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April 24, 2017

Via Electronic Filing

OREGON PUBLIC UTILITY COMMISSION
ATTENTION: FILING CENTER
PO BOX: 1088
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RE: Docket No. UM 1811 – In the Matter of
PORTLAND GENERAL ELECTRIC COMPANY,
Application for Transportation Electrification Programs.

Enclosed for electronic filing are the following:

Exhibit 100-102 Klotz
Exhibit 200-202 Hanhan and
Exhibit 300-304 Breish.

/s/ Kay Barnes
Kay Barnes
PUC- Utility Program
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CASE: UM 1811
WITNESS: JASON R. SALMI KLOTZ

PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 100

Reply Testimony

April 24, 2017

Q. Please state your name, occupation, and business address.

A. My name is Jason R. Salmi Klotz. I am a Principle Executive Manager employed in the Energy Resources and Planning Division of the Public Utility Commission of Oregon (OPUC). My business address is 201 High Street SE, Suite 100, Salem, Oregon 97301.

Q. Please describe your educational background and work experience.

A. My witness qualification statement is found in Exhibit Staff/101.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to analyze the four primary programs proposed by Portland General Electric (PGE or Company) to accelerate transportation electrification as required by Oregon Laws 2016, chapter 28, section 20 (SB 1547). In my testimony, I make recommendations to the Commission as to whether the programs are consistent with the six factors included in the statute and whether the programs should be approved at this time.[1] As discussed in the introduction below, Staff's final recommendations are based on the understanding that the proposed programs are pilots with specific learning objectives.

My testimony includes recommendations on PGE's Navigant Study; the Education, Outreach, and Technical Assistance proposal; and the Residential Smart Charging Pilot proposal. Staff's analysis of PGE's other program proposals can be found at Exhibit Staff/200 Hanhan (Charging

[1] Oregon Laws 2016, chapter 28, section 20(4)(a)-(f) provides six criteria for the Commission to consider when evaluating transportation electrification programs.

Infrastructure – Electric Avenue Network); and Exhibit Staff/300 Breish (Electric Mass Transit – TriMet Fleet).

Q. Did you prepare an exhibit for this docket?

A. Yes. I prepared Exhibit Staff/101 and Exhibit Staff/102.

Q. How is your testimony organized?

A. My testimony is organized as follows:

Q. Can you please summarize your testimony?

A. Yes.

1) Owing in large part to the novelty of the subject matter, the newness of the program activity proposed, questions raised by the statute, and the lack of current data, Staff found evaluation of PGE's proposed programs difficult. Staff proposes treating the proposed programs as pilot programs, whereby PGE will be allowed to conduct some of the proposed programs in part to collect necessary data that would enable PGE to propose larger programs supported by data, well developed program theories, the ability to track attribution, evaluate cost effectiveness, and propose programs that fit within a transportation electrification long-term plan.

2) The Navigant Study on cost effectiveness and attribution marks the first effort by PGE to analyze costs and benefits of EV pilot programs. Staff found the work to be non-transparent, incomplete and lacking necessary supporting data, and therefore recommends adjustments be made before it can be fully relied upon for evaluating cost effectiveness and attribution. Staff provides specific recommendations for improvements and outlines expectations for cost effectiveness and attribution analysis for future proposals.

3) Through a reasonable reading of the statute one can discern a role for the utility in transportation electrification acceleration as a provider of electricity as a transportation fuel, charging infrastructure and infrastructure-related services. This reasonable reading of the statute informs Staff as to what proposed programs could be funded. PGE's Electric Avenue, TriMet Bus chargers, and Technical assistance to help with private investment in charging infrastructure all fit within the scope of anticipated utility activity to accelerate transportation electrification. Market transformation and PGE's demand response charger pilot may also fit within defined scope, but Staff suggests an additional showing by PGE be made before funding could be approved.

4) Staff finds that only the technical assistance portion of PGE's Outreach and Education proposal is consistent with the six evaluation factors and discernable utility role in transportation electrification acceleration, and therefore should be approved. Additionally, market transformation activities may have some merit if PGE is not the only funder of such activity and the Company can demonstrate

how those activities will support PGE's infrastructure and infrastructure-related services, programs, and projects.

5) PGE's proposal for a residential demand response pilot should not be approved at this time. While the program has inherent merit, there is not enough evidence in PGE's testimony to conclude that PGE has had enough experience with EV owners on time-of-use (TOU) rates and the development of specific EV time-of-use rate design. Once PGE makes a convincing showing that they have made every effort to sign up EV owners to a TOU rate, and constructed and properly funded a time-of-use rate program for EV drivers, Staff recommends the proposal for a demand response home charger program be resubmitted to the Commission for review. At present there is no evidence that PGE's DR pilot program will be additive to their time-of-use efforts or that such an effort will improve PGE's electrical system efficiency and operational flexibility beyond a properly designed and managed time-of-use rate offering.

6) Staff identified a number of missing or incomplete program elements as required by Commission rule. I identify and offer some advice as to Staff's interpretation of the information required by the Commission's rules governing transportation electrification program proposals.

Q. Please explain the framework for Staff's evaluation and the difficulties Staff encountered in evaluating this inaugural filing of transportation electrification proposals.

A. Before proceeding with Staff's evaluation of PGE's four primary transportation electrification programs and Staff's subsequent recommendations to the

Commission, Staff must first recognize the difficulties it encountered in the review process.

Staff began its review of PGE's proposed programs by evaluating the programs in accordance with the six statutory factors (a)-(f) provided in SB 1547, which Staff understands is the universe of criteria by which the Commission may evaluate transportation electrification programs. However, Staff struggled in its evaluation of PGE's programs given that some of the factors appear inconsistent with common Commission practice for review of utility investments, such as the new factor (c) that capital investments must be "reasonably expected" to be used and useful and are determined to be (b) "prudent" for cost-recovery purposes before the project has even been outlaid. In addition, Staff found that evaluating programs against several of the factors related to (d) enabling the utility to support the electrical system, (e) improving system efficiency and operational flexibility, and (f) stimulating innovation required new methods to quantify and justify such expected benefits.

Further, and perhaps more importantly, the difficulty of determining which proposals promise clear benefits to Oregon ratepayers was compounded by the lack of hard data underlying PGE's proposed programs, the absence of a long-term vision to guide an electrification "plan" and integrate the proposals together, limited recognition by PGE that this truly is an early iterative stage for transportation electrification, and an evaluation methodology for cost effectiveness that remains largely non-transparent and has yet to be thoroughly vetted by stakeholders. Staff certainly recognizes the difficulty PGE likely

encountered in preparing these proposals in accordance with SB 1547's pressing statutory deadline and the Commission's new transportation electrification rules. Staff concedes that some of the application deficiencies simply cannot be cured by PGE at this time because some of the data does not currently exist for the state of Oregon and this is the first opportunity stakeholders have had to review PGE's proposed evaluation methodology.

For the reasons mentioned above, Staff found it very difficult to find measureable and verifiable benefits associated with the programs, and therefore hesitates to recommend approval of PGE's proposed programs. Staff notes that we are still in the early evolutionary stages of a market where traditional utility incentive programs and outreach methods may not in fact produce an accelerated uptake of EVs by customers. However, Staff does recognize that the legislature intended for utilities to operate in this nascent market to provide the push necessary to accelerate EV charging and the use of electrified transportation that private factors have yet to accomplish. Thus, Staff finds itself in a perplexing position—to make a meaningful attempt to transform the EV market, PGE would have to make significant inroads in installing multiple dozens of public charging stations throughout its service territory and saturate the service territory with outreach and direct incentives, but that would require an approval of a hefty outlay of Oregon ratepayer funds based on little to no supporting data, no way to measure attribution, and the inability to demonstrate that such a magnitude of investments are prudent. On the other hand, some of PGE's somewhat piecemeal programs proposed in its

inaugural application could be approved with minimal detriment to ratepayers, but Staff highly doubts they will lead to significant incremental impacts necessary to actually "accelerate transportation electrification" and stimulate innovation and competition as the legislature envisioned.

Therefore, after careful review of PGE's initial application and its supplemental filing made on March 15th, Staff finds that the only way to recommend approval of several of these first-step proposals is to view them as pilot programs. As a result, where Staff recommends approval of programs, those recommendations are based on an understanding that these are pilot programs subject to specific required conditions proposed by Staff, namely time limitations, spending limitations, and specific learnings that PGE will track and report back to the Commission. For example, PGE projects that the Network charging stations will achieve the goal of EV "lift" and thus increase public confidence in electric vehicles, yet there is limited market knowledge and data upon which the goal of market lift is measured. Staff believes that improving stakeholder understanding of program attribution is also an essential question that must be addressed. Staff believes the data from these pilot programs, if properly measured and tracked by PGE, will enable PGE and stakeholders to improve the attribution methodology that may allow for superior assessment of new utility transportation electrification programs going forward.

To that end, Staff suggests PGE look to examples of the work of entities that develop market transformation models for energy efficiency products to improve their attribution modeling efforts. Once PGE has

developed an attribution model, Staff would encourage broad stakeholder input on the model. Additionally, Staff suggests that PGE's pilot efforts eventually be aligned to support a broader long-term plan to accelerate transportation electrification. Staff expects that when data from the pilot programs becomes available and the utilities are in the position of implementing programs that fit within their "plan" (as will be described in a future rulemaking or order), Staff will have the tools to efficiently and thoroughly review transportation electrification programs.

ISSUE 1. NAVIGANT STUDY:

ANALYSIS OF COST EFFECTIVENESS AND ATTRIBUTION

Navigant Study: Analysis of Cost Effectiveness

Q. Please explain the purpose of the Navigant Study and why this is an important starting point for Staff's review of PGE's proposed programs.

A. The purpose of the Navigant Study, as commissioned by PGE, was to "develop a framework to continuously evaluate and improve PGE's transportation electrification support efforts, then apply that framework to PGE's proposed portfolio to provide initial indications about cost effectiveness."[2] The study sought to answer two questions: 1) What is the market baseline and PGE's influence on the market? and 2) What are the costs and benefits by program and portfolio wide? As provided in the filing, Staff looked to the study to lay the groundwork of assumptions and analysis from which all of the proposed programs could be evaluated, not only for

[2] Navigant study page 1.

cost effectiveness and attribution, but also as a source of information as to how the programs address the six factors listed in the statute.

Q. Did you review the Navigant Study filed with PGE's transportation electrification plan and program proposal?

A. Yes.

Q. What is your assessment of the Navigant Study?

A. The Navigant Study is a first attempt of an analysis of EV program cost effectiveness that has multiple shortcomings and lacks transparency and supporting data.[3] Therefore, until these deficiencies can be addressed, Staff does not recommend relying on the Navigant study to assess cost effectiveness or attribution of the programs proposed by PGE in this filing. That being said, the study does provide useful insight for Staff into the difficulties of performing such an analysis at this time and offers initial information useful to review of the programs as *pilot* efforts.

Q. Why does Staff recommend not relying on the Navigant study to assess cost effectiveness of the PGE Transportation Electrification proposed programs, specifically, what are the short-comings of the study?

A. Before detailing the short-comings of the Study, Staff would like to provide context for how the Commission reviews cost effectiveness of energy efficiency programs and the level of standards Staff applies for that analysis to be accepted. These expectations can then be applied to the work provided

[3] PGE supplied some additional data through DRs 1-17, but this data is not comprehensive to the methodology developed by Navigant. Additionally, such information, if important to the construction of the Navigant framework, should have been provided and discussed in the application. See Staff Exhibit 102.

through the Navigant Study to illustrate what Staff found to be incurable shortcomings.

There are currently five standard cost effectiveness tests in use throughout the country. Each captures and compares costs and benefits of an investment like an efficiency or EV program from the perspective of either the participant, utility, ratepayer, a combination of those three, or even broader to include the perspective of society. The corresponding tests are the Participant Cost Test (PCT), Utility Cost Test (UCT), Ratepayer Impact Test (RIM), Total Resource Cost Test (TRC), and the Societal Cost Test (SCT).

The basic structure of each cost test involves a calculation of the total benefits and total costs in dollar terms from a certain vantage point, depending on the test used, to determine whether or not the overall benefits of a program exceed its costs. On its own, each test essentially provides a single stakeholder perspective. When considered together, multiple tests provide a comprehensive approach to analyzing the benefits of a proposed program.

For energy efficiency, the Commission reviews the utility perspective and the combined perspective of ratepayers, participants and the utility by employing the UCT and the TRC tests. In the Navigant study, three benefit-cost tests are used by PGE to calculate the net present value for each pilot program: the TRC, SCT and RIM.

Q. What are the essential elements Staff reviews in cost effectiveness evaluations?

A. Proper identification and quantification of the costs and benefits of the investment are essential to the resulting determination of cost effectiveness. Benefits are driven by the underlying assessment of estimated program impacts, also known as program attribution. Therefore, the methodology used to determine program attribution is critical. If the anticipated program impacts are inflated or simply inaccurate, benefits are not valid, nor is the cost effectiveness evaluation. Examples of necessary underlying assumptions of the cost effectiveness tests include resource life, amount and timing (e.g., daily, seasonal, and annual variation) of utility system impacts such as energy, capacity, ancillary services and avoided transmission and distribution system investments, and costs for program administration, capital investments and O&M as applicable. For energy efficiency, Staff has vetted the analysis methods used by Energy Trust and can access all supporting documentation related to creation of these values.

Critical methodological design assumptions regarding which benefits and costs accrue to whom are also pivotal decisions which impact the results of a cost effectiveness test. These decisions vary based upon which test is considered, another important element of the analysis of the program. For energy efficiency, the specific tests used to evaluate investments were determined through a Commission process over twenty years ago within Docket No. UM 551.

Q. Please provide a summary of each of the costs effectiveness tests used today.

There are currently five tests in use throughout the county including:

(1) The participant costs test, or PCT, which asks whether the participants of a program benefit over the life of the measure. This approach attempts to compare the costs and benefits accrued to the customer who has installed the measure.

(2) The Utility Cost Test, or UCT, which asks whether customers' utility bills increase or decrease. This is achieved by comparing costs to administer a program to supply side resource benefits.

(3) The Ratepayer Impact Measure, or RIM, which asks whether utility rates increase or decrease. This cost test is a comparison of the utility costs to administer a program and the impact to utility revenues.

(4) The Total Resource Cost Test, or TRC, which asks whether the total costs of energy in the utility service territory will decrease. This test is a comparison of program administrator and customer costs to utility resource savings and customer benefits.

(5) The Societal Cost Test, or SCT, which is similar to the TRC but expands the perspective to include not just the benefits and costs to the utility and the participant, but to society, beyond interests of ratepayers specific to the utility. This test asks whether the utility, state or nation is better off as a whole due to the program.

Q. You stated earlier in your testimony that Staff does not recommend relying on the Navigant study to assess cost effectiveness of the PGE Transportation Electrification proposed programs, why?

A. To start, I have several concerns regarding the impact analysis used in the cost effectiveness study conducted by Navigant to calculate program benefits. First, in the study, the baseline and incremental impacts are projected as precise, discrete values, rather than ranges of values, yet Navigant asks the reader to regard the result with a high degree of uncertainty.[4] Additionally, Navigant does not note or recommend what short term reassessments or updates could be undertaken for the study to begin to narrow the uncertainty in PGE's proposed program investments.

Second, I have concerns about Navigant's attribution methodology, which is the approach used to estimate the degree to which PGE's specific efforts are expected to result in EV market lift. These concerns come in two parts; 1) how they developed their market baseline and 2) how they used the baseline to assess program impacts. This information is required for all program proposals pursuant to OAR 860-087-0030(1)(b).

It is unclear how the baseline forecast calibrates to actual. Navigant states the baseline as "9,000," but it is not clear from the description whether the baseline assumes 9,000 overall car sales in PGE territory or 9,000 incremental EV sales in PGE's territory in 2017. If Navigant is suggesting a baseline of 9,000 annual EV sales, Staff believes this number is overstated based on historical EV sales[5] and may include hybrids as well as pure EVs. Navigant may be including battery electric vehicles, plug-in hybrid electric vehicles and extended range electric vehicles, all of which are capable of using

[4] PGE Direct and Supplemental Testimony, Appendix A Page 6.
[5] PGE Response to OPUC DR 002, Attachment A.

electric infrastructure to fuel the car but all of which have different infrastructure use patterns and needs.[6] It is simply not clear from the data supplied by Navigant whether PGE and Navigant are comingling a variety of types of cars when counting baseline "EVs".

Moreover, how program impacts are assessed incremental to this questionable baseline is also not clearly explained. As an example, the study concludes that acceleration of EV adoption can be attributed to the proposed marketing and outreach programs, but the details supporting this assertion are unclear. Navigant did not provide the background data on which the analysis was based, did not explain from where the data was sourced, nor how it was used to model current and future EV sales. There is also no indication of how the data was used to assert that PGE's programs will result in an increase in EV sales. There is mention of "using what little data is available on traditional OEM consumer education spending estimates per vehicle sale and the historic growth of infrastructure relative to the electric vehicle market in the PGE service area." This begs the question of exactly what data is available and which data was used and how was it used?

Additionally, I'm concerned that when PGE and Navigant assessed attribution they grouped together all Education and Outreach programs. Typically when Staff assesses energy efficiency program cost effectiveness, Staff assesses each program individually, unless programs can only be offered if packaged together. PGE has several Education and Outreach programs that

act *independently* of one another, but their effectiveness has been assessed *as a package*, negating the opportunity to assess their individual merits.

Third, Staff does not know what information or data set Navigant is pulling from to estimate the baseline or program impacts. Staff requested information on the development of the baseline used by Navigant in DRs 3, 5, and 15, but the information provided by PGE does not fully demonstrate how the baseline was developed or where the information was pulled from.[7] As another example, in responding to Staff DR 10, PGE supplied an excel spreadsheet which shows numerical values behind the graphs provided in the Navigant Study.[8] Some of these estimates seem to be informed by the current Electric Avenue project, but whether PGE used other data points is not clear. Nor is it clear from the spreadsheet how the values were developed. Additionally, neither PGE nor Navigant makes any suggestion of what data is planned to be collected over the course of the programs to better inform the impact forecasts as well as tools to measure actual impacts.

Fourth, without having access to the underlying data, it becomes challenging to discern how PGE and Navigant developed their tables and plots which are meant to illustrate results such as the attribution numbers found in Table 19 of PGE's Application. Here PGE has developed a table showing cumulative new EV sales attributed to PGE pilots. Again, this table is difficult or impossible to fully comprehend because 1) PGE has not shared how these numbers were developed, and 2) the table is cumulative, but it's easy for the

[7] Staff Exhibit/102.
[8] Staff Exhibit/102.

reader of the table to misinterpret cumulative gains as year-over-year annual gains, giving a skewed representation of attribution. Additionally, the baseline annual sales graph, from which Navigant also draws attribution, is difficult to rely on because the single graph is used to represent both annual and cumulative EVs in PGE's service territory: in Table 7 of the Navigant study, the graph is used to show cumulative electric vehicles in PGE territory, and in Figure 1, the *same graph* is used to show annual baseline and new sales in PGE territory. This confusion is compounded when Navigant uses the same tables to underpin their discussion of EV lift or attribution to PGE programs being close to 5%.

Q. Do you have any recommendations on how Navigant or PGE could address baseline and impact issues?

A. Yes. Staff recommends PGE take steps to improve the market adoption curve and baseline. Consistent with the OARs governing Transportation Electrification Programs, Navigant and PGE must identify or propose the specific information that it plans to capture now during this "pilot program" phase that can help inform a better forecast going forward, in order to ensure that ratepayer money is being prudently expended to accelerate transportation electrification.

Additionally, I recommend, consistent with the OARs, Navigant and PGE propose, within the pilot evaluations, what activities should be undertaken to improve the baseline. Similarly, Navigant and PGE can also strive to identify what information is needed to determine at what point the EV market is

"transformed" and no longer requires intervention by PGE. Ultimately, such analysis should project over what timeframe it makes sense to have PGE conduct programs to accelerate electric vehicle adoption.

Staff notes that there are examples of new energy efficiency product market transformation plans that define a projected market baseline and incremental impacts of "lift" due to a new program. NEEA, funded in part by PGE ratepayers, is an excellent example of how this type of attribution work is conducted and structured for programs meant to accelerate market adoption. Staff encourages PGE to work to improve their attribution methods and transparency of supporting data.

Q. Do you have concerns over the use and construction of Navigant's Societal Cost Test (SCT)?

A. Yes. Although Navigant's work to develop the SCT is helpful, the Commission has not yet adopted use of the SCT in other dockets. Further, the Navigant SCT as proposed lacks supporting information, as well as the inclusion of some costs and benefits. It was not evident from the filing what information Navigant used to develop their SCT, where such information was sourced from, and why such information was used. However, Navigant states throughout their study that they have modeled their approach on the California and Seattle City Light transportation electrification study conducted by E3 and ICF. The study by E3 and ICF was conducted and developed over a series of years and had multiple parts. All data sources were shared, assumptions vetted and studies were conducted to acquire data necessary to develop a robust study. The body of

work developed to construct the California and Seattle City Light Study is significant and transparent. The same is not true with the Navigant study because Staff does not know what information or parts of the model studies were used by Navigant. Additionally, the work California conducted used specific CA market information, values and assumptions about market maturity and market growth. Navigant does not address how it approached these California-specific data points.

Q. In your analysis of the Navigant SCT did you find anything missing and what do you believe needs to be added to proposed approach?

A. Yes, I found several components missing. First, Navigant needs to better define the various cost/benefit categories used and provide better information about how those costs and benefits were monetized. In response to Staff DRs 17 and 36, PGE provided some insight into how the federal grant funds were included. Navigant includes a cost/benefit category called "Increase Energy Emissions" and notes this category to be a benefit. However, Staff does not know what Navigant is including in this category or how the item(s) included are monetized. Staff was hopeful that the Company's response to Staff DR 10 would provide this information, but it did not. [9]

Second, Staff would expect that the costs related to greenhouse emissions, NOx, particulate matter and volatile organic compounds would be included in the category.

[9] Staff Exhibit/102.

Third, Navigant did not explain which cost elements were included in this category or how the items were monetized. Although Navigant cites to a 2010 California Public Utility Commission Demand Response Cost Effectiveness Protocol methodology, Navigant caveats this footnote by stating, "Cost and benefits designations for each stream are based on Navigant analysis," and the 2010 CPUC demand response methodology. [10] This note lends little insight into what items were included or how Navigant monetized the items in their transportation electrification methodology. Staff asked what items were included in DR 1, to which the Company responded with a table from the California ICF E3 study.[11]

Fourth, Navigant's study excludes two generally accepted cost effectiveness tests, the UCT and the PCT. Previously in my testimony, I mentioned the various five cost effectiveness tests used when analyzing various types of resource investments. For energy efficiency, the Commission employs a modified TRC test and the UCT for program review. The decision to do so was based on more than thirty years of experience such that the Commission is confident that the use of these two tests provide the information necessary to evaluate funding for energy efficiency programs. Since the evaluation of EV program impacts is novel for all parties, Staff finds it premature to narrow the number of tests used for evaluation to the TRC, SCT, and RIM tests. Unlike energy efficiency, all parties can benefit from new

[10] Footnote 5 on page 6 of the Navigant study.
[11] Staff Exhibit/102.

potential understanding to be gained in reviewing the results of all test perspectives.

Fifth, Navigant admittedly excluded various cost-benefit categories: 1) the value of Low Carbon Fuel Standard credits that PGE may earn if it participates in the Clean Fuels Program[12]; 2) the value of ancillary services and/or power quality services that transportation electrification may provide to PGE's distribution grid; 3) non-energy and non-emission-related benefits from transportation electrification, including enhanced public image for PGE and the City of Portland, customer satisfaction, noise pollution; and 4) additional potential costs of transmission and distribution.

Sixth, it is not clear to Staff whether Navigant included deferred/avoided capital investments. It seems as though Navigant did include increased capacity costs as a cost under its three tests, but the assertion that electric vehicles would result in increased capacity costs is not explained in the Navigant Study; further, it may be at odds with other cost/benefit analyses cited to by Navigant, particularly the California methodology.

In California, ICF, the developers of their methodology, noted that a properly managed EV load can, especially in the near-term, assist with resource utilization off-peak if the EV load is properly managed through time-of-use rates. Similarly, two of the six criteria laid out by the Oregon Legislature for the Commission to consider before approving a program support the premise that EV load and the programs proposed by the utility should be evaluated

[12] At the April 18, 2017 Regular Public Meeting, Staff requested and received approval from the Commission to open an investigation into utility participation in the Oregon Clean Fuels Program.

based on their ability to support utility system operation, including variable resource integration.[13]

In its Transportation Electrification Assessment of Grid Impacts, ICF also found that EV load can be used to avoid increasing the need for new capacity while also addressing over-generation. While it is important to include an assessment and valuation of possible incremental capacity cost, it is not clear how these values were developed by Navigant or whether Navigant considered various EV load management schemes, such as dynamic rate structures. Staff requested through DR 21 information on PGE's Time-of-Use rate structures and how they were used to support the filing.[14] The response did not discuss how PGE and Navigant analyzed PGE's TOU rate structures.

Q. Do you have any additional general concerns with the Navigant Study?

A. Yes. The net benefits tables generated by Navigant lack clarity. Navigant does not clearly indicate whether costs and benefits are spread over 10 years, or some other timeframe. If a ten-year analysis was used (or any other discrete timeline), Navigant provides no insight or justification as to why that timeline was selected. Lastly, again, no underlying data was provided. As a result, the lack of transparency and the uncertainty in Navigant's assumptions does not provide Staff confidence that the proposed programs will be cost effective investments.

Q. Do you have any suggestions to address the methodology used by Navigant?

[13] SB 1547 Section 20(4)(d) and (e).
[14] Staff Exhibit/102.

A. Yes. Staff recognizes that an analysis of EV adoption is difficult so early in the evaluation of the EV market, however, Staff recommends that PGE identify what information should be gathered to inform improvements to the proposed programs and impacts of the programs. Opportunities to optimize the grid without the addition of new capacity costs to serve the new charging load should be an optimization of the existing system to benefit ratepayers, even if cost effective as analyzed; the inputs and assumptions are extremely uncertain.

However, because the investments are modest in size and have potential to be cost effective from the TRC perspective, moving forward with this group of programs (technical assistance, public charging infrastructure and TriMet's Bus Chargers) and evaluating them may be reasonable and in the public interest simply to test assumptions and program design for future, more-viable transportation electrification programs. Staff cautions, however, that the Navigant analysis is not robust and should not be used to expand beyond the level of current proposed investment.

Staff recommends that programs be designed so that there is no new capacity cost to meet new charging load, otherwise, ratepayers are both paying to expand the system for new EV load and paying to avoid having to expand the system through energy efficiency investments. Early pilots such as this may be needed to help transform the market to adopt EVs, but any future investment should be targeted at ensuring that charging is focused during off peak hours and that EV load is helping to optimize the existing system. Programs should have regular evaluation check points and off ramps built in to

ensure that if not leading to market lift, investments can be discontinued. For example, the Outreach and Education program is ~$500K per year, for five years. By the end of year two, Staff suspects PGE should be able to evaluate and justify continued funding or discontinue the program.

ISSUE 2. EVALUATION OF PROGRAMS TO ACCELERATE TRANSPORTATION ELECTRIFICATION

Q. How will proposed transportation electrification programs be evaluated at the Commission?

A. Oregon Laws Chapter 28, Section 20(4)(a)-(f) directs the Commission to consider six factors when assessing transportation electrification programs, specifically, whether the proposed investments and expenditures are:

a) Within the service territory of the electric company;

b) Prudent as determined by the Commission;

c) Reasonably expected to be used and useful as determined by the Commission;

d) Reasonably expected to enable the electric company to support the electric company's electrical system;

e) Reasonably expected to improve the electric company's electrical system efficiency and operational flexibility, including the ability of the electric company to integrate variable generating resources; and

f) Reasonably expected to stimulate innovation, competition and customer choice in electric vehicle charging and related infrastructure and services.

Q. What about factor (a) "within the service territory of the electric company" do you find informative in relation to the programs proposed by PGE?

A. Factor (a), investment within the service territory of the utility, could indicate that efforts undertaken by the utility to practice market transformation that affect markets beyond their service territory is not the purpose of these programs because then ratepayers would be subsidizing benefits accruing to customers outside their service territory (or community). PGE has mentioned possible market transformation efforts in its Education and Outreach program directly[15] and throughout the discussion of Education and Outreach in PGE's overall application. Staff's concern is it makes little sense to have PGE conduct such work independently in the broader transportation electrification area.

Q. How do factors (d), (e), and (f) of the law inform your analysis of the programs PGE proposed?

A. Items (d) and (e) refer to system impacts and system operations, and the benefits of operational flexibility that EV load could possibly provide to the system, including better integration of variable renewable resources. Factor (f) is constructed such that the direct objective is electric vehicle charging and related infrastructure, but indicates that innovation, competition, and customer choice are reasonably expected to increase as a result of the utility's proposed

[15] Page 9, as budgeted on page 13 of Spak – Goodspeed Testimony

projects. Taken as whole, factors (a), (d), (e) and (f) all reference infrastructure and infrastructure-related services as activities that the utility would propose to the Commission to accelerate transportation electrification.

Q. Did any other parts of the statute provide guidance for your assessment and evaluation of PGE's proposed programs?

A. Yes. First, sub-section three of the law states, "A program proposed by an electric company may include prudent investments in or customer rebates for electric vehicle charging and related infrastructure." This is informative because it indicates that a program proposed by a utility may include rebates to customers for EV charging and related infrastructure.

Second, in factor (f), the legislature used the term "services." Staff likens this to the obligation of the utility to provide safe and reliable electric service at least cost. Additionally, the law on acceleration transportation electrification (applicable here) and the Clean Fuels Program (developed by way of Oregon's Low Carbon Fuel Standard) both refer to electricity as a transportation fuel.[16] In Staff's opinion, this framework may indicate that the utility role with regard to transportation electrification is primarily as a service provider of electricity and electricity infrastructure to more readily provide electricity as an accessible transportation fuel, as opposed to programs such as Education and Outreach.

This is further narrowed when we look to factors (d), (e) and (f) previously referenced whereby the legislature required the Commission to

[16] See Oregon Laws Chapter 28 Section 20 (2)(b),(c) and (g).

consider utility operations in connection with electric vehicle charging. This perspective is further bolstered when we review how the statute defines "transportation electrification" as the use of electricity to provide power to a vehicle, programs related to developing the use of electricity to power vehicles, and through related infrastructure investments.[17] Staff used this framework regarding the scope of utility activities to accelerate transportation electrification when evaluating PGE's proposed programs.

Q. Do you think this perspective can help the Commission better define prudency in the context of transportation electrification?

A. I think that this perspective can help the Commission with their determination of prudency, but I don't think it fully defines prudency. From the lens discussed above, the Commission's prudency determination can be can be informed by whether PGE's programs advance fueling infrastructure programs and related infrastructure services that accelerate transportation electrification. However, Staff also believes that whether a utility program truly accelerates transportation electrification is a matter of attribution. As I discussed previously in this testimony, at present, attribution methodology is lacking proper definition and data. Staff believes that attribution, cost effectiveness, and the flow of net benefits to ratepayers should inform prudency.

Q. The legislation also asks the Commission to consider whether investments are reasonably expected to be used and useful. Do you find this factor informative?

[17] Oregon Laws Chapter 28 Section 20(1)(b).

A. Yes and no. Staff struggles to see how non-infrastructure investments, such as Education and Outreach items, can be reasonably expected to be used and useful. However, given the utility's new role in a market as defined by the legislature, it may be possible to find a connection between some Education and Outreach programs, such as PGE's Technical Assistance, which attempt to help with privately-owned charger investments. Here attribution or relation back from the private infrastructure investment to the technical assistance provided by PGE is very important in determining the prudence of the utility and ratepayer investment.

Q. Are there other aspects of the law that informed your assessment of the programs to accelerate transportation electrification or the question of prudency?

A. Yes. I would offer the language in the current law where the legislature used the term "net benefit." This term, in the context of a transportation electrification investment, relates back to a 2012 Commission decision, Order No. 12-013. In this order, the Commission adopted a policy that in order for a utility to justify general rate recovery of electric vehicle investments, "prudence, in the context of EVSE investment, requires a showing of net benefits to customers." The legislature (in SB 1547) referenced this term but modified it to state that by deploying transportation electrification, the utility has the opportunity to propose that a net benefit for the customers of the electric utility *is attainable*.

ISSUE 3. EDUCATION AND OUTREACH

Education and Outreach

Q. What is your recommendation on PGE's proposed education and outreach programs?

A. PGE has proposed six education, outreach and technical assistance programs: Specialized training, partner rewards, ride and drive events, time-of-use rates, outreach to EV drivers, and regional market transformation activities. I believe that when we apply the perspective gained from the law and the long history of how the Commission analyzes and approves utility investments, we can conclude that PGE's strongest proposal is the Technical Assistance Program.

Q. When you apply this perspective to PGE's Education and Outreach transportation electrification program proposals what do you find?

A. I find that only three of the six programs fit within the role and scope of activities that would accelerate transportation electrification. Only two of the programs directly support transportation electrification infrastructure: "Time-of-use Outreach to EV Drivers" and "Technical Assistance." One program investment, "Market Transformation," seems to promise support for infrastructure, while leveraging other investments and coordination, but its consistency with the statutory factors is complicated because such investments will undoubtedly have impacts beyond PGE's service territory.

Time-of-Use Outreach Proposal

Q. What aspects of PGE's proposed Time-of-Use to EV Drivers program does Staff support based on the six factors?

A. PGE's Time-of-Use to EV Drivers program supports not only the business case for the purchase of an EV but also is consistent with the legislative criteria laid out where by investments are reasonably expected to enable the electric company to support the electric company's electrical system, improve the electric company's electrical system efficiency and customer choice in electric vehicle charging. However, to be clear, the proposed program consists of outreach to EV drivers, i.e., marketing materials and technical assistance materials that would educate EV drivers about the benefits of TOU charging; this is not an actual TOU tariff proposal.

Q. Are there other meritorious aspects of PGE's Time-of-Use Outreach to EV Drivers?

A. If PGE is successful in offering time-of-use rates to EV drivers as a result of the outreach program, as shown by industry literature, it should help increase benefits to ratepayers. We know from various literature reviews that from the utility customer perspective, revenues from electric vehicles charging are a benefit and resources expended to deliver electricity for charging are costs.[18] PGE reflects this in the Navigant Cost Effectiveness model submitted as part of the application. When additional revenue from electric vehicle charging exceeds the marginal costs to deliver electricity to the customer, it results in positive net revenues that put downward pressure on rates. Tiered and flat

[18] For example - *California Transportation Electrification Assessment, Phase Two: Grid Impacts*, ICF International, E3, October 2014; *Patterns of Electric Vehicle Charging with Time of Use Rates: Case studies in California and Portland*, Biviji, et. Al. U.S. Department of Energy - Office of Electricity Delivery and Energy Reliability under Contract Number DE-AC02-06CH11357 (2014).

rates provide the highest revenues, but have the highest supply costs.[19] Finding or developing rate structures that provide an economic incentive to shift charging to lower cost off-peak hours is beneficial to customers and to the PGE system and system efficiency, which is consistent with factor (e) of the statute.

For example, when California studied time-of-use rate scenarios for electric vehicles they found that TOU rates do shift charging to off-peak hours, when both the rates and the costs of delivered electricity are lower.[20] Additionally, the study found that TOU rates provide higher net benefits for electric vehicle owners, which encourages adoption.[21] This same report looked into the benefits of dynamic charging for renewable integration. Using electric vehicle infrastructure to improve the utility ability to integrate variable generating resources was also a goal of the California legislature, similar to criteria (e) that the Commission must consider.

The California study found that during periods with low loads and high renewables, avoided costs can be negative during the day. This indicates that there is value in adding midday load to absorb the over-generation and reduce the morning and evening megawatt ramp requirements. When Energy and Environmental Economic, Inc., the authors of the above noted study, modeled a dynamic rate for electric vehicles meant to assist with variable generation integration, they found that charging was shifted to the early morning ramp period and that the peak charging level was also reduced. This changed the

[19] *Id.*
[20] *Id.*
[21] California Transportation Electrification Assessment Phase 2: Grid Impacts (October 23, 2014).

avoided cost seen in the model, resulting in additional benefits to the utility system beyond time-of-use rates.

Q. Although you seem to find merit in PGE's proposed Time-of-use outreach for EVs, do you find the proposal detailed enough for program approval?

A. Not at this time. PGE has provided limited information as to how it will conduct Time-of-Use outreach for EV drivers, so much so that it is impossible to determine whether PGE will be conducting marketing and outreach to residential customers or outreach to only Schedule 38 (non-residential) customers. While PGE's Electric Avenue customer would be exposed to a time-of-use rate, under PGE's proposal, there is little information to understand whether new chargers installed by companies other than PGE will or must also take service under a Time-of-Use rate. Therefore, I do not recommend approving the PGE proposed Time-of-Use Outreach to EV Drivers until such time that PGE makes clear that the Education and Outreach program will extend to public, private and residential chargers.

The program currently offered for home charging has little or no outreach or support from PGE, leaving most EV purchasers in the dark about the benefits of TOU or how to calculate potential savings. Although PGE currently has a bill stuffer campaign to notify prospective EV customers of potential savings from TOU, PGE's efforts could and should be increased given the opportunity presented by the new legislation. I would recommend that PGE revise the program to create a more aggressive EV TOU Education and Outreach campaign that includes tools to calculate bill savings, fuel savings,

emission reductions and other support activities such as coordinated technical assistance and outreach.

Technical Assistance Program

Q. Do you recommend other PGE proposed Education and Outreach programs be approved?

A. Yes. PGE has proposed a Technical Assistance program. This proposal is an expansion of their on-going ad-hoc technical assistance that the Company currently offers to business customers. PGE's stated goal for technical assistance is to provide support to transit agencies, low-income service providers, and community-based organizations who are considering procuring electric vehicles for their existing operations, while primarily providing formal EV technical assistance for non-residential customers considering fleet electrification by installing workplace charging infrastructure.

Staff believes the activities outlined by PGE for their new employee to provide technical assistance helps accelerate transportation electrification through bolstering infrastructure development and investment while creating the proper relationships with those making such investments such that PGE can better counsel and understand how such new loads can be managed to support PGE's system.

Q. Do you have concerns about PGE's proposed Technical assistance program?

A. Yes. At times within the application, PGE simultaneously refers to and seems to package the costs of technical assistance with other general outreach activities.

In Table 2 of the application, technical assistance costs are otherwise rolled into all other Outreach program costs. Table 10 shows that Technical Assistance costs through 2022 is estimated to cost ratepayers $1,021,700, while the entire bundle of Outreach programs is estimated to cost an additional $1,032,300. These programs include Specialized Training, Partner Rewards, Ride and Drive and Regional Market Transformation. Such bundling is problematic when trying to assess attribution and cost effectiveness on individual outreach programs.

In addition, in recommending Technical Assistance for approval as a "pilot" effort and not yet as program, Staff would like PGE to: 1) clearly define the research questions this offering is helping them answer, 2) identify data they will be collecting and analyzing from this pilot to inform potential future offerings, and 3) create short term milestones or review periods at which point in time the Commission can reassess the continued investment of ratepayer dollars.

Market Transformation

Q. Do you recommend approval of other Education and Outreach programs?

A. Another program that presents the possibility for net benefits while also addressing infrastructure and support of PGE's electrical system is funding to support Market Transformation activities. However, at present PGE has no formal proposal for how such funding would be used either by PGE or some other entity. Before ratepayer funding is granted for this activity, I think it is

important that PGE and other entities that PGE will fund or coordinate with come forward with a formal funding proposal for discrete activities.

Q. Does this mean you do not believe ratepayers should fund PGE's other Education and Outreach programs?

A. That's correct. While I believe efforts to address new building EV ready activities have value, I otherwise believe such activities are more properly conducted by entities with expertise and developed channels to these market factors, such as the building codes and new efficient homes. Lastly, as stated previously, I do believe TOU outreach for EVs does have merit, but specific details need to be submitted to the Commission.

Q. Why don't you believe the remainder of PGE's Education and Outreach programs should be funded by ratepayers?

A. First, it would be very hard to demonstrate attribution for such program investments. Second, there are market factors that presently better fit such roles or have primary responsibility in such markets. For example, PGE wants to conduct specialized training and rewards for a car dealership's salesforce. Staff objects to the utility filling the role of a car dealership to properly train their sales staff to sell the car company's own product—EVs—because the benefits to ratepayers of PGE paying to train car salespeople are so attenuated and it is nearly impossible to show attribution.

Third, PGE would like to place information in EV's owned by companies whose business model is to disrupt the car ownership paradigm, such as Uber. This basic premise goes against promoting electric car

ownership and acceleration of electric car sales. That is, EV ownership underpins the concept of acceleration. Uber and Lyft are looking to convince the market the car ownership is not necessary.

Lastly, the Ride and Drive program proposed by PGE is an activity better undertaken by an entity like Drive Oregon whose mission is to promote and educate potential EV purchasers of the benefits of EV ownership. Staff sees no language from the legislature that would support PGE's proposed expenditure for such a program, nor does it meet the six factors. Additionally, the cost proposed for Ride and Drive at $100,000 per year seems as though PGE is covering the full costs of such events without coordination or contribution from other entities whose market roll better fits with such activities. Coordination is a component addressed by Commission rule OAR 860-087-0030(1)(c)(C).

Q. What is your final recommendation regarding funding of PGE's Education and Outreach program proposals?

A. Only the Technical Assistance portion of PGE's Outreach and Education proposal seems supportable to fund at this time. Additional detail is needed to support funding for TOU EV outreach and market transformation funding.

ISSUE 4. PILOT PROGRAMS

Q. PGE has proposed a Residential Smart Charging Pilot with the stated purpose of testing whether smart charging demand response will improve electric vehicle integration and provide PGE flexibility in curtailing or shifting charging loads to off-peak periods or periods of excess

renewables energy. Do you think this program should be approved, why or why not?

A. While I believe this program is well within the scope of utility activity discussed earlier in my testimony based on factor (e), I have concerns about the timing and stated purpose of the pilot program and the lack of supporting data. PGE has not made a case with research and data to show that such a pilot would be more effective or additive to a properly developed time-of-use or other dynamic rate structure meant to shift residential electric car charging from the peak or to a period of excess renewable energy. The only data to support the viability and applicability of this proposed demand response (DR) program is PGE's 2016 IRP DR potential study, a study that PGE's own testimony (Josh Keeling, PGE) before the Commission on February 16, 2016 put into question.

Q. Does this mean that you don't believe that PGE's Residential Smart Charging Pilot is a viable program?

A. Not necessarily. Staff believes that PGE has proposed a viable concept but the proposal lacks the rigor and justification needed for approval. For example, Staff would expect PGE to provide an assessment of how a residential EV time-of-use rate would work in conjunction with the proposed demand response program; how many times per season PGE plans to trigger the DR program; how the development of the triggering practices will translate to dispatch under daily grid management and resource management by the company; and how PGE defines success of the program and what parameters or performance metrics must be met in order for PGE to determine the program viable for broad

rollout. Thus, Staff recommends that the demand response program be proposed after PGE better informs the Commission about all efforts, current and planned, to be undertaken to increase electric vehicle charging on time-of-use rates. Once PGE has submitted such TOU information and the information provided in the list of recommendations above, I believe we can revisit approval of the proposed Residential Smart Charging Pilot.

Q. What is your final recommendation regarding PGE's proposed Smart Charger Pilot Program?

A. PGE's proposal for a demand response pilot should not at this time go forward. While the program has inherent merit, there is not enough of a record to determine that PGE is doing enough to and has had enough experience with EV time-of-use rates and the development of specific EV time-of-use rate design. Once PGE has made a convincing showing that they have constructed and properly funded a time-of-use rate program for EVs, then they should resubmit the proposed program with the additional reforms and data requested.

ISSUE 5: DEFERRED ACCOUNTING FOR PROPOSED PROGRAMS

Q. How does PGE seek to recover the costs of its programs proposed in its application?

A. Pursuant to ORS 757.259 and OAR 860-027-0030, PGE will seek authorization to defer for later regulatory recovery the revenue requirement associated with the Transportation Electrification pilots outlined in its application. PGE indicates that the deferral application would not represent a change in prices, but would minimize the frequency of price changes and match appropriately the costs

borne by and benefits received by customers. PGE also intends to request a balancing account for the Electric Avenue Network proposal as part of the deferral in order to track costs and revenues associated with the project. Finally, PGE states that if it does not receive approval of a deferral of the costs associated with its proposed programs, it will not pursue the programs.[22] Staff could support recovery of prudent pilot costs through use of a deferral; however, other methods of cost recovery could also be explored.[23]

ISSUE 6. ANALYSIS OF INFORMATION AND DATA REQUIRED BY RULES

Q. Do you have any recommendations that you would like to share as to how PGE could better comply with the Commission's Transporation Electricifation Programs rules?

A. Yes. As this is the first time any utility has filed a program proposal under the new rules (OAR 860-087-0001 through 0040) I do have some comments and advice on how Staff believes PGE could better meet the intent of the Commission's rules.

For example, in OAR 860-087-0030, the Commission lays out the requirements for program submittal. In Staff's opinion, PGE has missed some important sections of the rule and could improve their reporting on other aspects. Specifically, OAR 860-087-0030(1)(a)(D) requires the utility to submit information regarding when subsequent program phases will be submitted to the Commisison for review. PGE notes throughout their filing that what has

[22] UM 1811/PGE/100, Spak – Goodspeed/26.
[23] Staff notes there may be some issues with regard to the recovery of revenue requirement effects through a deferral in this instance, but reserves such deliberations for legal briefing.

been filed is a pilot phase. This inherently suggests that there are subsequent phases to a number of these programs. Most notably, the Electric Avenue Network charging station proposal envisions additional infrastructure and additional chargers to be proposed above and beyond the six chargers in this application. The rule requires PGE to idenitify when or what might trigger their possible submittal for more chargers and how such charger buildout fits into various phases of proffered market intervenion. We conduct pilots to learn about program framework, operation market acceptance and to acquire data on these and other points. The pilot propsoal by PGE need to very clear about what the Company is trying to learn and what next steps might be. While PGE has done this to some extent, we feel the effort should be expanded and more detailed. Again, we point to the program developemnt efforts conducted by NEEA and the Energy Trust of Oregon where a great deal of detail is offered with each progrma proposal. Staff suggests PGE refamiliarize themselves with the level of effort that needs to be undertaken when developing and administristering a customer focused demand side program.

Q. Are there additional incomplete items?

A. Yes. First, PGE's application was not complete because it did not comply with OAR 860-087-0030(1)(b) by submitting all data used to suport the descriptions provided in paragraphs (1)(a)(A)-(L). PGE did supply an appendix of some data points, but Staff and stakeholders have had to resort to the data request process to uncover basic data that should have been provided, and is still left puzzled by PGE's underlying analysis due to lack of transparency.

Second, PGE has not fulfilled OAR 860-087-0030(1)(c)(B), effort to coordinate with related state programs. PGE is aware of and has been active in the Department of Environemental Quality's Clean Fuels Plan rulemakings and workshops. PGE is aware that Clean Fuels credits are being generated. Specifically, that as owners of chargers Blink and Powin, the current Electric Avenue sites, potential new bus charging infrastructue, and and six more Electric Avenue sites, PGE has the potential to aggregate credits at least in the residential charging sector, but did not discuss these opportunites in its application as required by rule.

Third, there is no dicsussion submitted that meets the requirements of OAR 860-087-0030(1)(c)(C), coordination of delivery with other market factors and activities, and how the market and other market actors can leverage the underlying program. PGE mentions funding market transformation efforts and funding Ride and Drive events which have been traditionally co-sponsored and co-funded activities. Additionally, under this pilot program PGE mentions demand rsponse enabled chargers but omits the name of the companies they will be working with. The only known home charger that can be integrated into PGE's current Rush Hour Rewards program through Nest is a new charger offered by ChargePoint. But PGE makes no mention of this in their filing and Staff questions the merits of PGE's proposal with so little detail provided. Staff believes part of this short coming was the short initial submittal period, but notes that PGE was given time to supplement their application to address such short comings, yet the information is still lacking.

Fourth, given that the criteria the legislature gave to the Commission to consider when reviewing program proposals addresses the utility system operations, Staff anticipated a discussion and supporting data on electrical system benefits as required OAR 860-087-0030(1)(e)(B). PGE has given scant information on how the plan to construct these programs would extract the greatest measure of electric system benefits. For the electric system benefits that have been identified, namely increased sales, PGE has not provided supporting data as required by OAR 860-087-0030(1)(b). Therefore, at this stage, it is very hard to determine what system benefits PGE has identified or expects to idenitifiy and then create larger or broader programs to obtain such system benefits.

Fifth, PGE seems to have grouped evaluation into one section of their proposal as opposed to informing the Commission exactly how evaluation would be undertaken for each proposed program. In particular, PGE has only offered a group evaluation of their Education and Outreach program portfolio instead of idenitfying how each program would be seperately evalauted. This will make the later discussion of cost effectiveness and attribution very difficult.

Q. In sum, what is Staff's recommendation with regard to each program evaluated in this testimony?

A. Staff recommends approval of the following programs in the form of a pilot program only, and conditioned on the following requirements:

- <u>Education and Outreach</u>: approval of the Technical Assistance proposal under the following conditions:

- PGE present a new budget for approval; and
- PGE develop and present an initial methdology, including necessary tasks for tracking attribution.

- Residential Smart Charging Pilot: denial of the Residental Smart Charging Pilot until such time as:
  - PGE demonstrates to the Commission that is has exhaustive efforts to sign-up current and new EV drivers on TOU rates; and
  - PGE present to the Commission a new EV owner whole home time-of-use rate and an optional sub-metered EV time-of-use rate.

Q. Does this conclude your testimony?

A. Yes.

CASE: UM 1811
WITNESS: JASON S. KLOTZ

PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 101

Witness Qualifications Statement

April 24, 2017

WITNESS QUALIFICATIONS STATEMENT

NAME: Jason R. Salmi Klotz

EMPLOYER: Public Utility Commission of Oregon

TITLE: Principle Executive Manager
Energy Resources and Planning Division

ADDRESS: 201 High Street SE. Suite 100
Salem, OR. 97301

EDUCATION: University of Montana – Missoula
Bachelor of Arts conferred May 1999

Vermont Law School
Masters of Studies in Environmental Law conferred 2003

Vermont Law School
Juris Doctor Conferred 2006

Admitted to Oregon State Bar 2012

EXPERIENCE: Vermont Public Utility Commission
Legal Analyst – 2003 – 2005

Federal Energy Regulatory Commission
Office of General Counsel 2005

California Public Utility Commission
Public Utilities Regulatory Analyst 2006 – 2009

Bonneville Power Administration
Smart Grid Project Lead 2009 – 2010

Northwest Energy Efficiency Alliance
Senior Policy Advisor 2010 – 2013
Oregon Public Utility Commission
Senior Analyst – Climate Change 2013 – 2017

Oregon Public Utility Commission
Principle Executive Manager- Climate Change Lead
2017 – Present

University of Oregon School of Law
Adjunct Professor of Energy and Law
2015 - Present

CASE: UM 1811
WITNESS: JASON S. KLOTZ

PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 102

Exhibits in Support
Of Reply Testimony

April 24, 2017

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 001
Dated March 29, 2017

Request:

What methodological differences did Navigant employ or methodological variances did Navigant use in crafting a cost effectiveness framework for PGE's transportation electrification as compared to the methodologies developed and used in California and Seattle?

Response:

Navigant consulted industry precedent, including methodologies employed in California and Seattle in order to design the cost effectiveness framework for this analysis. The differences in the framework can be broadly summarized by comparing the two tables included in this response as Attachments A and B (from California and Seattle respectively) with Table 2 in Appendix 4 of the Application for Transportation Electrification Programs filing.

The following bullets summarize the primary differences:

- PGE did not include ancillary service value. See PGE response to OPUC DR 006 response for more detail.
- PGE considered system-wide instead of locational T&D benefits (see response to OPUC DR 007 for more details).

- PGE considered the social cost of carbon in the societal cost test (SCT) only, not the total resource cost test (TRC). Furthermore, PGE did not consider health benefits or reduced petroleum benefits in the SCT.
- PGE did not consider RPS costs.

PGE differentiated tax credits at the federal and state level, and credits given to the customer vs those that go to the utility. These were treated separately and considered differently by test, as shown in Table 2 of Appendix A.

UM 1811

Attachment 001-A

Provided in Electronic Format only

Staff/102
Klotz/4

UM 1811

Attachment 001-B

Provided in Electronic Format only

PGE Response to OPUC Data Request No. 001 Attachment 001-A

Table 13: Detailed Cost Test Components for PEV Charging Load Increase

Component	PCT	RIM	TRC	SCT (740.8)
PEV Customer costs and benefits				
Incremental Vehicle Costs	-		-	-
Gasoline Savings	+		+	+
Utility Bills	-	+		
Federal Tax Credits	+		+	+
State Tax credits	+			
PEV Charger Cost				
Utility Asset		-	-	-
Customer Assets	-		-	-
Admin Costs				
Utility Program Administration		-	-	-
Electricity Supply Costs				
Energy Costs		-	-	-
Losses Cost		-	-	-
A/S Cost		-	-	-
Capacity Cost		-	-	-
T&D Cost		-	-	-
RPS Cost		-	-	-
Utility GHG Allowance Costs		-	-	-
Societal Benefits				
Transportation GHG Allowance Costs			+	+
"Societal" value for CO2				+
Health benefits				+
Decreased Petroleum Use				+

Source: California Transportation Electrification Assessment. Phase 2: Grid Impacts. October 23, 2014

UM 1811

PGE Response to OPUC Data Request No. 001 Attachment 001-B

Table 4. Cost Test Components

Component	PCT	RIM	TRC	SCT
PEV Customer costs and benefits				
Incremental Vehicle Costs	-		-	-
Gasoline Savings	+		+	+
Utility Bills	-	+		
Federal Tax Credits	+		+	+
State Tax credits	+			
PEV Charger Cost				
Utility Asset		-	-	-
Customer Assets	-		-	-
Admin Costs				
Utility Program Administration		-	-	-
Electricity Supply Costs				
Energy Costs		-	-	-
Losses Cost		-	-	-
A/S Cost		-	-	-
Capacity Cost		-	-	-
T&D Cost		-	-	-
RPS Cost		-	-	-
Utility GHG Allowance Costs		-	-	-
Societal Benefits				
Transportation GHG Costs			+	+
"Societal" value for CO2				+
Health benefits				+
Decreased Petroleum Use				+

Source: Seattle City Light. Technical Appendix: Implications of Electric Vehicle Adoption in City Light's Service Territory.

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Patrick Hager
Manager, Regulatory Affairs

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 002
Dated March 29, 2017

Request:

Figure 1 from the Navigant study, found at Appendix A p. 3, demonstrates new EV sales as a result of PGE's programs above the baseline of annual sales. Please break out the sales increases attributable to each individual program, by year.

Response:

Please see OPUC DR 002, Attachment A.

UM 1811

Attachment 002-A

Provided in Electronic Format only

Staff/102
Klotz/9

UM 1811
PGE Response to OPUC Data Request No. 002
Attachment 002-A

	2017	2018	2019	2020	2021	2022
Baseline Annual Sales	8,901	10,199	11,328	12,604	13,810	14,666
DCQC Stations	30	121	267	450	647	823
Education and Awareness	219	403	526	578	562	497

2023	2024	2025	2026	2027	2028	2029	2030	2031
15,299	16,028	16,836	17,621	18,385	19,130	19,855	20,588	21,239
940	974	916	780	599	413	255	140	67
404	305	214	140	86	50	27	13	7

2032	2033	2034	2035
21,901	22,541	23,161	23,161
28	11	3	1
3	1	0	0

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 003
Dated March 29, 2017

Request:

Please explain how Navigant attributed additional electric vehicle sales directly to PGE programs. Section 2.2 of the Navigant study does not state how attribution was assigned, but rather only states how the baseline was constructed.

Response:

Section 2.3 of the Navigant study discusses the anticipated transportation electrification program impact in detail. In order to capture the impact of PGE's program, the Navigant team first assessed what the impact of each program may be using what little data is available on traditional automaker consumer education spending estimates per vehicle sale and the historic growth of infrastructure relative to the electric vehicle market in the PGE service area. These impacts were then distributed over the forecast period under the assumption that impacts would vary over time based on the maturation of both the infrastructure and vehicle technologies and markets. All EV sales from these distributions are considered attributable to PGE efforts.

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 004
Dated March 29, 2017

Request:

Why did Navigant choose to include avoided gasoline costs in the total resource cost test and why did Navigant choose to include such in the societal cost test yet not include the cost of carbon or the cost of meeting Clean Air Act air quality standards in its societal cost test?

Response:

Regarding the first question related to including gasoline costs in the TRC: The Total Resource Cost Test, as defined by the California Standard Practice Manual (California Governor's Office of Planning and Research 2002), "measures the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's costs."

The cost avoided by participants when gasoline use is reduced is the retail price of gasoline; there are no utility costs associated with gasoline. This is consistent with industry precedent for electric vehicle cost benefit analysis (California Transportation Electrification Assessment 2014; Seattle City Light Transportation Electrification 2015).

The cost of carbon is included in the "reduced fuel emissions" value stream, quantified for the societal cost test (SCT).

Staff/102
Klotz/14

In regards to the cost of meeting Clean Air Act (CAA) standards for power generation the capacity values used in the model are inclusive of air quality compliance costs. PGE is not aware of precedent to quantify CAA costs separately for the SCT.

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 005
Dated March 29, 2017

Request:

Table 2, at Appendix A p. 8, includes pre-existing program benefits. Please identify the pre-existing benefits and their quantitative value.

Response:

From Section 2.1, page 6 of the Appendix to the Application for Transportation Electrification Programs: "Note that the Pre-Existing Program benefits and costs refer to PGE revenues and costs from the existing Electric Avenue, Blink, and Powin charging stations respectively." The 2017 present value of these benefits is $138.16 per vehicle.

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 006
Dated March 29, 2017

Request:

Oregon Laws 2016, Chapter 028, Section 20(4) indicates that, when considering a transportation electrification program and determining cost recovery for investment "...the Commission shall consider whether the investments are reasonably expected to improve the electric company's system efficiency and operational flexibility, including the ability of the electric company to integrate variable generating resources." Please explain why Navigant did not value ancillary services and/or power quality services that transportation electrification may provide to PGE.

Response:

PGE does not yet have the necessary systems to provide these services for behind the meter devices and therefore Navigant has chosen to exclude ancillary and power quality services as quantifying benefits at this time would be too speculative. Daily load shifting is certainly still possible (through either direct load control or time-of-use rates), which would help lower the cost of integrating renewables. Our proposal includes pilots to help quantify these value streams.

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 007
Dated March 29, 2017

Request:

Please explain why Navigant did not consider/include the costs of transmission and distribution?

Response:

The analysis conducted by Navigant does consider specific distribution costs when those are included in overall project costs (for example, distribution upgrades associated with installation of public fast charging infrastructure). Also, the analysis considers the avoided cost of transmission and distribution capacity as an annual value which applies system-wide.

Navigant did not conduct an analysis of locational T&D benefits on PGE's system due to lack of readily available data specific to certain locations. Furthermore, after investigating past research – such as the California and Seattle studies – Navigant determined that adding locational T&D benefits did not significantly affect the outcome of the cost benefit analysis.

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Patrick Hager
Manager, Regulatory Affairs

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 008
Dated March 29, 2017

Request:

Page 11 of Appendix A, page 9 of the Navigant study, appears to have a formatting error and is missing text and data to support the asserted electric vehicle market lift from PGE's Education and Awareness Program. Please provide a revised copy to fix this error.

Response:

Please see OPUC DR 008, Attachment A.

UM 1811

Attachment 008-A

Provided in Electronic Format only

Staff/102
Klotz/20

Cost Effectiveness Analysis of Transportation Electrification Program Options

Presented to:

Portland General Electric

Portland General Electric

121 SW Salmon St,

Portland, OR 97204

December 19, 2016

Presented by:

Navigant Consulting, Inc.

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Table of Contents

Executive Summary

PGE seeks to compare program options to determine which programs will cost-effectively support the transportation electrification market and to understand the cost effectiveness of a transportation electrification portfolio as a whole. The goal of this study was to develop a framework to continuously evaluate and improve PGE's transportation electrification support efforts, then apply that framework to PGE's proposed portfolio to provide initial indications about cost effectiveness.

Through the course of this study, Navigant developed a cost effectiveness framework for transportation electrification support efforts that builds on the methodologies employed in other jurisdictions, including California and Seattle, and is consistent with the framework that PGE set forth for demand response cost effectiveness.[1] The framework sought to answer two questions:

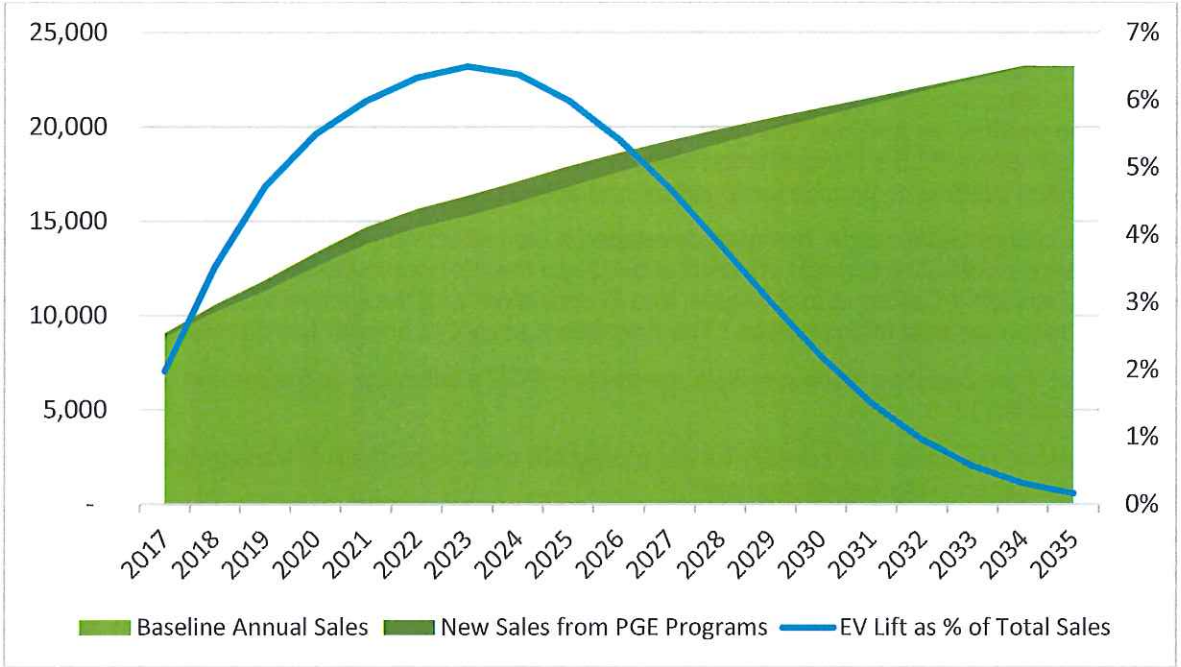
- What is the baseline electric vehicle market and PGE's influence on the market (i.e., electric vehicle "lift")?
- What are the costs and benefits for each program and the portfolio of transportation electrification programs as a whole?

The analysis considered these questions for PGE's Electric Mass Transit 2.0, Outreach & Education, and Community Charging Infrastructure programs, as well as PGE's transportation electrification portfolio as a whole. To do this, Navigant developed a baseline forecast of electric vehicles within PGE's service area, then forecasted the estimates of each program's influence on the market, and finally monetized the value streams identified for each program.

Navigant found that the electric vehicle lift caused by PGE programs represents an average increase of roughly five percent new vehicle sales in the total cumulative electric vehicle sales forecast. Annual forecast electric vehicle sales and electric vehicle lift are shown in Figure 1. As shows Figure 1, PGE's Light Duty Vehicle programs are expected to be cost effective. When combined with the Electric Mass Transit 2.0 program, PGE's transportation electrification market support efforts are cost effective at the portfolio level.

[1] UM 1708; http://edocs.puc.state.or.us/efdocs/HAD/um1708had113843.pdf.

Figure 1: Annual Baseline and New Sales in PGE Territory



Source: Navigant analysis, 2016

Table 1: Summary of Net Benefits by Program and Cost Effectiveness Test

	Rate Impact Measure Test	Total Resource Cost Test	Societal Cost Test
Net Benefits By Program (2017 $)			
DCQC Stations	$4,044,163	$2,297,870	$3,739,595
Education and Awareness	$2,089,176	$3,465,122	$4,234,224
Electric Mass Transit 2.0	$(1,037,395)	$(1,059,005)	$(1,332,532)
Overall Portfolio	**$5,095,945**	**$4,703,987**	**$6,641,287**
Net Benefits Per Vehicle (2017 $)			
DCQC Stations	$994	$592	$946
Education and Awareness	$734	$1,182	$1,452
Electric Mass Transit 2.0	$(1,037,395)	$(1,059,005)	$(1,332,532)

Source: Navigant analysis, 2016

Section I Introduction and Background

PGE seeks to compare program options to determine which programs will cost-effectively support the transportation electrification market and to understand the cost effectiveness of a transportation electrification portfolio as a whole. The goal of this study was to develop a framework to continuously evaluate and improve PGE's transportation electrification support efforts, then apply that framework to PGE's proposed portfolio to provide initial indications about cost effectiveness.

The framework is based on past studies and research:

- Studies in other jurisdictions (California and Seattle) quantify net benefits of electric vehicles on a per vehicle basis.
- Independent researchers develop electric vehicle sales forecasts based on market factors.
- State and local policymakers set electric vehicle sales goals.
- This framework is consistent with and builds upon the framework that PGE set forth for demand response cost effectiveness.[2]

The framework will allow PGE to:

- Determine net benefits on a per electric vehicle basis using different cost tests typically used for utility resource planning.
- Track transportation electrification market progress over time.
- Begin to attribute market progress to transportation electrification support efforts offered by PGE's portfolio of programs.

The scope of the analysis discussed in this report focused on the following program options:

- Outreach & Education
- Community Charging Infrastructure
- Electric Mass Transit 2.0

PGE is also currently conducting R&D pilots for transportation electrification; however, this analysis does not include R&D, given the focus is on longer-term learning, rather than direct market impacts, and does not lend itself to the same type of cost effectiveness analysis.

The remainder of this report includes the following sections:

- Section II outlines the cost effectiveness methodology employed for this analysis. This includes a description of the electric vehicle market forecast methodology, forecast estimates of PGE's influence on the market, and all monetized value streams in the analysis.
- Section III summarizes the results of the analysis by cost test and in terms of the additional electric vehicles sold as a result of PGE's programs.
- Section IV concludes findings from the analysis and provides a directive for further research required to more accurately assess the cost effectiveness of the PGE's transportation electrification programs going forward.

Section II Methodology

This section presents a high-level overview of the methodology, with more detailed information provided

[2] UM 1708; http://edocs.puc.state.or.us/efdocs/HAD/um1708had113843.pdf. See also EPRI http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=3002007751.

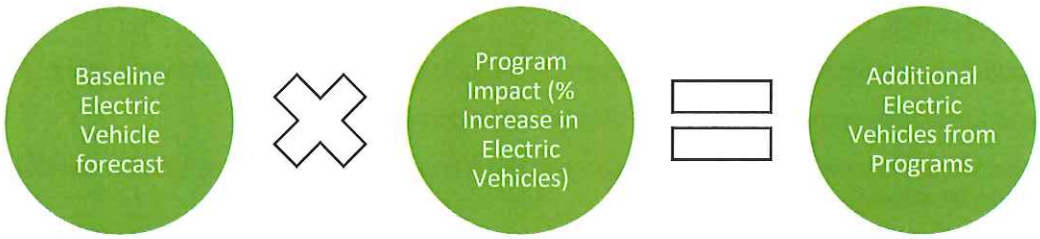
on the methodology for developing the baseline electric vehicle forecast and the transportation electrification program impacts.

Appendix B provides more detail on the overall methodology.

2.1 Overview of Methodology

The analysis was structured in two steps outlined below.

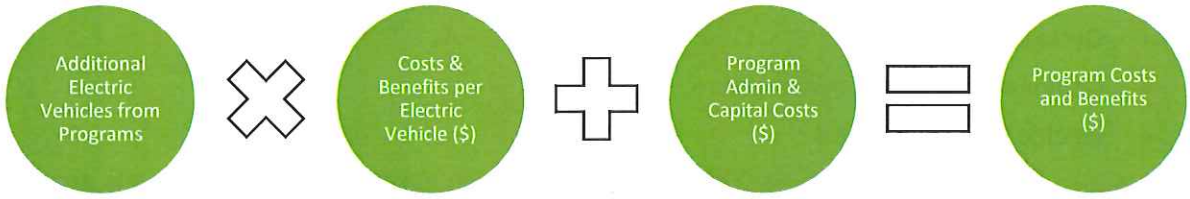
Step 1: What is the baseline electric vehicle market and PGE's influence on the market?



Source: Navigant analysis, 2016

Step 1 quantifies the additional electric vehicle sales attributed to PGE's programs, also known as "electric vehicle lift". The basis of this analysis is a baseline electric vehicle forecast by zip code in PGE's service area created by Navigant Research, as described in more detail in Section 2.2. The team defined the program impact using customized Weibull distributions to simulate market diffusion of electric vehicles based on the rationale for each program, as described in more detail in Section 2.3.

Step 2: What are the costs and benefits for each program?



Source: Navigant analysis, 2016

Step 2 quantifies the additional value streams (in terms of both costs and benefits) from each additional electric vehicle in the market. From there, addition of the overall program administrative and capital costs yields the total costs and benefits for each program.

As part of Step 2, Navigant assessed fourteen cost and benefit streams for transportation electrification cost effectiveness. Table 1 summarizes the cost and benefit streams quantified in this analysis by cost test.

This framework for transportation electrification cost effectiveness builds on the framework Navigant developed in coordination with PGE for demand response cost effectiveness,[3] with adjustments for costs and benefits specific to transportation electrification. The framework is consistent with the methods proposed in the California Public Utilities Commission's *2010 Demand Response Cost Effectiveness Protocols* and similar to the framework used in other jurisdictions, such as Seattle City Light and the Electric Power Research Institute.[4] Appendix A provides more information on each of the cost and benefit streams, including the definition, calculation description, and monetization unit.

Given the nascent and uncertain future of the impact of utility programs on electric vehicle adoption, the inputs and assumptions used within this analysis should be regarded as early indicators of market trends, with a high degree of uncertainty. Over time, Navigant expects that the uncertainty bands will

[3] UM 1708; http://edocs.puc.state.or.us/efdocs/HAD/um1708had113843.pdf
[4] Seattle City Light Transportation Electrification: Technical Impacts, Market Research, Program Design. 2015. See also EPRI http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=3002007751

narrow as the industry collects more robust data through retrospective evaluation, bringing the impact of programs on electric vehicle adoption into focus.

Table 2 below summarizes the cost effectiveness tests and value streams used in the transportation electrification analysis. Note that the Pre-Existing Program benefits and costs refer to PGE revenues and costs from the existing Electric Avenue, Blink, and Powin charging stations respectively.

Table 2. Summary of Cost-Effectiveness Tests and Proposed Value Streams for Transportation Electrification Programs[5]

Cost/Benefit Category	Total Resource Cost Test	Rate Impact Measure Test	Societal Cost Test
Avoided Gasoline Costs	Benefit		Benefit
Increased Capacity Costs	Cost	Cost	Cost
Reduced Fuel Emissions			Benefit
Increased Energy Emissions			Cost
Increased Electricity Sales		Benefit	
Increased Energy Supply Costs	Cost	Cost	Cost
Customer Tax Credits – Federal	Benefit		Benefit
Customer Tax Credits – State	Benefit		
Customer O&M Savings	Benefit		Benefit
Utility Tax Credits – Federal	Benefit	Benefit	Benefit
Utility Tax Credits – State	Benefit	Benefit	
Pre-Existing Program Benefits	Benefit		
Pre-Existing Program Costs	Cost		
Utility Capital Costs	Cost	Cost	Cost
Utility O&M Costs	Cost	Cost	Cost
Utility Admin Costs	Cost	Cost	Cost
Customer Charger Costs	Cost		Cost
Customer Vehicle Costs	Cost		Cost
O&M Payments from TriMet		Benefit	
Federal Bus Electric Vehicle Grant	Benefit		Benefit

Source: Navigant analysis, 2016

Several potential benefits and costs of transportation electrification were excluded from the analysis,

[5] Cost and benefit designations for each stream are based on Navigant analysis and California Public Utilities Commission, Attachment 1: *2010 Demand Response Cost Effectiveness Protocols*

due to the uncertainty associated with quantifying and monetizing the benefit. These include:

- The value of Low Carbon Fuel Standard[6] credits that PGE may earn as a result of the programs.
- The value of ancillary services and/or power quality services that transportation electrification may provide to PGE's distribution grid.
- Non-energy and non-emission-related benefits from transportation electrification, including enhanced public image for PGE and the City of Portland, customer satisfaction, noise pollution, etc.
- Additional potential costs of transmission and distribution

2.2 Baseline Electric Vehicle Forecast

Navigant Research uses a technology competition model to forecast electric vehicle sales at the national level. The forecast model uses high-level macroeconomic factors like gross domestic product and population as well as vehicle density and historic sales data to project overall light vehicle market growth. Sales forecasts per technology segment analyzed are determined by estimating the market share of the technology against competing platforms as a function of a number of variables that feed into the consumer choice such as: purchase and operating costs, vehicle range, refueling/recharging infrastructure and other factors influencing electric vehicle capability and convenience.

Results from the national sales model for PHEVs and BEVs are then fed into a model that disaggregates the forecasts by state. State PEV sales are disaggregated based on state and local purchase incentives, mandates, retail fuel prices, demographics, and historic sales data.

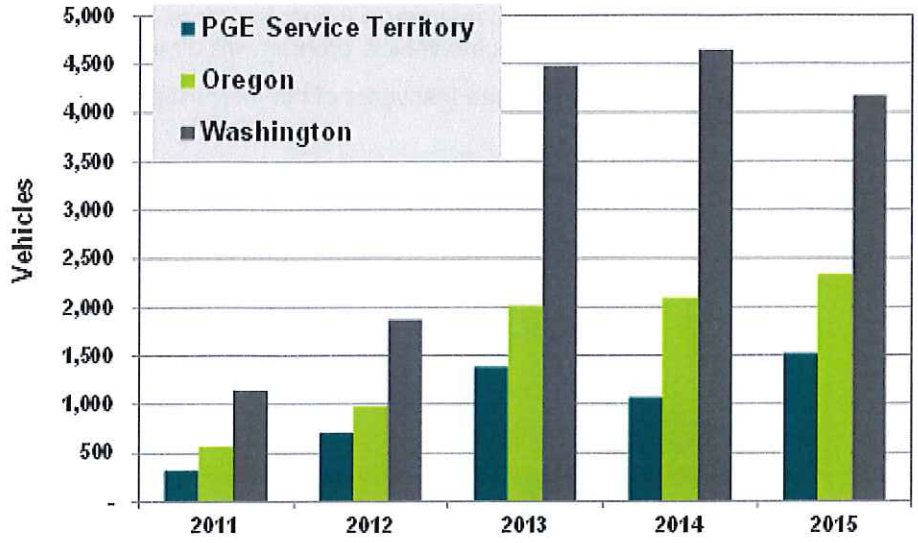
Results from the state-level disaggregation are fed into a model that further disaggregates the forecasts by county. This county-level disaggregation is based on consumer demographics, estimated county vehicle market size as a function of population density, sales history, and data derived from Navigant Research's *Electric Vehicle Consumer Survey*.

The Electric Vehicle Consumer Survey is used to determine the demographic distribution profile of the ideal PEV market. This PEV profile is used to compare demographic distributions among geographic jurisdictions in terms of potential interest in PEVs. The demographic characteristics analyzed include age, household income, and education. The PEV profile in 2016 is skewed toward younger, wealthier, and more educated population segments.

Navigant Research's underlying data on electric vehicle sales is updated depending on the level of its geographic granularity and availability. National level sales data is tracked monthly and is widely available publically; state level sales data is less available publically with the nearest tracking reports typically lagging the market by four to five months; lesser geographic segmentations are typically not available publically, however state DMV's do sometimes provide vehicle sales and registration data on request. Navigant Research does however collect county level vehicle registration data from a vendor on an annual basis. Figure 2 shows the plug-in electric vehicle sales in the region from 2011 through 2015.

[6] See SB 324 https://olis.leg.state.or.us/liz/2015R1/Measures/Overview/SB324

Figure 2: PEV Sales in Oregon, Washington, and PGE Service Territory 2011-2015



Source: Navigant Research analysis, 2016

2.3 Transportation Electrification Program Impact

As electric vehicles are a relatively new product, and utility electric vehicle programs have little history, estimates of PGE's impact on the local electric vehicle market are heavily assumption laden. The quickly evolving technologies and business models of the electric vehicle and infrastructure market continue to make empirical analysis of specific market development efforts difficult and few studies exist isolating the impact infrastructure or consumer education have on the electric vehicle market. Regardless of this aspect, it is clear, that investments in charging infrastructure and consumer education are highly likely to positively influence the market.

Navigant Research's *Electric Vehicle Consumer Survey* indicates a lack of charging infrastructure and familiarity with electric vehicles as primary disadvantages to electric vehicle ownership among respondents[7]. In order to capture the impact of PGE's program, the team first assessed what the impact of each program may be using what little data is available on traditional OEM consumer education spending estimates per vehicle sale and the historic growth of infrastructure relative to the electric vehicle market in the PGE service area. These impacts were then distributed over the forecast period under the assumption that impacts would vary over time based on the maturation of both the infrastructure and vehicle technologies and markets.

2.3.1 Education and Awareness Program

Surveys of PGE customers show that[8] awareness of plug-in electric vehicles is low and uncertainty regarding operation, reliability, costs, and charging is high relative to the conventional vehicle options. This is consistent with customer survey results throughout the United States[9] Given that, we assume:

- An education/marketing program's direct impact on the electric vehicle market would have the largest impacts early in the forecast period when the average consumer is less aware/educated

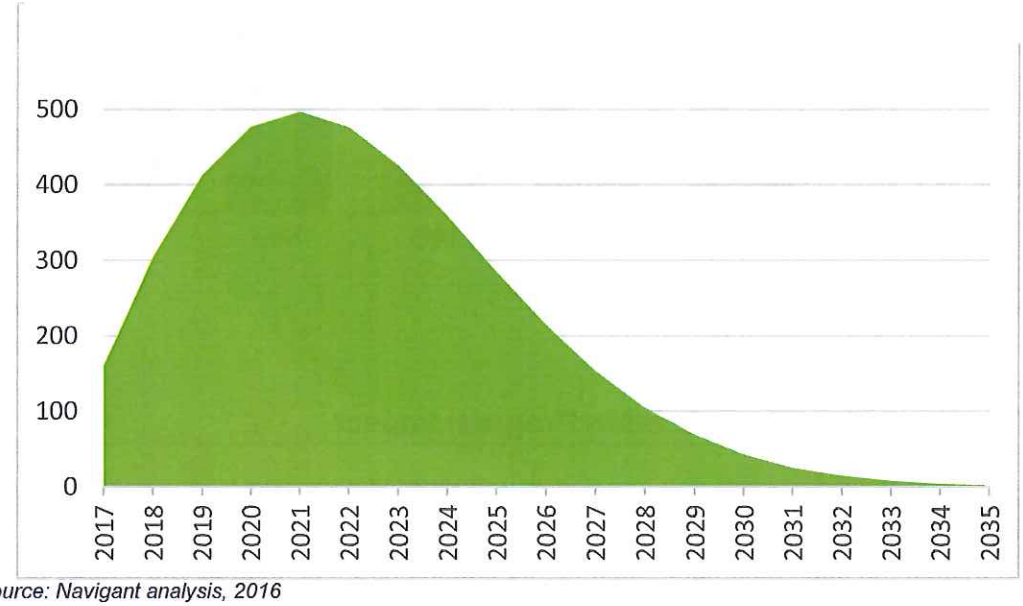
[7] 26 percent of respondents identified a lack of places to charge as the primary disadvantage to PEV ownership, 18 percent cited cost, 17 percent cited range; the remainder cited other concerns including battery reliability and technology unfamiliarity among others.
[8] 2014 PGE Customer Survey
[9] Navigant Research, Electric Vehicle Geographic Forecast Report, 2016

on the technology.

- As the technology matures the average consumer will become more educated through other avenues and the impact of the "utility" electric vehicle program will diminish over time.
- The program's impacts will improve over the first years of the forecast period as administrators identify and replicate best practices.

Figure 3 shows the distribution of the electric vehicle market lift on behalf of the education and awareness program.

Figure 3: New Electric Vehicles from Education and Awareness Program



Source: Navigant analysis, 2016

2.3.2 Community Charging Infrastructure Program

Though range anxiety and a lack of charging infrastructure are often cited as the primary drawbacks to purchasing a PEV,[10] there is uncertainty in the industry regarding which technical infrastructure solution[11] is the most impactful in resolving the range/infrastructure nexus. Regardless, all technical solutions are likely to mature and lead to greater consumer understanding of how an electric vehicle may replace their existing conventional vehicle. Additionally, the existence of visible charging infrastructure creates more awareness of Electric Vehicles as a potential transportation choice. Given that, we assume:

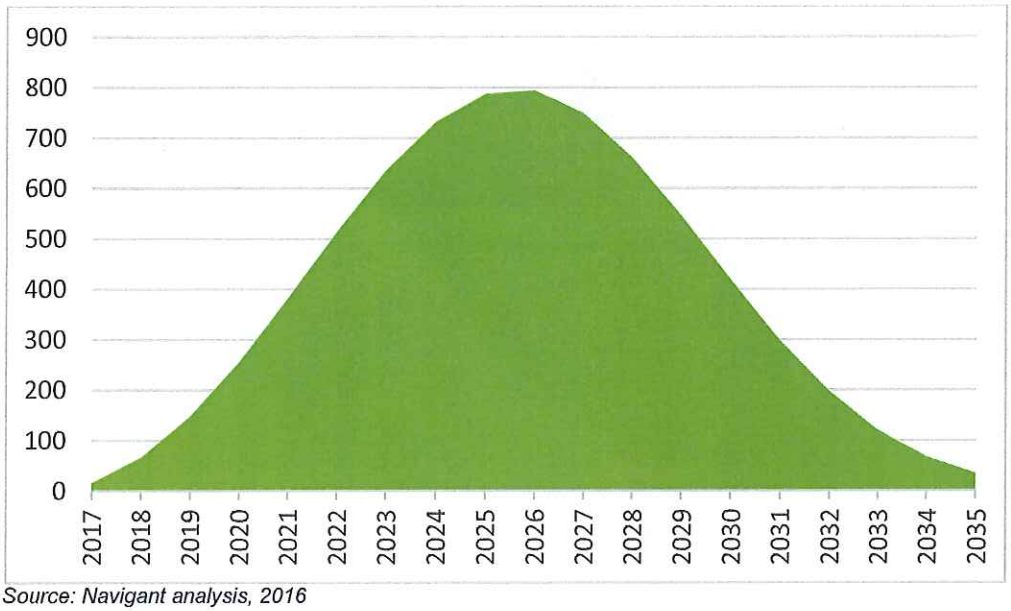
- The PGE DCQC network would be established early in the forecast period,
- The initial impact of the DCQC network would be small but would grow quickly as consumers' awareness of the network grows. The vehicle purchase cycle is a long (5-10 years) so the impacts of the programs are delayed accordingly. Though these programs are expected to increase Electric Vehicle adoption, they will not change the car purchasing process overnight.
- Growing availability of 200 mile+ BEVs[12] would also increase the impact the DCQC network would have on the market in the near term, and
- New electric vehicle Charging Services (Multiple Unit Dwellings, Workplace) will develop over

[10] Navigant Research, Electric Vehicle Geographic Forecast Report, 2016
[11] Potential solutions include: denser public charging, faster public charging, increased availability of MUD or 'end of commute' charging infrastructure
[12] Navigant Research, Electric Vehicle Market Forecast Report, 2015

time and new technologies (wireless charging, faster DCQC)[13] will be introduced that will diminish the impact of the DCQC network on the electric vehicle market in the latter portion of the forecast.

Figure 4 shows the distribution of electric vehicle lift from the community charging infrastructure program.

Figure 4: New Electric Vehicles from Community Charging (DCQC Stations) Program



Source: Navigant analysis, 2016

2.3.4 Electric Mass Transit 2.0 Program

Through this analysis, PGE also sought to explore the cost effectiveness of a unique charger lease program established with TriMet, Portland's public transit entity.

TriMet received a federal grant to pursue electrification of a portion of the bus fleet in Portland. The grant was sufficient enough for TriMet alone to purchase four electric buses and the associated charging infrastructure. TriMet later discovered that, through a partnership with PGE under PGE's Electric Mass Transit 2.0 program, PGE could construct and own the charging infrastructure and TriMet would pay PGE for O&M to utilize the chargers to power their fleet. This would allow TriMet to use operating budget for the charging infrastructure, and utilize the federal grant to purchase an additional bus, for a total of five buses.

For the purposes of this cost benefit analysis, the team assumed the following:

- The known impact of the program is a single bus. Though this program could result in incremental electric vehicle lift at a later date, no additional lift beyond the known impact was forecast for this analysis.
- All chargers and associated installation costs are considered utility capital costs.
- Lease payments to PGE from TriMet are considered a benefit in the RIM, but a transfer in the TRC and SCT.
- The federal grant per bus ($430,000) to TriMet is included as a benefit in the Total Resource

[13]Navigant Research, Electric Vehicle Charging Services, 2016

Cost test, but as a transfer in the Societal Cost Test.

- The utility tax credit value stream includes the Oregon Alternative Fuels Infrastructure Tax Credit[14], assumed to expire in 2020.

Table 3 summarizes the cost and benefit streams quantified in this analysis by cost test.

Table 3. Summary of Cost-Effectiveness Tests and Proposed Value Streams for Electric Mass Transit 2.0 Program

Cost/Benefit Category	Total Resource Cost Test	Rate Impact Measure Test	Societal Cost Test
Avoided Gasoline Costs	Benefit		Benefit
Increased Capacity Costs	Cost	Cost	Cost
Reduced Fuel Emissions			Benefit
Increased Energy Emissions			Cost
Increased Electricity Sales		Benefit	
Increased Energy Supply Costs	Cost	Cost	Cost
Customer O&M Savings	Benefit		Benefit
Utility Tax Credits - State	Benefit	Benefit	
Utility Capital Costs	Cost	Cost	Cost
Utility O&M Costs	Cost	Cost	Cost
Customer Vehicle Costs	Cost		Cost
O&M Payments from TriMet		Benefit	
Federal Bus Electric Vehicle Grant	Benefit		Benefit

Source: Navigant analysis, 2016

Section III Results

This section presents the market impacts from PGE's transportation electrification programs, as well as the costs and benefits of the transportation electrification portfolio from different cost test perspectives.

[14] http://www.afdc.energy.gov/fuels/laws/NG/OR

Navigant developed costs and benefits using both a flat rate structure and a residential time-of-use rate structure[15]. While the time-of-use structure provided greater net benefits, the difference between the two scenarios is slight due to the following factors:

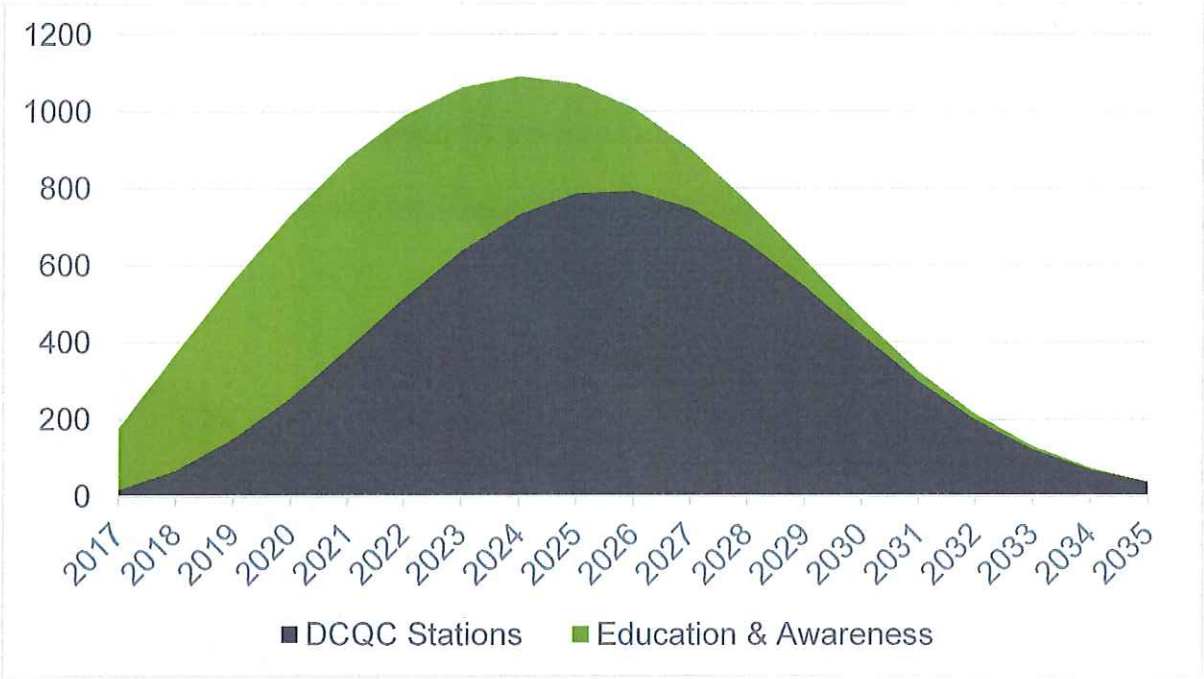
- Electric vehicle charging times are somewhat flexible and shift away from peak times under the time-of-use rate.
- The off-peak rate is approximately 70 percent of the flat rate, meaning that relative to the flat rate structure, revenue gains from charging during peak times are largely offset by the majority of charging occurring during off-peak times under the time-of-use rate.
- A portion of Electric Vehicle charging occurs at the workplace, which is subject to commercial rates.

This report conservatively presents results using the flat rate scenario only.

3.1 Electric Vehicle Market Impacts

The cost effectiveness analysis looked at additional electric vehicles sold (i.e., "electric vehicle lift") as the unit basis for program-level costs and benefits.

Table 4. New Electric Vehicles by Program

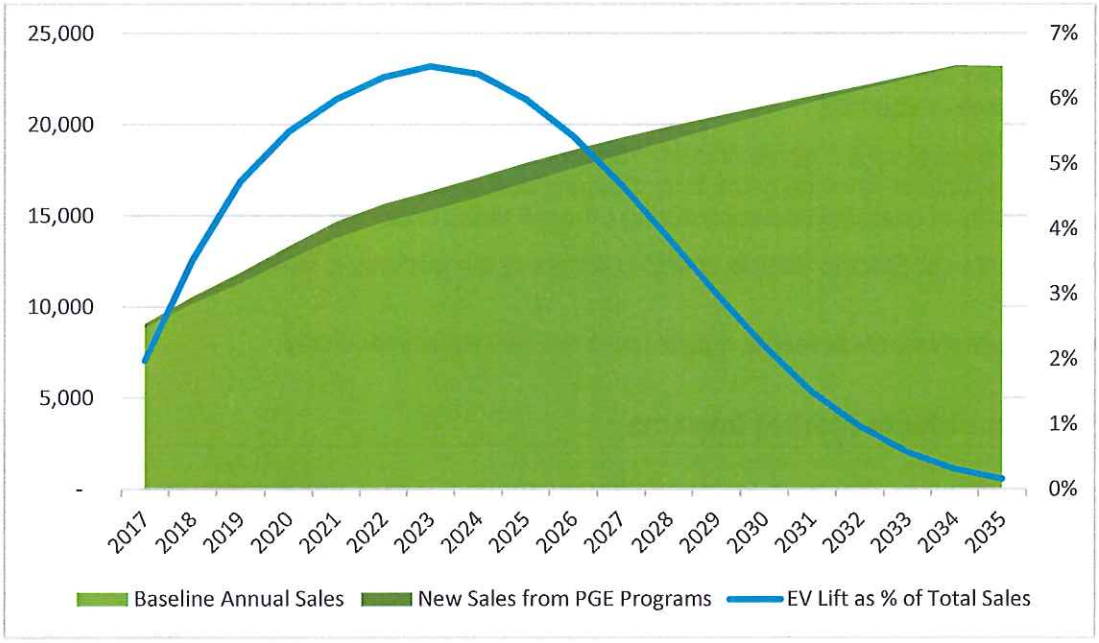


Source: Navigant analysis, 2016.

The electric vehicle lift caused by PGE programs represents an average increase of roughly five percent new vehicle sales in the total cumulative electric vehicle sales forecast.

[15] The flat structure is residential Schedule 7 Standard Service option, the time-of-use rate is the Schedule 7 TOU Portfolio option. https://www.portlandgeneral.com/our-company/regulatory-documents/tariff

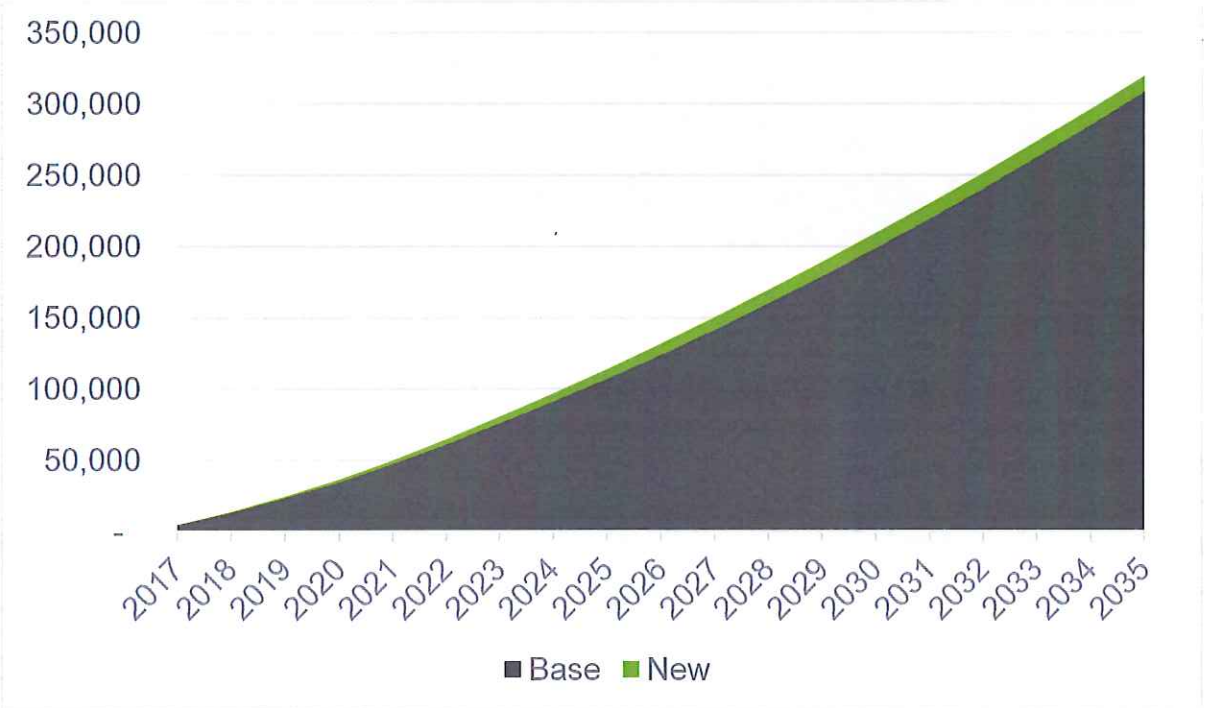
Table 5. Cumulative Electric Vehicles in PGE Territory



Source: Navigant analysis, 2016

The electric vehicle lift caused by PGE programs represents 3.4 percent of total annual sales during the analysis period.

Table 6. Annual Baseline and New Sales in PGE Territory



Source: Navigant analysis, 2016

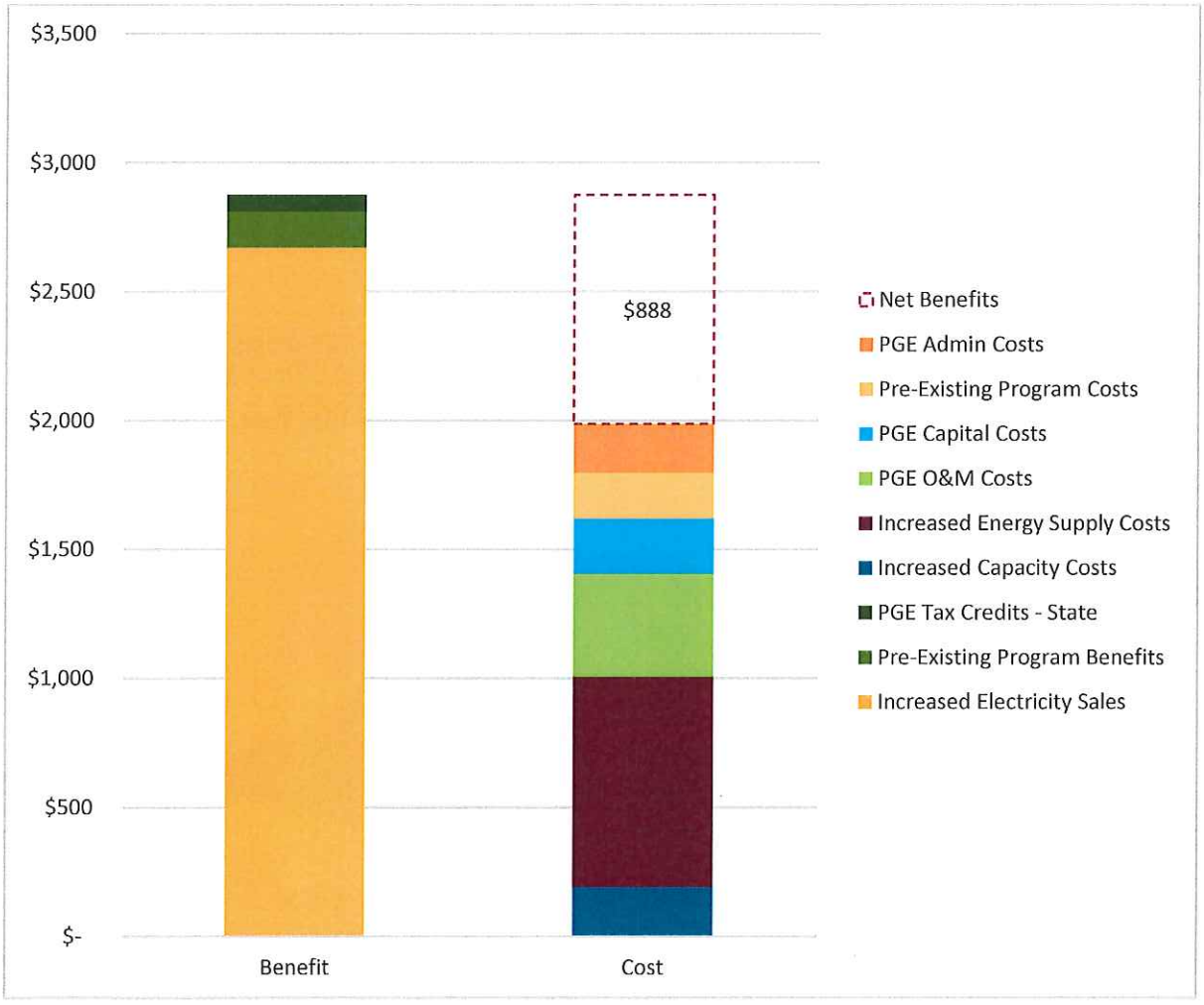
3.2 Rate Impact Measure (RIM) Test

This section presents the RIM test results for PGE's transportation electrification portfolio, as a whole.

The RIM test measures the net benefits of a program from the perspective of ratepayers. It is used to especially protect the interests of customers who are not program participants. Since programs are typically funded by customers, the cost streams included in the RIM test are overhead costs and capital costs. The benefit streams used in this test are increased revenue from electricity sales, and tax credits received by the utility.

The portfolio of programs result in a net revenue of approximately $888 per light duty vehicle.

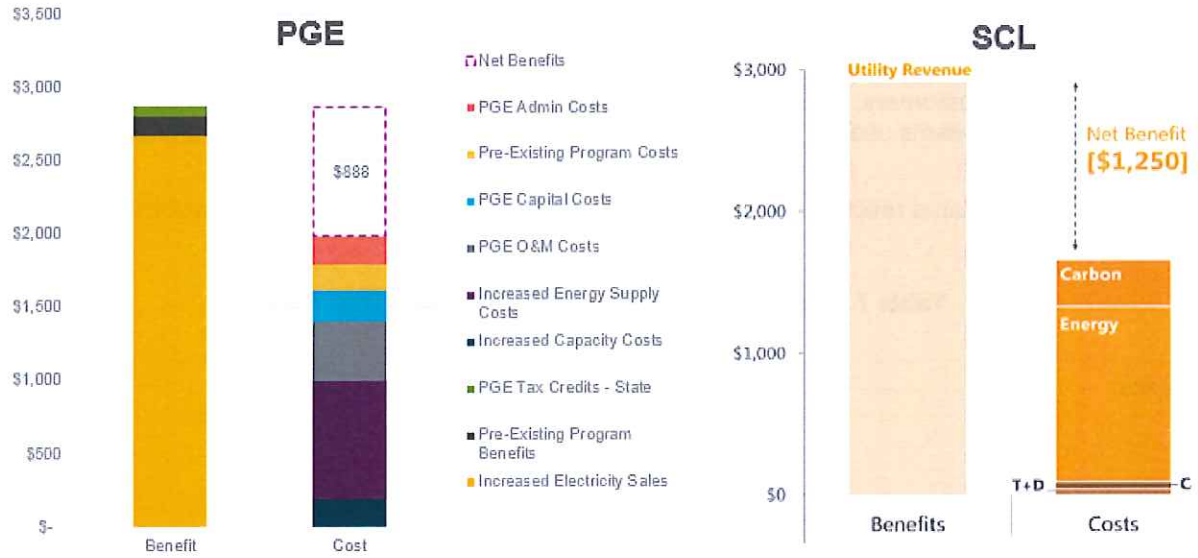
Table 7. Per Vehicle Benefits and Costs with RIM Test



Source: Navigant analysis, 2016

The results of PGE's analysis are roughly consistent with a recent analysis performed by Seattle City Light.

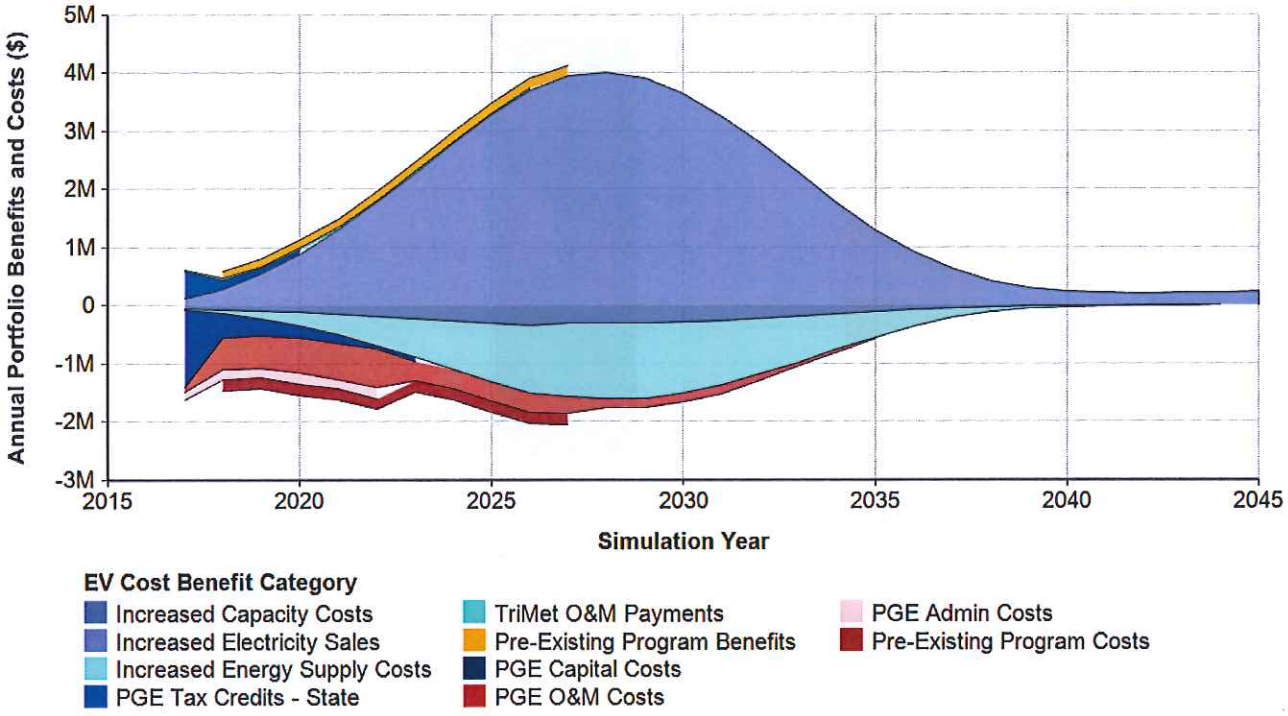
Table 8. Comparison of Results between PGE and Seattle City Light



Sources: Navigant analysis, 2016. Seattle City Light Transportation Electrification: Technical Impacts, Market Research, Program Design. 2015.

The time series graph below shows the quantified value streams for the RIM (costs and benefits) over time at the portfolio level. These results include the Electric Mass Transit 2.0 Program.

Table 9. Annual Portfolio Costs and Benefits with RIM Test



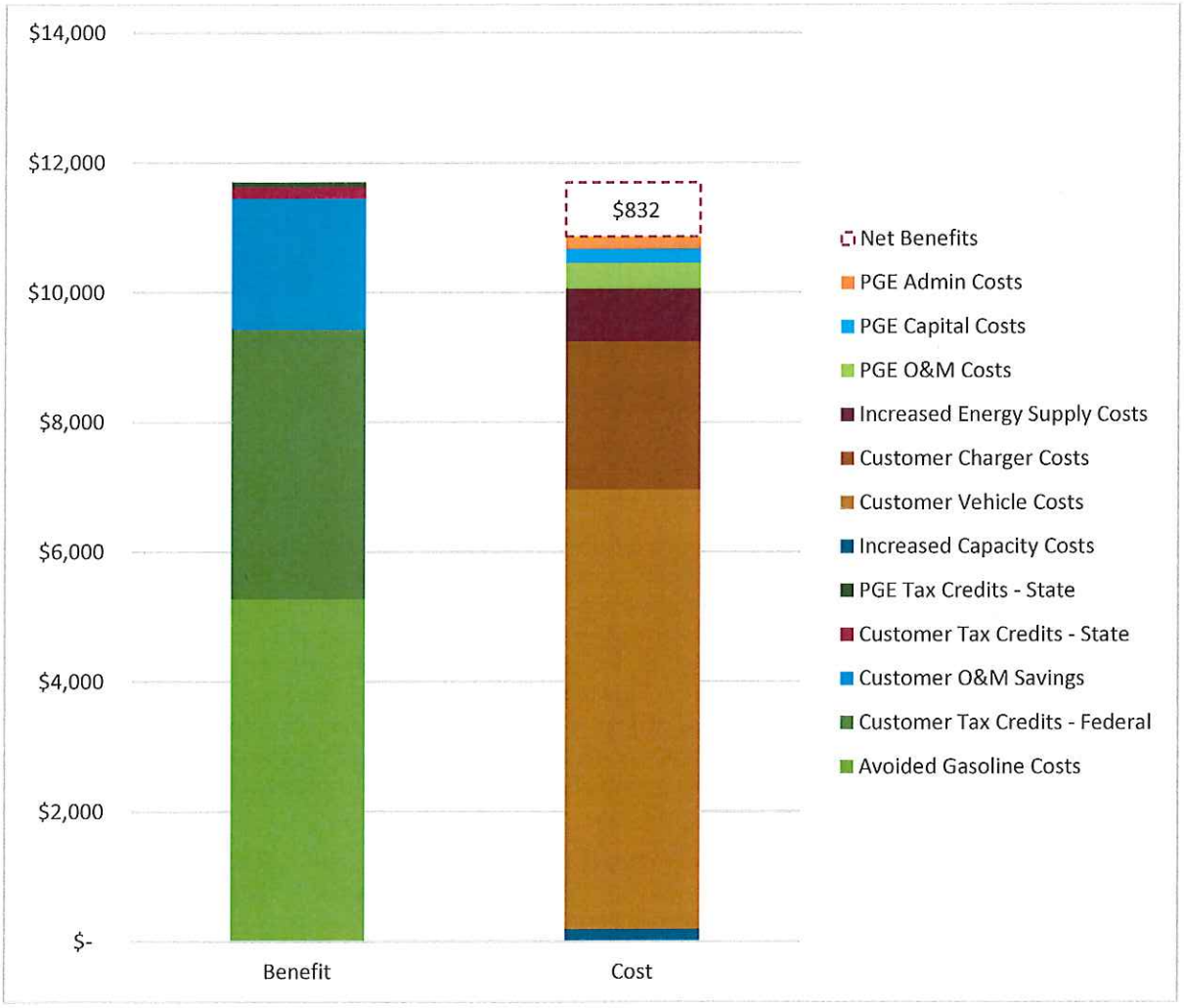
Source: Navigant analysis, 2016

3.3 Total Resource Cost (TRC) Test

The TRC measures net benefits of a program for all stakeholders involved. The cost streams included in the TRC test are overhead and capital costs incurred by the utility, as well as incremental costs of purchasing and installing equipment (e.g., vehicles and chargers) incurred by customers. The benefit streams used in this test are avoided costs of energy, capacity and gasoline; tax credits, and other non-energy benefits such as operations and maintenance savings. Increased electricity sales are not included in the TRC as they offset each other. Increased sales is a cost to customers on their electricity bills, while it is a benefit to the utility in the form of additional revenue.

The graph below shows the portfolio results per light duty vehicle using the TRC.

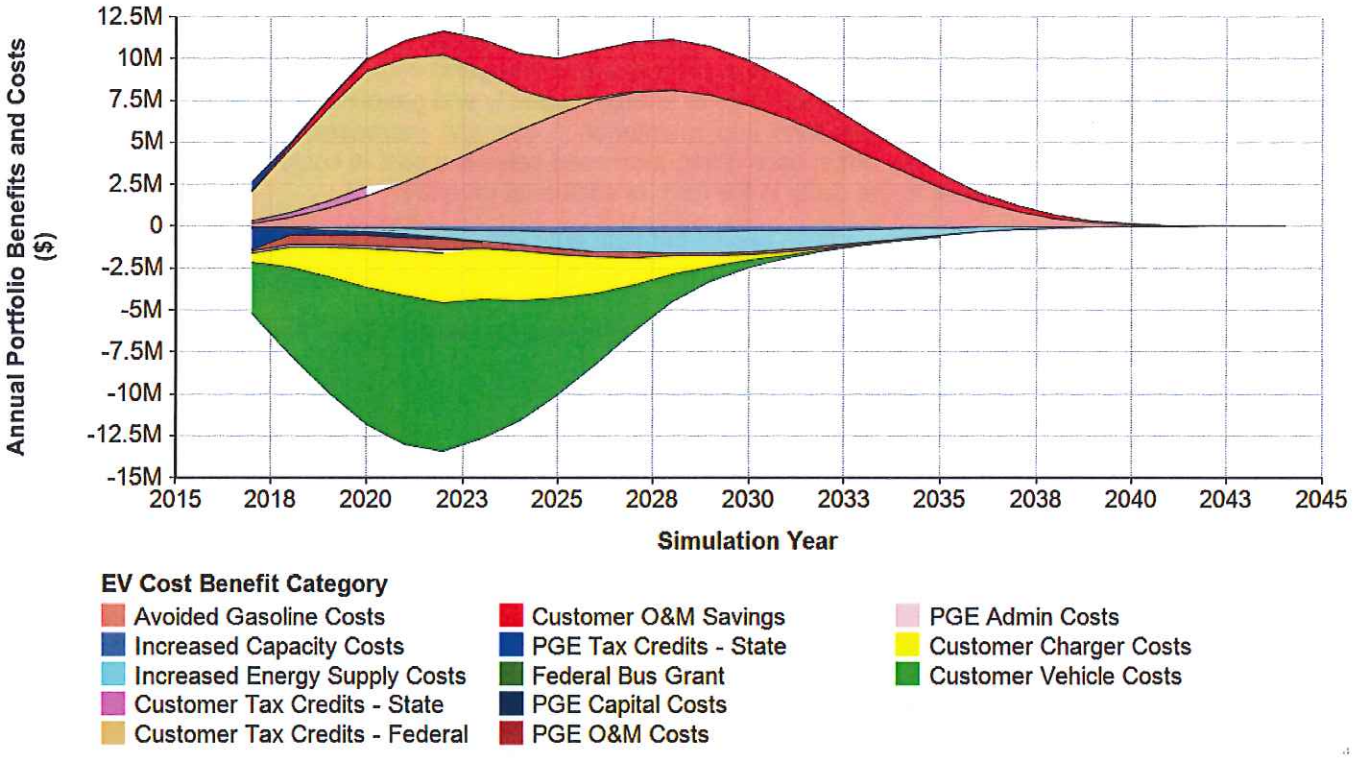
Table 10. Per Vehicle Benefits and Costs with TRC Test



Source: Navigant analysis, 2016

The time series graph below shows the quantified value streams for the TRC (costs and benefits) over time at the portfolio level, including the Electric Mass Transit 2.0 Program.

Table 11. Annual Benefits and Costs with TRC Test



Source: Navigant analysis, 2016

3.4 Societal Cost Test (SCT)

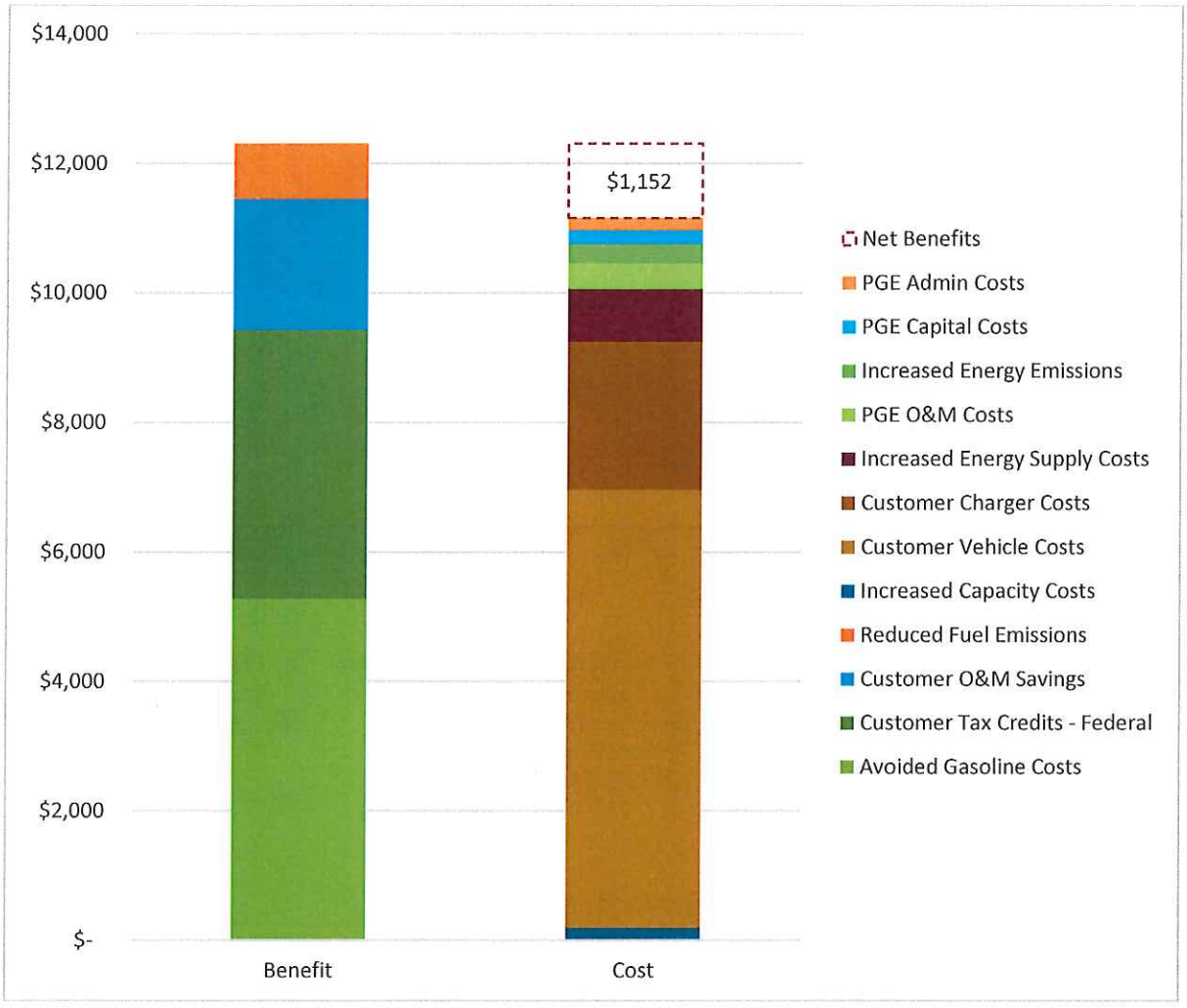
The SCT measures net benefits of a program for society at large. For this analysis, it is similar to the TRC, with the addition of benefits from reduced emissions, and the subtraction of state tax credits (tax credits are considered a transfer payment from the government to the recipient in the SCT, yielding no net benefit). As this analysis was conducted in response to Chapter 28, Oregon Laws 2016, the analysis team decided to define society as those within the state of Oregon[16]. Therefore, state tax credits are transfer payments in this analysis, while federal tax credits are still considered benefits. Notably, absent the tax credits, the programs are a net cost to society, due to the high incremental cost of an electric vehicle relative to internal combustion engine vehicles. As electric vehicles become more prevalent in the market, economies of scale will likely substantially reduce these incremental costs, yielding a significant net benefit to society per electric vehicle.

This analysis conservatively estimates the impact of only benefits to society that are easily monetized using Environmental Protection Agency values for the social cost of carbon[17], and does not consider other difficult-to-monetize benefits from transportation electrification[18].

The graph below shows the portfolio results per light duty vehicle using the SCT.

[16] During workshops conducted throughout Summer and Fall 2016, stakeholders did not object to this approach.
[17] https://www.oregonlegislature.gov/bills_laws/lawsstatutes/2016orLaw0028.pdf
[18] Such benefits may include building demand response, ancillary service, or transactive energy market potential for PGE, national energy security from reduced reliance on foreign energy sources, PGE and City of Portland public relations.

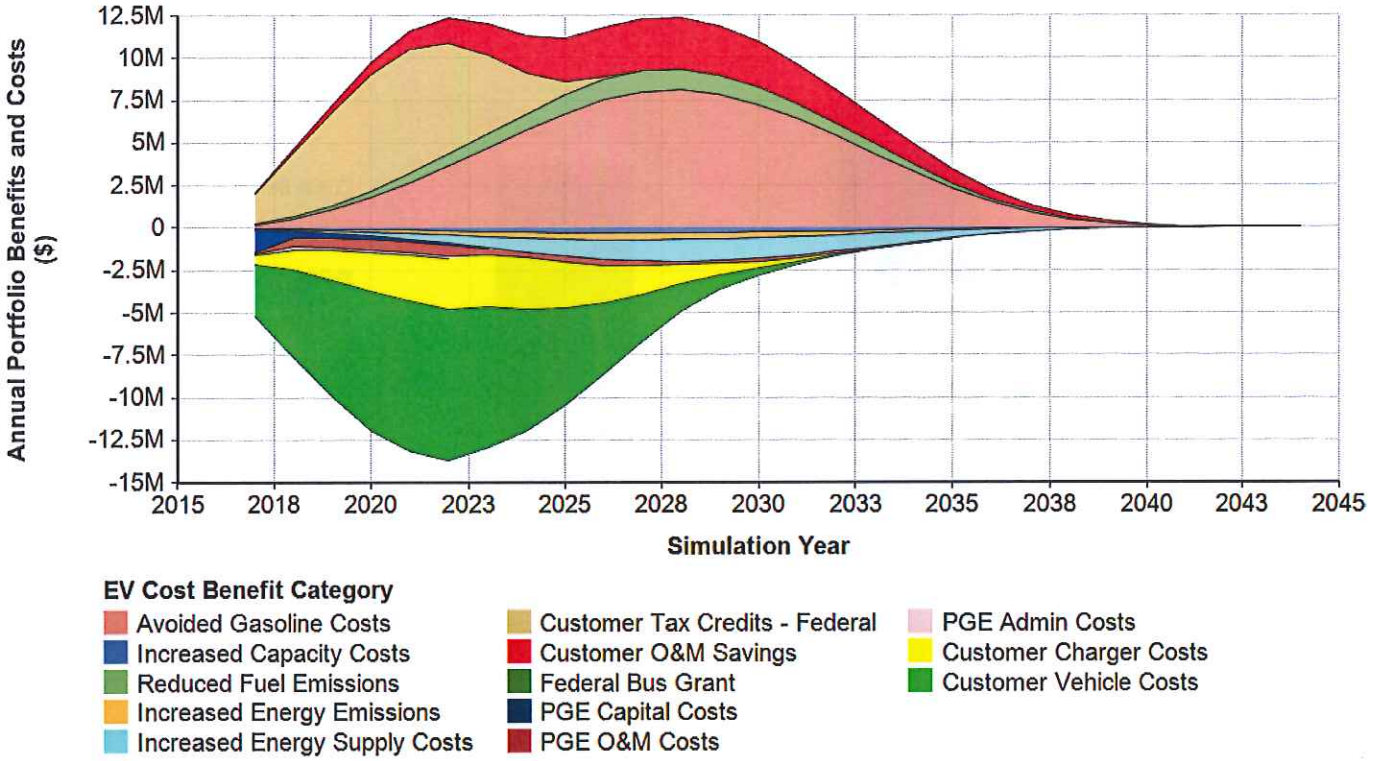
Table 12. Per Vehicle Benefits and Costs with SCT Test



Source: Navigant analysis, 2016

The time series graph below shows the quantified value streams for the SCT (costs and benefits) over time at the portfolio level, including the Electric Mass Transit 2.0 Program.

Table 13. Annual Benefits and Costs with SCT Test



Source: Navigant analysis, 2016

3.5 Electric Mass Transit 2.0 Program Results

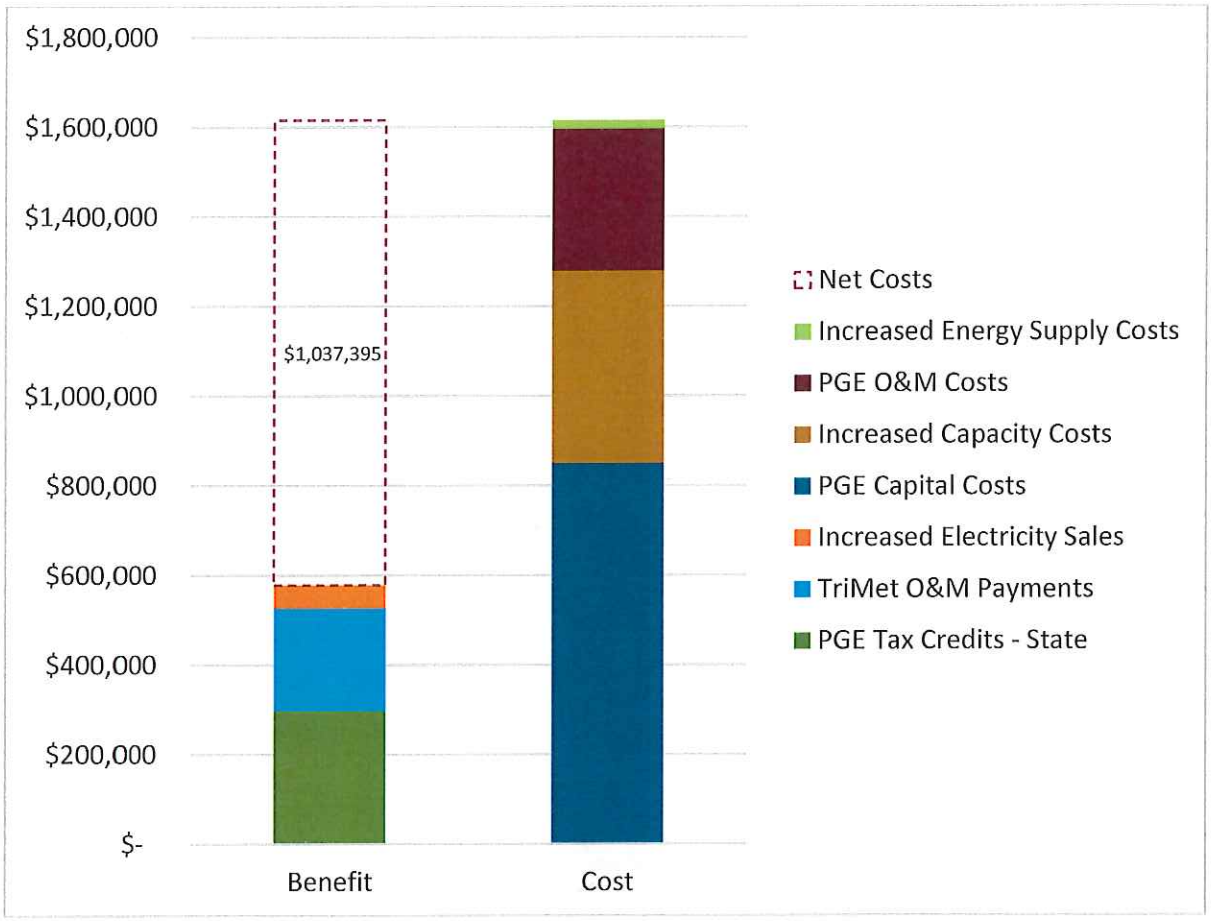
This section provides more detail on the results for the Electric Mass Transit 2.0 program individually, given the unique nature of this program within PGE's electrification transportation portfolio.

The Electric Mass Transit 2.0 program enables TriMet to purchase one additional bus. The program appears to have a net cost, predominately because the full cost of five chargers are incurred as utility capital costs, while the analysis only counts the benefits of the one additional bus attributed to the program. This is a conservative analysis, based strictly on the known impact of the chargers increasing the TriMet fleet by one bus. In reality, these five chargers could power significantly more than one or even five electric buses in the future. However, in order to stay consistent with the methodology employed in response to previous dockets[19] the analysis strictly accounts for only incremental costs and benefits as a direct result of the program.

The Electric Mass Transit 2.0 program results in a net cost of approximately $1 million according to the RIM test.

[19] UM 1708; http://edocs.puc.state.or.us/efdocs/HAD/um1708had113843.pdf

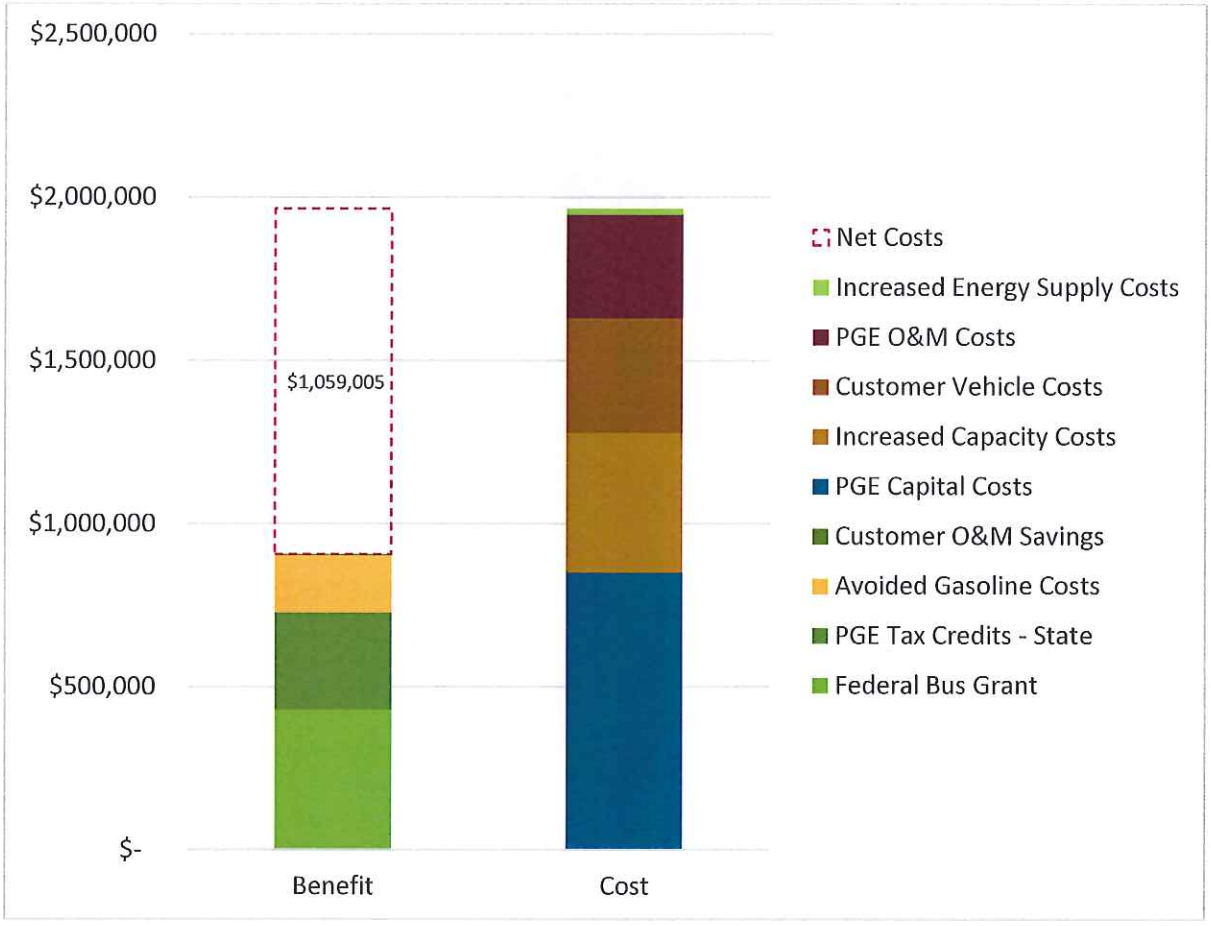
Table 14. Electric Mass Transit 2.0 Costs and Benefits with RIM Test



Source: Navigant analysis, 2016

The Electric Mass Transit 2.0 program results in a net total resource cost of approximately $1 million.

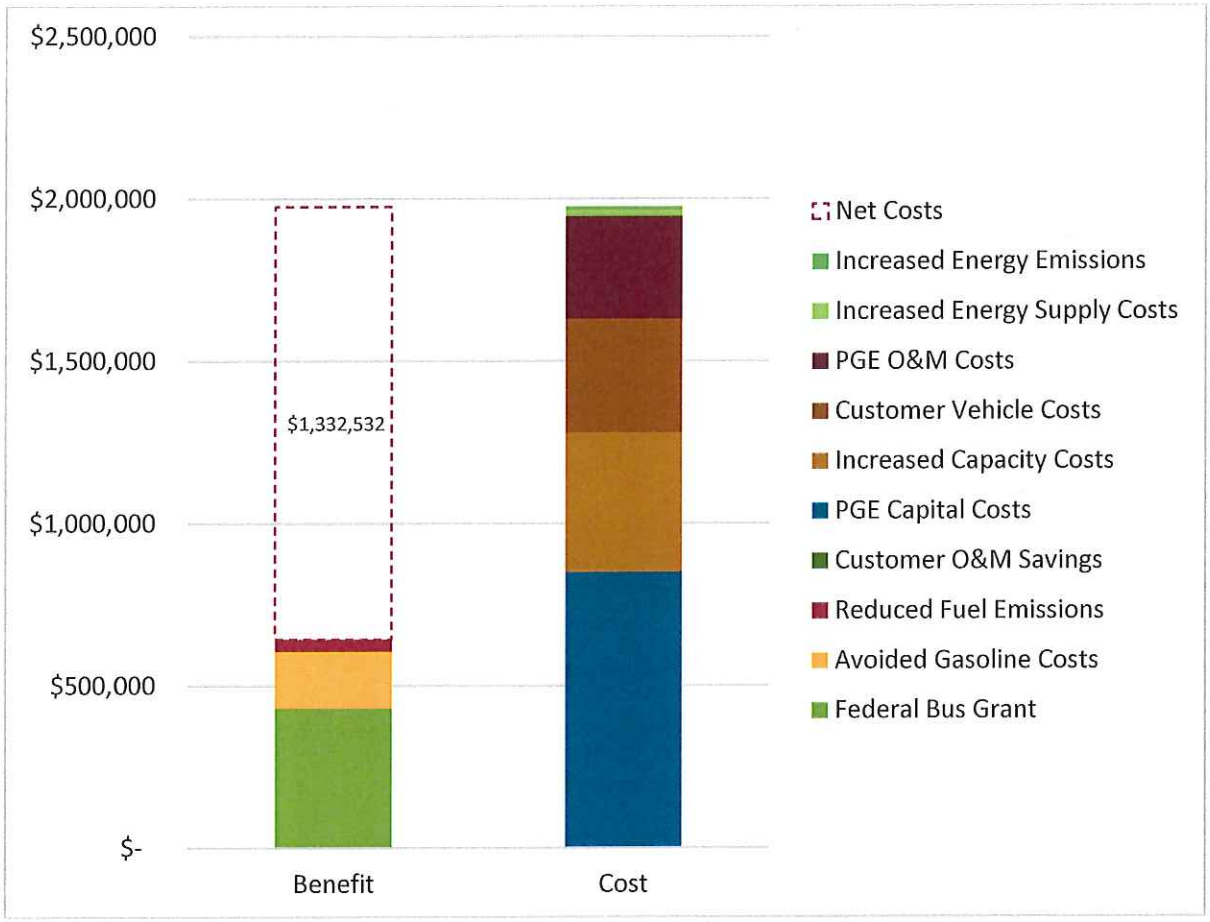
Table 15. Electric Mass Transit 2.0 Costs and Benefits with TRC Test



Source: Navigant analysis, 2016

The Electric Mass Transit 2.0 program results in a net societal cost of approximately $1.3 million. Consistent with the light duty vehicle analysis above, the societal cost test considers costs and benefits from the perspective of the state of Oregon. Therefore, the federal grant for the purchase of a single bus is considered a benefit in this analysis.

Table 16. Electric Mass Transit 2.0 Costs and Benefits with SCT Test



Source: Navigant analysis, 2016

Section IV Conclusions and Directions for Future Research

Based on the results presented above, PGE's transportation electrification program portfolio is expected to be a cost effective investment for PGE and their customers. In the future, additional research that may provide greater certainty in future cost effectiveness analyses for PGE's transportation electrification programs includes:

- Develop a framework to track key performance metrics and evaluate the impact of the transportation electrification program portfolio.
- Assess opportunities for transportation electrification to contribute to demand response and/or ancillary service benefits for PGE.
- Determine optimal criteria for siting of community charging infrastructure, and analyze traffic patterns, demographics, zoning restrictions, visibility etc. to optimize placement community charging infrastructure.

This framework is consistent with and builds upon the framework that PGE set forth for demand response cost effectiveness. PGE will continue to build on this robust framework as the Company continues to further develop customer-facing programs for encouraging adoption of distributed energy resources.

Appendix A. Cost Effectiveness Framework Definitions

Table 17. Cost Effectiveness Framework Definitions

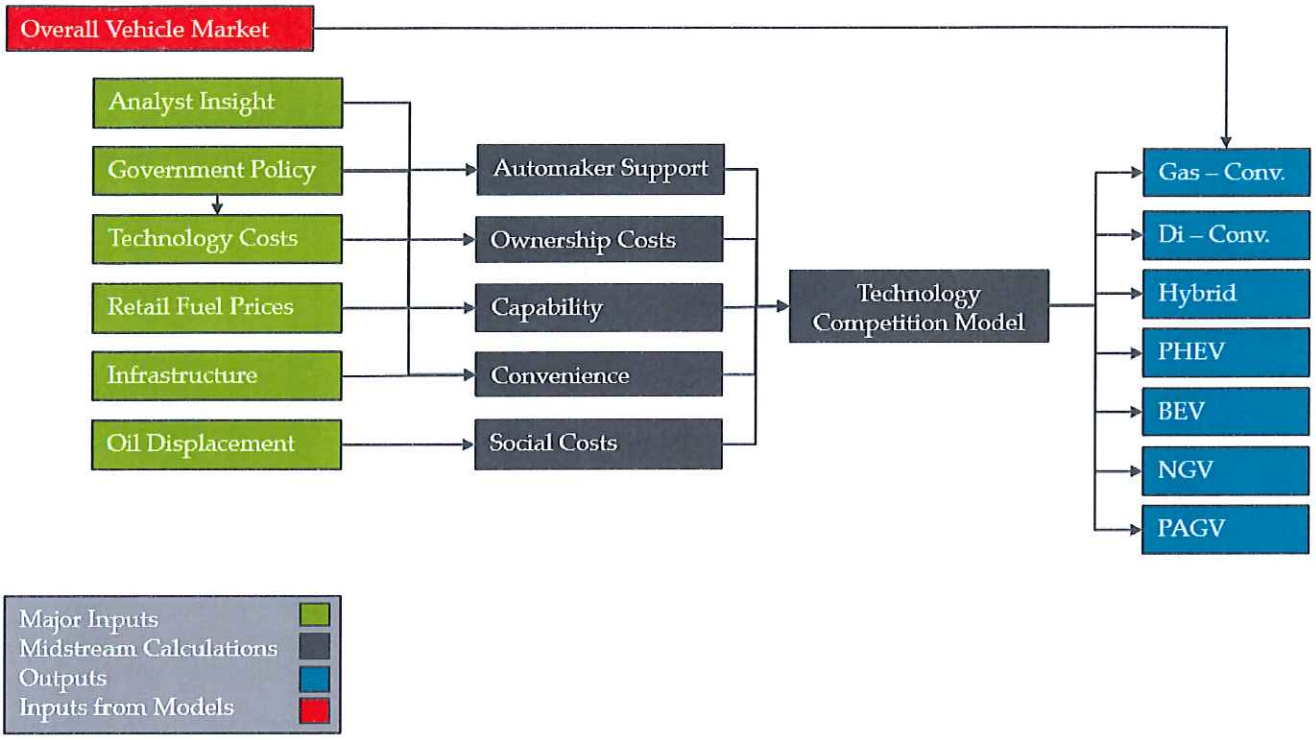
Cost/Benefit Category	Definition	Calculation Description	Monetization Unit
Avoided Gasoline Costs	A customer's value of avoided gasoline purchases	Based on VMT and fuel efficiency of the baseline gasoline powered vehicle	$/gallon of gasoline
Increased Capacity Costs	PGE's increased costs of capacity from providing electric vehicle charging service	Based on electric vehicle charging coincidence with system peak demand (MW)	the inverse of avoided capacity costs ($/MW)
Reduced Fuel Emissions	CO2, NOx, and PM reductions from reduced gasoline consumption	Fuel emissions intensity (tons/gal) * gallons avoided	Cost of emissions ($/ton) by emissions type
Increased Energy Emissions	CO2, NOx, and SOx emissions increases from more electricity consumption	Grid emissions intensity (tons/MWh) * increased energy consumption (MWh)	
Increased Electricity Sales	PGE revenue from increased electricity sales (MWh) due to electric vehicle charging	Electric vehicle charging consumption (kWh). Loadshape varies by sector and rate type	Retail rates by sector ($/kWh) varies by on/mid/off-peak and season
Increased Energy Supply Costs	PGE's increased costs of energy from providing electric vehicle charging service	electric vehicle charging consumption (annual kWh)	the inverse of avoided energy costs ($/MWh)
Customer Tax Credits	Customer tax credits for electric vehicle or EVSE purchases from federal and state sources	Vehicle purchase credit ($/electric vehicle) and Alt fuel infrastructure tax credit ($/project). With phase out assumptions.	
Customer O&M Savings	The decreased O&M associated with electric vehicles	Electric vehicle O&M costs relative to baseline vehicle O&M	Annual O&M savings ($/year)
Utility Tax Credits	PGE tax credits for EVSE purchases from federal and state sources	Alt fuel infrastructure tax credits (federal and state; percent of project costs). Phase out assumptions.	
Utility Capital Costs	PGE costs for installing DCQC and L2 chargers at public stations	Equipment, installation, interconnection, permitting costs for stations	$/station
Utility O&M Costs	PGE annual costs for O&M	DCQC station O&M, as well as marketing dollars for the Education & Awareness	$/year by program
Utility Admin Costs	PGE costs for administering the programs	Any additional FTEs for program admin	$/year by program
Customer Charger Costs	Customer costs for L2 chargers	Assume a percent of vehicle purchases also include L2 residential charger purchase	$/charger
Customer Vehicle Costs	Customer costs for electric vehicles	Incremental cost of electric vehicle over baseline gasoline vehicle	$/electric vehicle

Source: Navigant analysis, 2016

Appendix B. Visual Overview of Electric Vehicle Forecast Methodology

The following slides provide an overview of the electric vehicle baseline forecast methodology. Section 2.2 also contains detail on the methodology.

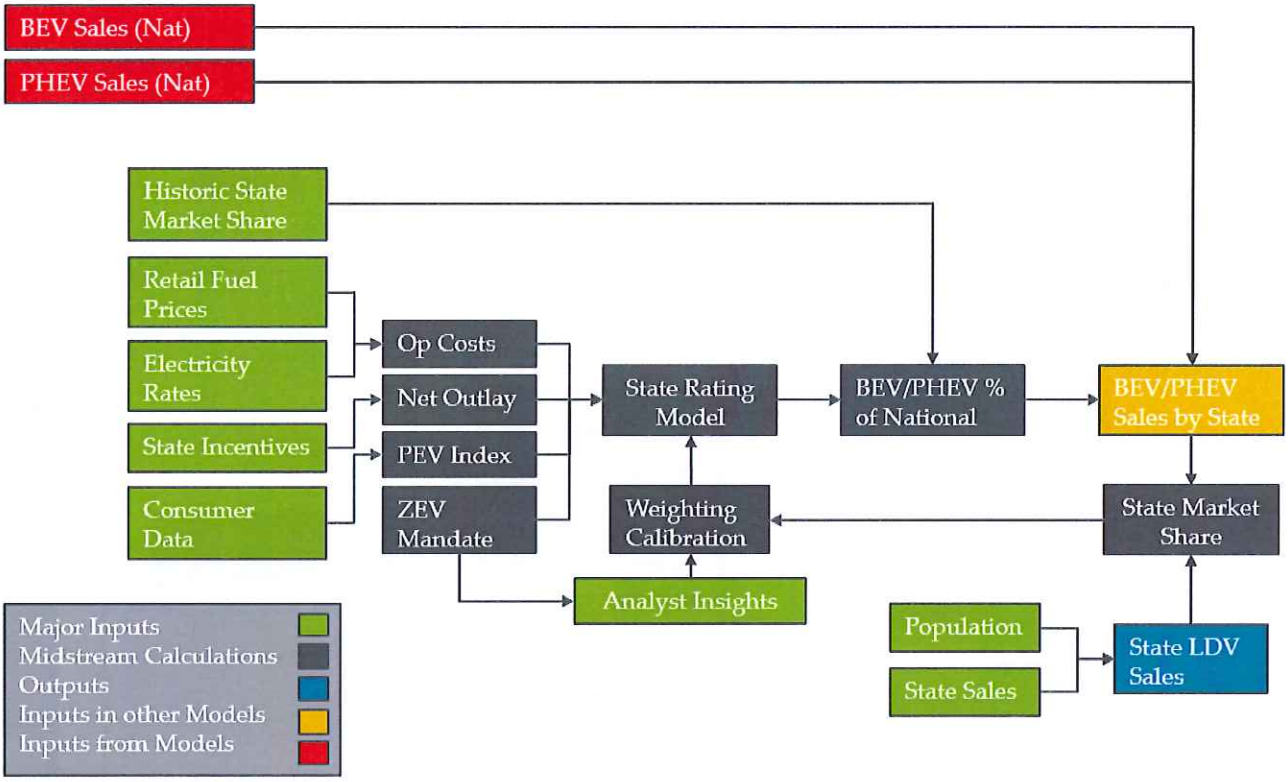
Figure 3: Electric Vehicle Forecast Method: Technology Adoption



Source: Navigant analysis, 2016

The above influence diagram visualizes the component of Navigant Research's national vehicle sales forecast model which determines market share of various vehicle fuel and powertrain combinations. The results of the model are disaggregated by lesser geographic jurisdictions.

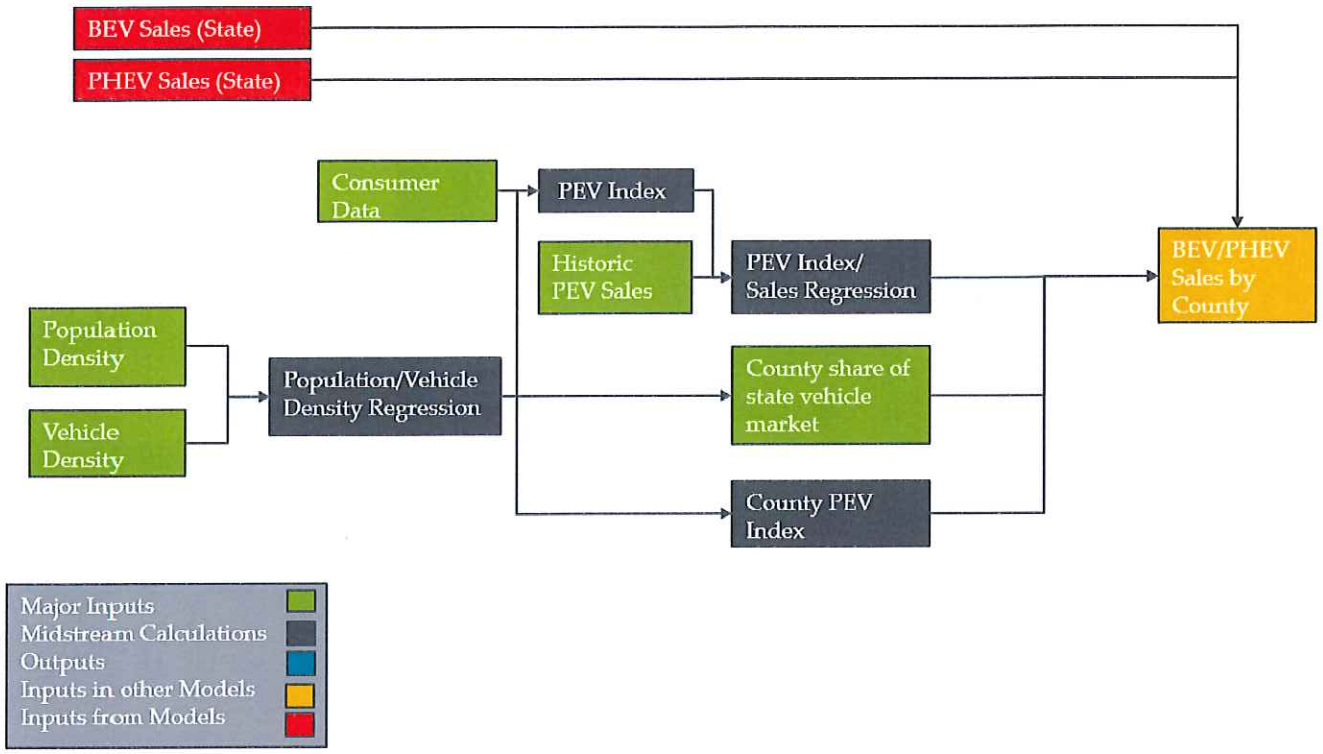
Figure 5: Electric Vehicle Forecast Method: State Disaggregation



Source: Navigant analysis, 2016

This influence diagram visualizes the first disaggregation of Navigant Research's national vehicle sales forecast model. This disaggregation is a function of a number of parameters including state regulations, incentives, retail fuel prices and electricity rates, demographics, and historic sales.

Figure 6: Electric Vehicle Forecast Method: County Disaggregation



Source: Navigant analysis, 2016

This influence diagram visualizes the second disaggregation of Navigant Research's national vehicle sales forecast model. This disaggregation is primarily a function of historic sales, demographics, and population density.

Appendix C. Stakeholder Workshop #1

See attached presentation for the first external stakeholder workshop, conducted on August 2, 2016.

Source: Navigant analysis, 2016

Appendix D. Stakeholder Workshop #2

See attached presentation for the second external stakeholder workshop, conducted on October 13, 2016.

Source: Navigant analysis, 2016

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 009
Dated March 29, 2017

Request:

Page 11 of Appendix A, page 9 of the Navigant study, states that Navigant assumes, based on a larger national U.S. survey, that education and marketing programs impact the electric vehicle market, but it does not state nor provide an analysis of how PGE's programs would accelerate transportation electrification in PGE's territory. Did Navigant conduct such analysis? If so, please provide the analysis. Please provide the missing Table 4 from Appendix page 12, Navigant Study page 10.

Response:
Section 2.3 of the Navigant study discusses the anticipated transportation electrification program impact in detail. In order to capture the impact of PGE's program, Navigant assessed what the impact of each program may be using publicly available data on traditional OEM consumer education spending estimates per vehicle sale and the historic growth of infrastructure relative to the electric vehicle market in the PGE service area. These impacts were then distributed over the forecast period under the assumption that impacts would vary over time based on the maturation of both the infrastructure and vehicle technologies and markets. Due to the uncertainty around how education and awareness and charging stations accelerate transportation electrification, Navigant estimated the impacts with Weibull distributions shown in Section 2.3 of the report. This is the extent of the analysis.

Regarding Table 4, actually this caption is referring to the graph that is present on Appendix page 13. This is in fact a Figure and not a Table.

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Patrick Hager
Manager, Regulatory Affairs

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 011
Dated March 29, 2017

Request:

It appears that Navigant evaluated all Education and Awareness Programs as one portfolio. Please provide a program by program cost effectiveness assessment for all Education and Awareness Programs.

Response:

PGE objects to this request on the basis that it is unduly burdensome. Neither PGE nor Navigant has conducted analysis at this level of specificity. Further, we feel that analyzing at this granular of a level may lead to false precision.

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 012
Dated March 29, 2017

Request:

On page 15 of Appendix A Navigant states, "The cost effectiveness analysis looked at additional electric vehicles sold (i.e. electric lift) as the unit basis for program-level costs and benefits." Does this mean that Navigant assumes all electric vehicles sold in PGE territory above the forecasted baseline are attributable to PGE marketing and outreach? How is Navigant assessing and assigning attribution (what metrics) to each of the PGE marketing and outreach programs, and the proposed electric avenue program?

Response:

The analysis in Section 2.3 of Navigant's study does not forecast all adoption of electric vehicles above the baseline, just the additional adoption from PGE's program, so all of the EV lift in the report is attributed to PGE programs.

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 013
Dated March 29, 2017

Request:

Table 9 on page 17 of Appendix A shows per vehicle benefits and costs with RIM test. This table shows over $2500 in increased electricity sales. Is this increased electricity sales per vehicle over the life of the vehicle? If so, what is the assumed life of the vehicle? Are the increased electricity sales assumed per vehicle residential electricity sales, or public charging sales, or a mix of both? If a mix of both, please create a table showing the assumed residential sales separate from the public charging sales.

Response:

This table shows the present value in 2017 dollars of the increased electricity sales over the ten year expected lifetime of the electric vehicle. This assumes a mix of private (both private residential and private commercial) and public charging sales.

Public Sales per EV	$	141.44
Private (res and com) Sales per EV	$	2,530.63
Total Increased Electricity Sales per EV	**$**	**2,672.06**

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 014
Dated March 29, 2017

Request:

Please define the electric vehicle market in PGE service territory. In other words, how is the PGE electric vehicle market separately defined from the broader state and national market for electric vehicles? How much of the anticipated new electric vehicle sales in PGE service territory are sales to PGE customers?

Response:

Navigant Research develops electric vehicle market forecasts by zip code. The PGE market is defined by all of the zip codes in PGE's service area. An overview of how this relates to state and national forecasts is detailed on pages 25-27 of the Navigant study. All of the anticipated additional electric vehicle sales in PGE's territory are assumed to be sales to PGE customers. The electric vehicle forecast methodology is detailed in Section 2.2 of the Navigant report, and relies on vehicle registration records by zip code to verify that EVs are registered in PGE's territory. The analysis excludes any sales that may occur in the Portland area, yet be registered to residences outside of PGE's service area.

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 015
Dated March 29, 2017

Request:

What costs did Navigant include in its assumed costs for Customer Charger costs? For example, does it include the cost of an additional outlet and conduit installation service to the new charger?

Response:

Charger costs utilized the US Department of Energy's EV project data on average charger costs plus average expected installation costs. Charger type chosen was simple non-networked wall charger for residential chargers, a pedestal mounted basic communication capable level 2 model for workplace, and a pedestal mounted with advanced communication for level 2 public chargers.

DC fast charger pricing was based on a 2-port high power capable with top level network communication features. Exact costs are expected to vary by charger(s) selected and local situation such as available panel capacity or if an additional power run is needed. Average installation costs from the DOE study does account for typical installation costs but will not cover full upgrades for sites with long power runs needed or additional capacity to support the chargers. The average customer cost for a level 2 residential charging station was assumed to be $2,785.

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 016
Dated March 29, 2017

Request:

Page 12 of Appendix A, page 10 of the Navigant study, states "Error! Reference Source not found." Please provide the missing information.

Response:

Please see OPUC DR 008 Attachment A.

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 017
Dated March 29, 2017

Request:

Please explain PGE's statement on page 105 that, "The federal grant per bus ($430,000) to TriMet is included as a benefit in the Total Resource Cost test." Why is the federal grant considered a total resource cost benefit if it is not a benefit under the societal cost test as indicated in Table 5 on page 11 of Appendix A?

Response:

The methodology was revised to include the federal grant as a benefit under both the TRC and SCT. The boundaries for the SCT are the state level, not the federal level, so any payment coming from outside the state is considered a benefit and not a transfer. A previous version of the report defined the SCT boundaries at the federal level, in which case this grant was considered a transfer.

Therefore, the statement from the report below is incorrect:
"The federal grant per bus ($430,000) to TriMet is included as a benefit in the Total Resource Cost test, but as a transfer in the Societal Cost Test."

The statement should read:
"The federal grant per bus ($430,000) to TriMet is included as a benefit in the Total Resource Cost test and the Societal Cost Test."

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 021
Dated March 29, 2017

Request:

On page 82, PGE states, "The typical electric vehicle uses existing grid infrastructure when it is otherwise underused, thereby creating downward pressure on prices." Please explain how this statement supports PGE's interest in time of use rates and demand response programs for electric vehicles and its relation to the programs proposed by PGE.

Response:

Though most EV charging naturally occurs during off-peak hours, it is important to create price signals that provide benefits to customers who elect to charge their vehicles during off-peak times. This may include discouraging charging during periods of system constraint through higher prices, encouraging charging during off-peak and overnight hours through reduced prices, and/or delaying charging to provide localized distribution system benefits. PGE's proposal includes 3 key elements of time-variant pricing and demand response:

1. Outreach & Education: Many EV drivers have the most to gain from a time of use rate, so we intend to make sure marketing collateral and technical assistance materials highlight these benefits.
2. Electric Avenue Network: To send appropriate pricing signals and to discourage on-peak charging, all customers on either payment plan may be charged for on-peak energy consumption. We propose to utilize Schedule 6's Two Period time of use defined Summer Hours to define on-peak periods (on-peak is 3pm – 8pm M-F

excluding holidays). By using this schedule year-round, we believe this will simplify customer education, signage development, and program administration. We also believe this will help make customers more aware of peak and off-peak times.

3. Residential Smart Charging Pilot: PGE intends to create an R&D pilot for up to 200 customers focused on demand response opportunities associated with residential charging. The pilot will explore customer impacts and achievable curtailment from residential charging.

5.1(c) Environmental Benefits

As indicated in 5.1(a), Navigant forecasts approximately 11,500 new EVs will be acquired relative to the baseline as a result of our proposed pilots. Those vehicles, as they are acquired by our customers will have immediate and lasting environmental benefits to our community.

Additionally, as generation fleet continues to be powered by more renewable energy sources, the environmental benefits grow. Table 19 illustrates a reduction of 595,071 metric tons of CO_2 emissions through 2035 as a result of the incremental EVs attributable to these pilots:

Table 19: Estimated Greenhouse Gas reductions due to PGE Transportation Electrification Pilots

Year	Cumulative New EVs due to PGE pilots	Est. Emissions Intensity (lbs. CO_2/kWh) *[PGE Preferred Portfolio, 2016 IRP]*	EV CO_2 Emissions (metric tons CO_2)	Gas Alternative CO_2 Emissions (metric tons CO_2)	Annual CO_2 Reductions due to PGE Pilots (metric tons CO_2)
2017	179	0.82	264	1,006	742
2018	551	0.76	750	3,097	2,347
2019	1,113	0.76	1,488	6,256	4,767
2020	1,846	0.78	2,527	10,376	7,849
2021	2,726	0.71	3,339	15,322	11,984
2022	3,717	0.64	4,108	20,892	16,784
2023	4,780	0.67	5,394	26,867	21,474
2024	5,872	0.67	6,641	33,005	26,364
2025	6,945	0.70	8,029	39,036	31,007
2026	7,954	0.70	9,199	44,708	35,508
2027	8,857	0.70	10,168	49,783	39,615
2028	9,623	0.73	11,272	54,089	42,817
2029	10,238	0.73	12,011	57,546	45,534
2030	10,701	0.72	12,184	60,148	47,964
2031	11,025	0.72	12,476	61,969	49,493
2032	11,238	0.72	12,594	63,166	50,573
2033	11,367	0.72	12,591	63,891	51,300
2034	11,439	0.73	12,620	64,296	51,677
2035	11,476	0.42	7,232	64,504	57,273
**Assumes 13,500 VMT/vehicle/year.*[73]			**Total CO_2 Reductions (2017 – 2035)**		**595,071**

[73] US DOT Federal Highway Administration. *Average Annual Miles per Driver by Age Group.* (Accessed Dec. 1, 2016). http://www.fhwa.dot.gov/ohim/onh00/bar8.htm

CASE: UM 1811
WITNESS: NADINE HANHAN

PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 200

Reply Testimony

April 24, 2017

Q. Please state your name, occupation, and business address.

A. My name is Nadine Hanhan. I am a Utility Analyst employed in the Energy Resources and Planning Division of the Public Utility Commission of Oregon (OPUC). My business address is 201 High Street SE, Suite 100, Salem, Oregon 97301.

Q. Please describe your educational background and work experience.

A. My witness qualification statement is found in Exhibit Staff/201.

Q. What is the purpose of your testimony?

A. I will be discussing PGE's (Company) application as it pertains to the Electric Avenue Network (Network). I will discuss Staff's concerns with the proposal, the consistency of the investment with the six factors set out in the Transportation Electrification Programs statute,[1] and Commission oversight of the Network. I will discuss on what basis the proposal might be approved, and I will present my recommendations.

Q. What do you mean by "consistency of the investment with the six factors set out in the Transportation Electrification Programs statute?"

A. I am referring to the six statutory factors outlined in Oregon Laws 2016, chapter 28, section 20(4). When considering transportation electrification programs that are proposed by a utility, the Commission shall consider the six following factors: (a) whether the investment is located within the utility's service territory; (b) whether the investment is prudent; (c) whether the investment is reasonably expected to be used and useful; (d) whether the investment is reasonably

[1] Oregon Laws 2016, chap. 28, sec. 20(4)(a)-(f) (SB 1547 six factors).

expected to support the electrical system; (e) whether the investment is reasonably expected to improve operational flexibility; and (f) whether the investment is reasonably expected to stimulate innovation, competition, and customer choice.

Q. Do you believe that the Network is consistent with the above considerations?

A. No. My position is explained throughout this testimony. Ultimately, PGE is attempting to comply with a new law that on the one hand is telling regulation-constrained utilities to increase transportation electrification, but on the other hand recognizes that the utilities are regulated entities, and thus puts restrictions on how the utility can accelerate transportation electrification. The six factors are difficult to meet, particularly in a nascent industry like electric vehicles. Regardless, Staff interprets the six factors as important criteria to protect customers and are consistent with the mission of the Oregon Public Utility Commission. Staff believes that even though the Network proposal itself does not meet all of the statutory factors, it is a good-faith effort by PGE that may be conditionally approved as a *pilot program*. The Commission has leeway to approve pilot programs subject to a lower standard, so long as they are time-limited and produce deliverable objectives, particularly in data-gathering. Staff recommends that the Network only be approved if it follows the set of recommendations outlined in this testimony.

Q. What are your recommendations regarding the Electric Avenue Network?

A. Staff recommends the following:

- If the Network proposal is approved and PGE is allowed to recover $591,000 in revenue requirement, the net revenue requirement cap should be $591,000.[2]
- PGE's role in the EV market should be limited. That is, PGE should not invest in charging sites other than the six in the Network proposal.
- PGE should work with stakeholders to develop proper attribution methodology.
- The Company should eventually provide an assessment of whether the tariff for the chargers needs to be changed as they coincide with peak station usage, as opposed to the currently proposed pricing structure that is based on residential usage.
- PGE should submit relevant data, including but not limited to load profile data, utilization data, duration data, voltage and power quality data, kWh delivery data, along with any insight about price sensitivities, time-variant rates, how often the customers charge, types of vehicles customers drive, and any additional insight as to the results of the program. PGE has indicated that it will have access to this data,[3] and, as such PGE should submit this data to the Commission yearly.
- Staff recommends that the pilot be limited to ten years, with regular check-in intervals.

[2] UM 1811/ PGE/100, Spak-Goodspeed/24 (PGE estimates that the cost of the Network will be approximately $4.1M over ten years, but it estimates that revenues from customer payments from using the charging stations will be approximately $3.5M, resulting in a net cost of $591,000).
[3] See Staff Exhibit Staff/202.

- Staff recommends that PGE establish good charging etiquette and best practices to ensure that the stations enjoy maximum benefits to its users.

Q. Did you prepare an exhibit for this docket?

A. Yes. Staff Exhibit/202.

Q. How is your testimony organized?

A. My testimony is organized as follows:

ISSUE 1. THE ELECTRIC AVENUE NETWORK BENEFITS

Q. Please explain your understanding of the Electric Avenue Network.

A. If approved, PGE's Electric Avenue Network will consist of six additional electric vehicle charging sites[4] with locations still under review by PGE.[5] If approved, each site will consist of up to four DC quick chargers (DCQCs) and one level 2 charger.[6] These additional charging sites are an expansion of the current Electric Avenue Network, which consists of already-existing sites from its participation in the EV Highway pilot program[7] and the chargers currently operating in its headquarters at the World Trade Center.[8]

Q. Please explain your understanding of PGE's reasons for proposing to build the six additional sites.

A. PGE states multiple times in its application and testimony that it needs to invest in public charging infrastructure to increase the visibility of electric vehicle charging.[9] Site visibility is among the first criteria listed in its consideration of charging station locations.[10] The Company also cites reliability and availability of public charging infrastructure as reasons that support the proposal,[11] in addition to increased accessibility for people living in multi-family dwellings,

[4] UM 1811 – PGE Transportation Electrification Plan. Pg 47 of 103.
[5] UM 1811 – PGE Transportation Electrification Plan. Pg 61 of 103.
[6] UM 1811 – PGE Transportation Electrification Plan. Pg 47 of 103.
[7] UM 1811 – PGE Transportation Electrification Plan. Pg 47 of 103.
[8] UM 1811 / PGE / 100 Spak- Goodspeed/ 14, line 4. Staff also notes that Oregon Laws 2016, chap. 28, sec. 21 clarifies that programs proposed by PGE pursuant to the new law must be installed *on or after* July 1, 2016, thus, the highway pilot and current Electric Avenue infrastructure must be accounted for separately in terms of cost recovery.
[9] UM 1811 / PGE / 100 Spak- Goodspeed / 16, line 8; UM 1811 – PGE Transportation Electrification Plan. Pg 9, 11, 37, 47, 50, 56, 61, and 97.
[10] UM 1811 – PGE Transportation Electrification Plan. Pg 61 of 103.
[11] UM 1811 – PGE Transportation Electrification Plan. Pg 9 of 103.

supporting car share company adoption of electric vehicles, and empowering Transportation Network Drivers to adopt electric vehicles.[12]

As Staff understands PGE's testimony, the purpose of the above justifications—particularly visibility—is to build public confidence in transportation electrification. That is, the more people are aware of charging stations around them, the more likely they will feel comfortable purchasing an electric vehicle because they will know that there is a charging station nearby if they need one. While some research suggests that the availability of charging stations has positive effects on electric vehicle sales,[13] in reality, the "benefits" mentioned above—such as visibility—are intangible effects.

In the nascent public charging market, having a regulated utility undertake efforts to accelerate transportation electrification by attempting to increase public confidence in the availability of charging infrastructure as justification for the Network proposal places ratepayers in a position to be exposed to new markets, and therefore new risks. Staff agrees that PGE should track the intangible benefits of additional charging stations in its service territory, but would be more persuaded by a showing of the opportunity for net benefits to ratepayers, which the Company has not done in this filing.

Q. Has PGE demonstrated in its testimony that the Network will lead to increased public confidence in transportation electrification?

[12] UM 1811 – PGE Transportation Electrification Plan. Pg 50 of 103.
[13] Li, Shanjun and Tong, Lang and Xing, Jianwei and Zhou, Yiyi, "The Market for Electric Vehicles: Indirect Network Effects and Policy Design" (May 2016), available at SSRN: https://ssrn.com/abstract=2515037 or http://dx.doi.org/10.2139/ssrn.2515037.

A. No. Although it is reasonable to speculate that visibility may build some level of public confidence in transportation electrification, this is very difficult to measure. The Company commissioned a study by Navigant Consulting to forecast the market effects of PGE's Network proposal. Though Navigant estimated a positive influence in the market as a result of PGE's Network proposal, Navigant also asserted that estimating PGE's market impact is "heavily assumption laden"[14] and "[g]iven the nascent and uncertain future of the impact of utility programs on electric vehicle adoption, the inputs and assumptions used within this analysis should be regarded as early indicators of market trends, with a high degree of uncertainty."[15]

Staff recognizes that the Company is obligated to comply with Oregon Laws 2016, chapter 28, section 20 (SB 1547), and thus proposes the Network program to accelerate transportation electrification. In evaluating the proposal, one of the ways to measure increased transportation electrification is by the number of electric vehicles on the road and the increase of market share over time, known as "EV lift."[16] The Navigant study projects that PGE will have a positive impact on EV lift as a result of investing in charging infrastructure. However, because results of this investment are speculative, as indicated by Navigant itself, Staff is concerned about the commitment of millions of

[14] UM 1811 – PGE Transportation Electrification Plan, Appendix A. Pg 10.
[15] UM 1811 – PGE Transportation Electrification Plan, Appendix A. Pg 10.
[16] UM 1811 – PGE Transportation Electrification Plan, Appendix A. Pg 3.

ratepayer dollars[17] to charging stations for the purpose of increasing the number of EVs on the road by a hypothetical 5,000 cars over ten years.[18]

Further, the Navigant study does not address whether PGE's investment in public charging infrastructure will directly lead to increased EV sales. This phenomenon—a measurement of how *PGE's actions* impact the market, which is different from general "EV lift"—is known as "attribution" and is not thoroughly addressed by PGE's program proposal or the Navigant Study. Staff Testimony from Jason Salmi Klotz addresses the issue of "attribution."

The Company must also demonstrate prudency as a criterion for rate recovery, and has not provided a clear methodology for tracking the increase in availability, reliability, or visibility as a result of the Network proposal. The end result is that ratepayers will be paying for highly speculative results. Therefore, Staff believes that a properly constructed attribution methodology is a keystone of the prudency question and must be developed with stakeholder input. One of the goals of this pilot should be to use the data garnered from the Network to develop a more robust attribution methodology.

Q. Has PGE proposed any measurable elements that would define the success of the Network?

A. PGE presents a list of data it plans to collect on the Network such as coincidence factor of charging stations, utilization, and load profile.[19] One

[17] As mentioned previously, PGE proposes to invest $4.1M in ratepayer funds over ten years, but estimates that revenues from customer payments from using the charging stations will be approximately $3.5M, thus, the anticipated net cost of the Network is $591,000.
[18] UM 1811 – PGE Transportation Electrification Plan. Pg 58 of 103. This is a cumulative effect over the course of 10 years.

additional reason PGE provides as justification for building the six additional Electric Avenue sites is that it will allow the Company to "[l]earn about system and customer impacts associated with various pricing and demand reduction strategies."[20] This would involve collecting hard data on pricing signals and customer demand. PGE describes this as an "opportunity,"[21] and proposes a two-tier preliminary pricing model[22] that may change as PGE gathers more data and measures utilization of the chargers. Staff does not believe that the two-tier pricing model should be permanent. Staff elaborates on this issue when Staff discusses "Additional Recommendations" below. However, Staff does believe that gathering this data would be useful, appropriate, and will assist in navigating how to integrate chargers into the grid and how the chargers are used for operational flexibility, integrating renewables, and electrical system support. The Company indicated in a discovery response examples of the sort of data it would be able to collect.[23] The Company should provide this data, as well as an analysis of its application, in yearly reports to the Commission.

Q. Even if PGE did increase public confidence by investing in the Network, does this translate into direct net benefits for customers?

A. No. As mentioned above, the prospect of roughly 5,000 additional electric vehicles on the road within ten years has, at best, has an ambiguous link to

[19] UM 1811 – PGE Transportation Electrification Plan. Pg 56 of 103.
[20] UM 1811 – PGE Transportation Electrification Plan. Pg 50 of 103.
[21] UM 1811 – PGE Transportation Electrification Plan. Pg 50 of 103.
[22] That is, off-peak vs. on-peak. See pg 54 of 103 in PGE's application.
[23] See Staff Exhibit/202.

ratepayer benefits. Customers, along with all Oregon residents, would presumably benefit from carbon emission reduction, but again, the link between PGE's activity and EV lift is tenuous without a properly constructed attribution methodology. The Company projects that the Network's estimated Revenue Requirement will be $4,098,000 with estimated EV charging customer payments being $3,547,000. This leaves $591,000 to be collected in revenue requirement from mostly non-participating customers.[24] From a revenue requirement perspective, ratepayers will have to finance $591,000 for the Network without seeing concrete net benefits. Other results, like visibility, are generally intangible. This $591,000 ratepayer subsidy also assumes that the Company will make enough revenue from the Network to cover most of the cost of the program.

Q. Are there possible benefits that Navigant did not incorporate into its study?

A. Yes. The Navigant study did not include the following:

- The value of Low Carbon Fuel Standard (LCFS) credits that PGE may earn as a result of participating in the Clean Fuels Program (CFP).
- Non-energy and non-emission-related benefits from transportation electrification, including enhanced public image for PGE and the City of Portland, customer satisfaction, noise pollution, etc.

[24] UM 1811 / PGE / 100 Spak- Goodspeed/ 24, Table 5.

- The value of ancillary services and/or power quality services that transportation electrification may provide to PGE's distribution grid. [25]

Q. Could these additional benefits redeem the losses as a result of the ratepayer subsidy of $591,000?

A. This will only be known once the full costs and benefits of the program are realized. In particular, Staff envisions that the greatest potential for net benefits rests with the utility's participation in the CFP. If PGE incorporates credits from the CFP and distributes those benefits to customers, there may be a possibility of recovering, or at least minimizing, the cost to customers.

Q. If the Network is approved, what does Staff recommend PGE do about the benefits that were not incorporated into the Navigant study?

A. PGE should continue to move forward with its effort to capture all benefits for ratepayers from the Network and the Network's interplay with other benefit opportunities. The benefits mentioned above should be reevaluated and efforts should be made to minimize the ratepayer subsidies that occur as a result of the Network.

Q. Does Staff have any additional concerns regarding the benefits of the Network?

A. Yes. If the gap between costs and benefits grows over time, in other words, if PGE has taken on more risk than it anticipates and the Network does not recoup the expected revenues to cover most of the cost of the Network,

[25] UM 1811 – PGE Transportation Electrification Plan, Appendix A. Pg 9.

ratepayers should not have to pay for the increasing gap. If the Network proposal is approved and PGE is allowed to recover $591,000 in net revenue requirement, the net revenue requirement cap should remain at $591,000. Staff does not believe that the Company should be allowed to subject ratepayers to any additional risk.

ISSUE 2. COMMISSION REVIEW AND APPROVAL

Q. Does SB 1547 give any guidance on how PGE might assist in managing the electrical grid?

A. The legislative findings in SB 1547, and the factors to be considered, indicate that transportation electrification and the use of EVs should assist in managing the grid by integrating generation from renewable energy resources and improving electric system efficiency and operational flexibility.[26]

Q. Does the Network help integrate load?

A. Somewhat. PGE has designed a time-of-use (TOU) rate to mitigate usage of the Network stations during peak hours.[27] If the proposal achieves the projected impacts on EV lift, there will be a positive impact on load. PGE has estimated that the Network's maximum impact on peak demand will be no more than 1.5 MW. By using price signals to manage the impact on load, the Company is making a reasonable effort to integrate the program into its system.

Q. Does the Network currently address the other areas of integration as directed by the legislature, such as integrating generation from renewable energy resources and improving electric system efficiency and operational flexibility?

A. This is less clear. As stated above, the Network's impact on energy demand could be increased by up to 1.5 MW. It is unclear how increased demand would improve system efficiency and flexibility, let alone integration of

[26] Oregon Laws 2016, chapter 28, section 20(c)(2)(e) and (4)(e).
[27] UM 1811 – PGE Transportation Electrification Plan. Pg 54 of 103.

renewable energy sources. Notably, PGE recognizes that "we remain years away from realizing that future state where we are able to utilize vehicles for efficient grid management and renewable energy integration."[28]

Staff does, however, recognize that expanded integration could theoretically happen with the introduction of energy storage or 2-way batteries, but PGE did not include these as part of the Network proposal. However, PGE is spearheading a vehicle-to-grid (V2G) research project with Nissan that will involve a 2-way charging station.[29] This 2-way station will not be one of the six Electric Avenue Network sites, but it will begin a process of researching how a V2G system could work and whether it could improve upon system efficiency, flexibility, and renewable integration, thereby meeting the goals of the legislature.

Q. Is Staff concerned about technology obsolescence affecting the benefits of the Network proposal?

A. Yes. As is the case with any technological investment, electric vehicles are also subject to obsolescence risk. PGE asserts that "[a]ll installations will be "future-proofed" to accommodate for advancements in fast charging infrastructure over time,"[30] primarily discussing that the conduit size will be installed to accommodate higher-powered equipment if needed over time. This appears to be the extent of PGE's "future proofing."[31] PGE's stations will include 50 kW DCQCs and they will be able to be replaced with higher-

[28] UM 1811 – PGE Transportation Electrification Plan. Pg 23 of 103.
[29] UM 1811 – PGE Transportation Electrification Plan, pg. 21 of 103.
[30] UM 1811 – PGE Transportation Electrification Plan. Pg 52 of 103.
[31] UM 1811 – PGE Transportation Electrification Plan. Pg 52 of 103.

powered equipment in the future, but it is unclear how this will meet the need in an evolving market. Staff is also aware of other efforts from market actors to increase the charging capacity of DC fast chargers to 350kW,[32] as compared to PGE's 50 kW chargers.

Q. All things considered, is PGE proposing concrete benefits to *ratepayers* as a result of the Electric Avenue Network proposal?

A. No. Staff is not convinced that PGE's proposal presents a net benefit to ratepayers. The Navigant study estimates a range of net benefits from the program,[33] but many of these are not direct benefits to all ratepayers, nor does Staff agree that some can even be considered "benefits." For example, avoided gasoline costs make up a significant portion of the benefits in the Total Resource Cost Test and the Societal Cost Test. While avoided gasoline cost is technically a benefit to the EV-owner who foregoes dollars at the pump, this is misleading because the average ratepayer does not gain from a private EV-consumer saving gas money. Thus, Staff does not consider this a ratepayer benefit.

Q. All things considered, is PGE proposing concrete benefits to *the public* as a result of the Electric Avenue Network proposal?

[32] Lambert, Fred, "5 major automakers join forces to deploy 400 ultra-fast (350 kW) charging stations for electric vehicles in Europe." Electrik. November 2016. Accessed at https://electrek.co/2016/11/29/ultra-fast-charging-electric-car-network-bmw-mercedes-ford-vw/.
[33] For example, see Table 2 in the Navigant Study. UM 1811 – PGE Transportation Electrification Plan. Appendix A, pg. 8.

A. Maybe. As noted above, the effects of the program are heavily assumption-laden.[34] If PGE accelerates enough EV lift and reduces enough carbon as a result of its proposal, measurable benefits to the public would be achieved.

Q. All things considered, is Staff comfortable that PGE's proposal attempts to comply with SB 1547?

A. Yes. Although there is a very limited number of charging sites being proposed, if PGE chooses the optimal locations, Staff believes it could have an impact on visibility and other intangible effects. However, because the charging sites are so limited in number (only 6 additional sites), the intangible effects become more difficult to measure. As the Navigant study concedes, expected results are heavily based on assumptions about the future.

There is an important observation to be made here: PGE is required to comply with SB 1547, but PGE is limited in its ability to do so as a utility 1) subject to the regulatory compact and 2) whose investments must be prudent and benefit customers. Although the Network might attempt to comply with SB 1547 in the sense that it is making an effort to increase transportation electrification, the risks are evidenced by the fact that market actors have already gone bankrupt.[35] The utility is thus knowingly venturing into an unstable market, which is uncharacteristic of the traditional utility model that relies on least-cost and least-risk planning. If PGE plays a role in this market, Staff recommends that the role be limited in participation until private entities

[34] UM 1811 – PGE Transportation Electrification Plan, Appendix A. Pg 10.
[35] UM 1811 – PGE Transportation Electrification Plan. Pg 15 of 103.

can meet demand and that the Company's initial investments be considered pilot programs.

In reality, PGE is proposing to recover over $500,000 in net revenue requirement from its entire customer base. This is a quantifiable cost to ratepayers, most of whom will not own an EV, meaning that most customers are paying for a program they will not use and a program for which Staff struggles to identify quantifiable benefits aligned with the six statutory factors.

Q. Does Staff support approval of the programs?

A. Yes, but with reservations. Staff believes that the Network does not present net benefits to customers. From PGE's testimony itself, the Network does not pay for itself and will result in ratepayers subsidizing a program they may never use. It is not like a peaker plant that is used several times a year or in extreme weather. These are charging stations that will be used by a limited number of customers and not benefit the electrical system as a whole. In normal circumstances, such a program would not be approved. However, Staff recognizes that these are not normal circumstances because SB 1547 authorizes utilities to venture into the EV market.

As far as the six factors that the Commission must consider in approving the programs, Staff does not believe that the Network meets all or most of the factors. The factors, repeated here, are (a) whether the investment is located within the utility's service territory; (b) whether the investment is prudent; (c) whether the investment is reasonably expected to be used and useful; (d) whether the investment is reasonably expected to support the

electrical system; (e) whether the investment is reasonably expected to improve operational flexibility; and (f) whether the investment is reasonably expected to stimulate innovation, competition, and choice.

For factor (a), the charging stations themselves will be in PGE's service territory. However, users of the program may not always be. Anyone can theoretically use the charging stations, so the service territory criterion is likely mostly satisfied, but there is no way to tell that every customer who uses the Network will be a PGE customer, or that PGE customers will reap the benefits of the program.

For factor (b), Staff cannot confidently state that the investment is prudent. In a nascent market with little data and a heavily assumption-laden analysis, the criterion of prudency would normally not be met. However, because Staff is approaching the Network proposal as a pilot program, and because the Company is trying to meet the goals of the statute, Staff holds this proposal to the lesser standard of a pilot program and, as a result, will require that the pilot be time-limited, used to collect specific data, and produce deliverable observations about the program's success or failure.

For factor (c), Staff reiterates that it views PGE's Network proposal as a pilot program, and as such, the lesser standard of a pilot program should not set a precedent for larger programs or investments, regardless of whether the proposed investments are "reasonably expected" to be used and useful once energized and installed. As Staff has already explained above, not all ratepayers are going to make use of the charging stations, though all

ratepayers will pay for them, which to Staff is inconsistent with a traditional capital investment in which all ratepayers benefit from the capital outlay.

For factors (d) and (e), PGE has indicated that it is still a long way away from integrating electric cars as a way to support the electrical system and integrate renewables.[36] Staff thinks these are important factors that are not "reasonably expected" to be met with the current Network proposal. However, Staff does recognize that PGE is investing in a V2G program that will move toward this goal.

For factor (f), Staff concedes that the Network fosters some innovation and choice in the sense that, if successful, automobile drivers may feel empowered to invest in an electric vehicle if they feel that they have more access to a charging station. However, given that PGE has a class of captive customers, this will make it more difficult for private charging companies to compete with PGE, particularly if PGE offers competitive rates.[37]

In summary, PGE is investing in the Network program because it is obligated to comply with state law. By investing in a limited number of charging stations, PGE is attempting to be conservative in its endeavor. It is attempting to increase visibility and public confidence in electric vehicles. For this, PGE should be commended. However, because of the nature of the investment, which Staff does not believe provides net benefits to customers, the usefulness of the Network will ultimately lie in the principle of attribution. Attribution of the program impacts is an essential question that must be addressed as a result of

[36] UM 1811 – PGE Transportation Electrification Plan. Pg 23 of 103.
[37] UM 1811 – PGE Transportation Electrification Plan. Pg 23 of 103. Figure 10.

the Network program, which Staff considers to be a pilot program based on the analysis provided by PGE in its application. As a pilot program endeavor, it is incumbent upon PGE to more robustly address attribution through methodology development. Staff expects that data from pilot programs will enable PGE to develop an attribution methodology.

ISSUE 3. ADDITIONAL RECOMMENDATIONS

Q. Has PGE indicated what pricing structure will be used at its proposed six new charging sites (in the Network program)?

A. Yes. PGE is proposing a flat fee per charge, with a $.19/kWh on-peak energy charge. As part of the Network proposal, PGE is also offering an option for PGE customers to opt for a monthly fee for use instead of paying per use.[38]

Q. If approved, should the Network's pricing structure be permanent?

A. No. Currently, the on-peak window lasts from 3 PM to 8 PM, and this is based on PGE's residential pricing pilot.[39] Staff is not convinced that residential peak demand would accurately reflect charging behavior and demand at a public charging station. Staff recommends that the Company collect usage data from all of its charging stations and eventually adjust prices as they coincide with peak station usage. Over time, this would help address the other areas of integration anticipated by the legislature, such as "improve[ment] of the electric company's electrical system efficiency and operational flexibility, including the ability of the electric company to integrate variable generating resources."[40] Staff recommends that PGE submit load profile data to the Commission yearly and an assessment of whether the tariff for these chargers needs to be changed to address peak usage and system efficiency.

[38] UM 1811 – PGE Transportation Electrification Plan. Pg 54 of 103.
[39] UM 1811 / PGE / 100 Spak - Goodspeed / 20, lines 18-20.
[40] Oregon Laws 2016, chapter 28, section 20(4)(e).

Q. Does Staff have any additional recommendations?

A. Yes. In its testimony, the Company states that it would request a balancing account as part of the deferral application in order to track revenues generated by the Network.[41] Staff agrees that it is necessary to track these costs and benefits but also believes that if the Network is approved, the Company should track the amount of labor and cost it takes to maintain the charging sites. Since utility-led charging infrastructure is still relatively new, Staff anticipates that PGE will be setting a number of precedents with the Network. In its application, PGE explains that charging stations can be unreliable because of a lack of established charging etiquette and consistency. This includes non-electric vehicles parking at the charging stations and unmaintained or out-of-service charging stations.[42] Staff recommends that PGE track the functionality of the charging stations and establish good charging etiquette and best practices to ensure that the sites enjoy maximum benefits to its users.

Q. In sum, what are Staff's final recommendations regarding the Network proposal?

A. Staff does not believe that the Network proposal meets all of the six statutory factors that the Commission must consider when evaluating transportation electrification programs. However, Staff recognizes the iterative nature of the electric vehicle market and the legislature's intent that utilities participate in the market in order to accelerate access to electricity as a transportation fuel and to stimulate innovation and competition. Thus, Staff recommends approval of

[41] UM 1811 / PGE / 100 Spak - Goodspeed / 25, lines 11-13.
[42] UM 1811 – PGE Transportation Electrification Plan, pg. 15 of 103.

the Network program in the form of a pilot program only, and conditioned on the following requirements:

- The net revenue requirement cap for the Network proposal be capped at $591,000.[43]
- PGE's role in the EV market should be limited. That is, PGE should not invest in charging sites other than the six in the Network proposal.
- PGE should work with stakeholders to develop proper attribution methodology.
- The Company should eventually provide an assessment of whether the tariff for the chargers needs to be changed as they coincide with peak station usage, as opposed to the currently proposed pricing structure that is based on residential usage.
- PGE should submit relevant data, including but not limited to load profile data, utilization data, duration data, voltage and power quality data, kWh delivery data, along with any insight about price sensitivities, time-variant rates, how often the customers charge, types of vehicles customers drive, and any additional insight as to the results of the program. PGE has indicated that it will have access to this data, [44] and, as such PGE should submit this data to the Commission yearly.
- Staff recommends that the pilot be limited to ten years, with regular check-in intervals.

[43] UM 1811/ PGE/100, Spak-Goodspeed/24 (PGE estimates that the cost of the Network will be approximately $4.1M over ten years, but it estimates that revenues from customer payments from using the charging stations will be approximately $3.5M, resulting in a net cost of $591,000).
[44] See Staff Exhibit Staff/202.

- Staff recommends that PGE establish good charging etiquette and best practices to ensure that the stations enjoy maximum benefits to its users.

Q. Does this conclude your testimony?

A. Yes.

CASE: UM 1811
WITNESS: NADINE HANHAN

PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 201

Witness Qualifications Statement

April 24, 2017

WITNESS QUALIFICATIONS STATEMENT

NAME:	Nadine Hanhan
EMPLOYER:	Public Utility Commission of Oregon
TITLE:	Utility Analyst Energy Resources and Planning Division
ADDRESS:	201 High Street SE. Suite 100 Salem, OR. 97301
EDUCATION:	Bachelor of Arts in Economics, CSUSB (2010) Bachelor of Arts in Philosophy, CSUSB (2010) Master of Science in Applied Economics, Oregon State University (2015)
EXPERIENCE:	I have nearly 5 years of utility regulation experience. For four years, I worked at the Citizens' Utility Board of Oregon as a ratepayer advocate for residential customers. While there, I provided analysis, expert testimony, and comments in a variety of dockets with topics including gas and electric integrated resource planning, solar resource value, renewable contribution to capacity, smart grids, power costs, natural gas hedging, and electric vehicles. While at the OPUC I have served as an analyst in a variety of dockets including smart grids, integrated resource plans, and voluntary green energy tariffs.

April 18, 2017

TO: Scott F Dunbar
Keyes & Fox LLP

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to ChargePoint Data Request No. 005
Dated April 4, 2017

Request:

Please reference page 18, line 3 – page 19, line 7.

a. **Please explain how PGE's proposed Electric Avenue expansion will stimulate innovation in electric vehicle charging and related infrastructure and services.**

b. **Please explain how PGE's proposed Electric Avenue expansion will stimulate customer choice in electric vehicle charging and related infrastructure and services.**

c. **Please explain in detail why PGE believes it must own the charging stations proposed in the Electric Avenue expansion in order to determine "how customers use visible public charging."**

d. **Please explain in detail why PGE believes it must own the charging stations proposed in the Electric Avenue expansion in order to determine "how visible charging infrastructure impacts customer attitudes toward purchasing electric vehicles."**

e. **Please explain in detail why PGE believes it must own the charging stations proposed in the Electric Avenue expansion in order to determine "how customer usage patterns can be integrated with [PGE's] distribution system."**

f. **Will PGE only attempt to integrate electric vehicle charging into its distribution system when the charging is done at charging stations that PGE owns? Please explain why or why not in detail.**

Response:

a. PGE anticipates the proposed Electric Avenue expansion will stimulate innovation in electric vehicle charging and related infrastructure and services by:

- **Increasing electric vehicle adoption:** as indicated in Navigant's report, PGE's proposed transportation electrification portfolio is expected to increase EV adoption. More EVs on the road will increase demand for electric vehicle chargers and charging-related services. Ultimately a larger customer base will create a larger incentive for EVSPs to create innovative products and solutions for the growing market.

- **Creating a platform for innovation:** by creating public charging infrastructure, PGE will empower the private market to create innovative solutions to Oregon's mobility and carbon challenges. An example of how Electric Avenue helped stimulate innovation is Uber Electric Portland. On April 12, Uber announced Uber Electric, a historic partnership between Uber, Drive Oregon, Black Parent Initiative, Cynergy E-Bikes, and the electric vehicle industry. The initiative aims to make 10% of all vehicles driven on the Uber platform in Oregon electric by 2019. The initiative will offer drivers low-cost leases of electric vehicles and perks for being trained by Drive Oregon as a "EV Ambassador". Electric Avenue has served as a hub for the approximately 100 Uber EV drivers today and inspired the development of this initiative. As indicated in Appendix 5, Uber believes "the Commission's approval of PGE's planned expansion of public charging stations would be essential to increasing the scale of Uber Electric." We believe this innovative initiative is representative of the potential that can stimulated by the deployment of Electric Avenue Network.

- **Creating a competitive RFP for charging infrastructure and network service providers:** As indicated by NRDC, "Utility-scale investment is also needed to facilitate the expansion of the nascent competitive EV charging service industry."[1] A competitive RFP inherently drives competition and supports growth of the industry. RFPs create opportunities for businesses to innovate, find ways to make products cheaper, and highlight new products/features. The EVSE industry is not limited to PGE's service area—our RFP will be one of many; it will be in a "market" of RFPs around the country that collectively will drive the EV product and service industry to innovate and shape the EVSE market by fostering competition among manufacturers and service providers.

  Further, our proposal estimates $500,000 - $1,000,000 of annual investment that will be awarded to charging equipment and service providers—this investment will contribute to the growth and health of a the EVSE industry, which inherently will help fund research and innovation.

[1] Baumhefner, Hwang, Bull. NRDC. Driving Out Pollution: How Utilities Can Accelerate the Market for Electric Vehicles (2016).

- **Sharing results of the Electric Avenue Model:** As a pilot, we hope the co-located chargers demonstrates a model that can be successful in our service area but also in other markets as well. The Electric Avenue model of co-locating several DCQCs each capable of providing a charge to nearly all EVs has not been broadly deployed, despite being the same basic approach as gasoline filling stations. This approach is and of itself is innovative (already deployed by Tesla), and we believe it has the potential to demonstrate greater results than other approaches to public charging have yet to show. As active participants in regional and national transportation electrification groups and conferences (i.e. Edison Electrical Institute, EV Roadmap, ROEV Association, etc.), PGE intends to share learnings (best practices, lessons learned, etc.) with other industry stakeholders in hopes to spur innovative ideas and further investment in EV charging infrastructure.

b. Just like with the deployment of Electric Avenue at World Trade Center, PGE's proposed Electric Avenue expansion will stimulate customer choice in electric vehicle charging and related infrastructure services by creating new sites and chargers where EV drivers can choose to charge.

   Regarding parts C-E of this request, PGE would like to clarify that the proposal of the Electric Avenue Network is not the only potential pilot that could achieve some of the legislature's goals. As indicated in the filed application for programs, PGE reviewed a number of potential program offerings. Ultimately, we believe the portfolio of pilots we have proposed (Electric Mass Transit, Outreach/Technical Assistance, Electric Avenue Network, and Residential Smart Charging) provide the greatest opportunity to meet the goals of the legislature and create benefit for customers. Our pilot portfolio, holistically, provides the greatest opportunity to accelerate efficient deployment of electric transportation, while limiting risk to customers and building foundations that will enable future generations of EVs to aid in the efficient integration of renewable energy.

c. As the owner of the charging equipment, PGE will have access to data that would otherwise be unavailable:

   - Charger-specific information:

     i. Who is using the chargers?

     ii. Load profiles

     iii. Utilization

     iv. Start time/end time of each charge

     v. Duration connected

     vi. Duration charging

vii. Voltage & Power Quality

viii. kWh delivery

- Customer-specific information:

  i. Insight into which specific customers use chargers/when (this could enable targeted outreach for TOU or DR programs)

  ii. Insight into how customers respond to time-variant rates/price signals

  iii. Payment method, amount, and pricing sensitivities

  iv. Customer vehicle year, make, and model, if provided by customer

  v. When, where, and how often do they charge?

d. In order to effectively answer the question of the impact of the presence of visible, reliable, and accessible charging infrastructure on customers' willingness to purchase an EV, PGE will need access to public charging facilities (for conducting customer and non-EV driver interviews) and access to customer enrollment and usage data (for targeting phone interviews and surveys). If we are not the owners of the chargers, we anticipate site hosts/service providers will be unlikely to grant us use of the facilities and access to necessary customer data in order to conduct a meaningful evaluation.

e. As directed by the legislation, PGE is working to ensure that we efficiently integrate electric transportation into our grid. By owning public charging infrastructure, PGE will have access to data that would otherwise be unavailable (see ChargePoint Data Request No. 005-C). This granular data may aid in system and program planning (i.e. demand response, time-of-use/rate design, and distribution system).

f. No. PGE welcomes electric vehicle charging onto its system and frequently works with customers and EV service providers to site and install EV charging infrastructure.

CASE: UM 1811
WITNESS: MICHAEL BREISH

PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 300

Reply Testimony

April 24, 2017

Q. Please state your name, occupation, and business address.

A. My name is Michael Breish. I am a Senior Utility Analyst employed in the Energy Resources and Planning Division of the Public Utility Commission of Oregon (OPUC). My business address is 201 High Street SE, Suite 100, Salem, Oregon 97301.

Q. Please describe your educational background and work experience.

A. My witness qualification statement is found in Exhibit Staff/301.

Q. What is the purpose of your testimony?

A. The purpose of my reply testimony is to provide analysis of the Electric Mass Transit Pilot (TriMet pilot) proposal described in PGE's Transportation Electrification program application and accompanying testimony. The analysis presented herein supports my recommendation on the TriMet pilot described later in my testimony.

Q. Did you prepare an exhibit for this docket?

A. Yes. I prepared three: Exhibit Staff/302, consisting of 1 page; Exhibit Staff/303, consisting of 1 page; and Exhibit Staff/304 consisting of 12 pages.

Q. How is your testimony organized?

A. My testimony is organized as follows:

SUMMARY OF PGE'S TRIMET PILOT AND STAFF RECOMMENDATION

Q. Please explain the partnership between PGE and the TriMet pilot.

A. PGE proposes to use monies that it will seek recovery of in customer rates to procure and own five electric bus charging stations for use by TriMet in one of the agency's bus depots and one en-route electric bus charging station. TriMet will pay for the installation of the six chargers and pay for the cost of charging infrastructure maintenance.[1] PGE will be responsible for the installation and ownership of the six bus charging stations, as well as for the maintenance of the charging infrastructure.

Q. Has TriMet secured federal funds for the program?

A. In August 2016, the Federal Transit Administration (FTA) awarded TriMet approximately 3.4 million dollars in the form of a grant. The grant funds were awarded to TriMet for the purchase of four electric buses, five depot chargers, and 1 en-route charger.[2]

Q. Does PGE's partnership with TriMet affect the federal grant?

A. Yes. By bearing the costs of owning the proposed six electric bus charging stations, PGE states that it is enabling TriMet to use the federal grant funds to purchase an additional electric bus that would have otherwise been spent on four bus charging stations. By allowing TriMet to purchase five electric buses in total, PGE is enabling the "electrification of an entire bus route."[3] However, the final outcome of the proposed modification to the grant is not yet known.

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[1] PGE Application for Transportation Electrification Programs, at page 32, Docket No. UM 1811, March 15, 2017.
[2] Ibid., at page 28.
[3] Ibid., at page 26.

Though TriMet welcomes PGE's partnership, the FTA has only provided preliminary approval of PGE's engagement with the grant work. PGE states that the FTA is "likely to allow" PGE's participation in the final grant agreement, which is expected in early 2017.[4]

Q. Why does PGE seek to procure and own the six electric bus charging stations?

A. The legislature has directed utilities to participate in transportation electrification, including making infrastructure investments to provide electric power to electric vehicles such as buses.[5] The legislature has also indicated a concern that widespread transportation electrification include efforts by the utilities to increase access to the use of electricity as a transportation fuel in low and moderate income neighborhoods, which certain stakeholders have indicated may be most effective through mass transit electrification.[6]

PGE claims that owning and operating the electric chargers "allows TriMet to purchase an additional electric bus, enabling the electrification of an entire bus route."[7] Furthermore, PGE claims that "ownership will create additional learnings from [TriMet's] pilot…that may enable faster growth of the electric bus market in PGE's service area."[8] Further, PGE's support for charging station ownership is based on the claims that it will also help

[4] Ibid., at page 28.
[5] Oregon Laws 2016, chapter 28, section 20(1)(b)-(c).
[6] Ibid., at section 20(2)(c)(legislative findings).
[7] Testimony of Spak-Goodspeed, at page 12, lines 21 – 23, Docket No. UM 1811, March 15, 2017.
[8] Ibid., at page 12, lines 23 through page 13, line 2.

accelerate bus electrification and allow PGE to begin evaluating utility system impacts associated with electric bus charging.[9]

Q. What are the specific learning opportunities that PGE anticipates gaining from the TriMet pilot?

A. They are:

1. The impacts of depot chargers on PGE's distribution system;
2. Coincident peak demand impacts of high-powered bus charging;
3. The additional infrastructure (and associated costs) needed to support bus charging infrastructure;
4. Fleet impacts and fleet facility upgrade costs;
5. Charging infrastructure installation, operation, and maintenance costs;
6. The potential to utilize energy storage to limit impacts to grid operations and upgrades;
7. The ability to utilize time-of-use rates, how to manage charging infrastructure's impact to grid operations, and ways to optimize benefits to all customers.[10]

Q. Does the TriMet pilot include any additional actions that PGE will undertake?

A. To accommodate the five electric charging stations that would be installed at a TriMet bus depot, PGE will need to run a new conduit to the TriMet bus depot

[9] PGE Application for Transportation Electrification Programs, at page 28, Docket No. UM 1811, March 15, 2017.
[10] Ibid., at pages 29 - 30.

and install a transformer pad and a 500 kV transformer.[11] To accommodate the one en-route electric charging station, PGE will need to upgrade distribution infrastructure.[12] Costs for these distribution system upgrades are *unknown*: in response to a discovery request submitted by ChargePoint, PGE states that "a site specific cost breakdown has not been completed."[13]

Q. Who will be responsible for the costs of these distribution system upgrades?

A. Staff understands that ratepayers will be responsible for the cost of distribution upgrades based on two reasons. First, PGE's statement that "if any construction is undertaken or equipment installed to accommodate future load growth at the TriMet's facility that is above the needed equipment to serve the 500 kW load of garage chargers, it will be directly paid by TriMet."[14] If TriMet will only be responsible for costs associated with "future" load growth according to PGE's statement, then PGE's customers will be responsible for the six electric charging stations and requisite infrastructure upgrades that contribute to the current expected load growth.[15] Second, in response to a discovery request from Staff, PGE provided the current FTA grant proposal. In the "Actual/Projected Breakdown of Estimated Total Project Expenditures" table of

[11] Ibid., at page 28.
[12] Ibid.
[13] Exhibit Staff/304, at page 11.
[14] PGE Application for Transportation Electrification Programs, at page 28, Docket No. UM 1811, March 15, 2017.
[15] Ibid.

the proposal, no line item is included for the distribution system upgrades identified as necessary to support the pilot proposal.[16]

Q. What is the total estimated cost of the TriMet proposal to ratepayers?

A. PGE estimates the 20-year net cost of the proposed pilot using three different cost-effectiveness methodologies. The costs, and the respective cost-effectiveness tests, are as follows:

1. Customer perspective test: $1,037,395
2. Total resource cost test: $1,059,005
3. Societal cost test: $1,332,532

Under all three tests, ratepayers face a net-cost over the 20-year lifetime of the infrastructure investments.

Q. What is Staff's recommendation regarding approval of the TriMet pilot?

A. PGE faces a difficult task presented by the legislature: pursue programs that accelerate transportation electrification, but also do so under the Commission's process for evaluating the prudency of a utility's proposal. Staff believes the six factors identified in SB 1547 are difficult to meet at this juncture in time, especially considering the infancy of the Company's efforts in developing transportation electrification programs. Staff appreciates PGE's efforts regarding this TriMet pilot, but believes it does not pass the six factors the legislature recommends the Commission consider when evaluating programs. Staff does not recommend approval of the TriMet pilot in its current form as presented in PGE's application and opening testimony.

[16] Exhibit Staff/304, at page 5.

As discussed in detail below, the TriMet pilot that PGE has proposed places a disproportionate amount of risk on ratepayers to achieve outcomes that necessitate at minimum an exploration of alternatives. Instead of conducting proper diligence into the risks and benefits of this program, PGE presents an option with minimal supporting substance and data. However, the Commission has discretion in approving pilots that do not meet the Commission's standards for prudency, as long as the pilots are limited temporally, have defined expenditures, and produce deliverable objectives, including robust data collection and finding determinations.

In sum, although Staff acknowledges that aspects of the proposal are uniquely beneficial to ratepayers and transportation electrification efforts, such as exposure for low-income communities and unique learning opportunities from high power charging infrastructure, overall, I find grounds to recommend disapproval of PGE's TriMet pilot unless specific conditions (outlined in my testimony) are met for this proposal and for related future mass transit proposals.

ISSUE 1. TRIMET PILOT SELECTION PROCESS

Q. Why begin with an issue of process rather than the substance of the application?

A. Staff notes that PGE failed to conduct a standard selection process with the TriMet proposal and as a result, the substance of the proposal is difficult to evaluate. Had PGE followed the standard process in utility proceedings for prudent resource acquisition, my conditions proposed in this testimony may have not been necessary. I begin with the process topic for two reasons: 1) identification of deficient actions in PGE's process lead to my comments on the substance of PGE's TriMet pilot, and 2) to provide guidance on what Staff views is the necessary processes to employ when developing future transportation electrification proposals.

Q. How does process factor into utility resource decisions like the TriMet pilot?

A. A transparent, accessible and judicious process that begins prior to a project's conception allows for the best possible outcome when developing complex plans in any resource situation, and is particularly important in the utility context when rate recovery from utility customers is a factor. Following a rigorous process is standard procedure for any utility's consideration of action, ranging from a pilot project described in a smart grid report to a major resource action presented and supported in a utility's integrated resource plan.[17] Doing so enables the Commission to have full insight into the process that led to the

[17] *See* Commission Order No. 07-002, Docket No. UM 1056, January 8, 2007; Commission Order No. 12-158, Docket No. UM 1460, May 8, 2012.

utility's proposed action to ensure that it adheres with all pertinent laws, rules and Commission guidelines.

Specifically, the commitment of ratepayer funds for a particular purpose is typically accompanied by a number of proposals. Examples include a utility's IRP (resource portfolios), smart grid reports (DSM pilots for example) or requests for proposals. In these proceedings, utilities identify a need, evaluate alternative options to meet that need through a transparent process, and present the outcome of that analysis to stakeholders and Staff for review. From a diversity of options arises a solution that is optimal for ratepayers, usually in the form of cost, risk and interoperability.

In regard to the TriMet pilot, because PGE delivered its Transportation Electrification proposal after already entering into a partnership with TriMet, it is difficult for Staff to conduct its standard analysis of whether a partnership with TriMet really was the least-cost approach to accelerating mass transit electrification and is the best use of ratepayer funds. Because a transparent selection process, like an RFP, was not conducted, there are no proposals to compare against TriMet's proposal. Furthermore, the supporting data and proposal justification provided by PGE are minimal at best.

Q. What are some of the concerns Staff identified and possible consequences of PGE's agreement with TriMet?

A. The TriMet pilot's schedule leaves very little time for proper execution. PGE's requested schedule that accompanies the TriMet pilot proposal calls for PUC

approval "in early 2017."[18] According to PGE, TriMet's original grant application to the FTA allows for one year of planning, procurement, and construction of charging infrastructure, which would commence in April 2017.[19] As shown in Exhibit Staff/302 under "Bus Procurement, Design & Build" and "Infrastructure Procurement, Design & Build," execution stages were set to commence April 3, 2017. PGE states that "a delay in approval on this pilot could complicate TriMet's project schedule."[20] According the procedural schedule in this docket, the earliest possible opportunity for a resolution is May 8th, when the first settlement conference between the parties is scheduled. Thus, PGE has shifted the burden of this particular proposal's schedule, to which now TriMet is also subject, to the PUC for hastened approval, a situation that leaves ratepayers in a compromised position and could have been avoided entirely had PGE engaged Staff from conceptualization of this proposal.

The lack of the FTA's final approval further complicates the partnership. As mentioned above, PGE and TriMet have only received a preliminary approval from the FTA for the proposed partnership. Not only has PGE's TriMet proposal left Staff and stakeholders under a compressed schedule for proper evaluation, but the entire proposal in its current form is in jeopardy if the federal government decides to deny the revised proposal.

Q. Can the proposal continue in its current form if the Commission disapproves of PGE's TriMet proposal?

[18] PGE Application for Transportation Electrification Programs, at page 32, Docket No. UM 1811, March 15, 2017.
[19] Ibid.
[20] Ibid.

A. Possibly. In the TriMet grant provided in response to Staff's discovery request, TriMet states that "PGE has indicated a willingness (but not made a legal commitment) to contribute these funds, even if the PUC does not approve the expenditure under their Plan submittal."[21] Evidenced from this statement is PGE's appetite to allow shareholders to accept some, maybe all, of the risk of this TriMet pilot. PGE's failure to indicate this willingness to Staff is troublesome, most importantly because the Company is choosing to place the risk of the pilot, which is not insignificant given PGE's identification of various risks, fully on ratepayers. Because of this disclosure, a condition of Staff's recommendation for approval is a cost-sharing arrangement between the Company and ratepayers.

[21] Exhibit Staff/304, at page 4.

ISSUE 2. TRIMET PILOT COMPLIANCE WITH THE LAW

Q. How does PGE's TriMet pilot satisfy the six statutory factors?

A. PGE's TriMet proposal in its current form does not engender a simple "yes, it satisfies all requirements" or "no, it fails across the board." Rather, certain subsections in the law require identification and explanation as they pertain to the TriMet pilot. As mentioned in the beginning of my testimony, considering that the TriMet proposal is a *pilot* and that the TriMet pilot is in the first round of program applications, Staff believes that all of the statutory factors do not have to be met in order to receive Commission approval. However, I propose conditions for this proposal in order to ensure that it is robust enough to deliver optimal results to ratepayers. In addition, I will make recommendations for future proposals of similar nature that Staff expects will be required to meet the statutory factors.

Q. Please provide a summary Staff's analysis of the TriMet program in accordance with the six statutory factors.

A. With regard to factor:

a. Service territory: Though TriMet serves both PacifiCorp and PGE service territories, as long as both the electric station chargers and the en-route charger is installed in PGE's service territory, then I believe factor (a) is satisfied, even if the route that is ultimately served by TriMet includes PacifiCorp service territory. TriMet has not identified a specific route yet, but Staff expects PGE to provide updates as the pilot progresses if the Commission approves it.

b. Prudent: I believe that the net cost of the TriMet pilot, the uncertain benefits, the lack of a transparent selection process, the proposed ownership structure and the disproportionate risks placed on ratepayers under the TriMet pilot make approval without conditions extremely difficult. I explore this more in under issues 2 and 3 later in this testimony.

c. Reasonably expected to be used and useful: Though I believe the TriMet pilot has the potential to be used and useful over the proposed 20-year lifetime of the pilot, risk exists due to TriMet's history with new bus technology. I explore this further under issue 3.

d. Reasonably expected to support electrical system: PGE proposes using time-of-use rates with the bus chargers, which should provide PGE additional data that enables the Company to analyze TriMet's charging behavior. With this data, the Company can design optimized pricing structures for future charging programs that provide additional benefits to all customers.

e. Reasonably expected to improve operational flexibility: PGE states they are evaluating the installation of a battery storage system along with the en-route charger in order to minimize distribution system upgrades and system impacts during high load conditions. PGE's use of time-of-use rates will aid the Company in encouraging customers' charging behavior that is optimal for the grid and all customers.

f. Reasonably expected to stimulate innovation, competition, and choice: Because PGE has proceeded with TriMet without conducting an RFP to explore options to meet the stated goals of mass transit electrification, I believe the TriMet pilot does not satisfy factor (f).

Q. Please explain Staff's conclusion regarding factor (f) – innovation, competition, and customer choice.

A. Factor (f) states that widespread transportation electrification should be reasonably expected to "stimulate innovation and competition, and customer choice." Likewise, the findings in the statute indicate that it should also "attract private capital investments."[22] Staff finds that neither directives are fulfilled by this proposal.

Integrating the comments I made earlier regarding the absence of a transparent and robust process, PGE's predetermination and commitment of ratepayer funds to the TriMet pilot deny the opportunity for competition and possible innovation. Partnering with TriMet for the purposes of mass transit electrification not only excludes alternative innovation opportunities within the TriMet system itself, but closes the door to a number of other non-TriMet mass transit systems that could benefit from PGE's electrification plans. For example, throughout the Transportation Electrification TriMet pilot program application, PGE identifies goals and objectives. Broadly, the Company states its role in the TriMet pilot would "help accelerate bus electrification; and [allow

[22] Oregon Laws Chapter 28 Section 20(2)(d).

the Company to] begin evaluating utility system impacts associated with electric bus charging."[23]

A concern that arises when considering PGE's stated pilot learning goals and objectives is what other opportunities could have accomplished the same objectives with more benefits to ratepayers and at cheaper cost? PGE later opines that "this learning [from the TriMet pilot] could be applied to other bus operations (i.e. transit agencies, school districts, academic institutions, travel organizations, etc.)."[24] The cities of Salem, Wilsonville and Woodburn (all located within PGE's service territory) also have transit agencies with bus fleets that could have engaged with PGE to produce a pilot with the same objectives and deliverables at possibly a lower cost than the TriMet pilot. Were school districts evaluated for potential electrification pilots? Districts across PGE's service territory likely have routes that could qualify for electrification and achieve PGE's objectives and goals, and even meet the legislative concern for providing transportation electrification in low-income communities. Perhaps a vendor other than New Flyer, who is TriMet's existing bus vendor who will supply the electric buses, would have been able to provide a similar, cheaper option, or perhaps an entirely innovative, different proposal that would have achieved similar, if not more objectives. Staff, stakeholders and ratepayers do not know the answers to these questions as the decision to proceed with the New Flyer vendor has already been made and no RFP will be issued.

[23] PGE Application for Transportation Electrification Programs, at page 28, Docket No. UM 1811, March 15, 2017.
[24] Ibid., at page 30.

PGE states that "because TriMet is choosing to sole source their charging buses (and consequently charging infrastructure), this pilot does not actively promote competition of bus charging manufacturers. That is the case, however, with or without PGE's involvement."[25] PGE could have developed a variety of alternative proposals, evaluated them publicly, and achieved the stated goal of the legislation. TriMet could continue successfully without PGE.

[25] Ibid., at page 33.

ISSUE 3. TRIMET PILOT COMPLIANCE WITH THE ADMINISTRATIVE RULES

Q. How does PGE's TriMet pilot satisfy the requirements of OAR chapter 860, Division 87?

A. I have identified two parts of the administrative rules that I believe PGE's TriMet pilot fails. One derives from the statue relating to net benefits, which I believe is a crucial component for the Commission to evaluate when contemplating a program's prudency in the context of transportation electrification.

First, Commission rules require "where applicable, a description of program phases, including a proposal for when each subsequent program phase will be submitted for Commission review."[26] When I consider this requirement along with the lack of process, full stakeholder evaluation and PUC authorization of PGE's predetermined partnership with TriMet, the following line from PGE's Plan raises serious concern: "As a component of this pilot, PGE hopes to work with TriMet on developing a short, mid and long-term bus electrification plan which will include route plans, charger siting planning and peak-mitigation planning."[27] The rules require a description of such phases to be filed with PGE in the initial application, as well as engagement with Staff and stakeholders before it proceeds with any additional planning or actions with TriMet.

[26] OAR 860-87-0030(1)(a)(D).
[27] PGE Application for Transportation Electrification Programs, at page 30, Docket No. UM 1811, March 15, 2017.

At this preliminary stage, PGE's TriMet pilot demonstrates excessive risk that ratepayers will likely bear if the proposal is approved in its current form. These risks include technology performance issues, pilot abandonment by TriMet, unfamiliarity with the technology, and vendor risk, as well as the risk resulting from a lack of an RFP. PGE's quoted statement contains no delineation of "short, mid and long-term" nor does it describe what each stage would entail regarding expansion of TriMet's electrified operations.

Second, the rules require "[a] discussion of how a net benefit to ratepayers is attainable."[28] In its current form, PGE's TriMet pilot has a 20-year net cost over $1,000,000 across all three cost-effective metrics. PGE stated that its cost/benefit analysis did not include "any credits associated with the low-carbon fuel standard…" Had PGE included the value of low-carbon fuel standard (LCFS) credits, ratepayers would stand to benefit from lower costs. Staff recommends, going forward and pending the outcome the Commission investigation into Clean Fuels Program participation, that PGE consider incorporating the value of LCFS credits in this pilot and any future mass transit pilot.

In addition to Staff's recommendation that LCFS credits be considered to offset costs borne by ratepayers, I also want to highlight an additional issue related to PGE's explanation on net costs. PGE states that "the pilot appears to have a net cost, predominately because the full cost of five chargers are incurred as utility capital costs, while the analysis only counts the benefits of

[28] OAR 860-87-0030(1)(f)(C).

the one additional bus attributed to the program."[29] However, table 16 of Navigant's Cost Effectiveness Analysis Report shows that of the nearly $600,000 in benefits to ratepayers using the rate impact measure test (the most generous in terms of overall net cost), approximately $50,000 is attributable to "increased electricity sales."[30] Extrapolating the electricity sales to include the other four buses would still result in a net cost of approximately $800,000. In other words, net benefits would still not be attainable even if all five buses were included in PGE's cost-effectiveness calculations. PGE states that "in reality, these five chargers could power significantly more than one or even five electric buses in the future."[31] Sixteen additional buses would be needed for net benefits to occur for ratepayers when evaluating PGE's ownership of the six charging stations.[32] Whether six charging stations can successfully charge a total of 21 buses is unknown. Therefore, without the LCFS credits and the marginal gain in net benefit for additional buses, Staff believes that the likely attainment of net benefits for the TriMet pilot is vastly overstated by PGE. Not only is the problematic when considering the statue and administrative rules, but it poses serious problems when considering prudency as I discuss in the following section.

[29] PGE Application for Transportation Electrification Programs, at page 31, Docket No. UM 1811, March 15, 2017.
[30] Exhibit Staff/303.
[31] PGE Application for Transportation Electrification Programs, at page 31, Docket No. UM 1811, March 15, 2017.
[32] If the net cost is approximately $800,000 and a single electric bus produces approximately $50,000 in increased electric sales, than 16 electric buses would be needed to at least produce no net cost.

ISSUE 4. TRIMET PILOT PRUDENCY

Q. Why is a discussion of the prudency of PGE's TriMet pilot important?

A. One of the six factors that the Commission must consider when evaluating programs proposed by the utilities is the "prudency" of the investments and other expenditures. Staff would further add that doing so is foundational to the Commission's role in ensuring ratepayers are paying just and reasonable rates for reliable and adequate service.

Q. What does the Commission specifically evaluate when it considers the prudency of an investment?

A. Generally speaking, the Commission considers whether a particular expenditure by the utility which seeks rate recovery was used and useful and least cost, least risk. Based on the precedent set by the Commission using these key metrics in evaluation of previous matters of prudency, such as rate cases and IRPs, I believe doing so in the case of the TriMet pilot is warranted.

Q. As it currently stands, do you believe that the TriMet pilot is reasonably expected to be used and useful?

A. Yes I do, but I have serious concerns about the execution and sustained use of the proposed investments. I will identify a couple of the major ones. First, PGE identifies in their Plan that vendor risk could imperil the longevity of this program. Further elaboration is not provided regarding the Company's statement that New Flyer has "only recently begun to manufacture electric buses," but one could assume that PGE is implying that the pilot faces considerable risk because it's characterized by relatively unknown and

potentially unreliable technology.[33] Because of these circumstances, PGE states "there is risk that the products have more maintenance and repair issues than estimated."[34] Unlike other technologies that utilities invest in that have substantial manufacture and operational experience, both PGE and TriMet will be investing in technologies that may not be useful in a few years because of operational or other issues. Though the Company asserts they will put clauses in the contracts that place responsibility of product failure on New Flyer, a practice standard on technologies both common and new, doing so does not necessarily shield ratepayers from investments made in the technologies or the infrastructure to support them. In response to discovery requests sent by Staff, PGE states that the distribution system upgrades for the bus depot could be used to support "future needs," while the infrastructure to support the en-route charger would likely be unusable if the pilot were to cease operation.[35] Because of these risks, a recommended condition for approval is that PGE provide the Commission contracts with TriMet and any affiliates that involve ratepayer funds for evaluation.

This first concern transitions to my second: TriMet's history with deploying new bus technology is worrisome. In 2003, TriMet invested in a number of hybrid-electric buses that "were not reliable and did not perform

[33] PGE Application for Transportation Electrification Programs, at page 27, Docket No. UM 1811, March 15, 2017.
[34] Ibid., at page 33.
[35] Exhibit Staff/304, at page 7.

well."[36] In 2006, TriMet attempted to increase the biofuel composition of the total fuel mix to 10 percent, with an ultimate goal of 20 percent. The result at the 10 percent mark was buses ended up having compromising mechanical issues that resulted in abandonment of the goal.[37] PGE cautions that "if TriMet abandons their electric bus program due to challenges with the technology or any other reason, the assets would be at risk of being stranded."[38] Even though PGE states that it would try to find a buyer of the stranded assets, TriMet's history with alternative bus technologies coupled with the infancy of complete bus electrification technology suggests that the TriMet pilot could result in stranded costs borne by ratepayers.

Q. What costs are PGE ratepayers responsible for in the TriMet pilot's current form?

A. According to PGE, based on the values presented in Navigant's cost-effectiveness study, PGE ratepayers would be responsible for approximately $800,000 in capital costs.[39] When including "increased capacity costs" and "PGE O&M Costs," the total cost to ratepayers climbs to nearly $1,600,000.[40] In a response to a Staff discovery request, PGE estimates the rate impact of the TriMet pilot would be an approximate 0.03 percent increase across all customer classes.[41]

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[36] http://www.pamplinmedia.com/pt/9-news/341732-221728-trimet-slow-to-board-electric-bus-bandwagon
[37] Ibid.
[38] PGE Application for Transportation Electrification Programs, at page 33, Docket No. UM 1811, March 15, 2017.
[39] Ibid., Table 16, Appendix A, at page 23.
[40] Ibid.
[41] Exhibit Staff/304, at page 8.

Q. How does the least-cost, least-risk principle inform your opinion of prudency?

A. Based on the TriMet pilot's current form, I believe that it is neither least-cost nor least-risk. Despite faith placed in the proposal by both parties, a significant amount of risk accompanies the TriMet pilot as I have identified in previous sections of this testimony. The lack of process preceding PGE's determination to enter a partnership with TriMet further compounds the least-risk consideration. Regarding least-cost, PGE's TriMet pilot is the only proposal found in its Plan to have net negative costs across all cost-benefit analysis tests.[42]

As described earlier in this testimony, the proposal as is fails to consider inclusion of LCFS credits and would require additional buses in order to generate enough additional sales of electricity to become net positive, the latter of which may not even be achievable with the six chargers. Based on these circumstances alone, I suspect PGE may have overlooked the least-cost option for customers. When I consider the fact that PGE did not conduct a process in which to weigh alternative proposals to accomplish the goals identified in the TriMet pilot proposal, I strongly suspect customers are being deprived of a likely lesser cost option than the TriMet pilot.

Q. Beyond the two principles discussed previously, do you have any other reasons to believe the TriMet pilot may struggle to meet factor (b) prudency?

[42] PGE Application for Transportation Electrification Programs, at page 31, Docket No. UM 1811, March 15, 2017.

A. Yes. PGE's decision to own the electric charging infrastructure is a decision that is both risky and costly, but also troublesome in that PGE has made no clear and convincing justification as to why it must own these six electric chargers. In PGE's accompanying testimony and TriMet pilot proposal, the Company provides the following reasons to support ownership of the charging infrastructure: 1) allows TriMet to purchase an additional electric bus, thereby enabling the electrification of an entire bus route, and 2) allows for learning opportunities to "most advantageously integrate" the impacts of mass transit electrification."[43] I believe both of these are insufficient reasons to support complete ownership by PGE as opposed to a cheaper, less risky ownership structure, such as private ownership that is supported by PGE funding.

First, PGE does not explain or justify why an entire route must be electrified. The goals for mass transit electrification pilots are assisting bus electrification and the opportunity to evaluate the system impacts by bus chargers. Those goals can be accomplished with any number of buses and chargers. PGE provides no justification for what incremental evidence will arise from the electrification of an entire route. If PGE's learnings from an entire route being electrified will then be extrapolated to assess impact on the system when considering expanded electrification of mass transit, then why not use extrapolation to assess the impact of an entire route's electrification using a partial amount of electrified buses? Bus routes are planned and largely

[43] Ibid., at page 26.

predictable; surely TriMet has plenty of historical ridership data that PGE could use to extrapolate the system impacts of an entire route's electrification.

Ultimately, PGE is asking ratepayers to pay for an investment that largely exceeds what is necessary. In response to a ChargePoint discovery request regarding PGE's proposed ownership of the charging infrastructure, the Company states that the "fifth bus allows for the electrification of a transit route, from which we can gather better data over a larger range of use cases – that one extra bus makes a significant difference."[44] PGE does not identify what these use cases are, how they can only be met by an entire route as opposed to what can be achieved by fewer buses, nor does it identify why there are no alternative means of securing that data.

Regarding point two, a number of alternative opportunities are available to the Company that would allow it to collect information to inform "key learnings." In the absence of PGE ownership of any infrastructure, the Company could still gain insightful learnings by receiving information from TriMet about how the buses are operating and being charged. PGE could have established a program operations and data exchange agreement for TriMet's initial grant proposal, which would have allowed the Company to evaluate the impacts of the pilot on the system. PGE could have also invited private investment by offering to subsidize a portion of the cost of the charging stations with the understanding that all operational and maintenance data be provided to the Company in order to allow maximum integration of expanded mass

[44] Exhibit Staff/304, at page 10.

transit electrification. Such arrangements are entirely in the realm of possibility: PGE does not own all its generating assets, such as PURPA facilities or third-party owned resources, yet PGE still has insight into how those resources impact system operations. Also, PGE is gaining valuable insights into a demand response program that is entirely operated by a third-party, the Nest thermostat program.

In PGE's response to the ChargePoint discovery request regarding reasons for ownership, PGE reiterates the three points that it presents in the Transportation Electrification program application that justifies the Company's ownership of the chargers: cost savings for TriMet, charging infrastructure lying outside the "core competency" of TriMet, and the ability to study system impacts."[45] In no way does PGE identify unique reasons why the infrastructure needs to be owned by the Company to achieve these goals as opposed to alternative ownership structures. Therefore, PGE's assertion that owning the charging infrastructure is the most advantageous way to integrate the impacts of mass transit electrification into its system is not well-grounded.

[45] Ibid.

ISSUE 5. UNIQUE BENEFITS OF THE TRIMET PILOT

Q. Does the TriMet pilot offer benefits that would allow PGE to accomplish the goals of the enabling legislation?

A. Yes, a few benefits would arise from the TriMet pilot. Most notably is that the proposal is the best case for PGE to learn about the future impact of larger capacity, direct-current fast chargers (DCFC). Although PGE only proposes to install 100 kW DCFCs, the learnings from this capacity will facilitate the possible integration of even more powerful DCFCs, which is essential for greater adoption of electric vehicles. For example, EVgo, a leading operator of public EV charging networks in the U.S., is currently developing a public charging station capable of 350 kW of output.[46] Similarly, Tesla believes that it can eventually charge its vehicles in under ten minutes, which would require a 720 kW output charger given the manufacturer's current battery size.[47] To further facilitate the electrification of the transportation sector, charging times will have to be reduced in order reflect those that characterize petroleum-based fueling. In response to a discovery request from ChargePoint, PGE notes that in "future proofing" installations for faster charging infrastructure, PGE's preparation and design for current power rates will enable the conversion to

[46] Fred Lambert, "The first electric vehicle DC fast-charging station capable of 350 kW output breaks ground in California," *electrek*, last modified December 15th, 2016, https://electrek.co/2016/12/15/electric-vehicle-dc-fast-charging-station-in-us-breaks-ground-in-california/.
[47] Eric Loveday, "Tesla Says Sub 10-minute Supercharging is Possible," *Inside EVs,* last modified January, 2013, http://insideevs.com/tesla-says-sub-10-minute-supercharging-is-possible-we-doubt-it/.

350 KW chargers.[48] PGE's TriMet pilot is a step in the necessary direction of preparation for improved and more powerful charging infrastructure.

Additionally, the TriMet pilot is also the most likely to achieve equity amongst all ratepayers. The electrification of mass transit enables all customers, particularly low-income customers, to access transportation electrification while also receiving the benefits of mass transit electrification, such as reduced emissions and noise. One concern that Staff does have regarding the possibility of low-income customers benefiting from electrified mass transit is that PGE does not have control over the route selection process, only TriMet does. PGE confirmed this in a discovery response to Staff.[49] Therefore, TriMet could select routes that are not optimal for, or do not increase access for, low-income customers.

[48] Exhibit Staff/304, at page 12.
[49] Ibid., at page 1.

CONCLUSION AND STAFF RECOMMENDATION

Q. Please state your conclusion and recommendation regarding the approval of the TriMet pilot.

A. Because of the legislature's directive for utilities to accelerate transportation electrification and the requirements of standard Commission prudency determinations, Staff believes evaluating the TriMet pilot under a less rigorous standard than the six factors, i.e., standards that are usually applied to pilots, is appropriate in this particular case. Pilot program standards require a clear financial limit, a temporal limit, and expectations for reporting results of the pilot. Based on the lack of process accompanying the proposal, the disproportionate risk placed on ratepayers that cannot be compared to the risks generated by alternatives, the net cost of the proposal in its current form, and the lack of support for PGE's entire ownership of the charging infrastructure, Staff cannot recommend approval of the program without conditions. However, Staff recommends approval of the TriMet proposal, as a pilot project only, subject to the following conditions:

1. PGE must provide all proposed contracts with TriMet and/or affiliates that involve ratepayer funds to the Commission for consideration of approval;
2. PGE must enter into a shareholder cost-sharing arrangement for costs incurred;

3. PGE must confer with Staff and Stakeholders in a transparent process during the design of future mass transit electrification proposals with TriMet or other transit agencies; and
4. PGE must regularly meet with Staff to review pilot progress to date, evaluate data collected, and recommend any changes to evaluation methodologies.

Q. Does this conclude your testimony?

A. Yes.

CASE: UM 1811
WITNESS: MICHAEL BREISH

PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 301

Witness Qualifications Statement

April 24, 2017

WITNESS QUALIFICATION STATEMENT

NAME:	Michael Breish
EMPLOYER:	Public Utility Commission of Oregon
TITLE:	Senior Utility Analyst Energy Resources and Planning Division
ADDRESS:	201 High Street SE. Suite 100 Salem, Oregon 97301
EDUCATION:	Bachelor of Science, Atmosphere/Energy Engineering, Stanford University 2012
EXPERIENCE:	I have been employed as a Utility Analyst at the Public Utility Commission since September, 2014. My current responsibilities include analysis, policy and technical support for energy resource planning related proceedings, with an emphasis on RPS compliance, integrated resource plans, voluntary customer programs and demand-side management filings. Prior to working for the OPUC I was an energy analyst at Boston Pacific Company, a consulting firm located in Washington DC, where I worked on a number of electricity-industry related cases including retail and wholesale markets, RTO/ISO practices, offshore wind development, and federal preemption cases involving state commissions and in-state power generation. .

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CASE: UM 1811
WITNESS: MICHAEL BREISH

PUBLIC UTILITY COMMISSION
OF
OREGON

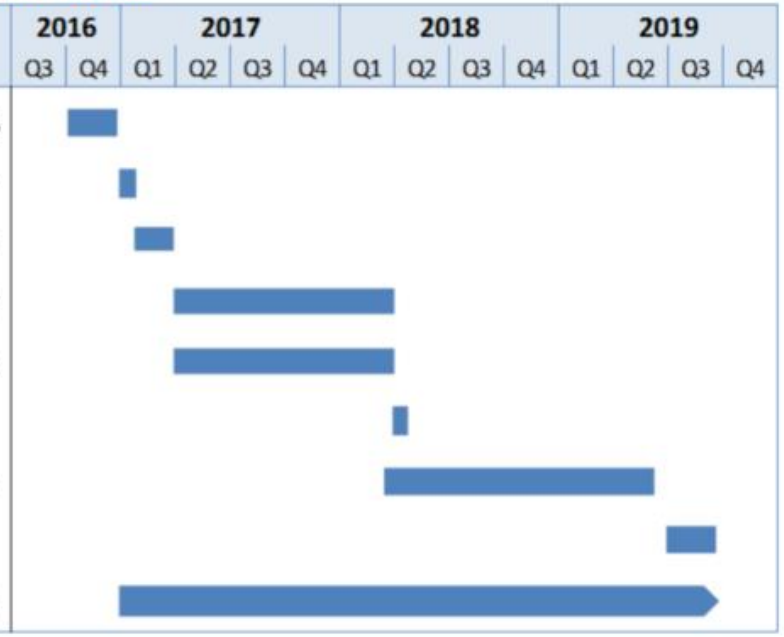
STAFF EXHIBIT 302

Exhibits in Support
Of Reply Testimony

April 24, 2017

Figure 4: TriMet's Grant Schedule[29]

Trimet Bus Project	Start	Finish
FTA Award & Sub-recipient contract execution	10/1/2016	12/30/2016
Project Planning & Initiation	1/3/2017	1/31/2017
Requirements Analysis	2/1/2017	3/31/2017
Bus Procurement & Build	4/3/2017	3/30/2018
Infrastructure Procurement, Design, & Build	4/3/2017	3/30/2018
Bus & Infrastructure Deployment	4/2/2018	5/1/2018
Deployment Validation	3/1/2018	5/31/2019
Project Closeout	6/3/2019	9/2/2019
Project Management, Reporting, & Operations	1/3/2017	8/31/2019



CASE: UM 1811
WITNESS: MICHAEL BREISH

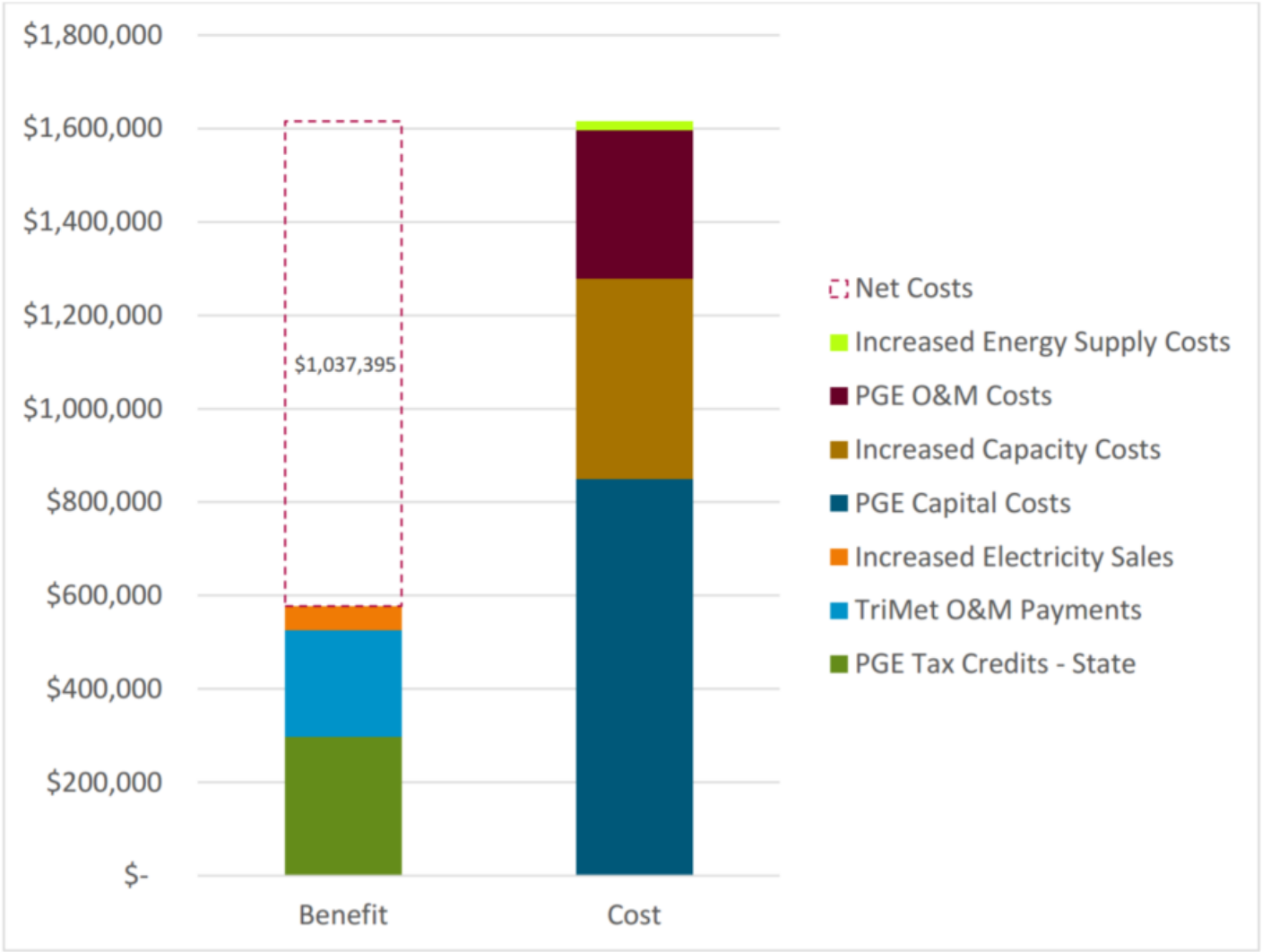
PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 303

Exhibits in Support
Of Reply Testimony

April 24, 2017

Table 16. Electric Mass Transit 2.0 Costs and Benefits with RIM Test



Source: Navigant analysis, 2016

CASE: UM 1811
WITNESS: MICHAEL BREISH

PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 304

Exhibits in Support
Of Reply Testimony

April 24, 2017

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 035
Dated March 29, 2017

Request:

How will low-income community access to proposed electrified routes be incorporated into the determination of said routes?

Response:

PGE will not be selecting the electric bus routes. Regardless of 1st electrified route, the learnings will be foundational in electrifying additional routes in the future. TriMet alone will determine the first and subsequent routes and has indicated that using the Merlo Bus garage as the source of the initial routes was mainly because of the available capacity of that site to easily support the added bus charging infrastructure.

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 036
Dated March 29, 2017

Request:

Please provide a copy of the agreement made between PGE and Trimet and a copy of the agreement and grant proposal that includes PGE's participation in Trimet's electric bus project filed with the FTA.

Response:

Please see OPUC DR 036 Attachment A.

UM 1811

Attachment 036-A

Provided in Electronic Format only

TriMet - Capital Improvement Program - Project Proposal & Summary Form

Project Name:	Low-No Zero Emission Bus Project	**Classification:**		**Project ID:** ?	
Project Location:	Merlo Garage (and additional TC, location TBD)	**Priority Level:**		**Alternatives to Project Attached:** ☐ Yes ■ No	
Project Manager:	Young Park	**Budget Coordinator:**	Sandy Bradley	**Project Proposal:** ☐ New ■ Existing	
ED Assigned:	Steve Witter S Bradley for S Witter	**Grants/Finance Analyst:**		**CPC Approval Date:**	

Evaluation Criteria	Project Readiness/Current Phase	Project Identified In		Divisional Dependencies/Impact	
■ Ongoing/Committed	■ General Concept Stage	☐ Metropolitan Transportation Plan	■	Capital Projects	
☐ Mandated/Regulartory Compliance	■ Pilot/Study Underway	☐ TM Documents	☐	Finance & Administration	
☐ Safety/Security Need	☐ Environmental Study/Complete	☐ TM Asset Management Plan	☐	Information Technology	
☐ Deteriorated Facility/Asset	☐ Preliminary Engineering/Design	■ TM Fleet Plan	☐	Labor Relations & Human Resources	
■ Productivity/Return on Investment	■ Procurement Process	☐ Community Plan (s)	☐	Legal Services	
■ Regular Replacement	☐ Construction	☐ General Plan (s)	☐	Office of General Manager	
■ Enhance Existing Asset/Service	☐ Other _____	☐ Other _____	☐	Operations	
☐ New Expansion	☐ Not Applicable		■	Public Affairs	
			☐	Safety & Security	

Project Description:

Purchase and deployment of up to 5 (five) 40' New Flyer Xcelsior Battery Electric buses, up to 5 depot-based chargers, 1 on-route fast-charger and 1 portable charging unit, supported by FTA Low-No grant funds, including required design, engineering, installation and project management.

Project Justification: (Attach supporting documentation/spreadsheets as necessary to make the case. Impact if not approved.)

This project represents a highly cost-effective opportunity to enable TriMet to gain experience with battery electric buses, with substantial support from FTA's Low or No Emission Vehicle Deployment (Low-No) program, which funds up to 85% of the incremental cost over the cost of a comparable diesel bus, and up to 90% of associated facilities improvements, including charging equipment. The agency is interested in deploying electric buses in full service applications to test their efficiency, reliability, and overall performance relative to our current fleet, given strong indications from other tests that electric buses could offer substantial lifecycle cost savings for the agency due to significantly reduced maintenance and fuel costs. In addition, electric buses offer significantly reduced local air pollutants, greenhouse gases and noise, all of which are also benefits valued highly by our riders and community as a whole. Providing the capacity within our Capital Improvement Program for the purchase and deployment of these buses since the grant has been awarded would enable the agency to evaluate these potential savings with a minimum additional upfront cost (limited to 15% above current diesel bus costs and 50% of associated charging infrastructure), while following through with our Federal partners on this intent.

Technology Component: ▪ Yes ▪ No **If yes, explain:**

.

Funding Issues and Operating Budget Impacts: (Must include estimates for on-going operating costs including maintenance, licensing, replacements, increases in head count, etc.)

Per TriMet bus fleet plan and CIP Project 4058 for Fleet Replacement, base bus costs ($470,000 per unit) are assumed to be displacing similar value in replacement bus budget capacity. Projected lifetime fuel and maintenance savings per bus of $450,000 due to reduced fuel costs and simpler maintenance schedule and fewer parts relative to diesel should cover remaining cost premium per bus of $430,000. Grant budget includes funding for operations and maintenance training on the electric propulsion technology. PGE contribution is reasonably anticipated, though requires approval (expected by July 2017, perhaps sooner) by Oregon Public Utilities Commission (PUC) as part of PGE's Transportation Electrification Plan submittal under SB1547. PGE has indicated a willingness (but not made a legal commitment) to contribute these funds, even if the PUC does not approve the expenditure under their Plan submittal.

Estimating Assumptions: (Collapse this section to increase areas above if lower right estimating assumption box is used.)

See budget in table below and attachments provided, which reflect the Low-No application assumptions of local and federal shares.

Achievements: (If a multi-year project describe what milestones have already been met. If project not yet initiated, describe hopeful achievements and/or efficiencies.)

FTA Low-No grant award notification received in July 2015, with proposed funding to support 4 buses and associated charging equipment.

Current Project Status: (if applicable)

FTA Low-No grant agreement being negotiated with FTA to increase local share (with funding support from PGE) to expand scope to 5 buses and associated charging equipment. Agreement reflecting this scope anticipated to be finalized by February 2017, per discussions with FTA Region 10 and TriMet Finance staff.

Staff/304
Breish/4

Actual/Projected Breakdown of Estimated Total Project Expenditures

	LTD $	FY2018	FY2019	FY2020	FY2021	FY2022	Sub-Total	5 - Year FY2023-27	10 - Year FY2028-37	Total Estimated Cost
Project Admin - Consultant		$ 275,000	$ 150,000	$ 50,000			$ 475,000			$ 475,000
Project Admin - TriMet (In-Kind)		$ 300,000	$ 150,000	$ 50,000			$ 500,000			$ 500,000
Bus Procurement			$ 4,765,000				$ 4,765,000			$ 4,765,000
Depot Charging Equipment Procurement		$ 300,000					$ 300,000			$ 300,000
Depot Charging Equipment Design/Build/Install		$ 225,000					$ 225,000			$ 225,000
On-Route Charging Equipment Procurement		$ 300,000					$ 300,000			$ 300,000
On-Route Charging Site Planning/Design		$ 275,000					$ 275,000			$ 275,000
On-Route Charging Design/Build/Install		$ 325,000					$ 325,000			$ 325,000
Portable Charger Procurement			$ 100,000				$ 100,000			$ 100,000
Total:	$ -	$ 2,000,000	$ 5,165,000	$ 100,000	$ -	$ -	$ 7,265,000	$ -	$ -	$ 7,265,000

Actual/Projected Breakdown of Estimated Total Project Funding

	LTD $	FY2018	FY2019	FY2020	FY2021	FY2022	Sub-Total	5 - Year FY2023-27	10 - Year FY2028-37	Total Estimated Funding
FTA Low-No Grant		$ 1,238,000	$ 2,117,750	$ 50,000			$ 3,405,750			$ 3,405,750
TriMet General Fund			$ 2,897,250				$ 2,897,250			$ 2,897,250
TriMet In-Kind (already in budget)		$ 300,000	$ 150,000	$ 50,000			$ 500,000			$ 500,000
PGE contribution		$ 462,000					$ 462,000			$ 462,000
"Funding Source"							$ -			$ -
"Funding Source"							$ -			$ -
"Funding Source"							$ -			$ -
"Funding Source"							$ -			$ -
"Funding Source"							$ -			$ -
Total:	$ -	$ 2,000,000	$ 5,165,000	$ 100,000	$ -	$ -	$ 7,265,000	$ -	$ -	$ 7,265,000

Estimating Assumptions:

Escalation % (if applicable):
Change:

APPROVAL: $ -

Executive Division Manager Review
Printed Name: S Bradley for Steve Witter
Preliminary Ranking
Additional Comments:

Signature: S Bradley for Steve Witter

Date: Feb 3 2017

Capital Program Committee Review
Printed Name:
Preliminary Ranking
Additional Comments:

Signature:

Date:

Staff/304
Breish/5

TRIMET

Memo

Staff/304
Breish/6

Date: February 2, 2017

To: Capital Projects & Construction Directors

From: Steven D. Witter
Executive Director

Subject: Delegated Authority
February 3, 2017

I will be out of the office Feb 3, 2017. With this memo I am delegating signature authority for the Capital Projects & Construction division to Sandy Bradley on my behalf.

cc: Accounts Payable
Project Control
Procurement

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 037
Dated March 29, 2017

Request:

On page 102 PGE lists a series of upgrades to be undertaken to service the new bus charger infrastructure. Will these upgrades be project specific or will such upgrades have value if the Trimet bus electrification project does not reach completion.

Response:

Original Text:

a. *Running new conduit across Merlo Road from PGE transformer to TriMet property;*
b. *Installing a transformer pad and a 500 kV transformer to serve new load;*
c. *Installing five (5) 100 kW bus chargers in TriMet's garage;*
d. *Upgrading distribution to support en-route charger; and*
e. *Installing of one (1) 300 kW en-route charger.*

The initial upgrades (items a & b) to the Merlo site will be needed to support the proposed added electric bus charging infrastructure. If Trimet does not get the Electric Buses or chargers, then the upgrades would not be needed. The upgrades could be used for other future needs that TriMet may have at that site, such as adding a new building

Upgrades "c, d and e" would likely be for the sole use of electric bus charging.

April 12, 2017

TO: Kay Barnes
Oregon Public Utility Commission

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to OPUC Data Request No. 054
Dated March 29, 2017

Request:

Please provide a rate impact estimate for each program by schedule and for an average residential monthly bill. Please also provide the total rate impact of all proposed program by rate schedule and an average residential monthly bill.

Response:

PGE has not allocated the costs of the proposed transportation electrification programs by rate schedule or customer class. We estimate that the total proposed transportation electrification programs would have a 0.22% price impact across all customer classes. This is comprised of the following sub-estimates:

Outreach and Technical Assistance: 0.12%
Mass Transit Electrification: 0.03%
Electric Avenue Network: 0.03%
Home Charge Pilot: 0.01%
Pilot Evaluations: 0.03%

April 18, 2017

TO: Scott F Dunbar
Keyes & Fox LLP

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to ChargePoint Data Request No. 008
Dated April 4, 2017

Request:

Please reference Section 3.1(c), page 28, where PGE states, "PGE proposes to install, operate, maintain, and own TriMet's bus chargers."

a. **Please explain in detail why PGE believes that it is necessary and a better use of ratepayer funds to own the proposed TriMet bus charging equipment, rather than owning only the "make ready" infrastructure.**

b. **Please provide and explain in detail the relative costs of both the installation costs and the hardware for the proposed bus chargers.**

c. **Please provide and explain in detail the cost of the proposed bus chargers and the cost of the "make ready" infrastructure.**

d. **Please explain in detail the relative risk and prudence with respect to shareholder funds for owning the proposed bus charging equipment versus only owning the "make ready" infrastructure.**

Response:

a. As indicated in Section 3.1 of the filed application for programs, there are several benefits PGE owning the charging infrastructure:
   - **Cost**: Currently, an all-electric bus costs roughly $500,000 - $750,000 more than a traditional diesel transit bus (costs varying based on battery size, functionality, size, etc.). In addition to paying the incremental cost of the bus, transit agencies are also faced with the incremental cost of charging infrastructure. By reducing TriMet's up-front capital costs of charging infrastructure, they will be able to purchase a fifth electric bus. The fifth bus allows for the electrification of a transit route, from which we can gather better data over a larger range of use cases – that one extra bus makes a significant difference.
   - **Core competencies**: In addition to the incremental costs of electric buses and associated charging infrastructure, transit agencies have no experience (and little interest) in maintaining and managing high-powered electric bus charging infrastructure. This is outside of the core competency of many fleet operators who specialize in transportation planning, logistics, and internal combustion vehicle maintenance.
   - **System Impacts**: Through the pilot, PGE will study the impacts of depot chargers on PGE's distribution system and non-coincident peak loads. Though these high-power chargers are not prevalent on our system today, it is likely they will proliferate over the next decade for bus, truck, and personal vehicle use—it is crucial we begin to understand how these impact the grid. Further, we will better understand impacts of coincident peak demand impacts of high-powered bus charging (both at the depot and also on route). We intend to study the system impacts on peak days, evaluate the bus charging use case, assess the customer's needs, and develop models that we believe will be beneficial to all customers. We may include these alternative dynamic pricing elements in the future to maximize the benefit of this program to all customers.

b. As indicated in Section 3.1(g) of the filed application for programs, PGE proposes to procure and own the chargers, while TriMet would bear the cost of their installation and maintenance. The capital cost for the five chargers is $625,000.

   Incremental energy used by these new chargers will be separately metered and will be recovered through Schedule 85-P, TriMet's current retail rate. En-Route chargers may be metered separately and incremental energy will be recovered through a standard retail rate.

   PGE will be responsible for maintaining charging equipment and TriMet will pay costs associated with PGE's maintenance of the charging infrastructure on a time and materials basis.

Table 1: Electric Mass Transit 2.0 Estimated Budget, ($,000)

Cost Element	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Capital Carrying Costs	$ 141	$ 132	$ 121	$ 111	$ 103	$ 95	$ 88	$ 81	$ 74	$ 70
O&M Expenses	$ 79	$ 80	$ 82	$ 84	$ 85	$ 87	$ 89	$ 91	$ 93	$ 95
Tax Credits	($ 63)	($ 63)	($ 31)	($ 31)	($ 31)	-	-	-	-	-
Total Rev. Requirement	$ 157	$ 150	$ 172	$ 164	$ 157	$ 183	$ 177	$ 171	$ 167	$ 165
Est. Customer Payments	$ 79	$ 80	$ 82	$ 84	$ 85	$ 87	$ 89	$ 91	$ 93	$ 95
Net Costs	$ 78	$ 70	$ 89	$ 80	$ 72	$ 95	$ 88	$ 81	$ 74	$ 70

c. PGE interprets 'the "make ready" infrastructure' to mean the distribution system upgrades, conduit, and conductor from the existing distribution system to the site of a new charging station. The costs of "make ready infrastructure" vary based on location, size, and number of chargers needed to fulfill the charging needs of the fleet being electrified. Specific sites for the proposed pilot have not been completed yet, so a site specific cost breakdown has not been completed.

d. PGE has not determined relative risk, reward, or prudence to shareholders as a result of the proposed Mass Transit Electrification pilot. Assisting TriMet in electrifying a single bus route is designed to be a limited, short-term pilot intended to foster learning for PGE and for Oregon's largest transit agency. Once the prudence of PGE's proposed pilot is determined by the Oregon Public Utility Commission, the potential risk and/or reward to shareholders may be evaluated.

April 18, 2017

TO: Scott F Dunbar
Keyes & Fox LLP

FROM: Karla Wenzel
Manager, Pricing

PORTLAND GENERAL ELECTRIC
UM 1811
PGE Response to ChargePoint Data Request No. 010
Dated April 4, 2017

Request:

Please reference Section 3.3(c), page 52, where PGE states, "All installations will be 'future-proofed' to accommodate for advancements in fast charging infrastructure over time." How does PGE propose to future-proof the DCFC hardware that it has proposed to own and operate as a part of the proposed Electric Avenue expansion from becoming obsolete in light of future vehicles that are expected to be able to charge at up to 350 kW?

Response:

"Future proofing" was used to denote minimizing the costs of future utility and site upgrades needed to be able to support high-powered charging infrastructure. This type of future planning is currently done when a new development is being planned in an area where future loads are expected to grow.

Future proofing is not intended to refer to a specific provider or platform, but to prepare the local distribution system for future load. PGE believes that preparing for 150 kW chargers will require thoughtful design that would also facilitate the conversion to 350 kW chargers should those become standard in public infrastructure.