Seattle Electric Vehicle Association

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To: The Washington Utilities and Transportation Commission
David Danner, Chairman, and Jeffrey Goltz & Philip Jones, Commissioners
Steven V. King, Executive Director and Secretary`

Re: Puget Sound Energy's Electric Car Charging Rebate Proposal
Docket No. UE-131585 (Advice No. 2013-15)
Items #A1-A4 on the April 24, 2014 Open Meeting Agenda

The Seattle Electric Vehicle Association (SEVA) would like to reiterate our strong support for Puget Sound Energy's (PSE's) proposal to provide residential electricity customers with rebates for the cost of installing Level 2 car charging equipment in their homes. We are disappointed, however, that the utility felt it necessary to lower the rebate amount and limit participation, in response to the concerns expressed by UTC staff at the April 10 meeting. This is much more than a study project. We urge the staff and the Commissioners to take a broader view of the ratepayer and public benefits generated by electric vehicles (EVs) and approve a higher rebate amount. In particular:

1. **The Commission could easily justify a rebate of $750 or more** based on more realistic energy usage assumptions. PSE's proposal assumes 2,400 kWh per vehicle annually, which would reflect about 7,200 miles of driving. This is much less than the standard average of 12,000-15,000 annual miles. A 4,000 kWh assumption (12,000 miles) would generate more than $1,100 in net revenue margin for PSE, which could support a $750 rebate for charging equipment and still allocate $350 of benefits to the utility's non-EV ratepayers via decoupling.

2. **Improvements to local air quality should be considered in setting the rebate amount**, as EVs will prevent many thousands of gallons of gasoline form being burned in PSE's service area, right where their customers live. Gas vehicles emit a host of toxic compounds regulated by the Environmental Protection Agency (EPA), which include many known carcinogens and causes of respiratory ailments, such as:

   - Benzene
   - Formaldehyde
   - Acetaldehyde
   - Acrolein
   - Naphthalene
   - 1,3-Butadiene
   - Fine particulates ($PM_{2.5}$)
   - Carbon Monoxide
   - Sulfur Dioxide
   - Volatile Organic Compounds (VOCs)
   - Nitrogen Oxides (NO_X)
   - Polycyclic aromatic hydrocarbons (PAH)

   The value of the health benefits to PSE ratepayers from cleaner air would be a legitimate consideration in setting the rebate amount.

3. **<u>Greenhouse gas emissions reductions should also be considered in setting the rebate amount</u>**. While Washington State does not yet have an emissions trading program or equivalent carbon tax, the EPA has estimated the social cost of carbon at between $12 and $61 per ton using various discount rates. Each conventional gas car replaced by an EV will lower CO_2 emissions by about 5 tons per year, or 75 tons over the 15-year period analyzed by PSE. This generates a ratepayer and global benefit worth $900 to $4,600 per vehicle, and the rebate amount should also reflect a share of this value.

4. **<u>Schedule 120, the Conservation Service Rider, is an appropriate place for this rebate program to reside, since EVs unequivocally and massively conserve energy</u>**. Joule-for-Joule, EVs use 75% less energy to drive the same distance. Electric motors are just that much more efficient than internal combustion engines in converting energy to motion. This energy content view is reflected in the EPA's mileage rating for the Nissan Leaf as 114 miles per "gallon-equivalent", more than a 4-fold improvement over today's average gas car and more than twice as good as today's hybrids. EVs are, admittedly, electricity load-building, which is not typical of PSE's conservation programs, but we urge the Commission and staff to regard it as "good load" that befits the conservation program. EVs help convert our transportation system from a more to a less carbon-intensive form of energy while also conserving massive amounts of energy in total.

5. **<u>Level 2 charging also improves electricity conservation at the margin</u>**, as it's 2-3% more efficient than Level 1 charging. At 12,000 annual miles, this will save 100-150 kWh per vehicle per year. If 5,000 vehicles adopt Level 2 charging, this equals 500,000 to 750,000 kWh annually, which is probably meaningful conservation at the utility scale.

6. **<u>The PSE rebate will spur additional EV sales</u>**. We were, frankly, confused by staff's assertion otherwise at the April 10 meeting. EVs currently cost $2,500 to $7,000 more than their conventional gas counterparts, even after carmakers have priced them at a loss and the Federal and State governments have chipped in tax incentives. In addition, they require $1,000 to $1,500 for the charging equipment and installation. So, beyond "range anxiety" worries, the upfront financial barriers to EV adoption are high. The cars, however, are cheaper to operate than gas cars, saving $600 to $1,200 per year in lower fuel and maintenance costs. After several years, the operating savings more than pay the upfront costs, but the payback comes with some uncertainty for potential EV buyers. Providing a rebate for the charging equipment will help alter the calculus of an EV purchase, accelerating the payoff period by a half year or so and spurring more sales. This is borne out by EV sales data: most of the top EV sales states (e.g. Washington, Oregon, Georgia) have state incentives over and above the Federal tax credit, while most of the bottom EV sales states (e.g. Kentucky, Mississippi, Arkansas) do not.

7. **<u>This is not just a program just for the affluent</u>**. Yes, Tesla is a great luxury car and gets a lot of public attention, but most EVs and plug-in hybrids are far more affordable than the Model S. Today, Nissan of the Eastside offers leases on the Nissan Leaf for as little as $199 per month, which goes a long way to affordability, *if* buyers are not dissuaded by the range constraints or the cost of the charging equipment. Other manufacturers (Ford, Mitsubishi, Smart, and Toyota) all have plug-in options under $35,000. High-income households were certainly prominent among the early adopters, but the technology is rapidly becoming a mass-market phenomenon, and this rebate program will assist that transformation.

So in summary, SEVA continues to applaud PSE's rebate proposal for Level 2 residential car charging equipment, and we urge the Commission to roll back the recent changes and approve the rebate at the full originally proposed $600 amount, or more. The remainder of this comment provides additional data and analytics in support of these points. We thank you for your consideration.

Sincerely,

John C. McCoy

Supporting Data, Analytics, and References

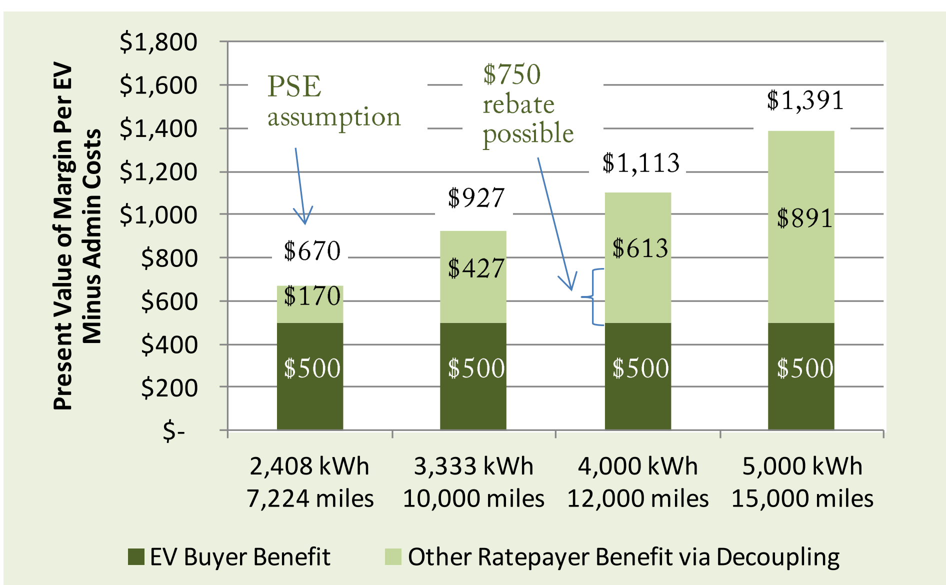
Point 1 – The Commission could easily justify a rebate of $750 or higher based on more realistic electricity usage estimates.

At an average efficiency of 3 miles / kWh, PSE's assumed usage of 2,408 kWh per vehicle per year is consistent with just 7,224 miles of driving. This is far less than a typical vehicle in the United States drives. The 2009 National Household Travel Survey for the Federal Highway Administration found an annual average miles per vehicle of 12,000 to 14,000 for vehicles under 5 years old and about 10,000 for all vehicles. Climate and fuel efficiency work by the EPA and Department of Energy plan for 12,000 to 15,000 annual miles. Similarly, most vehicle leases offered by manufacturers allow for 12,000 or 15,000 annual miles without extra payments. One MIT study of the Boston metro area found an average miles per vehicle of 11,716 with the average increasing to more than 13,000 the further out you go from the City center. PSE's service territory includes many suburban and rural areas, so driving patterns should be expected to reflect these national averages and be higher than Seattle averages with its density and transit service.

SOURCES: National travel survey available at *http://nhts.ornl.gov/2009/pub/stt.pdf, p. 42;* EPA greenhouse gas analysis at 12,000 miles *http://www.epa.gov/otaq/climate/documents/420f11041.pdf*; DoE fuel efficiency labels for gas cars and electric vehicles at 15,000 miles *https://www.fueleconomy.gov/feg/Find.do?action=bt1#electric*; Boston area analysis available at *http://web.mit.edu/11.521/metroboston/xujs_vmt/MetroFuture%20at%20Local%20Level.ppt* , slide 12.

Per PSE's figures, additional usage by electric cars will create additional revenue margin for the utility. This will, in turn, provide additional ratepayer benefit, as rates can then be reduced via decoupling.

Present value of revenue margin per EV (minus administrative costs) for PSE's usage assumption vs. alternative assumptions of 10,000, 12,000, or 15,000 annual miles



SOURCE: PSE worksheet "EV Incentive Workpaper 18 March 2014"
with changes to the Avg. Vehicle Consumption cell C3

A more typical 12,000 mile driving average would raise the projected revenue margin to more than $1,100 per EV (present value), which could easily justify a rebate of $750 or more and still allocate the remaining $350 benefit to the utility's other ratepayers for rate relief via the decoupling mechanism.

Please consider revising the rebates upward, as a higher amount will spur more customers to switch to EVs and multiply the benefits in the above chart. And as discussed elsewhere, the ratepayer benefits do not stop with the direct rate savings shown above, but rather also include better local air quality in PSE's service territory, and reduced greenhouse gas emissions.

Point 2 – The value to ratepayers of local air quality benefits should be considered in setting the rebate amount.

I have listed the substances commonly emitted by gas-powered cars, but SEVA does not have the methodology to value the health benefits of reducing these toxic air emissions from mobile sources. However, such a methodology to monetize the benefit should be readily available from EPA or WA Ecology. For more information on toxic emissions associated with gas-powered vehicles and their health impacts, see:

http://www.epa.gov/otaq/toxics.htm
http://www.ecy.wa.gov/programs/air/cars/automotive_pages.htm
http://www.bcairquality.ca/topics/vehicle-pollutants.html

Point 3 – Some share of the value of greenhouse gas emissions reductions should be considered in setting the rebate amount.

As estimated by EPA methods, the social value of CO_2 emissions reductions associated with this proposal could be worth $900 to $4,600 per EV, and it is reasonable to include a share of this value in setting the potential rebate amount. This is based on 5 tons of CO_2 emission reduction per vehicle annually for 15 years, multiplied by the EPA range of $12-$61 per ton, depending on the desired discount rate.

More information on the social cost of carbon is available at
http://www.epa.gov/climatechange/EPAactivities/economics/scc.html

Point 4 – The rebate proposal is appropriately considered a conservation program, since electric vehicles reduce total energy use by more than 75% compared with conventional gas cars. This can readily be seen by showing electricity and gasoline energy in equivalent units, such as Joules.

Energy use in Joules for Conventional Gas Cars vs. Hybrids and Electric Vehicles

(a)	Energy content of gasoline, per gallon	132 million Joules (mJ) / gal
(b)	Distance traveled per gallon for the average gas car	24 miles / gal
(c)	Energy per mile, average gas car = (a) / (b)	5.5 mJ / mile

(d)	Distance traveled per gallon for a typical hybrid car	45 miles / gal
(e)	Energy per mile, typical hybrid = (a) / (d)	2.9 mJ / mile

(f)	Energy content of electricity, per kilowatt-hour	3.6 mJ / kWh
(g)	Distance traveled per kWh on an average electric car	2.9 miles / kWh[1]
(h)	Energy per mile, electric car = (f) / (g)	1.2 mJ / mile

(i)	**Energy reduction, EV vs. average gas car = (c) - (h)**	**4.2 mJ / mile, or 77% less**
(j)	Annual energy savings per average gas car that switches = (i) * (12,000 miles driving)	51,000 mJ
(k)	Hypothetical equivalent conservation per car per year in terms of electricity = (j) / (f)	14,200 kWh

(l)	**Energy reduction, EV vs. typical hybrid = (e) - (h)**	**1.7 mJ / mile, or 57% less**
(m)	Annual energy reduction per hybrid that switches = (l) * (12,000 miles driving)	20,200 mJ
(n)	Hypothetical equivalent conservation per car per year in terms of electricity = (m) / (f)	5,600 kWh

SOURCES: *http://www.extension.iastate.edu/agdm/wholefarm/html/c6-87.html*
and Google calculator, plus author calculations

The numbers are overwhelmingly in favor of treating this program as energy conservation. Electric vehicles are substantially more efficient than gasoline-powered cars in converting energy to motion, utilizing about 75% less total energy to travel the same distance An additional virtue is that the new energy source, electricity, is less carbon-intensive than the old source, gasoline, on PSE's current generation mix, and PSE customers also have the option to use 100% carbon-free power for their transportation under PSE's Green Power option.

The same energy content view underlies the Environmental Protection Agency's "miles per gallon equivalent" or MPGe ratings for electric cars.

[1] Figure reflects "wall" efficiency -- that is, the Nissan Leaf typically gets 3.2 mi per kWh that is in the battery, but Level 2 charging is about 91% efficient, so it takes more than one kilowatt-hour from the wall to deliver one kilowatt-hour to the battery.

Energy Reduction for Specific Vehicle Models via EPA Miles Per Gallon Equivalent Ratings

	EPA Combined MPG or MPGe Rating	Energy Needed to Travel 12,000 Miles (Gal or Gal Equiv.)	Energy Reduction Compared with Average Gas Car	Energy Reduction Compared with Typical Hybrid Car
Average Gas Car	24 MPG	500.0		
Typical Hybrid Car	45 MPG	266.7	-47%	
All Electric Models				
Nissan Leaf	114 MPGe	105.3	-79%	-61%
Smart fourtwo Electric	107 MPGe	112.1	-78%	-58%
Mitsubishi i-MiEV	112 MPGe	107.1	-79%	-60%
Ford Focus EV	105 MPGe	114.3	-77%	-57%
Tesla Model S *85 kWh or 60 kWh battery*	89 MPGe, or 95 MPGe	134.8 126.3	-73% -75%	-49% -53%
Plug-in Hybrid Models				
Chevrolet Volt *Assumes 80% electric and 20% gas operation*	98 MPGe 37 MPG	162.8	-67%	-39%
Ford C-Max & Fusion Energi *Assumes 50% electric and 50% gas operation*	100 MPGe 43 MPG	199.5	-60%	-25%
Toyota Prius Plug-In *Assumes 30% electric and 70% gas operation*	95 MPGe 50 MPG	205.9	-59%	-23%

SOURCE: http://www.fueleconomy.gov/feg/evsbs.shtml plus author calculations

Point 5 – Level 2 charging is 2% to 3% more efficient than Level 1 charging and could conserve 100-150 kWh per vehicle per year. This places the program in the company of PSE's other efficiency rebate programs for light bulbs and home appliances. The conservation may be meaningful at the utility scale, saving 0.5 MWh to 0.75 MWh each year if 5,000 vehicles adopt Level 2 charging.

Idaho National Labs tested charging equipment on the Chevrolet Volt and found overall AC to DC charging efficiency of 90.8% on Level 2 charging vs. 88.8% on Level 1, a delta of 2%.

Similarly, Efficiency Vermont gathered fleet charging data, also on the Chevy Volt, and found a 2.7% average delta (86.4% vs. 83.7%) on Level 2 charging.

As I mentioned at the April 10 meeting, the delta can be significantly higher (12.8%) in small charging events, such as when a vehicle with a mostly full battery gets "topped off." This is likely due to the fact that the charge rate is slower when the battery is close to full, and efficiency improves with wattage. Efficiency can also vary with the ambient temperature.

Level 2 vs. Level 1 Charging at Independently Rated Efficiencies

Annual Driving	12,000		miles
Average EV Efficiency	3.0		mi / kWh
Total Battery Energy	4,000		kWh
	INL Rating	Vermont Rating	
Total wall energy required L2	4,405	4,630	kWh
Total wall energy required L1	4,505	4,779	kWh
Conservation per vehicle attributed to L2 charging	99	149	kWh
Annual Savings @ $0.11 / kWh	$10.91	$16.43	
Annual conservation with 5,000 vehicles at L2 relative to L1	496,091	746,714	kWh

SOURCES: http://avt.inel.gov/pdf/phev/EfficiencyResultsChevroletVoltOnBoardCharger.pdf and *http://veic.org/documents/default-source/resources/reports/an-assessment-of-level-1-and-level-2-electric-vehicle-charging-efficiency.pdf* plus author calculation

Point 6 – Rebates and incentives will spur additional EV sales. Standard economics tells us that the lower the cost of a good, the larger the quantity demanded, and this will be true for EVs as well. The rebate will clearly drive additional EV sales and leases for PSE customers, though SEVA does not have a price elasticity of demand estimate that might allow us to state how many with any certainty.

- In recent California surveys, 65% of EV drivers said that the available rebates were "extremely important" or "very important" in their decision to switch to electric. (Available at *http://energycenter.org/clean-vehicle-rebate-project/vehicle-owner-survey*, February 2014 report).
- Anecdotal reports from tracking services suggest that EV adoption rates are often highest in states with additional incentives and lowest in states without.

Partial List of States with and Without EV Tax Incentives

Examples of States With Tax Incentives Include:	**Value of State Incentives** (Varies, Approximate)	**2013 EV Adoption Rate** (% of New Registrations)
Washington	$3,500	1.6%
Oregon	$750	1.1%
Georgia	$6,500	1.1%
Examples of States Without Tax Incentives Include:		
Kentucky	$0	<0.1%
Mississippi	$0	<0.1%
Arkansas	$0	<0.1%

SOURCES: http://insideevs.com/top-10-and-bottom-10-us-states-for-ev-market-share-in-2013/ and http://www.ncsl.org/research/energy/state-electric-vehicle-incentives-state-chart.aspx

PSE's proposal is particularly well timed in that the Federal tax break for charging equipment and installation (previously a 30% credit) expired at the end of 2013 and may not get renewed by Congress, so the utility's rebate will help keep the EV momentum going.

Point 7 – This is not just a program for the affluent. EV's are quickly becoming mass-market.

It's true that high-income households have been prominent among the early adopters of this technology, but that is quickly changing. Many EV models and plug-in hybrids now cost less than $35,000 MSRP, and well under $30,000 when Federal tax incentives are taken into account. While the technology still costs more than a conventional gas car, we are no longer primarily talking about $80,000 Tesla Model S luxury sedans. (No offense intended, though. The Model S is unequivocally a great car). For example, Mitsubishi is now pricing the i-MiEV under $20,000 after incentives. Nissan and its local dealers are currently offering $199 per month leases for the 2014 Leaf in PSE's service territory. (*Available at http://www.eastsidenissan.com/bellevue-nissan-incentives*)

Moreover, this rebate program itself helps make EVs more affordable to more households.