Bills Committee on Air Pollution Control (Amendment) Bill 2013

Follow-up actions by the Administration

3. (a) The sources of emission of the seven pollutants specified in the Air Pollution Control Ordinance (Cap. 311), in particular, information regarding the emission of any of them by vehicles.

(b) Information on the actual number of exceedances in respect of the seven air pollutants in Hong Kong in the past few years.

(c) How the proposed number of exceedances of the seven pollutants compared to the international standard.

(d) Justifications for setting the number of exceedances allowed in the new AQOs and whether they would be tightened in future review.

(a) The Environmental Protection Department prepares an emission inventory on an annual basis to take stock of the emission levels of key air pollutants and their sources. A breakdown of emissions of sulphur dioxide (SO_2), nitrogen oxides (NOx), carbon monoxide (CO), respirable suspended particulates (RSP or PM_{10}) and volatile organic compounds (VOCs) from various air pollution sources in 2011 is at Appendix 3A. It is worth noting that among the seven air pollutants, ozone (O_3) is not directly emitted from air pollution sources but is formed from the photochemical reactions between NOx and VOCs. Nitrogen dioxide (NO_2) is mainly formed from the oxidation of NOx by O_3 or other oxidants after their emission into the ambient environment. We have therefore compiled the emission inventory for NOx and VOCs but not for O_3 and NO_2.

As for fine suspended particulates ($PM_{2.5}$), it is a major part of RSP and comes from similar sources of RSP. We did not compile emission inventory for $PM_{2.5}$ in the past but have already started such preparation for the compilation as part of the upgrading of the AQOs. Data on the emission of $PM_{2.5}$ will be available starting next year.

In addition, leaded petrol was the major emission source of lead in Hong Kong. Since the banning of the sale of leaded petrol in 1999, the ambient lead concentration has remained very low. Hence, no emission inventory is prepared for lead.

(b) The number of exceedances in respect of the seven air pollutants in Hong Kong from 2009 to 2012 under the current and proposed AQOs are set

out in Appendix 3B.

(c) A comparison table of the proposed AQOs and number of exceedances with those adopted by the European Union (EU) and US is summarized in Appendix 3C.

(d) In Hong Kong, AQOs are statutory criteria for assessing air quality under the Air Pollution Control Ordinance and Environmental Impact Assessment Ordinance. The World Health Organization (WHO) guidelines provide that "*when the standards are set to be legally binding, criteria must be identified to determine compliance. This is quantified through* ***the number of acceptable exceedances over a certain period of time*** *… Compliance criteria are defined in each country in order to compare the most representative data with the standards, and to minimize the designation of non-compliance owing to uncontrollable circumstances such as extreme weather. Such compliance criteria can be determined by evaluating historical data in the region as well as variability in weather and pollution patterns*[1]."

In light of the WHO advice and the practices of advanced countries like the EU, we have established the number of exceedances for each of the proposed AQOs after taking into account our local circumstances. Details on the rationale for setting the proposed new AQOs were presented in Annex D of the "Air Quality Objectives Review – Public Consultation" issued in July 2009. They are also reproduced in Appendix 3D for easy reference.

We will also review whether the number of exceedances can be tightened in our future review of the Air Quality Objectives.

Environmental Protection Department
May 2013

[1] WHO Air Quality Guidelines Global Updates 2005, p.183

Appendix 3A

Breakdown of Hong Kong Emissions in 2011

(Unit: Tonnes)

Pollutant Source Categories	**Sulphur Dioxide (SO_2)**	**Nitrogen Oxides (NOx)**	**Respirable Suspended Particulates (RSP)**	**Volatile Organic Compounds (VOC)**	**Carbon Monoxide (CO)**
Public Electricity Generation	14,000 (44%)	30,000 (26%)	998 (16%)	447 (1%)	3,720 (5%)
Road Transport	207 (<1%)	32,700 (29%)	1,180 (19%)	7,450 (23%)	45,700 (67%)
Navigation	17,200 (54%)	37,700 (33%)	2,310 (37%)	3,900 (12%)	12,200 (18%)
Civil Aviation	304 (<1%)	4,770 (4%)	58 (<1%)	329 (1%)	2,340 (3%)
Other Fuel Combustion[1]	237 (<1%)	9,290 (8%)	745 (12%)	878 (3%)	4,610 (7%)
Non-combustion[2]	N/A	N/A	934 (15%)	19,900 (60%)	N/A
Total	31,900	114,000	6,220	32,900	68,500

Note:-

1. Other fuel combustion sources include industrial, commercial and domestic applications.
2. RSP emission sources include quarrying, cooking fumes, construction site dust, tyre, brake and road surface wear. VOC emission sources mainly consist of consumer products, paints, printing, etc.
3. Figures in bracket are the percentages with respect to the total emission.
4. Figures may not sum up to the total due to rounding.

Appendix 3B

Exceedances of Air Pollutants in Hong Kong under the current and proposed Air Quality Objectives (AQO) from 2009 to 2012

Existing AQO:

(a) Sulphur dioxide

(i) 24-hour AQO: 350μg/m^3; No. of exceedances allowed = 1

Station	2009	2010	2011	2012
Central / Western General Station	0	0	0	0
Eastern General Station	0	0	0	0
Kwai Chung General Station	0	0	0	0
Kwun Tong General Station	0	0	0	0
Sham Shui Po General Station	0	0	0	0
Tsuen Wan General Station	0	0	0	0
Sha Tin General Station	0	0	0	0
Tai Po General Station	0	0	0	0
Tung Chung General Station	0	0	0	0
Yuen Long General Station	0	0	0	0
Tap Mun General Station	0	0	0	0
Causeway Bay Roadside Station	0	0	0	0
Central Roadside Station	0	0	0	0
Mong Kok Roadside Station	0	0	0	0

(b) Nitrogen dioxide

(i) 1-hr AQO: 300μg/m^3; No. of exceedances allowed = 3

Station	2009	2010	2011	2012
Central / Western General Station	0	0	0	0
Eastern General Station	0	0	0	0
Kwai Chung General Station	0	0	0	0
Kwun Tong General Station	0	0	0	4
Sham Shui Po General Station	0	0	0	0
Tsuen Wan General Station	0	0	0	0
Sha Tin General Station	0	0	0	0
Tai Po General Station	0	0	0	0
Tung Chung General Station	0	0	0	0
Yuen Long General Station	0	0	0	0
Tap Mun General Station	0	0	0	0
Causeway Bay Roadside Station	14	51	79	72
Central Roadside Station	31	61	54	66
Mong Kok Roadside Station	13	21	33	60

(ii) Annual AQO: 80μg/m^3; No. of exceedances allowed = 0

Station	2009	2010	2011	2012
Central / Western General Station	0	0	0	0
Eastern General Station	0	0	0	0
Kwai Chung General Station	0	0	0	0
Kwun Tong General Station	0	0	0	0
Sham Shui Po General Station	0	0	0	0
Tsuen Wan General Station	0	0	0	0
Sha Tin General Station	0	0	0	0
Tai Po General Station	0	0	0	0
Tung Chung General Station	0	0	0	0
Yuen Long General Station	0	0	0	0
Tap Mun General Station	0	0	0	0
Causeway Bay Roadside Station	1	1	1	1
Central Roadside Station	1	1	1	1
Mong Kok Roadside Station	1	1	1	1

(c) Respirable Suspended Particulates (PM_{10})

(i) 24-hour AQO: 180µg/m^3; No. of exceedances allowed = 1

Station	2009	2010	2011	2012
Central / Western General Station	0	3	0	0
Eastern General Station	1	3	0	0
Kwai Chung General Station	0	1	0	0
Kwun Tong General Station	0	3	0	0
Sham Shui Po General Station	1	3	0	0
Tsuen Wan General Station	1	2	0	0
Sha Tin General Station	0	2	0	0
Tai Po General Station	0	3	0	0
Tung Chung General Station	0	1	0	0
Yuen Long General Station	1	1	0	0
Tap Mun General Station	0	3	0	0
Causeway Bay Roadside Station	1	3	0	0
Central Roadside Station	1	3	0	0
Mong Kok Roadside Station	1	3	0	0

(ii) Annual AQO: 55µg/m^3; No. of exceedances allowed = 0

Station	2009	2010	2011	2012
Central / Western General Station	0	0	0	0
Eastern General Station	0	0	0	0
Kwai Chung General Station	0	0	0	0
Kwun Tong General Station	0	0	0	0
Sham Shui Po General Station	0	0	0	0
Tsuen Wan General Station	0	0	0	0
Sha Tin General Station	0	0	0	0
Tai Po General Station	0	0	0	0
Tung Chung General Station	0	0	0	0
Yuen Long General Station	0	0	0	0
Tap Mun General Station	0	0	0	0
Causeway Bay Roadside Station	1	1	1	1
Central Roadside Station	1	1	1	0
Mong Kok Roadside Station	0	0	0	0

(d) Ozone

(i) 1-hour AQO: 240μg/m^3; No. of exceedances allowed = 3

Station	2009	2010	2011	2012
Central / Western General Station	2	3	4	6
Eastern General Station	1	1	1	3
Kwai Chung General Station	1	1	0	4
Kwun Tong General Station	1	0	0	0
Sham Shui Po General Station	0	1	0	2
Tsuen Wan General Station	0	0	0	4
Sha Tin General Station	4	1	1	7
Tai Po General Station	3	0	1	3
Tung Chung General Station	11	8	18	19
Yuen Long General Station	8	3	9	12
Tap Mun General Station	3	3	5	8
Causeway Bay Roadside Station	n.a.	n.a.	0	0
Central Roadside Station	n.a.	n.a.	0	0
Mong Kok Roadside Station	n.a.	n.a.	0	0

n.a. – not available

(e) Carbon Monoxide

(i) 1-hour AQO: 30,000μg/m^3; No. of exceedances allowed = 3

Station	2009	2010	2011	2012
Central / Western General Station	n.a.	n.a.	n.a.	n.a.
Eastern General Station	n.a.	n.a.	n.a.	n.a.
Kwai Chung General Station	n.a.	n.a.	n.a.	n.a.
Kwun Tong General Station	n.a.	n.a.	n.a.	n.a.
Sham Shui Po General Station	n.a.	n.a.	n.a.	n.a.
Tsuen Wan General Station	0	0	0	0
Sha Tin General Station	n.a.	n.a.	n.a.	n.a.
Tai Po General Station	n.a.	n.a.	n.a.	n.a.
Tung Chung General Station	0	0	0	0
Yuen Long General Station	0	0	0	0
Tap Mun General Station	0	0	0	0
Causeway Bay Roadside Station	0	0	0	0
Central Roadside Station	0	0	0	0
Mong Kok Roadside Station	0	0	0	0

n.a. – not available

(ii) 8-hour AQO: 10,000μg/m^3; No. of exceedances allowed = 1

Station	2009	2010	2011	2012
Central / Western General Station	n.a.	n.a.	n.a.	n.a.
Eastern General Station	n.a.	n.a.	n.a.	n.a.
Kwai Chung General Station	n.a.	n.a.	n.a.	n.a.
Kwun Tong General Station	n.a.	n.a.	n.a.	n.a.
Sham Shui Po General Station	n.a.	n.a.	n.a.	n.a.
Tsuen Wan General Station	0	0	0	0
Sha Tin General Station	n.a.	n.a.	n.a.	n.a.
Tai Po General Station	n.a.	n.a.	n.a.	n.a.
Tung Chung General Station	0	0	0	0
Yuen Long General Station	0	0	0	0
Tap Mun General Station	0	0	0	0
Causeway Bay Roadside Station	0	0	0	0
Central Roadside Station	0	0	0	0
Mong Kok Roadside Station	0	0	0	0

n.a. – not available

(f) Lead

(i) 3-month AQO: 1.5μg/m^3; No. of exceedances allowed = 0

Station	2009	2010	2011	2012
Central / Western General Station	0	0	0	0
Eastern General Station	n.a.	n.a.	n.a.	n.a.
Kwai Chung General Station	0	0	0	0
Kwun Tong General Station	0	0	0	0
Sham Shui Po General Station	n.a.	n.a.	n.a.	n.a.
Tsuen Wan General Station	0	0	0	0
Sha Tin General Station	n.a.	n.a.	n.a.	n.a.
Tai Po General Station	n.a.	n.a.	n.a.	n.a.
Tung Chung General Station	0	0	0	0
Yuen Long General Station	0	0	0	0
Tap Mun General Station	n.a.	n.a.	n.a.	n.a.
Causeway Bay Roadside Station	n.a.	n.a.	n.a.	n.a.
Central Roadside Station	n.a.	n.a.	n.a.	n.a.
Mong Kok Roadside Station	0	0	0	0

n.a. – not available

Proposed New AQOs:

(a) Sulphur dioxide

(i) 10-minute AQO: 500μg/m^3; No. of exceedances allowed = 3

Station	2009	2010	2011	2012
Central / Western General Station	3	9	0	0
Eastern General Station	0	1	0	0
Kwai Chung General Station	0	2	0	0
Kwun Tong General Station	0	0	0	0
Sham Shui Po General Station	0	0	0	0
Tsuen Wan General Station	0	2	0	0
Sha Tin General Station	0	0	0	0
Tai Po General Station	0	0	0	0
Tung Chung General Station	0	4	0	0
Yuen Long General Station	0	2	0	0
Tap Mun General Station	0	0	0	0
Causeway Bay Roadside Station	0	1	0	0
Central Roadside Station	0	0	0	0
Mong Kok Roadside Station	0	6	0	0

(ii) 24-hour AQO: 125μg/m^3; No. of exceedances allowed = 3

Station	2009	2010	2011	2012
Central / Western General Station	0	0	0	0
Eastern General Station	0	0	0	0
Kwai Chung General Station	0	0	0	0
Kwun Tong General Station	0	0	0	0
Sham Shui Po General Station	0	0	0	0
Tsuen Wan General Station	0	0	0	0
Sha Tin General Station	0	0	0	0
Tai Po General Station	0	0	0	0
Tung Chung General Station	0	0	0	0
Yuen Long General Station	0	0	0	0
Tap Mun General Station	0	0	0	0
Causeway Bay Roadside Station	0	0	0	0
Central Roadside Station	0	0	0	0
Mong Kok Roadside Station	0	0	0	0

(b) Nitrogen dioxide

(i) 1-hr AQO: 200μg/m^3; No. of exceedances allowed = 18

Station	2009	2010	2011	2012
Central / Western General Station	11	5	12	9
Eastern General Station	6	7	11	8
Kwai Chung General Station	40	34	28	32
Kwun Tong General Station	24	9	41	78
Sham Shui Po General Station	17	34	26	21
Tsuen Wan General Station	10	19	16	4
Sha Tin General Station	6	5	3	11
Tai Po General Station	0	0	1	0
Tung Chung General Station	6	20	5	4
Yuen Long General Station	3	13	8	0
Tap Mun General Station	0	0	0	0
Causeway Bay Roadside Station	301	550	731	620
Central Roadside Station	436	831	827	587
Mong Kok Roadside Station	256	377	589	461

(ii) Annual AQO: 40μg/m^3; No. of exceedances allowed = 0

Station	2009	2010	2011	2012
Central / Western General Station	1	1	1	1
Eastern General Station	1	1	1	1
Kwai Chung General Station	1	1	1	1
Kwun Tong General Station	1	1	1	1
Sham Shui Po General Station	1	1	1	1
Tsuen Wan General Station	1	1	1	1
Sha Tin General Station	0	1	1	1
Tai Po General Station	1	1	1	1
Tung Chung General Station	1	1	1	1
Yuen Long General Station	1	1	1	1
Tap Mun General Station	0	0	0	0
Causeway Bay Roadside Station	1	1	1	1
Central Roadside Station	1	1	1	1
Mong Kok Roadside Station	1	1	1	1

(c) Respirable Suspended Particulates (PM_{10})

(i) 24-hour AQO: 100μg/m^3; No. of exceedances allowed = 9

Station	2009	2010	2011	2012
Central / Western General Station	9	12	15	6
Eastern General Station	7	7	2	2
Kwai Chung General Station	6	7	9	4
Kwun Tong General Station	8	9	6	6
Sham Shui Po General Station	10	6	9	4
Tsuen Wan General Station	8	6	9	2
Sha Tin General Station	8	7	6	2
Tai Po General Station	6	8	4	2
Tung Chung General Station	11	16	19	18
Yuen Long General Station	15	17	21	9
Tap Mun General Station	7	6	7	2
Causeway Bay Roadside Station	34	35	27	21
Central Roadside Station	14	27	29	9
Mong Kok Roadside Station	11	17	17	5

(ii) Annual AQO: 50μg/m^3; No. of exceedances allowed = 0

Station	2009	2010	2011	2012
Central / Western General Station	0	0	0	0
Eastern General Station	0	0	0	0
Kwai Chung General Station	0	0	0	0
Kwun Tong General Station	0	0	0	0
Sham Shui Po General Station	0	0	1	0
Tsuen Wan General Station	0	0	0	0
Sha Tin General Station	0	0	0	0
Tai Po General Station	0	0	0	0
Tung Chung General Station	0	0	0	0
Yuen Long General Station	1	0	1	0
Tap Mun General Station	0	0	0	0
Causeway Bay Roadside Station	1	1	1	1
Central Roadside Station	1	1	1	1
Mong Kok Roadside Station	1	1	1	0

(d) Fine Suspended Particulates ($PM_{2.5}$)

(i) 24-hour AQO: 75μg/m^3; No. of exceedances allowed = 9

Station	2009	2010	2011	2012
Central / Western General Station	n.a.	n.a.	n.a.	3
Eastern General Station	n.a.	n.a.	0	0
Kwai Chung General Station	n.a.	n.a.	n.a.	3
Kwun Tong General Station	n.a.	n.a.	n.a.	2
Sham Shui Po General Station	n.a.	n.a.	n.a.	1
Tsuen Wan General Station	8	5	2	0
Sha Tin General Station	n.a.	n.a.	n.a.	0
Tai Po General Station	n.a.	n.a.	n.a.	1
Tung Chung General Station	7	11	11	9
Yuen Long General Station	8	7	12	1
Tap Mun General Station	4	5	1	0
Causeway Bay Roadside Station	n.a.	n.a.	n.a.	6
Central Roadside Station	3	9	7	5
Mong Kok Roadside Station	n.a.	n.a.	6	3

n.a. – not available

(ii) Annual AQO: 35μg/m^3; No. of exceedances allowed = 0

Station	2009	2010	2011	2012
Central / Western General Station	n.a.	n.a.	n.a.	0
Eastern General Station	n.a.	n.a.	0	0
Kwai Chung General Station	n.a.	n.a.	n.a.	0
Kwun Tong General Station	n.a.	n.a.	n.a.	0
Sham Shui Po General Station	n.a.	n.a.	n.a.	0
Tsuen Wan General Station	0	0	0	0
Sha Tin General Station	n.a.	n.a.	n.a.	0
Tai Po General Station	n.a.	n.a.	n.a.	0
Tung Chung General Station	0	0	0	0
Yuen Long General Station	0	0	1	0
Tap Mun General Station	0	0	0	0
Causeway Bay Roadside Station	n.a.	n.a.	n.a.	1
Central Roadside Station	0	1	1	0
Mong Kok Roadside Station	n.a.	n.a.	1	0

n.a. – not available

(e) Ozone

(i) 8-hour AQO: 160μg/m^3; No. of exceedances allowed = 9

Station	2009	2010	2011	2012
Central / Western General Station	2	3	4	6
Eastern General Station	1	3	2	5
Kwai Chung General Station	0	1	0	3
Kwun Tong General Station	0	0	0	0
Sham Shui Po General Station	1	1	2	2
Tsuen Wan General Station	1	2	2	4
Sha Tin General Station	6	5	6	14
Tai Po General Station	8	3	5	7
Tung Chung General Station	14	10	16	22
Yuen Long General Station	12	4	10	19
Tap Mun General Station	27	13	22	41
Causeway Bay Roadside Station	n.a.	n.a.	0	0
Central Roadside Station	n.a.	n.a.	0	0
Mong Kok Roadside Station	n.a.	n.a.	0	0

n.a. – not available

(f) Carbon Monoxide

(i) 1-hour AQO: 30,000μg/m^3; No. of exceedances allowed = 0

Station	2009	2010	2011	2012
Central / Western General Station	n.a.	n.a.	n.a.	n.a.
Eastern General Station	n.a.	n.a.	n.a.	n.a.
Kwai Chung General Station	n.a.	n.a.	n.a.	n.a.
Kwun Tong General Station	n.a.	n.a.	n.a.	n.a.
Sham Shui Po General Station	n.a.	n.a.	n.a.	n.a.
Tsuen Wan General Station	0	0	0	0
Sha Tin General Station	n.a.	n.a.	n.a.	n.a.
Tai Po General Station	n.a.	n.a.	n.a.	n.a.
Tung Chung General Station	0	0	0	0
Yuen Long General Station	0	0	0	0
Tap Mun General Station	0	0	0	0
Causeway Bay Roadside Station	0	0	0	0
Central Roadside Station	0	0	0	0
Mong Kok Roadside Station	0	0	0	0

n.a. – not available

(ii) 8-hour AQO: 10,000μg/m^3; No. of exceedances allowed = 0

Station	2009	2010	2011	2012
Central / Western General Station	n.a.	n.a.	n.a.	n.a.
Eastern General Station	n.a.	n.a.	n.a.	n.a.
Kwai Chung General Station	n.a.	n.a.	n.a.	n.a.
Kwun Tong General Station	n.a.	n.a.	n.a.	n.a.
Sham Shui Po General Station	n.a.	n.a.	n.a.	n.a.
Tsuen Wan General Station	0	0	0	0
Sha Tin General Station	n.a.	n.a.	n.a.	n.a.
Tai Po General Station	n.a.	n.a.	n.a.	n.a.
Tung Chung General Station	0	0	0	0
Yuen Long General Station	0	0	0	0
Tap Mun General Station	0	0	0	0
Causeway Bay Roadside Station	0	0	0	0
Central Roadside Station	0	0	0	0
Mong Kok Roadside Station	0	0	0	0

n.a. – not available

(g) Lead

(i) Annual AQO: 0.5µg/m^3; No. of exceedances allowed = 0

Station	2009	2010	2011	2012
Central / Western General Station	0	0	0	0
Eastern General Station	n.a.	n.a.	n.a.	n.a.
Kwai Chung General Station	0	0	0	0
Kwun Tong General Station	0	0	0	0
Sham Shui Po General Station	n.a.	n.a.	n.a.	n.a.
Tsuen Wan General Station	0	0	0	0
Sha Tin General Station	n.a.	n.a.	n.a.	n.a.
Tai Po General Station	n.a.	n.a.	n.a.	n.a.
Tung Chung General Station	0	0	0	0
Yuen Long General Station	0	0	0	0
Tap Mun General Station	n.a.	n.a.	n.a.	n.a.
Causeway Bay Roadside Station	n.a.	n.a.	n.a.	n.a.
Central Roadside Station	n.a.	n.a.	n.a.	n.a.
Mong Kok Roadside Station	0	0	0	0

n.a. – not available

Appendix 3C

Proposed Hong Kong Air Quality Objectives (AQOs) – Comparison with international standards

Pollutant	Averaging Time	Proposed HK AQOs		USA		EU	
		µg/m3	No. of Exceedances	µg/m3	No. of Exceedances	µg/m3	No. of Exceedances
Sulphur Dioxide (SO_2)	10 min	500	3	-	-	-	-
	1-hr	-	-	200	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years	350	24
	24-hr	125	3	-	-	125	3
RSP (PM_{10})	24-hr	100	9	150	Not to be exceeded more than once per year on average over 3 years	50	35
	Annual	50	Not to be exceeded	-	-	40	Not to be exceeded
FSP ($PM_{2.5}$)	24-hr	75	9	35	98th percentile, averaged over 3 years	-	-
	Annual	35	Not to be exceeded	12	annual mean, averaged over 3 years	25	Not to be exceeded

Pollutant	Averaging Time	Proposed HK AQOs		USA		EU	
		µg/m3	No. of Exceedances	µg/m3	No. of Exceedances	µg/m3	No. of Exceedances
Nitrogen Dioxide (NO_2)	1-hr	200	18	190	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	200	18
	Annual	40	Not to be exceeded	100	Not to be exceeded	40	Not to be exceeded
Ozone (O_3)	8-hr	160	9	147	Annual 4th highest daily maximum, averaged over 3 years	120	25
Carbon Monoxide (CO)	1-hr	30 000	Not to be exceeded	40 000	1	-	-
	8-hr	10 000	Not to be exceeded	10 000	1	10 000	Not to be exceeded
Lead (Pb)	3-mth	-	-	0.15	Not to be exceeded	-	-
	annual	0.5	Not to be exceeded	-	-	0.5	Not to be exceeded

Annex D
Rationale behind Setting of Proposed New Air Quality Objectives

Sulphur Dioxide

1. Table D.1 below gives the concentration levels of sulphur dioxide (SO_2) and the number of exceedences against the World Health Organisation Air Quality Guidelines (WHO AQGs) and various Interim Targets (ITs) recorded in the general monitoring stations in 2008. The data collected from the Tap Mun air quality monitoring station, which does not have any local emission sources and should be representative of the extent of regional influence on Hong Kong's air pollution levels, are also presented in the table.

Table D.1 : Comparison of 2008 Monitoring Data on SO_2 with WHO AQGs / ITs

Averaging Time	WHO AQGs / ITs ($\mu g/m^3$)	Highest Concentration in 2008 (Ambient)	Highest Concentration in 2008 (Tap Mun)	No. of Exceedences in 2008 (Ambient)	No. of Exceedences in 2008 (Tap Mun))
10-min	AQG: 500	1,173	409	20	0
24-hour	IT-1:125	149	71	2	0
	IT-2: 50			86	1
	AQG: 20			284	63

Average annual ambient concentration: 20 $\mu g/m^3$.

2. The monitoring data show that the highest concentration levels and the number of exceedences recorded in Tap Mun are much lower than other ambient stations, suggesting that SO_2 concentration in urban areas is mainly contributed by local sources. Hong Kong has been taking strong actions to reduce SO_2 emissions. Since December 2007, diesel vehicles have been using Euro V diesel, which has virtually no sulphur and is the cleanest form of diesel. Hong Kong is amongst the very few places in the world which require the use of ultra low sulphur diesel across all industrial and commercial processes. Moreover, power plants are being retrofitted with flue gas de-sulphurisation devices as part of the efforts to achieve the regional 2010 emission reduction targets. The scope of further reducing drastically the local emissions as well as concentration of SO_2 over the short to medium term is thus rather limited.

3. Taking into account the local circumstances and making reference to the European Union (EU) air quality standards (i.e. 125 $\mu g/m^3$ with three exceedences), the Review proposes that the 24-hour SO_2 objective be tightened from the current 350 $\mu g/m^3$ to the WHO IT-1 of 125 $\mu g/m^3$ with three exceedences allowed.

4. The WHO also sets a 10-minute AQG of 500μg/m³ for SO_2. The Review proposes to adopt the WHO AQG of 500 μg/m³ and, similar to 24-hour AQO, allow three exceedences a year. The WHO has not proposed any 1-hour and annual concentration guidelines for SO_2 because achieving the 10-minute and 24-hour concentration guidelines can provide adequate health protection. The Review therefore proposes to do away with the current 1-hour and annual objectives for SO_2.

Nitrogen Dioxide

5. The WHO has not proposed any IT for the concentration levels of nitrogen dioxide (NO_2). Table D.2 below shows that the NO_2 concentration recorded in Hong Kong's general air quality monitoring stations (except the Tap Mun station) in 2008 exceeded the WHO AQGs' 1-hour guideline on a large number of occasions. No exceedence was recorded in Tap Mun, indicating that NO_2 concentration in urban areas is largely contributed by local sources. Further modelling results also show that implementation of suitable emission control measures, particularly those targeting at vehicular emissions, could help bring down the concentration levels of NO_2 in Hong Kong.

Table D.2 : Comparison of 2008 Monitoring Data on NO_2 with WHO AQGs

Averaging Time	WHO AQGs (μg/m³)	Highest Concentration in 2008 (Ambient)	Highest Concentration in 2008 (Tap Mun)	No. of Exceedences in 2008 (Ambient)	No. of Exceedences in 2008 (Tap Mun))
1-hour	AQG: 200	282	119	84	0
Annual	AQG: 40	69	14	Not Met	Met

Average annual ambient concentration: 53 μg/m³.

6. Having considered the standards being adopted by other advanced countries, particularly the EU, and our local circumstances, the Review recommends that the respective WHO AQGs of 40 μg/m³ and 200 μg/m³ for annual and 1-hour NO_2 be adopted, which represent a substantial tightening as compared with the existing AQOs of 80 μg/m³ and 300 μg/m³ respectively. On the number of exceedences allowed for 1-hour NO_2, the Review recommends that 18 exceedences per year be allowed taking account of the allowable exceedences being adopted by the EU and the consultant's modelling results.

Fine Suspended Particulates

7. There are currently only concentration targets for respirable suspended particulates (RSP or PM_{10}) but not fine suspended particulates (FSP or $PM_{2.5}$) under the existing AQOs. Evidence has accumulated in recent years to show that health risk attributable to exposure to particulate matters (PM) is better represented by $PM_{2.5}$. The Review therefore proposes to introduce a set of new AQOs for this air pollutant.

8. Despite major reduction in local PM emissions of 62% between the peak in the early 1990's and 2007, the data collected in our general air monitoring stations, as set out in Table D.3 below, show that widespread exceedences of the WHO AQGs and ITs for $PM_{2.5}$ were recorded in various parts of Hong Kong including Tap Mun. Based on these measurements and the fact that Hong Kong's PM emissions account for only about 1% to 2% of the entire emissions in the Pearl River Delta (PRD) region, it is apparent that $PM_{2.5}$ concentration in Hong Kong is subject to very strong regional influence. It would be difficult to significantly bring down the concentration level of $PM_{2.5}$ in Hong Kong solely through local efforts. Concerted actions on a regional scale would be required to bring about improvement.

Table D.3 : Comparison of 2008 Monitoring Data on FSP (or $PM_{2.5}$) with WHO AQGs / ITs

Averaging Time	WHO AQGs / ITs ($\mu g/m^3$)	Highest Concentration in 2008 (Ambient)	Highest Concentration in 2008 (Tap Mun)	No. of Exceedences in 2008 (Ambient)	No. of Exceedences in 2008 (Tap Mun))
24-hour	IT-1: 75	113	99	39	13
	IT-2: 50			128	87
	IT-3: 37.5			191	160
	AQG: 25			259	219
Annual	IT-1: 35	41	35	Not Met	Met
	IT-2: 25			Not Met	Not Met
	IT-3: 15			Not Met	Not Met
	AQG: 10			Not Met	Not Met

Average annual ambient concentration: 38 $\mu g/m^3$.

9. Taking into account the strong regional influence, the Review proposes that as a start the respective WHO IT-1 of 35 $\mu g/m^3$ and 75 $\mu g/m^3$ for annual and 24-hour $PM_{2.5}$ be adopted. The EU directive does not provide for any 24-hour $PM_{2.5}$ limit. Given that $PM_{2.5}$ concentration is contributed significantly by regional

sources, the Review proposes to allow nine exceedences in a year, which has been determined with reference to the results of the mathematical air quality modelling following implementation of the proposed Phase I emission control measures set out in Chapter 6.

Respirable Suspended Particulates

10. As with $PM_{2.5}$, widespread exceedences of the WHO AQGs and ITs were recorded for PM_{10} in 2008 (please refer to Table D.4 below). The predominant regional contribution to local background PM_{10} concentration underscores the importance of regional collaboration in reducing PM emissions.

Table D.4 : Comparison of 2008 Monitoring Data on RSP (or PM_{10}) with WHO AQGs / ITs

Averaging Time	WHO AQGs / ITs ($\mu g/m^3$)	Highest Concentration in 2008 (Ambient)	Highest Concentration in 2008 (Tap Mun)	No. of Exceedences in 2008 (Ambient)	No. of Exceedences in 2008 (Tap Mun))
24-hour	IT-1: 150	164	147	4	0
	IT-2: 100			51	19
	IT-3: 75			134	78
	AQG: 50			211	167
Annual	IT-1: 70	60	52	Met	Met
	IT-2: 50			Not Met	Not Met
	IT-3: 30			Not Met	Not Met
	AQG: 20			Not Met	Not Met

Average annual ambient concentration: 51 $\mu g/m^3$.

11. $PM_{2.5}$ accounts for about 70% of PM_{10} found in Hong Kong. Taking account of this $PM_{2.5}$ / PM_{10} ratio and the concentration objectives for $PM_{2.5}$ proposed above, the Review proposes to tighten the annual and 24-hour PM_{10} objectives from 55 $\mu g/m^3$ and 180 $\mu g/m^3$ to the WHO IT-2 of 50 $\mu g/m^3$ and 100 $\mu g/m^3$ respectively. In line with the number of exceedences for $PM_{2.5}$, nine exceedences per year are proposed for PM_{10}.

Total Suspended Particulates

12. The existing AQOs also set out the concentration targets for total suspended particulates (TSP), which are PM with larger particle sizes. TSP mainly cause nuisance rather than adverse health effects on the public. As the health effects of PM have been aptly represented by $PM_{2.5}$ and PM_{10}, the Review proposes to take away TSP from the AQOs. This proposal is in line with the international practices.

Ozone

13. Ozone (O_3) is not a pollutant directly emitted from man-made sources. It is formed by photochemical reactions between sunlight and other primary pollutants such as nitrogen oxides (NOx) and volatile organic compounds (VOCs). As it takes several hours for these photochemical reactions to take place, O_3 recorded in one place could be attributed to VOC and NOx emissions from places afar. Measurements from the general air monitoring stations set out in Table D.5 below indicate that the WHO AQG and IT were widely exceeded at both Tap Mun and other monitoring stations.

Table D.5 : Comparison of 2008 Monitoring Data on O_3 with WHO AQG / IT

Averaging Time	WHO AQGs / ITs (µg/m^3)	Highest Concentration in 2008 (Ambient)	Highest Concentration in 2008 (Tap Mun)	No. of Exceedences in 2008 (Ambient)	No. of Exceedences in 2008 (Tap Mun))
8-hour	IT-1: 160	320	320	29	19
	AQG: 100			185	184

Average annual ambient concentration: 39 µg/m^3.

14. Taking into account the local circumstances and the results of the mathematical air quality modelling following implementation of the proposed Phase I emission control measures, it is recommended that the existing 1-hour objective of 240 µg/m^3 for O_3 be replaced by the 8-hour objective of 160 µg/m^3 under the WHO IT-1 with allowance of nine exceedences per year. This proposed new AQO is statistically similar to the EU air quality standard of 120 µg/m^3 with allowance of 25 exceedences.

Carbon Monoxide

15. The monitoring data in Table D.6 below show that carbon monoxide (CO) concentration in Hong Kong was very low. The current 1-hour and 8-hour AQOs of 30,000 µg/m^3 and 10,000 µg/m^3 respectively for CO, which are the same as the WHO AQGs, have been met.

Table D.6 : Comparison of 2008 Monitoring Data on CO with WHO AQGs

Averaging Time	WHO AQGs (µg/m^3)	Highest Concentration in 2008 (Ambient)	Highest Concentration in 2008 (Tap Mun)	No. of Exceedences in 2008 (Ambient)	No. of Exceedences in 2008 (Tap Mun))
15-minute	AQG: 100,000	3,439	2,312	0	0
30-minute	AQG: 60,000	3,324	2,116	0	0
1-hour	AQG: 30,000	3,220	2,060	0	0
8-hour	AQG: 10,000	3,034	1,536	0	0

Average annual ambient concentration: 748 µg/m^3.

16. It is therefore proposed to retain the current AQOs for CO with no exceedence allowed.

Lead

17. The principal source of lead (Pb) emissions in Hong Kong used to be the Pb additives in petrol. Following the introduction of the unleaded petrol in April 1991 and the ban on leaded petrol in April 1999, the concentration levels of Pb in Hong Kong have been very low. The 2008 monitoring data set out in Table D.7 below show that the concentration of Pb in Hong Kong was much lower than the annual WHO AQG of 0.5 μg/m^3.

Table D.7 : Comparison of 2008 Monitoring Data on Pb with WHO AQG

Averaging Time	WHO AQG (μg/m^3)	Highest Concentration in 2008 (Ambient)	Highest Concentration in 2008 (Tap Mun)	No. of Exceedences in 2008 (Ambient)	No. of Exceedences in 2008 (Tap Mun))
Annual	AQG: 0.5	0.064	[1]	Met	[1]

[1] Lead is not measured at Tap Mun.
Average annual ambient concentration: 0.054 μg/m^3.

18. The current AQO provides for a 3-month concentration objective of 1.5 μg/m^3. In line with the WHO guidelines, it is proposed to update the current AQO for Pb by adopting the WHO AQG of 0.5 μg/m^3 averaged over one year.