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Deploying electric vehicle charging infrastructure in BC

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Issue

Emissions from the transportation sector account for 37% of British Columbia's greenhouse gas (GHG) inventory[1]. This significant contribution makes it important that efficient transportation is part of the mechanism to achieve GHG reduction targets. Many major auto manufacturers are positioned to enter the plug-in electric vehicle (PEV) market strongly in late 2011 or early 2012[2], and those already in the market are expected to increase product lines. To support this move there is a need to deploy simultaneously an integrated charging infrastructure network, or electric vehicle service equipment (EVSE) - colloquially called 'charge stations'. The installation of EVSEs faces significant barriers associated with public uncertainty, unclear standards and no clear financial incentive for installation. Clearly communicated policy and standards integration are needed now, along with financial mechanisms that will help defray unit and installation costs.

Background

A range of different charging 'levels' exist for EVSEs. Each requires different electrical supply, different charge times, levels of service (Table 1) and so on. There is, currently, a wide range of manufacturers offering units at all levels.

Table 1: Summary of Charge Station Approaches

Charge Level	Level I	Level II	Level II DC Fast Chargers (also called Level III)
Voltage	120V	208-240V	400-500V
Complete Vehicle Charge Time	12-14 hours	6-8 hours	20-30mins
Applicability	-Residential	-Day-stay public -Fleets -Residential	High demand public space
Electrical Integration Difficulty	Minimal	Location dependant	High
Part of Charge Station 'Network'	No	Yes	Yes
Unit Cost	\$1000-\$2000	\$3000-\$7000	\$40,000-\$100,000

Leading from the front

Some jurisdictions are setting the pace. In Germany, Berlin is deploying hundreds of charging stations in three major projects[3,4,5]. Similar efforts are being made in other European countries including France[6] , and also Japan[7]. The very large *EV Project* from the US Department of Energy at \$400M is bringing together integrated government funding structures, vehicles and EVSEs, with a geographic reach that spans the continental US. London Transport in the United Kingdom has recently launched an extensive procurement framework[8] to maximise its purchasing power and provide an integrated framework for the purchase of EVSEs, with the ability for private entities to also access the framework.

The City of Vancouver has taken substantive action to facilitate access to appropriate electrical supply for residential EVSE applications through its newly amended building bylaws. The bylaw requires all new multi-family residences to have 20% of parking stalls EVSE ready and electrical space for the remaining 80%[9], although the lack of easy access to electric circuits for on-street and underground parking is still to be effectively tackled by any public or private entity.

The most salient questions for EVSE deployments are: who is to decide what facilities are to be deployed, how and when they will be rolled out, and how they should be incentivised, if at all[10]?

Technical Risks

Installing an individual or a small network of low-level EVSEs poses minor technical risks since electrical grid impacts are minimal. However fast-charge (Level III) installations possess a markedly greater risk due to their higher initial cost and more difficult grid integration. These risks are centred around ensuring the local distribution grid has enough capacity to provide, without equipment failure, a significantly higher voltage than currently supplied to most potential sites. Upgrading is almost always necessary and requires observance of enhanced safety measures. Current electrical standards are not comprehensive, although standards from the Canadian Standards Association and Underwriters Laboratory Canada are being applied[11] in lieu of specific EVSE codes. There is, however, uncertainty as to what legacy provision will feature in future & harmonized standards, with similar concerns over the associated network communications protocols, since common standards (including those of the nascent 'smart-grid') are still emerging.

Pricing Uncertainty
Widespread hosting of public EVSEs is impeded by the difficulty faced by the host in pricing the use of the station. Under many jurisdictions (including BC) the host does not easily have the legal ability to charge for the electricity consumed by the customer. Where that provision is made, the host often cannot charge more than the customer would have had to pay the utility directly[12,13]. The host can circumvent resale problems by charging for the use of the EVSE, rather than the electricity it dispenses. There are also some examples of EVSE vendor/utility agreements that govern widespread public installations[14] and EVSE/vehicle collaborations for domestic installations[15], both of which offer the potential for revenue sharing.

Cost recovery
Currently a lack of knowledge of EVSEs and the significant upfront cost make the barriers to EVSE deployment difficult to overcome. For private entities, or municipalities wishing to host public EVSEs, the material risks are significant since the deployment risks are not underwritten if the PEVs fail to materialise or if vehicle uptake is not substantial.

Recommendations

Regulation as an Imperative
Regulatory and standards harmonisation[16,17] is required for jurisdictions to act as 'facilitators'[18], to speed progress[19]and open up development, and avoid technology lock-in and select winning technologies[20,18]. This harmonisation can be achieved at minimal expense[17]. Technology priorities must be set to be consistent with the Electric Vehicle Technology Roadmap for Canada[21] and the BC Hydro Electric Vehicle Charging Infrastructure Deployment Guidelines[11].While these are in need of market testing and validation, setting priorities will help to develop a national policy direction[17]. Regulation must be flexible enough to adapt to regional differences and technology maturity, with exact deployment patterns to be governed by local market analysis[22]. Deployment needs to be scaled up quickly via policy directives[23], and must move beyond city-centric planning while establishing linked corridors between cities[2,24]. There is a clear need for support from a public champion[23] such as a major utility or power authority.

Regulation as an Incentive
The economics of early EVSE roll-out do not add up for large-scale public deployment[25] and will require governmental support. While this need for support will diminish over time, it should be viewed through a long term lens[26], the financing of which should embrace revenue recycling[27], carbon pricing mechanisms, *bonus-malus* schemes and direct financial incentives (see below). Substantive EVSE integration will require the development of the 'smart' electrical grid, something that must be implemented in parallel with EV deployment. Electricity resale regulations for private entities should also be eased. Long-term contracts that guarantee a reasonable return for early movers could provide a significant technology pull[28].

Direct Financial Incentives

Incentive structures that will foster more rapid cost recovery are essential, with mechanisms similar to those used to encourage electric vehicle purchase likely being most effective. Incentives should focus on:

- EVSE cost rebates, discounts or tax breaks (*e.g.* US federal incentives[29])
- Cost sharing between the customer and the utility for design, permitting and installation costs[30]

In both cases, and particularly for private individuals, the incentives may be bundled with the original vehicle purchase[31], while cost support for EVSE deployment in support of fleet operations can be rolled in with other fleet purchasing incentives (*e.g.* rebates, *bonus-malus* schemes, tax deductions *etc.*). Direct financial incentives may also be disbursed through existing incentive schemes to ease administration burden (*e.g.* the ecoEnergy program[17]). Workplace charging of outside fleets may see cost recovery through support from monthly parking fees paid by users, via payroll deductions or employee benefits programs[32].

Conclusions

Policy actions must support the public and private deployment of electric vehicle charging infrastructure in four clear ways: 1) financial incentives to support unit purchase and installation; 2) easing regulation of electricity re-sale; 3) development of a purchasing framework for EVSE units; and 4) regulation and standards harmonisation across Canada and the US. Regulatory risk and cost are likely to apply significant downward pressure on private public EVSE deployment, which needs to be tackled in a coherent fashion at the municipal, provincial and federal levels and in collaboration with the EVSE technology developers, original vehicle equipment manufacturers and electricity utilities. These collaborations must also extend to potential hosts, non-governmental organisations and academic institutions to encourage installation and to circumvent the 'chicken and egg problem' of which comes first - the cars or the charge stations? The answer needs to be neither - the two must come together.

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