BY EMAIL ONLY

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3 May, 2016

Dear Sirs and Madam,

Health Risk Due To Air Pollution and Development Planning

Green Power, a local charitable green group, has been monitoring the Air Quality Health Index (AQHI) and the previous Air Pollution Index (API) data for over a decade. Enclosed with this letter is a brief reports produced by Green Power regarding our AQHI and API analyses, i.e. ***A Brief Review of AQHI Data of Hong Kong for 2015***.

According to yearly average AQHI data of 2014-2015 (refer to enclosed report), Tuen Mun, Tung Chung and Yuen Long ranked the highest in terms of "High" health risk (HHR) hours (hourly AQHI ≥7) and HHR days (daily maximum AQHI ≥7). This indicates that in 2014-2015 people staying in Tuen Mun, Tung Chung and Yuen Long ran higher health risk due to air pollution.

The longest HHR hours (AQHI ≥7) and the greatest number of HHR days (daily maximum AQHI ≥7) recorded in Tuen Mun, Tung Chung, and Yuen Long may be attributable to the presence of several major emission sources, including international airport, power plants, trunk roads, container terminals and heavy road and marine traffic.

The situation is anticipated to worsen with additional emission sources will come into operation in the near future, including: Expansion of Hong Kong International Airport into a Three-Runway System, Hong Kong-Zhuhai-Macao Bridge and Boundary Crossing Facilities, Tuen Mun-Chek Lap Kok Link and incinerators.

However, the Administration has downplayed the anticipated air pollution in their planning for the western territory such as Lantau Development[1], Tung Chung New Town Extension[2], Hung Shui Kiu

[1] Lantau Development: http://www.landac.hk/data/filemanager/uploads/miscellaneous/LanDAC_Digest_Submission10_20160125.pdf
[2] Tung Chung New Town Extension: http://www.tung-chung.hk/eng_index.html

New Development Area[3], Yuen Long South[4], Kam Tin South[5] and Boundary Crossing Facilities Island of Hong Kong-Zhuhai-Macao Bridge[6]. There will be a population of over 511,000 living in the high health risk due to air pollution in these areas if the situation is not improved.

Green Power urges the Administration to commence a study to investigate the air pollution problems of the western territory and provide effective policies, measures and proper transport strategy and town planning, before settling people in the likely most polluting areas in Hong Kong. Also, the Government should launch more health and environment caring transport strategy and measures to improve air quality in polluted areas and protect the unpolluted area from road transport.

For any queries, please contact the undersigned at Green Power (T: 3961 0200, Fax: 2314 2661, Email: lkcheng@greenpower.org.hk)

Thank you very much for your kind attention. I look forward to your favourable response.

Yours faithfully,

CHENG Luk-ki
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Encl
A Brief Review of AQHI Data of Hong Kong for 2015

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[3] Hung Shui Kui New Development Area: http://www.hsknda.gov.hk/
[4] Housing Sites in Yuen Long South: http://www.yuenlongsouth.hk/
[5] Land Use Review of Kam Tin South: http://www.pland.gov.hk/pland_en/info_serv/ava_register/ProjInfo/AVRG79_ExpReport.pdf
[6] Topside Development at Hong Kong Boundary Crossing Facilities Island of Hong Kong - Zhuhai - Macao Bridge: http://www.hzmbbcf-topside.hk/study.php

A Brief Review of AQHI Data of Hong Kong for 2015

By Green Power
April 2016

1. The Air Quality Health Index system

1.1 Environmental Protection Department (EPD) launched the Air Quality Health Index (AQHI) on 30 December, 2013 in replace of the previous Air Pollution Index (API)[7] which was operated for over 14 years from 1999 to 2013. API presented air pollution level with a scale of 1-500. API of 101 to 200, categorized as "Very High" air pollution level, and up to 500 implied a short-term health impact to the general public[8]. Whereas AQHI is a health-risk based index with a new scale of 1 to 10 and 10+ which an index of 7, categorized as "High" health risk, and up to 10+ indicates a short-term health risk to the general public[9].

1.2 The AQHI system has operated for more than two years starting from 30 December, 2013. In this preliminary review, the yearly AQHI 2015 data of the twelve General Air Quality Monitoring Stations[10] (General Stations) are summarized, reviewed and compared to the data in 2014 and the 14-year API statistics in terms of the number of hours and days when AQHI and API reached or exceeded 7 and 101 respectively in all General Stations. These analyses excluded Roadside Air Quality Monitoring Stations.

1.3 Two new General Stations was set up in Tuen Mun and Tseung Kwan O upon the introduction of AQHI and on 16 March, 2016 respectively.

1.4 For convenience, AQHI data of 30-31 December 2014 will not be included in the following analyses and discussions. Abbreviation ***HHR represents AQHI ≥7*** and ***VHAPL represents API ≥101***.

2. Number of hours of AQHI with HHR and API with VHAPL (Table 1)

2.1 During 2015, a total of 3558 hours of HHR (AQHI ≥7) were recorded from 12 General Stations (General AQHI), whereas 4116 hours were recorded in 2014. The average number of HHR hours in 2014-2015 was 3837 hours. Among these General Stations in 2015, the newly established Tuen Mun station has the longest hours followed by Tung Chung and Kwun Tong with 416, 346 and 344 hours respectively. Similar to last year, Tuen Mun station ranked first for the second consecutive year, while Tung Chung replaced Yuen Long ranking second and Kwun Tong replaced Tung Chung ranking third.

2.2 However, the yearly average values of 2014-2015 showed that Tuen Mun, Yuen Long and Tung Chung had the most hours of HHR (AQHI ≥7). The API statistics from 1999-2013 also showed that Tung Chung had the most hours of VHAPL (API≥101), followed by Kwun Tong and Kwai Chung. The percentage frequency of HHR and VHAPL hours of General Stations are shown in Graph 1. Overall, the distribution pattern of HHR and VHAPL among the stations are similar.

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[7] Press release on Air Quality Health Index: http://www.info.gov.hk/gia/general/201312/06/P201312060342.htm
[8] API and Air Quality: http://www.epd.gov.hk/epd/english/environmentinhk/air/air_quality/backgdf_6.html
[9] About AQHI: http://www.aqhi.gov.hk/en/what-is-aqhi/about-aqhi.html
[10] Namely: Central/Western, Eastern, Kwun Tong, Sham Shui Po, Kwai Chung, Tsuen Wan, Yuen Long, Tuen Mun, Tung Chung, Tai Po, Sha Tin, Tap Mun

2.3 If only AQHIs reaching 10 and 10+ in 2015 are taken for analysis, Kwun Tong has the greatest number of hours followed by Tung Chung, Tuen Mun and Central/Western (both ranked the third) with 48, 47 and 40 hours respectively compared to Tung Chung, Tuen Mun and Yuen Long ranking top three in 2014. Kwun Tong has replaced Tung Chung with the longest hours of the worst health risk associated to air pollution in 2015.

2.4 Compared to the API records of 2000-2013, the General Stations had 4311 hours of VHAPL (API ≥101) in 14 years with an average of 308 hours per year. Tung Chung was ranked first with 52 hours per year in average, followed by Kwun Tong and Kwai Chung with 50 and 47 hours per year in average respectively.

2.5 For all the General Stations, it was noted that a total of 3558 hours with HHR (AQHI ≥7) was recorded in 2015 which is about 12 times of 308 hours of VHAPL in yearly average for 2000-2013 API records. This considerable exceedance is reasonable and foreseeable because AQHI system is based on more stringent AQOs[11] than those for the replaced API system[12], and also additional counting was collected from one more station, Tuen Mun.

2.6 The monthly distribution of HHR (AQHI ≥7) and VHAPL (API ≥101) are shown as percentage frequency in Graph 2. It seems that the two systems have similar index peak seasons in autumn months, i.e. September to October for HHR and August to September for VHAPL, and in January.

3. Number of days of Daily Maximum AQHI with HHR and API with VHAPL (Table 1)

3.1 In terms of days, 79 days were recorded with one or more General Stations with daily maximum AQHI reached HHR (AQHI ≥7) level in 2015. Tuen Mun had the most days reaching HHR with 64 days while Tung Chung had 60 days and Yuen Long 58 days. If compared to the yearly average values, Tung Chung still ranked first during 2014-2015 followed by Tuen Mun and Yuen Long. The percentage frequency of HHR and VHAPL days of General Stations are shown in Graph 3.

3.2 The HHR percentage frequencies peaks at Tung Chung, Yuen Long and Tuen Mun for the average of 2014 and 2015, while similarly VHAPL frequencies peaks at Tung Chung and Yuen Long (Tuen Mun station was only set up in Dec 2013 therefore cannot be compared to API statistics). When compared HHR frequencies to the VHAPL frequencies, the percentage of all 12 general stations having HHR days was greater than VHAPL percentage. For example, Tung Chung station has recorded 135 days with AQHI≥7 out of 175 HHR days in 2014-2015, which was 77% of the total number. Whereas in 2000-2013, 213 out of 325 VHAPL days in Tung Chung station was recorded with AQHI≥7, which was 66% of the total number. The reasons for greater share of polluting hours for all general stations in 2014-2015 should be due to the more stringent reporting system.

3.3 If only daily maximum AQHIs reaching 10 and 10+ in 2015 are taken for analysis, Tung Chung had the greatest number of days followed by Kwun Tong and Tuen Mun/Central Western District with 16, 10 and 9 days respectively. Tung Chung had the greatest number of days of the worst health risk associated to air pollution in 2015.

3.4 Compared to the API records of 2000-2013, a total of 325 VHAPL days (daily maximum API

[11] New AQOs effective from 2013:
http://www.epd.gov.hk/epd/english/environmentinhk/air/air_quality_objectives/air_quality_objectives.html
[12] Historical AQOs effective from 1987 to 2013:
http://www.epd.gov.hk/epd/sites/default/files/epd/english/environmentinhk/air/air_quality_objectives/files/Table_of_historical_AQOs_Eng.pdf

≥101) were recorded in all General Stations, with an average of 23 days per year. Tung Chung earned the highest number of VHAPL days in those 14 years. Tung Chung had 15 VHAPL days followed by Yuen Long and Kwai Chung with 7 and 6 days per year in average respectively.

3.5 For all the General Stations, it was noted that a total of 79 HHR (daily maximum AQHI) days was recorded in 2015 which is about 3 times of 23 days of VHAPL in yearly average for 2000-2013 API record. The possible reasons are mentioned in section 2.5 above.

3.6 The monthly distribution of HHR (daily maximum AQHI ≥7) and VHAPL (daily maximum API ≥101) days are shown as percentage frequency in Graph 4. It seems that two systems have similar index peak seasons in autumn month, i.e. September to October for HHR and August to September for VHAPL, and in January. The situation is same as that of HHR and VHAPL hours shown in Graph 2.

4. AQHI and weather conditions

4.1 In addition to the quantity of air pollutants discharged into the air, the air quality of an area depends highly on the weather conditions which will affect the dilution, dispersal and transportation of air pollutants. The main meteorological parameters concerned include, temperature, humidity, cloud amount, rainfall, wind direction and speed.

4.2 The weather conditions influencing Hong Kong on the days with AQHI ≥7 (i.e. HHR days) in 2014-2015 are categorized into 4 groups, i.e. tropical cyclones/low pressure system, anticyclone/high pressure ridge, trough/cold front and other weather conditions.

4.3 Among the four weather conditions, the HHR days occurs most frequently when Hong Kong was under the influence of anticyclones and high pressure ridges, accounting for 116 out of 175 HHR days (66.3%). Northerly winds are prevailing over Hong Kong when anticyclones and high pressure ridges located in mainland China that carry the air pollutants from the emission sources in mainland to Hong Kong.

4.4 When tropical cyclones approach Hong Kong from the east, Hong Kong may very likely be under the subsiding air aloft. As a result, the weather will be fine, cloudless and hot that favours the formation of ozone and attributes to high AQHIs. Moreover, northerly wind or calm condition will be maintained for a few days. There were 39 out of 175 HHR days (22.3%) under this weather condition in 2014-2015. Some of the days were even recorded with the worst AQHI of 10 or 10+.

4.5 Air masses may converge over Hong Kong when a trough or cold front is nearby. The converged air masses, associated with low wind speed will trap the air pollutants resulting in poor air quality. Although this weather situation is usually transient that lasts shortly, it still accounted for 11 out of 175 HHR days (6.3%) in 2014 and 2015. The remaining 9 HHR days (5.1%) occurred under other weather conditions mostly when the wind speed over Hong Kong was slow, e.g. small pressure gradient.

5. Health risk due to air pollution and development planning

5.1 According to yearly average AQHI data of 2014-2015 (Table 1), it is worthwhile to highlight that Tuen Mun, Tung Chung and Yuen Long ranked the highest in terms of HHR hours(hourly AQHI ≥7) and HHR days (daily maximum AQHI ≥7). The three areas also had the most HHR days in 2015. Compared to last year, the AQHI levels for Kwun Tong has increased significantly which might be due to the large volume of traffic and industrial activities. This indicates that in 2014-2015 people staying in Tuen Mun, Tung Chung, Kwun Tong and Yuen Long ran higher health risk due to air pollution.

5.2 The longest HHR hours (AQHI ≥7) and the greatest number of HHR days (daily maximum AQHI ≥7) recorded in Tuen Mun, Tung Chung, Kwun Tong and Yuen Long in 2015 may be attributable to the presence of several major emission sources, including international airport, power plants, trunk roads, container terminals and heavy road and marine traffic.

5.3 The situation is anticipated to worsen with additional emission sources will come into operation in the near future, including: Expansion of Hong Kong International Airport into a Three-Runway System, Hong Kong-Zhuhai-Macao Bridge and Boundary Crossing Facilities, Tuen Mun-Chek Lap Kok Link and incinerators.

5.4 However, the Administration has downplayed the anticipated air pollution in their planning for the western territory such as Lantau Development[13], Tung Chung New Town Extension[14], Hung Shui Kiu New Development Area[15], Yuen Long South[16], Kam Tin South[17] and Boundary Crossing Facilities Island of Hong Kong-Zhuhai-Macao Bridge[18]. There will be a population of over 511,000 living in the high health risk due to air pollution in these areas if the situation is not improved.

5.5 The Administration should commence a study to investigate the air pollution problems of the western territory and provide effective policies, measures and proper transport strategy and town planning, before settling people in the likely most polluting areas in Hong Kong.

6. Occurrence of VHAPL days during days of the week

6.1 The occurrence of days with API ≥ 101 (i.e. VHAPL days) during different days of the week are analyzed from August 1999 to December 2013 to show whether there are any difference in distribution of VHAPL days between working days (i.e. Monday to Saturday) and non-working days (i.e. Sunday and Public holidays). The occurrence of VHAPL days of 11 General Air Quality Monitoring Stations (General Stations) during this period were counted separately from Monday to Sunday as well as public holidays (Table 2).

Overall Distribution of All Stations

6.2 If VHAPL days occur evenly among the seven days of week, the percentage occurrence on each day is 14.3% (i.e. 1/7). Thus, the total percentage occurrence for working days and Sundays is 85.7% (i.e. 6/7) and 14.3% (i.e. 1/7) respectively.

6.3 During August 1999 to December 2013, there was a total of 333 days when any of the General Stations recorded VHAPL. Excluding the public holidays, the actual occurrence of VHAPL working days was 88.2%, a bit higher than the evenly distributed percentage of 85.7%. In contrast, Sundays had a percentage occurrence of 11.8% which is slightly lower than the evenly distributed percentage of 14.3%.

6.4 The deviation of percentage occurrence of working days and Sundays may be attributable to

[13] Lantau Development: http://www.landac.hk/data/filemanager/uploads/miscellaneous/LanDAC_Digest_Submission10_20160125.pdf

[14] Tung Chung New Town Extension: http://www.tung-chung.hk/eng_index.html

[15] Hung Shui Kui New Development Area: http://www.hsknda.gov.hk/

[16] Housing Sites in Yuen Long South: http://www.yuenlongsouth.hk/

[17] Land Use Review of Kam Tin South: http://www.pland.gov.hk/pland_en/info_serv/ava_register/ProjInfo/AVRG79_ExpReport.pdf

[18] Topside Development at Hong Kong Boundary Crossing Facilities Island of Hong Kong - Zhuhai - Macao Bridge: http://www.hzmbbcf-topside.hk/study.php

the higher traffic activities during the working days, as vehicles are one of the major sources of air pollutants in the territories. The result may also imply that vehicular emission affects not only the roadside air quality but also the ambient pollution level.

VHAPL Distribution among the General Stations

6.5 Similarly, the occurrence of days with API ≥ 101 (i.e. VHAPL days) for each General Station during different days of the week are analyzed from August 1999 to December 2013 (Tables 3 and 4).

6.6 In Table 4, when comparing the working days, 8 out of 11 General Stations (i.e. all except Eastern District, Kwai Chung and Kwun Tong) had a percentage occurrence of VHAPL days higher than the even distribution percentage (i.e. 85.7%). Tai Po had the highest percentage occurrence of VHAPL working days, followed by Yuen Long, Sham Shui Po and Tap Mun. Eastern District had the lowest percentage occurrence of VHAPL working days.

6.7 Such phenomenon is most readily explained by the heavy traffic during the working days. However, the high discrepancy of percentage occurrence of VHAPL working days over even distribution value (85.7%) recorded in Tap Mun (90.2%) is unexpected.

6.8 Regarding VHAPL Sundays, 3 out of 11 General Stations (i.e Eastern District, Kwai Chung and Kwun Tong) had a percentage occurrence of VHAPL days higher than the even distribution percentage (i.e. 14.3%).

6.9 In overall, Sham Shui Po and Yuen Long exhibited a more obvious high percentage occurrence of VHAPL working days while Eastern District had a distinctively low percentage.

Distribution of VHAPL on Public Holidays

6.10 From August 1999 to December 2013, there was a total of 270 statutory public holidays. 11 days of these public holidays recorded VHAPL. In overall, the percentage occurrence of VHAPL public holidays was very low, varying from 0.9 to 4.3%, during this period.

6.11 Regarding public holidays, Tung Chung had the highest number of VHAPL days among all General Stations but none for Eastern District and Tai Po. However, if the percentage occurrence of VHAPL public holidays of all the General Station was compared, Shatin had the highest percentage of 4.3%, though it is the third lowest in terms of number of VHAPL days (46 days).

6.12 Accounting to the past API record, VHAPL days for all General stations did not occur during long holidays, namely Christmas, Chinese New Year and Easter. But it happened occasionally on some holidays such as New Year's Day (1st January) and the Day after Mid-Autumn Festival (16th of the eighth lunar month) when the prevailing north or northeast wind carried inland pollutants to Hong Kong. The "clean long holidays" phenomenon may be due to the lower local traffic activities and even industrial activities in the Pearl River Delta during these long vacations.

7. Conclusion

7.1 Although the tightest standards of the World Health Organization's Air Quality Guidelines has not been adopted for the new Air Quality Objectives of Hong Kong in 2013, the new AQOs and AQHI system do provide the public more promptly and updated health risk information related to air pollution.

7.2 According to the AQHI findings in 2015, the HKSAR Government should notice that not only the western territory has been experiencing poor air quality since 2014, the eastern territory of Hong

Kong such as Kwun Tong have recorded with the most days of AQHI 10 or 10+, imposing high health risk to the public. It is unwise to plan major infrastructure and residential developments in Hong Kong without effective measures to improve the air quality, particularly for the most polluting districts.

7.3 Also, vehicular exhaust gas is the major threat to the health of people on the streets. The Government should launch more effective transport strategy and measures to lower the vehicular emission of air pollutants or provide more segregation of the pedestrians from the major traffic.

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Table 1: The statistics of VHAPL (2000-2013) and HHR (1 Jan 2014 to 31 Dec 2015).

	Central/ Western	**Eastern District**	**Kwun Tong**	**Sham Shui Po**	**Kwai Chung**	**Tsuen Wan**	**Yuen Long**	**Tuen Mun**	**Tung Chung**	**Tai Po**	**Sha Tin**	**Tap Mun**	**Total**
Total hours of VHAPL in yearly average (API≥101, **2000-2013**)	*28*	*9*	*50*	*33*	*47*	*19*	*39*	*0*	*52*	*7*	*10*	*13*	***308***
Total hours of HHR (AQHI≥7, 1 Jan to 31 Dec **2015**)	281	213	344	308	337	286	339	416	346	224	238	226	**3558**
Total hours of HHR (AQHI≥7, 1 Jan to 31 Dec **2014**)	251	164	390	326	378	318	499	519	454	209	286	322	**4116**
Total hours of HHR in yearly **average** (AQHI≥7, 1 Jan 2014 to 31 Dec 2015)	266	189	367	317	358	302	419	468	400	217	262	274	**3837**
Total days of VHAPL in yearly average (API≥101, **2000-2013**)	*5*	*1*	*5*	*4*	*6*	*3*	*7*	*0*	*15*	*2*	*3*	*4*	***57***
Total days of HHR (AQHI≥7, 1 Jan to 31 Dec **2015**)	42	32	46	46	50	47	58	64	60	39	39	37	**560**
Total days of HHR (AQHI≥7, 1 Jan 2014 to 31 Dec **2014**)	39	26	50	46	59	56	73	70	75	38	42	43	**617**
Total days of HHR in yearly **average** (AQHI≥7, 1 Jan 2014 to 31 Dec 2015)	41	29	48	46	55	52	66	67	68	39	41	40	**589**
No of hours with AQHI =10 or 10+ from 1 Jan to 31 Dec **2015**	32	21	48	26	26	21	31	40	47	17	19	9	**337**
No of days with AQHI =10 or 10+ from 1 Jan to 31 Dec **2015**	9	6	10	6	5	6	8	9	16	5	4	3	**87**

Figures in red, orange and yellow box are the first, second and third highest across the row.

Table 2: Distribution of VHAPL days from August 1999 to December 2013.

Days of the Week	MON	TUE	WED	THU	FRI	SAT	SUN	Public Holiday (PH)	Total
No. of VHAPL Days	43	51	51	45	54	40	38	11	333
% occurrence of VHAPL days	13.4*	15.8*	15.8*	14*	16.8*	12.4*	11.8*	3.3**	
	88.2* / 85.3**						14.7**		

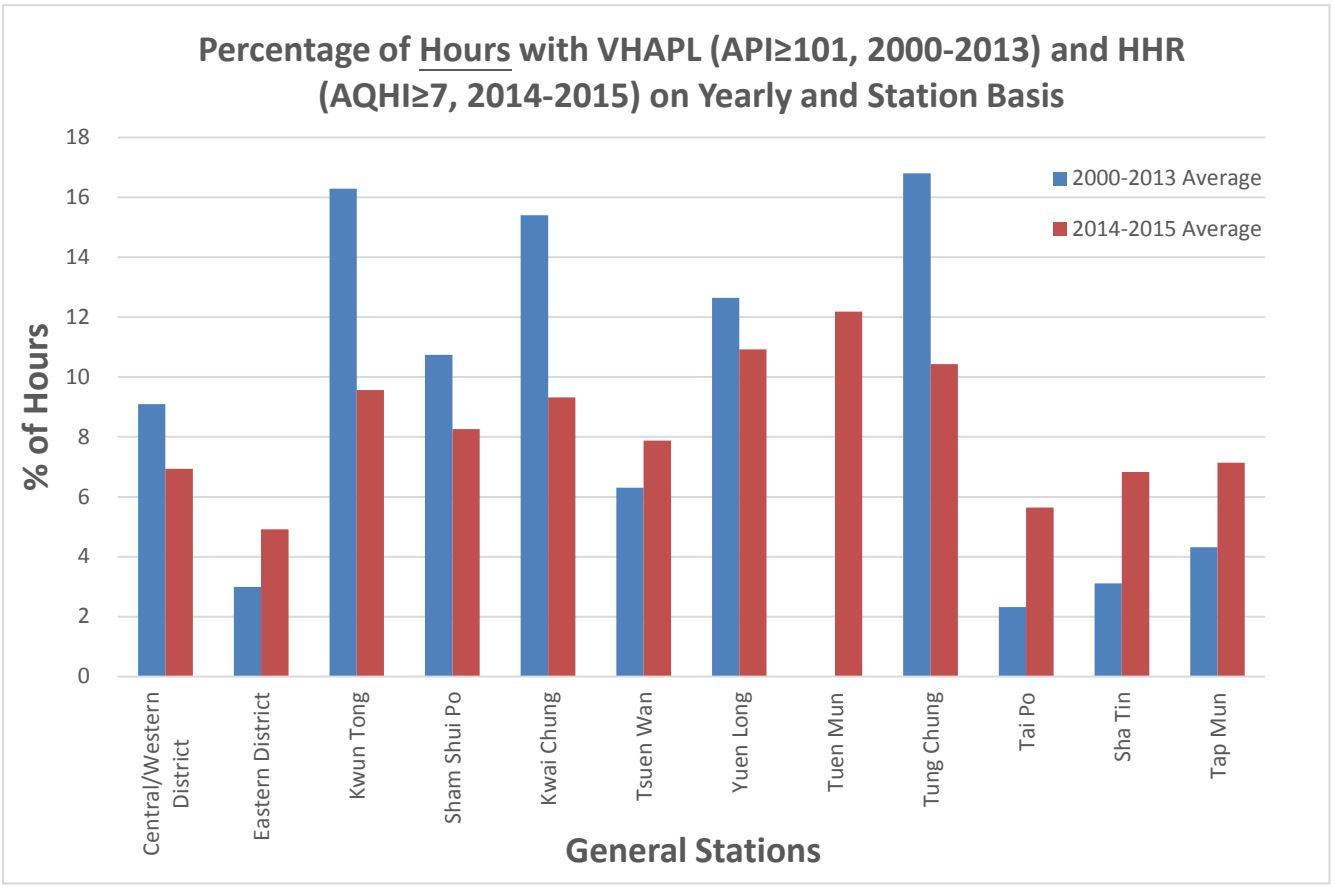
*Percentage based on the total number of VHAPL excluding public holidays (322 days)
**Percentage based on the total number of VHAPL including public holidays (333 days)

Tables 3 and 4: Distribution of VHAPL days of individual General Stations from August 1999 to December 2013.

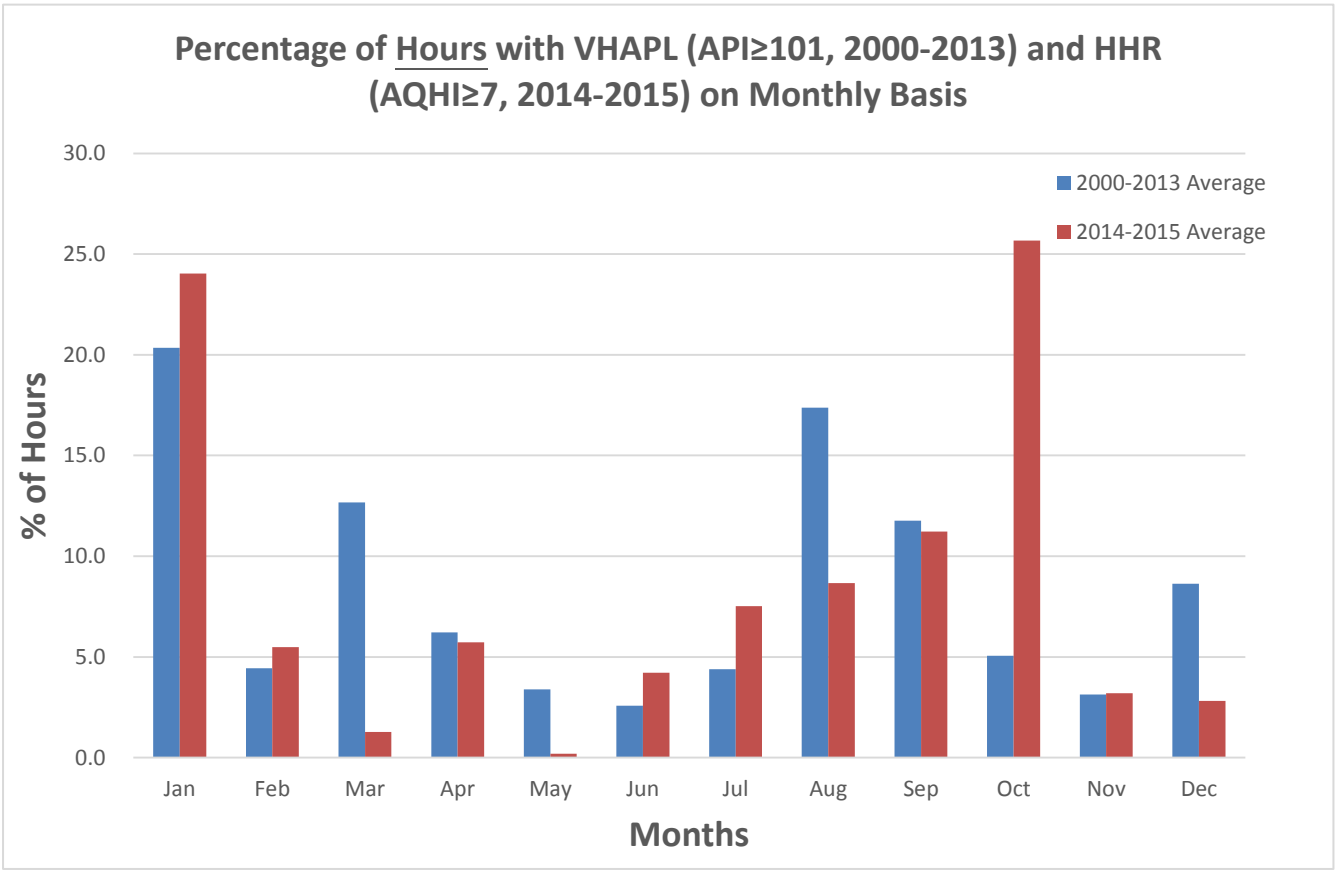
	Central/Western District	Eastern District	Kwai Chung	Kwun Tong	Shatin	Sham Shui Po	Tai Po	Tap Mun	Tsuen Wan	Tung Chung	Yuen Long	Total(Day)
Mon	12	3	12	9	8	12	3	9	6	30	11	115
Tue	13	2	10	9	6	10	4	10	4	42	13	123
Wed	13	4	7	13	10	10	8	13	7	37	16	138
Thu	6	1	12	10	4	5	1	6	9	22	17	93
Fri	10	1	16	7	5	9	6	11	10	29	21	125
Sat	7	3	14	11	5	9	1	6	7	24	18	105
Sun	9	6	12	12	6	6	2	6	5	27	9	100
PH	1	0	3	3	2	2	0	1	1	7	1	21
Total(Stn)	**71**	**20**	**86**	**74**	**46**	**63**	**25**	**62**	**49**	**218**	**106**	**820**

		Central/Western District	Eastern District	Kwai Chung	Kwun Tong	Shatin	Sham Shui Po	Tai Po	Tap Mun	Tsuen Wan	Tung Chung	Yuen Long	Total
Working Days (WD)	Subtotal(WD)	61	14	71	59	38	55	23	55	43	184	96	699
	%(Stn)=Subtotal(WD)/ Subtotal(Non-PH)	87.1	70.0	85.5	83.1	86.4	90.2	92.0	90.2	89.6	87.2	91.4	
Sunday	Subtotal (Sunday)	9	6	12	12	6	6	2	6	5	27	9	
	%(Stn)=Sun/ Subtotal(Non-PH)	12.9	30.0	14.5	16.9	13.6	9.8	8.0	9.8	10.4	12.8	8.6	
Public Holidays (PH)	Subtotal (PH)	1	0	3	3	2	2	0	1	1	7	1	
	%(Stn)=PH/Total	1.4	0.0	3.5	4.1	4.3	3.2	0.0	1.6	2.0	3.2	0.9	

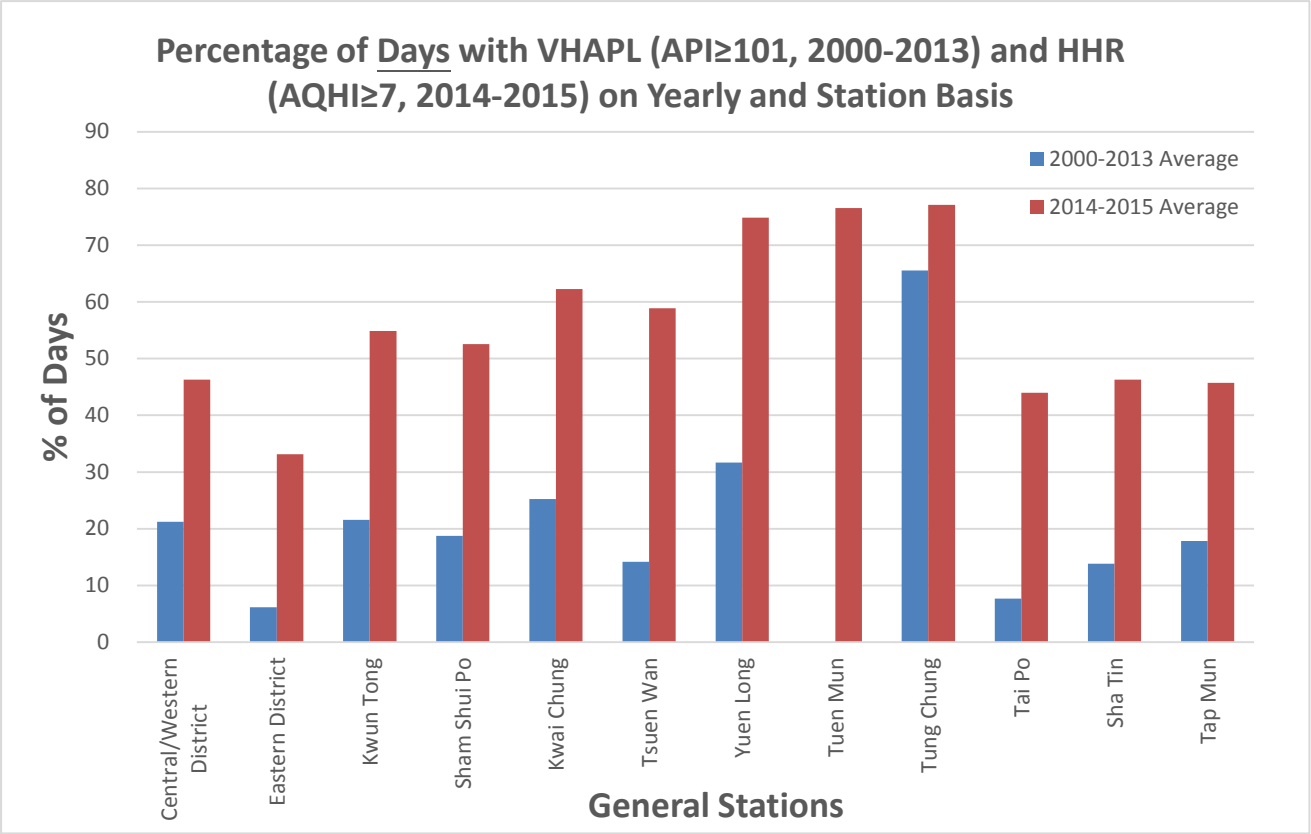
Graph 1



Graph 2



Graph 3



Graph 4