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Chief Council Secretary (1)1
Council Business Division 1
Legislative Council Secretariat
Legislative Council Complex,
1 Legislative Council Road, Central
Hong Kong
(Attn: Ms Angel Shek)

14 August 2017

Dear Ms Shek,

Panel on Environmental Affairs
List of follow-up actions

During the discussion on "Improvement of roadside air quality" at the meeting on 22 May 2017, Members requested the Administration to provide supplementary information on the control of excessive external lighting, roadside vehicle emission control and air quality. Please find our response at **Annex.**

If you have any queries, please contact the undersigned on 25946401.

Yours sincerely,

(S.T. MAK)

for Director of Environmental Protection

Encl.

(a) the latest approach and measures to be taken by the Administration on the control and regulation of excessive external lighting

Reply

The Administration launched in April 2016 the Charter on External Lighting (the Charter) to invite owners of and persons responsible for external lighting installations to switch off lighting with decorative, promotional or advertising purposes that affect the outdoor environment during preset times (11pm or midnight to 7am) to minimise light nuisance and energy wastage. As of July 2017, over 4 800 properties and shops have signed up to the Charter.

2. To better promote the Charter, we have launched a Partnership Scheme to invite advertising companies, trade/professional bodies to become Charter Partners. The Partners will, through their networks, encourage companies, business contacts, partners and clients, etc., to sign up their premises with external lighting installations to the Charter. Gold and Platinum prizes will be awarded to partners who recruit over 50 and 100 signatories respectively before April 1 next year. As of July 2017, we have recruited nine partners. Under the Partnership Scheme, Partners would conduct initial vetting of each signatory's compliance with the Charter within three months after the signing of the Charter and inform the Environment Bureau of the findings. Vetting can be done by different credible means, such as conducting site visit to the lighting installations, or requesting the signatory to provide photos or any other evidence to demonstrate compliance, etc.

3. The Administration also re-launched the Guidelines on Industry Best Practices for External Lighting Installations and hosted a number of seminars starting from May last year to appeal to various sectors to observe the Guidelines. We will assess the effectiveness of the above measures around 2018 to 2019.

(b) questions provided at the meeting by a Member and circulated vide LC Paper No. CB(1)997/16-17(01) on 24 May 2017.

Question 1. It is mentioned in paragraphs 4 and 9 of the LC Paper No. CB(1)949/16-17(03) that poorly maintained liquefied petroleum gas (LPG) or petrol taxis and light buses can emit nitrogen oxides up to ten times their normal levels. Please advise:

a. **On what basis did the Government come to the figure of "ten times"?**
b. **Does the Government know the number of poorly maintained LPG or petrol taxis and light buses? If yes, please provide detailed data. If no, what are the reasons?**

Reply:

4. Both petrol and LPG vehicles are equipped with catalytic converters, which can reduce over 90% of carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxides (NOx) emitting from engines. A study conducted by the Environmental Protection Department (EPD) in 2014 found that the malfunction of the catalytic converter could result in the emission of up to more than nine times of these pollutants than normal[1]. Aside from the catalytic converters, the maintenance and adjustment of the engine and related devices are also important. The emissions of pollutants may increase largely if these components are not properly maintained or adjusted. If the state of repair of catalytic converters, engine and related devices are extremely poor, excessive emissions can be over ten times.

5. Since 1993, EPD has started to use roadside remote sensing equipment to collect emission data of petrol and LPG vehicles and found that many of these vehicles emitted excessively due to lack of proper maintenance. In 2011, there were about 80% of LPG vehicles with excessive emissions while that of petrol vehicles was about 10%[2]. To target these gross emitters, EPD has, after consulting the transport trade and the Legislative Council, strengthened the control of emissions from petrol and LPG vehicles through the use of roadside remote sensing equipment since September 2014 ("remote sensing control programme"). Vehicles identified to have excessive

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[1] In 2014, EPD used dynamometer to test 131 taxis and found that the average emissions of CO, HC and NOx of taxis which emitted excessively were 9.2 times that of the normal taxis.

[2] Legislative Council Panel on Environmental Affairs Paper No. CB(1)353/11-12(01)

emissions by the remote sensing equipment[3] will have to undergo proper repair and pass an emission test done with the aid of a chassis dynamometer ("dynamometer") within 12 working days from receipt of Emission Testing Notices (ETNs) issued by EPD or else their vehicle licences will be cancelled. As at April 2017, EPD has screened about 1.6 million petrol and LPG vehicle counts (including taxis, light buses, private cars and light goods vehicles). During this period, about 7 600 petrol and LPG vehicles were found emitting excessively. Comparing these remote sensing data with those before implementation of remote sensing control programme, excessively emitting LPG vehicles has been reduced from about 80% to 20%[4] while that of petrol vehicles has been reduced from about 10% to 5%. That the percentage of excessively emitting petrol and LPG vehicles has significantly reduced reflects the effectiveness of the remote sensing control programme. In addition, the concentration of roadside nitrogen dioxide decreased by 31% between 2012 and 2016.

Question 2. There are data[5] showing that many taxis were still found emitting excessively despite the use of roadside remote sensing equipment. Some of them exceeded the limit by 31 times. In other words, the emissions or pollution extent from LPG or petrol taxis and light buses are being far underestimated. Please advise:

a. Is the Administration aware of the situation? Is there any measure to improve the problem of emissions being underestimated? If yes, what are the details? If not, what are the reasons?

Reply:

6. There are various ways to test the emissions of petrol and LPG vehicles, including dynamometer, portable emission measuring system (PEMS) and roadside remote sensing equipment. Their testing methods and applications are different. The dynamometer can simulate the start, stop, acceleration and deceleration road driving modes of a vehicle in laboratory.

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[3] Even vehicle with proper maintenance will gradually have higher emissions than that at new due to normal engine wear. Therefore, EPD sets the in-use vehicle emission limits at two times the vehicle design standards for the corresponding manufacturing year of the vehicles. The emission limits in Hong Kong are comparable to that in other areas. (Refer to paragraph 10 of the Legislative Council Panel on Environmental Affairs Paper No. CB(1) 353/11-12(01))

[4] In March 2017, the numbers of LPG taxis and light buses are 18 152 and 4 018 respectively.

[5] Carol K.L. Wong (2016). Recent Findings in On-board Vehicle Emission Measurement and Modelling in Hong Kong. P.13. https://www.polyu.edu.hk/cee/MOVE2016/4c-04-WONG.pdf

It is used for formulating emission limits and testing compliance of vehicles under standard driving modes and conditions. The PEMS is installed inside a vehicle to collect the emission data when the vehicle is actually running on the road. EPD has been using the PEMS to measure emissions from different type of vehicles as early as 2008. The data is used for calibrating the emission factors of vehicle emission model to fine tune the estimation of vehicle emissions. As PEMS testing is time-consuming and expensive, it is only used to test a limited number of vehicles and will not be used for the daily monitoring of large number of vehicles. Roadside remote sensing equipment can test the emissions of petrol and LPG vehicles quickly while they are running on the road and hence can effectively detect gross emitters. Therefore, we use roadside remote sensing equipment to screen out gross emitters in the petrol and LPG vehicle fleets and require them to pass a dynamometer emission test after fixing the emission problem, so as to ensure that the excessive emission problem is fixed.

7. Citing the data in the document in footnote 5, the Member suggests that EPD had underestimated the extent of emissions of taxis. The document in footnote 5 is in fact EPD's presentation delivered at a workshop in 2016. The data therein was collected by EPD between 2009 and 2016 during real world driving tests of in-use LPG taxis installed with PEMS. The data was used for calibration of emission factors of the vehicle emission model. The document provided a comparison of the NOx emission of the LPG taxis running on the road and that according to the emission limit of their vehicle design standards. The comparison reflects the situations as described in paragraph 4 above: the amount of pollutants emitted from in-use taxis varies significantly due to factors such as vehicle age, vehicle emission design standards and maintenance, etc. ranging from close to the emission limit of the vehicle design standards to exceedance of a few ten times. Poor maintenance (including damage of catalytic converters and improper adjustment of engine and relevant devices, etc.) is the major cause of these taxis emitting excessively.

8. As shown in paragraphs 5 to 7 above, EPD has not underestimated the problem of excessive emissions from petrol and LPG vehicles. On the contrary, we collected data through roadside remote sensing and PEMS to identify the severity and cause of the problem. We also introduced timely and targeted enforcement measures (i.e. remote sensing control programme) with remarkable outcome. In order to further reduce the percentage of excessively emitting vehicles in the long run, we plan to increase the number

of roadside remote sensing monitoring points. According to the latest plan, we will increase the number of monitoring points from a maximum of three per day at present to a maximum of five per day starting 2018.

9. Beside the remote sensing control programme, EPD has been promoting the importance of vehicle maintenance to the transport trade. Before implementing the programme, we provided free dynamometer emission tests and promoted the programme through radio, TV, public carnivals and publicity leaflets so as to raise vehicle owners' awareness of proper maintenance of their vehicles. Furthermore, the Vocational Training Council has been providing petrol and LPG vehicle maintenance courses for the vehicle repair trade since December 2014. From early 2014, having regard to the needs of the trade, EPD has also organised over ten seminars and demonstrations to share cases of repairing vehicles with excessive emissions and to show how to conduct the emission test with a dynamometer, during which the trade was shown how to use a portable five gas analyser to inspect, repair and adjust the vehicle engine control system to rectify vehicle emission defects. The repair trade's feedback is that mechanics have generally mastered the skills of repairing petrol and LPG vehicles with excessive emissions. EPD has set up a telephone hotline (8100 8656) to continuously provide technical support to the vehicle mechanics in need. EPD will continue to organise more seminars and demonstrations to suit the needs of the repair trade.

Question 2b. Vehicle emissions can be more accurately monitored by conducting the dynamometer emission tests than by deploying roadside remote sensors. However, it is mentioned in paragraph 11 of the LC Paper No. CB(1)949/16-17(03) that the Administration is not intending to incorporate the dynamometer emission test into the annual examination for renewal of vehicle licence because of the higher costs of the test. Does it mean that the Administration prefers to give up improving the air quality and the public health because of a limited increase in costs, even though the dynamometer emission tests can better facilitate the monitoring of roadside air quality than roadside remote sensors do, making it possible to formulate more effective improvement measures? Or does the Administration consider that there is not much

difference between the dynamometer emission tests and roadside remote sensors in effectiveness? If not, how will the Administration explain the data provided in Note 5?

c. **Has the Administration studied the provision of allowance or subsidy, the cost increase for including the dynamometer emission test in the annual examination, as well as the resultant effects on air quality improvement? If yes, what are the details? If not, what are the reasons?**

Reply:

10. Before implementing the remote sensing control programme, EPD had carried out a comparison test on the dynamometer and the remote sensing equipment, which proved that both devices had the same level of accuracy in detecting vehicles with excessive emissions. The remote sensing and related dynamometer emission testing standards were confirmed by a local expert panel (comprising vehicle experts, university academics and relevant government departments). We would also like to clarify that the use of dynamometer emission test is a part of the remote sensing control programme. As described in paragraph 5 above, the vehicles identified by the remote sensing equipment for emitting excessively will have to undergo repair and pass a dynamometer emission test within 12 working days from receipt of ETNs or else their vehicle licences will be cancelled.

11. After the implementation of the remote sensing control scheme, the number of petrol and LPG vehicles with excessive emissions has reduced significantly. Currently, only a small percentage of these types of vehicles are emitting excessively. This reflects that our control programme targeting gross emitters is effective. If we mandate all petrol and LPG vehicles to undergo dynamometer emission test during annual examinations, all vehicle owners concerned (including the majority vehicles without excessive emission problem) will be affected including the need to pay additional testing fees as high as 106%[6]. On the other hand, under the current targeting approach, only owners of excessively emitting vehicles need to pay for the dynamometer emission testing. With the sound evidence showing

[6] Fees for annual roadworthiness examination for private cars and taxis are $585 and that for light buses is $695. If $620 of dynamometer emission test fee is added to the fees, the total fees for private cars/taxis and light buses will be $1,205 and $1,315 (increase by 106% and 89%) respectively.

that the current control programme is effective in tackling excessive emissions of petrol and LPG vehicles, there is no reason to introduce measures causing inconvenience to all vehicle owners for the purpose of screening out only a small percentage of excessively emitting vehicles. Furthermore, we should not provide a subsidy requiring all petrol and LPG vehicles to carry out annual dynamometer emission testing while the overwhelming majority has no excessive emissions. It is more cost effective and would cause less inconvenience to vehicle owners to strengthen the control of petrol and LPG vehicles with excessive emissions through increasing the number of roadside remote sensing points than mandating the annual dynamometer emission testing for these vehicles.

(c) the implementation of micro-sensors installed for monitoring roadside air quality in Hong Kong, the statistics collected by such sensors and how the statistics were used for assessment and improvement of roadside air quality

Reply

12. Apart from setting up 13 general air quality monitoring stations (AQMSs) in Hong Kong, EPD has also set up 3 roadside AQMSs respectively at Causeway Bay, Central and Mong Kok. The objectives of setting up these roadside AQMSs are to monitor the air quality at busy urban roads and to provide a scientific basis for the formulation of roadside air quality improvement measures and evaluation of their effectiveness.

13. To ensure that the air quality data is accurate, reliable, representative and internationally comparable, the AQMSs were set up with reference to internationally recognized guidelines (such as the guidelines of the United States Environmental Protection Agency) and are operated under a stringent quality control and assurance system. Low-cost portable air quality monitoring devices, such as micro-sensors, in general cannot meet such data quality requirements. Nonetheless, such devices could provide supplementary information for reference, e.g. to reflect the variation of air quality in general near an emission source, etc.

14. In 2013-2015, EPD conducted a territory-wide short-term air quality monitoring study to assess roadside nitrogen dioxide level, the key indicator of roadside air pollution, in different districts. Diffusion tubes were

deployed at 172 selected roadside locations with heavy vehicular or pedestrian traffic; or with poor dispersion characteristics (including locations next to the three existing roadside AQMSs). The study, results summarized at Appendix, revealed that the average nitrogen dioxide levels near the three existing roadside AQMSs were the highest among all the monitoring points. This demonstrates that these roadside AQMSs are sufficiently representative of places with high roadside air pollution levels in Hong Kong.

(d) the cost and installation charges of a solar air-conditioning system for coach under trial, including the estimated recovery period of the cost.

Reply

15. The Pilot Green Transport Fund has approved a trial of solar air conditioning system for a coach, and the trial result indicated a 10% fuel cost saving. In order not to adversely affect future successful applicants in obtaining competitive bids during their tender exercises, we do not made public the amount of funding and the actual cost for individual approved projects.

16. The payback period of trial products will be affected by various factors such as the cost of product, driving mileage and fuel cost of the coach during the trial period. The estimated payback period for using the solar air conditioning system in this trial is about 11 years.

Appendix

2013-15 Short-term Air Quality Monitoring Study Results

Roadside location type	Number of locations	Average nitrogen dioxide concentration ($\mu g/m^3$)	
		Summer	Winter
Heavy vehicular traffic	65	92	87
Heavy pedestrian traffic	48	89	81
Poor dispersion characteristics	56	101	93
Near existing roadside air quality monitoring stations	3	130	123