilot Reinforcement Group Design

Group	Reinforcement	Incentive Strategy	Description
1	Control/baseline	N/A	Upfront incentive. Observation of EV customers' charging behavior with little or no interference. The purpose of this reinforcement group is to establish baseline. The customer will be provided an incentive upfront, but receive no further communication or ongoing incentives.
2	Education without commitment	Education Only	Upfront incentive. Identify charging that occurs with providing EV charge-time education but without any customer commitments or ongoing incentives.
3	Education with commitment	Education Only	Upfront incentive. Identify charging that occurs with providing EV charge-time education and with a non-binding written commitment by customer to shift EV charging behavior.
4	Fixed monthly incentive	Incentive with rigid-requirements	Monthly incentive. Customer forfeits incentive for month if program requirements for number of on-peak charge events are exceeded. Identifies shifting behavior under a rigid/strict incentive structure.
5	Sliding monthly incentive	Incentive with flexible requirements	Monthly incentive. Incentive amount is reduced, based on the number on-peak charge events incurred. Identifies shifting behavior under a flexible/relaxed incentive structure.

Sample Size

To achieve a 90% (90/10) confidence and precision level[21], a sample size of 68 participants is required for each reinforcement group, assuming that the population of interest (i.e., EV drivers in PSE service territory) is between 10,000 and 15,000 EV customers. PSE is targeting 100 participants per reinforcement group to compensate for any drop-outs and to provide a small buffer against other unforeseen technical difficulties. Table 3 summarizes the sampling requirements for all reinforcement groups.

Figure 6. Off-Peak Pilot Target Sample Size

Group	Reinforcement	Required Sample Size	Target Recruitment	Target Confidence/ Precision Level
1	Control/baseline	68	100	90/10
2	Education without commitment	68	100	90/10
3	Education with commitment	68	100	90/10
4	Fixed monthly incentive	68	100	90/10
5	Sliding monthly incentive	68	100	90/10

[21] 90% confidence in reliability of results

PUGET SOUND ENERGY

Public Charging Pilot Program

Program Support for Market Transformation

Public charging is one of the essential needs for a successful electric vehicle (EV) market. It provides the ability for current EV drivers to travel longer distances, and helps instill confidence in prospective EV drivers that they will be able to get to their destination.[1] However, the current system of public charging in Washington State, especially direct current fast charging (DCFC), is insufficient for enabling longer distance travel for many EV drivers. With EV market growth projected to double in the next 3 years, substantially more public charging locations must be installed.[2]

There are multiple challenges with the existing charging network in Washington State. First, the existing public charging network lacks coverage in many key areas along main freeways/corridors and urban centers.[3] Second, PSE's many charging locations were often installed based on lowest cost to meet project requirements, rather than highest convenience and utility for drivers, which drivers have indicated are the most important.[4] Third, most current locations only have one charging port (i.e. lack "redundancy") and many stations only support one connector type for fast charging, leaving many customers without a charging option.[5] Fourth, current public chargers have a capacity only up to 50kW and recharging speeds in the coming years are estimated to reach between 150-350 kW[6]. Lastly, there are no reliability standards for the current stations, resulting in inoperable or out-of-service stations.[7]

PSE can provide value to its customers and the general market by alleviating hurdles with public charging and increasing access. PSE's Public Charging pilot program is designed to improve upon these factors and provide the added benefits of scalable infrastructure (thus decreasing the cost per station in the future), as well as facilitate the incorporation of other emerging modes of transportation (i.e. car sharing).

[1] "Draft Guiding Principles for Utility Transportation Electrification Programs." NRDC. 2017.
[2] "Electric Vehicle Charging Infrastructure." Washington State Department of Transportation. 2018. https://www.wsdot.wa.gov/Funding/Partners/EVIB.htm.
[3] "Alternate Fuels Data Center." U.S. Department of Energy. 2017. https://www.afdc.energy.gov/locator/stations.
[4] 52% of customers ranked location as the #1 important feature (ranked features were location, speed, price, interoperability). "PSE Customer Research." 2017.
[5] In Washington State, there are 91 total fast charging sites, with 241 charging ports. There are 9 sites that are Tesla-only (80 charging ports). Of the remaining 82 fast charging sites (161 total charging ports), 24 have only one charging port. "Alternative Fuels Data Center." U.S. Department of Energy. March 2018. https://www.afdc.energy.gov/locator/stations.
[6] "Electrify America chooses four partners to join in nationwide EV charging network." Electric Light & Power. 4/17/2018.
[7] "Washington Laws and Incentives." U.S. Department of Energy. 2017. https://www.afdc.energy.gov/laws/state_summary?state=WA.

Program Objectives

1) Increase supply of reliable, interoperable, and future-proofed public charging stations in the region, beyond what can be served by the private market and the public sector, in order to support market transformation for customers[8]
2) Build local experience in public charging and evaluate the ideal charging mix among other options (e.g. residential, workplace)[9] in coordination with other portfolio programs
3) Identify impacts of public charging patterns on system peaks, demand charges, and energy usage[10]
4) Identify partnerships, locations, and infrastructure that can support multiple modes of electric transportation[11]
5) Provide a charging program option available to all electric vehicle drivers, regardless of participation in other PSE charging services

Program Summary

Washington State has a basic amount of public charging infrastructure, but it will not be sufficient to meet the growing driving needs for public charging[12], even with current funding for WSDOT Electric Vehicle Infrastructure Pilot Program (EVIPP)[13] and Electrify America's announcement[14] of investment in the Everett-Seattle-Tacoma metropolitan statistical area (MSA). There are still significant gaps in providing coverage and reliable charging throughout PSE's service territory.

PSE's Public Charging program builds upon local public charging initiatives[15] while focused on learning and building public charging best practices to meet regional charging needs.[16] PSE's program will provide reliable, interoperable charging to the region to meet customer needs and increase confidence of potential EV buyers to support market transformation.[17]

Locations will be driven specifically by the needs of current and potential EV drivers to ensure that the network is designed and managed to meet PSE's customers' charging behaviors.[18] To site the stations, PSE will survey its current EV program participants,[19] conduct outreach to additional EV drivers, and hold public meetings to gather EV driver feedback on the best areas for station sites. Based on this feedback and considering any transportation-based studies on EV charging infrastructure needs, PSE will identify a list of potential sites. This list will be shared with the Stakeholder Group, to allow for better coordination with EVIPP[20] and other

[8] Hall, D. and Lutsey, N.. "Emerging Best Practices for Electric Vehicle Charging Infrastructure." Oct 2017.
[9] There is a need for additional information gathering on best practices for public charging. Other programs nationally are also focused on learning which locations have high utilization rates and which business models are most effective for public charging offers. ChargeNY. "New York State Electric Vehicle Charging Station Quarterly Report." NYSERDA. Dec 2016.
[10] "Electric Vehicle Charger Incentive Program Report", Puget Sound Energy, 2018.
[11] Schefter, Kellen. "Accelerating Electric Vehicle Adoption." Edison Electric Institute. Feb 2018.
[12] N. Nigro, D. Welch and J. Peace, "Strategic Planning to Implement Publicly Available EV Charging Stations: A Guide for Businesses and Policymakers," November 2015. http://www.c2es.org/publications/strategic-planning-implement-publicly-available-ev-charging-stations-guide-businesses.
[13] WSDOT Electric Vehicle Charging Infrastructure, https://www.wsdot.wa.gov/Funding/Partners/EVIB.htm
[14] Electrify America Infrastructure Plan, https://www.electrifyamerica.com/our-plan
[15] "Schedule 77: Electric Vehicle Supply Equipment (EVSE) Pilot Program." Avista Corporation. 2018.
[16] Merchant, Emma F. "Utilities Tackle the Challenge of EV-Charging Infrastructure." Greentech Media. Mar 1 2018.
[17] Schefter, Kellen. "Accelerating Electric Vehicle Adoption." Edison Electric Institute. Feb 2018.
[18] "From Gas to Grid." Rocky Mountain Institute. Sep 2017.
[19] "Electric Vehicle Charger Incentive Program Report", Puget Sound Energy, 2018.
[20] "Electric Vehicle Infrastructure Program." WSDOT. 2017. https://www.wsdot.wa.gov/NR/rdonlyres/0DED5F62-5C83-456A-BD26-

infrastructure development.

The installation of public charging infrastructure will be on an as-needed basis. This means a comprehensive assessment of where public charging is required, where drivers will utilize charging infrastructure, and where the grid has the capacity to support charging.[21] PSE is planning to assess the need for public charging on a rolling basis, with initial targets planned for the first two years. Depending on customer feedback, PSE may seek to expand the number of sites in the future. This allows flexibility to adapt the program if other programs, including EVIPP and Electrify America, have met the market need for fast charging, or a viable self-funding business model for public charging emerges.

From the short list of sites, PSE will estimate service construction costs and enter into negotiations to secure property rights to the sites through easement, lease, or property ownership. For each selected location, PSE will install the necessary electrical wiring, system upgrades (i.e. transformers), and charging equipment. At each charging location, PSE will install up to four DCFC and two Level 2 (L2) chargers. The target numbers for locations and installation for the program are outlined in Figure 1 below; Year 1 and 2 are projections on number of installations.

Figure 1. Target Locations and Installations per Year

	Year 1	**Year 2**
Locations	3	5
Maximum Number of DCFC Ports installed	12	20
Maximum Number of L2 Ports Installed	6	10

Each site will include multiple charging ports, and sites will be "future-proofed"[22] to allow for additional or higher-powered chargers in the future. At a minimum, at least two CHAdeMO charging ports and two Combined Charging System (CCS) DC Fast Charge charging ports, and two Level-2 charging ports, will be available at each site.[23] The charging stations will be located on land that PSE owns, has easement to, or leases to ensure that the chargers can be accessed and remain functional.

PSE intends to site at least two of the first 8 sites in locations within close proximity to multi-family housing or are in areas with a significant number of renters to help determine if fast charging locations can remove barriers to transportation electrification in these areas.[24] This will be compared against PSE's multi-family charging utilization and used to assess whether one format (public or multi-family) may better serve customers. PSE will also seek partnerships with

6176941A5F29/0/EVIPP_NOPA.pdf.

[21] "Community Planning Guide for Plug-In Electric Vehicles. Version 3.0" Advanced Energy. 2013.

[22] "Future-proofing" in this document means setting stations up so that they advance along with technology and "capable of making upgrades as batteries improve." Bomey, N. "Thinking of buying an electric vehicle? Here's what you need to know about charging." USA Today. 2018. https://www.usatoday.com/story/money/cars/2018/01/25/electric-vehicle-car-charging/1059349001/.

[23] CHAdeMO and CCS port chargers are available as part of multi-standard charger solutions. CHAdemo ports serve vehicles produced by BMW, Daimler, Ford, Fiat Chrysler, General Motors, Honda, Hyundai, and Volkswagen. CCS ports serve vehicles produced by BMW, Daimler, Ford, Fiat Chrysler, General Motors, Honda, Hyundai, and Volkswagen. There are also Tesla to CHADeMO adapters available. Hall, D. and Lutsey, N.. "Emerging Best Practices for Electric Vehicle Charging Infrastructure." Oct 2017.

[24] Nygaard, N. "Removing Barriers to Electric Vehicle Adoption by Increasing Access to Charging Infrastructure." Seattle Office of Sustainability and Environment. 2014.

transportation network companies (TNCs) and transit agencies to identify sites that may be used by a variety of types of users and complement other transportation modes.

PSE will also develop specifications for charging equipment, network services, and maintenance services. The equipment, network services, and maintenance services will be procured through a competitive RFP process. From PSE's experience and the program goals of encouraging market competitiveness, PSE believes that an RFP process will provide a more robust list of qualified vendors. In addition, it is PSE's desire to procure equipment and services from multiple vendors to mitigate risk of failure of equipment or software to enhance system resilience[25], though a final evaluation of this matter will depend on response to the RFP. Prior to issuing the RFP, PSE will hold a workshop to discuss interoperability to assist PSE with developing interoperability specifications for the RFP.[26]

Based on experience from peer utilities,[27] the operations and maintenance of public charging stations takes significant ongoing support. This means servicing stations when they are not working, replacing parts, and answering customer questions. PSE is planning to have an RFP for maintenance services, which will include service guarantees.

PSE will charge a fee for the use of its chargers to avoid interfering with market dynamics of existing public charging sites.[28] The rate for use of the chargers will be a market-based rate, based on the average rate for chargers in PSE's electric service territory. PSE will survey usage costs for fast chargers in its service territory regularly and update rates where PSE is not priced at the market average. PSE will file these rates after evaluation of the RFP responses and siting work, but prior to awarding vendor contracts and acquiring sites.

In the third year of the program (when approximately 8 locations will be installed), PSE will re-evaluate how to expand the network based on utilization of the current stations and feedback from drivers.

PSE will monitor charging energy use as a baseline to determine load from public charging. This will be compared to system peak and to demand charge peaks. PSE will report results of the program to the stakeholder group, and provide metrics around installation, utilization, and demand. In addition, PSE will develop best practices and lessons learned which may include:

- Site enrollment
- Cost of acquisition of site
- Community support for charger placement
- Technology & site integration experiences
- Time to install
- Total cost of charger ownership (purchase, installation, and maintenance)
- Number of sessions/period of time; total kWh delivered/session

[25] U.S. Department of Energy, "Enabling Fast Charging: A Technology Gap Assessment," October 2017. https://energy.gov/sites/prod/files/2017/10/f38/XFC%20Technology%20Gap%20Assessment%20Report_FINAL_10202017.pdf.
[26] Hall, D. and Lutsey, N.. "Emerging Best Practices for Electric Vehicle Charging Infrastructure." Oct 2017.
[27] PSE discussions with peer utilities with utility-owned DCFC networks (i.e. Hawaiian Electric, Sacramento MUD)
[28] Avista Corporation will charge users of its Public DC Fast Charging EVSE $.35 per kWh. "Schedule 77: Electric Vehicle Supply Equipment (EVSE) Pilot Program." Avista Corporation. 2018.

- Percentage of total charging at public versus residential (single family & multi-family) and workplace
- Impacts of public charging on demand charges
- Best use cases for DCFC

Program Schedule & Budget

Figure 2. Public Charging Pilot Program Projected Schedule

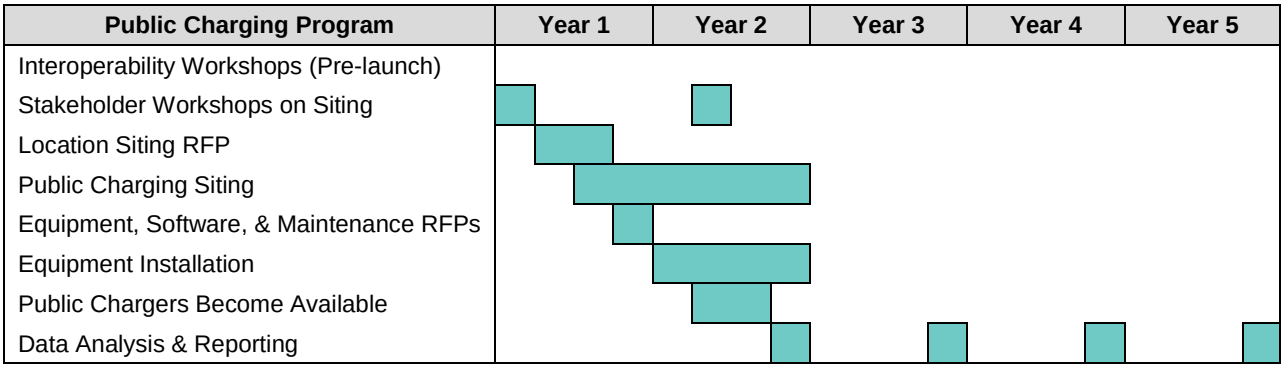

Figure 3. Public Charging Pilot Program Budget Projection

(in '000)	Year 1	Year 2	Year 3	Year 4	Year 5
Projected Capital Costs	$1,284.8	$890.7	$0	$0	$0
Projected Expenses	$611.8	$920.1	$925.3	$898.4	$835.0
Anticipated Revenue from Charger Use	$36.9	$308.2	$566.0	$580.2	693.4

PUGET SOUND ENERGY

Workplace and Fleet Charging Pilot Program

Program Support for Market Transformation

Workplace charging is critical to the growth of electric transportation.[1] Workplace charging gives Battery Electric Vehicle (BEV) drivers a place to charge during the day, thereby allowing drivers with longer commutes to use a BEV and allowing Plug-In Hybrid electric vehicle (PHEV) drivers to increase their electric vehicle (EV) miles traveled (VMT).[2] It may also provide charging access for customers without charging options at their homes.[3] A number of market transformation efforts related to workplace charging have been in effect in recent years. However, the largest of these was the U.S. Department of Energy's recently defunded Workplace Charging Challenge.[4] Workplace charging is identified as a key action on Washington State's Electric Vehicle Action Plan.[5]

Many corporate fleets are also considering adoption of electric transportation. Fleets, which are more likely to charge overnight, may also be able to provide off-peak charging similar to residences. Fleets which are also based at workplaces may also provide an opportunity for shared use of chargers between fleet vehicles and employee vehicles. This new model of shared utilization, if successful, could decrease infrastructure costs for both employees and employers, thus supporting market transformation.

PSE's Workplace and Fleet Charging pilot program seeks to build upon existing and ongoing efforts, test and identify effective practices to reduce barriers to workplace/fleet charging for employers and employees to support market transformation.[6] PSE's program will work to establish a broad baseline of workplace charging while also developing data on best practices for installing and managing charging in a variety of building types. In addition, the program will evaluate whether workplaces can avoid peak loads and integrate renewables into utilization.

[1] "Workplace Charging Challenge." DOE/EE 0964. U.S. Department of Energy. 2013.
[2] "Plug-In Electric Vehicle Handbook for Workplace Charging Hosts. Clean Cities, Energy Efficiency & Renewable Energy." U.S. Department of Energy. 2013.
[3] Cooper, A. and Kellen, S.. "Plug-in Electric Vehicle Sales Forecast Through 2025 and the Charging Infrastructure Required." Edison Electric Institute. Jun 2017.
[4] "Workplace Charging Challenge." DOE/EE 0964. U.S. Department of Energy. 2013.
[5] "Washington State Electric Vehicle Action Plan." Washington State Department Of Transportation. 2015.
[6] MJB&A found that utilities can leverage established relationships and experiences to deploy effective transportation electrification programs. "Accelerating the Electric Vehicle Market: Potential Roles of Electric Utilities in the Northeast and Mid-Atlantic States." MJB&A. Mar 2017.

Program Objectives

1) Support market transformation by increasing the supply and access of workplace and fleet charging to current and potential EV drivers and determining whether workplace charging raises awareness[7,8]
2) Identify impacts of workplace charging patterns on system peaks, demand charges, and energy usage[9]
3) Build a local best practice toolkit for installation of charging in different parking lot types, placement, servicing, and ideal charging mix among other options (e.g. public, residential, multifamily)[10] in coordination with other portfolio programs
4) Determine viability and methodologies to shift charging at workplaces to off-peak times[11]
5) Identify potential shared charging models for workplace and fleet use of chargers, and test their adoption

Program Summary

Washington State's Electric Vehicle Action Plan identifies workplace charging as a key action item, but as of January 2017, there was only 4% of the needed level 2 workplace and public charger ports nationally to support EVs in 2025.[12] Workplace charging has become an increasingly important access point for EV drivers and can often serve as a substitute for residential charging.[13]

PSE's Workplace and Fleet Charging program will initially run for 2 years and increase the supply of reliable and interoperable workplace/fleet charging in the region to meet current EV employee needs and increase the confidence of potential EV drivers in workplace charging options. To reach potential customers, PSE will use outreach methods to its business customers including emails, meetings, and advertising. PSE can leverage multiple contact channels with businesses to support effective electrification transformation efforts for workplaces/fleets.[14] Locations in PSE's program will be driven by workplace interest and achieving a mix of parking and use types and will help inform workplace/fleet charger best practices.

Equipment selection and installers will be developed in concert to vendor information gathered from PSE's Residential Charging and Off-Peak program. Through a Request for Proposal (RFP) PSE intends to select at least two equipment manufacturers that meet specifications to

[7] According to the Edison Foundation, as of January 2017, there were an estimated 50,000-70,000 level 2 workplace and public charger ports in the nation. However, based on models from NREL and EPRI, this is only 4% of the ports needed to support electric vehicles in 2025. Cooper, A. and Kellen, S. "Plug-in Electric Vehicle Sales Forecast Through 2025 and the Charging Infrastructure Required." Edison Electric Institute. Jun 2017.
[8] "The U.S. Department of Energy reported findings from a study through its EV Everywhere Workplace Charging Challenge that employees of companies with at-work charging are 6 times more likely to drive a plug-in car than those who work at companies with no provision for electric car charging." "Washington State Electric Vehicle Action Plan." Washington State Department Of Transportation. 2015.
[9] "Electric Vehicle Charger Incentive Program Report", Puget Sound Energy, 2018.
[10] Rocky Mountain Institute reported "the current patchwork network of vehicle charging infrastructure in the U.S. is still small enough and young enough that we lack sufficient data and rigorous analysis to answer many" charging best practice questions and called on stakeholders to design pilots to answer these questions, which may vary greatly by utility or state. "From Gas to Grid." Rocky Mountain Institute. Sep 2017.
[11] Muraugh, D. and Chediak, M.. "Why Charging Your Electric Car at Night Could Save the World." Bloomberg. Feb 25 2018.
[12] Cooper, A. and Kellen, S.. "Plug-in Electric Vehicle Sales Forecast Through 2025 and the Charging Infrastructure Required." Edison Electric Institute. Jun 2017.
[13] Idaho National Laboratory, "Plugged In: How Americans Charge Their Electric Vehicles," September 2015. https://avt.inl.gov/sites/default/files/pdf/arra/PluggedInSummaryReport.pdf
[14] "Accelerating the Electric Vehicle Market: Potential Roles of Electric Utilities in the Northeast and Mid-Atlantic States." MJB&A. Mar 2017.

demonstrate smart charging. From PSE's experience and the program goals of encouraging market competitiveness, PSE believes that an RFP process will provide a more robust list of qualified vendors.

PSE and its contracted electricians/installers will assess applicants' sites with the property owners to identify parking locations, assess wiring requirements and routing, and complete load estimates.[15] PSE will install the necessary electrical wiring and Level 2 (L2) charging equipment. Businesses will be required to provide PSE with an access and maintenance agreement for PSE-installed equipment. Businesses will be required to designate and mark the parking stalls and install signs in accordance with Washington State requirements (PSE will provide signs).[16] PSE may choose to install all chargers in a location at once, or on a rolling basis based on employer tenant needs.

Participating customers may initially qualify for up to 10 chargers at their location(s), though PSE may reduce the number of chargers per site to allow more customers to participate if initial interest is high. PSE is estimating that on-average employers will have three ports per location, see Figure 1. For customers/employers who do not have any employees currently driving EVs, at least two Level 2 charging station per site will be installed. PSE may also install electrical capacity for additional sites in the future.

PSE will install L2 charging stations[17] and supporting electrical infrastructure in workplaces and facilities with electrified fleets in its electric service territory; the target workplace enrollment and charger port numbers for the program are outlined in Figure 1 below. At this time, PSE is only planning to provide L2 chargers at participating workplaces. Participating customers and their employees will provide data through surveys and collection of EV charging information that will help PSE determine what factors in workplace charging best enable market transformation across the broader electric transportation market.[18] Best practices in procuring, installing, and managing workplace charging will be determined from program monitoring and evaluation and made available to all PSE customers.[19]

Figure 1. Target Enrollments and Installations per Year

Metric	Year 1	Year 2
Number of Workplace Locations Enrolled	50	0
Number of Workplace Locations Installed	25	25
Number of L2 Charging Ports[20] Installed	75	75

Property owners and businesses will be eligible to participate in the program. Program applicants must provide the following information during application and throughout the pilot:

[15] "Multifamily Housing Charging Station Installation Handbook, Version 4.0" Advanced Energy. 2014.
[16] "Electric vehicle charging stations—Signage—Penalty." Washington State Legislature. 2013.
[17] RMI reported that level 2 chargers are the most cost-effective charging option to meet workplace charging needs. "From Gas to Grid." Rocky Mountain Institute. Sep 2017.
[18] "From Gas to Grid." Rocky Mountain Institute. Sep 2017.
[19] Data collection and program evaluation is needed to quantify the value of workplace charging and determine most cost-effective options to fill employee needs. "Best Practices for Workplace Charging." Calstart. 2013.
[20] "Ports" are the number of available handles attached the charging unit. For this product offering, PSE estimates an average of three ports per location

- Indicate how many EVs they are planning for and over what time period
- Agree to participate in surveys, inclusive of a baseline survey and subsequent follow-up surveys
- Agree to participate in one interview during program duration
- Agree to survey its employees or tenants' employees, inclusive of a baseline survey following installation and subsequent follow-up surveys[21]
- Agree to dedicate parking stalls for EV charging for a minimum period of 5 years
- Announce a workplace charging program to employees
- Pay costs for electricity, though applicants may choose to charge employees for use of the chargers[22]
- Provide PSE with necessary agreements for equipment installation and maintenance.
- Mount signage and paint parking spots to comply with Washington State and Federal requirements[23]

PSE will monitor charging energy use as a baseline to determine load from charging at workplaces; PSE will use the smart-charging technology and software to determine load. This will be compared to system peak and to demand charge peaks from participating businesses. From this baseline data, methods to shift charging will be evaluated during the 3rd year of the program.

PSE will report the results of the program to the stakeholder group every 6 months, and provide metrics around participant enrollment, changes in employee awareness around electric transportation, and utilization. In addition, PSE will develop best practices and lessons learned which may include:

- Acquisition cost of participant/site
- Employer buy-in for charger installation
- Technology & site integration experiences
- Time to install
- Total cost of charger ownership (purchase, installation, and maintenance)
- Parking lots (number and type)
- Percentage of total charging at workplace versus residential (single family & multi-family) and public
- Participant/workplace level of satisfaction with pilot

[21] "Workplace Charging: Guiding employers through the process of planning, installing, and managing charging infrastructure for electric vehicles."ChargeNY, NYSERDA. Aug 2015.
[22] "Plugging in at Work: How to Effectively Install, Share and Manage Electric Vehicle Charging Stations." California Plug-IN Electric Vehicle Collaborative. 2015.
[23] "Electric vehicle charging stations—Signage—Penalty." Washington State Legislature. 2013.

Program Schedule & Budget

Figure 2. Workplace and Fleet Charging Pilot Program Projected Schedule

Workplace Charging Program	Year 1	Year 2	Year 3	Year 4
Outreach to employers				
Equipment, Software, & Maintenance Selection				
Charger Installation				
Data collection				
Data analysis & progress reports				

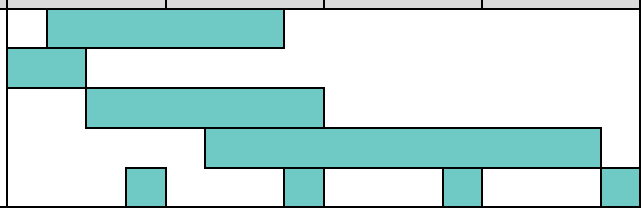

Figure 3. Workplace and Fleet Charging Pilot Program Budget Projection

(in '000)	Year 1	Year 2	Year 3	Year 4	Year 5
Projected Capital Costs	$654.9	$328.3	$0	$0	$0
Projected Expenses	$605.0	$516.2	$274.6	$208.1	$213.2

PUGET SOUND ENERGY

Multi-Family Charging Pilot Program

Program Support for Market Transformation

Charging in Multi-Family (MF) or Multi-Unit Dwellings (MUD) has been identified as a challenge to electric transportation adoption.[1] Several reasons make it a challenge to the electric vehicle (EV) marketplace. First, a common method of metering energy use for common areas in MF dwellings, including parking areas, is on a single common area meter and is paid by the property owner or manager (and not the tenants).[2] This creates a disincentive for the property owner to increase load on these circuits, as electric vehicle charging will raise operating costs of the building. While these costs may be recoverable from tenants, providing charging infrastructure will also increase the management requirement in maintaining equipment.[3] Second, in rental properties, length of tenancy and EV ownership are uncertain, making it less appealing for building owners to pay for charging installation in the case that their tenants with EVs end up moving. Third, charging infrastructure installation can be expensive, especially when it needs to be retrofit into buildings. Finally, some properties may not have assigned parking, and dedicating parking locations to EV drivers may be difficult.[4]

PSE's Multi-Family Charging pilot program seeks to address these barriers in multiple building types while and finding effective solutions to the major challenges. PSE's program will increase access to charging infrastructure while also evaluating methods for encouraging property manager participation. The program will develop load curves for MF residential charging and energy use information, while also evaluating whether MF load can potentially be shifted to off-peak times.

Program Objectives

1) Support market transformation by increasing the supply and access of MF charging to current and potential EV drivers[5]
2) Build a local best practice toolkit for installation of charging in different parking lot types, placement, servicing, and ideal charging mix among other options (e.g. public and workplace)[6]

[1] "Electric Vehicle Charging for Multi-Unit Dwellings." DOE Alternative Fuels Data Center. 2017. https://www.afdc.energy.gov/fuels/electricity_charging_multi.html.
[2] "Multifamily Housing Charging Station Installation Handbook, Version 4.0" Advanced Energy. 2014.
[3] "Plug-in Electric Vehicle Charging Infrastructure Guidelines for Multi-Unit Dwellings." California Plug-In Electric Vehicle Collaborative. November 2013. http://www.pevcollaborative.org/sites/all/themes/pev/files/docs/MUD_Guidelines4web.pdf.
[4] "Plug-in Electric Vehicle Charging Infrastructure Guidelines for Multi-Unit Dwellings." California Plug-In Electric Vehicle Collaborative. November 2013. http://www.pevcollaborative.org/sites/all/themes/pev/files/docs/MUD_Guidelines4web.pdf.
[5] Currently there is no public database information on multi-family charging numbers in Washington state. "Alternative Fuels Data Center." U.S. Department of Energy. March 2018. https://www.afdc.energy.gov/locator/stations.
[6] According to Rocky Mountain Institute, there is insufficient data currently available to determine the best ratio of charging stations to EVs. RMI calls on stakeholders to share charger station data early and often. "From Gas to Grid." Rocky Mountain Institute. Sep 2017.

3) Identify impacts of MF dwelling charging patterns on system peaks, demand charges, and energy usage[7]
4) Determine viability and methodologies to shift charging in MF buildings to off-peak times[8]

Program Summary

To date, EV drivers and potential adopters in PSE's territory have predominantly lived in single family homes because of access to a home charging location (typically in a garage or driveway).[9] In order to transform the market, charging options need to be expanded to different customer groups, including those who live in MF dwellings. MF dwelling parking types come in a range of configurations, which include garages, carports/driveway, parking decks, parking lots and on-street parking.[10]

PSE's MF pilot program will run for two years and is designed to increase availability of EV charging, identify impacts on system demand and demand charges, and build out best practices in MF charging. PSE will seek to include a variety of parking types, including underground parking and surface parking lots, and properties with and without dedicated parking to further inform MF charger installation and operation best practices.[11] PSE will determine the initial participating properties through an application process and through outreach efforts. The program will also seek properties with proximity to public charging sites to better determine charging interest and viability of different types of charging to serve MF needs.

Equipment selection and installers will be developed in concert to vendor information gathered from PSE's Residential Charging and Off-Peak program. Through a Request for Proposal (RFP) PSE intends to select at least two equipment manufacturers that meet specifications to demonstrate smart charging. From PSE's experience and the program goals of encouraging market competitiveness, PSE believes that an RFP process will provide a more robust list of qualified vendors.

PSE and its contracted electricians/installers will assess applicants' sites with the property owners to identify parking locations, assess wiring requirements and routing, and complete load estimates.[12] PSE will install the necessary electrical wiring and Level 2 (L2) charging equipment. Property owners will be required to provide PSE with an access and maintenance agreement for PSE-installed equipment. Property owners will be required to designate and mark the parking stalls and install signs in accordance with Washington State requirements (PSE will provide signs).[13] PSE may choose to install all chargers in a location at once, or on a rolling basis based on MF tenant needs.

[7] "Electric Vehicle Charger Incentive Program Report", Puget Sound Energy, 2018.
[8] Muraugh, D. and Chediak, M.. "Why Charging Your Electric Car at Night Could Save the World." Bloomberg. Feb 25 2018.
[9] PSE customer research found that of potential EV adopters, 66% lived in standalone homes, while 20% were in apartments, 8% in townhomes, and 5% in condos. "PSE EV Intender Analyst Report", Puget Sound Energy, 2017.
[10] "Multifamily Housing Charging Station Installation Handbook, Version 4.0" Advanced Energy. 2014.
[11] "Multifamily Housing Charging Station Installation Handbook, Version 4.0" Advanced Energy. 2014.
[12] "Multifamily Housing Charging Station Installation Handbook, Version 4.0" Advanced Energy. 2014.
[13] "Electric vehicle charging stations—Signage—Penalty." Washington State Legislature. 2013.

PSE will install and operate L2 charging equipment in up to 25 MF properties. The target MF enrollment and charger port numbers for the program are outlined in Figure 1 below. Each property enrolled in the program can have up to four charging handles installed at their property.

Figure 1. Target Enrollments and Installations per Year

Metric	Year 1	Year 2
Number of Properties Enrolled	25	0
Number of Properties Installed	15	10
Number of Level 2 (L2) Ports[14] Installed	45	30

As part of participation in the program, MF dwelling owners and tenants will provide data through surveys and collection of EV charging information that will help PSE determine what factors in MF charging best enable market transformation across the broader electric transportation market. Best practices in procuring, installing, and managing MF charging will be determined from program data and included in program reporting.

PSE will obtain interest from MF dwelling owners/managers on a rolling basis. Program applicants must provide the following information during application and throughout the pilot:

- Indicate how many EVs are currently at their building, what they are planning for and over what time period
- Response to surveys, inclusive of a baseline survey and subsequent follow-up surveys
- Participation in one interview during program duration
- Survey their tenants (with and without EVs), inclusive of a baseline survey and subsequent follow-up surveys
- Dedicate parking spots for EV charging for the duration of the program
- Announce a tenant charging program to residents
- If energy cannot be billed individually, pay costs for electricity, though applicants may choose to charge tenants for use of the chargers
- Provide PSE with necessary agreements for equipment installation and maintenance.
- Mount signage and paint parking spots to comply with Washington State and Federal requirements

PSE will investigate if chargers could be integrated into PSE's billing system as part of vendor selection, such that chargers could be individually tied to a individual customer's (tenant's) PSE account. These results will be reported with recommendations to the Stakeholder Group and a tariff for billing filed with the Commission if appropriate. If energy cannot be billed individually, property owners will be required to pay electricity charges, at their current billed rate, and may charge EV-driving residents for use of the chargers. As part of the program, PSE may set a cap on the maximum amount an owner/property manager can bill for a charging session.

[14] "Ports" are the number of available handles attached the charging unit. For this product offering, PSE proposes having an average of three ports per location

PSE will monitor charging energy use as a baseline to determine load from charging at MF dwellings; PSE will use the smart-charging technology and software to determine baseline load. This will be compared to system peak and to demand charging peaks from participating buildings. From this baseline data, methods for shift charging will be evaluated. Methods will draw off of findings of the residential smart charging program, which will likely happen in Year 4 of the program.

PSE will report the results of the program to the stakeholder group every 6 months, and provide high level metrics around participant enrollment, changes in tenant awareness around electric transportation, and utilization. In addition, PSE will develop best practices and lessons learned which may include:

- Acquisition cost of participant/site
- Owner buy-in for charger installation
- Technology & site integration experiences
- Time to install
- Total cost of charger ownership (purchase, installation, and maintenance)
- Parking lots (number and type)
- Percentage of total charging at residential (single family & MF) versus public and workplace
- Participant/property manager level of satisfaction with pilot

Program Schedule & Budget

Figure 2. Multi-Family Charging Pilot Program Schedule

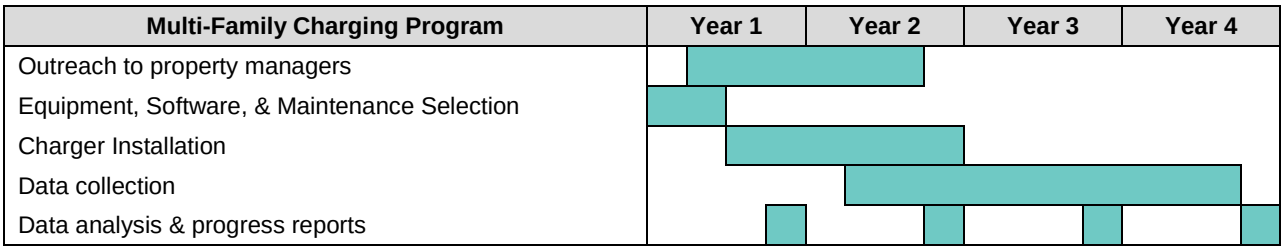

Figure 3. Multi-Family Charging Pilot Program Budget

(in '000)	Year 1	Year 2	Year 3	Year 4	Year 5
Projected Capital Costs	$526.8	$131.3	$0	$0	$0
Projected Expenses	$579.4	$490.6	$240.5	$193.9	$198.7

PUGET SOUND ENERGY

Low Income Pilot Programs

Program Support for Market Transformation

In many transportation studies, it's found that low income communities are typically located near major roadways which can lead to more severe health effects from vehicle tailpipe emissions[1]. Transportation electrification provides the opportunity to address some of the impacts to low income communities by reducing the adverse impacts of carbon and emissions. Utilities nationwide are exploring different measures for including low income communities in transportation program offerings, which is an important component in addressing equity through programs[2].

Piloting different program measures to low income customers represents an important component of PSE's overall portfolio offering. PSE has worked with partner organizations and advocates to design low income pilot programs that will be meaningful to our customers while also helping transform the electrified transportation market.

Program Objectives

This pilot program is designed to support and improve customer access to transportation electrification through a series of pilots targeted at low income customers. Program objectives to support this strategy include:

1) To find new, scalable models to electrify transportation services for customers who may not have access to electric transportation in forms of new vehicle ownership or transit access.
2) To accelerate adoption of electric transportation across a range of income levels and locations within PSE's service territory.
3) To develop new partnerships to increase education around electric transportation options across PSE's service territory.

Program Summary

PSE designed its low income programs in partnership with Community Action Partnership (CAP) agencies that already provide transportation services to low-income customers in order to provide pilot programs that would be tailored to the customers using them. PSE has proposed three pilot programs in our portfolio offering, ranging in topic from medical transportation, dial-a-ride, and multi-family housing services. These programs are meant to build upon current programs of CAP and other service agencies and organizations, while merging the desire to incorporate transportation electrification into programming.

[1] "How Electrified Transportation Can Benefit Low-Income Communities." Center for Climate and Energy Solutions. 2017.
[2] "Guiding Principles for Utility Programs to Accelerate Transportation Electrification." NRDC. 2017.

Non-Emergency Medical Services Transportation Pilot

Through the CAP agency, Hopelink, more than 1.6 million rides are provided annually to over 45,000 individuals in need of non-medical emergency transportation. This pilot will evaluate whether electrified transportation options can fulfill the need for these rides.

Pilot Goals

This pilot is targeted at providing direct access to electric vehicles (EVs) for low-income PSE customers for their transportation needs. By using EVs in medical transportation services, this can reduce the operational expenses for transportation services, and allow for additional support or services to be provided in other areas. There is also the additional benefit of better health outcomes for customers using EVs since their localized exposure to vehicle emissions will be lower.

In this pilot program, the first phase will be focused on how electrification of transportation could provide lower cost to the service providers. This requires:

- Understanding business model and use patterns of existing providers and the customers they serve
- Identifying potential vehicle solutions and charging locations
- Identifying potential barriers such as finance, technology familiarity, etc

In order for this pilot to be successful, it will require addressing barriers such as recruiting contract driver to participate. The may be a challenge given that there is an additional capital expense associated with an EV purchase. This barrier may be addressed through the program development and business planning process in order to address vehicle acquisition barriers.

Partners	Hopelink; Small business contractors providing rides; Hospitals & Doctor's Offices
Anticipated Budget	$313,000
Timeline	3-year pilot

Low-Income Weatherization EV Transportation Pilot

This pilot would provide direct access to an EV for one weatherization program to utilize for the purpose of audit/inspection/project coordination needs during the course of delivering weatherization projects to PSE served low-income households.

Pilot Goals

This pilot would reduce operational expenses associated with transportation related costs incurred in the delivery the PSE funded Low-Income Weatherization Program. The reduced costs for program delivery could allow for additional households to be served. If the pilot proves successful it could be replicated throughout the state and region in the delivery of the Low-Income Weatherization Program.

In program development of this pilot the main barriers to be addressed are around the types of

EVs that would be adequate to meet program needs while addressing capital and operating expenses associated with an EV.

Partners	Opportunity Council PSE
Anticipated Budget	$52,500 (includes vehicle acquisition of a commercial vehicle)
Timeline	3-year pilot

Multi-Family Low-Income Housing Transportation Pilot

Many multi-family affordable housing buildings exist within PSE service territory; these are managed by non-profit agencies, including CAP agencies. This pilot would provide an EV and charging station at select buildings and be bundled with an education component and staff training. In addition the pilot would assess necessary infrastructure to support car sharing for staff and residents at building. Many of the same features of PSE's Multi-Family Charging Program would be incorporated into this low-income program.

Pilot Goals

This pilot would provide direct access to EVs for low-income communities, and determine whether multi-family building would be an appropriate format for using these types of vehicles.

The primary barriers to be addressed in program development is around improving knowledge of EV usage and charging, insuring vehicles, and the expenses associated with an EV. There is the opportunity to learn from similar pilots like the Hacienda CDC project in Portland, OR.

Partners	PSE, Forth Mobility, Community Organization TBD
Anticipated Budget	$425,000
Timeline	3-year pilot

Program Schedules & Budgets

Figure 1. Low Income Pilot Program Schedule

	Year 1	Year 2	Year 3	Year 4	Year 5
Program Development					
Partner On-boarding					
Non-Emergency Medical Pilot					
Low-Income Weatherization EV Transportation Pilot					
Multi-Family Pilot					
Data Analysis and Reporting					

Figure 2. Low Income Pilot Program Budget

(in '000s)	Year 1	Year 2	Year 3	Year 4
Projected Expenses	$241.2	$305.1	$274.1	$143.3