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**Report of the Subcommittee on Improving Air Quality
for submission to the Panel on Environmental Affairs**

Purpose

This report gives an account of the work of the Subcommittee on Improving Air Quality during the 2010-2011 legislative session.

Background

2. The ambient air pollution problem has all along been a public concern. It has a significant bearing on public health and the quality of life, and also on the long-term development of Hong Kong. Multinational enterprises are reluctant to set up their regional headquarters in Hong Kong due to the deteriorating air quality. The problem is compounded by a combination of factors, including high population density, high concentration of vehicles, as well as air pollution in the Pearl River Delta (PRD) Region. On the regional front, the Hong Kong Special Administrative Region Government (HKSARG) and the Guangdong Provincial Government (GPG) have jointly formulated the PRD Regional Air Quality Management Plan (Management Plan), which aims at achieving specific emission reduction targets by 2010. On the local front, the Administration is reviewing the Air Quality Objectives (AQOs) taking into account the World Health Organization (WHO)'s Air Quality Guidelines (AQGs). Other measures, including imposing emission caps on power plants, providing financial incentives to encourage early replacement of pre-Euro and Euro I diesel commercial vehicles, banning idling vehicles with running engines, promoting energy conservation and saving, are being undertaken or contemplated.

The Subcommittee

3. To enable focused discussion on Government's efforts in addressing air pollution, the Panel decided at its meeting on 27 October 2008 to set up a subcommittee to monitor and study policies as well as public concerns on

improving air quality. The terms of reference and membership of the Subcommittee are given in **Appendices I and II** respectively. At the first meeting of the Panel in the 2010-2011 session on 14 October 2010, it was decided that the Subcommittee should continue its work in the 2010-2011 session.

4. Under the chairmanship of Hon Audrey EU Yuet-mee, the Subcommittee has held two meetings to exchange views with the Administration and academia.

Major work

Progress of measures to achieve the emission reduction targets under the Pearl River Delta Regional Air Quality Management Plan

5. To improve regional air quality, HKSARG reached a consensus with GPG in April 2002 to reduce, on a best endeavour basis, the emissions sulphur dioxide (SO₂), nitrogen oxides (NO_x), respirable suspended particulates (RSP) and volatile organic compounds (VOC) by 40%, 20%, 55% and 55% respectively in PRD Region by 2010, using 1997 as the base year. In December 2003, the two governments jointly drew up the Management Plan with a view to meeting the emission reduction targets. The Pearl River Delta Air Quality Management and Monitoring Special Panel was also set up under the Hong Kong/Guangdong Joint Working Group on Sustainable Development and Environmental Protection to follow up the tasks under the Management Plan.

6. The Subcommittee has been monitoring the progress of implementation of measures, including those under the Management Plan, to improve air quality and to meet the 2010 emission reduction targets. According to information, emission levels of all the four pollutants have dropped when compared with those in 1997. Details are as follows –

	Emission Level in 1997 (Tonnes)	Change in Emission Level during 1997-2009	Emission Reduction Target for 2010
SO ₂	66 200	-24%	-40%
NO _x	124 000	-33%	-20%
RSP	11 500	-57%	-55%
VOC	68 800	-57%	-55%

Power sector

7. Given that the emission level of SO₂ is way behind schedule, members have enquired whether additional measures would be adopted with a view to

meeting the 2010 emission reduction target for SO₂ emissions. According to the Administration, power generation is the main source of air pollutant emissions in Hong Kong. To deliver the emission reduction targets, all power plants have been subject to emission caps since 2005 which are progressively tightened during licence renewals. In 2008, the Air Pollution Control (Amendment) Ordinance 2008 was enacted to give statutory effect to the emission caps for power plants in 2010 and beyond through a Technical Memorandum (TM). The First TM was promulgated in December 2008 under which stringent emission caps for 2010 were imposed on the two power companies. Following a review of First TM in 2010, the emission caps for the power sector from 2015 onward were tightened by maximizing the use of existing gas-fired generation units and prioritizing the retrofitting of coal-fired generation units with emission abatement facilities. The Second TM promulgated in December 2010 further reduces the emission allowances for SO₂, NO_x and RSP by about 50%, 35% and 34% respectively when compared with the First TM. As the two local power companies have retrofitted their coal-fired power generation units with emission reduction facilities in 2010 as planned, it is expected that emissions of SO₂, NO_x and RSP from the power sector would further drop, and that Hong Kong could fully achieve the 2010 emission reduction targets. The Administration has further advised that to encourage the two power companies to take further steps to reduce emissions, a number of incentives and penalty arrangements have been set out in the new Scheme of Control Agreements. These arrangements include linking the permitted rate of return to their compliance with the emission caps, providing a higher rate of return for their investment in renewable energy facilities, and offering a bonus in permitted return depending on the extent of renewable energy in their electricity generation.

Transport sector

8. Motor vehicles are the second largest source of air pollution, and the main source of roadside air pollution in Hong Kong. Of the vehicle fleet, diesel commercial vehicles are the major air pollution emitters, accounting for about 88% and 76% of the total vehicular emission of RSP and NO_x respectively. Phasing out aged commercial vehicles thus holds the key to cleaner roadside air quality.

9. In April 2007, the Administration introduced a \$3.2 billion three-year one-off grant scheme to encourage early replacement of pre-Euro and Euro I diesel commercial vehicles. Before the application deadline in end-March 2010, 17 300 applications have been received, representing about 30% of the eligible vehicles. In July 2010, the Administration introduced another \$540 million one-off grant scheme to encourage early replacement of Euro II diesel commercial vehicles. As at end-November 2010, 590 applications have been approved, accounting for about 2% of the eligible vehicles. Subcommittee members have expressed concern about the low

take-up rate of the scheme, which in their views may be attributed to the low grant level as owners will still have to pay huge sums of money to replace their vehicles. There is also a need for the Administration to ascertain the performance of Euro IV vehicles to ease the concerns of the transport trade and encourage participation in the scheme. Some members have suggested that the Administration should consider buying back all pre-Euro and Euro I diesel vehicles so that these vehicles could be permanently removed from the roads. According to the Administration, the subsidy level under the one-off grant scheme is considered adequate to compensate vehicles owners in replacing their vehicles. The Administration has also advised that it is inappropriate to use public fund to buy back polluting vehicles because some of these vehicles might no longer be needed for running their business.

10. As franchised buses are a major and visible source of roadside air pollution, the Subcommittee generally welcomes the proposed trial to retrofit Euro II and Euro III franchised buses with selective catalytic reduction (SCR) devices to upgrade their emission performance to Euro IV level. Subcommittee members have enquired if the trial would help increase the ratio of low-emission franchised buses to facilitate early commissioning of the pilot low-emission zones (LEZ) in busy corridors. To facilitate better understanding, the Administration has been requested to provide an annual breakdown on the estimated supply of low-emission buses through retrofitting with SCR devices and replacement of buses for the period from 2011 to 2015. According to the Administration, preparatory work for setting up pilot LEZs in busy corridors in Causeway Bay, Central and Mong Kok by 2015 was underway. The Administration is also working with the franchised bus companies to conduct a trial on retrofitting Euro II and Euro III buses with SCR devices, which is expected to be commenced in around August 2011. A review will be conducted six months after the trial has been launched. Subject to satisfactory trial results, the Administration will discuss with the franchised bus companies details of the SCR retrofit programme, including the schedule of the programme, relevant bus models, and number of buses involved in the programme. Regarding replacement of buses, the Administration has advised that the franchised bus companies are committed to replacing their buses before they reach 18 years old. It is estimated that about 2 000 buses (about 35% of serving franchised buses), including all pre-Euro and Euro I buses, as well as some Euro II buses, will retire and be replaced between 2011 and 2015, with the estimated annual breakdown of 120, 310, 400, 390 and 780 buses respectively.

Progress of review of Hong Kong's Air Quality Objectives

11. In 2007, the Administration commissioned a consultancy study to recommend a new set of AQOs for Hong Kong with reference to WHO AQGs, and an air quality management strategy to achieve the new AQOs. The Review has recommended a new set of AQOs and a host of air quality improvement measures required for attaining the proposed new AQOs.

In July 2009, the Administration launched a four-month public consultation on the recommendations. The summary of comments on the proposed Phase I air quality improvement measures is given in Annex D to LC Paper No. CB(1) 2324/09-10(06) issued for the meeting of the Panel on Environmental Affairs on 28 June 2010. In gist, the general feedback indicates that the community has a strong aspiration for effective actions to improve the air quality. Many respondents have indicated that they are willing to bear some of the costs arising from the implementation of the proposed measures. Some also call for the Administration to bear part of the costs so as to reduce the impacts of these measures, particularly on the low-income families. The public would like to see a clear timeline as to when the proposed measures for attaining the proposed new AQOs could be implemented. There is also a need for strategic planning, effective prioritization and integrated coordination among the various policy bureaux and departments under the steer of a high-power body to lead and oversee the implementation of the proposed air quality improvement measures.

12. Subcommittee members are concerned about the slow progress made by the Administration in taking forward the air quality improvement measures, and updating AQOs. They have enquired about the reason for the delay. According to the Administration, it is examining the best way to take forward the AQO Review in the light of the feedback from the public consultation. Given that the proposed air quality improvement measures for attaining the new AQOs straddle different policy areas, and that some proposed measures are rather controversial, more time is required for the Administration to develop a comprehensive strategy.

Study on Impact of Loss of Visibility on Mortality Risk: A Report of Regional and Global Importance

13. Noting that a research group of the School of Public Health, The University of Hong Kong, has conducted an environmental research on "Daily visibility and mortality: Assessment of health benefits from improved visibility in Hong Kong", the Subcommittee has invited Professor Anthony J HEDLEY to present the findings of the research at the meeting in January 2011.

14. According to the research, visibility in Hong Kong has deteriorated significantly over the past 40 years, and the number of days with visibility below eight kilometers has substantially increased from 6.6 days in 1968 to 54.1 days in 2007. The decline in visibility is mainly attributed to particulates (PM₁₀) and nitrogen dioxide (NO₂), which are signatures of traffic emissions. It is found that the higher the pollutant concentrations, the lower the visibility. Apart from visibility, the research has taken into account other factors, including temperature, humidity, day of the week, as well as epidemics of influenza and severe acute respiratory syndrome occurred during the study

period, in determining the relationship between daily visibility and daily death counts. Analysis has indicated that every kilometre reduction in visibility causes 70 additional deaths per year. The majority of the additional avoidable deaths are due to respiratory and cardiovascular disease. To protect the health of Hong Kong, the research has concluded that a cohesive strategy is necessary to ensure consistent and immediate actions to be taken by the relevant Government departments.

15. Some members have sought Professor Anthony J HEDLEY's views on the propriety for the Administration to use emission levels of the four major air pollutants as the parameters in assessing air quality. Professor HEDLEY has advised that the use of average annual concentration of air pollutants as an indicator may be misleading because emission levels will vary in different seasons. The research has found that there is a marked U-shaped curve in seasonal pollutants, and that the highest pollution level usually occurs in winter. As air pollution could increase susceptibility to seasonal viruses and increase the risk of illnesses, such as pneumonia and respiratory diseases, the Administration should place greater emphasis on auditing and evaluation of exposures. Professor HEDLEY has also stressed the need to reduce NO₂ emission given its adverse impacts on deaths and hospital admissions. The Administration should take the lead in improving air quality by adopting a carrot-and-stick approach in encouraging the replacement of polluting vehicles, and subsidizing the replacement of franchised buses with cleaner models given the substantial fiscal surplus. It should also make exemplary interventions to encourage the Mainland to improve regional air quality.

16. In response to Professor HEDLEY's views, the Administration has advised that it attaches great importance to the impact of air pollution on public health, and that relevant departments would step up concerted efforts in improving air quality. While much effort has been made in reducing roadside emissions, including the use of cleaner fuels and replacement of polluting vehicles, the air quality in Hong Kong is affected by regional emissions. As regards NO₂ emission, the Administration has advised that this is a complex issue as NO₂ emission is affected by ozone (O₃)/VOC emission and sunlight. Notwithstanding, NO₂ emission can be reduced through retrofitting of franchised buses with SCR devices and proper maintenance of vehicles.

Trend of primary nitrogen dioxide emissions from vehicles

17. Noting that a research group of the School of Public Health and Primary Care, The Chinese University of Hong Kong, has published a report on "Increasing trend of primary NO₂ exhaust emission fraction in Hong Kong", the Subcommittee has invited Professor TIAN Lin-wei to present the findings of the study at the meeting in May 2011.

18. According to the study, roadside concentration of NO₂ is not on the decline despite the successful reduction in the level of roadside NO_x. One underlying cause may be the rising fraction of primary NO₂¹ as a fraction of total NO_x (f-NO₂), which has increased from about 2% in 1998 to 13% in 2008. The two particular periods of rising f-NO₂ coincided with the implementation of the two retrofitting programmes for light-duty vehicles and heavy-duty vehicles. As exposure to NO₂ can give rise to adverse health effects, including aggravation of existing respiratory diseases and reduction in lung function, there is a need to ensure that future vehicle emission control measures should not only target at NO_x but also primary NO₂.

19. Given that the Administration is working with the franchised bus companies to conduct a trial on retrofitting Euro II and Euro III buses with SCR devices, some members have sought Professor TIEN's views on the effectiveness of SCR in reducing NO₂ emissions. According to Professor TIEN, SCR is designed to reduce NO_x to meet the Euro emission standards. The inclusion of diesel oxidation catalyst (DOC) in the design of SCR system to reduce RSP emission would have the disadvantage of increasing f-NO₂ because NO₂ is intentionally produced as an oxidant. Since the performance of Euro IV or V vehicles in terms of NO₂ emissions is no better than Euro III, there is no point in retrofitting Euro III vehicles to meet Euro IV standard. Besides, studies conducted in Europe have revealed that SCR devices may not be able to perform well under the urban driving conditions. The right way to control NO₂ is to drastically reduce NO_x to Euro VI level, and the share of NO₂ in total NO_x emissions. Instead of retrofitting Euro II and III vehicles with SCR devices, efforts should be made to expedite replacement of these vehicles with Euro VI models.

20. In response to Professor TIEN's suggestions, the Administration has advised that SCR devices are well proven to be effective in reducing both NO and NO₂. In the design of a SCR system for vehicle applications, it is desirable to have a high ratio of NO₂ in NO_x at the inlet of SCR so as to attain a high reduction efficiency of both NO and NO₂. Placing a DOC ahead of a SCR device can serve the purposes of reducing the harmful diesel particulate emissions and providing a favourable working condition for SCR to function at the same time. As long as the design is in good order, there should be significant reduction in both NO and NO₂ emissions. This also explains why SCRs will continue to be a key emission control technology to help vehicles meeting the much tightened NO_x emission standard of Euro VI. As compared with Euro II buses, Euro III, IV and V buses emitted about 30%, 50% and 70% less NO_x respectively. Retrofitting Euro II buses with SCR devices could upgrade their NO_x emission performance to Euro IV level and Euro III buses to Euro V level. Studies conducted in Belgium have revealed that retrofitting

¹ NO₂ is either emitted directly by vehicles (i.e. primary NO₂) or formed after the further oxidation of the nitrogen oxide emitted also by vehicles (i.e. via a secondary formation route involving VOC and O₃).

Euro II diesel vehicles with SCR devices is able to reduce both RSP and NO_x emissions. The studies have included testing of vehicle emission performance under urban driving as well as motorway driving conditions. While acknowledging that Euro VI vehicles are better than Euro IV or V vehicles in respect of both NO_x and RSP emissions, the Administration has advised that there has yet to be any country in the world which adopts Euro VI as the statutory vehicle emission standards. Besides, vehicle manufacturers are still making preparations for developing Euro VI diesel vehicles, which will not be commercially available from Japan until 2016 and Europe until 2014 at the earliest.

21. To facilitate better understanding, members have requested the Administration to provide a comparison table showing the improvements in emission performance of Euro II to VI diesel vehicles if these were retrofitted with SCR devices.

Way forward

22. In view of the far-reaching implications of the AQOs review and the anticipated Government initiatives in improving air quality, members have decided that the Subcommittee should continue its work in the 2011-2012 legislative session.

Advice sought

23. The Panel is invited to note the work of the Subcommittee and the recommendation set out in paragraph 22.

Panel on Environmental Affairs

Subcommittee on Improving Air Quality

Terms of Reference

To monitor and study policies as well as public concerns on improving air quality.

Panel on Environmental Affairs
Subcommittee on Improving Air Quality

Membership list

Chairman Hon Audrey EU Yuet-mee, SC, JP

Members Hon Miriam LAU Kin-yee, GBS, JP
Hon LEE Wing-tat
Hon Jeffrey LAM Kin-fung, GBS, JP
Hon KAM Nai-wai, MH
Hon Cyd HO Sau-lan
Hon CHAN Hak-kan
Hon CHAN Kin-por, JP
Hon IP Wai-ming, MH
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(Total : 10 Members)

Clerk Miss Becky YU

Legal Adviser Miss Kitty CHENG

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