

**For discussion  
on 28 January 2019**

**LEGISLATIVE COUNCIL  
PANEL ON ENVIRONMENTAL AFFAIRS**

**Promoting the Use of Electric Vehicles**

**PURPOSE**

This paper outlines the progress of promoting the use of electric vehicles (EVs) by the Government and possible measures for the development and enhancement of the charging network for electric private cars (e-PCs).

**KEY POLICIES AND MEASURES TO PROMOTE THE USE OF EVs**

2. Commercial vehicles (CVs) account for 95% of the vehicular emissions of respirable suspended particulates (RSP) and nitrogen oxides (NO<sub>x</sub>), both major air pollutants. Hence, CVs have all along been a major target of the Government's measures to improve roadside air quality. The Government has been implementing various measures to reduce vehicular emissions in recent years, including phasing out old diesel CVs, strengthening the emission control of petrol vehicles and liquefied petroleum gas (LPG) commercial vehicles and retrofitting franchised buses of earlier models with emission reduction devices. Roadside concentrations of major air pollutants have dropped by around 30% over the past five years (see **Annex I**).

3. EVs have no tailpipe emissions and are efficient in converting energy from the grid to power at the wheels. Replacing conventional vehicles, especially CVs, with EVs can help improve roadside air quality and reduce greenhouse gas emissions. That said, the formulation of policies on promotion of EVs and the actual outcome of the measures would depend on various factors, including local conditions (e.g. climate and terrain conditions, local demand for vehicles, quantities of air pollutants emitted from different types of vehicles, the Government's environmental protection and transport policies), development of EVs and related technologies (e.g. operational performance of EVs, cost

effectiveness and technologies of charging facilities), economic situations (e.g. vehicle owners' affordability) and market situations (e.g. EV prices, vehicle owners' preferences, availability of EV models and their supply) and so on.

## **Electric Commercial Vehicles**

4. As technologies for electric CVs (e-CVs) are still under development, with their prices generally higher than their conventional counterparts, the Government currently focuses on promoting e-CVs through the following measures:

- (a) The Government has fully waived the first registration tax<sup>[1]</sup> (FRT) of e-CVs since 1994 until 31 March 2021, to encourage owners to purchase e-CVs and promote the development of e-CVs;
- (b) Since 2010, enterprises which procure environment-friendly vehicles including EVs are allowed full profit tax deduction for the capital expenditure on the vehicle in the first year of procurement;
- (c) A \$300 million Pilot Green Transport Fund (PGTF) has been put in place since March 2011 to encourage the public transport sectors, goods vehicle operators and charitable / non-profit-making organizations to try out green innovative transport technologies, including e-CVs; and
- (d) \$180 million has been provided to fully subsidise the franchised bus companies to purchase 36 single-deck electric buses (including 28 battery-electric buses and eight supercapacitor buses and their charging facilities) for trial on a number of routes.

5. The effectiveness of our policies on promoting the use of e-CVs depends very much on the maturity of e-CV technologies, their prices and

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<sup>1</sup> The FRT of a conventional vehicle is derived from the taxable value of the vehicle times the appropriate tax rate. The tax rates for different vehicle classes are shown below:

- FRT rates of private cars are 40% on the first \$150,000 of vehicle taxable value, 75% on the next \$150,000, 100% on the next \$200,000 and 115% on the remainder.
- FRT rates of CVs (except van-type light goods vehicles not exceeding 1.9 tonnes permitted gross vehicle weight) are 3.7% to 17% of their taxable values depending on their vehicle classes, and motor cycles and motor tricycles at 35%.
- FRT rates of van-type light goods vehicles not exceeding 1.9 tonnes permitted gross vehicle weight are 35% on the first \$150,000 of vehicle taxable value, 65% on the next \$150,000 and 85% on the remainder.

suitability for use in Hong Kong (including their ability to suit the modus operandi of local transport sectors), etc.

## **Pilot Green Transport Fund**

6. The PGTF subsidises local trials of green innovative transport technologies that stand a good chance of coping with the local operational requirements and could be adopted by the relevant transport sectors for wider use upon successful trials.

7. The PGTF subsidises the price premium between an e-CV and its conventional vehicle or half of the cost of the e-CV, whichever is higher. In addition, e-CVs can generally save a large amount of fuel cost<sup>[2]</sup>. The PGTF can thus provide certain financial incentive to encourage the transport sectors to try out e-CVs.

8. As at the end of December 2018, the PGTF approved 140 trials, including 75 trials of e-CVs with a subsidy of some \$90 million, covering various types of vehicles (a total of 106 vehicles including taxis, light buses, single-deck buses and goods vehicles). E-CVs are yet to become popular for the time being<sup>[3]</sup> mainly because their technologies still need to be developed and they are yet to fully meet the operational requirements of the local CVs. Results of the trials have shown that most of the e-CVs currently in the local market have limitations such as high production cost, limited service life, long charging time and/or low energy density of the batteries. Thus, the driving range and charging time of most e-CVs are yet to be able to fully cope with the requirements of the local transport sectors<sup>[4]</sup>. Besides, prices of e-CVs are generally not as competitive as their conventional counterparts. The trades also reflect that insufficient

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<sup>2</sup> According to the current PGTF trial results, e-CVs could save 31% to 91% of their fuel cost on an individual vehicle basis as compared with their conventional counterparts.

<sup>3</sup> As at the end of December 2018, there were only 130 privately-owned licensed e-CVs (see **Annex II**).

<sup>4</sup> The electric light bus trialed under the PGTF could not sustain the daily mileage of a typical public light bus after a full charge taking four hours. The three electric taxis once on trial under the PGTF take four hours a day for charging, which cannot cope with their round the clock operation. Furthermore, the low energy density of e-CV batteries will reduce the goods and passenger payloads of e-CVs. For example, an electric light goods vehicle model with payload of only 0.65 tonne in the market is sold at some \$400,000 (with FRT waived), whereas the most popular conventional counterpart with payload of around 0.85 tonne is sold at some \$305,000. In addition, under the ongoing franchised electric bus trials, the unit price of a single-deck electric bus with the provision and installation of corresponding charging facility is about \$5 million, which is around 2.5 times of the conventional bus (the unit price of a conventional single-deck diesel bus is about \$2 million). The battery-electric buses normally take three to four hours for full charging. With full operation of air-conditioning system in summer, they cannot meet the general daily mileage requirement of single-deck buses after a full charge.

maintenance service support is quite common.

9. Results of the trials have also shown that compared with other e-CVs, electric light goods vehicles (e-LGVs) are more likely to gain popularity in Hong Kong and are suitable for operators who require relatively lower daily mileage and payload because batteries of these vehicles can be topped up outside operation hours. In order to promote the use of e-LGVs, we have organised experience sharing workshops for the transport sectors who are suitable to adopt this vehicle type.

10. We will continue to keep in view the development of e-CV technology and encourage the transport sectors to make use of the PGTF to try out other green innovative transport technologies and other suppliers to introduce more products to the local market. Since the results of the PGTF trials have also shown successful examples, such as e-LGVs, that could meet the operational requirements of some transport sectors as evidenced by the willingness of more transport operators to try out e-LGVs under the PGTF, the Government considers it necessary to explore means to facilitate the transport sectors' wider use of those green innovative transport technologies that have been proved to be relatively mature and suitable for adoption locally, so as to further improve roadside air quality and reducing carbon emissions. In the 2018 Policy Address, it has been announced that the PGTF will be reviewed. The Environmental Protection Department (EPD) is conducting the review along the following directions:

- (a) Whilst the current conditions for approving subsidy for the PGTF trials (i.e. trials of technologies that stand a good chance of coping with the local operational requirements and could be adopted by the relevant transport sectors for wider use upon successful trial) should be retained, we would review if improvements could be made in various areas such as the subsidy scope, applicants' eligibility, subsidy levels, limits on the number of applications for each type of technologies and conditions for receiving the subsidy.
- (b) The review should also explore means to encourage wider use of technologies that have been proved by the trials to be relatively mature and suitable for adoption locally, e.g. whether subsidy should be provided to the trades for procuring the products for use and not for trial. We also need to map out the specifications and criteria for implementation.

11. The EPD aims to complete the review in 2019 and would consult

the Panel after formulating the relevant proposals.

### **Electric Franchised Buses**

12. As for franchised buses, the feasibility of deploying electric bus services throughout or in individual areas of Hong Kong depends very much on the maturity of development of electric bus technologies, their prices and suitability for use in Hong Kong. It is incumbent upon us to fully test and prove that the relevant technology is suitable for the local environment and the actual modus operandi of the public transport sector before introduction of electric buses on a large scale.

13. There are about 6 100 franchised buses in Hong Kong. About 95% of them are double-deckers and the remaining are single-deckers. Currently the technology of double-deck electric buses is still developing and there are very few models available in the international arena. Furthermore, their passenger carrying capacity and operational efficiency still cannot meet the operational needs in Hong Kong (including long daily service hours, high peak passenger loadings, the need to tackle hilly terrains as well as intense air-conditioning demand in hot and humid summer). We will keep in view the development in other places and introduce trials in due course. Besides, EPD is now working with the two franchised bus companies to preliminarily explore the feasibility of developing double-deck electric franchised buses suitable for local use.

14. Regarding the single-deck electric buses, as mentioned in paragraph 4(d), the Government provided \$180 million to fully subsidise the five franchised bus companies (including Kowloon Motor Bus Company (1933) Limited (KMB), Long Win Bus Company Limited (LWB), Citybus Limited (CTB), New World First Bus Services Limited (NWFB) and New Lantao Bus Company (1973) Limited (NLB)) to acquire 36 single-deck electric buses (including 28 battery-electric buses and eight supercapacitor buses) and their charging facilities for conducting two-year trials to test out their performance, reliability as well as economic feasibility in local conditions. The distribution of 36 single-deck electric buses is as below (as at the end of 2018).

Franchised bus company/ Type of electric bus	No. of buses undergoing or completed the trial (total no. of buses under the trial programme)
KMB: Supercapacitor Buses	4(8)
KMB/LWB: Battery-electric buses	14(14)
CTB/NWFB: Battery-electric buses	10(10)
NLB: Battery-electric buses	2(4)

15. At present, 26 battery-electric buses and four supercapacitor buses have commenced operations on a number of routes. The other four supercapacitor buses of KMB will commence operation in the first half of 2019. The remaining two battery-electric buses of NLB are under re-tendering process, and are expected to commence operation by the end of 2019 at the earliest. A summary of preliminarily data of the trial programme is at **Annex III**.

16. The two-year trial of the first batch of five BYD battery-electric buses was completed in May 2018. The overall average daily driving range of the five buses during the trial was about 190 kilometers (km). However, under high ambient temperature demanding high loading of air-conditioning system, the driving range reduced to about 150 km, which could not meet the normal daily requirement of most of the single-deck bus routes of 200 to 300 km. The observation and findings of the trial of five battery-electric buses are at **Annex IV**.

17. Based on the current trial results, our initial view is that the wider use of single-deck battery-electric buses in Hong Kong will hinge on the following two factors –

- (a) whether the battery capacity of single-deck battery-electric bus could eventually be substantially increased, enabling it to travel about 300 km a day after a full charge; and/or
- (b) whether there is adequate space and power capacity at the bus termini and public transport interchanges for the installation of charging facilities for top-up charging of the single-deck battery-electric buses in daytime. Whether the mode of daytime charging can cope with the high operation frequency of bus service in Hong Kong also needs to be considered.

18. As for single-deck supercapacitor buses, they are characterised by fast charging and can travel about 20-30 km after 20 minutes of a full charge, and are thus more suitable for short routes. However, charging facilities at bus stops and/or bus termini would be required for timely re-charging, which takes about 6-10 minutes each time. Whether the supercapacitor buses can be further promoted in Hong Kong depends on the availability of suitable short routes run by single-deck buses and whether the public transport interchanges or bus stops that these routes pass through can provide adequate space and power capacity for installation of top-up charging facilities.

19. The trial programme of single-deck electric buses is still in-progress. Subject to the outcome of the trials, the Government will promote wider use of electric buses by the franchised bus companies, taking into account affordability of the companies and passengers.

### **Electric Private Cars**

20. As for e-PCs, the Government's standing policy is to encourage the public to use public transport as far as possible, and should they need to acquire private cars, choose e-PCs. The Government promotes the use of e-PCs in Hong Kong mainly through offering financial incentives such as tax concession and lower annual vehicle licence fee, and facilitating the development and enhancement of charging networks for e-PCs.

### **Financial Incentives**

21. On the provision of financial incentives:

- (a) From 28 February 2018 to 31 March 2021, the FRT concession for purchasing e-PCs has been capped at \$97,500. During the same period, the "One-for-One Replacement" Scheme (the Scheme) has also been introduced. Private car (PC) owners who arrange to scrap and de-register their own eligible old PC and then first register a new e-PC could enjoy a higher FRT concession up to \$250,000;
- (b) E-PCs also enjoy a lower annual vehicle licence fee under the Road Traffic (Registration and Licensing of Vehicles) Regulations

(Cap. 374E)<sup>[5]</sup>. For example, annual vehicle licence fees for e-PCs range from about \$600 to \$1,100, which are significantly lower than those for conventional PCs ranging from \$3,815 (for petrol PCs with engine cylinder capacity not exceeding 1 500 cubic centimetres (c.c.)) to \$12,675 (for diesel PCs with engine cylinder capacity exceeding 4 500 c.c.); and

(c) Energy efficient EVs will save fuel cost<sup>[6]</sup>.

### **Arrangements for FRT concession**

22. In introducing the arrangements for FRT concession in paragraph 21(a) above, the Government on one hand aims to avoid the overall growth of PCs causing traffic congestion and aggravating roadside air pollution; and on the other hand, hopes that these financial incentives could aptly encourage vehicle buyers to go for e-PCs when purchasing PCs.

23. With ongoing technology development in e-PCs, more affordable e-PC models are available in the market. They are priced between \$240,000 and \$400,000 (FRT excluded), with laboratory-tested driving range reaching 280 km to 400 km, thus fairly meeting most Hong Kong drivers' general needs of daily mileage of only a few tens of km. Out of the 15 e-PC models available for sale in the local market, the FRT of eight of them (more than half) are fully waived under the Scheme. The Scheme could help encourage more vehicle manufacturers to introduce different types of e-PCs, particularly the relatively more affordable models, thereby popularising the use of e-PCs in Hong Kong by letting PC buyers having more choices.

24. As at the end of December 2018, there are 10 670 privately-owned licensed e-PCs (see **Annex II**). From 1 March 2018 (i.e. immediately after the launch of the Scheme) to the end of December 2018, there were a

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<sup>5</sup> Annual vehicle licence for e-PC is charged based on the unladen weight of the vehicle, at a fee of \$440 for the first tonne and an additional fee of \$95 for each additional 250 kilograms or part thereof. Annual vehicle licence for conventional PC is charged based on the cylinder capacity of the engine ranging from \$3,815 (for petrol PCs with engine cylinder capacity not exceeding 1 500 c.c.) to \$12,675 (for diesel PCs with engine cylinder capacity exceeding 4 500 c.c.).

<sup>6</sup> According to the Electrical and Mechanical Services Department's Energy Utilisation Index ([http://ecib.emsd.gov.hk/en/indicator\\_trp.htm](http://ecib.emsd.gov.hk/en/indicator_trp.htm)), for a petrol PC with engine cylinder capacity of 1501 - 2500 c.c. (most dominant type in Hong Kong), the fuel consumption of its internal combustion engine is about 11.6 litres per 100 km on average. Assuming a petrol price of \$15 per litre, PCs need \$1.74 to travel one km on average. The most common e-PC model in Hong Kong consumes about 0.2kWh per km on average. Taking an electricity tariff of \$1.3 per kWh, e-PCs need \$0.26 to travel one km on average, far lower than the cost incurred by a conventional vehicle. To note however is that, the fuel economy of a car depends on various factors, including Hong Kong's road conditions and the driving habit of drivers, and hence the actual difference of costs may vary.



total of 454 first registered e-PCs (see **Annex V**), of which 321 of them were granted with partial or full FRT concessions under the Scheme.

## **Charging Networks**

25. Regarding the charging arrangements for e-PCs, it has always been the Government's policy direction that e-PC owners should perform daily charging of their e-PCs by using charging facilities at their home, workplace or other suitable places. Public charging facilities in Hong Kong are supplementary in nature, set up for EVs to top up their batteries at times of occasional needs. They do not serve as daily charging facilities or their alternatives. Potential buyers of e-PCs should fully consider the daily charging arrangements required and should not rely on public charging facilities for daily charging of their e-PCs.

### Current Measures

26. Given the policy direction in paragraph 25 above, the Government's priority is to facilitate and encourage the installation of charging facilities in private premises when planning for the development of charging facilities for e-PCs. For **private premises**, granting of concession on gross floor area for new private buildings have been tightened from April 2011 to encourage developers to provide EV charging-enabling infrastructure, including provision of sufficient power supply, cabling and conduits for all parking spaces in the private car parks of the new buildings concerned. The policy helps to avoid owners of parking spaces being unable to install the required EV chargers owing to constraints in power supply capacity, cabling and conduits, etc. when EVs are widely used in the future. According to the information of the Buildings Department, from April 2011 to September 2018, over 80% of parking spaces in the newly approved developments, involving about 440 car parks and around 48 000 parking spaces, will be provided with EV charging-enabling infrastructure.

27. For existing private premises, as there are constraints in installing charging facilities in their car parks, EPD established in 2011 a dedicated team and a hotline to provide information and technical support. Besides, EPD has appealed to owners' corporations for their support in installing EV chargers at their premises upon request by EV users, and has shared successful experience with the property management sector. The two power companies also provide technical advice to EV owners and render service to connect power supply for car parking spaces at their homes. In

recent years, several private companies have been providing EV owners, housing estates or business establishments with one-stop EV charging services, including installation of charging facilities at EV owners' parking spaces and provision of charging services at other specified locations. As far as we know, these companies have installed charging facilities in over 34 housing estates.

28. With regard to the development of **public charging network** as ancillary facilities, there are currently 782 Government public chargers provided in Government car parks<sup>[7]</sup>. In the past few years, the Government has gradually upgraded the standard chargers to medium chargers<sup>[8]</sup> in the car parks of the Transport Department (TD) and the Government Property Agency (GPA), which are open to the public. Apart from 61 standard chargers located at the TD car parks which will be demolished and 94 chargers which have both standard and medium charging functions, standard chargers at TD and GPA car parks open to public have been upgraded to medium chargers. In addition, the review of the Government's trial on outdoor chargers was completed by the end of 2018. The results show that these outdoor chargers are operating satisfactorily (see paragraphs 33-35 for future plans).

29. Apart from taking the lead in providing and enhancing its public charging facilities, the Government also encourages the private sector to set up and enhance non-governmental public charging networks. As for non-governmental public charging network, we have all along been encouraging the two power companies and both public and private establishments to actively support the installation of EV charging facilities. Besides, concessions on gross floor area for car parks have been extended to cover underground public car parks since March 2017. There are currently about 1 384 public chargers provided by private sector, and the two power companies are upgrading their existing public standard chargers to medium or even quick chargers. EV suppliers have also been proactive in adding their EV charging facilities for their EV models at public venues.

30. The number of public chargers in Hong Kong (including both owned by the Government and the private sector) which are distributed in 18 districts increased from about 1 000 in 2013 to 2 166 in the end of 2018 (see **Annex VI**).

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<sup>7</sup> Including TD, GPA, Leisure and Cultural Services Department (LCSD), Electrical and Mechanical Services Department (EMSD), Housing Department, Tourism Commission and Highways Department.

<sup>8</sup> As compared with standard chargers, medium chargers can reduce the charging time by up to 60%.

31. Information on public chargers, including their locations, types and numbers, is currently available on EPD webpages. Some EV charging service providers and EV suppliers provide mobile applications through which EV owners can obtain instant information of chargers available and make reservations.

### Stepped-up Measures

32. In response to the rapid changes in the use of e-PCs, the Government is reviewing various policies and measures to promote the use of EVs, including exploring ways to encourage the setting up of charging facilities to cope with the usage of EVs, installing additional charging facilities in existing car parks and updating relevant guidelines and planning standards as appropriate. The progress of the review is as follows.

#### Short to Medium Term Measures

##### *Installing additional medium chargers at Government car parks*

33. To meet the demand for top-up charging arising from the continued growth of e-PCs, the Government plans to install additional medium chargers at car parks under the TD, the GPA and the LCSD, which are fully or partially open to the public. The Government is reviewing the technical feasibility and hopes to confirm the plan for installing additional medium chargers (including the number of chargers and timetable) as soon as possible.

##### *Provision of charging facilities at on-street parking spaces*

34. The parking spaces set up at roadside serve mainly short-term parking needs, and parking meters are generally erected at these parking spaces to increase the circulation of the parking spaces for use by more drivers. Taking into account the potential impact on nearby traffic and other drivers' parking needs, as well as related technical considerations (such as power supply and space constraints), relevant Government departments are actively looking for suitable on-street parking spaces to install charging facilities as a pilot.

##### *Pilot scheme on quick charging station (non-parking)*

35. A quick charger (charger with a power output of at least 50 kW)

can add 50 to 100 km of driving range to e-PCs in 15 to 30 minutes. To enable EV owners to top up their batteries quickly to meet occasional need during their trips, the Government is looking for suitable locations to set up public quick charging stations for trial. When searching for trial sites, the Government will consider the impact on traffic flow and explore the possibility of whether the quick charging stations can be co-located with other Government facilities so as to reduce costs and optimise land use.

*Enhance the requirements on EV charging facilities for new government premises*

36. Regarding the requirements on EV charging facilities for new Government premises, the current requirement of setting up EV medium chargers for not less than 30% of indoor parking spaces will be extended to cover new outdoor Government car parks. The EPD is coordinating with relevant departments to revise the relevant Government circulars.

*Stepping-up the promotion of installing charging facilities*

37. To encourage the installation of EV charging facilities in the existing private housing estates, the EPD, in collaboration with the Home Affairs Department, organised three workshops on Hong Kong Island, Kowloon and the New Territories in December 2018 and January 2019 to encourage the owners' corporations to support the installation of EV charging facilities in existing buildings. The Government will continue to step up the communication, publicity, education and technical assistance to building owners, property management companies and owners' corporations in the installation of EV charging facilities.

38. In addition, the EPD also intends to update the relevant guidelines on EV charging and the relevant guidelines in the "Hong Kong Planning Standards and Guidelines" on EV charging facilities. To be in line with the latest developments in EVs and their charging technologies, the revised guidelines will propose that the newly installed EV chargers should be medium chargers instead of standard chargers.

## Long Term Measures

*Smart system for EV charging*

39. To support the development of Smart City, the Government plans to set up a smart system for the Government's public EV charging network. The features will include, but not limited to, instant electronic information

on the status of chargers, payment system and management facilities for parking spaces equipped with chargers, etc. The feasibility of enabling reservation of parking space equipped with chargers will also be explored. The EPD is now installing equipment on public chargers in some Government car parks to test the real-time electronic information on the use of 100 chargers for public information through the Government Electronic Platform. The trial will be completed by the end of this year.

*To further encourage installation of charging facilities at existing and new buildings*

40. In addition to the stepping-up of publicity and promotion activities (paragraph 37 above), the Government will continue to explore practicable measures to encourage installation of EV charging infrastructure or chargers in existing private buildings.

41. For new buildings, as explained in paragraph 26 above, underground car parks with EV charging-enabling for each parking space will be entitled for full concessions on GFA. The aim is to avoid situations where EV charging facilities cannot be installed in the future due to constraints on power supply, cabling and conduits, etc.

42. There were views that the Government could require developers to provide EV chargers for public use under the GFA concession mechanism. The Government has examined this. The Building Ordinance (BO) aims to ensure that the planning, design and construction of private premises comply with the prescribed standards regarding safety and sanitation, but not to regulate the usage right of the building services. It is also difficult for the Government to ensure through BO that the intended use of the building services installed in the premises would continue to be maintained after the occupation. Hence, we consider the suggestion not viable. The Government will continue to review other guidelines and explore suitable instruments so as to strike a balance between requiring the developer to continue providing public EV chargers and not undermining the interest of private property ownership.

**EVs in GOVERNMENT FLEET**

43. When procuring vehicles, the Government will consider the operational needs of the departments, appropriate models available in the market, resources and environmental factors in assessing whether or not suitable EVs can be procured to replace vehicles in the Government fleet that need to be replaced. As at the end of 2018, there were 253 EVs in

the Government fleet, consisting mainly of small and medium-sized saloon cars.

44. With ongoing technology development in EVs, there are more EV models with higher driving range available in the market, which we believe can better suit the departments' operational needs. The Government will continue to keep in view EV models available in the market suitable for operational need of Government departments, and to encourage departments to choose EVs as far as possible when procuring vehicles.

### **EV BATTERIES**

45. Regarding the recycling of EV batteries, as most EVs in Hong Kong remains were of a low age, the number of retired EV batteries remains small at this stage, being mainly the disposal of those individual waste EV batteries that are damaged and cannot be repaired. Most EV manufacturers or agents currently have engaged licensed collectors to handle these waste EV batteries. After proper preliminary treatment, these waste EV batteries are exported to treatment facilities in Japan, Korea or Belgium for recycling. As EVs will become more popular in the future, we have been exploring with EV suppliers the issues of proper collection and handling of waste EV batteries so as to enhance protection of the environment.

### **PROMOTING USE OF NEW ENERGY VEHICLES**

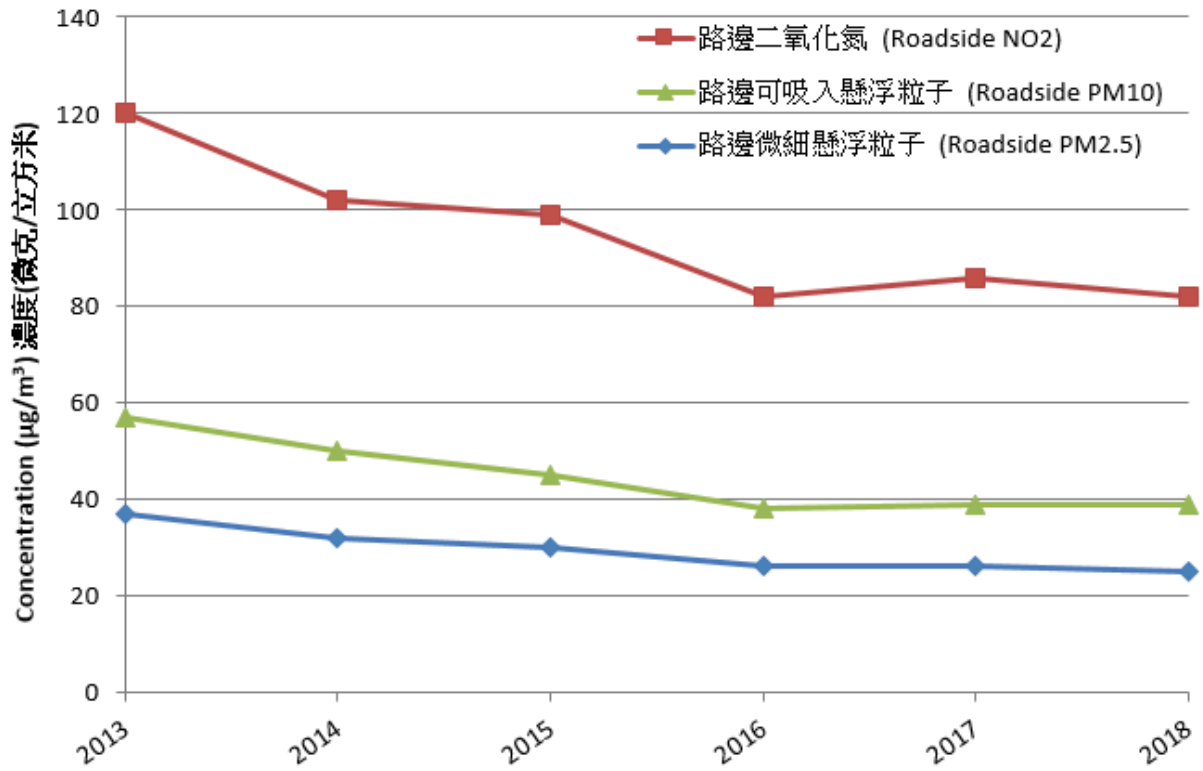
46. To further reduce emissions of air pollutants from PCs, the Government will continue to encourage the public to use new energy vehicles in the hope that all newly registered PCs in Hong Kong will ultimately become new energy vehicles in the long run. As the first step, we may consider ceasing the first registration of diesel PCs subject to consultation with stakeholders. Similarly, we will also consider whether the first registration of diesel motor cycles should be ceased.

### **ADVICE TO BE SOUGHT**

47. Members are invited to note and comment on the Government's progress in promoting the use of EVs in Hong Kong.

**Environment Bureau/Environmental Protection Department**  
**January 2019**

**Concentrations of Key Roadside Air Pollutants**  
**(2013 to 2018)**



**Number of Licensed Electric Vehicles (EVs) by Vehicle Class**  
**(as at the end of December 2018)**

	<b>Government EVs</b>	<b>Privately-owned EVs</b>	<b>Total</b>
Private cars	169	10 670	10 839
Light goods vehicles	22	83	105
Medium goods vehicles	-	-	-
Light buses	-	6	6
Taxis	-	-	-
Buses	-	41	41
Motor cycles	62	10	72
<b>Total</b>	<b>253</b>	<b>10 810</b>	<b>11 063</b>

Note: The above figures exclude electric fork-lift trucks and electric industrial tractors (commonly used for handling waste by property management companies within residential areas) which are special-purpose vehicles not intended for ordinary use on roads.



## Annex III

### Summary of preliminary observation of the trial of single-deck electric buses (up to 30 September 2018)

Franchised bus company/ Type of electric bus/ Manufacturer	No. of buses undergoing or completed the trial (No. of buses under trial)	(a) Total mileage (km) <sup>[i]</sup>	(b) Average Energy Consumption Rate (kWh/km)	(c) Emission Benefit (NO <sub>x</sub> / PM <sub>10</sub> ) <sup>[ii]</sup> (g/km)	(d) Average Electricity Cost (\$/km)	(e) Average No. of On- Road Breakdowns / Month <sup>[iii]</sup>	(f) Bus Availability (%) <sup>[iv]</sup>	(g) Projected driving range <sup>[v]</sup> (km)
KMB / Supercapacitor Buses / China Youngman Automobile Group Company Limited	2 (8)	61 800	2.34	NO <sub>x</sub> : 2.59  PM <sub>10</sub> : 0.11	2.84	0.1	53%	18
KMB/LWB / Battery- electric buses / BYD Auto Industry Company Limited (BYD)	14 (14)	83 600	1.25		1.55	0.01	75.9%	207
CTB/NWFB / Battery- electric buses / BYD <sup>[vi]</sup>	5 (5)	362 100	1.36		1.77	0.35	77.3%	191
CTB/NWFB / Battery- electric buses / Great Dragon International Corporation Limited	5 (5)	91 500	1.92		2.38	0.61	56.5%	115
NLB / Battery-electric buses / BYD	2 (2)	7 300	1.48		1.87	0	84.4%	175
NLB / Battery-electric buses <sup>[vii]</sup>	0 (2)	Not Applicable						

Notes:

[i] From trial commencement to the end of September 2018

[ii] NO<sub>x</sub>- Nitrogen oxides; PM<sub>10</sub>- Respirable suspended particulates

It is assumed that electric buses replaced the Euro V single-deck diesel buses running on the same routes to reduce the emissions. Emission from the power companies for the use of electric buses is not counted

[iii] Breakdowns only include failure of passenger-carrying buses which necessitate passenger evacuation except those owing to accidents

[iv] The outages unrelated to malfunctions (including inspections for Certificate of Road Worthiness/Certificate of Fitness, monthly inspections, routine maintenance/checking, cleaning) are excluded

[v] The projected driving range is calculated from usable battery capacity (80% of the highest battery capacity for Youngman and BYD, and 70% of the highest battery capacity for Great Dragon as recommended by the manufacturers) divided by average energy consumption rate

[iv] The trial completed in May 2018

[vii] Undergoing re-tender process

**The Trial of Single-deck Electric Franchised Buses  
Trial Report of Five BYD Battery-electric Buses**

1. The trial of five Citybus Limited (CTB)'s and New World First Bus Services Limited (NWFB)'s battery-electric buses manufactured by BYD Auto Industry Company Limited (BYD) commenced in December 2015 and completed in May 2018. The observation and findings are below.

***Technical Problems***

2. During the first year of the trial, four major technical issues leading to bus recall occurred for follow up inspections (including malfunction of bus doors, broken wheel bolts, malfunction of DC-DC converter for air conditioning systems and braking performance affected during rainy days by excessive regenerative braking torque), indicating that there was room for improvement for design and manufacturing of electric buses. With the endorsement of the Task Force, the trial period was extended for five months to make up the downtime for rectification of the problems. Malfunction of air-conditioning system<sup>[9]</sup> which occurred from time to time was another concern.

3. Despite the above teething problems, CTB/NWFB considered that the driving performance of BYD battery-electric buses was comparable with that of the conventional diesel buses.

***Bus Availability***

4. Unlike the well-developed repair and maintenance programmes for conventional diesel bus fleets, there were insufficient spare parts to support the repair and maintenance of the limited number of electric buses in particular when two or more of them concurrently encountered similar problem. The availability of the trial's buses was relatively low (overall average of about 77.3%), as compared to the diesel single-deck control bus<sup>[10]</sup> of 88.3%. As such, more electric buses would be required to maintain the same level of service.

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<sup>9</sup> BYD battery-electric buses' air-conditioning units are electrically driven while those of conventional diesel buses are commonly mechanically driven.

<sup>10</sup> Five diesel buses deployed on routes with similar characteristics of trial routes were selected as control buses serving as benchmark for comparing the operational performance of electric buses.

### ***Energy Consumption***

5. Unlike the public buses in other cities, the operational mode of franchised buses in Hong Kong is much more intensive<sup>[11]</sup>, characterised by high operation frequency, long service hours, high peak hour passenger capacity, hilly terrains, as well as high air-conditioning demand in hot and humid summer. These stringent operational conditions put electric buses, particularly their batteries to very severe test. The trial results showed that the average energy consumption of trial's buses was 1.36 kWh/km, which was much higher than that of the similar bus model in Shenzhen of about 1 kWh/km.

### ***Driving Range***

6. During the trial period, the overall average daily driving range of trial's buses is about 190 km<sup>[12]</sup>, despite manufacturer's reference of 250 km<sup>[13]</sup>. The relatively low average daily driving range of the trial's buses could not meet the normal daily requirement of most of CTB/NWFB's single deck bus routes of 200 to 300 km. Under high ambient temperature demanding higher loading of air-conditioning system, the driving range further decreased to about 150 km.

7. Referring to Shenzhen's experience, more battery-electric buses are required to be deployed at a ratio of battery-electric buses to diesel buses of 1.2 or above and top-up charging at public transport interchanges or bus termini during non-peak hours are the crucial elements to overcome the shortcoming of limited driving range.

### ***Benefits***

8. Throughout the trial, the five CTB/NWFB's BYD battery-electric buses traveled a total of 362 115 km. The electricity cost of battery-electric buses and fuel cost of diesel buses were \$1.77/km and \$3.34/km<sup>[14]</sup> respectively. Thus, the use of battery-electric buses could have \$568,520 saving in energy cost.

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<sup>11</sup> The average daily mileage of Shenzhen's public buses is about 185 km.

<sup>12</sup> 190 km is the projected driving range for fully-charged battery system based on the 80% usage battery capacity as recommended by BYD.

<sup>13</sup> The driving range is estimated by the manufacturer based on the usage conditions of typical public buses in China.

<sup>14</sup> The diesel price for bulk purchase by CTB/NWFB is assumed 60% of the list price.

### ***Repair and Maintenance***

9. As mentioned in paragraph 4 of this Annex, there was problem of insufficient spare parts to support the repair and maintenance of the limited number of electric buses.

10. After about one and a half year of operation of BYD electric buses, the projected average driving range after a full charge was decreased by about 15% indicating deterioration of the batteries of the buses. As such, the batteries of five battery-electric buses were replaced with new ones by BYD for free during warranty period and the projected driving range was then significantly improved. Additional cost would incur for replacement of the deteriorated batteries during the battery-electric buses' 8-year service life.

11. The performance of the charging facilities with an average availability rate of 99.3% was considered satisfactory. When compared to the maintenance cost of batteries, the maintenance cost of charging facilities was insignificant.

**Number of First Registered Electric Vehicles**  
**between April 2017 and December 2018**

<b>Year</b>	<b>Number of First Registered Electric Vehicles</b>
April to December 2017	99
January to February 2018	17
March to December 2018 *	454 (321 under “One-for-one Replacement” Scheme)

\* After the launch of “One-for-One Replacement” Scheme

**Distribution of Public Charging Facilities for Electric Vehicles**  
**(by District - as at the end of December 2018)**

District	Number of Chargers					
	Standard		Medium		Quick	
	Government	Non-Government	Government	Non-Government	Government	Non-Government
Central & Western	52	10	93	17	0	36
Eastern	11	17	50	13	0	52
Southern	0	4	0	11	0	27
Wan Chai	18	49	65	52	0	35
Kowloon City	61	3	0	1	0	15
Kwun Tong	13	201	4	77	0	42
Sham Shui Po	9	6	32	10	0	37
Wong Tai Sin	5	19	35	11	0	9
Yau Tsim Mong	40	61	6	36	0	50
Kwai Tsing	9	16	0	9	0	33
Tsuen Wan	7	10	33	13	0	9
Sai Kung	6	18	20	11	0	25
North	6	18	15	10	0	12
Tai Po	25	3	0	3	0	7
Sha Tin	43	34	20	24	0	47
Yuen Long	9	37	2	31	0	18
Tuen Mun	0	10	0	10	0	17
Islands	0	14	89	21	4	23
<b>Subtotal:</b>	<b>314<sup>[i]</sup></b>	<b>530</b>	<b>464<sup>[ii]</sup></b>	<b>360</b>	<b>4</b>	<b>494</b>
<b>Total:</b>	<b>844</b>		<b>824</b>		<b>498</b>	
	<b>2166</b>					

Note:

[i] Include (1) 94 chargers with both standard and medium charging functions installed at TD and GPA's car parks;

(2) 61 chargers located at car parks to be demolished; and

(3) 159 chargers located at Leisure and Cultural Services Department, Housing Department and Tourism Commission's car parks.

[ii] Include 94 chargers with both standard and medium charging functions as mentioned in Note [i](1). These chargers with two charging speeds provide an alternative for EVs, hence no need to be removed.