



BUSINESS
ENVIRONMENT
COUNCIL
商界環保協會

BEC's Roadside Emissions Taskforce Report



WMA Open Photo Contest - Henry Ng

December 2016

FOREWORD

Though major improvements have been made in air quality in recent years, air pollution remains one of Hong Kong's main environmental problems. Transport emissions are a major contributing factor making the problem particularly acute by busy roads. The Hedley Index shows that poor air quality was responsible in 2016 for around 100,000 days in hospital and 1500 premature deaths locally¹. This is a substantial improvement from the recent peak in 2013 of 210,000 days in hospital and 3300 premature deaths. But there is still more to be done for our well-being and to reduce the economic costs of ill-health.

Emissions from road transport also include carbon emissions, and hence contribute to climate change. Of the 44.4 million tonnes of CO₂e emitted in Hong Kong in 2013 overall², 17.1% were from transport, the second major contributor after electricity generation (mainly used to light and cool our buildings).

Tackling roadside emissions can benefit Hong Kong substantially, by making it a clean and healthy place to live, helping in the recruitment and retention of talent in the city, as well as supporting higher levels of well-being. Hong Kong's substantial investment in public transport as well as walking facilities put us in a good position, but one we need to enhance and maintain.

This is why BEC decided to set up the Transport & Logistics Advisory Group in 2015, and establish a Roadside Emissions Taskforce. The aims of the Taskforce are both to support business in working towards environmental excellence, and to develop policy recommendations for the Government.

This report includes key findings and recommendations for businesses to reduce their emissions. It also includes a broad set of recommendations for the Government to ensure a policy framework that puts us on the path to an even cleaner Hong Kong, considerably reducing health risks, and supporting a transition to a low carbon economy.

by Ir TC Yee, Chairman, BEC Transport & Logistics Advisory Group

¹ <http://hedleyindex.sph.hku.hk/html/en/>

² http://www.epd.gov.hk/epd/sites/default/files/epd/english/climate_change/files/HKGGHG_CarbonIntensity_201606.pdf

CONTENTS

FOREWORD	2
CONTENTS	3
SUMMARY	4
01 Introduction	8
1.1 Why are roadside emissions an issue for Hong Kong?.....	8
1.2 What are the main causes of roadside air pollution in Hong Kong?	11
1.3 Trends in Carbon, RSP and NOx emissions from Transport.....	14
02 The Policy Framework – Hong Kong	17
2.1 What are the current policy measures in place in Hong Kong?.....	17
2.2 Planned Future Policies.....	17
2.3 Conclusions.....	18
03 Overarching Recommendations	20
3.1 Public transport: opportunities to improve.....	21
3.2 Addressing congestion on our roads – Smart Systems.....	24
3.3 Diesel Commercial Vehicles & Non-Road Mobile Machinery (NRMM) – transitioning to cleaner vehicles	25
3.4 Opportunities from new technologies and fuel types – private vehicles and taxis	26
3.5 Provide safe and comfortable urban walking and cycling.....	29
3.6 Set Clear Long Term Goals – the AQOs	29
04 What can business do to help meet these recommendations?	31
4.1 Buy lower emission vehicles – Euro VI, hybrids, electric – buses, trucks, taxis and cars	31
4.2 Putting in infrastructure for EVs	32
4.3 Better routing/management of logistics.....	33
4.4 Promote eco-driving practices	33
05 What policy changes do we recommend to Government?	34
ACKNOWLEDGMENTS	43
ANNEX A: The Transport Policy Framework: Hong Kong.....	46
ANNEX B: Comparison of Country/City Policies	53
ANNEX C: Figures on Emissions from Different Vehicle Types	54

SUMMARY

VISION

- A healthy and livable city: an attractive place to live and work with good air quality and healthy forms of transport e.g. walking and cycling;
- A highly mobile and efficient city: reliable systems of transport so that people and goods can move from one place to another quickly, without delay and with minimum emissions;
- Transitioning to a low carbon city: with a transport infrastructure consistent with a transition to a low carbon economy; and
- A fast-moving and innovative Hong Kong: quick to use and develop new technology including highly efficient vehicles and low carbon fuel types.

PRINCIPLES UNDERLYING OUR RECOMMENDATIONS

The policy framework needs to:

- **enable and speed up movement of people and goods**. This means supporting the movement of buses and goods vehicles on our roads more so than private vehicles;
- **address high emission vehicles and reduce congestion**, which is more important than shifting private vehicles from higher emitting to lower emitting vehicles;
- take on board **both GHG emissions and other air pollutants** in developing policy;
- **incentives kept under review** to ensure a good relationship between the policy outcomes sought and the funds incurred, so that funding is used in a proportionate way. This is a complex matter considering the number of policy outcomes: roadside air pollution, carbon emissions, noise and waste, and it is recognised that an exact relationship will not be possible but greater proportionality should be achievable.
- **walking and cycling** should be seen as a mode of transport, and the potential reduction of emissions through commuter cycling recognised.

RECOMMENDATIONS TO GOVERNMENT

The Taskforce's recommendations are as follows:

Recommendation 1: Continue to support strongly public transport as the preferred mode of travel for journeys, and support a transition to cleaner buses and lower emission fuel types

- a. Progressively introduce more bus lanes and priority at junctions for buses.
- b. Ensure better connectivity between modes of public transport and improve supporting pedestrian routes.
- c. For public light buses and other single deckers, support a faster shift to low emitting vehicles (Euro VI, hybrid and EV) increasing incentives as appropriate. For the medium term, continue trialing and piloting of electric buses, whilst also supporting their introduction through the provision of Government funds to help meet the extra costs. Consideration to be given to making electric buses the norm in the medium term.
- d. For franchised buses (double deckers), support a swift transition to Euro VI buses and hybrids, through early replacement of Euro IV and below, supported by Government funds and introduce an early scrappage scheme for existing Euro

- I and II buses, as well as continued piloting of EV technology for the medium to long term.
- e. Install charging facilities at every transport hub or enable easy installation of charging infrastructure for EV buses.
 - f. Look to introduce the mandatory use of blended biodiesel (such as B5, following satisfactory trials), made from local waste cooking oil, and price differentials to support its use.

Recommendation 2: Address congestion through smart systems, avoiding putting more pressure on Hong Kong’s landscape, and instead minimising unnecessary vehicular movements.

- a. Take forward electronic-road pricing, whilst also enforcing parking breaches and enhancing alternative modes of transport.
- b. Use smart systems to discourage peak time deliveries, and encourage staggered deliveries.
- c. Continue the process of bus route rationalization.
- d. Better enforcement in relation to illegal parking.

Recommendation 3: Ensure a transition to low emission diesel commercial vehicles and Non-road Mobile Machinery, using regulation and subsidies for a quick transition and encourage low emission fuels.

- a. Introduce a requirement for goods vehicles (diesel commercial vehicles) imported to Hong Kong to be at minimum Euro VI, and provide incentives to support a shift by owners to newer vehicles.
- b. Establish a combined “stick and carrot” approach to accelerating emissions reductions from Non-Road Mobile Machinery (“NRMM”). This means extending the existing incentive scheme to give subsidies to NRMM owners to transition to low emission NRMM by moving from pre Euro III to higher standards.
- c. Extend the Green Transport Fund to test new fuels and new technologies like logistics software, and further research to establish the emissions reductions and costs implications of different vehicle and fuel types.
- d. Consider implementing a mandatory blend of biodiesel like B5 (5% biodiesel) for all Government owned vehicles and Government contracted vehicles, supported by a price differential benefitting lower carbon/emission fuels.

Recommendation 4: Support low emission private vehicles and taxis, develop and implement a medium term plan, in conjunction with a cross-sectoral dialogue platform, to make use of low emission vehicles types and fuels. In addition, review the current tax and incentive framework to ensure adoption in the short term of a targeted and cost-effective approach to support a transition to lower emission vehicles in terms of carbon and other pollutants, seeking to ensure that vehicle numbers are at minimum maintained if not reduced.

- a. Set up a Government Working Group on low emission road and non-road vehicles, which helps develop a medium term roadmap that takes on board future scenarios, technological innovation, and options for progress in Hong Kong over the longer term in relation to different vehicles types and infrastructure. Alternatively or in any event, we support the establishment of a dialogue platform on road transport with members from a range of related business sectors.
- b. Detailed consideration be given to how the incentive structure can be varied to strengthen the relationship between the level of tax waivers/incentives and

- reduction in carbon emissions/pollutants and take on board the possibility of a short term shift to other low emitting vehicles which may be more practicable in the short term than a transition to EVs.
- c. These policies should be consistent with the aim of reducing or at minimum keeping within current private vehicle numbers.
 - d. Introduce an incentive scheme to support installation of electric charging facilities in existing buildings, and in the longer term supporting parking space owners to install charging facilities at their own cost.
 - e. Develop and put in place a “Scrappage Scheme” for older private vehicles.
 - f. Introduce a scheme to enable owners of taxis to buy new low emission vehicles e.g. LPG hybrids.
 - g. Implement strict emissions testing of taxis and mandate the use of new parts for repairs.

Recommendation 5: Make more of the opportunities for healthy and low emission modes of transport including commuter walking and cycling

- a. Improve the pedestrian experience by introducing a choice of walking – over or underground, or at street level, safe junctions and more appealing pedestrian routes with shade and shelter and shopfront experiences.
- b. Develop cycling routes in particular in urban regeneration areas and also within and to the central districts of Hong Kong. In some cases, this may involve “shared space” for commuter and leisure use such as on the Harbourfront.
- c. Put in place cycling route pilots that enable the development of rules and protocols to ensure safety.
- d. Explore how greater use could be made of electric bikes and scooters.

Recommendation 6: Develop an ambitious but achievable roadmap with a phased improvement of Air Quality Objectives (“AQOs”)

- a. Set stretching objectives in the form of a roadmap, with progressively increasing emission limits.
- b. Broad stakeholder engagement in the process, including business and experts.
- c. To support these stretching AQOs, develop a high level plan that relates to the Road Transport element of these AQOs, to take on board technological innovation, infrastructure design, planning and policy, with the engagement of the Low Emission Vehicle Working Group and/or the proposed Road Transport Dialogue Platform (as recommended above). This plan should also take on board carbon emissions and set clear timescales and policy direction for a shift to low carbon alternatives.

RECOMMENDATIONS TO BUSINESS:

Recommendation 1: Buy lower emission vehicles - Euro VI, hybrids, electric – buses, trucks, taxis and cars.

- a. Franchised bus companies encouraged to upgrade to Euro VI as swiftly as possible, and to hybrids as appropriate, and continue to trial and pilot EVs and hybrids.
- b. Public light buses encouraged to trial EVs and hybrids, whilst also introducing progressively more into their fleet in the short and medium run.
- c. Owners and operators of diesel commercial vehicles are encouraged to begin replacing their fleet with Euro VI vehicles, with a preference for more efficient Euro VI hybrids. Also to make use of the Green Transport Fund to trial new vehicles, fuel types, and improved logistics systems, monitoring and reporting on results in terms of emissions and savings.
- d. Taxi owners are encouraged to make use of low emission vehicles for example LPG hybrids as well as to employ good driving practices including reduced idling.
- e. Encouraged to transition to electric vehicles in the longer run, beginning to buy EVs in the short term and have the infrastructure developed. In the short term Euro VI hybrids are a good option.

Recommendation 2: Putting in infrastructure for EVs

Property developers and managers are encouraged to commit to installing charging facilities, with rising targets, in particular in residential buildings to enable management of peak demand.

Recommendation 3: Better routing/management of Logistics

Make greater use of route optimization systems.

Recommendation 4: Promote Eco-driving Practices

Use training and other behaviour change techniques to encourage drivers to use good driving practices and thereby reduce emissions.

Recommendation 5: Support Walking & Cycling

Support the last mile pedestrian infrastructure, design appropriate features into new buildings from bike parking to pedestrian walkways, and make provisions where feasible in existing developments.

Recommendation 6: Explore demand-side management

For the longer term, explore ways of reducing the need to travel.

01 Introduction

This report is informed by our vision of a future Hong Kong.

Roadside Emissions Taskforce – Our Vision

- A healthy and livable city: an attractive place to live and work with good air quality and healthy forms of transport e.g. walking and cycling
- A highly mobile and efficient city: a reliable system of transport which enables people and goods to move from one place to another quickly and without delay.
- Transitioning to a low carbon city: with a transport infrastructure consistent with a transition to a low carbon economy
- A fast-moving and innovative Hong Kong: quick to use and develop new technology including highly efficient vehicles and low carbon fuel types.

1.1 Why are roadside emissions an issue for Hong Kong?

Emissions from road transport contribute to poor air quality and increase carbon emissions, with the share of emissions shown in Figure 1.

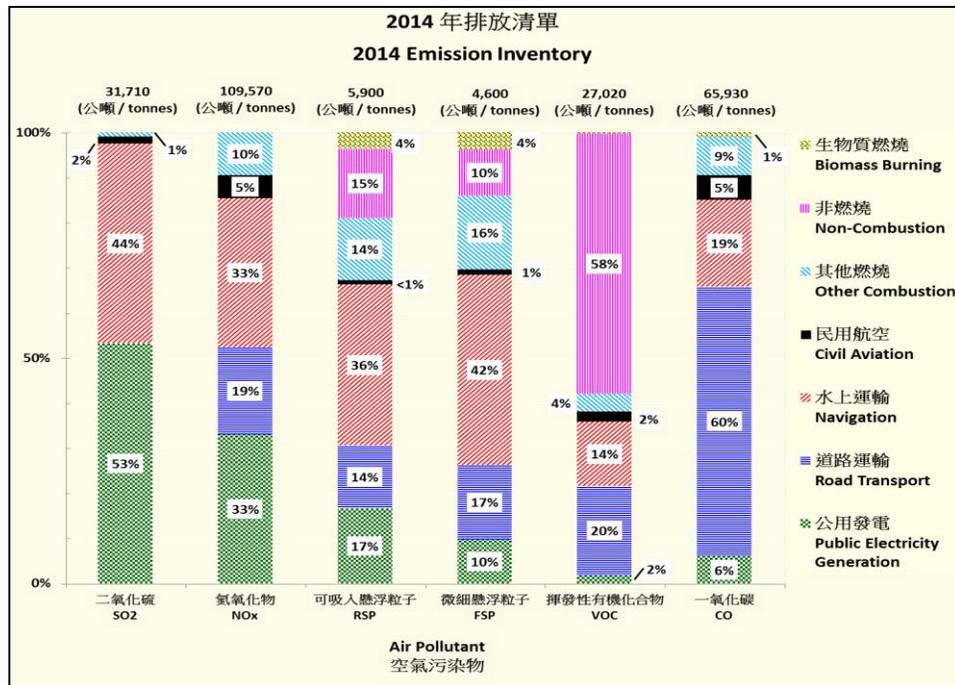


Figure 1: Contribution of different sectors to Hong Kong Air Pollution (EPD, 2014)

People in Hong Kong particularly those with respiratory problems remain at risk from air pollution, though huge improvements have been made (see section 1.3 of this report). Air quality is often rated as poor on the Hong Kong SAR Government website, with the highest emissions recorded in Hong Kong's three roadside monitoring stations, Central, Mong Kok and Causeway Bay. These show high emissions of NO_x in particular³.

From August 2015-July 2016, NO_x values were between 80 and 93 µg/m³ at the roadside monitoring stations, more than double the WHO Air Quality Guidelines of 40µg/m³. However, even in monitoring stations over 15 metres high such as in Sham Shui Po (17metres) and Tuen Mun (31 metres), average readings were around 60µg/m³.

The highest 1-hour average NO_x values (496 µg/m³) and the highest annual average (106 µg/m³) were both recorded at the Causeway Bay roadside station. As regards the 1-hour AQO (200 µg/m³) with allowance of exceedance for eighteen occasions, all general stations, except Kwun Tong, Sham Sui Po and Kwai Chung, were in compliance with the respective AQO in the year. Non-compliance with the 1-hour and annual AQOs for NO₂ were recorded at all the three roadside stations.

It is not only NO_x emissions, but also particulate matter which remains a problem. Both larger particulates (PM₁₀s) referred to as Respirable Suspended Particulates ("RSPs") and finer particulates (PM_{2.5}s) referred to as Fine Suspended Particulates ("FSPs") are around double⁴ or even more than WHO limits⁵. For example, the level of FSPs in 2015/16 was around 40µg/m³, whether at the roadside monitoring stations or higher up, just over four times the WHO Air Quality Guidelines of 10µg/m³⁶.

Though Hong Kong is one of many cities struggling with poor air quality, combined with significant carbon emissions from transport, it is in a good position to lead the way. It has a well-developed transport infrastructure with high usage of mass transit, in particular the MTR, and relatively fewer private cars per person. In addition, the Hong Kong SAR Government ("the Government") has introduced a range of regulatory policies and financial incentives, which have led to air quality improvements (as shown in our trends section, 1.3). Other cities and countries can learn from this experience.

Transport is the second largest contributor to Hong Kong's carbon emissions, and road transport is the major part of this. With the Paris Agreement on Climate Change in 2015, countries are expected to develop plans to reduce their carbon emissions to "net zero" emissions by 2050. For Hong Kong, this will involve developing a plan with this long-term goal in mind. Substantial reductions in carbon emissions from transport will be necessary.

³ <http://www.gov.hk/en/residents/environment/air/aqhi.htm>

⁴ See Air Pollutant Concentrations Trend at <http://www.aqhi.gov.hk/en/annual-aqi/annual-aqi-trend5ca5.html?stationid=71>

⁵ See WHO outdoor air pollution database. http://www.who.int/phe/health_topics/outdoorair/databases/cities/en/

⁶ <http://www.aqhi.gov.hk/en/annual-aqi/latest-annual-aqi.html>

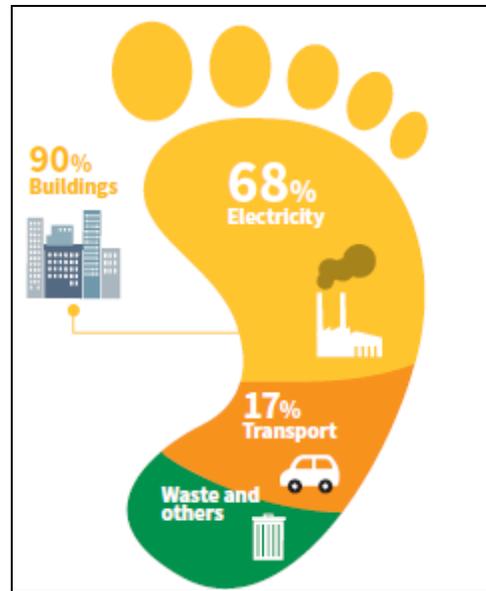


Figure 2: Source of GHG emissions in Hong Kong (Hong Kong Climate Change Report 2015, Environment Bureau)

Air Pollutants – direct health impacts

Particulate matter including larger particles known as PM10s or Respirable Suspended Particulates (“RSPs”) or PM2.5s or Fine Suspended Particulates (“FSPs”) and nitrogen oxides including Nitrogen Dioxide (“NOx”) are the major harmful pollutants in Hong Kong⁷ in terms of immediate health impacts. VOCs and Ozone are also a concern.

The Hong Kong Medical Association estimates that air pollution can exacerbate asthma, impair lung function and raise the risk of cardio-respiratory death by 2 to 3 percent for every increase of 10 micrograms per cubic meter of pollutants. Aside from these serious long-term effects, air pollution harms short-term health by causing pneumonia or bronchitis. The presence of air pollution can also induce headaches, dizziness, nausea, and irritation to skin, eyes, and nose.

“...the World Bank has concluded that one in 10 deaths worldwide are attributable to air pollution exposure – that is more than 5.5 million premature deaths due to pollution, out of an annual total of around 55 million deaths worldwide. That is six times more deaths than from malaria, and four times more than HIV/Aids. Of these premature deaths, over 1.7 million are in China, and over 1.5 million in India.”¹

According to the Hedley Index⁸, the number of premature deaths due to air pollution in Hong Kong was 3279 in 2013, the peak of poor air quality, and 1,568 in 2016. The total number of hospital bed days was 210,024 in 2013, reduced to 105,706 in 2016. In terms

⁷ A Clean Air Plan for Hong Kong, 2013 http://www.enb.gov.hk/en/files/New_Air_Plan_en.pdf

⁸ <http://hedleyindex.sph.hku.hk/html/en/>

of economic costs, the Hedley Index translates this into losses of \$4.32bn in 2013 and \$2.04bn in 2016. So the impact though reduced is still substantial.

Carbon emissions – indirect impacts

Carbon emissions have an indirect impact on health and mortality, as well as general well-being and security, through climate change.

Though this report is about “roadside emissions”, we cover GHG emissions and other emissions arising indirectly from power generation to ensure we take on board the full environmental impacts of different vehicle types. This is also in recognition of BEC’s commitment to support action to reduce emissions to meet the objectives of the Paris Agreement.

1.2 What are the main causes of roadside air pollution in Hong Kong?

Transport is a major contributor in particular in relation to Carbon Monoxide and VOCs, and also NOx and RSPs, which we have the most to worry about in health terms.

Major Causes – within the Transport & Logistics Sector

The biggest contributor to NOx and RSPs in Hong Kong’s road transport sector are diesel commercial vehicles, buses, light goods vehicles, and taxis broadly in that order. Private cars, which are often the focus of public attention, have relatively low emissions as a whole, and the level of emissions from each vehicle type is quite different from the number of those vehicles.

While not classified as road vehicles, NRMM also make a significant contribution to street level emissions.

Figure 3 below shows how many tonnes of particulate matter and nitrogen oxides each class of vehicle emits in Hong Kong, displaying the relative contributions of different types of registered vehicles in Hong Kong as of December 2012.

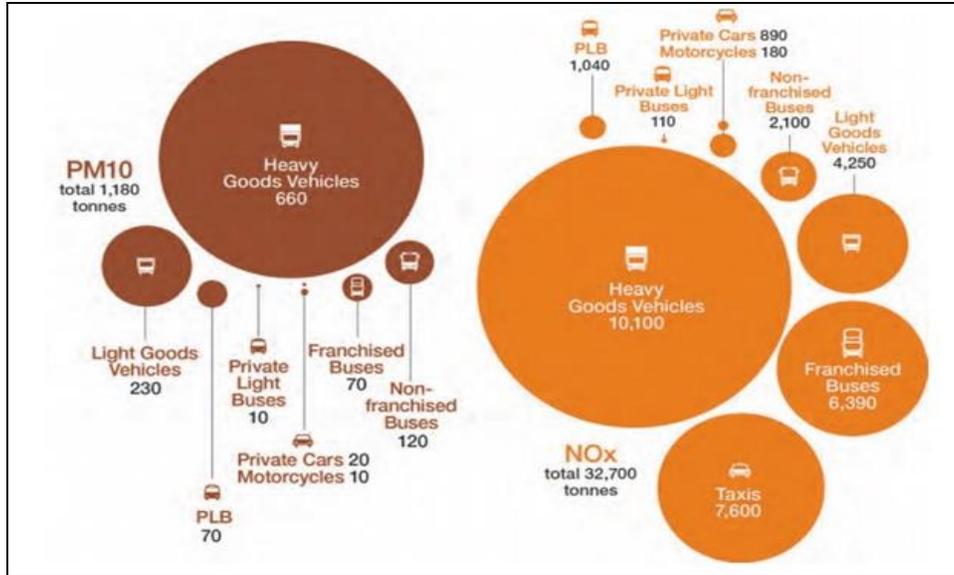


Figure 3: PM10 and NOx source of pollution as of 2012 (Environment Bureau, 2013)

However, private cars by far dominate the roads of Hong Kong and the past few years, there has been an increasing number on the roads in recent years⁹.

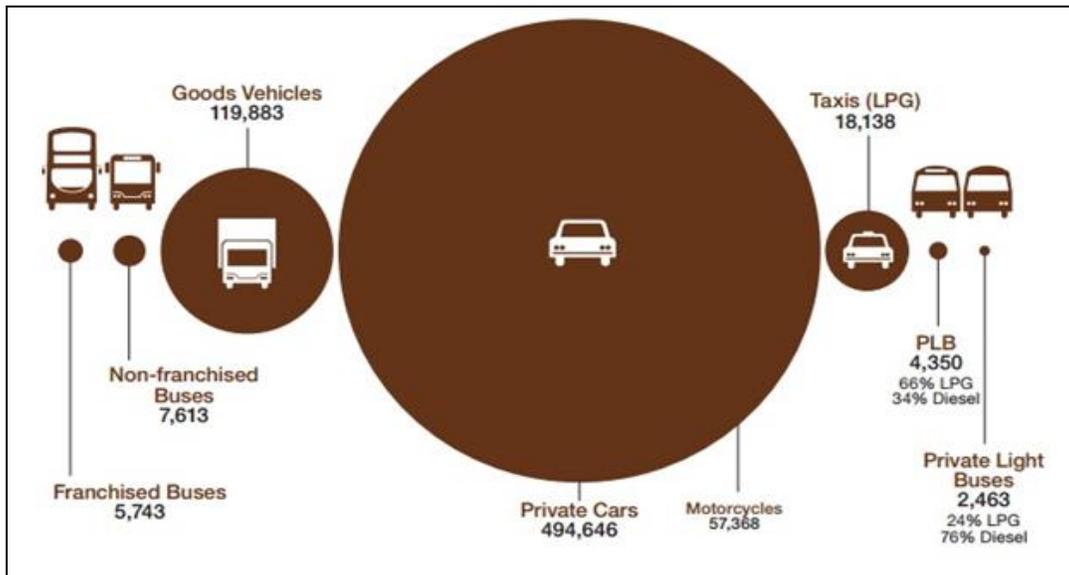


Figure 4: Number of registered vehicles in Hong Kong by type as of 2012 (Environment Bureau, 2013)

Private Vehicles & Taxis

Though NOx and RSP emissions from private cars are not high, this sector is still important because numbers are growing in Hong Kong. The fundamental problem is that more cars cause greater congestion, leading to additional idling by higher emitting

⁹ A Clean Air Plan for Hong Kong, 2013 http://www.enb.gov.hk/en/files/New_Air_Plan_en.pdf

vehicles, releasing more emissions. Though most private vehicles are petrol vehicles with lower NOx and RSPs compared with diesel vehicles, the number of diesel vehicles has increased gradually since the removal of tax from diesel but not petrol.

The introduction of catalytic converters has reduced emissions of both NOx and Carbon Monoxide (“CO”) substantially but if the catalytic converters are not replaced once worn out, emissions are high. With half a million private cars and a lot of private car owners who do not know their converters are worn out, or do not make the effort to have them fixed, the problem is substantial.

For taxis, use of cleaner fuel, Liquid Petroleum Gas (“LPG”), by most of the city’s taxis has reduced NOx, RSP and CO emissions. However, poor maintenance, even with the use of LPG, means high NOx emissions. As of 2013, 80% of taxis and 45% of minibuses in Hong Kong were estimated to have worn out catalytic converters⁹.

More efficient vehicles including conventional and plug-in hybrids and electric vehicles (“EVs”) are available in the market but the price differential is significant, and EVs require provision for charging. Hence, penetration remains modest. For further information on the relative emissions of different vehicle types, see Annex C.

Goods Vehicles

Heavy goods vehicles release the most pollutants into the atmosphere. As of 2011, they released more than half of the 1,180 tonnes of RSPs into the atmosphere and almost a third of the 32,700 tonnes of nitrogen oxides¹⁰. Emissions from old, commercial diesel vehicles and vehicles with worn out catalytic converters, in particular, produce heavy concentrations.

Buses

The franchised buses and public light buses also contribute a large proportion of the pollutants especially NOx, because of their size and use of diesel. Many of the franchised buses are pre-Euro III buses and thus are still major contributors to air pollution.

Non-Road Mobile Machinery

Non-Road Mobile Machinery Vehicles (construction vehicles, trucks and mobile cranes for container terminals, and airside vehicles and ground support equipment at HKIA), known as NRMM, are responsible for an increasing proportion of air pollution in Hong Kong. Some 40,000 NRMM were registered following recent introduction of legislation.

¹⁰ A Clean Air Plan for Hong Kong, 2013 http://www.enb.gov.hk/en/files/New_Air_Plan_en.pdf

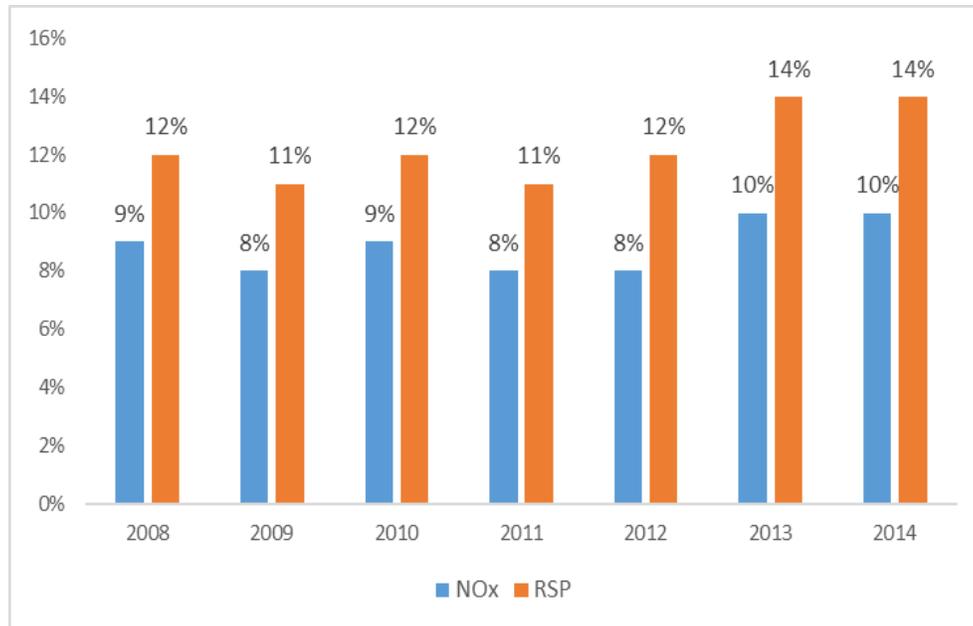


Figure 5: Percentage Contribution of NOx and RSP for NRMM in Hong Kong Total Emission¹¹

1.3 Trends in Carbon, RSP and NOx emissions from Transport

For many years, cities across the world saw an increase in vehicle numbers with urbanization and growing affluence. This led to higher levels of emissions in particular NOx and particulate matter (RSP and FSP), as well as carbon dioxide¹² in the atmosphere. The problem world over was cumulated by pollution from factories, roadside emissions blown over from neighbouring areas, power generation, and from other local sources too (see figure 1 above). The deteriorating air quality in urban areas poses harmful effects in particular to the health of urban residents. In developed world cities, the trend in recent years however is for emissions to fall. In many cases, this is partly related to a reduction in numbers of private vehicles with the link between growing affluence and vehicle numbers broken.

Hong Kong has been relatively successful in keeping air pollutants (NOx and RSP) from transport and power generation under control. This is not only through policy measures at a local level and a steady increase in public transport provision but also through the Environmental Protection Department collaborating with Guangdong Province to improve the air quality of the Pearl River Delta region. In 2012, both governments set emission reduction targets for four major air pollutants: sulphur dioxide (SO₂), nitrogen oxides (NOx), respirable suspended particulates (RSP) and volatile organic compounds (VOC). Hong Kong has also been fortunate in not having a major shift to diesel from petrol in private cars, which has increased NOx levels in other cities.

¹¹ Hong Kong Emission Inventory Report

¹² US Environmental Protection Agency 2016, February 24 - Air Pollution Emissions Overview
<https://www3.epa.gov/airquality/emissns.html>

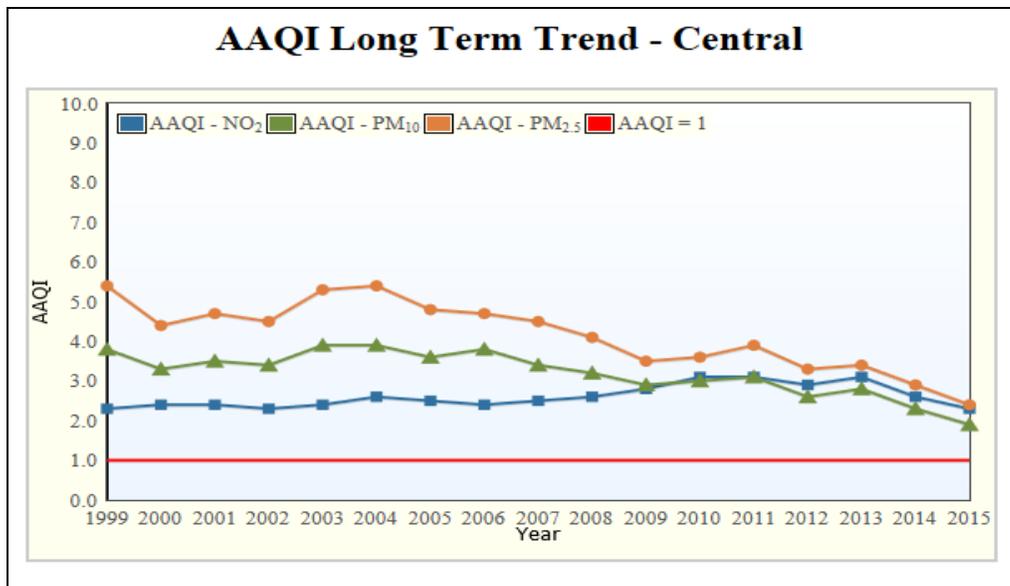


Figure 6: Trends regarding NO₂ levels in Hong Kong – Annual Air Quality Index¹³ (Air Quality Report, AQHI)

Pollutant levels are now below their peak in 1997 and in 2004, and are lower than some cities like New York and Seoul. In 2014, the roadside concentrations of respirable air particles (RSP), sulphur dioxide (SO₂), and nitrogen oxides (NO_x) were 45%, 67% and 45% lower, respectively, than levels in 1999¹⁴. Improvements in levels of other pollutants like Sulphur Dioxide and Carbon Monoxide have been made, making NO_x emissions and RSPs the major air pollutants from road transport.

Though a major reduction is evident in particular in relation to NO_x in the last two years, we have not seen a steady downward trend generally. Figure 7 compares Hong Kong's NO₂ levels with six other cities and countries: New York, Singapore, Seoul, London, Shanghai and USA. In some of these cities, the numbers of vehicles has fallen, though from a higher level of vehicle ownership than in Hong Kong. This is different from the situation in Hong Kong where private vehicle numbers are growing by about 4.8% a year¹⁵.

Hong Kong's emissions trends are not that dissimilar to those in Singapore, but Hong Kong levels are higher. Similar to Hong Kong, Singapore has adopted the European emissions standards¹⁶. Newly registered vehicles driven in Singapore must currently comply with Euro IV or Euro V emissions standards. Singapore plans to move to the new Euro VI standard for diesel vehicles by January 2018¹⁷.

¹³ <http://www.aqhi.gov.hk/en/annual-aqi/annual-aqi-trend.html>

¹⁴ Environmental Protection Department, 2015 - http://www.epd.gov.hk/epd/english/environmentinhk/air/air_maincontent.html

¹⁵ http://www.td.gov.hk/filemanager/en/content_281/table41a.pdf

¹⁶ National Environment Agency of Singapore 2014 - Air Pollution Regulations - <http://www.nea.gov.sg/anti-pollution-radiation-protection/air-pollution-control/air-pollution-regulations>

¹⁷ National Environment Agency of Singapore 2014 - Singapore Will Usher In Euro VI Emission Standard For Diesel Vehicles From January 2018 - <http://www.nea.gov.sg/corporate-functions/newsroom/news-releases/year/2014/month/12/singapore-will-usher-in-euro-vi-emission-standard-for-diesel-vehicles-from-january-2018>

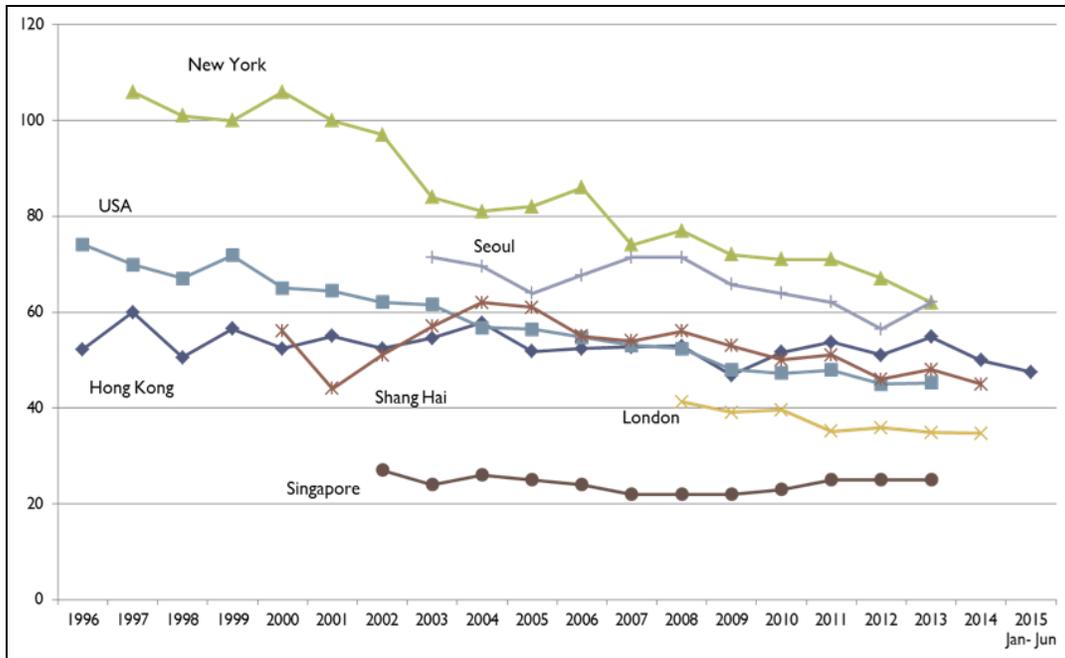


Figure 7: Recent pollution concentrations in several major cities and countries¹⁸

¹⁸ <http://www.hongkongcan.org/eng/2016/01/no-improvement-in-no2-reduction-in-nearly-two-decades-hong-kong-air-quality-falls-behind-world-cities/>

02 The Policy Framework – Hong Kong

2.1 What are the current policy measures in place in Hong Kong?

Hong Kong has witnessed substantial improvements in its air quality. This is in part due to falling emissions from neighbouring Guangdong Province, improvements in power generation and in part due to the HKSAR Government's transport infrastructure strategy with its strong focus on mass transport and policies designed to reduce air pollution caused by vehicles¹⁹. Technological progress worldwide has also made a difference.

In summary, the current policy framework includes the following:

- a. **Regulatory measures:** as to emissions standards of imported vehicles largely following European standards but with a time lag, compulsory retirement of Pre-Euro IV buses, and requirements as to standards to be met by non-road mobile machinery (NRRM).
- b. **Taxes and Subsidies:** high levels of First Registration Tax for new vehicles, with an exemption for fully electric vehicles, a subsidy scheme for installing new catalytic converters in buses, and an ex-gratia payment scheme for Diesel Commercial Vehicles and non-franchised buses to transition from Pre-Euro IV to lower emitting vehicles. Fully electric vehicles also have a partial-waiver from the annual license fee – approximately 10% of the usual cost²⁰. A wider range of low emission vehicles benefit from profits tax concessions.
- c. **Low Emission Zones:** for buses in specific parts of Hong Kong.
- d. **Idling and Maintenance:** regulatory provisions in respect of idling and excessively smoky vehicles.
- e. **Walking & Cycling:** improvements in pedestrian facilities in Hong Kong, with cycling provision in the New Territories and Outlying Islands.

The full range of policies that have been introduced are set out in Annex A to this report, with a short table comparing tax policies between different cities at Annex B. A number of policy changes are in development and are explained below.

2.2 Planned Future Policies

➤ **Electronic Road Pricing**

Hong Kong has consulted the public on implementing an Electronic Road Pricing Scheme ("ERP"), as in Singapore or London to reduce road congestion in Central. A co-

¹⁹ A Clean Air Plan for Hong Kong, 2013 http://www.enb.gov.hk/en/files/New_Air_Plan_en.pdf (page 7)

²⁰ http://www.td.gov.hk/en/public_services/fees_and_charges/ - diesel vehicles annual license is slightly more costly than petrol one.

benefit of this will be a reduction in roadside emissions in an area that has high pollution levels. There is evidence from many countries to support the introduction of ERP on the grounds of efficiency and speeding up movement of people, goods and services, as well as a cleaner environment, which brings health and well-being benefits and a reduced carbon footprint.

➤ **Vehicle standards – Euro VI and 6**

Euro VI heavy goods vehicles emit 80% less NO_x and 55% less RSPs than Euro V and light goods vehicles emit 55% less NO_x. With the increasing availability of these vehicles in the market, the Government proposes to tighten the vehicles emission standards for all newly registered motor vehicles. The Government has indicated to LEGCO that from July 2017, Euro 6b will apply to private cars and taxis, and from 1 January 2018 to LGV, light buses (with design weight < 3.5 tonnes) and from Jan 2018 for DCV and buses with design weight above 9 tonnes. For light buses and buses with design weight under 9 tonnes, the Government has indicated that it will wait for an adequate supply of Euro VI models on the local market before revising the emission standards

➤ **Revising the Air Quality Objectives (AQOs)**

The Air Pollution Control Ordinance (Cap. 311) sets out Air Quality Objectives (AQOs) and provides for the periodic review of the AQOs periodically. This is with a view to ensuring good air quality and thereby help safeguard public health. The AQOs are currently under review by the Government with changes to take effect in 2018. Despite being a significant contributor, Non-Road Mobile Machinery has not been included in the scope of the review.

2.3 Conclusions

Hong Kong has adopted a set of policies largely consistent with those used worldwide, but it has some distinctive policies too. For a comparison of tax/incentive policies, see Annex B. Significant progress has been made and ill health and deaths from air pollution are falling. Figure 8 below shows the recent positive trends in deaths from air pollution. We highlight some key successes and some issues that remain which we seek to address in our recommendations in the next chapter:

Successes

- (a) Hong Kong's commitment to mass public transport – buses and trains and even trams - has been second to none. The number of journeys on public transport is one of the highest in the world, making Hong Kong an efficient and fast-moving city;
- (b) The combination of tighter regulation and a range of subsidies/ex-gratia payments scheme for goods vehicles and non-franchised buses as well as for retrofits of catalytic converters for buses and taxis has been successful in reducing emissions. By directing funds to some of the most highly emitting sectors, good value has been obtained for funds spent.
- (c) Good walking facilities and cycling facilities have been introduced in some new development areas, which can be learnt from to enable wider improvements.

- (d) The Electric Vehicle policy has had some success but may take many years for a transformation with today's policies.

Issues for Further Consideration

The Taskforce has identified the pressing issues and opportunities that remain. These are set out in the next chapter. Subsequent chapters set out recommendations for the short term and the longer term, relevant to business and the Government.

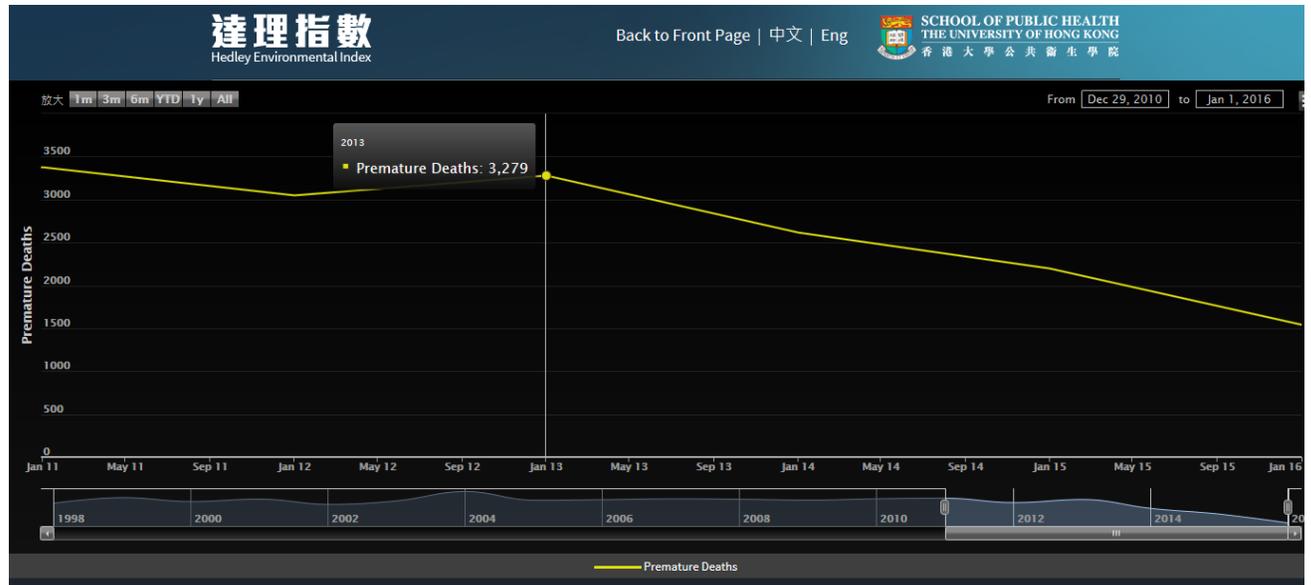


Figure 8: Extract from the Hedley Index showing improvements in health statistics related to air pollution since 2013

03 Overarching Recommendations

Key Issues and Opportunities Identified

- (a) Growing numbers of private vehicles, adding to congestion and emissions. Not so much from those vehicles but by causing congestion that slows down higher emitting commercial vehicles and buses,
- (b) Excellent public transport but opportunities to improve remain, in particular as buses are currently affected by congestion. Some buses have relatively high emissions, and barriers exist to transitioning to ultra-low emission vehicles (e.g. EVs),
- (c) The combination of sticks and carrots applied successfully in tandem to other vehicle classes could equally be applied to Non-Road Mobile Machinery, to obtain further improvement swiftly,
- (d) There are opportunities to enhance the public transport and walking experience through improved connectivity between MTR and buses and supporting pedestrian facilities,
- (e) Goods vehicles provide an essential service but may block roads with deliveries. As well as addressing this issue, there appears to be potential to use smart technologies to increase the efficiency of the logistics sector,
- (f) Best in class vehicles types or even second best are not always purchased due to a lack of knowledge by buyers as to which are best on a life-cycle assessment approach (taking into account carbon and other air pollution) as well as relative costs, and difficulty in accessing the right infrastructure. A smarter use of taxes and other incentives may be possible, looking at first registration tax, annual license fees, fuel taxes (for example in relation to low carbon fuels), company profits tax and electronic road pricing,
- (g) Walking can be uncomfortable and unsafe by large roads with few crossings and without shelter. The streetscape in many areas still emphasizes cars over pedestrians, and in many areas there are insufficient level-differentiated walking routes, and those that do exist may not provide an engaging pedestrian experience,
- (h) Limited facilities for commuter cycling compared to other big cities, and
- (i) The focus to date has been on supply-side management (more routes, more buses, more MTR etc.) but there are also opportunities for demand-side management by reducing people's need to travel or at least to do so over long distances e.g. home office, flexible working hours (out of peak hours).

The key issues identified through our research and discussions in workshops and Taskforce and Advisory Group meetings are explained below. Overarching recommendations for the Government and business to address these issues are set out. Detailed recommendations are set out in the next two chapters, for both business and the Government with regard to these Overarching Recommendations.

3.1 Public transport: opportunities to improve

Retaining or increasing public transport levels

Public transport is the most efficient mode of transport. Approximately 90% of people use public transport in HK²¹, and public road transport (including taxis) carries more than 60% of passengers on the road²², but represents only 20% of the vehicles on the road. Private cars, taxis and motorcycles only carry 28% of people (23% if taxi drivers are excluded). The pollution per passenger travelling by bus is therefore comparatively lower since buses carry many more passengers than other modes. It goes without saying, that travelling by the MTR is also highly efficient with low emissions overall, and limited impact on roadside air quality.

There is a case therefore to shift the use of road space so that more is given over to buses and trams. In this way, we can increase the average speed of the buses for passengers and the speed of movement for the majority of people. In some countries (e.g. Singapore), cars are mandated to give way for buses leaving the bus stop. In Europe, the introduction of bus lanes and bus priority junctions has increased the speed of public transport and made it in many cases more appealing than private cars. Currently, in Hong Kong, there is no priority for public transport except for trams at junctions (traffic lights, buses lanes) and the increasing congestion in Hong Kong makes road-based public transport less attractive and adds to pollution.

Continuing bus route rationalization should also be part of the picture, helping reduce unnecessary vehicular movements.

Increasing Public Transport Connectivity

Usually, the first and last mile of a journey by public transport is on foot. Improving this first and last mile provision greatly supports the convenience of public transport. Though the connectivity and accessibility of the public transport network in Hong Kong is excellent compared to many other parts of the world there is room for low cost improvements. This includes more all-weather walkway connections, and improving the street level experience by introducing shading of pavements, improving the safety of junctions, and increasing the number of pedestrian crossings. Better information on bus routes at MTR stations as well as better signposting for pedestrians taking on board programmes like “legible London” can connect the different parts of the public transport system as well as pedestrian routes to public transport.

Low Emission Buses

As explained in the introductory section, emissions from buses make up a large proportion of total roadside emissions especially in terms of NO_x and CO₂ emissions. We are supportive of the Government’s aim to ultimately shift Hong Kong to zero or at least ultra-low emission buses and welcome a focus on addressing emissions from this sector. A transition to EVs will shift pollutants away from the roadside, reducing their health consequences, and as the grid decarbonizes and gets cleaner overall emissions will fall.

²¹ http://www.td.gov.hk/en/publications_and_press_releases/speeches/20101211/index.html

²² <http://www.info.gov.hk/gia/general/201104/09/P201104090213.htm>

The Government has put in place a policy framework for addressing emissions from buses, focused on removing buses older than 18 years from the road and supporting maintenance and retrofitting of catalytic converters. The latest requirement is for all new buses to comply with Euro VI standards from January 2018. Although it will support this shift, this is a gradual transition with buses only having to be replaced when 18 years old.

The Taskforce considers that there is room not only to address the problem of some buses still being Euro II and III, but also in supporting the introduction of ultra-low emission buses such as electric buses and hybrids.

To encourage this shift we consider that a number of steps need to be taken:

Public Light Buses and other single-decker buses

EV technology is already available and used in cities across the world including China. The figures below show CO₂ emission savings from the more efficient electric buses. For these buses, a transition in the short term towards EV technology is possible supported by trialing and pilots, Government funds to help vehicle owners meet the extra costs, and the introduction of charging facilities at transport hubs or at minimum simplifying the process for obtaining consent to install charging points is possible. In the short term, a shift to Euro VI and hybrid diesel buses would also make a significant difference. For the medium to long term, as Hong Kong develops a low emission grid, the Government should explore making EVs standard, in line with its vision of Zero Emission transport in Hong Kong.

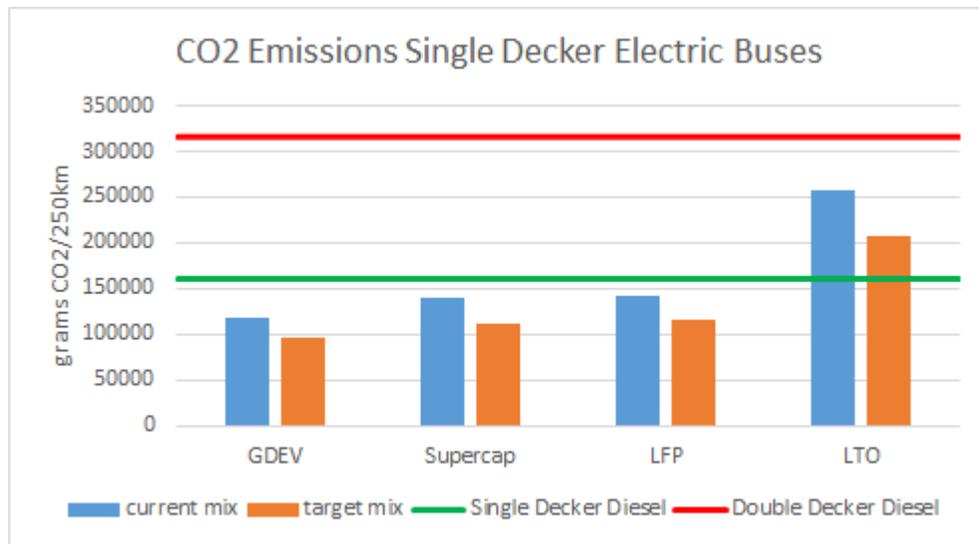


Figure 9: Carbon emissions of electric buses (EMSD, 2014) (US Department of Energy, 2016) (WPI Report, Appendix C) Note: GDEV, Supercap, LFP and LTO are different manufacturers.

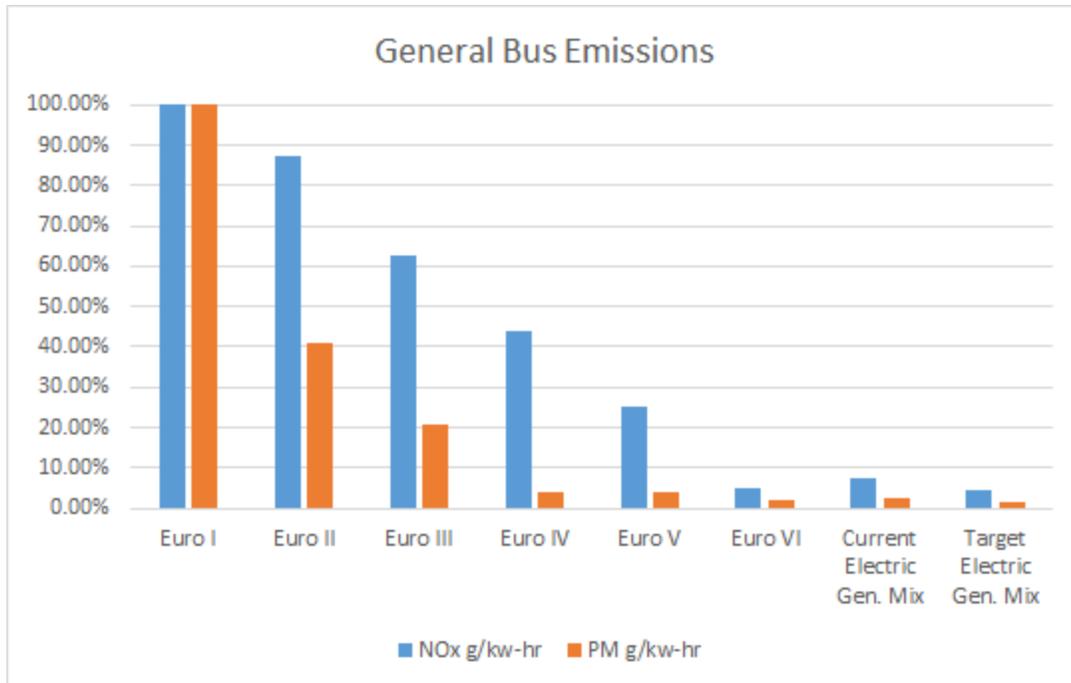


Figure 10: NOx and PM emissions of electric and Euro buses (US Department) WPI Report (2016)

Franchised Buses

For franchised bus companies, shifting to EV and hybrid technology is more challenging as fleets are largely double decker, over 90% of bus fleets in Hong Kong. Electric air-conditioned 3-axle double-deckers are not currently available. Moreover, in a hilly landscape and with high air-conditioning needs, the batteries required add substantial weight reducing their efficiency. The uncertainty as to battery life combined with higher capital costs also makes it difficult to support commercial decisions in favour of EVs and hybrids. At present, trials suggest there is greater potential for use of hybrid technology especially in urban areas.

Euro VI buses are available. They do not require any additional infrastructure or operating costs, and would greatly reduce roadside emissions and even has NOx and PM standards about the same as those from the proposed electricity generation fuel mix.

To support the shift, a transition in the short term to Euro VI and to hybrids through early replacement of older buses of Euro IV standard or below, is possible with adequate Government support. This would not require any additional infrastructure and should significantly alleviate roadside emissions. To enable a shift in the longer term, continued piloting of EV technology and the introduction of charging facilities, as stated in relation to public light buses, is important.

Alternative fuels

Use of biodiesel and fuel additives has potential benefits, particularly during the extensive phasing out process of older buses. Studies suggest that using biodiesel (a 5% blend known as B5 or other blends below B10) would reduce CO₂, as long as the biodiesel is from locally sourced waste cooking oil and other biowaste, and possibly

even other roadside emissions. B5 appears to be compatible with all diesel engines and that there is no technical barrier for the conversion of bus fleets to B5. In the EU this is used widely with a standard developed for the fuel (EN590). There is currently a concern that there will be a slight increase in operating costs and reduced efficiency, though it may be possible to reduce these impacts by the use of fuel additives, making local trials and price differentials important. Using biodiesel made from agriculturally produced biodiesel can in fact increase carbon emissions and is not supported.

Recommendation 1: Continue to support strongly public transport as the preferred mode of travel for journeys, and support a transition to cleaner buses and lower emission fuel types.

Most importantly by ensuring it is fast and there is improved connectivity between different forms of public transport, as well as good supporting pedestrian routes. In addition, making a faster shift towards low emitting vehicles (Euro VI, hybrid and EV), increasing incentives as appropriate, and making use of lower emission fuels, whilst preparing the ground for a shift in the medium term towards EVs as battery technology improves.

3.2 Addressing congestion on our roads – Smart Systems

From 2003-13, the number of private cars rose 40%, compared with a 3.6% rise in the number of buses and minibuses. More cars have caused greater congestion, leading to additional idling, releasing more emissions. Illegal parking adds to this congestion.

Congestion also stems from commercial vehicles, which often park illegally when loading and unloading, due to a shortage of loading space on roads, holding up traffic as a result. Deliveries occur during peak hours in particular which increase congestion. Though there are charges for the harbor tunnels, these are constant throughout the day.

Bus route rationalization to avoid unnecessary vehicular movement can also help reduce congestion, and continued efforts in this respect are supported.

An efficient transport system increases commercial efficiency and quality of life, and the scope for further expansion of the road network is increasingly limited taking on board Hong Kong's limited landscape.

The study by the Working Group on Road Traffic Congestion set up in April 2014 under the Transport Advisory Committee is noted and our broad recommendation below and the detailed recommendations that follow are in line with the conclusions of the Report²³.

Recommendation 2: Address congestion through smart systems, avoiding putting more pressure on Hong Kong's landscape, and instead minimising unnecessary vehicular movements.

²³ Report on Study of Road Traffic Congestion in Hong Kong (2014)
http://www.thb.gov.hk/eng/boards/transport/land/Full_Eng_C_cover.pdf

3.3 Diesel Commercial Vehicles & Non-Road Mobile Machinery (NRMM) – transitioning to cleaner vehicles

Diesel Commercial Vehicles

In Hong Kong, delivery vehicles can often be old and polluting (pre-EURO IV). Grants are in place to support a transition to lower emission vehicles. However, as implemented, there is no business case for transitioning to the most efficient vehicles such as Euro VI diesel or Euro VI hybrid considering the higher capital costs.

Using newer commercial vehicle types e.g. hybrids and EVs can reduce emissions, but have their own costs, for example for EVs, the introduction of a charging infrastructure.

Euro VI trucks require very little change to infrastructure, while still reducing roadside emissions, in particular NO_x and RSPs over Euro V. They have the flexibility of being capable of using other fuel sources. This means a Euro VI truck or biodiesel Euro VI truck can easily be converted for use as a LPG vehicle. Doing this would bring the benefits from both the Euro VI engine and the fuel source of choice. A hybrid Euro VI truck has the same benefits as a standard Euro VI but brings greater reductions in CO₂ emissions, and also lower emissions when idling.

The position as to the use of biodiesel is the same as with buses. As long as the fuel is made from locally sourced waste cooking oil, it brings CO₂ emission reductions. There are currently no incentives to encourage cleaner fuels e.g. biodiesel (which has lower carbon emissions) with no price differentiation with diesel. Moreover, some fuels from waste, like biogas, are not recognised as a fuel. This is even though research has shown that biogas can help reduce GHG emissions that arise from organic waste as well as from transport.

Non-road Mobile Machinery

There is a wide range of mobile machinery (including transportable industrial equipment), or vehicles powered by internal combustion engines used primarily off-road in construction sites and locations like the airport. This is known as Non-road mobile machinery (NRMM), and the machines are often powered by diesel and have high emissions. There are approximately 40,000 NRMM in Hong Kong, producing a substantial proportion of Hong Kong's emissions.

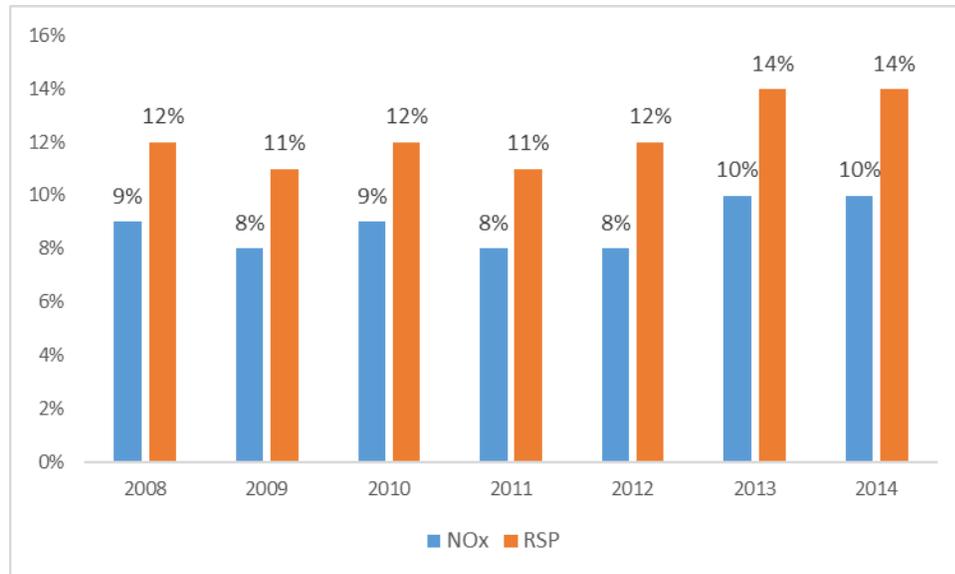


Figure 11: Proportion of NOx and RSP from NRMM in Hong Kong²⁴

Under the Air Pollution Control (NRMM) (Emission) Regulation²⁵, since June 2015, every such vehicle needs to be registered and labelled with respect to its emissions. These regulations aim to bring NRMMs under emission controls in line with environmentally advanced countries.

Currently, there are no policy measures to encourage trials or adoption of lower polluting NRMM. The Government has not supported the regulatory “stick” of the Air Pollution Control Emissions for NRMM with any incentives. This is different from the approach towards other commercial and franchised vehicles and is likely to undermine the success of the new regulations.

Recommendation 3: ensure a transition to low emission diesel commercial vehicles and Non-road Mobile Machinery, using regulation and subsidies for a quick transition and encourage the use of low emission fuels.

3.4 Opportunities from new technologies and fuel types – private vehicles and taxis

There are a number of vehicle types that could be more widely used in Hong Kong at present to reduce carbon emissions and other air pollutants, including conventional hybrids, plug-in hybrids and fully electric vehicles, but possibly also hydrogen fuel cell vehicles. Euro 6 petrol and diesel are also significantly better than Euro 5 in terms of air pollution. See Annex C for more details.

²⁴ Hong Kong Emission Inventory Report

²⁵ http://www.epd.gov.hk/epd/english/environmentinhk/air/guide_ref/guide_apco.html#NRMM

However, though Euro 6 petrol vehicles have lower air pollution impacts than Euro 5, they bring no significant reduction in carbon emissions. A Euro 6 hybrid (plug-in or traditional) reduces carbon emissions, though not as much as an electric vehicle (especially from 2020 onwards when the carbon intensity of the grid is expected to fall), as well as air quality impacts. Considering their fuel efficiency and flexibility, hybrids are a reasonable option considering their relative affordability and lower emissions. Comparative carbon, NOX and RSP emissions are difficult to map with certainty. However, what appears to be clear is that both fully electric and hybrids can help reduce emissions significantly at this stage.

Considering the ultimate carbon emission objective of net zero carbon emissions, the best option for private vehicles in the longer term would appear to be EVs, as the carbon intensity of the grid improves and other emissions fall. Improvements are planned for 2020 under the relevant Technical Memorandum²⁶, and further reductions in the longer term are expected. In terms of longer-term transformative change, a vehicle company has calculated that a shift of Hong Kong's 500,000 private vehicles to electricity will only mean a 3% increase in electricity needs in Hong Kong, and if the grid were to improve towards carbon neutrality this shift would help achieve the objectives of the Paris Agreement. EVs have other benefits in terms of electricity storage which would enable a reduction in peak demand in the event of a smart grid being developed in Hong Kong, though this will require vehicles to be connected to the grid for much of the time.

Deciding on the best way of using taxes and other incentives to reduce emissions from this sector and transport overall is a complex matter. It involves looking at reducing emissions in the short term and more radically in the longer term, to help achieve the objectives of the Paris Agreement on climate change.

The current approach is to use waivers of the First Registration Tax ("FRT") and annual license fee to support a shift to **fully electric vehicles**, and not hybrids or plug-in hybrids²⁷. This reflects the lower carbon emissions and RSPs from electric vehicles over other vehicles and the lower NOx emissions on the roadside, as well as the suitability of EVs to Hong Kong considering the short distances travelled. The health impact of emissions from power generation relating to EVs are also lower, though it is difficult to quantify this difference, because they are not on the roadside and will disperse faster. The tax waivers can be substantial – around \$500,000 for a top of the range EV to \$160,000 for a medium-sized EV in respect of the FRT waiver alone. Annex B shows how this approach relates to that adopted in other cities, with the main difference being lower levels of tax waiver as well as support for other low emission vehicles.

There are a number of **arguments for modifying this approach**. The first is that the current tax waiver has achieved its aim of getting car owners to think electric and creating an impetus in this direction, but full waivers beyond this are not the best use of funds. The argument is that with relatively low emissions from private vehicles, the bigger issue at present is congestion caused by the numbers of vehicles on the road, and consequently higher emissions from high emitting vehicles. The waiver may in fact may lead to more cars being purchased adding to this problem. These funds arguably

²⁶ http://legco.gov.hk/yr10-11/english/subleg/brief/1041ss5_brf.pdf

²⁷ The profits tax arrangements support a wider range of low emission vehicles.

would be better put towards reducing emissions from high emitting vehicles or perhaps developing a charging infrastructure for EVs to facilitate long-term change. The second is that it would be better for the waiver to be technology neutral reflecting the benefits of different vehicle types which would support innovation in existing technologies to reduce emissions as well as new vehicle types like hydrogen cell vehicles. The third is that supporting a wider range of low emission vehicles would lead to a more substantial shift in the short to medium term away from conventional vehicles. So for example, conventional hybrids and plug-in hybrids could play a larger role in reducing emissions in the short term if their purchase was encouraged. See Annex C for an estimate of relative emissions.

The Taskforce discussed alternative approaches such as an incentive scheme that supports scrapping of poor performing vehicles either without replacement or with low emission vehicles. Other suggestions made include restricting the FRT waiver to purchase of first vehicles in a household, with no waiver for second vehicles, only providing this for scrapping a high emitting existing private vehicle, and the technology neutral emissions based approach mentioned in the above paragraph.

Taking into account Hong Kong's longer-term carbon emission goals, investing and developing the infrastructure to support a more far-reaching transition is important. Currently there are only 1,300 public charging stations are in place in HK and low level of residential chargers. It was generally felt that targeting funds towards this may help achieve more transformative change.

Considering the range of other emerging technologies e.g. hydrogen fuel cells, as well as the emission reductions from established hybrid technology, many members of the Taskforce were supportive of a more technology neutral approach, and a plan for the medium to longer term that takes on board the potential from different technologies. It should be noted that in Hong Kong, the Vocational Training Council ("VTC") is carrying out some research that should help show the relative emissions of hybrid vehicles which will help all to understand the benefits and to design a waiver/incentive system which recognizes their contribution.

Taxis

For LPG Taxis, the key issue is maintenance. If vehicles – and in particular catalytic convertors - are poorly maintained this may lead to more pollution than from conventional taxis. There are also newer technologies that are mature and can be used such as LPG hybrids. Based on current hybrid systems, the LPG hybrid system would reduce emissions by up to about 40%, compared to conventional LPG engines.

Recommendation 4: To support a shift to low emission private vehicles and taxis, develop and implement a medium term plan, in conjunction with a cross-sectoral dialogue platform, to make use of low emission vehicles types and fuels. In addition, review the current tax and incentive framework to ensure adoption in the short term of a targeted and cost-effective approach to support a transition to lower emission vehicles in terms of carbon and other pollutants, seeking to ensure that vehicle numbers are at minimum maintained if not reduced.

3.5 Provide safe and comfortable urban walking and cycling

In Hong Kong, urban and transport planning has been positive in situating homes close to MTR stops and, in new development areas, providing footpaths and cycle routes to MTR stations.

However, transport planning tends to prioritise road vehicles over pedestrians and cyclists. Safe seamless connections between activity nodes are not provided for pedestrians or cyclists. Walking can get difficult in Hong Kong with crossing highways, or even dangerous when safe crossings are not provided²⁸. When walking in Hong Kong, pedestrian often have to take long detours and make level changes, and shelter from the sun or rain is not provided in a systematic way.

In urban areas, it is almost impossible to commute by cycle and even where this may be possible e.g. urban regeneration areas like Kai Tak, Kowloon East, West Kowloon, it is not being actively designed into the infrastructure. There is also potential for more commuter cycling which could be explored for example Shatin to North Kowloon and along the Harbourfront using a shared use approach. Pilots to trial such arrangements and develop appropriate rules and protocols to ensure pedestrian and cyclist safety are important. These facilities can help reduce emissions whilst also bringing health and well-being benefits.

Electric cycles and scooters may also offer some potential which could usefully be considered.

Recommendation 5: Make more of the opportunities for healthy and low emission modes of transport including commuter walking and cycling in urban regeneration areas, as well as within and to the central districts of Hong Kong. In some cases this may involve “shared space” for commuter and leisure use such as on the Harbourfront.

3.6 Set Clear Long Term Goals – the AQOs

Hong Kong updated its Air Quality Objectives (AQOs)²⁹ in 2014 taking on board the 2006 World Health Organisation (WHO) Air Quality Guidelines (AQGs) that help countries set good Air Quality standards that protect public health. We welcome the commitment to a regular review at least once every five years with a view to promoting the conservation and best use of air in the public interest.

Different cities have different situations and constraints, but currently our set of AQOs appears not to be as ambitious as other cities like Tokyo and it appears that they could be further improved. We would like to see a “roadmap” type approach which sets out a set of AQOs improving over a period of time.

²⁸ http://www.civic-exchange.org/materials/event/files/20130507%20Walkable%20City%20Living%20Streets/20130507_WalkableCityLivingStreets_Report.pdf

²⁹ Air Pollution Control Ordinance (Cap. 311).

These AQOs could usefully be supported with a high level overarching plan which helps give general direction and timescales for change away from fossil fuels to low carbon alternatives. This will encourage R & D and help businesses provide for the shift. We are already seeing some of this innovation in Hong Kong such as in relation to electric buses. This clear direction and timescales can help support this.

Recommendation 6: Develop an ambitious but achievable roadmap with a phased improvement of Air Quality Objectives (“AQOs”) set to cover a period of time, engaging business and experts fully in developing these limits, and a supporting high-level plan.

04 What can business do to help meet these overarching recommendations?

4.1 Buy lower emission vehicles – Euro VI, hybrids, electric – buses, trucks, taxis and cars

One solution to tackle roadside emissions is for companies to create a fleet of low emission vehicles depending on the type of vehicles they use. Here we explain the choices that they may wish to make:

- **Buses**

For double decker buses, franchised bus companies are encouraged to upgrade to Euro VI as swiftly as possible, or to hybrids where they are appropriate, whilst at the same time continuing to pilot and trial both hybrids and EVs to identify the best technologies and how to optimize the use of hybrids. Increased measuring and monitoring of emissions to understand best practice in the Hong Kong context is supported.

For public light buses as well as single decker franchised buses, we consider there is room for use of EV and hybrid technology. Bus owners are encouraged to continue to trial EVs, supported by the Pilot Green Transport Fund, and to introduce more EVs and hybrids into their fleets in the short to medium term.

Bus companies are encouraged to use blended B5 fuel, made with biodiesel from waste cooking oil.

- **Commercial Diesel Vehicles**

To support the shift to lower emission fleets, owners and operators of diesel commercial vehicles are encouraged to begin replacing their fleet with Euro VI vehicles, with a preference for more efficient Euro VI hybrids. They are also encouraged to make use of the Green Transport Pilot Fund to trial new vehicle and fuel types and to monitor and report on emissions and costs savings from different vehicle and fuel types in Hong Kong conditions. Opportunities are also available from the use of Compressed Natural Gas, which can usefully be explored.

- **Taxis**

There are cleaner and more efficient taxis than those currently in use. LPG hybrids appear to be the best vehicle type for taxis. They use the same fuel as the current taxis, so they can be integrated without the need for additional infrastructure, nor the complexity of introducing charging time to the taxi schedule as would be the case with EVs. Eliminating idling would also reduce emissions. **Taxi operators are encouraged**

to use low emission vehicles for example LPG hybrids as well as to employ good driving practices.

- **Private Vehicles**

In the short term, hybrid Euro VI vehicles as well as EVs are a good option, though in some cases the charging infrastructure may be limited for EVs.

Considering the ultimate carbon emission objective of net zero carbon emissions as well as improved local air quality, the best option for private vehicles in the longer term would appear to be EVs, especially as CO₂ emissions from electricity generation decrease (in line with fuel mix plans for Hong Kong).

As charging facilities can be installed by parking space owners as long as they fulfill various technical, safety and insurance requirements as well as get permission from the Building Management Office / Incorporated Owners, the charging facility issue is not insurmountable. Both power companies (CLP and HEC) already have programmes that facilitate private users to install their own chargers. **Businesses are encouraged to begin purchasing these vehicles and installing chargers as necessary, working with property companies and the electricity companies.**

4.2 Putting in infrastructure for EVs

With the number of private vehicles in Hong Kong, many more charging stations or facilities in residential buildings need to be installed in order to make switching over possible. Some car parking spaces in residential buildings under newly approved development plans have been equipped with the infrastructure needed for the installation of charging facilities. But this is not sufficient. Property developers and property managers could usefully begin installing chargers as part of a process of supporting a clean low carbon Hong Kong.

There are clear advantages in charging within residential buildings including the potential to make use of off-peak electricity capacity at night, and reduce the need to drive around to look for and queue for charging facilities.

In the long term, there may even be potential for EV batteries to be used to store energy reducing peak demand, as part of a smart grid. A well-developed charging structure that ensures that vehicles are connected for a large part of the day and night is important to enable this to work effectively.

Property management companies should look to commit to installing chargers for a significant proportion of their parking spaces, rising progressively, and commit to allowing an EV owner to install a charger for their own parking space where practicable.

4.3 Better routing/management of logistics

Today, business fleets are facing increasing pressures from different angles: safety, costs, improved efficiency, air quality and reporting & measurement. Route Optimization is a technique that tackles those pressures and helps reduce roadside emissions and logistics costs.

When it comes to logistics improvement, businesses can usefully install telematics and cameras in their fleet of vehicles to collect good data and identify ways in which their routing could be improved. Once data has been collected and analysed, businesses can use logistic optimization software to reduce the journeys and number of vehicles.

Several routing companies already exist and can help businesses to optimize their logistics. Case studies showed that implementing such solutions requires investment in telematics and software, but routing systems enable them to obtain a good return on investment with transport cost reduction paired with reduced pollution³⁰.

4.4 Promote eco-driving practices

Introducing eco-driving practices can lead to a 13% reduction on average in fuel consumption, reducing both cost and environmental impact.

Training is important to achieve this. To do so, telematics can be used to track a driver's performance and train the driver again before his/her driving habits comes back to the initial point. This solution allows significant fuel and emission reductions, an average improvement of 10% and huge potential CO₂ reduction.

An alternative approach to achieve behaviour change would be to give the money saved by those drivers who practice ecodriving to them as a bonus.

Businesses should encourage eco-driving practices through better training for their drivers and incentives.

4.5 Support Walking and Cycling

Businesses especially from the property development sector can support the development of last mile transport schemes and improvement of the pedestrian experience, as well as make provision for cycle parking which can support cycle routes.

Business is encouraged to design these features into new buildings, and make provision where appropriate and feasible in existing developments.

4.6 Explore Demand-side Management

For the longer term, business could usefully develop ideas and ways of working that help reduce the need to travel. In some countries, greater use is being made of home-working and flexible hours reducing pressure on transport systems. Consideration should be given to what may be appropriate here considering local circumstances.

³⁰ Route Monkey – Kate Armitage (2016)

05 What policy changes do we recommend to Government?

Overarching Recommendations

- 1 Continue to **support strongly public transport** as the preferred mode of travel for journeys, most importantly by ensuring it is fast and has improved connectivity between different forms of public



transport, as well as good supporting pedestrian routes. In addition, making a faster shift towards low emitting buses (Euro VI, hybrid and EV), increasing incentives as appropriate, and making use of lower emission fuel types, whilst preparing the ground for a shift in the medium term towards EVs as battery technology improves



- 2 **Address congestion** through smart systems, avoiding putting more pressure on Hong Kong's land space, and instead minimising unnecessary vehicular movements

- 3 Ensure a transition to **low emission diesel commercial vehicles and NRMM** using regulation and subsidies for a quick transition and encourage low emission fuels



- 4 **Support low emission private vehicles and taxis, develop and implement a medium term plan, in conjunction with a cross-sectoral dialogue platform, to make use of low emission vehicles types and fuels. In addition, review the current tax and subsidy framework to ensure adoption in the short term of a targeted and cost-effective approach** to support a transition to lower emission vehicles in terms of carbon and other pollutants, whilst seeking to ensure that vehicle numbers are at minimum maintained if not reduced



- 5 Make more of the opportunities for healthy and low emission modes of transport including commuter **walking and cycling**



- 6 **Develop an ambitious but achievable Roadmap** with a phased improvement of **Air Quality Objectives** set to cover a period of time, engaging business and experts fully in developing these limits, and a supporting high-level plan.

Principles

Business Environment Council held a workshop with Hong Kong businesses, NGOs and the Government, organized an evening Leadership Network Series event, and held Advisory Group meetings to discuss the policies that would lead to a greener Transport & Logistics sector.

From these discussions, Members concluded that a transport policy fit for the challenges of the 21st century should be in line with the following **principles**:

- **enable and speed up movement of people and goods**, not of vehicles. This means supporting the movement of buses on our roads more so than private vehicles;
- **address high emission vehicles and reduce congestion**, which is more important than shifting private vehicles from higher emitting to lower emitting vehicles;
- take on board **both GHG emissions and other air pollutants** in developing policy;
- **incentives kept under review** to ensure a good relationship between the policy outcomes sought and the funds incurred, so that funding is used in a proportionate way. This is a complex matter considering the number of policy outcomes: roadside air pollution, carbon emissions, noise and waste, and it is recognised that an exact relationship will not be possible but greater proportionality should be achievable.
- **walking and cycling** should be seen as a mode of transport, and potential reduction of emissions through commuter cycling recognised.

Detailed Policy Recommendations

Recommendation 1: Continue to support strongly public transport as the preferred mode of travel for journeys, and support a transition to cleaner buses and lower emission fuel types. Most importantly by ensuring it is fast and there is improved connectivity between different forms of public transport, as well as good supporting pedestrian routes. In addition, making a faster shift towards low emitting vehicles (Euro VI, hybrid and EV), increasing incentives as appropriate, and making use of lower emission fuels, whilst preparing the ground for a shift in the medium term towards EVs as battery technology improves.



Buses

Bus Lanes and Junctions

Government policy should focus on increasing the average speed of buses for the benefit of passenger mobility, reflecting their high carrying capacity. **It is recommended**

that the Government develop a more extensive system of bus lanes and a programme for priority for buses at junctions.

We suggest an incremental policy. For example, developing bus lanes wherever there are more than 80 buses on a road, and 2 years later, reducing this number to 70 buses, and so on. Good enforcement for infringement into bus lanes by unauthorized users is necessary, and steps to minimize the impacts of more extensive bus lanes on people and goods.

Public Light Buses and Single Deckers

For these buses, we would like to see **continued trialing and pilots, considering the variation between buses and charging technology, supported by the Green Transport Pilot Fund.**

In parallel and with the benefit of those pilots, **to support a faster shift to cleaner vehicles, the ex-gratia scheme should be extended to support replacement of Green Public Light Buses with hybrid/electric buses (are available for single deckers). At present, Euro VI and hybrid diesel buses should also be supported by these funds, as they offer significant reductions in emissions. These changes may require the amount of subsidy per vehicle to be increased and varied reflecting the higher upfront costs of the cleaner vehicle.**

For the medium to long term, as Hong Kong develops a low emission grid, the Government should **explore making EVs standard in this sector**, in line with its vision of a Zero Emission Hong Kong.

Franchised Buses

For franchised buses, Euro VI buses are available. They do not require any additional infrastructure or operating costs, and would greatly reduce roadside emissions with NOx and PM standards about the same as those from the proposed electricity generation fuel mix.

To support the shift, we recommend an early transition to Euro VI and to hybrids through early replacement of older buses of Euro IV standard or below, supported by government subsidies **similar to the current ex-gratia grant scheme for commercial vehicles, to support a transition to Euro VI franchised buses³¹ (and not Euro V).** This would not require any additional infrastructure and should significantly alleviate roadside emissions. In parallel, to support a shift in the medium term, we support continued piloting of EV technology and development of a charging infrastructure.

The Government should also implement an early scrappage scheme for existing Euro I and Euro II buses, so that they are not retained to the end of their lifetime.

Charging Infrastructure and Low Emission Fuel

Barriers should be addressed as to the usage of EVs by the Government either **putting in place charging facilities at transport hubs or at minimum simplifying the process for obtaining consent to install charging points.**

³¹ Starting 2018, no new registration of **newly purchased** Euro V buses. The proposed policy option here is for existing buses.

For both type of buses, because of the low CO₂ emissions, the Government should look to **mandate the use of a blend of biodiesel like B5 (5% biodiesel) made from locally sourced waste cooking oil or other bio-waste, for public transport at minimum, supported by a price differential between B5 and diesel³², following satisfactory completion of local trials.** We request the Government to support these local trials.

On a general level, public transport should be improved by **enhancing the connectivity between buses and the MTR, for example, with maps and signposting. The last mile pedestrian experience should also be enhanced.**

Recommendation 2: Address congestion through smart systems avoiding putting more pressure on Hong Kong’s land space, and instead minimising unnecessary vehicular movements

The Government should take forward the proposed **electronic road-pricing pilot for Central**, seeking to expand this further in the longer term if successful whilst also **enforcing breaches of parking restrictions, a further way of discouraging unnecessary vehicle movements.** Full details of our recommendations are set out in our 2016 policy submission on [Electronic Road Pricing](#). They include a recommendation for ring-fencing of funds to improve alternative transport/mobility systems from pedestrian walkways to improved bus provision and out of town parking.

As goods vehicles can contribute to congestion problems, particularly in the peak hours, to mitigate these impacts, it is recommended that **the Government encourages deliveries in off-peak hours through restrictions on timing of loading bays or differentiated charges for the cross-harbour tunnels, as well as through Electronic Road Pricing schemes.**

Continued efforts to rationalize bus routes is also supported.

In the longer term, consideration to be given to how reductions in the **“demand-side”** – or the need to travel – could be encouraged.

Recommendation 3: Ensure a transition to low emission diesel commercial and Non-Road Mobile Machinery, using regulations and subsidies for a quick transition and encouraging low emission fuels.

Goods Vehicles

In the short term, considering the low NO_x emissions of Euro VI compared to Euro V, **Government is encouraged to introduce requirements for new vehicles to comply with Euro VI standards**, as soon as is practicable, in accordance with its plans for other vehicle classes. **It should consider giving incentives to support replacement of**

³² It is recognised that exemptions may need to be granted where fuel suppliers are not able to source sufficient waste cooking oil.

commercial vehicles with Euro VI (conventional and hybrid) rather than just to Euro V, which requires a review of the level of subsidy to ensure it is sufficient to encourage this shift.

As goods vehicles are the largest source of pollutants, **we recommend further research by the Government to look at the cost per unit of CO₂, NO_x and PM reduced at the roadside (and for carbon, into the atmosphere) for different vehicle and fuel types.**

The Green Transport Fund should be extended and used to trial fleet management systems eg new logistics software and driver development. Current testing of biogas is supported.

As with buses, we recommend that the Government supports use of low carbon emission biodiesel beginning with its own fleet, and once again supported by a price differential to encourage its use over ordinary fuels. The use of other low emission fuels such as compressed natural gas (“CNG”) also need consideration.



Non-Road Mobile Machinery (NRMM)

Looking at the huge impact of NRMM on roadside emissions, **the Government should combine tighter regulation of NRMMs with incentives for pilots and earlier adoption of new equipment to encourage NRMM owners to move more swiftly to Euro IIIa, IIIb and IV.**

Recommendation 4: Support low emission private vehicles and taxis, develop and implement a medium term plan, in conjunction with a cross-sectoral dialogue platform, to make use of low emission vehicles types and fuels. In addition, review the current tax and incentive framework to ensure adoption in the short term of a targeted and cost-effective approach to support a transition to lower emission vehicles in terms of carbon and other pollutants, seeking to ensure that vehicle numbers are at minimum maintained if not reduced.



Private Cars/Taxis

The broad consensus amongst the Taskforce is that the **priority in terms of public policy must be to minimise the number of cars** in Hong Kong, in line with the principle of speeding up movement of people and goods, rather than all vehicles. In addition, tax incentives should be used in a manner that is proportionate to the emission benefits.

The Government Working Group on EVs is best transformed into a **Government Working Group on low emission road and non-road (NRMM) vehicles and**

innovative vehicles. EVs, hybrids, fuel cell vehicles could be covered. We support a high level of transparency and wider membership. Alternatively or in any event, we support **a dialogue platform** for business and the Government involving a range of businesses with an interest in road transport and related non-road mobile machinery. This would ideally include: those that sell and supply vehicles and fuel, significant users of vehicles and mobile machinery, and those with a strong interest in better air quality or reduced carbon emissions from vehicles.

This working group or dialogue platform could usefully **develop a roadmap considering future scenarios or options for progress over the medium to longer term in relation to different vehicles types and infrastructure.** The Roadmap should focus on setting a pathway for reduced emissions leaving open possibilities of how to reduce CO₂ / NO_x / Sox / PMs, rather than favoring one technology. Complex evidence-based decisions may however need to be taken by Government on measures and investment in relation e.g. to hybrid, EV or fuel cells, to help ensure the optimum solutions for Hong Kong as a whole and for different parts of Hong Kong which may have different needs.

The Taskforce recognizes the complexity of using the **range of tax waivers and other incentives** in a smart way. It takes the view that the **First Registration Tax waiver for Electric Vehicles**, due to expire in March 2017, has worked reasonably well in highlighting the benefits of EVs. It supports continued use of tax waivers to encourage a transition to low emission private vehicles and taxis such as fully electric vehicles. However, it recognizes that there is room for improvement in the current system. We recommend detailed consideration be given to how the incentive structure can be varied to strengthen the relationship between the level of tax waivers/incentives and reduction in carbon emissions/pollutants and take on board the possibility of a short term shift to other low emitting vehicles e.g. petrol hybrids (plug-ins or conventional) which may be more practicable in the short term than a transition to EVs. Such a scheme needs to be designed so that it does not support an increase in private vehicles and also takes on board the limited reduction in overall emissions that can be made by a focus on a shift in types of private vehicles.

The Government is encouraged to develop an incentive scheme for installation of charging facilities in existing public and private carparks or residential buildings. The incentives should be designed to ensure a comprehensive charging infrastructure³³, which supports charging outside peak demand hours and the development of a smart grid with EVs playing an energy storage or “peak shaving” role. The Government should maintain policies on EV charging for new buildings, and in the longer term should provide for owners of parking spaces to install charging facilities in private buildings as long as they pay for the installation and equipment, addressing current barriers for example as to agreement by owners committees.

A solution for older cars could be to **develop a Scrappage Scheme**, widely used around the world to take the oldest vehicles off the roads. For Hong Kong it is a way of reducing

³³ Care needs to be taken to avoid simply extending parking spaces, though some very specific situations it may be appropriate to allow a new parking space on condition that it is for a low emission vehicle.

vehicle numbers overall, and it is not suggested that this be attached to buying a new car.

A large proportion of taxis in Hong Kong, 9000, are over 12 years old (pre-Euro V), and though the requirement to maintain catalytic converters is helpful, this is difficult to enforce. **The Government is encouraged to introduce a subsidy scheme to enable owners buy new low emission taxis such as LPG hybrids.**

Proper maintenance of the vehicles should be required. It is recognized that replacement of catalytic convertor is mandatory and subsidies are available to support replacement, which is a very constructive policy. **The Government should however also implement strict emissions testing of taxis and mandate the use of new parts for repairs.**

Any variation in the scheme should take on board the importance of reducing emissions from high emitting vehicles: diesel commercial vehicles, buses and NRMM and the desirability of reducing congestion and targeting incentives accordingly.

Recommendation 5: Make more of the opportunities for healthy and low emission modes of transport including commuter walking and cycling.



Walking & Cycling

Walking is an excellent form of low carbon travel and has health benefits too. Hong Kong has made some good progress including pedestrian walkways to and from new developments in places like Central, TST and Kowloon. It has been innovative in its development of an extensive escalator system. However, improvements are needed to enable commuters to walk safely to their offices and other places of work without encountering dangerous junctions. The pedestrian experience would also be improved by giving pedestrians a choice of walking at a raised or underground level as well as the street level, and a more pleasant and engaging experience through ensuring shade and shelter or plants, art and retail/food outlets.

The Government is encouraged to build on progress to date continuing to enhance the system of pedestrian walkways and take from experiences in other cities, to improve the pedestrian experience in terms of making it safe and appealing.

Cycling is a form of transport in many modern cities for a significant and growing proportion of the population. It offers health and well-being benefits as well as reducing the pressure on peak time transport. It is a low emission form of transport. However, in Hong Kong's urban spaces, cyclists do not feel safe or welcome.

We recommend that Government seeks to develop routes in particular in urban regeneration areas and for commuting to urban areas such as from Shatin to Northern Kowloon, as well as within urban areas. On the Harbourfront there is an opportunity for a shared use approach allowing cycling for commuting and leisure.

Some proposals have been put forward by local groups to support commuter cycling in a way that also makes more use of Hong Kong's iconic waterfront. For example the Harbour Loop Initiative³⁴ has been developed by Lead 8 to transform the contours of Hong Kong's waterfront into an iconic 23-kilometer urban running, walking and cycling network. Urban renewal such as in Kowloon East, Kai Tak and Kowloon West also offer the possibility to introduce routes.

To introduce cycling safely, pilots are important to develop the necessary rules and protocols. Some cyclists are not experienced, and for areas like the Harbourfront shared use requires rules and protocols, recognizing the importance of pedestrian as well as cyclist safety.

There are also opportunities to make more use of electric bicycles and scooters which take little roadspace, and have low emissions, but consideration is needed as to how to integrate this into Hong Kong's roadspace and parking system.

The Government is encouraged to:

- **develop cycling routes in particular in urban regeneration areas and also within and to the central districts of Hong Kong** allocating a budget to the Transport and Housing Bureau to improve cycling, as well as walking in these areas.
- Put in place **pilots** to **develop appropriate rules and protocols** to ensure safety.
- **explore how greater use could be made of electric cycles and scooters.**

Recommendation 6: Develop an ambitious but achievable roadmap with a phased improvement of Air Quality Objectives (“AQOs”)

The introduction of AQOs has been an important part of the policy framework and helps set the overall direction and level of ambition. The current review and use of a range of working groups is supported. In terms of improving this framework, the Taskforce emphasizes the benefits of setting objectives sufficiently far into the future so as to enable industry to respond, as well as a broad and open approach to engagement. In this way, more ambitious objectives can be set.

The development of a high level plan that relates to the Road Transport element of these AQOs would help support their achievement. This high level plan could take on board technological innovation, infrastructure design, planning and policy, with the engagement of the Low Emission Vehicle Working Group and/or the proposed Road Transport Dialogue Platform (as recommended above). The Roadmap recommended at 4 above would support this.

Government is encouraged to:

³⁴ <http://www.lead-8.com/en/news/detail.php?id=106&t=HarbourLoop%20Hong%20Kong&type>

- **Set stretching objectives in the form of a roadmap, which would involve progressively falling emission limits.**
- **Seek to ensure broad stakeholder engagement in the process of developing these limits.**
- **Work with stakeholders to develop a high level plan for Road Transport that supports the AQO Roadmap, and which gives clear policy direction and sets timescales for change from fossil fuels to low carbon alternatives.**

This approach would give business advance notice of intended changes supporting R & D that facilitates the change as well as in order to help plan their services and arrange for supplies of vehicles accordingly.

BEC Transport and Logistics Advisory Group

Steering Committee

Ir T.C. Yee	The Hongkong Electric Company Limited
Mr Mike Kilburn	Airport Authority Hong Kong
Mr Joseph Lau	BMW Concessionaires (HK) Ltd
Mr Ron Chung	CLP Holdings Limited
Ms May Liu	COSCO Pacific Limited
Mr Eddie Tse	Gammon Construction Limited
Mr Mark Chung	Hongkong International Terminals Limited
Mr Alexander Mastrovito	Scania (Hong Kong) Limited
Ms Susanna Wong	Sun Hung Kai Properties Limited

Ordinary Members

Mr Donald Johnston	Green Island Cement Company Limited
Mr Cliff Chow	HUD General Engineering Services Limited
Mr Patrick Lee	Inchcape Motor Services Limited
Ms Janice Lao	MTR Corporation Limited
Mr Simon Shum	Netsphere Solution Limited
Mr K Yiu	Orient Overseas Container Line
Mr Vincent Wong	Sino Land Company Limited
Mr David Leung	Syn-Tech Fine Chemicals Co. Ltd
Mr Alok Jain	The Kowloon Motor Bus Company Limited
Mr Serge Gander	Tuenbo (Holdings) Company Limited/ Greenlife Corporation Limited

Workshop Participants (other than those on the BEC T&L AG)

Mr Roberto Vazquez	ASB Biodiesel
Mr Caris Yuan	BMW
Mr Sunny Lam	Civic Exchange
Mr Patrick Fung	Clean Air Network
Ms Christine Loh	ENB (Introductory Remarks)
Mr Paul KS Wong	EPD
Dr ST Mak	EPD
Mr WC Mok	EPD
Mrs Alice Cheung	EPD
Ms Wendell Chan	Friends of the Earth
Mr Raymond A. Yap	Heroes too Foundation
Ms King Yan Tang	HKUST
Ms Kate Armitage	Route Monkey
Mr Bruce Organ	VTC

BEC Interns

Mr Trevor Lowe	University of Colorado
Mr Daniel Pfaff	WPI Student
Mr Michael Pickett	WPI Student
Mr Marc Toomajian	WPI Student

BEC Staff

Ms Maya de Souza	Senior Manager - Policy Research
Ms Gentiane Gastaldi	Specialist - Policy Research & ESG Advisory

ANNEX A: The Transport Policy Framework: Hong Kong

Hong Kong's policy framework relevant to the issues which the Taskforce has focused on is explained below. Planned policies are set out in Section 2 of the Report.

➤ **Overarching – across Different Vehicle Types**

The Government has used a range of policy measures from overall air quality objectives, regulatory measures³⁵ for new vehicles, taxes, subsidies/incentives, low emissions zones for goods vehicles and buses, to expanding the capacity of public transport, urban planning and investment in a pedestrian-friendly infrastructure. These policies are outlined in *A Clean Air Plan for Hong Kong (2013)*. They are described in more detail in this Annex.

Regulatory measures

In 2012, Hong Kong implemented **Euro 5 and Euro V standards (Environmental Protection Department, 2015b) for newly registered motor vehicles**. As Euro VI heavy duty vehicles emit 80% less NO_x and 50% less RSPs than Euro V and diesel light duty vehicles 55% less NO_x, with the increasing availability of these vehicles in the market, the Government proposes to tighten the vehicles emission standards. Euro 6b will apply from 1 July 2017 for petrol private cars and taxis, Euro VI from 1 January 2018 for LGV, light buses (with design weight ≤ 3.5 tonnes), buses (with design weight above 9 tonnes) and goods vehicles, and California LEV III will apply from 1 July 2017 for diesel private cars. For light buses (with design weight > 3.5 tonnes) and buses (with design weight under 9 tonnes), the Government has indicated that it will wait for an adequate supply of Euro VI models on the local market before upgrading the emission standards³⁶.

Taxes and subsidies

The key measures used are:

- A high First Registration Tax (FRT) for private vehicles that increases with the value of a vehicle but with a full discount for fully electric vehicles (EVs).

³⁵

[http://www.legislation.gov.hk/blis_pdf.nsf/4f0db701c6c25d4a4825755c00352e35/86682A3515C78D29482575EE005BD610/\\$FILE/CAP_311_e_b5.pdf](http://www.legislation.gov.hk/blis_pdf.nsf/4f0db701c6c25d4a4825755c00352e35/86682A3515C78D29482575EE005BD610/$FILE/CAP_311_e_b5.pdf)

³⁶ <http://www.legco.gov.hk/yr15-16/english/panels/ea/papers/ea20151127cb1-180-3-e.pdf>

Class of Motor Vehicle	Rate of Tax
I. Private cars	
(a) on the first \$150,000	40%
(b) on the next \$150,000	75%
(c) on the next \$200,000	100%
(d) on the remainder	115%

Figure A1: Hong Kong’s general FRT tax guidelines when purchasing a non-EV car

- EVs pay a small proportion of the annual license fee, approximately 10%³⁷.
 (a) not exceeding 1 tonne unladen weight - \$440
 (b) an additional fee for each 250 kg unladen weight or part thereof - \$95.
- There is no tax on diesel but there is a tax of \$6.06 per litre on unleaded petrol. Unlike in the EU, this has only led to a small switch³⁸, from petrol to diesel for private vehicles, because the Hong Kong Government requires diesel private cars to meet the emission standards of the California. Commercial goods vehicles have always been run on diesel so the tax shift has made little difference.
- Businesses that purchase EVs, hybrids and environmentally friendly commercial vehicles may deduct the capital expenditure have the benefit of the “Tax Incentives Scheme for Environment-friendly Commercial Vehicles” administered by the EPD which makes them eligible for the “Profits Tax Deduction for Capital Expenditure on Environment-friendly Vehicles”

³⁷

http://www.epd.gov.hk/epd/sites/default/files/epd/english/environmentinhk/air/prob_solutions/files/PTD_EFCV_list_e_as_at_31.3.2016.pdf

³⁸ As Above. Increase from 2 606 in December 2013 to 5 290 in August 2015.

- Vehicle owners of pre-Euro IV diesel commercial vehicles can apply for the ex-gratia payment for phasing out their vehicles (see Goods Vehicles section below).
- No equivalent subsidy applies to electric or low emission NRMM.

Supporting Innovation

In March 2011, the Government implemented a HK\$300 million Pilot Green Transport Fund for application by transport operators and goods vehicles owners, encouraging trialing of innovative green and low carbon transport technologies (including EVs). Transport operators may apply the Fund to try out different green products subject to a maximum subsidy of \$9 million for each application and \$12 million in total. NRMMs are not eligible to apply for the fund.

Urban Planning & Low Emission Zones

Sound urban planning principles have been used to improve air pollution and maintain air quality (in those areas with good air quality) through siting housing close to transport nodes and zoning policies. Some parts of Hong Kong like South Lantau and Lamma have a strict policy on the number of private vehicles allowed on those islands, and Franchised Bus Low Emission Zones have been setup in three busy corridors in Causeway Bay, Central and Mong Kok.

Idling and Maintenance

Under the Motor Vehicle Idling (Fixed Penalty) Ordinance (the Ordinance), a driver is prohibited from leaving the engine of a stationary vehicles idling for more than three minutes in any 60-minute period. There are exceptions to the Ordinance, such as vehicles stopped due to traffic or weather conditions, such as very hot weather warning.

Another way Hong Kong control vehicles pollution is through the Smoky Vehicle Control Program (The Government of the Hong Kong Special Administrative Region, 2015b). Under this program, trained accredited spotters will report vehicles that emit excessive dark smoke. The Environmental Protection Department, after investigation and screening of those reports, will require those vehicles to undergo a smoke test within the specified period at designated vehicle emission testing centre. Should the vehicles' owner fail to comply, or if the vehicles fail the test within the specified period, the vehicle license will be cancelled.

A poorly maintained petrol/LPG vehicle could emit excessive pollutants up to 10 times than that of a normal one. To tackle the excessive emission problem, EPD, with the support of the LegCo, launched in September 2014 a strengthened emission control scheme for these vehicles, including deployment of roadside remote sensing equipment for catching those with excessive emissions for their owners to repair. These vehicles will have to undertake an emission test done with the aid of a dynamometer to ascertain the effectiveness of the repair. Failure to pass the test will lead to cancellation of their vehicle licenses.

Walking & Cycling

Under the Clean Air Plan, the Government is looking at urban greening (that is, the planting of trees and other foliage, which trap pollutants and make walking cooler and more pleasant), pedestrian schemes, and cycling networks. With these plans, the Government hopes to improve the air quality of Hong Kong by the end of the decade.

An example of progress on this front is in Kowloon East. The Energizing Kowloon East Office (EKEO), established in June 2012 by the Government to facilitate the transformation of Kowloon East, has focused on enhancing the Connectivity, Branding, Design and Diversity of the area. EKEO's place-making approach to energize the area, by making it a locality where the local community likes to work, do business, walk, to stay and to play has led to the concept of a "Walkable Kowloon East" aiming to encourage a healthy lifestyle of walking.

As for cycling policies, though routes are fairly good from home to MTR in the New Territories, in urban areas cycling is not supported. It is not allowed in road tunnels, and provision has not yet been made for long distance commuting and urban cycling either through safe junctions, bike lanes on streets or segregated cycle routes.

Though EKEO considered the possibility of commuter cycling in this area and in the area surrounding Kai Tak, they have not pursued this. The only cycling facilities planned are for recreational purposes, which will not have an impact on emissions. In respect of commuter cycling, Hong Kong is now out of line with neighbouring cities from Shenzhen and Guangzhou as well as Taipei which have introduced cycling routes in urban areas.

In contrast with some Mainland cities such as Beijing where electric bicycles and scooters, are well-used, bicycles fitted with add-on motors are considered illegal by the Transport Department, based on its interpretation of the law.

➤ **Policies relating to Different Vehicle Classes**

➤ **Buses**

Government policy is a mixture of retiring pre-Euro IV vehicles, encouraging good maintenance/upgrading, and low emission zones to address air pollution hotspots:

- Under the Clean Air Plan, between 2013 and 2017, about 2,950 buses will be retired, all Euro I buses, most Euro II buses, and some Euro III buses, and will be replaced by cleaner models. Bus companies are also required to replace buses before they are 18 years old.
- The Government has implemented a subsidy scheme to reduce the emissions of the buses. Franchised buses received a subsidy to retrofit Euro II and II buses with selective catalytic reduction devices (to reduce NOx emissions). For LPG

Light Buses, the Government provides subsidies to replace catalytic converters and oxygen sensors.

- As well as directly regulating and incentivising higher vehicular standards, the Government has used low emission zones (LEZ), designating these areas in 2015 (Hong Kong Environment Bureau, 2013). Only clean model buses, Euro IV or higher, are allowed to operate in these areas

The ultimate policy objective of the Government is to have zero emission buses (in terms of tailpipe emissions at least) running across the territory³⁹. To this end, the Government allocated \$180 million for franchised bus companies to purchase 36 single-deck electric buses for trial runs to assess their operational efficiency and performance under the local conditions. The first batch of five battery-electric buses commenced operation in 2015, and the remaining electric buses are expected to enter service progressively in 2017.

➤ **Goods Vehicles: Commercial Vehicles**

Under the Clean Air Plan, the Government developed a program to incentivize the phasing out of pre-Euro IV diesel commercial vehicles.

- In 2007, grants were offered to encourage vehicle owners to replace their pre-Euro and Euro I diesel commercial vehicles with new commercial vehicles complying with the prevailing statutory emission standards. About 17,000 applications, which represented 29% of the eligible vehicles, were approved, totaling approximately \$770 million HKD in grants (Environmental Protection Department, 2015b).
- In 2010, grants were offered to replace Euro II diesel commercial vehicles. Approximately 7,400 vehicles (about 27% of eligible vehicles) were replaced with new vehicles through \$650 million HKD in grants (Environmental Protection Department, 2015b).
- In 2014, the Government launched an incentive-cum-regulatory scheme with an aim to phase out by end 2019 progressively some 82,000 pre-Euro IV diesel commercial vehicles (Environmental Protection Department, 2015c). About 47,500 vehicles (i.e. about 58% of the eligible vehicles) were retired under this scheme as at end October 2016, involving an ex-gratia payment of some \$6 billion HKD. Note: At present, though there are Euro VI vehicles on the market, the subsidies can be used to buy Euro V trucks. The vehicle owner can also opt for not buying a replacement vehicle.

As for the regulatory part, the Air Pollution Control (Air Pollutant Emission) (Controlled Vehicles) Regulation (Cap 311X) stipulates the retirement deadlines for

³⁹ http://www.epd.gov.hk/epd/english/environmentinhk/air/prob_solutions/promotion_ev.html

pre-Euro IV diesel commercial vehicles and limits the service life of diesel commercial vehicles first registered on or after 1 February 2014 to 15 years.

The Government stops issuing licenses for those vehicles after the retirement deadlines, unless they can comply with the emission standards applicable to them as if they were first registered on the date of the vehicle licence application.

Of the \$11.4 billion HKD allocated by the Government, approximately \$5.4 billion HKD remained as of end October 2016.

➤ **Non-Road Mobile Machinery**

There is a wide range of mobile machinery (including transportable industrial equipment), or vehicles powered by internal combustion engines used primarily off-road in construction sites and locations like the airport. This is known as Non-road mobile machinery (NRMMs), and the machines are often powered by diesel and have high emissions. There are approximately about 42,000 NRMM in Hong Kong, producing a substantial proportion of Hong Kong’s emissions.

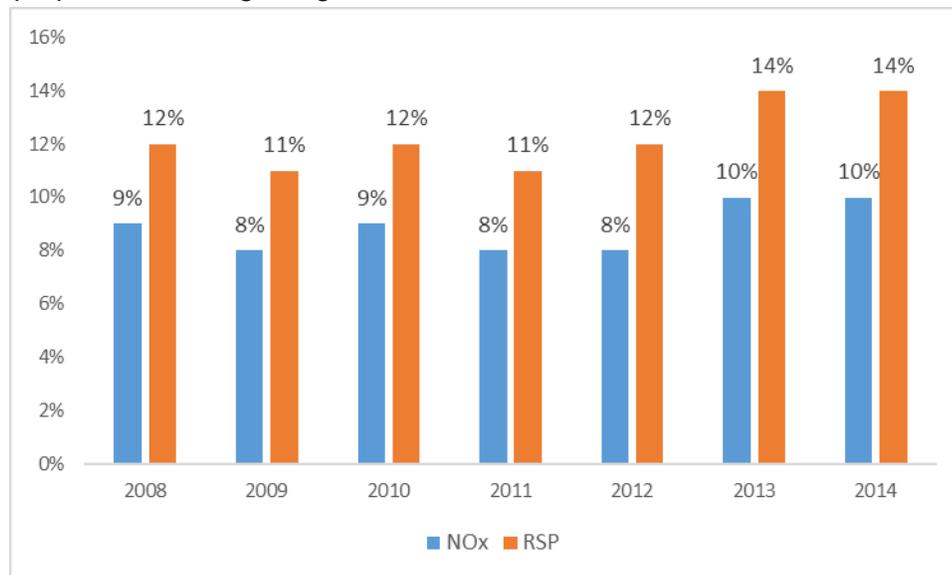


Figure A2: Proportion of NOx and RSP from NRMM in Hong Kong⁴⁰

- Under the Air Pollution Control (NRMM) (Emission) Regulation⁴¹, since June 2015, newly supplied NRMM for use in Hong Kong need to comply with the statutory emission standards and have proper labels adhered to them. These regulations aim to bring NRMMs under emission controls in line with environmentally advanced countries.

⁴⁰ Hong Kong Emission Inventory Report

⁴¹ http://www.epd.gov.hk/epd/english/environmentinhk/air/guide_ref/guide_apco.html#NRMM

- Another initiative is for Government's major public capital works projects to progressively phase out the use of aged NRMM.
- No incentives of any kind are available to NRMM owners

➤ **Private Cars/Taxis**

The Hong Kong Government has implemented several policies to require and to incentivize the purchase of environmentally friendly vehicles (Environmental Protection Department, 2015e). Many of these policies apply to purchasing electric vehicles (EVs), as they have zero tailpipe emissions.

- All vehicles registering for the first time in Hong Kong must comply with Euro 5 or equivalent. However, with the increasing supply of Euro 6 vehicles, the Government proposes to tighten the vehicles emission standards for newly registered petrol cars and taxis to Euro 6 or equivalent starting from July 2017 (see Regulatory Measures at p.16 of this Report).
- the First Registration Tax (FRT) explained above is waived for purchasing a newly registered EV, until the end of March 2017.
- The annual license fee is partially waived for EVs – approximately 10% of the usual cost⁴² - which ranges from approximately \$4000 – \$11,000 HKD a year for private diesel vehicles⁴³.
- businesses that purchase environmentally friendly vehicles may deduct the expense incurred under their profits tax. This tax concession applies to EVs, hybrids and taxis under the “Tax Incentives Scheme for Environment-friendly Commercial Vehicles” administered by the EPD.
- the Government is also seeking to ensure that there are adequate charging facilities available for EVs in Hong Kong. Currently, there are more than 1,400 EV chargers available for public use. Subsidies are not provided.
- there are no fuel taxes on diesel but there are taxes on petrol.

These policies have helped make EVs more popular in Hong Kong. As of the end of October 2016, there were around 6800 EVs on the road in Hong Kong, up from less than 100 in 2010. But this is only a small proportion of the overall number of around 580,000 private vehicles.

⁴² http://www.td.gov.hk/en/public_services/fees_and_charges/ - diesel vehicles annual license is slightly more costly than petrol one.

⁴³ http://www.td.gov.hk/en/public_services/fees_and_charges/

ANNEX B: Comparison of Country/City Policies

Hong Kong	UK	Singapore	Sweden	France
<p>First Registration Tax: waiver for 100% electric vehicles <i>[e.g. a tax waiver of HK\$ 510,000 for a Tesla Model S]</i></p> <p>No tax breaks for hybrids</p>	<p>Plug in car grant: 35% of list price up to 53,000 HKD Must meet certain emissions criteria and larger more expensive EVs not covered. Plug-in hybrids and full EVs covered. No initial tax credit for non-plug in hybrids Also applies to plug-in vans. Up to 20% of cost price.</p>	<p>Technology-neutral scheme - an electric car is treated like other cars under the Carbon Emissions-based Vehicle Scheme (CEVS). Cars with high carbon emissions will incur a corresponding registration surcharge. Rebates for cars that emit less than 160g CO2/km and surcharge if > 210g CO2/km(range from 160,000 HKD to 28,000 HKD for 0-135g CO2/km)</p>	<p>A grant is given for the purchase of a new electric or hybrid electric vehicle: 18,400 HKD for cars with CO2 emissions between 1 and 50g/km (plug-in hybrids) 36,800 HKD for cars with zero CO2 emissions (EVs)</p>	<p>Regions have the option to provide an exemption from the registration tax (either total or 50%) for alternative fuel vehicles (i.e. electric, hybrids, CNG, LPG and E85). A grant is given for the purchase of a new electric or hybrid electric vehicle:</p> <ul style="list-style-type: none"> from Jan 2016, for a car (not applicable to Light Commercial Vehicles) emitting between 61 and 110g CO2/km, the amount of the bonus is 6,600 HKD for a vehicle (car or LCV) emitting between 21 and 60g CO2/km, the bonus amounts to 8,750 HKD for a vehicle (passenger car or LCV) emitting 20g CO2/km or less, the bonus amounts to 55,100 HKD
<p>Annual Road Tax for EVs are 1/10th the price of gas cars</p>	<p>Dependent on engine size, fuel type and CO2 emissions. Electric vehicles (with CO2 emissions < 100g/km) are exempt from the annual road tax. Other alternative fuel cars receive a 100 HKD discount on the paid rates.</p>	<p>Road Tax is based on the size of engine; smaller for Euro 5 (1.1 HKD per cc of engine capacity payable twice a year against \$3.5 HKD for euro 4) Currently Singapore adopts Euro 5 standards for new vehicles, will adopt the stricter Euro 6 emission standard for petrol vehicles on Sept 1, 2017.</p>	<p>A five-year exemption from annual circulation tax applies for green cars (electric cars and plug-in hybrids, with electrical energy consumption per 100km which not exceed 37 kWh).</p>	<p>No annual road tax (since 2006) – a road-toll system instead</p>
<p>Businesses that buy EVs are given 100% profit tax deduction for the first year</p>	<p>Pure electric cars are exempt from the company car tax. All cars with CO2 emissions lower than 50g/km pay 5% for the tax year 2015/2016.</p>	<p>No rebate for company car tax.</p>	<p>Reduction of company car taxation for electric vehicles and plug-in hybrids.</p>	<p>Electric vehicles are exempt from the company car tax. Hybrid vehicles emitting less than 110g CO2/km are exempt during the first 2 years after registration.</p>

Table B1: Comparison of road taxes and incentives in Hong Kong, UK, Singapore, Sweden and France

ANNEX C: Figures on Emissions from Different Vehicle Types

This Annex presents BEC estimations of NO_x, PM and CO₂ emissions for five different vehicle types. It is a rough assessment of relative impacts making best use of the data we can find. We welcome further data to update our figures for the future.

The different vehicle types considered are described below, along with the model used for our calculations, and relative figures in relation to NO_x, PMs and CO₂ are set out below. It should be noted that for electric vehicles emissions will be not be at the roadside but at the power station which reduces the ill-health consequences.

- Euro 6 petrol car: (2016 Mercedes-Benz S500 L Auto) Conventional Internal combustion engine. Highest standard as of 2016.
- Euro 6 diesel car: (no model chosen – same fuel efficiency as petrol car to facilitate the comparison) Conventional Internal combustion engine. Highest standard as of 2016.
- Conventional Hybrid: (Sales weighted average of 2016 model year vehicles with sales in 2015: 2015 sales from "U.S. HEV Sales by Model" (<http://www.afdc.energy.gov/data/vehicles.html>); MPGs from 2016 Fuel Economy Guide (<https://www.fueleconomy.gov/feg/>)). A conventional hybrid electric vehicle (HEV) combines a conventional internal combustion engine (ICE) propulsion system with an electric propulsion system. The main fuel source is petrol/diesel. The amount of fuel required is less relative to a petrol/diesel vehicle, because the electric motor uses regenerative braking to capture energy and store it in batteries, then used to power the electric motor.
- Plug-in Hybrid (PHEV) BMW 330e is a smaller car than a Tesla Model S. A plug-in hybrid has an internal combustion engine and an electric motor. It uses rechargeable batteries, recharged with electricity from the grid and has regenerative braking. Its advantage over a fully electric vehicle is that it can use petrol/diesel to extend its range.
- Fully Electric: EV Tesla Model S 90D - full size 5-seater luxury car with quick acceleration. It is a fully EV car powered entirely by electricity from the grid. Uses regenerative braking.

The emissions from hybrids (conventional and hybrids) depend on a number of factors including the amount of traffic and driver behaviour. It is generally accepted that hybrids are significantly more efficient in their use of fuel and therefore have lower emissions than internal combustion engine vehicles because they use regenerative braking. We expect the carbon emissions of conventional hybrids to be similar to those of a plug in hybrid and close to those of an electric vehicle, from looking at figures for the US State of Wisconsin with similar carbon intensity of its grid as Hong Kong. Trials are currently being carried out in Hong Kong as to air pollution from conventional hybrids. Calculating emissions from plug-in hybrids also involve assumptions as to how much of the time the driver relies on electricity over petrol/diesel.

Assumptions used in the calculations:

Fuel efficiency	Electricity Emissions	Fuel emissions
- Euro 6 petrol car: 8.9L/100km	- NOx (2015): 0.578 g/kWh	- NOx and PM emissions (g/km) for petrol and diesel car: from GREET Model
- Euro 6 diesel car: 8.9L/100km	- NOx (2020): 0.471 g/kWh	- CO ₂ e well to wheel for petrol cars: 3.2 kg/litre
- Tesla Model S: 20.625 kWh/km	- PM (2015): 0.013 g/kWh	- CO ₂ e well for diesel cars: 2.95 kg/litre
- BMW Model 330e: 11.9 kWh/km and 6.4 L/100km	- PM (2020): 0.013 g/kWh	
	- CO ₂ e (2015): 0.598 g/kWh	
	- CO ₂ e (2020): 0.482 g/kWh	

Other Assumptions

- No transmission losses taken into consideration
- To model plug-in hybrid, the two energy sources were split into 80% of electric battery use and 20% of fuel use⁴⁴

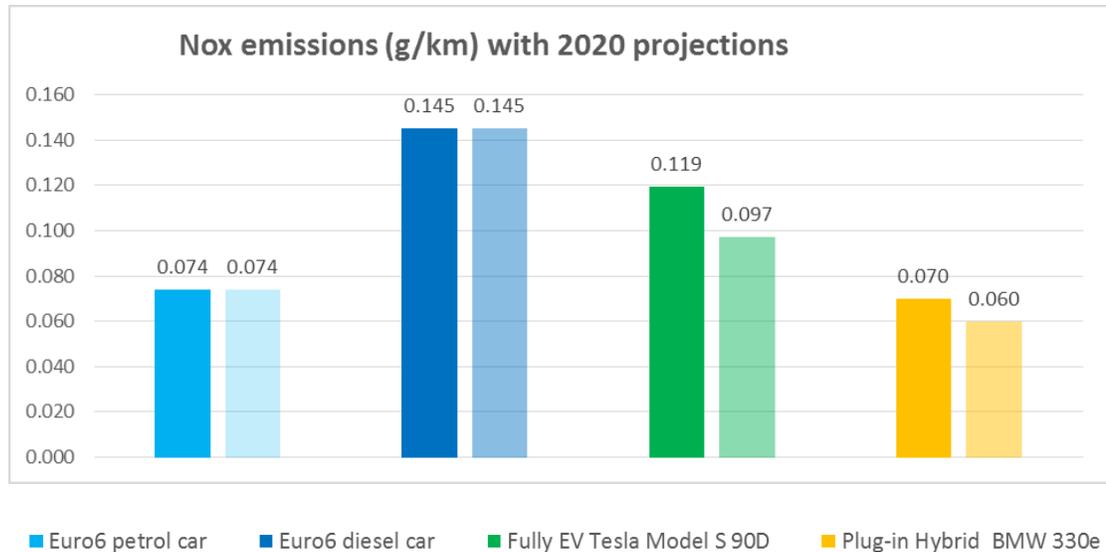


Figure C1: NOx emissions (g/km) for different private vehicle types in 2015 and projection with HK electricity mix in 2020 in transparent

⁴⁴ <https://www.fueleconomy.gov/feg/Find.do>

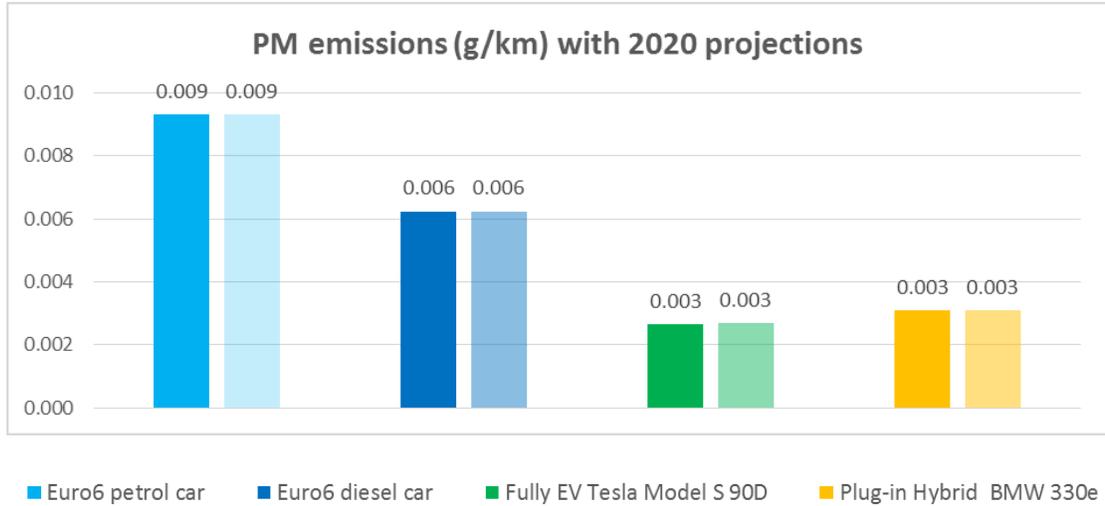


Figure C2: PM emissions (g/km) for different private vehicle types in 2015 and projection with HK electricity mix in 2020 in transparent

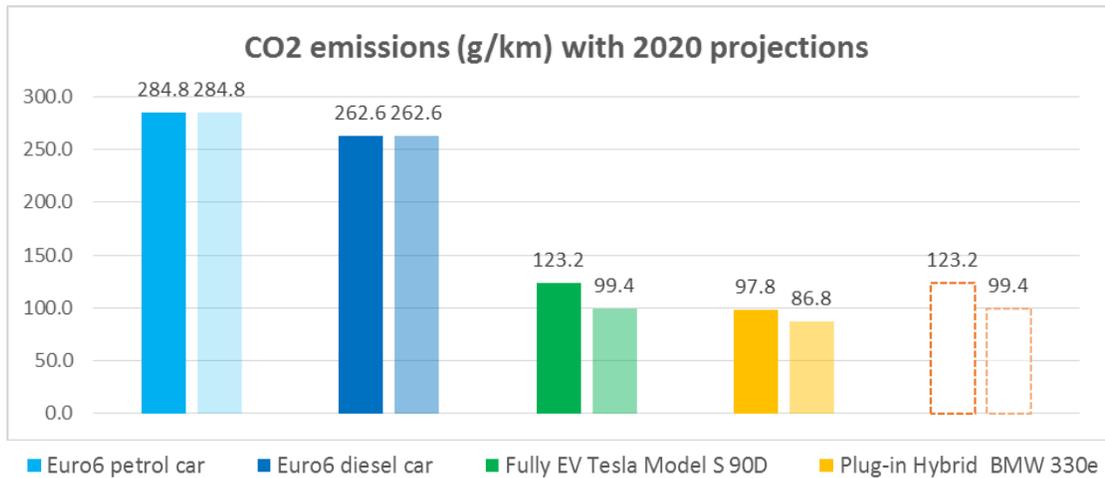


Figure C3: CO₂ emissions (g/km) for different private vehicle types in 2015 and projection with HK electricity mix in 2020

The dotted bar represents conventional hybrid vehicles. Based on the results of the U.S Alternative Fuels Data Center⁴⁵, we assumed that for a grid mix similar to Hong Kong (i.e in Wisconsin), GHG emissions from conventional hybrids and from electric vehicles are similar.

⁴⁵ http://www.afdc.energy.gov/vehicles/electric_emissions.php