Concluding Remarks

The electric car market has been growing exponentially in the past few years. But it is still a small percentage of the new car market in most places, typically representing less than 1% of new car sales. Currently, in Ontario the EV market share is 0.8 per cent (Canadian EV Sales, 2017).

The results of a series of EV surveys (which conducted with over 2,000 participants from the U.S., Canada, the U.K., and Australia) shows that one of the key benefits cited by EV owners was the convenience of home charging for their vehicle, and the avoidance of going to a gas station and having to refill their tank at those locations. However, EV drivers also indicated that having more abundant EV charging would be the number one way to promote EV adoption. Non-EV owners cited more abundant charging infrastructure as the second-best solution to increase EV adoption, behind better financial incentives (Shahan, 2015).

When potential EV owners were asked about factors that would increase their likelihood of purchasing an EV, 65 per cent stated that they would be significantly more attracted to a fully electric model if they had access to a fast-charging network of Level 3 charging stations (ibid.). However, it is important to note that the costs of Level 3 systems installations is around $50,000 USD, but with the inclusion of costs for project development, design, permitting, and electric system upgrades, the total costs for deployment could reach up to $300,000 USD each. The high costs limit the business argument for Level 3 or DCFC chargers, with the ability to afford such a charger being dependent upon rate design, ownership, and utilization rates. It may therefore be more beneficial for a jurisdiction to offer rebates on the installation of home or workplace Level 2 charging stations to best serve the charging patterns of EV owners (Fitzgerald & Nelder, 2017).

In addition, 26 per cent of EV owners frequently find that current charging infrastructure presents a limitation on where they may want to go with their EV, while another 29 per cent state that it is sometimes a limitation. A total of 36 per cent of EV owners indicate that charging infrastructure only becomes an issue on long trips, while only 9 per cent of EV owners indicate that EV charging infrastructure availability is never a problem or limitation on travel. It is important to note that of all respondents, approximately 30 per cent owned a Plug-In Hybrid Electric Vehicle (PHEV) or Extended Range Electric Vehicle (EREV) and 28 per cent owned a Tesla; therefore, even owners of high-capacity long-range electric vehicle models experience some limitations in available charging infrastructure (Shahan, 2015). The availability of EVSEs and improvements to current charging infrastructure constitute an important solution in addressing consumer limitations regarding EV adoption and in supporting demand growth within the EV market.

The final section of this report provides several normative recommendations that may help the County optimally locate and deploy EVSEs based on the guiding principle that increasing EV ownership and best supporting current EV owners in the community today will help to achieve Oxford’s long-term sustainability plans.

General recommendations

Charging Systems dedicated to condominium and high-rise buildings

Over 90 per cent of EV charging occurs at home for EV owners with home garages. For owners living in dwellings with parking garages or on-street parking, where the installation of a charging station is out of their control, EV adoption may be less likely without an expanded public charging network. The good news for these individuals is that the EV charging station market is growing exponentially, with carmakers, governments and commercial charging firms all investing in the installation of new EVSEs. Tesla is planning to expand its global network of 145 kW “supercharger” stations to 10,000. Nissan now has a global network of 4,000 fast chargers. In 2016, Daimler, BMW, Volkswagen and Ford also stated their intention of collectively installing 400 public charging-point in Europe delivering 350 kW (The Economist, 2017).

Therefore, for further EVSE expansion, it might be better to focus any data collection, targeted at accommodating personal vehicle use for Oxford County residents, on densely populated urban areas with condominiums and apartments. Residents within these buildings looking to purchase a personal EV are often dependent on the landlord to install EV chargers in the underground parking lot. If insufficient condominium or apartment building charging is available, then providing charging stations at workplaces could help building residents receive adequate access to charging infrastructures. The data collection may include gathering information about the location of high-rise condominiums, and whether there are any EV owners living in those buildings.

Workplace charging systems

Another opportunity to encourage EV adoption is the workplace charging stations. The U.S. Department of Energy PEV studies found that around 30 per cent of drivers almost exclusively charged up at work, showing that workplace charging availability could make EVs viable for people without access to home charging stations (Francfor *et al.*, 2015). Chargepoint - a California-based company that runs many charging stations worldwide - encourages businesses to offer employees free [or discount rate] charging in the office car lot (ibid.).

Innovative solutions

Innovative business models and technology should also increase the availability of charging options for EV owners. For example, an app called Chargie (similar to PlugShare in Canada and U.S.) was recently launched in Britain that allows owners of home chargers to rent them to the public, similar to an Airbnb rental. Technological innovations such as wireless inductive charging from road to car is already a technically feasible, albeit expensive, but boasts strong merit for vehicles that sit idle such as taxis (ibid.).

Ownership models

There is no set EVSE ownership or billing structure as of yet, and EV owners have complained about crossing over from one network to another and needing to carry a variety of cards or accounts to charge their vehicles in different jurisdictions. When determining EVSE ownership roles, it is beneficial to assess EVSE ownerships in nearby areas or along highway routes to determine what would be most convenient for EV owners and encourage the highest usage (Fitzgerald & Nelder, 2017).

According to a report published by the Rocky Mountain Institute (RMI), there is no ideal ownership model for EVSE and jurisdictions should test various models through pilot projects to determine what works best in a given region (ibid.). Examples of different ownership models

include ownership by the state authority as a form of public utility, municipalities, charging network operators and businesses.

Most legislative and regulatory bodies are in agreement that utilities should be permitted to build and own make-ready locations (i.e., power supplied to the point where a charging station might be installed), and to recover the investments through the rate base as a general social good. Allowing utilities to create make-ready locations would align with the long-established principle of line extension, where all customers pay for extending the distribution grid, including new service for rural customers where the cost of providing that service is far greater than that for customers living in densely populated urban environments (ibid.).

Following this reasoning, the extension of the grid to support EVSEs is not justified through a cost-benefit analysis when burdened only by a specific group of customers. The value of the entire network is considered to be shared by all customers and the environmental benefits of EV will reach all customers. This reasoning allowed telephone companies to build out the pay phone network; each new phone wasn't necessarily expected to make a profit, but installation was considered necessary to create a functional and accessible network (ibid.).

Utilities owning and installing charging stations could be the fastest way to deploy EVSEs since utilities have access to large amounts of low-cost capital and an ability to recover investments over decades. Utility ownership may also serve to regulate electricity markets and avoid overpricing by private sector companies (ibid.).

However, regulators should also be cautioned against creating a situation where a utility could leverage its low internal cost of power generation and delivery to undercut private sector competitors on retail charging prices. Full utility ownership could prevent a competitive private sector market in charging stations, and utilities may not be as innovative in terms of technology or business model design as the private sector would likely be. If regulators choose utility ownership as the primary model, they should ascertain some opportunity for private sector companies or ensure that once the EVSE market matures in an area, it is possible for private companies to re-enter the market (ibid.).

EVSEs ownership models exclusively for private sector companies would likely yield the installation of chargers since private businesses are less likely to have large amounts of patient capital and may wait for guaranteed demand of charging station and market maturation prior to installation. The California Public Utilities Commission (CPUC) exemplified this pattern. The CPUC initially thought that competitive benefits from a private market would outweigh the benefits of utility ownership and therefore deployed an exclusive private market model. However, the rate of EVSE installation was found to be too slow to meet the state's objectives, and an alternative model with mixed utility ownership is now being tried (ibid.).

Tariff models

It is important for utilities to offer appropriate tariffs for EV charging early on before EV penetration is large. Once EV drivers acquire their charging habits it can be hard to break them. It is important that the tariffs are developed appropriately to guide charging towards the valley of system load profiles and away from the peaks. Field experiences studied indicate that optimal tariffs for EV charging use a time-of-use (TOU) design. Tariffs should also be lower for Level 1 and Level 2 charging than for Level 3 systems, because the cost of providing service to Level 1 and 2 chargers is lower and they are easier to manage and deliver grid services (Fitzgerald & Nelder, 2017).

To encourage off-peak charging, a business may find that a commercial tariff with a flat rate for electricity is best for its general, nondiscretionary loads, but that Level 2 charging stations installed for customers and employees should have a TOU tariff that features a large differential

between on- and off-peak rates. For this occur, many utilities require that a charging station be connected through a dedicated meter, separated from other loads at the site, although this does incur an additional cost to the business (ibid.).