British Columbia Utilities Commission Inquiry into the Regulation of Electric Vehicle Charging Service – Addendum No. 1

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1.1. Introduction

As the Commission has agreed to extend the deadline and allow for additional submissions, I would like to provide additional information for the Commission's consideration.

In my original submission, I alluded to a shift in technology that could lead to stranded assets for ratepayers of a public utility. I would like to take this opportunity to elaborate on this subject.

1.2. Battery Technology

Battery technology will continue to evolve to increase the energy density of the EV battery packs. This will lead to increase EV range and reduced charging times. Since my thesis in the 60's, we have seen the transition from lead-acid (1859) and ni-cad batteries to the nickel-metal-hydride (2x capacity) and the current EV Li-ion batteries. While Li-ion batteries have been pushed to higher energy densities, there are already new technologies on the horizon. Currently, the solid-state battery[1] could become a challenger in the near future. These new solid-state batteries[2] ($Li\text{-}O_2$) may permit even faster charging rates, lower losses, increased range and reduce the risk of over charging. These features would be an improvement over the current Li-ion batteries of today.

Henrik Fisker, a former chief designer for Aston Martin, claims that he will soon revolutionize the world of electric cars with a new, superior solid-state battery the details remain undisclosed. However, it is known that it will be able to hold 2.5-times the energy of a traditional

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[1] https://www.greencarreports.com/news/1111717_2022-toyota-electric-car-to-use-solid-state-batteries-for-faster-fast-charging-report

[2] http://moneyinc.com/overcoming-the-major-shortcomings-of-lithium-air-batteries/

lithium-ion battery and it will charge at a much faster rate. Fisker even suggests that this battery could be charged in as little as one minute[3].

Further, solid-state batteries remained stable and operated reliably across a temperature range of -30 to 100 °C and exhibited high energy and power densities with negligible internal resistance; being solid state, the thermal runaway characteristics appear to be better than the Li-ion batteries[4].

1.3. High-Capacity Charging

Porsche's first all-electric vehicle, the Mission E, is coming relatively soon and aside from the vehicle itself, it will come with the deployment of the German automaker's new ultra-fast 800-volt charging technology. This ultra-fast EV charger is capable of supporting a 350 kW charging rate, which could charge up the Mission E's battery pack to 80% in about 15 minutes. They also said that they were working for the ultra fast-charging infrastructure to also work with Tesla and other EVs. This is twice as fast as other chargers on the market.

BMW and Porsche are already working together and with other major automakers, like Mercedes and Ford, on the major "Ionity" ultra-fast (350 kW) electric car charging network in Europe. But now they want to lay a path to improve that charge rate to 450 kW in order to enable quicker electric car charging.[5]

Ionity[6] has partnered with Shell, Tank & Rast[7], Circle K and OMV to incorporate EV stations in Europe with existing petrol stations.[8]

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[3] https://futurism.com/battery-charges-one-minute-beat-tesla-race-tomorrows-clean-car/

[4] https://www.automotive-iq.com/electrics-electronics/articles/solid-state-batteries-answer-li-ion-batteries-shortcomings

[5] https://electrek.co/2017/12/05/bmw-porsche-electric-car-charging-450-kw-charge-rate/

[6] http://www.ionity.eu/ionity-en.html#whoweare

1.4. Inductive Charging (Wireless)

Similar to the stove top induction heating elements, EV charging systems are moving towards the inductive charging of EV batteries.[9] The inductive coupling uses air-core transformer principles and magnetic resonance to transfer energy. In the future there may be ways found to improve the reluctance path to increase the transfer of energy. The following highlights the current trends. This type of charging may make Level 1 and Level 2 charging systems obsolete because the EV owner does not have to plug in the EV. If these chargers evolve to higher capacities, Level 3 chargers may be at risk.

1.4.1. Wireless Electric Vehicle Charging (WEVC) Technology

This technology uses resonant magnetic induction to transfer energy wirelessly, from a ground-based pad to a pad integrated in the stationary EV.

1.4.2. Magneto Dynamic Coupling (MDC) Technology

ELIX Wireless has developed Magneto Dynamic Coupling (MDC) technology and has been deploying wireless chargers for automobiles. They are in trials with EV companies in China and USA. Their solution produces no heat, no EMI, safe to use, has the ability to work in the rain, can push aside debris. They have built and deployed 7.7KW chargers, these are undergoing trials, the company is also making 3.3KW and 22KW chargers which will be beta tested in 2018.[10]

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[7] https://tank.rast.de/en/company.html

[8] https://electrek.co/2017/11/27/ionity-ultra-fast-electric-car-charging-network-partners-with-petrol-stations-chargers/

[9] https://tec.ieee.org/newsletter/february-2014/wirelessly-charge-electric-vehicles-by-induction-while-driving

[10] https://www.elixwireless.com/news/elix-wireless-ev-charging-using-their-magneto-dynamic-coupling-mdc-technology

1.5. Moving Wireless Electric Vehicle Charging

Stanford University have made a significant step towards getting round this problem – by successfully transferring electricity wirelessly to a moving object. This may be the ultimate solution to the range anxiety issue. The transfer of electricity in this way is based on magnetic resonance coupling, where electricity moving through wires creates an oscillating magnetic field which causes electrons in nearby coils of wire to oscillate. The result is a wireless transference of power. While this EV charging method is in its infancy, it may well present a potential range solution and may be adaptable to the wireless stationary EV charging systems that are becoming available to the market place in the near future[11],[12]. This type of charging may occur in the future and reduce the need for Level 3 charging stations.

1.6. Recommendations

As the battery technology changes; the method of EV charging will change. We have almost abandoned the Level 1 charging technology as being too slow. Level 2 may experience the same decline. Levels 3 & 4 offer fast charging. However, induction charging is promising as it does not involve much effort on the part of the EV owner (i.e. does not need to be plugged in). As the charging rate of induction charging increases, it may even displace Level 3 (DCFC) chargers. As there is still volatility in this market, it would be prudent for a public utility to stay with its core business and use a non-regulated business model to compete in this market to avoid unnecessary risks being transferred to its ratepayers. The newer solid-state batteries, although not available yet, have even faster charging times and will most likely displace the Level 3 & 4 DCFC chargers.

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[11] https://cleantechnica.com/2017/09/04/wireless-electric-vehicle-charging-breakthrough-achieved/

[12] http://theconversation.com/wired-up-roads-will-soon-charge-your-electric-car-while-youre-driving-72625

Even if the provincial government decides the provision of DCFC charging stations are desirable, private enterprise should provide them. Regardless, the Commission must safeguard the public utility's ratepayers against cross-subsidization and stranded assists.

For these reasons and the reasons in the previous submission, the public utility should not engage in this market. However, the non-regulated business arm of the public utility may engage in the EV charging station market.

1.7. References

1.7.1. Porsche's new ultra-fast EV charging technology - https://electrek.co/2017/09/19/porsche-ultra-fast-charging-stations-electric-cars-us/

1.7.2. The future of electric vehicle charging is wireless - https://www.qualcomm.com/solutions/automotive/wevc

1.7.3. Wireless Electric Vehicle Charging Breakthrough Achieved - https://cleantechnica.com/2017/09/04/wireless-electric-vehicle-charging-breakthrough-achieved/

1.7.4. ELIX Wireless EV charging - https://www.elixwireless.com/news/elix-wireless-ev-charging-using-their-magneto-dynamic-coupling-mdc-technology

1.7.5. Wired Roads - http://theconversation.com/wired-up-roads-will-soon-charge-your-electric-car-while-youre-driving-72625

1.7.6. Why electric charging infrastructure will prove crucial to the future of driving - https://www.cnbc.com/2018/03/02/why-electric-charging-infrastructure-will-prove-crucial-to-the-future-of-driving.html

1.7.7. Costs of electric vehicles, BC Hydro, https://www.bchydro.com/powersmart/electric-vehicles/owning-an-electric-vehicle/costs.html