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Development Strategy on
Charging Facilities for
Electric Private Vehicles in
Hong Kong**

Final Study Report

Executive Summary

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Development Strategy on Charging Facilities
for Electric Private Vehicles in Hong Kong**



Hong Kong Productivity Council

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EXECUTIVE SUMMARY

BACKGROUND

As of the end of December 2017, there were 11,099 electric vehicles (EVs) on Hong Kong's roads, up from less than 100 at the end of 2010. Similar to other jurisdictions, electric private cars (e-PCs) dominate the composition of the EV market, accounting for 98 per cent of the EV fleet in Hong Kong at the end of 2017. As EV technology continues to advance, it is expected that e-PCs will become more popular. Thus, a sound EV charging development strategy is crucial to fulfilling the demand that will be associated with the continuous future growth in the number of e-PCs. In 2016, the Environmental Protection Department (EPD) engaged the Hong Kong Productivity Council (HKPC) to gather information from around the world on the developments and practices related to charging facilities for e-PCs, and study the pros and cons relating to the adoption of these practices in Hong Kong.

It is important to note that although the use of electric commercial vehicles, including goods vehicles and public transport vehicles, may be more effective in improving air quality than the use of e-PCs – given that major source of roadside pollution emissions is diesel commercial vehicles – there are numerous challenges related to electric commercial vehicles, for example limited driving range, inadequate payloads and long charging times. These challenges make it hard to fulfil the unique needs of different commercial operation modes and hence electric commercial vehicles have yet to become popular. Therefore, research on EV charging for electric commercial vehicles has been excluded from this study.

OBJECTIVES

This study has two key objectives:

- a) To gather information from around the world on the latest developments and practices relating to EV charging for e-PCs, including development strategies for EV charging infrastructure, incentives for the private sector's participation in building EV charging networks, and information platforms which monitor real-time utilisation of chargers, charging fees and others, in order to plan for future development strategies that facilitate the utilisation of an EV charging network which closely follows the EV market growth; and
- b) To study the pros and cons of the identified practices, examine the crucial factors that make them work, and comment on the relevance of their application in Hong Kong.

METHODOLOGY

This study gathers information on the latest EV charging developments and practices from a number of places outside Hong Kong. These places include Mainland China, Japan, Singapore, South Korea, the United States, France, Germany, the Netherlands, Norway and the United Kingdom. Desktop research was conducted to review development strategies for the charging infrastructure in these

geographies, as well as business models used by the private sector when setting up public chargers, charging fees, information platforms, which monitor the real-time utilisation of chargers and other variables.

Additionally, stakeholders representing EV charging service providers, EV manufacturers and distributors and EV associations located in Hong Kong were interviewed to gather their views on developments in EV charging. This study analyses how applicable overseas strategies and measures are to Hong Kong, making reference to information uncovered in the interviews with these local stakeholders.

KEY CHALLENGES

As EV technology advances, more competitive and affordable e-PC models will be launched. It is expected that the number of e-PCs will continue to grow, reaching a significant level in the future. It will be challenging to cater to this coming demand with the current EV charging infrastructure.

While the Government currently builds EV charging facilities, private companies are also entering this market; however, the EV charging service business is still in its infancy. At present, the Government and other charging facility providers, such as Hong Kong's power companies, are providing EV charging free of charge. This is holding other potential EV charging service providers back from entering the market and preventing them from developing sustainable EV charging service business models that are able to recover operating and maintenance costs. In addition, the incorporated owners of some buildings are hesitant to approve the installation of EV chargers in residential buildings. These are the major obstacles standing in the way of private companies running sustainable charging businesses and contributing to the development of Hong Kong's EV charging infrastructure.

While in general stakeholders are positive about and keen to see innovation and technology emerge and take off, the industry also has various concerns about adopting various new technologies.

DEVELOPMENT STRATEGY FOR e-PC CHARGING FACILITIES IN HONG KONG

Hong Kong is a small place, and commuting journeys are generally short. Private cars generally have a daily travelling distance of tens of kilometres, as compared to much longer distances in other geographies. This is a unique advantage, which favours e-PCs in Hong Kong. The corresponding EV charging development strategy would require e-PC owners to have a primary charging practice of charging their e-PCs either at their homes or at their workplaces. The current public charging network mainly serves to provide supplementary charging facilities, enabling e-PCs to top up their batteries and complete their journeys when the need arises – i.e. e-PC owners should not solely rely on public chargers to fulfill their daily charging needs.

Although the overseas EV charging conditions may not be directly comparable to the situation in Hong Kong, this study analysed applicable overseas situations and assessed the following development strategies which were deemed to be applicable to the Hong Kong context:

1. Connect Stakeholders

Establishing an industrial platform or association can connect key stakeholders including the Government, power companies, charging service providers, property management offices, universities, R&D institutes, and e-PC user groups; allowing these stakeholders to harmonise strategies to develop an e-PC charging infrastructure in Hong Kong.

2. Encourage Daily Charging at Home and Workplace

The Government's policy objective is that e-PC owners should charge their vehicles daily by using charging facilities at their homes, workplaces or other suitable places, including charging facilities provided by e-PC suppliers. Public charging facilities in Hong Kong are supplementary in nature, set up so that e-PCs can top up their batteries to complete their journeys at times of occasional need. As seen in places like mainland China, Japan, the Netherlands and South Korea, the driving force behind providing EV charging facilities is now moving from governments to the private sector as the EV charging markets in these countries continues to develop.

The Hong Kong Government has introduced measures to facilitate the private sector to expand the EV charging network. Since April 2011, the Government has been granting concessions on Gross Floor Area for car parks in new buildings to encourage developers to provide necessary EV charging-enabling infrastructure, which will facilitate the future installation of EV chargers. Between April 2011 and December 2015, nearly 80 per cent of car parking spaces in newly-approved development plans were provided with the infrastructure for EV charging facilities – indicating that this is an effective measure that should be maintained.

The EV charging-enabling infrastructure installed by developers is only a base – EV charging facilities are needed at the front end. Further collaboration between developers and EV charging service providers is also encouraged, so that both the EV charging-enabling infrastructure and the chargers themselves can be accessible to residents at the same time. This would also solve an existing problem: e-PC owners who rent parking spaces sometimes have difficulty installing their own EV chargers in these spaces.

In the past, the primary challenge associated with providing charging facilities in existing buildings was obtaining the agreement of the Incorporated Owners, rather than the associated cost. During the interviews conducted as part of this study, some interviewees said that gaining the Incorporated Owners' approval for installing EV chargers was becoming less difficult, as these owners were becoming more aware of EVs and EV charging facilities through various channels like the media, seminars, or even members of Incorporated Owners are also EV users. In addition, service providers often provide a “one-stop-shop” solution, with “subscription” and “buy and own” models having been successfully implemented in private premises. Continued dissemination of successful cases and further experience sharing may help incorporated owners understand more about charging facilities in residential buildings and gain further confidence to approve their installation.

3. Continue the Upgrade to Medium Chargers and the Installation of Multi-Standard Quick Chargers

Thanks to advances in battery technology, the energy capacity of e-PC batteries is increasing, offering a longer driving range. However, charging with standard chargers results in prolonged charging times, thus reducing the utilisation rate.

Since medium charging is an economically-viable solution that improves charging efficiency and is desirable for large-scale implementation, the industry should focus on installing more medium chargers in both public and private car parks. Currently, the majority of e-PCs in Hong Kong are imported from the U.S., Japan and Europe. When suitable charging cables are used, these models are compatible with European standard medium chargers (IEC Type 2). These types of medium chargers have also gained wide acceptance in the local market, thus this standard is encouraged over other standards.

The need for quick chargers should not be neglected, since they can top-up e-PC batteries in a short time, helping e-PC drivers complete their journeys when necessary. However, quick chargers have various incompatible charging standards and utilise unique charging sockets. Multi-standard chargers can thus balance the benefits among EV users in Hong Kong, since at present, this is the only solution that allows e-PCs from the U.S., Japan and Europe to be recharged. In future, the harmonisation of standards should be closely monitored. It is important to note that installing quick chargers requires a high power capacity, and thus these chargers are more suitable for supplementary top-up use in times of occasional need, rather than for large-scale deployment.

4. Encourage Private Sector Business Innovation

Need for shifting from free-charging service to paid-charging service

The Government and other charging facility providers like Hong Kong's power companies are currently providing free EV charging for e-PCs. This is demotivating other charging service providers, preventing them from entering the market and developing sustainable business models that allow for the recovery of operating and maintenance costs. A lower contribution from the private sector may lead to a heavy reliance on Government resources for providing EV charging facilities to e-PC users.

Paid charging services are gaining acceptance from e-PC users. A 2015 study¹ conducted in the U.S. shows that the imposition of a price did not eliminate consumer demand for charging. Evidence also shows that a European charging service provider achieved break-even on two charging stations after a few years of operation. The continuous revenues generated illustrate that e-PC users are not particularly reluctant to pay for charging services. Paid charging services also discourage the unnecessary occupation of parking spaces with EV charging facilities, thus helping e-PC users with a real need to use the facilities. This "user pays" principle should facilitate the recovery of operating and maintenance costs, and help private companies develop a sustainable business model.

¹ Center for Climate and Energy Solutions, "STRATEGIC PLANNING TO IMPLEMENT PUBLICLY AVAILABLE EV CHARGING STATIONS: A GUIDE FOR BUSINESSES AND POLICYMAKERS", 2015
<https://www.c2es.org/docUploads/ev-charging-guide.pdf>

There are three primary types of fee collection schemes: namely “time charge”, “energy charge” and “subscription”:

- Time charge:** The rate is set per unit of time, i.e. per minute or hour, or per session. This scheme is more familiar to drivers as it is similar to how parking fees are collected; it also encourages drivers to move their e-PCs after they are charged, as they will be billed for any idle time. One disadvantage of this scheme is that users may feel that it is unfair, since they pay the same amount but the speed of charging varies by EV model.
- Energy charge:** The rate is set per unit of energy, i.e. per kWh. Some e-PC users may find this scheme to be more fair, since they pay only for the energy transferred to the battery of their EVs. One disadvantage of this scheme is that it is less intuitive than the time charge scheme. Furthermore, since there is no further energy output from the EV charger if the EV has been fully charged, no additional fees are charged unless an additional “idle fee” is added on.
- Subscription:** Users sign up for a plan that allows them to use EV chargers provided by service providers – in either a limited or unlimited usage manner. While a subscription plan offers convenience, it also commits EV users to a certain level of expenditure when they may not yet be certain of how they will utilise their vehicles.

Aside from the charging fee, some stations also collect an “idle fee”, which begins as soon as the charging session is over – i.e. the EV is connected to the charger but the charging process is complete. This idle fee encourages EV users to leave immediately after their charging session, thus freeing up the charging facilities for other users. Sometimes, vehicles occupy EV parking spaces without being connected to a charger; some public car parks in private premises have begun to impound these vehicles, with the drivers of these vehicles needing to pay a fee to get their vehicles back.

In Hong Kong, paid charging services are still in the early stages of development. Currently, EV charging service providers collect charging fees or allow users to activate their charging sessions by the Octopus card, or other RFID cards or tags or through mobile apps. Users first need to set up an account with an electronic payment system such as Octopus, Autotoll, their credit card, PayPal systems and so on. Some service providers offer online reservations, which allow EV users to book chargers in advance to avoid long wait times.

In terms of business models, there are successful examples of both the “Subscription” model and the “Buy and Own” model. For the subscription model, service providers build the charging infrastructure at their own cost. Tenants of these car parks then use EV charging services at their own private parking spaces by subscribing to various monthly service plans. For the buy and own model, the charging facilities are sold to the site host and the service provider then becomes responsible for operating the charging facilities. Both these business models can facilitate the sustainable provision of EV charging services by the private sector.

Collaborating with other business partners is another option that may help EV charging service providers explore new business innovations such as value-added charging services, using EV chargers as a means of advertising, providing charging services to create intangible value to other business

segments and so on. In the long term, the ultimate aim is to encourage more service providers to provide charging services.

5. Leverage Internet of Things Technology

In the 2016 Policy Address, the Chief Executive re-affirmed the Government's commitment to building Hong Kong into a smart city. Introducing Internet of Things (IoT) technology is vital to making existing facilities "smarter". Internet-connected EV chargers can make these facilities more convenient. For example, the provision of availability information allows e-PC users to find the closest available EV charger. Service providers can also take advantage of real-time charging status information to notify e-PC users to pick up their fully-charged vehicle. Connected EV chargers are also fundamental to realising electronic payment and reservation services. In general, EV charging service providers can provide the following information to EV users:

- Station name and location (with photo)
- Number of chargers in the station
- Charging standards
- Car park operating hours
- Pricing details (if applicable), e.g. charging fees, parking fees
- Real-time occupancy
- Charging session information (e.g. charging duration, energy, amount)
- Transaction records (if applicable)

6. Support the Use of Innovation and Technology

Further studies and trials of various innovative technologies among the research, academia and industry sectors will allow the industry to identify the requirements and industrial practices that are most suitable for the local market. Having dedicated demonstration sites to centralise the trial and demonstration of EV charging technologies will facilitate more experience sharing and knowledge exchange that will lead to further technological developments. These sites may also exhibit the emerging technologies, allowing them to gain greater public acceptance.

From a consultancy point of view, the following three technologies have promise in the EV industry and may well benefit the EV charging market in future:

- Interoperable EV charging network to allow data sharing (e.g. real-time charging status)
- Load management for smart charging
- High power charging

The Government, along with the academia and research sectors and the industry itself, should pay close attention to the development of these technologies to understand their impacts and make early preparations to embrace them in near future.

KEY ELEMENTS FOR SUCCESS

The two key elements of the above development strategies are i) engagement, and ii) innovation and technology. As the EV market in Hong Kong is moving from the early deployment stage to the development stage, the Government cannot be the only stakeholder responsible for developing future EV charging infrastructure. The engagement of other stakeholders from the academic and research sectors and the industry itself will facilitate better communication, mutual understanding and result in harmonised goals and strategies. These strategies will also be implemented more effectively through the acceptance of the industry and the public. Making use of innovation and technology will turn existing challenges into opportunities, and align the development of EV charging with the Government's initiative of building Hong Kong into a smart city.