

**Submissions made to the
Legislative Council Environmental Affairs Panel
for discussion on 27th November 2006**

Review of Air Quality Objectives in Hong Kong

Submissions included from:

- ◆ Civic Exchange
- ◆ Department of Community and Family Medicine, Chinese University of Hong Kong
- ◆ Department of Community Medicine, The University of Hong Kong
- ◆ Institute for the Environment, The Hong Kong University of Science and Technology

Copies of all submissions are available at:

www.civic-exchange.org (under publications) or

<http://www.legco.gov.hk/yr06-07/english/panels/ea/agenda/eaag1127.htm>

<http://www.legco.gov.hk/yr06-07/chinese/panels/ea/agenda/eaag1127.htm>

Considerations regarding the setting of Hong Kong's Air Quality Objectives

Submission to the Chairman and Honourable members
of the Legco Environmental Affairs Panel

Civic Exchange
20 November 2007



Legco Submission 20 November 2006

(I) THE ABILITY TO MAKE INFORMED DECISIONS

- Among the most important reasons for having air quality objectives is to serve as indicators of the health risks posed by air pollution.
- If the objectives are not based on scientific evidence of the true health risks, then they mislead the public and policy makers.
- Policy makers and the public need valid information on the health risk so they may better weigh the benefits of action to limit air pollutions against the costs of doing so.
- This includes government policy initiatives to reduce air pollution as well as decisions by individuals about whether to curtail their activities.
- When the level of the objectives does not reflect the best scientific evidence available, this will result in a systematically inefficient response to the problems being faced.
- Government's proposal to wait until 2009 to come up with new objectives (when the scientific basis for them is already available) needlessly prolongs the time in which the public continues to be misled about the true 'costs' of living with our air pollution.

(II) VOLUNTARY VERSUS INVOLUNTARY RISKS

Some argue that we all benefit directly or indirectly from the economic prosperity of Guangdong and so must accept the air pollution imports as a necessary price for those benefits.

This is invalid for at least two reasons.

- First, while some level of pollution is unavoidable in the manufacturing sector, the level of pollution for each dollar of output in Guangdong is far higher than it needs to be. It could be reduced at costs well below the level of the resulting health benefits. In other words, while it is necessary to accept some type of 'bargain' between economic prosperity and air quality, *today we are getting a bad bargain.*
- Second, there is a fundamental distinction between risks voluntarily taken on (e.g., smoking, playing the stock market, engaging in potentially dangerous sports) and those imposed on an unwilling public (e.g., second hand tobacco smoke, insider trading, faulty sports equipment).
 - In the case of voluntary risk, those engaging in the activity accept the risk after weighing for themselves what they see as the benefits and costs.

- In the case of involuntary risks, someone else is making the decision and leaving out of their benefits/cost calculations the impact on the public.

Misleading or weak AQOs tend to cover up the extent of the involuntary risks being imposed on society and keep us from understanding just how bad the bargain we have been handed really is.

(III) CONCLUSION - THE PATH IS CLEAR

- Our conclusion is that the HKSAR Government should make clear that the purpose of setting AQOs is for the protection of public health, and in reviewing how to re-set them, the authorities must use the latest health evidence, which already exists with the World Health Organisation's global air quality guidelines.
- We should set Hong Kong's AQOs at levels that inform rather than mislead the public and policy makers about the costs of failing to reduce air pollution.
- For the purposes of the Environmental Impact Assessment Ordinance's (EIAO) implications for project approval, we should set up Interim Air Quality targets which will be gradually tightened and eventually converge with the health-based AQOs.
- As for what the HKSAR Government can do to improve air quality, we enclose Civic Exchange's comprehensive *Air Management Plan* (September 2006). We also enclose a pamphlet on Hong Kong's Air Quality (August 2006) and a report commissioned by CLSA titled *Boomtown to Gloomtown* (September 2006). We believe the authorities must fight on all fronts to reduce polluting emissions.

To: Honourable Members of the Legco Panel on Environmental Affairs,
Legislative Council,
Hong Kong Special Administrative Region of the People's Republic of China,
Legislative Council Building,
8 Jackson Road, Central,
Hong Kong

Dear Honourable Members

17 November 2006

Re: Submission on the Review of Air Quality Objectives in Hong Kong

I would like to make my submission of the captioned subject in a 'question and answer' (Q & A) format. I hope this will facilitate the understanding of air pollution and its control, which are multi-disciplinary issues involving environmental sciences, health sciences, engineering, economics and politics.

1. What are Air Quality Objectives? Were they established with a view to protect the health of the public in Hong Kong?

According to the Air Pollution Control Ordinance, Air Quality Objectives (AQO) are set up to "*promote the conservation and best use of air in the public interest*".¹ This is a vague, all-embracing statement that does not refer specifically to the protection of public health. If I were to speculate on the law-drafters' real meaning of "the best use of air", it would mean that the air that we breathe should not be harmful to our health. Since many activities in an urban community pollute the air, it is the responsibility of the Government to ensure that such activities are regulated and controlled so that the air is safe for us to

¹ In Section 7 – Secretary to establish quality objectives, of Cap. 311 Air Pollution Control Ordinance: The air quality objectives for any particular air control zone or part thereof shall be the quality which, in the opinion of the Secretary, should be achieved and maintained in order to promote the conservation and best use of air in the zone in the public interest. Any air quality objective may be amended from time to time by the Secretary, after consultation with the Advisory Council on the Environment. (amended L.N. 165 of 1984; L.N. 57 of 1994)

breathe. There is reference to health in the Ordinance, in Section 2,² where “air pollution” is defined as “*an emission of air pollutant which either alone or with another emission of air pollutant, is prejudicial to health.*”

The commitment by the Government to improve air quality is stipulated in this Ordinance. In Section 8 - Authority to seek to achieve air quality objectives: “*The Authority shall aim to achieve the relevant air quality objectives as soon as is reasonably practicable and thereafter to maintain the quality so achieved.*”

Numerically, AQOs in Hong Kong are expressed as concentrations of several specified air pollutants that are continuously monitored by the Environmental Protection Department (EPD) – the “criteria air pollutants”, so-called because criteria (AQOs) have been set up by the Government.

2. Where did the values of our current AQOs come from?

According to a paper to the Advisory Council on the Environment, ACE Paper 14/2006 – *A Proposal for Reviewing the Air Quality Objectives and Developing a Long Term Air Quality Strategy*, AQOs were established in 1987 by “making references to research results done mainly in the United States”. These AQOs have remained unchanged despite progressive changes in the direction of more stringent criteria in many developed countries. The research results obtained from studies in the U.S. and other countries were used by the U.S. Environmental Protection Agency (USEPA) to formulate Air Quality Standards in the United States almost two decades ago.

² In Section 2 – Interpretation, of Cap. 311 Air Pollution Control Ordinance: "air pollutant" (空氣污染物) means any solid, particulate, liquid, vapour, objectionable odour or gaseous substance emitted into the atmosphere (amended 13 of 1993 s. 2); "air pollution" (空氣污染) means an emission of air pollutant which either alone or with another emission of air pollutant- (a) is prejudicial to health; (b) is a nuisance; (c) imperils or is likely to imperil the safety of or otherwise interferes with the normal operation of aircraft; or (d) is determined to be air pollution under a technical memorandum; and, "air quality objective" (空氣質素指標) means an air quality objective established by the Secretary under section 7.

3. What are the Air Quality Standards as defined by USEPA? How are they determined?

Since the Hong Kong AQOs were derived by making references to U.S. studies, I shall describe the relevant laws and standards in the U.S. and explain the underlying principle in the setting of Air Quality Standards (AQS). In the U.S., the relevant law is the Clean Air Act. The Clean Air Act requires USEPA to set national air quality standards for particulate matter and five other pollutants considered harmful to **public health** and the **environment** (the other pollutants are ozone, nitrogen oxides, carbon monoxide, sulfur dioxide and lead). The Clean Air Act establishes two types of national air quality standards. Primary standards set limits to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, and damage to animals, crops, vegetation, and buildings. The law also requires USEPA to periodically review the standards and ensure that they provide adequate health and environmental protection, and to update those standards as necessary.³

From the most up-to-date scientific evidence on air pollution and health, the conclusion is that even at very low levels of air pollution currently experienced in the urban environment in many cities over the world, there is a significant effect on health. The evidence is derived from epidemiological studies – the study of the health of populations and the causes of diseases among them. Note that in the formulation of the AQS, the

³ The following is extracted from the USEPA website <http://www.epa.gov/ttn/naaqs/standards/basic.html>

EPA's Process for Updating the National Ambient Air Quality Standards: Reviewing the National Ambient Air Quality Standards is a lengthy undertaking. First, EPA's Office of Research and Development develops a "criteria document" a compilation and evaluation of the latest scientific knowledge useful in assessing the health and welfare effects of the air pollutants. Based on the criteria document, EPA also develops a "staff paper" that helps translate the science into terms that can be used for making policy decisions. The staff paper, prepared by staff in EPA's Office of Air Quality Planning & Standards, includes recommendations to the EPA Administrator about any revisions to the standards needed to ensure that they protect public health with an adequate margin of safety, and that they protect the environment and the public welfare.

Before either the criteria document or staff paper can be used as the basis for any policy decisions, they undergo rigorous review by the scientific community, industry, public interest groups, the general public and the Clean Air Scientific Advisory Committee (CASAC). Based on the scientific assessments in the criteria document and on the information and recommendations in the staff paper, the EPA Administrator determines whether it is appropriate to propose revisions to the standards.

economics (how much the community is prepared to pay for cleaner air?) and technology (can air quality be improved with existing technology?) involved to achieve these standards are not considered. Only scientific evidence of the effects on health and the environment caused by these air pollutants are reviewed in the process of setting the AQS. Moreover, the AQS are reviewed regularly and revised in the light of evidence derived from newer research.

4. In the past, has the Government done any work to review and revise AQOs in Hong Kong?

The Environmental Protection Department (EPD) established a Working Group on the Health Effects of Air Pollution which held its first meeting on 5 March 1997. This group was chaired by an Assistant Director of EPD and comprised officials from EPD, the Department of Health, the Hospital Authority, and university academics and professionals representing different organizations (Hong Kong College of Community Medicine, Hong Kong Institute of Occupational and Environmental Hygiene, Hong Kong Society of Occupational and Environmental Medicine, Hong Kong Medical Association and Hong Kong Thoracic Society). A review of the AQOs in Hong Kong was high on the agenda, and a Sub-Working Group on the Health Effects of Air Pollution was formed. After 18 months of work, a comprehensive report⁴ was produced by the Sub-Working Group and submitted to the Working Group. No further meetings were convened either by the Sub-Working group or the Working Group thereafter. Nothing was heard about the fate of the report produced by the Sub-group. Nor were any follow-up discussions / actions taken until now. (The underlying reasons for the abrupt halt and subsequent inaction by the Government might be a subject for Legco members to follow-up, in the interest of the public.)

5. What are the deficiencies in the current AQOs in Hong Kong?

The most obvious deficiency is that they are grossly out of date, and have not been reviewed even when other developed countries (the U.S., the European Community,

⁴ The 150-page-long report entitled "Health Effects of Air Pollution" was published and submitted to the EPD in July 1999. It is available from Prof. AJ Hedley of The University of Hong Kong or the author.

Australia, the U.K., and others) have progressively tightened their standards. There is still no explicit acknowledgement by the Government that AQOs should be set up for the protection of public health. Air pollutants like the fine suspended particulates (PM_{2.5} – these are particulate matter with an aerodynamic diameter of less than 2.5 micrometres) are now considered by many researchers to be more harmful to health than the larger particles (PM₁₀) are. Levels of PM_{2.5} have been monitored routinely in some developed countries. In a study commissioned by the EPD, data on PM_{2.5} collected in some districts of Hong Kong have been used to assess its effects on health, and the findings are broadly in agreement with the conclusion that PM_{2.5} are more harmful than PM₁₀. AQS for PM_{2.5} have been established by many developed countries. The World Health Organization (WHO) has set up Air Quality Guidelines (AQGs) for the reference of member countries. These guidelines are also health-based.

6. What should be the rationale for setting up AQOs in Hong Kong?

The Hong Kong AQOs should be set with the sole purpose of protecting the public's health, without consideration of social and economic factors. This should be based on scientific evidence: evidence based on epidemiology (the study of the health of populations and the causes of disease among them) and toxicology (the study of toxic substances and their effects).

7. Is the time frame for the proposed review of AQOs reasonable?

There has been an unexplained delay in the process for 9 years already! The Hong Kong citizens have waited too long. There is no need to re-invent the wheel. References can readily be made from standards adopted by developed countries and the WHO guidelines, which has reviewed scientific studies on air pollution and health worldwide, including Hong Kong studies conducted by local academics.

There appears to be a mis-interpretation of the WHO statement that their AQGs should be used by each country according to its own circumstances. The point to note is that there are few racial differences in the human body's response to air pollution. Physiologically,

all humans are very similar, and the association between air pollution and ill-health is consistent in studies done in different countries. Moreover, these studies also show a similar magnitude of risk to health caused by a unit increase in the concentrations of air pollutants (i.e., a unit increase in air pollutant concentrations causes a similar increase in the risk of illness / death). My interpretation of the WHO statement is: how air pollution control measures should be implemented, and when the target of AQS should be achieved for an individual country, must be determined by the local situation – the technological advancement and economic strength of the country concerned. In Hong Kong, we are technologically advanced and affluent enough to afford to do more to improve our air quality, and to act quickly.

8. Who should be involved in the revision of AQOs?

The formulation of AQOs is a scientific process. While the Government is keen to consult the public, in particular the ‘stakeholders’ which may include many polluters, such as the power companies and the transport industry, the process must involve experts in this highly specialized field. There is sufficient expertise in academic and professional bodies that can be consulted for the task. The Government must take the lead in the process.

9. Re-writing the AQOs alone is not going to improve the air quality. What more needs to be done, and by whom?

To protect human health, and to reduce the illnesses and deaths due to air pollution, especially among the vulnerable groups in the community, the levels of air pollutants must be reduced both locally and regionally. The following are some useful suggestions:

Locally, we need to revamp our transport policies. We must discourage the use of motor vehicles and highways and encourage the development of railways and the mass transit. We need to control the population of motor vehicles. Public transport must be regulated in order to reduce the generation of air pollutants (e.g., the rationalization of bus routes and their frequencies of service). In districts where air pollution is extremely serious

(such as Central, Causeway Bay, Tsim Sha Tsui and Mong Kok), the traffic volume should be reduced, for example, by charging a road toll or by pedestrianization, or a combination of both. The emission of air pollutants by power companies must be controlled stringently. Policies that favour less polluting vehicles and cleaner fuels should be advocated. The use of highly polluting fuels by ships must be prohibited. Town planning, urban development and architectural design must take into consideration the generation of air pollutants by traffic and other sources, and the pollutant dispersion pattern. The conservation of energy, reduction of air pollution and the concept of sustainable development must be built into the school curriculum. For all of the above policies and strategies, the Government must take the lead. The desire for clean air, expressed so strongly by various sectors of the community, ensures that initiatives that will improve our air quality will have good community support.

Regionally, besides better communication and sharing of air pollution monitoring data, efforts must be made to discourage the more polluting practices in the manufacturing and power industries in the Pearl River Delta. Here, the Hong Kong SAR Government and the Guangdong Government, as well as the business sector (especially the pollution-producing industries), must work together.

Looking forward to cleaner air in Hong Kong,

Sincerely

Wong Tze Wai

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**The impact of air pollution on population health,
health care and community costs**

Submission to the chairman and honourable members
of the Legco Environmental Affairs Panel

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November 27, 2006

Key points

- There is incontrovertible evidence from the worldwide literature that air pollution causes damage to body tissues (especially the eyes, nasal passages, lungs, blood vessels and heart) and causes severe illness episodes and shortening of life expectancy. Longer term effects of pollution cause cardiopulmonary problems and also increase the risk of lung cancer. Long term studies from overseas show that pollution impairs normal development of lung function in young people, so that by the time they reach maturity at around age 18 years old they have suboptimal lung growth – a lifetime defect with major implications for health experience and life-expectancy.
- In Hong Kong analyses of environmental health clearly show that short term effects of pollution have a very large impact on diseases of the lungs, blood vessels and heart. Long term studies of population health overseas give bigger estimates of effects than short term analyses. Most of the current evidence in Hong Kong is based only on short term effects which are likely to under-estimate the total health impact of air pollution on our population.
- There is evidence that pollutants entering the blood circulation of a pregnant mother damage the unborn infant. Effects of pollution on the growth and health of unborn infants, reported from the mainland and overseas, have not yet been investigated in Hong Kong.
- The mechanisms by which air pollution harms population health is being demonstrated by human clinical studies, population surveys, and animal toxicological tests and other experimental analyses. Harmful effects include widespread inflammation in the body, increased susceptibility to infection, development of atherosclerosis in blood vessels and interference with the normal neuro-electrical control of the heart. Illnesses resulting from exposure to pollution include exacerbations of asthma; heart attacks; strokes; lung and other respiratory infections; acute and chronic bronchitic symptoms, and eye and skin irritation.
- Health related community costs of air pollution in Hong Kong are conservatively valued at \$2 billion for health care and lost productivity and about \$19 billion for intangible costs related to willingness-to-pay to avoid serious illness or death from air pollution.
- There is evidence that pollutants from the combustion of fossil fuels from power generation, road traffic and industrial plants all contribute to these health risks, including particulates, gaseous pollutants, with a wide range of chemicals components including metals.
- Prevention of the health effects of pollution must include a comprehensive approach to pollution abatement from several sources. The World Health Organization Air Quality Guidelines provide a framework for immediate action. They are based on the best evidence worldwide of pollution related health impacts, including those from Hong Kong and other Asian regions. Further delays in initiating and achieving major reductions in air pollutant *concentrations* will be accountable in terms of life long damage to young people, severe losses of health related quality of life and premature deaths.
- We have demonstrated that poor health outcomes are avoidable through interventions which improve air quality. Public health research in Hong Kong has provided one of the very few demonstrations of the large scale population benefits which have resulted from improvements in air quality. The 1990 restriction of sulphur in fuel led to health gains for thousands of school children, and a reduction of 600 deaths per year in those aged 46 and over.

Health effects of air pollution in Hong Kong

Although most studies of air pollution effects on health have been conducted in the US, Europe and other developed regions, there is now a substantial body of high quality research which demonstrates the relationship between concentrations of air pollutants and health outcomes in many Asian countries and regions. Hong Kong public health research on air pollution, from the University of Hong Kong and the Chinese University of Hong Kong, has made an important contribution to this evidence base. This was recognized by the global review process which led to the formulation of the World Health Organization Air Quality Guidelines, launched on October 5, 2006. (Attachment 1)

It is important to acknowledge that the decision analysis in the WHO review was strongly influenced by analyses conducted in Hong Kong and other parts of Asia.

Which pollutants are harmful to health?

In terms of environmental management, reduction of the level of *emissions* is clearly a key measure. However in assessing public health effects we need to focus on the daily *concentrations* of pollutants in the air breathed by individuals in the population.

The pollutants which are commonly used as indicators of the harmful effects of emissions from different sources are the combustion products of fossil fuels and include particulates, nitrogen oxides, sulphur oxides, and the secondary pollutant ozone. Other chemicals implicated in health effects include transition metals and volatile organic compounds. Particulates include elemental and organic carbon compounds, nitrates, sulphates, acids and metals.

The easiest pollutants to measure and those which are used as “criteria pollutants” to estimate health effects include respirable suspended particulates (RSP or PM₁₀), nitrogen dioxide (NO₂), sulphur dioxide (SO₂) and ozone (O₃).

At present there is no conclusive evidence that either one single pollutant or a particular component of particulates is responsible for the observed harmful effects. From a public health viewpoint this emphasizes the need to control *sources* of emissions rather than attempt to focus exclusively on individual pollutant species.

In Hong Kong and other centres in China all four criteria pollutants show significant associations with adverse health effects. However for adverse health outcomes in terms of hospital admissions and deaths risk estimates are consistently higher for nitrogen dioxide and sulphur dioxide than for particulates. Again this emphasizes the need to address sources of pollution in this region rather than place too much emphasis on any one pollutant.

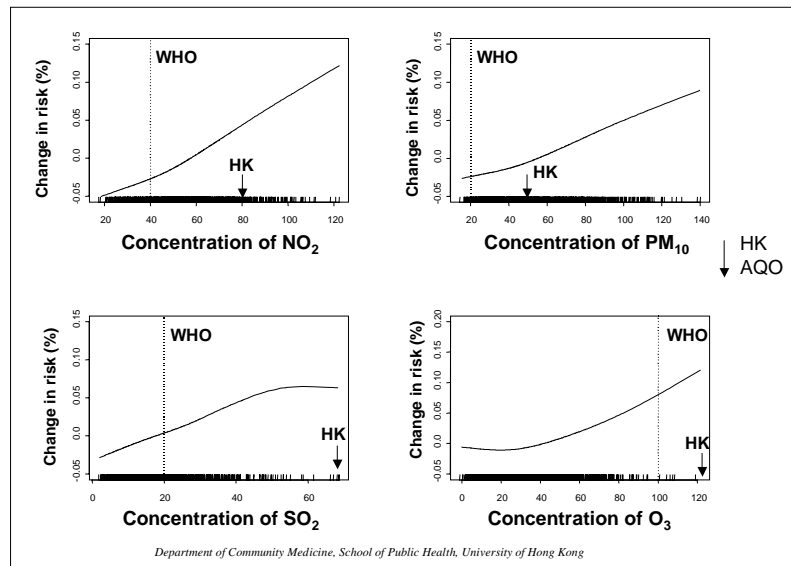
What is the relationship between pollutant concentrations and health effects in Hong Kong?

In Hong Kong all four criteria pollutants (Respiratory Suspended Particulates (RSP) estimated as PM₁₀, NO₂, SO₂ and O₃) are associated with increased daily risks of hospitalization and death at the current prevailing daily levels of pollution.

In studies of the short term (daily) events attributable to pollution, the excess risk estimates for illness episodes, hospital admissions and deaths, for each pollutant, typically lie in the range 0.5% to 1.5% per ten micrograms of pollutant per cubic metre.

It is important to note that most of the estimated bad health outcomes are occurring at levels of pollution which are well *below* the present Hong Kong Air Quality Objectives (AQOs) (Figure 1). The biggest proportion of the harmful effects are determined by the average levels of pollution and not simply the highest pollution days. The risks associated with these levels are not adequately signaled by the Hong Kong Air Pollution Index (API). This is because the index is scaled to the Hong Kong Air Quality Objectives which are far too high. For example a level of pollution at only 50% of the AQO would still be 32% (PM₁₀) to 100% (SO₂) above the WHO guidelines on an annual basis. So even an API as low as 25 would not be a valid indicator of health protection.

- The slope of the curves show the increasing risk with increases in pollutants.
- The “brush border” on the horizontal axis shows the number of days a year at those pollutant levels (µg/m³).
- The arrow is the Hong Kong (HK) present AQO; the vertical broken line is the new WHO AQG.



**Figure 1: Air Quality Standards: do they protect health?
Respiratory Admissions to HA Hospitals**

These risks of pollution health effects are estimated by a method known as time-series analysis. In this procedure daily concentrations of pollutants are modeled against daily deaths or hospital admissions. These short-term effects are now widely considered to be under-estimates. It is important for the Panel to note that longer term follow-up (cohort) studies of well-populations in other countries give risk estimates which are at least twice those from time series analyses.

How does air pollution harm body tissues?

A sound evidence base for clean air advocacy is essential if the arguments for urgent intervention are going to be accepted. There is now a large body of evidence which points to fundamental harmful effects of air pollutants on body cells in animals and humans.

Current scientific evidence indicates that the complex chemicals which are common components of air pollution, damage body tissues in a variety of different ways. Probably the most important mechanism is *oxidative stress*. Oxidative stress is a series of reactions which may be caused by smoking, alcohol abuse, radiation, exposure to cold and air pollution. Air pollution may cause oxidative stress because of the presence of several highly reactive *free radicals* in pollutant mixtures.

Free radicals may overcome our anti-oxidant defence mechanisms and cause a widespread inflammatory response, initially in the lungs and then throughout the body as a result of a

secondary wave of inflammatory cells. Common pollutants in urban air pollution include nitrogen dioxide, ozone and particulates. All of these have been clearly shown to cause or trigger oxidative stress and the inflammatory cell response.

Our lungs have a very large surface area (sometimes approximated to the size of a tennis court) and they are the first target of inhaled environmental pollutants. In apparently healthy subjects the antioxidant defences in the lung may be robust, but there is likely to be a wide range of different degrees of susceptibility. Those people with existing health problems such as asthma may already have deficient lung defences.

Who is most affected by air pollutants?

Air pollution concentrations, which are currently typical of the Hong Kong environment, cause serious health problems in a large minority of the Hong Kong population. It is likely that everyone in Hong Kong is affected to some extent by ambient pollution with increased levels of inflammatory cells in their circulation and body tissues.

We know from experimental studies in humans that when people move to geographical areas with much lower pollution the body markers of inflammation decline.

Typically we find that the health risks are bigger at the extremes of life, in young children and older people from middle age (eg 45 years plus) onwards, and those who have other health risks such as active or passive smoking, poor nutrition, heart or lung disease, or any factor which impairs the immune system.

Studies carried out by the University of Hong Kong and Chinese University of Hong Kong have shown that young children in areas of higher pollution suffer more episodes of bronchitic symptoms and impaired lung function compared with those in less polluted regions. There is clear evidence that the burden of respiratory health problems in children across the whole HKSAR would decline with air quality improvement.

Between January 1996 and December 2002, hospital discharge diagnoses and mortality statistics showed that:

- Acute lung infections in the young, exacerbations of asthma and chronic respiratory problems at all ages were strongly associated with the four criteria pollutants in Hong Kong.
- Cardiovascular diseases (heart attacks and stroke) were also strongly associated with pollutant concentrations when analyzed for hospital admissions and deaths across all ages, not only in the elderly.

Hong Kong has, almost by chance, one of the best pieces of evidence on the health gains which can be achieved by different groups in the population through air quality improvements from analyses of the 1990 fuel restriction on sulphur:

The Hong Kong Air Quality Intervention 1990

On Sunday July 1st 1990 a new Ordinance restricted the sulphur content of fuel to 0.5% by weight. The impact of this very modest intervention on both the environment and population health was immediate and beneficial:

Environmental Impact:

- Levels of sulphur dioxide (SO₂) fell by about 80% in Kwai Tsing district and by about 50% territory wide. These reductions were maintained and eventually improved on until 2000 when an increasing trend in SO₂ is again observed.

Concentrations of the transition metals Nickel and Vanadium also showed a sharp decline and this was also maintained until 2000-2004 when a significant upward trend is observed.

Health gains:

- Following the intervention there was a marked improvement in the respiratory health of primary school children (and their mothers) with reduction of bronchitic symptoms such as cough, phlegm and wheeze. Tests of lung function showed an improvement over a two year period with children in Kwai Tsing Kwai Chung/Tsing Yi improving to the level of health of children in the less polluted Southern District. Thousands of young children benefited from this reduction in one group of pollutants from sulphur rich fuels.

There was a marked effect on mortality patterns, mainly from cardiovascular and lung disease, with a 2.2% downturn in the trend in annual numbers of deaths. This was equivalent to 600 deaths avoided each year over the 5 years following the intervention. The reduction in mortality risks was seen at all ages over the age of 45 and the reduction in respiratory causes of death was greatest in the 46-64 year group. (Attachment 2)

The current situation 2006:

Despite claims by the Government there is little if any evidence of substantial and sustained improvements in air quality in Hong Kong in the past 6 years. There are several problems: (a) Any proportional reductions in concentrations are small in relation to the high average levels; (b) Uncertainties in the data (omissions of monitoring data and yearly fluctuations in pollutants are not properly taken into account; (c) Trends in emissions from power generation, marine and civil aviation sources (58% of the total) are upwards and (d) Extrapolation from current trends in pollutant levels indicate that there will be no reasonable health protection from air pollution in Hong Kong in the foreseeable future.

What are the community costs of air pollution?

We can use the risk estimates to calculate the numbers of bad health outcomes and then put a dollar value on the resulting financial stress on the individuals and families affected, the health care system and employers who lose the services of the workforce through illness or premature death. Additional costs, known as intangible costs, can be valued as the willingness-to-pay to avoid daily respiratory symptoms (such as cough), a serious illness episode requiring hospital admission, and a death due to pollution.

We estimate each year that the difference between Hong Kong's *average pollution levels* and much lower levels which are close to the new *WHO Guidelines* is the cause of a large scale epidemic of disease (Figure 2)

- 6.8 million doctor visits for respiratory complaints alone,
- over 60,000 hospital bed days and
- about 1600 deaths.

These translate into annual direct (health care) and indirect (lost productivity) costs of about \$2 Billion and a further \$19 Billion for the intangible costs (Figure 3). (see also Attachment 3)

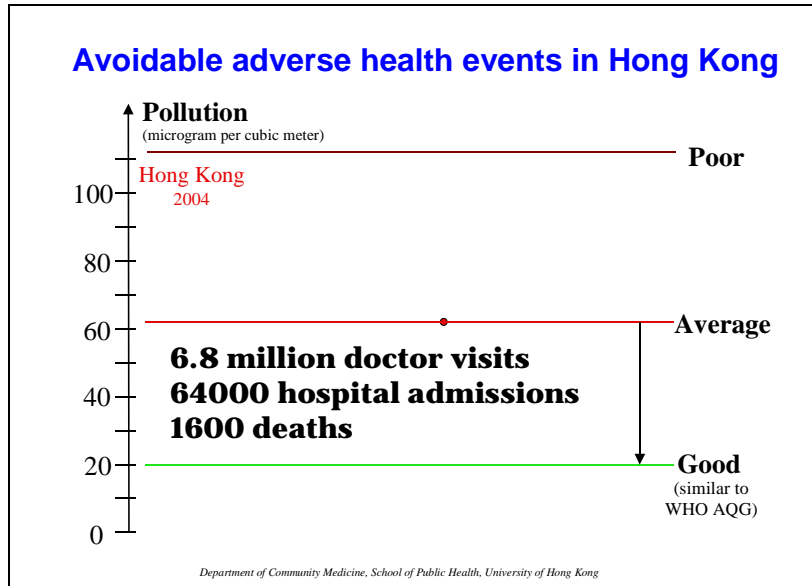


Figure 2: Doctor visits, hospital admissions and deaths avoided with improvement in Hong Kong air pollution from the current average level to a level close to the WHO 2006 Guidelines

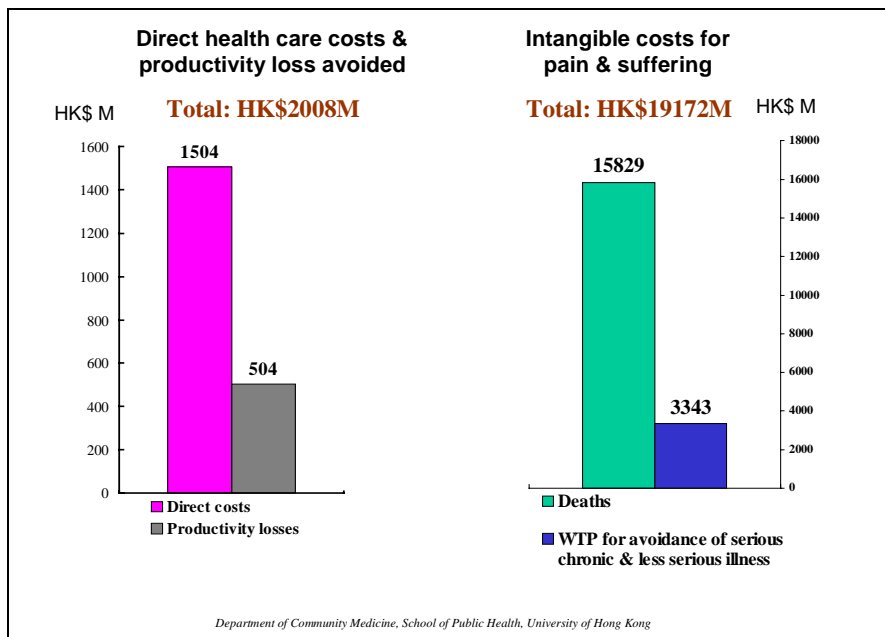


Figure 3: Values for direct costs and productivity loss and intangible costs associated with the difference between Hong Kong's average pollution and levels similar to the WHO Guidelines

These dollar values are conservative and do not yet include all of the harm from pollution.

What can we gain from the new World Health Organization Air Quality Guidelines?

The recent release of the new WHO Air Quality Guidelines (AQG) provides the most detailed and comprehensive analysis to date of the relationship between air pollutants and population health. The full report is expected to be published in December 2006.

The review of the world's literature, on which the WHO AQG are based is the best summation of available evidence on health effects and the Guidelines should therefore be the benchmark adopted in Hong Kong for environmental management and health protection in the immediate future.

While there is always scope for furthering knowledge and developing analytical insights we believe that the new AQG provide a very sound basis for setting Air Quality Objectives in Hong Kong. The strength and consistency of the associations between pollutants and health effects between different regions, on which the Guidelines are based, and the process by which the WHO Working Group handled uncertainties underpin their validity and relevance to Hong Kong.

On the basis of recent statements from the Environmental Protection Department we believe that the Government may misconstrue the intention of WHO in providing a framework of "interim targets" for each pollutant. As stated by WHO these are intended for use in areas where pollution is high. However the majority of cities which are as badly polluted as Hong Kong do not have the financial resources, technological capability and organizational infrastructure which is possessed by Hong Kong.

We would want to strongly re-assert that considerable public health protection from air pollution in Hong Kong and the surrounding region can be achieved on a relatively short timescale providing that there is political will to use the WHO Guidelines as our objectives.

It is important to acknowledge that the new Guidelines themselves are likely to be regarded as interim guidelines in the longer term. They should not be regarded as *safe*, only *safer* than previously adopted levels of pollutants.

There is general agreement that analyses of health effects do not show any evidence of a threshold concentration below which harm to health does not occur.

Conclusions

In Hong Kong we have already seen, sixteen years ago, that even modest air quality interventions can have a large beneficial effect on population health. We see no reason in principle why this same process cannot be applied across the whole region including the HKSAR and the Pearl River Delta.

Hong Kong should take a resolute lead in this process. Failure to do so will be accountable in terms of lifelong damage to young people, high costs in terms of acute health care, and severe losses to families through premature deaths.

The Hong Kong population urgently needs the application of the precautionary principle to prevent further environmental degradation, health impairment and costs to the whole community.



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The numbers game: interpretation of the EPD's assessment of air quality trends

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1. The Hong Kong Environmental Protection Department (EPD) has repeatedly claimed that roadside air quality is improving in terms of reductions of concentrations of Nitrogen Oxides (NO_x) and Respirable Suspended Particles (RSP).
2. After careful inspection of the data for the years 1999, 2004 and 2005 we suggest that the EPD's analysis lacks rigor and is potentially seriously misleading for the public.
3. The EPD claim is that from 1999-2005 NO_x has declined by 17% and RSP by 14%.
4. The EPD use only two annual data points in their analysis of the trend in NO_x and RSP whereas 7 data points are available between 1999 to 2005.
5. There are three roadside monitoring stations (Causeway Bay; Central; Mongkok) but it is apparent from re-working the calculations that EPD have excluded Mongkok. After January 2001, the roadside Mongkok monitoring station moved from Pumping Station, Mongkok Road to the junction of Nathan Road and Lai Chi Kwok Road. The distance between the two locations is less than 1km. Both locations could reasonably be considered to represent the area of Mongkok. There should be a clear justification provided for the exclusion of Mongkok.

If Mongkok was included in the two point analysis for 1999-2005 then the estimates for average decline in pollutant concentrations would only be 8% for NO_x and 9% for RSP. For the equivalent analysis using 1999-2004 data (instead of 2005) the declines are NO_x 12% and RSP 3%, and for an average of 2004 and 2005 the apparent declines were NO_x 10% and RSP 6%. All of these estimates are considerably below the estimates from which Mongkok is excluded.

6. The analysis of a trend over 7 years is subject to inherent random fluctuation and therefore uncertainty in the interpretation. We can calculate the error due to this random fluctuation for the mean percentage decline in pollutants using all available data (7 annual points) from 1999-2005. We performed regression analyses on NO_x and RSP respectively. The mean percentage decline in pollutants and the lower and upper estimates (based on the 95% confidence interval) were derived from the regression analysis (Table).

With the inclusion of Mongkok the estimates for the decline for 1999-2005 are much smaller and non-significant with wide intervals. For NO_x the decline is 11% with an interval of -22% to +1% and in the case of RSP is 6% with an interval +13% to -22%.

7. There are limitations to the precision with which a trend in a short series can be estimated, but it is essential, from a public health viewpoint that the interpretation is cautious.
8. The two point analysis used by EPD can also be assessed by inspecting the individual data points. This shows where the weighting for the crude *average* reductions in pollutant concentrations is derived from:

NO_x: In 1999 the NO_x levels in Causeway Bay were extremely high at 517 µg/m³; they fell progressively between 2000 and 2004 to a level of 323 in 2004, but were higher at 383 in 2005. In other word the possible development of a J-shaped curve. In Central the levels have essentially been stable at 387 in 1999 to 366 in 2005 and in Mongkok they increased from 262 in 1999 to 342 and 319 in 2004/05. The exclusion of Mongkok leads to a much bigger weighting, for the trend estimation, being put on Causeway Bay. The data is sparse but there is no clear indication of an overall improvement in the environmental trend.

RSP: Again the very high average level of 105 µg/m³ for 1999 in Causeway Bay leads to a greater bias in deriving the trend for RSP if Mongkok is excluded. The Causeway Bay trend stabilizes at 80-83 µg/m³ between 2002 and 2005. In Mongkok there is no significant trend in RSP levels but the average for 2003-2005 is higher than in 1999. Exclusion of Mongkok again leads to undue weighting from the apparent reduction in RSP in Causeway Bay between 1999 and 2002.

9. This inspection of the data emphasizes why the information provided to the public, media, legislators and other government departments should be explicit and transparent and presented using a strict precautionary approach. If the EPD's interpretation of these data is used to justify present policies any conclusions drawn are likely to be invalid.

The most important issue of over-riding concern, and the one which the Environment, Transport and Works Bureau and EPD should be acknowledging to the public, is that these air pollutant concentrations are extremely high by any criteria. The annual reductions, even if real, are very small indeed. Projections based on these slopes, or even much more optimistic estimates, indicate it will take decades to reach air quality which is reasonably safe.

Annual concentration ($\mu\text{g}/\text{m}^3$) from EPD annual report

Roadside monitoring stations	NO _x				RSP			
	1999	2004	2004/05 ^a	2005	1999	2004	2004/05 ^a	2005
Causeway Bay (CB)	517	323	353	383	105	88	86	84
Central (CL)	387	360	363	366	76	77	74.5	72
Mongkok (MK)	262	342	330.5	319	67	75	72	69
Average								
1. exclude MK	452	342	358	375	91	83	80	78
2. include MK	389	342	349	356	83	80	78	75

Key: ^a Average of the annual concentration in year 2004 and 2005

Changes (%) in average annual concentrations of pollutants

Roadside monitoring stations	NO _x			RSP		
	2004	2004/05 ^a	2005	2004	2004/05 ^a	2005
Two point analysis using 1999 baseline						
1. exclude MK	-24	-21	-17	-9	-11	-14
2. include MK	-12	-10	-8	-3	-6	-9
Model of 7 annual points: ^b						
Percentage change (95% CI) for CB, CL and MK using 1999 baseline	-15 (-28, 1)		-11 (-22, 1)	-6 (-29, 25)		-6 (-22, 13)

Key: ^b Poisson model starting from 1999



To: Honourable Members of the Legco Panel on Environmental Affairs
From: Alexis Lau, Institute for the Environment, HKUST
Date: November 20, 2006
Subject: Comments on the “Review of Hong Kong’s Air Quality Objectives”

Air Quality Objectives (AQOs) and the Protection of Public Health

Air Quality Objectives should and must be set to protect public health.

The World Health Organisation (WHO) has already conducted a comprehensive study, by world renowned experts, using the most up-to-date peer-reviewed research results, including many from Asia and in particular Hong Kong and has arrived at a set of guidelines. It is unlikely that Hong Kong can assemble a better team of experts and come up with a set of guidelines that is significantly different.

Hence, we should not waste time re-inventing the wheel and should adopt the WHO AQGs as our AQOs, as soon as possible.

AQOs and Air Pollution Index

The current Air Pollution Index (API) is derived from the AQOs. Our lax AQOs lead to lower API values, which are in turn misleading for the public as they under-represent the health impacts of the ambient air.

Hence, with or without the revision of AQOs, the API should immediately be revised according to the WHO AQGs.

The public must be better informed (through the API) of the health crisis related to ambient air quality. When the public is better informed, it will be easier to get the stakeholders to accept the cost required for improvement of air quality.

AQOs and Environmental Impact Assessment (EIA)

There are concerns that a substantial tightening of the AQOs will effectively stop all new development projects in HK as EIA approval is currently anchored with the AQOs. We acknowledge this difficulty but first note that the use of verifiable emission offsets could be considered for new projects (similar to the emissions trading scheme). Further, initially, the EIA approval can be modified to anchor with a set of WHO Interim Targets, rather than the WHO AQGs.



The Interim Targets, provided also by the WHO, are to be used “as incremental steps in a progressive reduction of air pollution and are intended for use in areas where pollution is high.” For some pollutants (e.g. PM), multiple interim targets were set.

However, the Interim Targets should not be used as a long-term benchmark. The ultimate benchmark must be the WHO AQGs, and if we adopt the Interim Target(s), we must also have a clear time-table for the EIA anchors to converge to the WHO AQGs.

A study to map out a long-term air quality management strategy

We do not need an 18-month study to revise the AQOs. We should immediately use the WHO AQGs to report API, and adopt the WHO AQGs as our AQOs, as soon as possible.

Tightening our AQOs is just the first step. We do need a comprehensive study to identify control measures, policy options and action items to achieve the AQOs over the long term. Hence, we support a study to map out a long-term air quality management strategy.

The government so far has mainly highlighted the substantial cost for improving air quality, without acknowledging the potentially greater costs to society if air quality fails to improve or continue to deteriorate. The study must also look at and document clearly the tangible and intangible impacts for Hong Kong (and the Pearl River Delta) if we fail to act.

Finally, any action plans to be developed must have a clear time-frame, and be associated with health-based milestones (i.e. achieving specific, lower ambient concentrations targets, rather than reducing emissions on a best endeavour basis). These health-based milestones must ultimately converge to the WHO AQGs.

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Hong Kong’s development path and our style of living are not sustainable. We must be prepared to go beyond simple control measures for emissions reductions to include planning measures, new policies and life-style changes if we are to achieve better air quality. This can only be done through an informed government and informed society that fully understand the current state of air pollution, its health and economic costs, and the benefits of making fundamental changes.