➢ Charging Perks Pilot

A. Description

Electric vehicles ("EVs") are poised to become a significant source of electricity demand over the coming decades. Bloomberg New Energy Finance ("BNEF") projects that EVs could represent 60% of all US light duty vehicle sales and 40% of the US fleet by 2040.[1] Moreover, BNEF forecasts that over this same time period electric vehicles will begin to proliferate in the medium and heavy-duty market segments. For example, BNEF's analysis estimates that electric buses will constitute 80% of municipal bus fleets in the US by 2040.[2]

If electric vehicles approach these levels of penetration and charge without their charging being managed, they could require a substantial electric system infrastructure investment to integrate. MJ Bradley, for example, estimates that achieving a scenario where 26% of the light duty vehicle fleet is electrified could increase summer peak demand in Colorado by 1.5 gigawatts. If the state achieves its decarbonization goals—electrifying 98 percent of the fleet—EV demand would increase the summer peak by 7 gigawatts.[3]

The Company seeks to offer the Charging Perks Pilot to proactively address and manage the peak demand from EVs and explore the potential for EVs as a flexible load that can be managed to support the integration of renewable energy. An electric vehicle that charges at home can be plugged in for nearly 12 hours, and its charging can be shifted and throttled up or down in ways that could reduce peak demand, help absorb excess renewable energy, or even facilitate electric system ramping requirements.[4]

The pilot is intended to test how Xcel Energy can directly manage EV charging through enabling technology to reduce system capital and operating cost, while providing opportunities for residential EV customers to reduce their EV fuel costs. The pilot will also plan to test customer interest in participating in smart charging products, and it will gather baseline and smart charging load profiles from various makes and models of light duty passenger EVs.

To carry out the pilot, the Company intends to partner with four automobile original equipment manufacturers ("OEMs") to manage EV demand, and it will be one of the first such pilots in the United States. By working with BMW, Ford, General Motors, and Honda, the Company will communicate demand management instructions to each OEM, who then communicate directly to vehicles that are charging at home. Demand management could also be performed by communicating with networked charging

[1] Bloomberg New Energy Finance. (2018). Electric Vehicle Outlook 2019.
[2] Ibid.
[3] MJ Bradley. (2017). Electric Vehicle Cost-Benefit Analysis. Retrieved from https://mjbradley.com/sites/default/files/CO_PEV_CB_Analysis_FINAL_13apr17.pdf.
[4] The EV Project. (2014). EV Project Electric Vehicle Charging Infrastructure Summary Report. Retrieved from https://avt.inl.gov/sites/default/files/pdf/EVProj/EVProject%20Infrastructure%20ReportJan13Dec13.pdf.

stations, and the Company is exploring this avenue in other pilots across its service territories.

The Company's collaboration with OEMs for this pilot provides several unique aspects. Because the pilot manages demand through the vehicle, customers can participate with networked or non-networked Level 1 or Level 2 charging stations. Working with OEMs allows the OEM to market the pilot direct to their customers. And the OEMs are able to access a vehicle's state of charge, allowing the vital piece of data to be leveraged in making load shifting decisions.

The Company will target customers who are on time-of-use ("TOU") and non-TOU rates in order to evaluate rate design impacts on charging behaviors. Addressing how smart charging pairs with different rates and the benefits it can provide across different rate options is important as the Company is considering a time-varying rate will become the default option for residential customers in the future. Evidence of the impact of rates shows that rates can be very effective at shifting EV charging outside of system peak, but more active control via smart charging capabilities may improve the customer experience and provide greater precision to accomplish other objectives like integrating renewable energy.[5] The pilot will test how rate designs combine with smart charging to accomplish three different grid applications.

First, the Company will shift EV charging demand outside of its system peak to provide capacity savings. Second, the Company will shift charging into the hours with the lowest electricity production costs. Third, the Company will initiate charging events in the evening in response to a wind curtailment event when additional electricity demand can be used to reduce the amount of wind power that is curtailed. The combination of these three applications will demonstrate how smart charging can mitigate on-peak demand from this important new load, and it will also pave the way for future opportunities to use this flexible load to operate the system of the future.

To attract customers to the pilot, the Company will provide incentives directly to participants. All customers will receive a sign-up incentive of $100. Customers that charge using a Level 1 charging station or a standard 120 volt wall outlet will receive a further $50 credit at the end of the first full year of the pilot (2020). Customers that charge using a Level 2 charging station will receive a larger incentive of $100 after the first full year of the pilot. Level 2 customers receive higher incentives because the higher charging rate provides greater ability for the Company to shift the customer's charging load.[6] The Company is using these incentives to attract up to 100 EV customers that are

[5] Customers on the Company's residential EV charging time-of-use rate in Minnesota perform less than 10% of their charging during the on-peak period. Xcel Energy. (2019). Compliance Filing-Residential Electric Vehicle Charging Tariff. Docket No. E002/M-15-111. Similar results have been found in other places. For example, see: Pacific Gas & Electric, San Diego Gas and Electric, and Southern California Edison. (2019). Joint IOU Electric Vehicle Load Research – 7th Report. Docket 19-IEPR-04.

[6] The EV Project. (2014). EV Project Electric Vehicle Charging Infrastructure Summary Report. Retrieved from https://avt.inl.gov/sites/default/files/pdf/EVProj/EVProject%20Infrastructure%20ReportJan13Dec13.pdf.

already on the TOU rate and have self-identified as EV drivers and another 500 that are not on the TOU rate.

The data collected through the pilot will be thoroughly analyzed to evaluate the effectiveness and benefits of smart charging and gather the experiences of participating customers. The Company plans to collect charging event data without smart charging at the start of the pilot to establish a baseline. After collecting baseline information, beginning in the first quarter of 2020, the Company will begin performing smart charging.[7] This quantitative data will be supplemented by a pre- and post-pilot survey to gather customer information regarding their interest and experience in the pilot.

This pilot is a testing ground to evaluate and learn about smart charging technology and product design before launching a full product where many more EV customers would be eligible to participate. Although this filing focuses on collaborating with specific auto OEMs, the Company intends for many of the aspects of the pilot to be vendor agnostic, allowing the Company to engage a broader array of auto OEMs, charging station providers, or EV software management providers in future offerings.

The following pages of the write-up provide additional detail on the scope of Charging Perks.

B. Targets, Participants & Budgets

Targets and Participants

The pilot will target residential customers that drive a connected EV from the participating OEMs and that are able to charge their vehicle at night on a typical weekday.[8]

The pilot will seek to enroll up to 100 customers that are on the RE-TOU rate. If the pilot rate is not extended, Charging Perks will not pursue these TOU customers, and it will focus exclusively on non-TOU customers.

The pilot also targets up to 500 customers that are on other residential rates (e.g., Residential General, Net Metering Service).

Budgets

The largest share of the budget is for the services that the auto OEMs are providing. These services include marketing, enrollment, demand management capabilities, and data

[7] Since the Company will only be collecting baseline data during the first few months of the pilot, the Company does not show any benefits in the Technical Assumptions in 2019.

[8] In the 2019/2020 Demand Side Management Plan, the Company noted that the pilot may focus on residential home charging, fleet charging, and/or residential multi-family charging. The Company has chosen to focus this pilot exclusively on residential home charging. The majority of charging is done at the home (see, for example, Electric Power Research Institute's (2018) "Electric Vehicle Driving, Charging, and Load Shape Analysis). Given the importance of charging at the home, the Company wants and needs to better understand solutions for this segment sooner than in other segments. The Company also believes the technical learnings from this pilot will be transferable.

sharing to support measurement and verification. Administrative expenditures are also incorporated to manage vendor relationships and activities, manage the demand management event schedule, and review interim results to identify any mid-pilot changes that may be required to achieve the pilot's objectives. The Company also has inserted costs to incentivize customers and to perform measurement and verification ("M&V").

C. Application Process

The application process will request that the customer provides information that will allow each OEM and the Company to confirm they have an eligible EV and are an Xcel Energy customer. In addition, the customer will be required to agree to terms and conditions ("Ts and Cs") for the OEM and the Company. The enrollment process may differ for TOU and non-TOU customers. The Company may manage enrollment for TOU customers since it is able to identify who these customers are as part of their existing participation in the TOU rate. Each OEM will develop its own enrollment processes.

D. Marketing Objectives & Strategies

The OEMs have direct relationships and contact information for their EV customers. Consequently, the OEMs will market the pilot directly to eligible customers. OEMs plan to use a broad range of marketing channels possibly including email, text, and mail.

For customers that are already on the Company's TOU rate and have self-identified as an EV owner, the Company may market the pilot directly to them. The Company plans to use a combination of marketing channels, potentially including email, phone, and mail.

National research describing EV customers has highlighted that these customers are often motivated by cost savings and reducing their environmental impact.[9] Through two EV-specific focus groups, the Company heard similar feedback. The Company plans to put emphasis on these two aspects of the pilot in marketing and communications to the targeted customers.

E. Product-Specific Policies

Residential Customers that Charge at Home

The pilot is targeting residential customers that primarily charge at home and are able to shift their charging into the evening on most weekdays. If a customer fails to meet either of these criteria as determined during the enrollment process, they would be deemed ineligible to participate.

Vehicle Type

Only customers that drive an EV[10] made by one of the participating automakers will be able to participate in the pilot. At present, the Company expects this to include BMW,

[9] Center for Sustainable Energy. (2016). EV Consumer Characteristics, Awareness, Information Channels & Motivations. Retrieved from https://energycenter.org/sites/default/files/docs/ext/transportation/2016-07-20%20EVR9-CSE-PEVmarkets%20handout.pdf.

Ford, General Motors, and Honda. Furthermore, the customer's vehicle must be connected through on-board vehicle communications with the OEM.

The Company may alter this list of OEMs prior to launch. Changes in OEM business priorities and contracting could affect the final set of OEMs involved in the pilot.

Data Sharing

Through the enrollment process, the customer must agree to share their EV home charging data with Xcel Energy to allow for measurement and verification of the pilot. The customer will be asked to agree to a set of Terms and Conditions that describe the pilot incentives, the customer's responsibility, and the data that will be shared by their OEM with Xcel Energy.

F. Stakeholder Involvement

During the pilot development process, the Company engaged numerous stakeholders to gather feedback and refine the pilot. The table below summarizes stakeholder involvement:

Stakeholder Type/Group	Date	Description
Electric Vehicle Workshop #1	3/11/2019	• Discussion of definition and terms, pilot design process, and key design questions
Electric Vehicle Workshop #2	6/17/2019	• Review of focus group results and revised pilot concept • Feedback on concept
Environmental Non-Profits	Various in person and phone meetings	• Natural Resources Defense Council, Southwestern Energy Efficiency Project, and Western Resources Advocates expressed interest in learning more about the pilot during 2019/2020 Demand Side Management Plan settlement talks or in

[10] Electric vehicles as referenced here and eligible for the pilot include both battery electric vehicles ("BEVs") and plug-in-hybrid electric vehicles ("PHEVs"). BEVs are defined as vehicles that "run completely on electricity stored in batteries and have an electric motor rather than a gasoline engine." PHEVs are defined as vehicles that "combine an electric motor that can be plugged in and recharged, with a gasoline engine." California. (2019). Plug-in Electric Vehicle Resource Center. Retrieved from https://www.driveclean.ca.gov/pev/.

		other forums • Initial meeting involved discussion of definition and terms, pilot design process, and key design questions • Follow-up meetings shared updated pilot design and discussed data collection
Colorado Energy Office ("CEO")	Various in person and phone meetings	• CEO expressed interest in engaging on the pilot during the 2019/2020 Demand Side Management Plan settlement discussions • Meetings provided same content as described above for the interested environmental non-profits
Automotive Original Equipment Manufacturers	Various meetings throughout 2019	• Led multiple meetings to describe pilot objectives, gather feedback on pilot design, and co-develop approach to execute the pilot
Electric Vehicle Customers	4/2/2019	• Held two focus groups to gather feedback regarding smart charging product offerings

G. Rebates & Incentives

The Company will offer an enrollment incentive of $100 per EV to customers that enroll in the pilot. In addition, customers will receive a further $50 per EV at the end of the first full year of the pilot if they charge using a Level 1 charging station or $100 per EV if they use a Level 2 charging station.

Should the Company see slow participation uptake that limits its ability to adequately achieve pilot objectives, Public Service may consider raising total incentives by up to a further $100 per enrolled EV.

H. Evaluation, Measurement, & Verification

The Company will release a publicly available report to share evaluation, measurement, and verification ("EM&V") results from the pilot after its conclusion. The report will use a similar format to past reports in the residential area, such as reports currently available on Public Services' website for smart thermostats and the in-home device pilot.[11]

The EM&V report will discuss programmatic implications based on pilot findings and data in a number of topic areas:

- Customer pilot profile—This area will discuss who enrolled in the pilot, the vehicle makes and models represented, and the solution the customer uses for home charging;
- Smart charging benefits—This area will include analysis of the benefits of smart charging including generator peak kW savings, energy cost savings, reduced wind power curtailment, and emissions savings;
- Charging basics—This area will summarize how customers in the pilot are charging and will include aggregated data on aspects of charging such as when charging occurs, how long charging takes, the amount of charging, the frequency of charging, and how these elements differ across variables such as model type and charging station type;
- Customer experience—This area will discuss aspects of the customer experience, satisfaction with enrollment and the pilot, and frequency of customer opt-outs in daily load shifting.

In order to perform the analysis, the Company will collect and analyze data from the pilot. Data will come from pre- and post-pilot surveys and event data[12] from the OEMs regarding vehicle charging patterns.

The specific information shared publicly in the report will be governed by data sharing rules set by the Public Utility Commission, policies of the participating OEMs, and the contract terms agreed to between the Company and the OEMs. The data included in the final report may differ from the illustrative list described above if data availability and contract terms necessitate.

I. Cost Effectiveness

The cost-benefit analysis included in this filing and highlighted in Table 1, shows a pilot that falls well below the threshold for a cost effective product. While pilots are not strictly held to the same cost-effectiveness standards as products, the Company only pursues pilots that it believes have a chance of achieving cost effectiveness in the foreseeable future. The Company reasonably believes that the moderate investment in

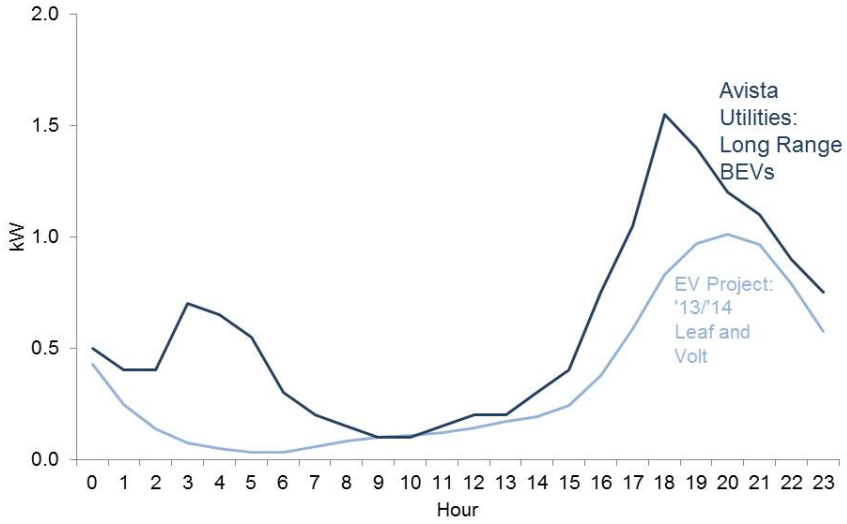
[11] In-home Smart Device Pilot report: https://www.xcelenergy.com/staticfiles/xe/Regulatory/Regulatory%20PDFs/CO-DSM/CO-2014-IHSD-Pilot-Evaluation.pdf; Smart Thermostat Pilot report: https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/Regulatory%20Filings/CO-Smart-Thermostat-Pilot-Evaluation.PDF.

[12] As described, the OEMs are able to provide event data with descriptive statistics for each home charging event. This type of data does not include 15-minute interval data.

this pilot will provide the information necessary to create a cost effective Charging Perks product at scale for several reasons.

- Generator Peak kW Savings Assumptions—Similar to other demand management products, capacity savings drive a significant share of the benefits of Charging Perks. The Company has estimated the avoided capacity from smart charging of Level 1 and Level 2 home charging stations using modeled electric vehicle consumption data from National Renewable Energy Laboratory.[13] For non-TOU Level 2 customers, it has also included empirical and modeling data from several different studies. The available data suggest that the capacity benefit could be larger than the Company's initial estimates. As an example, a study from Avista Utilities shows that battery electric vehicles ("BEVs") with larger battery capacities charge at higher average rates and use more kWh during the hours of the Company's system peak. Figure 1, shows a load profile from Avista Utilities for BEVs with batteries equal to or greater than 60 kWh relative to a profile from the EV Project, where all EVs had batteries between 16 and 24 kWh and were not able to charge at rates higher than 3.3 kW. As battery costs continue to decline and OEMs offer more high range vehicles, the Company expects to see charging patterns similar to what Avista Utilities has seen—producing higher impacts on the system peak, and increasing the benefit of smart charging.

Figure 1: Hourly average energy use from electric vehicles[14]



- System Changes in Timing of Peak Demand—As the Company integrates higher levels of solar power, it is possible that its system peak could shift to a later

[13] Muratori, M. (2018). Impact of uncoordinated plug-in electric vehicle charging on residential power demand. Nature Energy 3. Data set associated with this article retrieved from https://data.nrel.gov/submissions/69.

[14] Chart created and Xcel Energy analysis performed using information from: Avista Utilities. (2019). Semi-Annual Report on Electric Vehicle Supply Equipment Pilot Program. Docket UE-160082; The EV Project. (2013). EV Charging Summary Infrastructure Reports July-September 2013. Retrieved from https://avt.inl.gov/project-type/data.

period than typically observed today. For example, analysis by the Independent System Operator New England ("ISO NE") showed that going from no behind-the-meter solar on its system to 8 gigawatts of solar generation shifted the system summer peak hour by four hours.[15] Since home EV charging typically begins as soon as the customer gets home, a later system peak may mean more EV charging occurs during peak hours. This would further increase the benefit from off-peak rates and potentially smart charging through higher peak-coincident demand savings.

- Size of Other Benefits—The pilot tests how EV load can be used to increase demand during the hours when the Company is curtailing wind power. By reducing curtailed renewables, the Company would service this load with zero cost energy and displace the kWh served at a different time of the day when production costs are driven by the cost of the marginal power plant.[16] As the Company increases the share of wind power on its system, the number of curtailed hours will grow significantly—creating additional system savings opportunities for smart charging.

- Upfront Costs vs. On-going Product Costs for First-of-its-Kind Pilot—As is true with any pilot, the pilot must bear start-up costs for measurement and verification and higher administrative needs than are typical for a fully functioning product. In product phase, these costs will not exist, will be lower in absolute magnitude, or will be spread out across a much larger group of participating customers.

- Vendor Costs in the Future—A large share of the "Administrative and Program Delivery" budget is allocated to OEMs. These costs reflect the need for OEMs to develop and maintain the necessary technology and systems to manage smart charging, during a time when there are relatively few smart charging pilots and programs nationally. The Company expects that these costs following a pilot would decline to reflect fewer start-up expenses and development costs and the economies of scale associated with a program with more enrolled customers, more time in market, and greater interest in similar programs nationally. The Company has seen a similar transition with smart thermostat products through its AC Rewards program. During its Smart Thermostat Pilots in Colorado and Minnesota, setup fees were incurred for online tools such as customer enrollment portals and data access with smart thermostat vendors. These setup fees varied based on capabilities and vendor experience, among other factors. Since the time of the pilot, the AC Rewards Program has migrated to the use of an aggregated system which enables the Company to avoid the incremental costs of individual development from each vendor. The Company would expect to see significant

[15] ISO NE. (2019). Solar Power in New England: Concentration and Impact. Retrieved from https://www.iso-ne.com/about/what-we-do/in-depth/solar-power-in-new-england-locations-and-impact.
[16] This is a simplification of the economic analysis regarding savings from reducing renewable curtailments. Other factors that affect the value of curtailed renewables include whether the renewable energy resource being curtailed still receives the federal Production Tax Credit and if the energy is purchased through a PPA or the resource is company-owned.

service cost declines in the future as smart charging programs scale throughout the country. Moreover, smart charging can be performed by a variety of vendors. In the future, the Company could work with multiple OEMs, charging station vendors, aggregators with management software, and even smart plugs vendors. The competitive forces in smart charging should serve as another force that drives vendor costs down over time.

For the reasons discussed above, it is reasonable to assume that smart charging will increase in cost effectiveness with time and scale.