November 23, 2016

Mr. Steven V. King
Executive Director and Secretary
Washington Utilities and Transportation Commission
1300 South Evergreen Park Drive
Olympia, WA 98504-7250
Re: Comments Proterra on Docket UE-160799 CR-101 Inquiry

Dear Mr. Steven King,

Proterra Inc. appreciates the opportunity to provide comments on Docket UE-160799 CR-101 Inquiry for additional input on the scope and content of a rulemaking or policy statement on utility investment in electric vehicle supply equipment and whether the Commission should consider or adopt other transportation electrification policies.

We believe that the Commission's effort undertaken under this Docket can provide guidance not only for the implementation of RCW 80.28.30 but for the future of transportation electrification in Washington including heavy duty vehicle applications such as EV bus transit.

Proterra is an American manufacturer of battery-electric transit buses. These are full size 35' and 40' purpose-built EV buses that do not differ in terms of passenger capacity and amenities from a standard transit bus except that Proterra's buses consume zero diesel fuel, require no overhead wires and are dramatically more efficient than fossil-fueled buses.

Proterra has delivered almost than 90 vehicles to transit agencies across the country which have logged over 2.75 million service miles. In total, 35 customers are operating and/or have orders for a total of 312 vehicles.

In 2016, Proterra launched its 2nd generation bus - the Catalyst platform - with King County Metro receiving the first three in the country. These buses went into service February 2016 on routes 226 and 241 in Bellevue with each bus operating 100-180 miles per day. To date, the battery-electric fleet has driven over 70,000 miles and saved over 11,000 diesel gallons as shown in KCM's online data portal.[1] KCM was awarded federal funding for an additional 8 buses and charging infrastructure to fully electrify routes 226 and 241. It recently received $15 million in budget authority to operate two additional bus routes as battery-electric.[2] Metro is also undertaking a study to determine options and costs for future expansion.

In addition, Kitsap Transit, Everett Transit and Pierce Transit have funding for initial Catalyst fleets. Other agencies in Washington are exploring potential for battery-electric bus transit including Whatcom County and Spokane Transit.

Increasingly, we are seeing agencies transitioning from demonstration/test fleets to planning for complete conversion to battery-electric. For example, Foothill Transit in Southern California has committed to transitioning its entire 300 bus fleet to 100 percent battery-electric by 2030.[3] With policy support, we would expect transit agencies in Washington to start down the same zero emission path.

Recommendations Summary

Proterra believes the Commission should consider:

1) Recognizing that the multiple legislative policies and statements of legislative intent enacted to reduce petroleum use in transportation for clean air, clean water, greenhouse gas reduction and economic benefits provide sufficient authority for taking broad action to increase utility support of transportation electrification both for light duty and heavy duty vehicles.
2) Adopting Environmentally Beneficial Electrification (EBE) as a distinct regulatory framework from the existing conservation framework to address transportation electrification policy and rule-making. EBE increases electricity use in order to reduce overall emissions.
3) Using quantifiable health, environmental, low income community and economic benefits to evaluate EBE proposals.
4) Amending WAC 480-100-223 (1) to allow utility expenditures for "promotional advertising" targeted at increasing Environmentally Beneficial Electrification.
5) Determining that heavy duty bus transit electrification is EBE because of the benefits flowing to low-income transit dependent communities and reducing the disproportionate health impacts of diesel emissions on those communities.

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[1] King County Metro provides up-to-date online data for the battery-electric fleet via http://metro.kingcounty.gov/am/innovations/examples/battery-buses.html click on "Performance benefits in action."

[2] King County 2017-18 Budget Ordinance p87 http://www.kingcounty.gov/~/media/Council/documents/Budget/2017-18/2016-0475StrikingAmendmentdatedNov9.ashx?la=en

[3] "Foothill Transit Announces All Electric Bus Fleet by 2030." May 24, 2016. http://foothilltransit.org/foothill-transit-announces-all-electric-bus-fleet-by-2030/

6) Enabling different business models and ownership structures in addition to utility ownership of EVSE including leases, service agreements and on-bill financing of EVSE and batteries.
7) Inviting utilities to work with customers operating heavy duty vehicle fleets to develop and submit specific tariffs for heavy duty vehicle electrification including:
   a) Reducing demand charges and/or waiving demand charges for first three years of fleet operation.
   b) Increasing Line Extension allowances to reduce the upfront costs of utility infrastructure related to establishing charging for heavy duty EV fleets.

EV Transit Bus Background

Batteries, Range and Charging Strategies

Buses unlike light duty vehicles typically run on a set route with known energy requirements. Battery types, size and charging strategies can vary based on the requirements of the route.

Lithium-based batteries include a family of chemistries that have different performance characteristics relative to energy density and charging power and other factors. For example, Lithium Titanate Oxide (LTO) batteries have lower energy density but can take a very high power charge allowing for complete recharge in minutes. Other Li-ion chemistries have higher energy density but charge at lower power levels.

Proterra's Catalyst platform uses underfloor placement of the energy storage system and changeable battery packs that allow for configuring and reconfiguring a bus with different cell chemistries and sizing of on-board energy storage appropriate to agency needs.

Recently, Proterra unveiled the Catalyst E2 series with its unprecedented storage capacity of 440 – 660 kWh and nominal range of 194 – 350 miles.[4] An E2 series vehicle achieved a new milestone at Michelin's Laurens Proving Grounds where it logged more than 600 miles on a single charge under test conditions. The Catalyst E2 series is capable of serving the full daily mileage needs of nearly every U.S. mass transit route on a single charge and offers the transit industry the first direct replacement for fossil-fueled transit vehicles.

A battery is considered at the end of its life for a transit application when its capacity is 80% of original. Depending on how the battery is used, this can occur in six years. At 80% of original capacity, the battery has significant energy storage capabilities and can be used in 2nd life applications such as grid storage.

Transit EV applications can use overhead charge stations which in the case of Proterra's system operate up to 500 kW and/or plug-in depot chargers operating at 60-120kW. For example, King County Metro's current Proterra battery-electric fleet uses Fast Charge batteries to run an 18-mile loop from Eastgate Park & Ride through Bellevue and back and recharges with an overhead charge station for 10 minutes or less during layover. Peak demand is 400 kW. Other agencies run Proterra Fast Charge buses on short downtown circulators and recharge in ~4 minutes.

[4] Nominal range = total energy/ projected Altoona efficiency. Actual range will vary with route conditions, battery configuration and driver behavior.

An E2 bus could also use an overhead charge station throughout the day to recover charge though at a lower power level than a Fast Charge bus or just charge overnight at the base using a standard plug-in charger with an SAE CCS Combo connector.

Energy to be recovered through charging and therefore charge time is dependent on vehicle efficiency which will vary by length and speed of route, amount of regenerative braking and elevation gain, HVAC loads, passenger loads, and driver technique. We are projecting the E2 bus will have an efficiency of 1.75 kWh/mile with a full passenger load. Therefore, an E2 running a 175 miles in a day will need to recover at least 300 kWh. Using a 60 kW plug-in charger that would take ~5 hours overnight to recover the energy consumed.

EV transit buses are more cost-effective than fossil-fueled buses

The lower operating costs of an EV bus both for fuel and more significantly the lower maintenance costs of electric drive enable Proterra's customers to realize an estimated $400k - $460k in 12-year operational savings vs. diesel, diesel-hybrid and CNG powered transit buses.[5] Today, the operational savings more than offset current higher upfront costs of an EV bus to provide a lower Total Cost of Ownership (TCO) than fossil-fueled vehicles.[6] And we expect the TCO difference with fossil-fueled buses to increase as battery costs continue to decline.

Diesel Emissions and Benefits of Heavy Duty Vehicle & Bus Transit Electrification

Proterra believes that eliminating diesel emissions via heavy duty vehicle electrification has significant health benefits. Diesel emissions include ozone, lead, particulate matter, carbon monoxide, sulfur oxides, and nitrogen oxides that are regulated as criteria air pollutants. These pollutants can harm both human health and the environment.

Reduction of diesel emissions is a top priority of the Puget Sound Clean Air Agency and it has identified that diesel exhaust represents 78 percent of the potential cancer risk from all air toxics in the Puget Sound area. It finds that on-road vehicles generate 34 percent of the region's diesel exhaust.[7]

The California EPA found that:

> Residents of neighborhoods near freeways and other major roadways are exposed to a disproportionate share of emissions impacts from vehicle traffic. Traffic-related air pollution can represent a significant source of exposure to air pollution in disadvantaged urban communities.[8]

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[5] Based on: 36,000 annual miles; 12-year lifetime; DOT Transit Bus Lifecycle Analysis: 3.86 MPG Diesel, 3.27 MPG CNG, 5 MPG Diesel-Hybrid; US EIA Projections - Annual Energy Outlook 2015, 12-year Average Forecast: $3.5/DGE Diesel, $2.2/ GGE CNG (Does not include compression charges), $0.11/ kWh; Maintenance based on Proterra Customer Data: $0.90/mile Diesel, $1.00/mile CNG, $1.1/mile Diesel-Hybrid, $0.55/mile Proterra.

[6] 40' transit bus costs: Proterra EV, $749k; CNG, $470k; Diesel, $454k; and Diesel-Hybrid, $650k.

[7] http://www.pscleanair.org/airquality/airqualitybasics/health/Pages/default.aspx

[8] California Environmental Protection Agency. 2016. Environmental Justice Program Update 2013– 2015. Sacramento, CA. http://www.calepa.ca.gov/EnvJustice/Documents/2016/EJReport.pdf

A recent study by the Union of Concerned Scientists and The Greenling Institute found that that life cycle emissions of battery electric buses are nearly 75 percent lower for GHGs than both CNG and diesel buses, lower for NOx emissions than diesel and CNG buses including CNG buses with soon to be released engines certified to meet California's voluntary low-NOx standards and lower for particulate matter emissions than diesel buses.[9]

In addition, electrification of bus transit spreads the direct benefits of transportation electrification from higher income single family homeowners that own the majority of light duty EVs to lower income communities, commuters and those that may not own a vehicle.

Recommendations Discussion

State Policy Supports Transportation Electrification

The Legislature has adopted policies and statements of legislative intent over the years to reduce petroleum use in transportation for clean air, clean water, greenhouse gas reduction and economic benefits. We believe these actions provide sufficient authority for taking broad action to increase utility support of transportation electrification both for light duty and heavy duty vehicles. Examples of such legislative policy actions include:

RCW 70.94.011 Declaration of public policies and purpose. It is declared to be the public policy to preserve, protect, and enhance the air quality for current and future generations. Air is an essential resource that must be protected from harmful levels of pollution. Improving air quality is a matter of statewide concern and is in the public interest...

RCW 70.94.011 Finding—1991 c 199: "The legislature finds that ambient air pollution is the most serious environmental threat in Washington state. Air pollution causes significant harm to human health; damages the environment, including trees, crops, and animals; causes deterioration of equipment and materials; contributes to water pollution; and degrades the quality of life…"

[9] UCS and Greenling Institute. 2016. Delivering Opportunity: How Electric Buses and Trucks Can Create Jobs and Improve Public Health in California. http://www.ucsusa.org/sites/default/files/attach/2016/10/UCS-Electric-Buses-Report.pdf

RCW 70.120A.010 Findings—2005 c 295: "The legislature finds that:

(1) Motor vehicles are the largest source of air pollution in the state of Washington, and motor vehicles contribute approximately fifty-seven percent of criteria air pollutant emissions, eighty percent of air toxics emissions, and fifty-five percent of greenhouse gas emissions;

(2) Air pollution levels routinely measured in the state of Washington continue to harm public health, the environment, and the economy. Air pollution causes or contributes to premature death, cancer, asthma, and heart and lung disease. Over half of the state's population suffers from one or more medical conditions that make them very vulnerable to air pollution. Air pollution increases pain and suffering for vulnerable individuals. Air pollution imposes several hundred million dollars annually in added health care costs for air pollution-associated death and illness, reducing the quality of life and economic security of the citizens of Washington;

(3) Reductions of greenhouse gas emissions from transportation sources are necessary, and it is equitable to seek such reductions because reductions in greenhouse gas emissions have already been initiated in other sectors such as power generation…"

RCW 70.235.005 3) It is the intent of the legislature that the state will: (a) Limit and reduce emissions of greenhouse gas consistent with the emission reductions established in RCW 70.235.020; (b) minimize the potential to export pollution, jobs, and economic opportunities; and (c) reduce emissions at the lowest cost to Washington's economy, consumers, and businesses.

RCW 47.80.090 Finding—Purpose—2009 c 459: "The legislature finds the development of electric vehicle infrastructure to be a critical step in creating jobs, fostering economic growth, reducing greenhouse gas emissions, reducing our reliance on foreign fuels, and reducing the pollution of Puget Sound attributable to the operation of petroleum-based vehicles on streets and highways…"

RCW 80.28.360 Findings—Intent—2015 c 220: "(1) The legislature finds that the transportation sector is Washington's largest contributor to greenhouse emissions and hazardous air pollutants as defined by federal national ambient air quality standards and mobile source air toxics rules…"

Environmentally Beneficial Electrification

It is inappropriate to classify transportation electrification as conservation as it is defined in Washington statute and administrative code. For example, RCW 19.285.030 (6) and WAC 480-109-007 (3) provide the following definition:

> "Conservation" means any reduction in electric power consumption resulting from increases in the efficiency of energy use, production, or distribution.

It would be difficult to call a UTC policy or rule that lead to the support of a fleet of 250 EV transit buses consuming 1.6 million kWh AC monthly as a reduction in electric power consumption. However, this same fleet will reduce petroleum consumption by over 100,000 diesel gallons per month and lower transportation-related air emissions.

The electrification of energy end uses that have been powered by fossil fuels is known as "environmentally beneficial electrification."[10] We encourage the Commission to examine the literature on EBE as it develops a regulatory framework for transportation electrification.

In a recent paper in the Electricity Journal titled "Environmentally beneficial electrification: The dawn of 'emissions efficiency'", the authors expand upon the concept of EBE and state:

> Achieving the greenhouse gas emissions reductions possible through environmentally beneficial electrification will require routinely revisiting and updating prevailing energy efficiency metrics and accounting methodologies in order to maximize gains. Specifically, it is timely to consider whether reduced electricity consumption (i.e., kWh) is the optimal compass with which to navigate the path to a low-carbon future when, in fact, substitution of electricity for fossil fuels may in some cases *increase* electricity consumption.[11]

The authors find that a consensus is growing that meeting aggressive GHG reduction goals will require electrification of end uses including in transportation:

> A recent report by Environmental and Energy Economics (E3) states that "critical to the success of long-term GHG goals" is "fuel-switching away from fossil fuels in buildings and vehicles."[12] Lawrence Berkeley National Laboratory similarly concludes that "widespread electrification of passenger vehicles, building heating, and industry heating" is essential for meeting California's GHG reduction goals.[13] Work at Stanford University also indicates that "one potential way to combat ongoing climate change, eliminate air pollution mortality, create jobs and stabilize energy prices involves converting the world's entire energy infrastructure to run on clean, renewable energy."[14]

The importance of developing a new framework to encourage utilities to support EBE opportunities is exemplified by among other rules WAC 480-100-223 which prohibits rate-basing expenses for promotional advertising that increase electricity use. This rule runs counter to a framework that regulates not just for conservation but increasing electricity use for EBE. A change to WAC 480-100-223 may be partially symbolic but would be part of signaling to IOUs that pursuing transportation electrification is an important objective of the Commission.

During the September 13, 2016 Docket UE-160799 Workshop, Eric Cutter with E3 presented on Transportation Electrification Cost-benefit Analysis. We thought the presentation provided the Commission a good overview of the considerations for establishing a regulatory framework for EBE. However, we note that the presentation was focused exclusively on light duty vehicle electrification.

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[10] Dennis, K. 2015. "Environmentally Beneficial Electrification: Electricity as the End-Use Option." The Electricity Journal 28(9): 100–112

[11] Dennis K., Colburn K., Lazar J. 2016. "Environmentally beneficial electrification: The dawn of 'emissions efficiency'." The Electricity Journal 29(6): 52–58

[12] Borgeson, Sam. Haley, Ben. Hart, Elaine. Mahone, Amber. Price, Snuller. Ryan, Nancy. Williams, Jim. 2015. "California PATHWAYS: GHG Scenario Results." *Energy + Environmental Economics*.

[13] LBNL. 2013. California's Carbon Challenge Phase II Volume I: Non- Electricity Sectors and Overall Scenario.

[14] Jacobson, Mark Z. 2015. "Stanford Engineers develop state-by-state plan to convert U.S. to 100% clean, renewable energy by 2050". *Stanford News*.

We believe that the Commission, as it develops transportation electrification policy, must broaden its focus to include heavy duty vehicle electrification because of the health and environmental benefits in reducing diesel emissions and benefits to low income communities. In addition, we encourage the Commission to consider the increased emissions benefits of transit electrification due to higher passenger miles over single occupancy EVs and emissions displacement from avoided auto trips and congestion relief per the methodology established by the American Public Transportation Association.[15]

Evolving Business Models for EV Transit Bus

Policy efforts that help lower capital expenditures of transit agencies for EV buses, charging infrastructure and utility infrastructure serve to bring upfront costs close to parity with fossil-fueled buses and will have significant impact on adoption.

We are seeing several different business models develop that are aimed at reducing upfront capital costs of heavy duty vehicle electrification which utilities can play a role if enabled by their regulators.

Battery financing. An important business model that Proterra has developed is to lease the EV bus energy storage system instead of having the agency paying for it out of its capital budget. Lease costs are paid for out of fuel and maintenance savings. A utility can be the lease financier. A utility can also guarantee a residual value for the battery at end of life that enables the lease financier to use a known residual value for its pro forma and provide a lower cost lease.

On bill financing. In this model, the transit agency buys a battery-electric bus at the price of a diesel bus while the utility pays for the upfront premium of the battery and charging station, provided that agency agrees to let the utility recover its costs over the warrantied life of the bus.

To recover its costs, the utility puts a fixed charge on the agency's electric bill that is less than the estimated energy savings from moving to battery-electric.

The agency has no loan, no lien, and no debt associated with this transaction.

When the utility recovers its costs, the agency's obligation to pay ends and the entire asset belongs to the agency.

Bus battery owned by the utility. A utility could own the bus battery outright with no payments required by the transit agency and at end of transit battery life take the battery for a 2nd life grid storage application. By making it possible for an agency to go EV instead of diesel, the utility is able to evidence significant EBE benefits and increases in retail rate revenue to justify the expenditure.

[15] APTA. 2009. "Recommended Practice for Quantifying Greenhouse Gas Emissions from Transit." http://www.apta.com/resources/hottopics/sustainability/Documents/Quantifying-Greenhouse-Gas-Emissions-APTA-Recommended-Practices.pdf

Reducing transit agency's utility infrastructure costs

The Commission should consider special line extension allowance rates for utility infrastructure required to serve heavy duty EV charging loads.

Upgrading utility transformers and feeders to serve bus charging can be a significant capital cost for the agency. For example, one Proterra overhead charge system will require a 500 kVa transformer. A fleet of 6 Fast Charge buses using one overhead charging station that has a similar usage pattern as King County Metro's Catalysts (~6,500 kWh AC consumed per month per bus) would be expected to consume around 500,000 kWh AC annually. Under PSE Schedule 85, this would qualify the agency for approximately a $50,000 allowance that may not cover the complete cost of the utility infrastructure upgrade.

For a fleet of 250 EV buses using overnight charging at a base, the load could be 7,500 to 15,000 kW depending on the use of smart charging and would require a significant level of utility infrastructure investment.

Commission policy and how it relates to utility infrastructure-related capital expenditures to deploy EV buses will have significant effect on the ability of an agency to scale.

Demand charges

Demand charges in Washington are typically far lower than in other states like California. For an overhead high power charge station, demand charges can be as high as $1,800 per month on PSE Schedule 25. Demand charges represent a fixed cost that will be lower on a per bus basis as a fleet scales.

In California, the CPUC has allowed special EV charging tariffs. In Washington, we believe that the Commission should invite transit agencies to work with their utilities to examine their expected usage patterns and whether it would make sense to seek special heavy duty EV charging tariffs to facilitate bus electrification. There are a couple of scenarios that may make lower demand charges important including initial small scale battery-electric fleet deployment where demand charges are a significant cost per bus, where there could be coincidental fast charging caused by having two or more overhead fast charge stations operating at one site producing peak loads of 800 - 1200 kW, and large scale deployment of overnight EV bus charging.

Conclusion

Thank you for the opportunity to provide comments on UE-160799. We appreciate that the Commission extended the opportunity for comments under CR-101 Inquiry. Proterra appreciates the efforts of the Legislature and Commission to move our transportation system off of petroleum and onto clean electricity. We look forward to further engagement as the Commission proceeds with this rule making. Please do not hesitate to contact us for additional information or clarifications of our comments.

Sincerely,

Rich Feldman
Proterra Inc.
Northwest Business Development Manager

cc: Eric McCarthy, VP of Government Relations and General Counsel, Proterra Inc.
Kent Leacock, Director, West Coast Government Relations, Proterra Inc.