

Hong Kong ROADMAP ON POPULARISATION OF ELECTRIC VEHICLES



March 2021



環境局
Environment
Bureau

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Message from the Financial Secretary

In response to global climate change, electrification of transportation system has become a global trend. Adoption rate of electric vehicles (EVs) has been surging under relentless promotion from governments around the world. In 2010, there were only 17 000 pure battery EVs. The number increased by nearly 300 times to over 4.8 million in 2019. Many countries have also announced their intention to boost the adoption of EVs in the coming decade, as well as plans to reduce or even terminate the production of fuel-propelled vehicles.

Hong Kong is a world class city. The Government is determined to improve air quality and develop Hong Kong to be a smart city, and at the same time has set a target of striving for attainment of carbon neutrality before 2050. To reach these goals, promoting the use of EVs is a very vital measure. The Steering Committee on Promotion of Electric Vehicles that I chair has been actively promoting the use of EVs. After consulting the Committee and other stakeholders, the Government has formulated the Roadmap on Popularisation of EVs to comprehensively strengthen our efforts to push ahead the use of EVs and make preparation on all fronts to meet the new era of rapid and wide adoption of EVs, advancing towards zero vehicular emissions before 2050.

After the formulation of the Roadmap, we will soon promulgate the Clean Air Plan for Hong Kong 2035 and Hong Kong's Climate Action Plan 2050, which will respectively elaborate on the Government's overall strategies and measures to improve air quality and strive to achieve carbon neutrality so as to address climate change, driving Hong Kong in pursuit of green and sustainable development.

Looking ahead, the Government will continue devoting necessary resources and get prepared for the popularisation of EVs. I also look forward to the collaboration between all sectors of the society and the Government to make Hong Kong a more liveable, green and smart city.

Paul Chan Mo-po
Financial Secretary
March 2021



Message from the Secretary for the Environment

To tie in with the development of a green and liveable smart city, popularisation of electric vehicles (EVs) is a general trend. Hong Kong is making timely preparation for reducing carbon emissions, enhancing air quality, creating green employment, and upholding green recovery and the blueprint of a smart city with a view to benefitting the entire society.

Zero carbon emissions

The Chief Executive announced in the 2020 Policy Address that Hong Kong will endeavour to achieve carbon neutrality before 2050. Coupled with the transformation of low-carbon power supply, the promotion of zero carbon emissions from vehicles serves as one of the key strategies around the globe to strive for carbon neutrality and combat climate change.

Currently, transportation makes up of about 20% of carbon emissions in Hong Kong. Thus, while we are exploring how to reduce carbon emissions from generation of electricity and save energy, promoting popularisation of EVs in pursuit of zero carbon transportation is our key measure to drive for carbon neutrality.

Air quality

To further improve roadside air quality to enhance public health, the Government has implemented some key measures including promoting the replacement of diesel taxis and minibuses with liquefied petroleum gas ones since 2000, tightening the emission requirements of newly registered vehicles gradually (i.e. diesel private cars need to fulfil the emission standard of California Level III while other vehicles excluding motor cycles and electric tricycles have to meet Euro VI emission standards), phasing out pre-Euro IV diesel commercial vehicles from 2014 to 2020, as well as launching a scheme in 2020 to further phase out Euro IV diesel commercial vehicles. On the other hand, we have retrofitted Euro II and Euro III franchised buses to tighten the air pollutant emission standard to Euro IV.

The roadside air quality in Hong Kong has improved significantly over the past two decades under the multi-pronged approach. Compared with the highest levels, the concentration of major air pollutants such as sulphur dioxide, nitrogen dioxide, respirable suspended particulates and fine suspended particulates has dropped by 34% to 82%. The promotion of popularisation of EVs, irrespective of private cars or commercial vehicles, will further help improve air quality.

Keeping up with the times

We anticipate that EV technologies, in particular that on commercial and heavy vehicles, will develop rapidly in the future. The strategies of promoting popularisation of EVs will have to be adjusted in time, taking into account technological, environmental, social and economic developments. In this connection, the Roadmap is a living document, keeping up with the times.

We will review the strategies, measures, progress, etc. in the Roadmap around every five years with a view to providing an update to keep up with the developments and move towards the target of zero vehicular emissions early.

WONG Kam-sing
Secretary for the Environment
March 2021



Summary of Roadmap on Popularisation of Electric Vehicles

Vision ————— **Zero Carbon Emissions • Clean Air • Smart City**

Existing Key Initiatives

First Registration Tax (FRT) Concessions

FRT concessions and **One-for-One Replacement Scheme** for e-private cars. Accumulated concessions exceeding **\$7.4 billion** in 6 years since 2015

Lower Vehicle Licence Fees
Licence fees for e-private cars are lower

Free Charging
Free EV charging services at government car parks

Tax Concessions

Full FRT waiver and profits tax deduction for e-commercial vehicles

Supporting Technological Developments

\$1.1 billion New Energy Transport Fund to subsidise trials and application of green transport technologies

Private Charging Facilities

NEW BUILDINGS:
Must install charging infrastructure to apply for gross floor area concessions for car parks starting from 2011. 68 000 parking spaces have been approved

EXISTING BUILDINGS:
\$2 billion EV-charging at Home Subsidy Scheme open for application since end-2020 which is expected to subsidise installation of charging infrastructure for more than 60 000 parking spaces in existing private residential buildings

Public Charging Network

NEW BUILDINGS:
Install EV medium chargers at 30% of parking spaces at new government buildings

EXISTING CAR PARKS:
Allocated **\$120 million** to add 1 000+ medium chargers at government car parks by 2022

Green and Decarbonisation • Innovation and Cooperation

Multi-pronged approach to create conducive environment for popularisation of EVs

Task Force

Examine high-end development of new decarbonisation technologies globally, including new energy vehicles and fuel technology such as hydrogen fuel

Green Tech Fund

\$200 million Green Tech Fund to fund R&D of green technologies, including EV projects



Smart City

Make good use of development in technologies including Internet of Things, big data and artificial intelligence

Continue to promote the adoption of autonomous driving and technologies in smart mobility

Regional Collaboration

Seize opportunities to be brought about by the EV technological development in Greater Bay Area

Electric Private Cars

No new registration of fuel-propelled private cars including hybrid vehicles in 2035 or earlier



Tax Concessions

Increased the FRT concession cap under **One-for-One Replacement Scheme** for e-private cars to **\$287,500**

Extended FRT concessions and **One-for-One Replacement Scheme** to March 2024

Government Taking the Lead

EV as standard for government small and medium private cars to be procured or replaced

Public Organisations

Encourage public organisations to make reference to the government's new green procurement policy for vehicles

Electric Commercial Vehicles

Dedicated Trials

Promoting trials for electric public transport and commercial vehicles proactively, with a view to setting a more concrete way forward and timetable around 2025

Single-deck Bus



\$180 million trial for single-deck e-buses to put into service progressively to test the operational performance

Double-decker



Trials for double-deckers and other types of buses under New Energy Transport Fund (NET Fund)

Public Light Bus



\$80 million trial for e-public light buses to be commenced in 2023

Taxi



Explore with operators for suitable operational mode and EV models for trial

Goods Vehicle



Trial for available medium goods vehicles model under NET Fund

Other Vehicles



Funding scope of NET Fund expanded to cover motorcycles and non-road vehicles

Charging Network

Private Charging Facilities

2025 ≥150 000

With the encouragement and incentive measures, we expect more private commercial or residential parking spaces to be equipped with charging infrastructure

Examine requiring parking spaces in new private buildings to be equipped with charging infrastructure

Public Charging Facilities

2025 ≥5000
(Plan to double in the future)

Public Transport

Designate charging bays for public transport at public transport interchanges of new development areas

Quick Charging Facilities

Identify sites for a territory-wide quick charging network, including exploring the feasibility to convert petrol and LPG filling stations to charging stations

Promoting Marketisation

Fees for EV charging at government car parks to be imposed from around 2025

Marketise charging services progressively with a view to promoting its sustainable development in the long run

Travelling to the Mainland

Study proposals to facilitate EV charging in the Mainland

Maintenance Services

Post-secondary Training

Work closely with post-secondary institutions to provide sufficient training, re-training and education opportunities

Collaboration with the Trade

Strengthen communication with the trade and facilitate cooperation between EV suppliers and local institutes to offer additional education programmes



Battery Recycling

Eco-responsibility

Strive to legislate a Producer Responsibility Scheme for retired EV batteries in the next few years

Green Technologies

Cover second life applications of EV batteries in the priority themes under the **Green Tech Fund**



Target



Before 2050

Zero Vehicular Emissions

Act in concert with Hong Kong's target to achieve carbon neutrality before 2050

Regular reviews Strategies and targets will be reviewed roughly every 5 years to keep abreast of the latest situation

1 Vision

1.1 Electric vehicles (EVs) have no engines thus no emission of air pollutant at roadside. Their designs allow easy integration with artificial intelligence and wireless network, thus enhancing performance, functions and safety of vehicles remarkably, and enable smart features that make lives more comfortable and convenient. In this context, the wider or eventual full adoption of EVs will be a key element that drives Hong Kong towards the vision of **“Zero Carbon Emissions • Clean Air • Smart City”**.

Zero Carbon Emissions • Clean Air • Smart City

1.2 Hong Kong strives to achieve the target of zero vehicular emissions before 2050 in order to facilitate the attainment of carbon neutrality within the same time frame and improve air quality concurrently. The technology of e-private cars has become relatively mature and their market supply will increase quickly, gradually replacing conventional fuel-propelled private cars. The technological development of other types of EVs is also anticipated to catch up with that of e-private

cars in the next few years. In view of the above, we need to keep abreast of their development with a view to identifying technologies and models suitable for local applications in the future. As regards infrastructure, the establishment of a charging network to support EVs is vital, coupled with marketisation of the network to ensure its sustainable development. On the other hand, talents to support adoption of EV technology and appropriate handling of retired EV batteries are subjects that need to be thoroughly considered in the course of attaining zero vehicular emissions. Against the above, we have devised short, medium and long term strategies that comprehensively cover all key areas of EV development in Hong Kong.

1.3 Realising the vision requires both the private and public sectors to stay innovative and open-minded so as to embrace new trends and operational modes that come along with EV development, and to work hand in hand with each other to strive to attain zero vehicular emissions. We look forward to collaborating closely with different stakeholders, supporting Hong Kong to become a frontrunner in capitalising on the opportunities brought about by EV development.

The new generation of EV technology


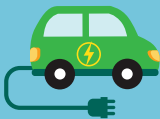


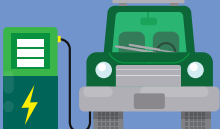


Smart mobility is an important cornerstone of Hong Kong's development as a smart city. As the Internet of Things, sensor technologies, artificial intelligence, automation, big data mature over time, the Government needs to systematically optimise the use of innovative technologies to improve the transport system. The Transport Department published the Smart Mobility Roadmap for Hong Kong in July 2019, which sets out specific actions in the next 5 years under three key strategies, namely Smart Transport Infrastructure, Data Sharing and Analytics, and Applications and Services. Actions include commencing the pilot intelligent traffic signal system, automatically detecting the real-time volume of pedestrians and vehicles, examining vehicle technologies such as autonomous vehicles and the vehicle-to-everything (V2X) technology, developing a big data platform to enable different sources of traffic data to be linked, correlated, combined and analysed, exploring introduction of a smart parking system to provide real-time parking vacancy information, etc.

In the context of developing smart mobility, apart from being more environmentally friendly, the development of new generation EV technology can combine with the new generation technologies including mobile communications, V2X technology, big data, and artificial intelligence mentioned above. This can also achieve synergy with the development of smart transport and smart city. The rapid development of these “smart vehicles” has been encouraging car manufacturing trade

to develop and enhance the various new technologies including driver assistance systems and environmental sensing. In addition, these smart vehicles can provide real-time information to compute road infrastructure, traffic environment, as well as traffic management. All these make operating vehicles more humanised, safer, and more comfortable and effective than conventional vehicles.

The development of smart vehicles has also facilitated breakthrough of autonomous vehicles, and some countries have begun putting the associated technology into test on road. The Mainland is also advancing rapidly in this regard: in the middle of last year, there were more than 20 cities in the Mainland allowing corporations to commence road test of autonomous vehicles, involving roads more than 2 600 kilometres. Some cities have further commenced trials for carrying passengers and goods. Hong Kong has also conducted trials at designated routes. The trial sites include CIC-Zero Carbon Park, West Kowloon Cultural District, Hong Kong Science Park, Hong Kong University of Science and Technology, Tai Po Industrial Estate, Hong Kong Air Cargo Terminals, Hong Kong Productivity Council, etc. The Transport Department has also set up the Technical Advisory Committee on the Application of Autonomous Vehicle Technologies in Hong Kong in November 2019. The Committee, comprising representatives and experts from the trade and relevant research and development institutes, explores how best to draw up an appropriate regulatory framework for autonomous vehicles.

Figure 1 Target and new key measures

Target	
<p>Zero vehicular emissions by 2050 To act in concert with Hong Kong's target to achieve carbon neutrality before 2050</p> 	
Key Measures	
<p>E-private cars</p> 	No new registration of fuel-propelled private cars including hybrid vehicles in 2035 or earlier
<p>E-commercial vehicles</p> 	Promote trials for e-public transport and commercial vehicles proactively in the next few years, with a view to setting a more concrete way forward and timetable around 2025
<p>Government fleet</p> 	Set EV as standard for government small and medium private cars to be procured or replaced
<p>Charging network</p> 	Develop a comprehensive and proper EV charging network comprising public and private charging facilities, and promote its marketisation for sustainable development
<p>Maintenance services</p> 	Provide sufficient training, re-training and education opportunities to groom professionals and mechanics to support development of EV technology and maintenance
<p>Battery recycling</p> 	Strive to legislate a Producer Responsibility Scheme for retired EV batteries in the next few years

2 Challenges and Progress Made



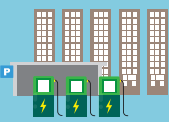

Overall Challenges

- 2.1 Hong Kong has an extremely high population density and compact urban form. Adoption of EVs in Hong Kong comes with challenges unique to the city, including setting up appropriate charging infrastructure and identifying models of EVs that are suitable for local application. As Hong Kong's roads are relatively narrow, there is not much space for installation of roadside charging facilities. Unlike other places where people live in houses or less populated setting, most buildings in Hong Kong are high-rises with comparatively less number of parking spaces. Given that these buildings are usually of multiple ownership and under third-party property management, Hong Kong's EV owners are often required to obtain consent from other owners of the same premises for the installation of charging facilities at parking spaces, and may encounter other sticky issues including the concern about electricity supply and installation costs of charging infrastructure.
- 2.2 On the other hand, as Hong Kong has a hilly terrain, vehicles are often required to run on slopes. The hot and humid weather also demands air-conditioning for most of the time. Hence, EVs in Hong Kong need to have greater battery capacity than that in many other places.
- 2.3 In Hong Kong, 90% of the total passenger trips each day are made through public transport. Hence, public transport has long operating hours and travel distance every day. For example, a taxi is generally being operated for over 20 hours and over 400 km on a daily basis; whereas more than 95% of public buses adopt large double-deck buses with large capacity to cope with the passenger demand and mitigate traffic congestion. Similar double-deck buses are rarely used in other places and there is yet supply that can match Hong Kong's various operational needs. EV technologies suitable for heavy transport are also under development around the globe.

Current Policies and Measures

- 2.4 The Government has been promoting EV adoption and has formulated a series of policies and measures. Given that the structure of EVs is very different from that of conventional fuel-propelled vehicles, a new set of type approval requirements¹ has been established separately to cover the battery and charging system. The calculation of vehicle licence fees for e-private cars are also based on the vehicle weight, instead of cylinder capacity of engines for petrol or diesel private cars.

Figure 2 Current measures promoting EV adoption

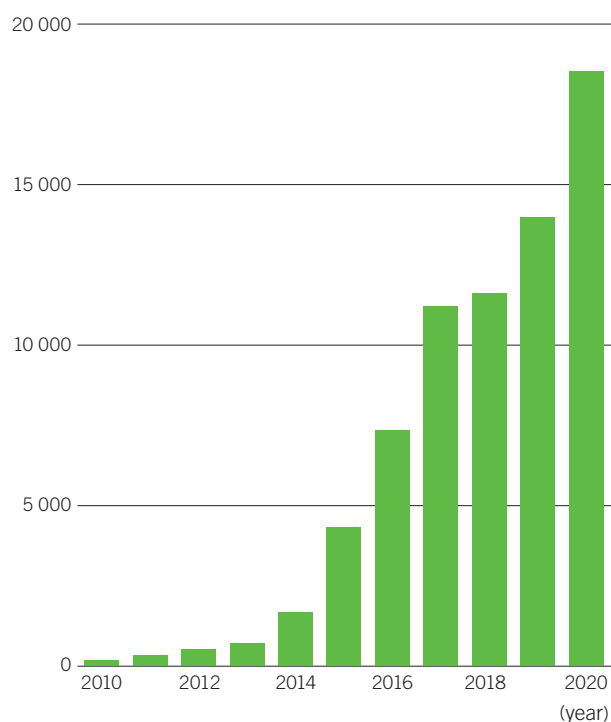
Financial incentives 	First registration tax (FRT) concessions and One-for-One Replacement Scheme for e-private cars. Accumulated concessions exceeding \$7.4 billion in 6 years since 2015
	Full FRT waiver for e-commercial vehicles and profits tax deduction
	Lower licence fees for e-private cars
	Free EV charging services at government car parks
Public charging network 	\$120 million fund in 2019 to add 1 000+ medium chargers at government car parks, making a total of 1 800 chargers by 2022
	Install EV medium chargers at 30% of parking spaces at new government buildings
	Update the requirements for EV charging network in the <i>Hong Kong Planning Standards and Guidelines</i> and the Government Circular on <i>Green Government Buildings</i>
Private charging facilities 	Charging infrastructure installed in new buildings in order to be qualified for gross floor area concessions for their car parks starting from 2011. 68 000 parking spaces approved
	\$2 billion EV-charging at Home Subsidy Scheme launched in October 2020. Expected to subsidise installation of charging infrastructure for over 60 000 parking spaces in existing private residential buildings
Trial of EVs and relevant technologies 	\$80 million trial for e-public light buses
	\$180 million trial for single-deck e-buses
	\$1.1 billion New Energy Transport Fund to subsidise trials and applications of green transport technologies
	\$200 million Green Tech Fund to fund research and development (R&D) of green technologies, including EV projects

1. Prior to vehicle registration, applications should be made to the Transport Department for vehicle type approval or parallel import pre-registration inspection so as to ensure that the design and constructions of vehicles comply with the requirements stipulated in the Road Traffic Ordinance (Cap. 374) and its subsidiary regulations.

Progress Made

2.5 The number of EVs in Hong Kong has grown by more than 100 times, from about 180 in 2010 to over 18 500 by the end of 2020. The growth reflects the increasing acceptance of EVs among the public. Among the 18 500 EVs in 2020, more than 18 100 are e-private cars, which made up 2.7% of all private cars. We have observed an increasing market share of e-private cars in Hong Kong in the recent years. Their percentage among all new private cars has grown from 0.1% in 2010, 5.2% in 2015 to 12.4% in 2020, representing 1 out of every 8 new private cars is electric. The increase in adoption rate compares well with other economies.

Figure 3 Number of EVs in Hong Kong in 2010-2020



2.6 Globally, EV as a whole is still at the early stage of development. While technologies of e-private cars are getting more mature, models available in the market are less than that of fuel-propelled private cars at this stage. However, with countries making efforts to promote EV application and encouraging car manufacturers to conduct research and development, we will certainly see exponential developments in the EV technologies and their applications in the years to come. The breakthroughs in e-private cars will also

Figure 4 Percentage of e-private cars among newly registered private cars in Hong Kong

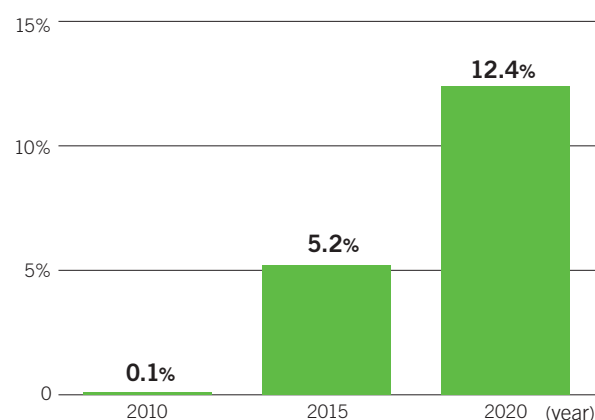
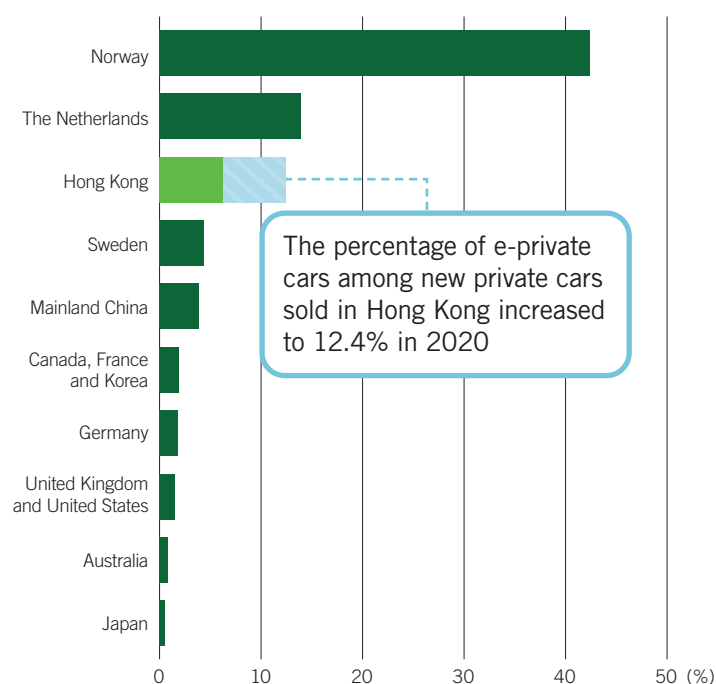


Figure 5 Electric car market shares of major economies in 2019



extend to various commercial and heavy vehicles. We will keep abreast of the technological development on various fronts and make reference to policies and measures to be taken by other economies. In the meantime, we will work hard to establish local charging infrastructure and encourage the trade to conduct trials on different e-commercial vehicles so as to get prepared for the new era of EV. Our strategies and measures are elaborated in the ensuing chapters.

3 Targets and Promotion

I. EV Readiness

3.1.1 To attain our long-term target of zero vehicular emissions before 2050, we have to formulate a comprehensive set of strategies that diligently identifies gaps for actions and prioritises tasks, taking into account various factors including technological development, local environment, social acceptance and economic considerations. In general, a type of EV is ready for wider adoption if it suits the criteria below.

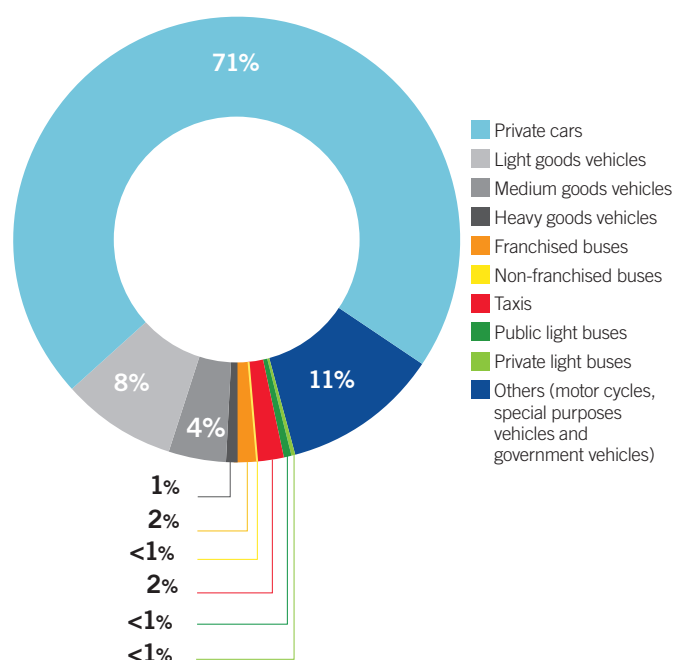
Technological readiness

3.1.2 The technology of the type of EV must be relatively mature and reliable. The battery capacity, driving range and payload have to meet local operational requirements. Other factors such as charging speed, battery life and safety also need to be considered.

Vehicle availability

3.1.3 Steady local supply is of paramount importance to promote healthy market competition, provide choices to the public, and enhance confidence in EVs. The market should provide models of different prices for vehicle owners to choose. In particular, the supply of affordable models is an important prerequisite for wider EV adoption.

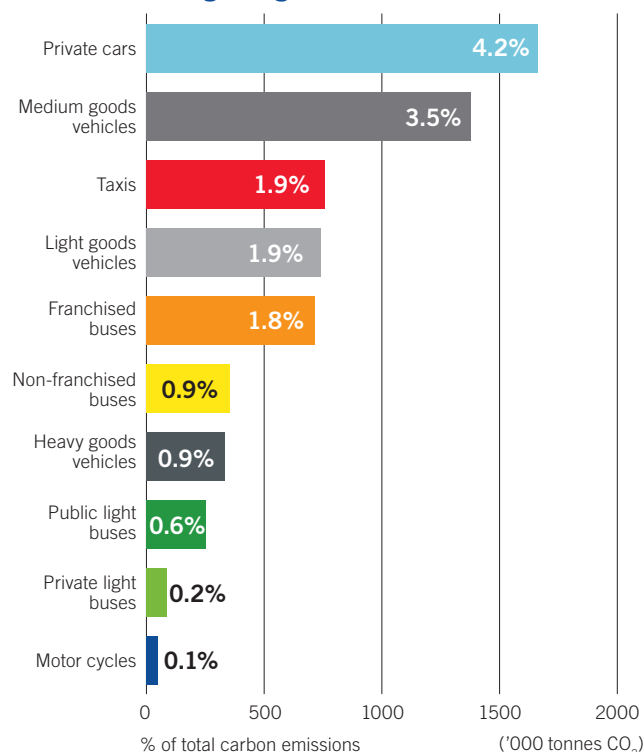
Figure 6 Types and numbers of registered vehicles in Hong Kong



Supporting facilities

3.1.4 Sufficient charging facilities are required. Affordable charging and supporting facilities, as well as timely and cost effective maintenance support are both essential for the popularisation of EVs.

Figure 7 Carbon emissions of vehicles in Hong Kong in 2018



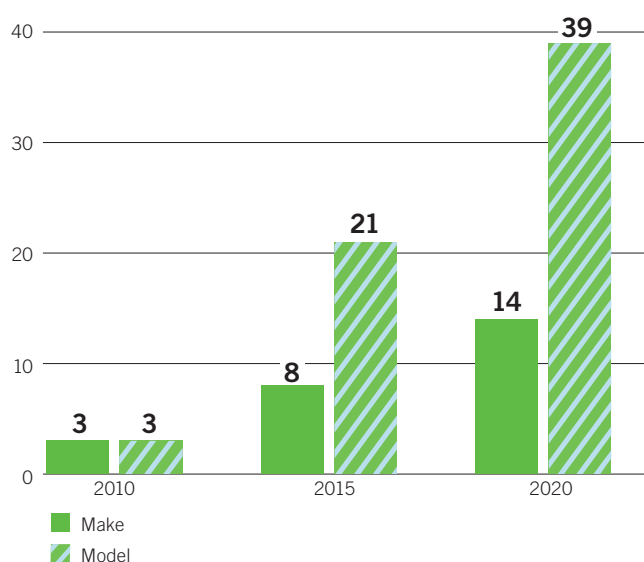
II. Electric Private Cars

3.2.1 Private cars account for more than 70% of vehicles in Hong Kong, and their total carbon emissions are the highest among vehicle types. Hence, promoting use of e-private cars can speed up the pace towards carbon neutrality. As the technology of e-private cars is relatively mature, there are more and more models suitable for wider applications available in the market. In view of this, it is appropriate to first focus on the promotion of e-private cars.

3.2.2 The battery capacity of e-private cars has been enhancing significantly and charging speed is also catching up. New models introduced in the last two years often have a range of over 300 km under a single charge, with some reaching over 500 km. Most of these models can also be charged to 80% full within an hour. Such rapid development renders e-private cars suitable for daily use in Hong Kong generally.

3.2.3 The global market of e-private cars has been also expanding dramatically in the past few years. Major car manufacturing countries including the Mainland China, Korea, and the United States have implemented various measures to encourage their car manufacturers to increase production of EVs and intensify the associated R&D. Local car importers and suppliers also introduce more and more EV models to Hong Kong. In 2020, there were 39 e-private car models from 14 manufacturers locally.

Figure 8 Local supply of e-private cars in 2010-2020



3.2.4 As for the supply of more affordable e-private cars, there were only 6 models priced \$400,000 or less (before first registration tax) in early 2018. The number has increased to 25 in 2020, i.e. 4 times more in the past 2-3 years. It is expected that more affordable models will enter the market given conventional car manufacturers are allocating additional resources to develop EVs and some of them have already set timelines to produce only EVs in the foreseeable future.

3.2.5 As regards charging facilities for e-private cars, we notice that there are two major trends of development. Some drivers rely on public charging facilities provided by car manufacturers, the Government and private sectors. Others charge at home, office or places where they often visit. Details will be set out in the next chapter.

Pure battery electric vehicles, plug-in hybrid electric vehicles, and hybrids



Pure battery electric vehicles (BEVs) are propelled by only battery and emit no air pollutant when running. BEV models available in the local market currently can already travel for at least 100 to 500 km after a full charge. In practice, range varies according to driving pattern, terrain the vehicles run on, and the use of other vehicular equipment such as air conditioning.

Plug-in hybrid electric vehicles (PHEVs) are propelled by batteries. They also use another fuel, usually gasoline, to power an internal combustion engine. These vehicles typically run on electric power until the battery is depleted, and then automatically switch over to the other fuel. They have a smaller battery than BEVs.

Hybrids do not need to plug in. They are basically fuel-propelled vehicles with a small battery which can be recharged during driving. The batteries are complementary and can only drive for a limited distance usually. Therefore, the market share of hybrids has been, to a certain degree, absorbed by PHEVs in recent years.

Compared with conventional fuel-propelled vehicles, PHEVs and hybrids may have less emission of air pollutants. However, whether these vehicles are really less polluting is subject to the driving mode of users, i.e. how much time the vehicles are propelled by batteries. As these vehicles carry a battery, a motor and an engine each, they are heavier than fuel-propelled vehicles of similar types and require more fuel to drive. Hence, if these vehicles are propelled by fuel most of the time, they might be less environmentally friendly than fuel-propelled vehicles.

PHEVs and hybrids are usually higher priced than conventional vehicles. With the decreasing EV prices and improving range, these vehicles will lose their market share over time, and the global development speaks for itself. In 2019, there was a 10% year-on-year drop in the worldwide sales of plug-in hybrid electric cars, whereas e-private cars accounted for almost three-quarters of worldwide combined sales of e-private cars and plug-in hybrid electric cars.

More importantly, PHEVs and hybrids still emit roadside air pollutants and are not the ultimate solution to achieve zero roadside emissions. By the same token, the Mainland China and the United Kingdom have already taken steps to reduce or withdraw their incentives. The United Kingdom will also ban the sale of hybrids from 2035. Taking into account the local circumstances, Hong Kong should focus on promoting EVs and other new energy vehicles that emit no roadside air pollutant.

No new registration of fuel-propelled private cars including different types of hybrids in Hong Kong in 2035 or earlier



3.2.6 A number of leading economies in EV adoption such as Denmark, Ireland, and the Netherlands have announced targets for 100% zero emission vehicle (ZEV) sales for private cars in the next decade or two. For Norway, the economy with highest EV adoption rate in the world, the target for 100% ZEV sale is set at 2025. To cater for the demand of EVs in the private car market, many conventional car manufacturers have formulated plans to shift their focus to develop and produce EVs. Hong Kong needs to plan ahead to act in tandem with the world to phase out fuel-propelled vehicles progressively, with a view to heading towards our target of zero vehicular emissions.

3.2.7 Taking into account the global trend to promote EVs, Hong Kong will **stop new registration of fuel-propelled private cars, including plug-in hybrids and hybrids, in 2035 or earlier**. This target will prompt stakeholders to prepare for better transition to EVs. For instance, public and private organisations can plan for charging facilities accordingly, while more models of e-private cars of different price levels and performance could be timely introduced into the market. Furthermore, post-secondary institutions can offer training and re-training to professionals and technicians in the repair and maintenance sector. Car manufacturers and importers can also plan for the recycling arrangement of EV batteries with the recycling trade.

3.2.8 We will review the Roadmap roughly every 5 years. Depending on the then global technological development, local EV uptake, the development of supporting facilities, etc., we will examine whether it is opportune to set timetables for the electrification of other fuel-propelled vehicles, including public transport and other commercial vehicles. We will also consider if there is any room to promulgate more aggressive targets to attain zero vehicular emissions. In particular, we will pay special attention to e-light goods vehicles and e-motor cycles as the development of these two types of EVs will likely become comparatively mature in the next few years and more popular in the international market. In the long term, we will also actively explore the possibility to stop renewing vehicle licences of fuel-propelled vehicles before 2050 in order to cater for Hong Kong to achieve carbon neutrality within the same timeframe.

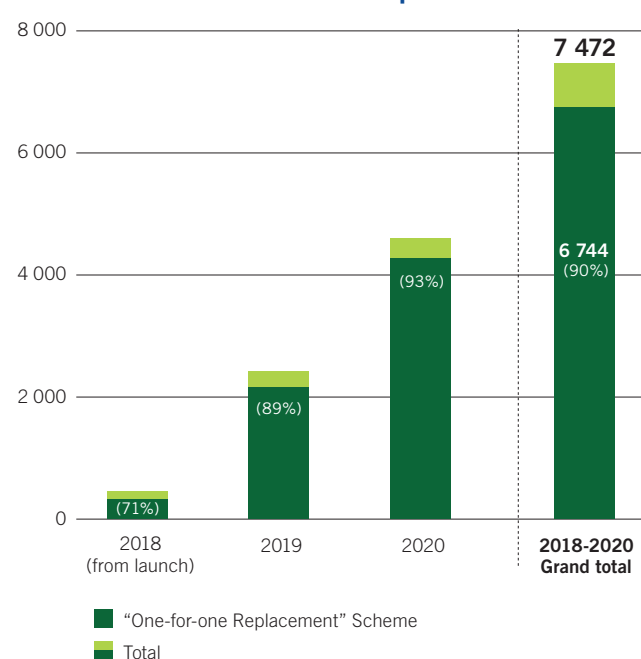
Use of financial incentives

3.2.9 Subsidies and tax concessions can lower the costs of purchasing and using EVs, thus narrow the gap in total cost of ownership between EVs and their fuel-propelled counterparts. They have been one of the effective government measures in increasing adoption of EVs both locally and internationally.

3.2.10 In view of land scarcity and population density in Hong Kong, it is important to strike a balance between promoting adoption of EVs and giving unintentional impetus to vehicular growth. Therefore, Hong Kong has implemented the “One-for-One Replacement” Scheme since 28 February 2018 to provide higher first registration tax (FRT) concessions to car owners that replace their old private cars with EVs. From 24 February 2021, EV owners can enjoy FRT concessions at \$287,500 under the Scheme, while the basic FRT concession level for new EVs not under the Scheme is \$97,500. E-commercial vehicles will continue to have their FRT fully waived.

3.2.11 The “One-for-One Replacement” Scheme is proven to be effective. From its launch to the end of 2020, around 90% of the 7 500 first registered e-private cars have opted for the Scheme.

Figure 9 New e-private cars registered and their FRT arrangements from the launch of the “One-for-One Replacement” Scheme



3.2.12 In view of the success of the FRT concession arrangements, the Government has announced in 2020 the extension of the deadline for three years from March 2021 to March 2024. We are confident that the arrangements will continue to keep EVs' competitiveness while addressing public concerns about vehicular growth.

3.2.13 Looking forward, as more and more affordable e-private cars enter into the local market, the cost of purchasing and using EVs will become increasingly closer or even the same as that of fuel-propelled vehicles. It is worthwhile to note that certain economies leading in EV adoption have already adjusted their policy and reduced subsidies for purchasing EVs. We will closely monitor the market development. When the cost gaps between EVs and fuel-propelled vehicles narrow in the local market, the Government will review policies for subsidies and concessions in good time and may adjust relevant financial incentives, making reference to other economies' experience.

Other measures to promote EVs

Mobile app: The Government's overarching policy is to encourage owners of e-private cars to charge at home or workplace. That said, we are preparing to set up a mobile app that is handy for EV drivers to locate vacant public chargers when needed. When the platform is ready, we will explore inviting other private organisations to provide information on the availability of their chargers so as to make the app more comprehensive.

Designated parking spaces: The Transport Department has been implementing a trial scheme since August 2020 to designate some parking spaces equipped with EV chargers in four government car parks (i.e. Rumsey Street Car Park, Star Ferry Car Park, City Hall Car Park and Tin Hau Car Park) for EVs' exclusive use. Any non-EVs occupying such parking spaces are impounded and only released upon settlement of a charge of \$320. The Transport Department is reviewing the trial scheme.

Eco-driving: The Transport Department introduces the "Driving on Lantau Island" scheme to enable members of the public to drive their own private cars via the closed roads on Lantau Island on weekdays when the traffic is not heavy, to visit places such as Ngong Ping, Tai O, Cheung Sha and Mui Wo for leisure and recreational purposes. To promote green mobility, 5 of the 25 quotas under the scheme will be reserved for e-private cars.

III. Electric Commercial Vehicles

3.3.1 Promoting adoption of e-commercial vehicles has met with different challenges. First of all, e-commercial vehicle models available nowadays generally do not have the battery capacity to cope with the unique and demanding operating environment in Hong Kong that requires air-conditioning all seasons and has hilly terrains. Commercial vehicles often have long hours of operation, high daily mileage and high passenger loading, thus speedy and affordable repair and maintenance services are needed to meet their operational needs.

3.3.2 On the other hand, most types of e-commercial vehicles are still in an early stage of development globally and are not yet ready for mass application in business. For example, the current price of a double-deck e-bus is more than double of a diesel counterpart. The high loading also requires operators to change batteries frequently, thus escalating the operating costs. Furthermore, the types of double-deck buses and public light buses commonly used in Hong Kong are not usually found in other parts of the world. The development and production of these types of vehicles are noticeably slower than other vehicle types that are commonly adopted in the global market. Options are therefore very limited.






3.3.3 Yet, the cost of EV batteries has fallen over 80% in the past 10 years and the energy density of new battery models has enhanced remarkably. The new generation of lithium-ion battery technology is much improved with regard to fire resistance, environmental friendliness, quick charging capability and life span. As for other next generation batteries including lithium air battery, nanotech battery, lithium sulphur battery, solid state electrolytes battery, etc., their energy density, charging speed, durability, safety and other aspects are all expected to register further enhancement. The breakthrough in technology will help tackle the current challenges faced when switching to e-commercial vehicles.

3.3.4 The Government will pave the way for the trades to switch to e-commercial vehicles progressively in the coming few years. As the first step, we will continue to conduct trials together with the trades to test the technical and commercial viability of different types of e-commercial vehicles for use in the local environment, so as to identify the best options for Hong Kong. We will take the opportunity of the 5-year regular review mentioned above to assess the situation as a whole in around 2025. Subject to the development of technologies and supporting facilities, we will then set out a more concrete way forward and timetable for the promotion of e-commercial vehicles.

3.3.5 Apart from the above, as the Mainland is the world's frontrunner in the manufacturing, R&D and application of EVs, including e-commercial vehicles, we will closely monitor the development with a view to tapping the ample opportunities that include application of suitable technologies and models, participation in the R&D, learning practical experience of applying e-commercial vehicles, and developing smart mobility with the use of big data and artificial intelligence.

Taxis

Figure 11 Registered taxis in Hong Kong

	LPG 	Petrol 
Urban taxi 	15 247	3
New Territories taxi 	2 838	0
Lantau taxi 	75	0

3.3.6 Taxis have a payload similar to a private car. However, it is common for a taxi in Hong Kong to run for more than 20 hours and over 400 km a day. Apart from requiring convenient and quick charging, taxi drivers also demand to have their vehicles repaired and/or serviced within a very short period of time.

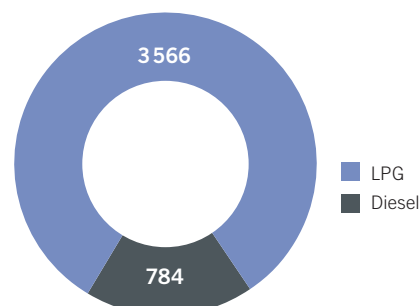
3.3.7 On the other hand, EV suppliers are usually providing warranty for batteries for around 6 to 8 years or 150 000 to 240 000 km. However, as an average taxi will be operated for more than 100 000 km a year, change of batteries may occur frequently under the current technology, leading to operating cost concern.

3.3.8 To overcome the challenges, the Government is identifying potential sites for setting up quick charging stations across the territory. Details will be set out in the next chapter. The Government has also been actively approaching and encouraging vehicle suppliers to introduce suitable e-taxi models to Hong Kong, and provide longer warranty period for the batteries and timely maintenance support.

3.3.9 Currently, we are in close liaison with taxi operators for a potential trial of e-taxis to test the operation and performance of different e-taxi models. We explore to first conduct a small-scale trial in relatively confined areas including Lantau Island and Sai Kung. In parallel, various government departments have been working together to identify appropriate locations in the above two areas to set up quick EV chargers for e-taxis. The outcomes of the e-taxi trial will be useful for the trade to identify viable operational modes and EV models, and facilitate the Government to formulate policies and measures to further promote electrification of taxis.

Public light buses (PLBs)

Figure 12 PLBs in Hong Kong by fuel used



- 3.3.10 PLB is a unique mode of transportation in Hong Kong with a unique dimension, specification and number of seats, and no suitable e-PLB has been introduced to the local market. To speed up the adoption of e-PLBs in Hong Kong, the Government engaged the Hong Kong Productivity Council in March 2019 to develop the basic specifications and requirements for e-PLBs and their charging facilities that are suitable for the local operating environment, in order to provide guidance to EV manufacturers and charging service providers in the manufacturing of e-PLBs capable of fast charging and their charging facilities. Relevant guidelines were published in October 2020.



- 3.3.11 The Government earmarked \$80 million in 2020 to launch a 12-month trial that will subsidise about 40 e-PLBs running on various routes so as to test their operations under local environment. We will first focus on green PLBs as they are running on fixed routes that are relatively short and hence their requirements on driving range and charging power are easier to cope with. Quick charging facilities will be installed at the termini, public transport interchanges or other places where the PLBs operate.
- 3.3.12 The Government anticipates that the trial scheme will commence in 2023 and it will help gather operational data from PLB operators and charging service providers during the trial, so as to evaluate the performance of e-PLBs and their charging facilities, and devise a concrete and feasible roadmap for the electrification of PLBs.

Environmentally Friendly Linkage System for Kowloon East



With the gradual development and transformation of Kowloon East into the second core business district of Hong Kong, there is progressive rise in the residential and working populations in the area. Relevant government departments have been contributing to provide appropriate transport infrastructure facilities and convenient public transport services to cope with the traffic demand in the area.

On the basis of the increasingly comprehensive road and railway infrastructures facilities, as well as convenient public transport services provision in Kowloon East, a study by the Development Bureau recommends to implement a supplementary “multi-modal” Environmentally Friendly Linkage System, which comprises a package of green initiatives that serve complementarily to enhance connectivity in the area. They include enhancing public transport services in Kowloon East, and deploying EVs to run new bus and green PLB routes in the area for connecting Kai Tak Development Area, Kowloon Bay and Kwun Tong with Mass Transit Railway (MTR) stations and neighbouring districts such as Yau Tong, Sau Mau Ping and Diamond Hill. The Government plans to gradually introduce from 2021 onwards the use of e-buses and e-PLBs for the additional routes, and will also introduce green and smart transport initiatives, adhering to the vision of shaping Kai Tak Development Area into a green community.

Moreover, smart public transport interchanges will be provided at Kwun Tong, Kowloon Bay and the Tourism Node site in Kai Tak. Apart from the provision of charging facilities to support the deployment of e-buses and e-PLBs, the smart public transport interchanges will also offer better passenger waiting environment and facilities such as air-conditioned waiting halls with seats, free Wi-Fi service and interactive display panels.



Buses

3.3.13 Franchised buses are one of the major sources of nitrogen oxides emission, accounting for 17% of vehicular emissions. Hence, mitigating emissions from double-deck buses have been one of the key tasks of the Government to improve air quality. With e-bus models emerging in the global market, Hong Kong is pushing ahead with our research and trial with a view to electrifying the bus fleet.

3.3.14 Currently, more than 95% of the franchised buses are double deckers, which need more powerful battery to support their bigger size and higher passenger capacity than single-deck buses. As the double-deck buses used in Hong Kong are not commonly adopted in other parts of the world, their development and production are relatively sluggish. Therefore, as the first step to electrify the bus fleet, the Government has been examining the performance, reliability and commercial viability of the single-deck e-buses in local conditions by subsidising franchised bus companies (FBCs) to purchase 36 single-deck e-buses for trial.

Figure 13 Franchised buses in Hong Kong

	Single-deck	Double-deck
The Kowloon Motors Bus Co. (1933) Limited (KMB)	143	3 885
Citybus Limited (CTB)	34	1 002
New World First Bus Services Limited (NWFB)	17	673
Long Win Bus Limited (LWB)	4	237
New Lantao Bus Company (1973) Limited (NLB)	92	58

3.3.15 In the meantime, the Government has been working with the FBCs to install new charging facilities at Hong Kong Station Bus Terminus, Central Ferry Bus Terminus and Kai Tak Cruise Terminal for single-deck e-buses to conduct top-up charging during daytime, in order to test the suitability of this operational mode for frequent bus services in Hong Kong.



3.3.16 The initial findings of the trial show that the passenger carrying capacity and driving performance of the single-deck e-buses are comparable with that of conventional buses. However, the wider use of single-deck e-buses locally hinges on their ability to cope with the distance normally travelled by their conventional counterparts. We expect that the range constraints could be overcome in the next few years when the battery capacity is further enhanced to support more than 300 km a day after a full charge; or if there are adequate charging facilities at bus termini and public transport interchanges for top-up charging during daytime operation. Fleet management is also a feasible option, taking into account experiences in other places.

3.3.17 In view of the Government's support and experience gained over the years, the FBCs are more experienced in the adoption of e-buses and are taking proactive actions including procuring more e-buses to conduct further trials or replace diesel buses that will retire soon. They are also establishing new depots equipped with charging facilities, carrying out conversion works for existing bus termini, and training more staff for the maintenance of e-buses. In view of the above, the Government is in active discussion with the FBCs on the arrangement of the full electrification of single-deck buses.

3.3.18 On the other hand, the FBCs are keen on putting on trial double-deck e-buses with higher passenger capacity and battery performance that are available recently in a few foreign markets. The New Energy Transport Fund (NET Fund) has approved funding to two FBCs to embark on trials of the double-deck e-buses in the next two years.

3.3.19 Apart from franchised single- and double-deck e-buses, the NET Fund is also supporting trials for non-franchised buses such as shuttle buses serving residential estates or coaches. With the improving battery technology and performance of these buses, we will continue exploring the adoption of e-buses with different operators.

3.3.20 We will make use of the opportunity of the review every 5 years to examine the trial outcomes. Taking into account the international development and production of large e-buses, we will proceed to explore formulating strategies and timetables for electrification of both the franchised and non-franchised bus fleets in Hong Kong.



Fund and are proven to be reliable and have similar performance and lower fuel costs than their diesel counterparts. Although most of the existing models can only support modest daily use, the technological development should be able to support their wider adoption within a moderate period of time. However, similar to taxis, we have to cope with the requirements for speedy and affordable maintenance and relatively frequent change of batteries.

New Energy Transport Fund

The NET Fund (previously named Pilot Green Transport Fund) was set up in March 2011 to subsidise the transport sector, charitable organisations and non-profit making organisations to try out green innovative transport technologies.

As at end-2020, the Fund has approved 196 trial applications. These applications involved 163 e-commercial vehicles, 103 hybrid commercial vehicles and 9 technologies applicable to conventional buses or ferries. About \$154 million of subsidy was approved.

To further promote the trial and use of green innovative transport technologies, the Government has injected another \$800 million into the Fund in 2020 to extend its scope. The Fund will now subsidise trials of various modes of transport including goods vehicles, taxis, light buses, buses, vessels, motor cycles, non-road vehicles, etc. The subsidy cap for each trial application has been increased to \$10 million. The Fund will also support the transport sector, charitable organisations and non-profit making organisations to directly purchase products of technologies that have been tested to be mature and suitable for local use, with a view to facilitating their wider adoption.

Light goods vehicles

3.3.21 The development of e-light goods vehicles is following in the footsteps of e-private cars. There are already a few models with driving range up to 300 km and payload more than 1 000 kg introduced in recent years. Some models have also been subsidised for trial under the NET

Medium and heavy goods vehicles

3.3.22 The technologies of e-medium and heavy goods vehicles are developed at a relatively slower pace. These types of EVs are also significantly more expensive than their fuel-propelled counterparts, and have greater demand for quick charging than light duty vehicles. Currently, there is only one model of e-medium goods vehicles in the local market and it is on trial under NET Fund. Besides, the Hong Kong Productivity Council is applying funding under the Innovation and Technology Fund for the R&D of a 16-tonne e-truck for solid waste collection. Tentatively, the Council will produce the e-truck in 2021 and commence a 12-month trial at the West New Territories Landfill in 2022.



3.3.23 Despite the current limited supply of goods vehicle models in Hong Kong, we notice that car manufacturers around the globe are expanding their product lines to this market segment and prototypes start to emerge. Meanwhile, the Government will develop a quick charging network across the territory as an important infrastructure to prepare for the electrification of the heavier duty vehicles (to be discussed in the next chapter). The Government will also keep abreast of the development of different new energy vehicles, especially the technological development in the Greater Bay Area for cross-border heavy vehicles, with a view to exploring the need to promote and support other heavy duty vehicles with zero emissions in Hong Kong.

Hydrogen fuel cell EVs and other new energy vehicles



Hydrogen fuel cell EVs (FCEVs) offer an attractive new energy vehicle alternative, especially for heavy commercial vehicles, given their long travel range and fast refueling comparing with battery EVs. However, given Hong Kong's high urban density, it would be a challenge to locate sufficient and proper sites for setting up necessary infrastructures such as hydrogen filling stations to support additional types of new energy vehicles. On the other hand, as battery EVs are more mature technologically, we will put more emphasis on battery EVs in the course of promoting Hong Kong's transition to adoption of new energy vehicles. Nevertheless, considering that the Mainland is developing hydrogen FCEVs and the supporting facilities, in particular for heavy vehicles, the future progress might influence cross-border heavy vehicles. In view of this, we will closely monitor the development of the new energy vehicles in the Mainland, especially in the Greater Bay Area. We will also commence a study to examine the technology and supporting facilities required for using some hydrogen FCEVs in Hong Kong, and closely communicate with academics and R&D institutes to keep abreast of the development of various new energy vehicles. We will refine our policy direction as required in good time.

Furthermore, to tie in with Hong Kong's target to attain carbon neutrality before 2050, the Government will establish a task force, with a view to keeping abreast of high-end development of new decarbonisation technologies globally, including green transport, new energy vehicles, fuel technology, etc. This will facilitate the Government's understanding of the latest technology, information, and development, thus assisting in the formulation of forward-looking policies.

Other vehicles and corporate fleets

3.3.24 In September 2020, the Government extended the scope of the NET Fund to cover new energy motor cycles and non-road vehicles, including e-commercial vehicles in airport and container terminals. As meal delivery has become very popular in the past few years and uses mainly motor cycles as the transport mode, we have encouraged service operators to make use of the NET Fund to try out e-motor cycles once suitable models are available locally.

3.3.25 On the other hand, we are maintaining close liaison with large corporates to encourage them to electrify their fleets once there are e-models that could meet their operational requirements. In this connection, the Hong Kong International Airport have replaced all airside saloon cars with e-models since 2017. Other types of airside EVs or machinery, such as vehicles less than 3 tonnes, passenger buses, and ground services equipment, are also being introduced.

IV. Fleet of Government and Public Organisations

3.4.1 To demonstrate the commitment in pushing forward Hong Kong's transition to EVs, the Government is prepared to switch our vehicle fleet to EVs at a faster pace. Alongside with our various policies and incentives as deliberated in this chapter, we have just formulated a new policy to set EV as standard for small and medium private cars to be procured or replaced, unless there are special circumstances such as operational needs that render the use of EVs technically infeasible. For other types of vehicles, EVs and other more environmentally friendly vehicles will be accorded priority for use. Senior government officials will also take the lead in switching their saloon cars to EVs when their cars are replaced.

3.4.2 Regarding contract vehicles under public works contracts, the Development Bureau has updated the relevant contract terms in 2020, to specify that contract vehicles supplied in a new public works contract of which the tender invitation is issued in or after February 2021 should include a certain number of EVs. Each EV should also be equipped with a medium charger of specified standards.

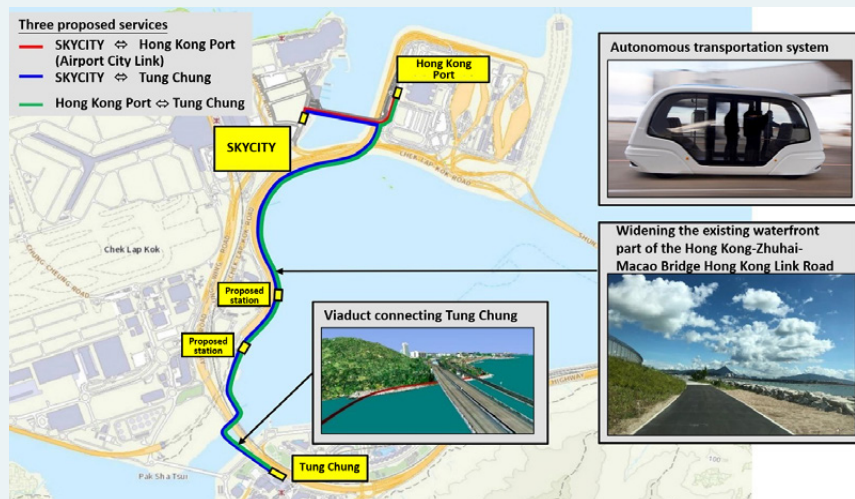
3.4.3 To facilitate the electrification of the government fleet, we are preparing to invest more resources to install charging facilities to cope with the operational needs. We will also advance in tandem with the global development in exploring electrification of other types of special purpose vehicles in the government fleet such as refuse collection vehicles and street washing vehicles, and will strike a balance between prudent use of public monies and taking the lead in promoting EVs.

3.4.4 With the champion by the Government, we aim to promote public organisations to make reference to the above new measures in fleet procurement, with a view to further advancing the popularisation of EVs in Hong Kong.

Autonomous Transportation System on the Airport City Link

The Airport Authority Hong Kong (AAHK) has put forward the Airport City vision and blueprint, a number of proposals in which have already been accepted by the Government. Among them, AAHK proposes to take forward the Airport City Link project to construct a bridge system connecting the Hong Kong Boundary Crossing Facilities (HKBCF) Island of the Hong Kong-Zhuhai-Macao Bridge (HZMB) and the SKYCITY which comprises of hotel, retail, restaurant and entertainment elements. The project will also apply autonomous transportation system to strengthen the overall transportation network and enhance capacity, thereby connecting the SKYCITY, the HZMB Hong Kong Port and the Hong Kong International Airport as one. AAHK will also explore extending the autonomous transportation system of the Airport City Link to Tung Chung Town Centre to provide a comprehensive and environmentally friendly transport link.

The proposed autonomous transportation system will shorten the time travelling by land transport between Tung Chung and the airport further, with the travelling time between the SKYCITY and the HKBCF Island to be about 2 to 3 minutes, and about 8 to 10 minutes between the HKBCF Island or SKYCITY and Tung Chung Town Centre.



Route alignment and illustration of the autonomous transportation system on the Airport City Link

Targets and Promotion

Elements of EV development

Technological readiness • Vehicle availability • Supporting facilities



E-private cars



No new registration of fuel-propelled private cars including hybrid vehicles in 2035 or earlier

Increased the first registration tax (FRT) concession cap under One-for-One Replacement Scheme for e-private cars to \$287,500

Extended FRT concessions and One-for-One Replacement Scheme to March 2024

Set up a mobile app to provide real-time information on EV public chargers

E-commercial vehicles

Promoting trials for electric public transport and commercial vehicles proactively, with a view to setting a more concrete way forward and timetable around 2025

Taxis



Encourage vehicle suppliers to introduce e-taxi models and provide appropriate battery warranty and timely maintenance services

Explore testing out applicable operational modes and e-taxi models with operators, and identify suitable locations for setting up quick charging facilities

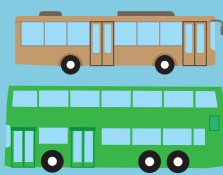
Public light buses



Developed basic specifications and requirements for e-public light buses, suitable for local operating environment

Earmarked \$80 million for a trial for e-public light buses to be commenced in 2023

Buses



\$180 million trial for single-deck e-buses to test the operational performance. Franchised bus companies already procuring e-buses actively, with a view to carrying out more tests or replacing diesel buses due for retirement

Work with franchised bus companies closely to install new charging facilities and explore arrangements for electrifying the bus fleet

Continue subsidising trials for double-deck e-buses and other types of buses under the New Energy Transport Fund

Goods vehicles and other vehicles



E-light goods vehicles to be widely adopted in the medium run

Set up a territory-wide quick charging network to get prepared for the electrification of medium and heavy goods vehicles

Continue subsidising trials for various types of commercial vehicles under the New Energy Transport Fund. The expanded funding scope covers goods vehicles, motor cycles, non-road vehicles, etc.

Establish a task force to examine high-end development of new decarbonisation technologies globally, including new energy vehicles and fuel technology such as hydrogen

Fleet of government and public organisations



EV as standard for government small and medium private cars to be procured or replaced

Encourage public organisations to make reference to the government's new green procurement policy for vehicles

4 Supporting Measures and Facilities


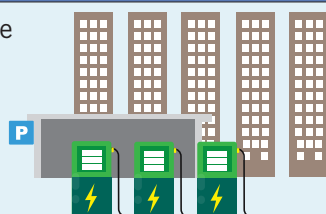




I. Overall Strategy of Charging Facilities and Infrastructures

4.1.1 To support mass adoption of EVs, corresponding charging facilities would become part of the infrastructure of Hong Kong. We need to introduce different charging arrangements for different types of EVs, and progressively marketise the charging services, taking into account the scarce land resources in Hong Kong and the role of the Government in promoting adoption of EVs.

4.1.2 It is common around the globe for e-private car owners to charge their cars at home, work place or places they travel to regularly. Charging private cars overnight also helps balance the demand for electricity between day and night. For e-private cars, the public charging network should only provide ad hoc top-up charging services in case of occasional needs.

4.1.3 For larger vehicles such as coaches, goods vehicles and other commercial vehicles, the optimal arrangement will be equipped with charging facilities at their depots or usual overnight parking spaces. Before further breakthrough in battery capacity and charging technology, high usage drivers could top up the batteries of their vehicles during daytime at conveniently located quick charging facilities. As for higher usage public transports including public light buses and franchised buses that are required to run long hours and mileage, the provision of quick charging facilities at their termini, stations or public transport interchanges can facilitate opportunity charging in addition to overnight charging. For taxis, due to their almost non-stop daily operation and the lack of fixed routes, they need to be supported by a territory-wide quick charging network. However, as battery capacity and charging technology are still under development, opportunity charging may only be a transitional arrangement in the long run.

Figure 14 Charging arrangements for different types of EVs

Vehicle type	Main charging arrangement
Private cars/light duty vehicles/motor cycles 	Parking spaces at home or workplaces 
Larger vehicles (coaches, franchised buses, public light buses, goods vehicles, etc.) 	Depots/termini/stations/public transport interchanges/regular parking spaces 
Commercial vehicles with no designated parking spaces, including taxis 	A network of quick charging facilities across the territory 

II. Private Charging Facilities

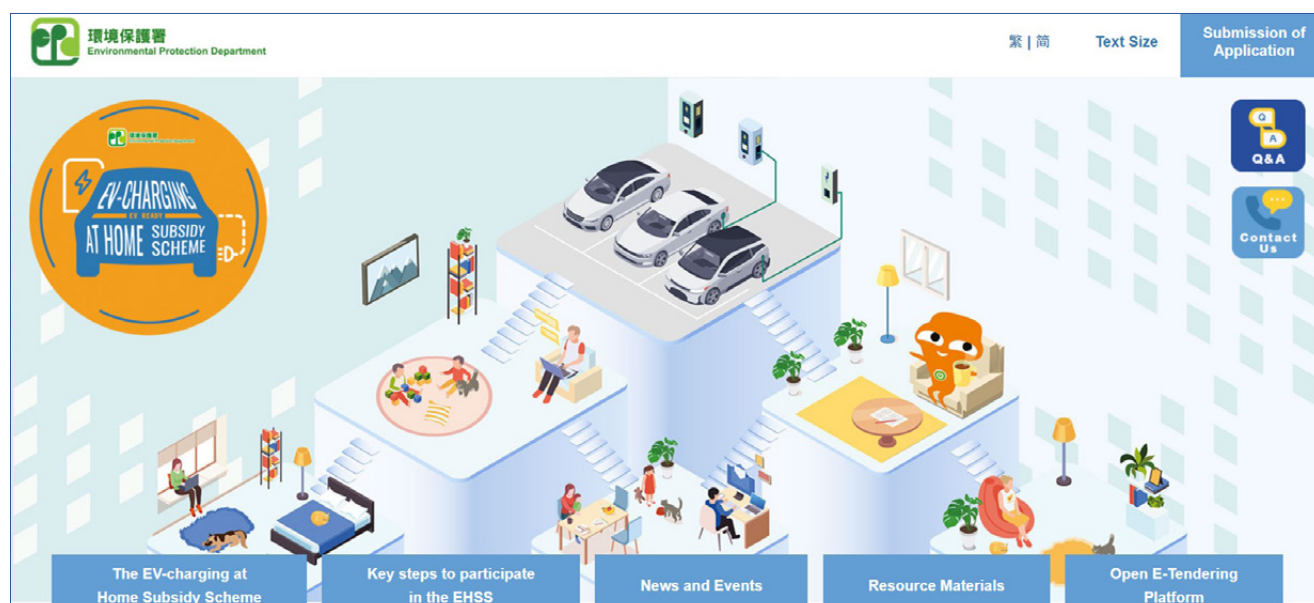
- 4.2.1 Along the above strategy, it is our target to have at least 150 000 parking spaces in private residential and commercial buildings equipped with EV charging infrastructure before 2025, to support mainly e-private cars and certain e-light goods vehicles. We will further look into the timetable of EV development and set direction for expanding the infrastructure in the next 5-year review. To achieve the targets, the policies will cover both new and existing private buildings.

New private buildings

- 4.2.2 To encourage installation of charging infrastructures in new private buildings, the Government tightened the arrangement of gross floor area (GFA) concessions in 2011 to only provide full concession to underground car parks that have EV charging infrastructure installed at each car parking space. As for the above ground car parks equipped with EV charging infrastructure, half GFA concession is granted.
- 4.2.3 Since the implementation of the arrangement, about 68 000 parking spaces have been approved and will be equipped with charging infrastructure. To keep abreast of the market situation and technological development, we are now exploring to adjust the requirement for EV charging infrastructure in car parks of new private buildings so that all parking spaces are required to be provided with charging infrastructure that supports medium chargers.

Existing private buildings

- 4.2.4 The majority of Hong Kongers live in housing estates and the car parks are often located at commonly-managed space. Hence, EV owners may encounter technical difficulties and financial considerations in installing EV charging infrastructure in the buildings they reside. Obtaining consent from other owners of the buildings for the installation work may take time, or even be unsuccessful.
- 4.2.5 To help EV owners overcome the above-mentioned challenges in the early stage of EV popularisation, the Government launched a \$2 billion EV-charging at Home Subsidy Scheme (EHSS) in October 2020 to subsidise installation of charging infrastructure in car parks of existing private residential buildings.
- 4.2.6 With charging infrastructure, EV owners can install chargers that suit their own needs and charge at home easily. We expect that the scheme will cover more than 60 000 parking spaces at existing private residential buildings in 3 years. Responses to the scheme are very positive, with more than 200 applications received in 4 months after its launch, covering nearly 60 000 parking spaces.
- 4.2.7 We have to stress that the Government will provide financial support for e-private car owners to resolve difficulties in the installation of charging infrastructure in the initial stage of e-private car development. With wider adoption of EVs, the market demand for EV charging will continuously grow, and the Government will gradually let the



The EHSS Website

market play its role to provide and enhance the EV charging infrastructure and supporting facilities. For installation of charging facilities in existing buildings, the Government will formulate guidelines and standards, and actively promote collaboration among private sector, property management, homeowners and the general public to expand the charging network to get the community prepared for the transition to EVs.

III. Public Housing and Developments of the Urban Renewal Authority

- 4.3.1 The Hong Kong Housing Authority and the Hong Kong Housing Society have been installing medium chargers at car parks of existing public housing estates when technically feasible. The Housing Authority has conducted a feasibility study and will install medium chargers at hourly parking spaces of existing car parks if electricity loading allows. To ensure efficient use of resources, it will carry out installation works in phases. Depending on the utilisation of chargers, the Housing Authority will consider increasing the number of medium chargers in suitable existing car parks gradually.
- 4.3.2 The Housing Authority will also continue to make reference to the *Hong Kong Planning Standards and Guidelines* to provide EV chargers at 30% of private car parking spaces in indoor car parks of new public housing developments, while the remaining 70% will be equipped with EV charging infrastructure and space is reserved for future installation of chargers. On the other hand, the Housing Society is providing EV charging facilities in their new housing developments. For example, over 85% of parking spaces in the recently completed Mount Verdant in Tseung Kwan O and Greenhill Villa in Sha Tin are equipped with EV chargers.
- 4.3.3 The Urban Renewal Authority has imposed requirements on new developments for infrastructures that enable future installation of charging facilities in new residential carparks. The Authority has also specified charging facilities required in new commercial carparks. For instance, medium or quick chargers are installed at all 60 plus parking spaces in the commercial portion of the eResidence and Grand Central.

IV. Public Charging Facilities

Charging facilities in government car parks

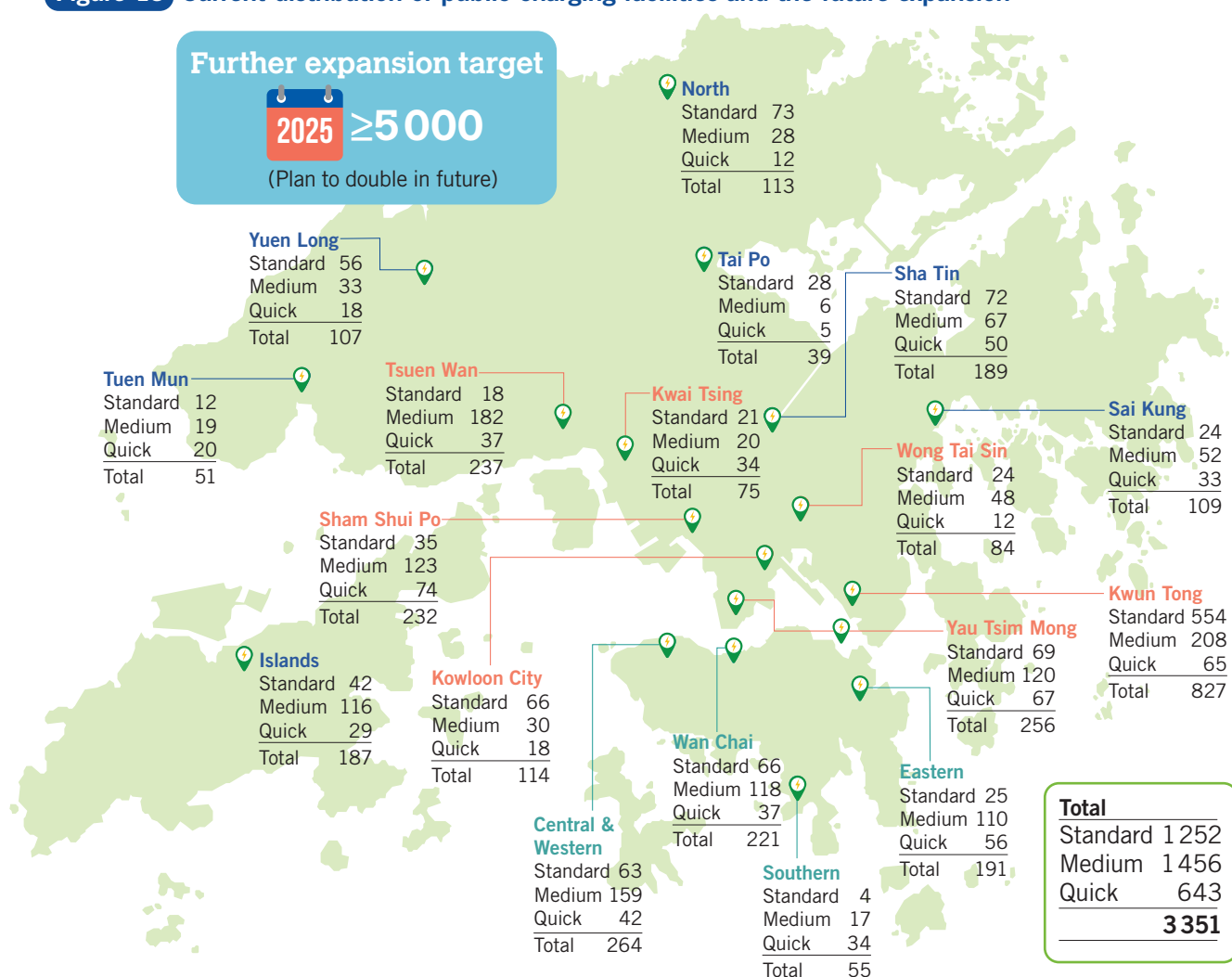
- 4.4.1 Public chargers are provided by both public and private sectors for top-up charging of EVs, mainly private cars and light goods vehicles. As at end-2020, more than 3 300 chargers from the private and public sectors are open to the public, among which more than 1 100 are offered by the Government and the rest are provided by the private sector. The Government has also allocated \$120 million for a three-year programme to gradually increase the number of chargers in government car parks to 1 800 by 2022.
- 4.4.2 Furthermore, the Transport Department is actively exploring the provision of new public car parks in around 20 works projects (e.g. 'Government, Institution or Community' facilities and public open space). Subject to technical feasibility, around 5 000 parking spaces will be provided in batches under these projects. According to the Hong Kong Planning Standards and Guidelines, 30% of the private car parking spaces in public car parks will be equipped with EV chargers, while the remaining 70% will be provided with charging infrastructures.

Marketisation of charging services

- 4.4.3 Currently, EV charging services in government car parks are free of charge. This is intended to provide financial incentives in the initial stage of EV development to encourage early adoption. Yet, with the growing EV uptake, it is needed to marketise the EV charging services so as to promote their sustainable development in the long run, and avoid abuse of the chargers.
- 4.4.4 In this connection, we have embarked on the preparation work, hardware and software upgrade, etc. for fee charging, with a view to imposing EV charging fees in government car parks from around 2025.

Further extension of public charging network

- 4.4.5 The Government's target is to have at least 5 000 public chargers provided by 2025, and plans to double the number in future. To achieve the targets, the Government will continue exploring different approaches and install public charging facilities. This includes examining the feasibility of providing roadside charging facilities. Together

Figure 15 Current distribution of public charging facilities and the future expansion

with the growing demand, the marketisation of charging services will give impetus to the provision of additional public charging facilities.

- 4.4.6 For cross-border vehicles, we will continue to provide public charging facilities at ports linking with the Guangdong-Hong Kong-Macao Greater Bay Area, such as the Hong Kong-Zhuhai-Macao Bridge and Liantang Port, to support EVs travelling between Hong Kong and Shenzhen, Zhuhai and Macao. Chargers installed will also be compatible with various charging standards.

- 4.4.7 Furthermore, the Government Circular on *Green Government Buildings* requires all new government development projects to provide medium chargers at not less than 30% of parking spaces in car parks. Charging infrastructures therein should also support

the capture and dissemination of information such as real-time availability of chargers and usage data, and enable future development of load management system, fee collection system, etc.

Turning petrol filling stations to charging stations

- 4.4.8 With the rapid development of new energy vehicles in recent years, in particular EVs, demand for fuels from conventional vehicles will decrease. The demand will drop further after Hong Kong stops new registration of fuel-propelled private cars. In this connection, we need to explore the need and feasibility to gradually convert existing petrol or liquefied petroleum gas (LPG) filling stations to quick charging stations in the medium to long term, including turning some larger filling stations to mega charging stations that offer charging services to various types of vehicles simultaneously.

V. Charging Facilities for Public Transport and Heavy Commercial Vehicles

- 4.5.1 A comprehensive territory-wide quick charging network is needed to support the wider adoption of e-public transport and heavy commercial vehicles. Through trials on different e-public transports, we will examine various charging patterns and charging technologies, and look into how the market can construct and operate quick charging facilities as a business to best address the charging needs of different vehicles.

Charging arrangements for e-buses, e-public light buses and e-taxis

e-buses: With the technological development of batteries, charging a single-deck bus overnight for 3 to 4 hours at termini could already support the daily mileage of some bus routes (i.e. around 300 km). The Environmental Protection Department has provided policy support to KMB to expand their bus depot at Tai Po. Near 450 charging-enabling bus parking bays will be provided after such expansion.

Furthermore, the provision of charging facilities in bus termini or public transport interchanges are of great importance to full electrification of franchised bus fleet. The charging facilities could support opportunity charging of e-buses in non-peak hours during daytime, subject to the actual needs of different routes.

e-Public light buses (e-PLBs): Charging e-PLBs at night, especially for those park on street, is not necessarily viable. Frequent return journeys, limited charging time, huge air-conditioning demand during summer time, and driving on hilly terrain are all common challenges faced in the adoption of e-PLBs. The technical guidelines published by the Government in October 2020 set out the basic specifications and requirements for e-PLBs that are suitable for the local operating environment, and suggest equipping e-PLBs with high output power charging, short charging time and long battery life. Pantograph can also be adopted as a universal quick top-up charging mode for e-PLBs.

e-taxis: A taxi commonly runs for more than 20 hours and over 400 km a day and an e-taxi driver can hardly spend hours to charge. Hence, only a comprehensive territory-wide charging network can satisfy their operational needs, e.g. 100 kW quick chargers that can top up around 100 km of driving range in 15 minutes.

Charging facilities in new development areas

We will designate charging bays for e-buses, e-PLBs and e-taxis at public transport interchanges or bus termini in new development areas, and provide an additional traffic lane next to the charging station to ensure that the nearby traffic will not be affected when vehicles are charging. The number of charging facilities provided will be subject to the usage, number and daily mileage of e-buses and e-PLBs. As for e-taxis, the charging infrastructure (including power supply, electricity meters, switches, conduits and trunking etc.) will support at least three quick chargers with output power not less than 100 kW each for future installation of quick charging facilities.

Suitable sites for quick charging facilities

- 4.5.2 Given the limited developable land in Hong Kong, we are looking for every possible site for setting up charging facilities, taking into account a basket of factors (e.g. accessibility, traffic impact, land zoning, technical feasibility, etc.) on top of identifying different charging arrangements for the above-mentioned public transports. The Government is actively identifying sites of various scale and shapes, such as government premises, power substations, spaces under flyovers and road-dividing zones to complement the development of charging network. As mentioned above, we will explore the feasibility of turning petrol and LPG filling stations to charging stations that can offer quick charging services to heavy commercial vehicles in the medium to long run.

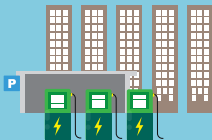





VI. EV Charging Standards

- 4.6.1 Currently, EV charging standards vary among regions across the world. Charging standards adopted by EVs sold in Hong Kong include the International Electrotechnical Commission (IEC) adopted by most of the European car manufacturers, SAE International adopted by those from the United States and Japan, and GuoBiao (GB) adopted by the Mainland manufacturers. As for quick charging standard, Europe, the United States and other countries mainly adopt the Combined Charging System (CCS) and CHAdeMO, while quick chargers in the Mainland adopt GB.
- 4.6.2 In the long run, we need to prepare for facilitating EVs from Hong Kong to also charge easily in the Mainland. Some propose considering adopting GB as the charging standard in Hong Kong. However,

as the Mainland is left-hand driving, Hong Kong will become the only right-hand driving area in the world that adopts GB with a comparatively small vehicle market. This will considerably affect the numbers and models of EVs supplied to Hong Kong. On the other hand, the use of specified adaptors could temporarily solve the charging issues in most situations currently. It is simple and easy, resembling using adaptors to charge electronic devices when travelling. In view of the above, as regards exploring the possibility to set up a local charging standard and enhance convenience for charging in the Mainland, the Government has started to explore feasible approaches with the EV trade. Issues covering the mechanism, timing, conditions of implementation as well as transitional arrangements will be considered.

Charging Facilities and Infrastructure

Private charging facilities 	Continue encouraging the installation of EV charging infrastructure in new private buildings
	\$2 billion EV-charging at Home Subsidy Scheme to continue subsidising the installation of charging infrastructure at 60 000 parking spaces in existing private residential buildings
	Provide charging facilities in public housing
	Examine requiring all parking spaces in new private buildings to be equipped with charging infrastructure
Public charging facilities 	Target: ≥ 5 000 public chargers by 2025, and plan to double in the future
	\$120 million to increase the number of medium chargers to 1 800 at government car parks by 2022
	Install EV medium chargers at 30% of parking spaces in new government buildings
	Provide charging facilities compatible with different charging standards in ports connecting to the Greater Bay Area for cross-border vehicles
Charging facilities for public transport and heavy commercial vehicles 	Fees for EV charging at government car parks from around 2025 to promote marketisation of EV charging services
	Designate charging bays for public transport at public transport interchanges of new development areas
	Explore the feasibility to gradually turn petrol and LPG filling stations to charging stations
Travelling to the Mainland 	Identify sites to complement the territory-wide quick charging network, including government premises, spaces under flyovers, road-dividing zones, etc.
	Study proposals to facilitate EV charging in the Mainland

VII. Repair and Maintenance

Green employment

- 4.7.1 The built of EVs and conventional vehicles are very different. For instance, conventional vehicles are powered by internal combustion engines, thus most parts are mechanical. However, EVs are propelled by battery-powered electric motors and involve less mechanical parts but more power electronics and electrical systems. Hence, repair and maintenance of EVs require knowledge of power electronics and electrical engineering, which is a skill set completely different from what the existing and conventional vehicle mechanics possess.
- 4.7.2 With the increasing market share of EVs, EV manufacturers around the globe have started to allow third-party access to their software and diagnostic systems, as well as disclose their repair manuals and other servicing and parts documents and information. This facilitates the provision of EV repair and maintenance services by the third parties, as well as the training and education of mechanics. We will continue making reference to experience in other places to prepare for the ever-rising demand for EV maintenance in future.
- 4.7.3 On the other hand, more green employment opportunities will emerge as EVs become increasingly popular. For example, Hong Kong needs sufficient number of qualified professionals to repair EVs, and it is vital to both train new vehicle mechanics and provide retraining opportunities for existing mechanics.

Post-secondary institutions

- 4.7.4 For the training of new professionals and mechanics, post-secondary institutions funded by the University Grants Committee (UGC) are currently offering academic programmes in design, R&D and maintenance of EVs. These programmes cover study areas of chemical engineering and materials techniques, electrical and electronic engineering, manufacturing and industrial engineering, mechanical engineering, etc.
- 4.7.5 The UGC-funded institutions are tasked to maintain the quality and academic standards of the programmes offered and at the same time ensure that their curricula can meet the needs of the society. The Government will closely liaise with

the institutions to keep them informed of the policy directions in the promotion of EVs and facilitate their planning and design of appropriate courses to meet the needs of the EV market.

- 4.7.6 At present, the Vocational Training Council (VTC) offers full-time training programmes relevant to automobile maintenance, including the Higher Diploma in Automotive Engineering and Diploma of Vocational Education (Automotive Technology). These programmes have embedded professional knowledge and EV maintenance skills in their curricula. They also include the latest technological development, safety standards, design, and operational principles. Workplace Learning and Assessment will also be implemented in the curriculum of the Higher Diploma in Automotive Engineering. This structured pedagogical practice enables students to learn the latest EV technologies and standards directly from their real work experience in an authentic workplace. The skills so learned will be assessed there.

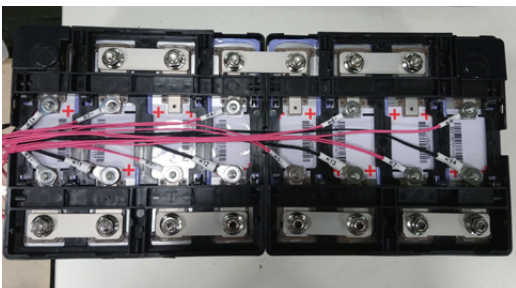
- 4.7.7 While pre-employment programmes will supply talents to the maintenance sector, it is equally important to provide existing vehicle mechanics opportunity to gain knowledge of the maintenance of EVs and upgrade their skill set. In this regard, the VTC offers a number of part-time evening courses for existing mechanics and technicians to equip themselves with knowledge of the structure, operation, and safety procedures relevant to EV and their maintenance. The Government will also strengthen communication with the trade, and explore facilitating EV suppliers to cooperate with local institutes for the further provision of EV maintenance courses, with a view to providing retraining opportunities for vehicle mechanics to upgrade themselves, and meeting the rising demand for EV maintenance.

- 4.7.8 To continuously improve and update the programme curricula, the VTC gathers feedback from stakeholders regularly, and will include the latest EV technologies and standards in the programmes, in order to cater for the industry development trends and demands. The VTC's representatives are also members of the Vehicle Maintenance Technical Advisory Committee of the Electrical and Mechanical Services Department, which ensures that courses offered by the VTC can meet the needs of the motor trade.

VIII. Handling of Batteries

Current situation

- 4.8.1 Handling and disposal of retired EV batteries are regulated under the Waste Disposal Ordinance (Cap. 354) and its subsidiary Waste Disposal (Chemical Waste) (General) Regulation (Cap. 354C). EV suppliers have currently engaged licensed collectors to collect the retired batteries of their brands' EVs. After proper preliminary treatment (e.g. sorting, discharging and insulating) and packaging, these retired EV batteries are exported to appropriate treatment facilities overseas, e.g. Japan, Korea or Belgium, for recycling.



Retired EV batteries

- 4.8.2 Although the number of retired EV batteries in Hong Kong remains small at this stage, as EVs become more popular, there will be more retired EV batteries. The Environmental Protection Department has been maintaining close liaison with the trade and EV suppliers to explore solutions that are applicable to local situations. On the other hand, the Electrical and Mechanical Services Department has conducted a technical study with the Hong Kong Productivity Council to examine the feasibility of second life applications of the retired EV batteries. Retired batteries of the same brand combined are able to power an electric wheelchair.

Green Tech Fund



The Government has set up a \$200 million Green Tech Fund to fund R&D projects which help Hong Kong decarbonise and enhance environmental protection. Local public research institutions, R&D centres and private companies undertaking these projects can get better and more focused funding support.

The per project funding support of the Green Tech Fund ranges from \$2.5 million to \$30 million. The fund will accord priority to projects relevant to four areas, namely, decarbonisation and energy saving, green transport, waste management, and air and water quality. Projects relevant to the promotion of EVs and giving second life to EV batteries are both under the priority theme of the green transport.



Fast-changing EV battery technology

- 4.8.3 Lithium-ion batteries are commonly used in EVs. Due to the constant development of EV battery technology in recent years, the average life of EV batteries and their warranty period have increased to about eight years. Driven by market demand, the battery technology has kept evolving rapidly with new design, improved material compositions and new recycling technologies. As the recycling of retired EV batteries is complicated and highly technical, a sufficiently large market demand was required to support the setting up of a local battery recycling facility. It is anticipated that the number of retired EV batteries in the coming few years will not reach the required amount. Therefore, an effective mechanism will be required to ensure that batteries will be properly collected and treated in Hong Kong, and the recycling process will be conducted outside Hong Kong.

Way forward

- 4.8.4 Regions and countries such as the Mainland China and the European Union have gradually implemented or conducting trials for using Producer Responsibility Scheme (PRS) for retired EV batteries as a policy tool. Typically, EV producers, including manufacturers and importers, have to take up responsibility for the collection, recycling, treatment and disposal of end-of-life products with a deposit-refund and incentive scheme, with a view to facilitating collection and recycling. In parallel, the PRS will also encourage development of second life applications of retired batteries. We will engage EV suppliers and relevant stakeholders to explore approaches suitable for Hong Kong, with a view to legislating a PRS for retired EV batteries in the next few years.

Concluding Remarks

To strive for attaining the target of carbon neutrality in Hong Kong before 2050, promoting zero carbon emissions transport is one of the indispensable strategies. Unlike conventional fuel-propelled vehicles, EVs emit no air pollutants and thus serve as a crucial tool for air quality improvement.

Wider adoption of EVs in Hong Kong faces multiple challenges, especially that Hong Kong is densely-populated with compact urban space. In promoting the establishment of EV charging network, we have to fully utilise the limited space by adopting a multi-pronged approach with an innovative perspective, in response to the enormous demand for EV charging and supporting facilities in future.

In the meantime, considering the rapidly evolving EV technologies, we have to flexibly adjust the policies and measures in Hong Kong so as to keep pace with the international developments in batteries and charging technology. The arrangement of periodic review roughly every five years allows us to look into the progress made in EV popularisation and development of other new energy vehicles in a timely manner, and will offer an opportunity to examine the overall strategies and targets accordingly.

Apart from the Government's policies, measures and support, the continuous transition to EVs requires the various sectors of the community to maintain an open attitude, appreciate and embrace changes brought about by technological development, support green economy, and create green employment opportunities. Echoing with our country's vision to achieve carbon neutrality before 2060, we look forward to working hand in hand with the society to push ahead the popularisation of EVs towards zero vehicular emissions and turn Hong Kong into a smart and liveable city.



Targets of zero emission private car sales of various economies

Year	Economy
2025	Norway ¹
2030	Denmark ² , Iceland ³ , Ireland ⁴ , Netherlands ⁵ , Singapore ⁶ , United Kingdom ⁷
2035	United States (California) ⁸
2040	Canada ⁹ , France ¹⁰ , Taiwan ¹¹ , Spain ¹²

Note: Apart from the above economies, others have set a target proportion of zero emission vehicle instead of requiring all new vehicle sales to be zero emissions. For example, the Mainland China aims for 20% of new vehicle sales to be new energy cars in 2025, and the target of Korea is 33% of new vehicles being battery EVs or hydrogen fuel cell EVs by 2030.

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Abbreviations

AAHK	Airport Authority Hong Kong
BEV	Battery electric vehicle
CCS	Combined Charging System
CTB	Citybus Limited
e-	Electric
EHSS	EV-charging at Home Subsidy Scheme
EV	Electric vehicle
FBC	Franchised bus company
FCEV	Fuel cell electric vehicle
FRT	First registration tax
GB	GuoBiao
GFA	Gross floor area
HKBCF	Hong Kong Boundary Crossing Facilities
HZMB	Hong Kong-Zhuhai-Macao Bridge
IEC	International Electrotechnical Commission
KMB	The Kowloon Motors Bus Co. (1933) Limited
LPG	Liquefied petroleum gas
LWB	Long Win Bus Limited
MTR	Mass Transit Railway
NET Fund	New Energy Transport Fund
NLB	New Lantao Bus Company (1973) Limited
NWFB	New World First Bus Services Limited
PHEV	Plug-in hybrid electric vehicle
PLB	Public light bus
PRS	Producer Responsibility Scheme
R&D	Research and development
UGC	University Grants Committee
V2X	Vehicle-to-everything
VTC	Vocational Training Council
ZEV	Zero emission vehicle



**Zero Carbon
Emissions**



**Clean
Air**



**Smart
City**