

Report

by

The Council for Sustainable Development

Clean Air and Blue Skies

- The Choice is Ours

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1. Introduction

Most of us are aware that the air we breathe has a direct bearing on our health and well-being. Increasingly we are also concerned about our quality of life - a common complaint in recent years has been the absence of “blue skies” and the sense of well-being associated with it. In recent months there has been what can more broadly be termed public outcry at what is seen as an unacceptable state of affairs.

In a modern city like Hong Kong, we enjoy the luxury of reliable energy supplies and efficient transport facilities; however, we pay the penalty for our economic development and the constraints we face in trying to manage the consequences. Being next door to the “world’s factory” in Guangdong province has benefited us economically. But it has also damaged our environment, and our air quality is the most serious issue.

Background

This report has been commissioned by the Council for Sustainable Development (the Council) to outline the issues and examine the choices available to the Government, businesses and the general public to promote actions to achieve better air quality for Hong Kong.

Following the stakeholder forum organised by the Council in July 2005, at which stakeholders considered the air quality in Hong Kong as one of the most imminent sustainable issues that needed to be addressed, the Council has decided to take forward the priority area of Better Air Quality in its second engagement process¹.

To do so, the Council set up a Study Group on Better Air Quality, under the leadership of the Vice-chairman, Dr Edgar Cheng, to study and identify the current state of air quality in Hong Kong, the Government’s and various sectors’ committed action programmes, key issues relevant to Hong Kong’s long-term sustainability as well as scope for the community to contribute their views, and to come up with a list of actions and recommendations that the Council can present to Government.

The Study Group reached its first set of conclusions in April 2006 and presented its recommendation to the Council for endorsement. The Council endorsed the recommendations and these are presented in this paper’s final chapter for Government’s consideration. In addition, this report also contains cost analyses of the proposed measures as supplementary information provided by the Council for Government to deliberate on in deciding on the next course of action.

It is important to acknowledge the substantive inputs of the various members of the Study Group, which comprised members of the Council with experience and expertise in the environmental, social and business sectors, as well as government officials (composition at Appendix A). Furthermore, in the course of the research conducted to gather the necessary information in compiling this paper, the views of stakeholders from the power,

¹ The other priority area taken forward in the second engagement process is population policy. A relevant Invitation and Response document was launched at the end of June 2006, and the engagement process is now underway and due to last until 31 October 2006.

transport and industry sectors have been included together with those offered by members of civil society. This study therefore represents a collective effort seeking to bring together the diverse views of different stakeholders in order to generate solutions to our air quality problems.

Purpose of this report

As stated earlier, the purpose of this report is to outline the issues surrounding the air pollution debate and, in doing so, obtain common acknowledgement of the seriousness of the problem, to set out the concerns of the different bodies and groups addressing air pollution issues, and to provide an understanding of the realities of what we can do and the resulting trade-offs.

This report offers a series of options and suggestions to tackle the problem, which are summarised in two parts:

- Council’s advice: Issues that the Council has taken a clear position on and given advice and recommendations to Government in order that the latter can formulate appropriate policies.
- Stakeholder engagement: Issues that will require the involvement of stakeholders and that should form the basis for informed stakeholder discussion and engagement.

The final outcome of this process should be support for the formulation of robust policies by the respective Bureaux for tackling air pollution nested within a strategic framework that Government can use to advance critical measures with stakeholder inputs.

For immediate reference, these options begin on page 36.



Figure 1. Hong Kong’s Air Quality Can be Seen

(Source: AFP Worldwide)

2. Acknowledging the Problem

2.1 The Effects of Poor Air Quality

Each day, the air-monitoring network in Hong Kong registers the level of air pollution in the atmosphere, effectively informing us that on certain days and at certain times the air can harm our health. Experts may claim that such conditions are dangerous not only in the short term but, because of the cumulative effect, in the long term as well. Unlike some cases where we can take deliberate and direct action, like recycling waste or treating our water supplies, we cannot carry out similar actions with air, because it is pervasive and has no respect for boundaries. This is why we have a problem that has crept upon us over the years and which we now cannot easily resolve. But we must find some solutions and we need to decide how bold we want to be in tackling a problem which has not only grown worse but will continue to do so unless we collectively act.

The effects of poor air on Hong Kong's health are significant – and they are being dealt with in other various forums. This report acknowledges that work and seeks to propose firm actions which will support all efforts to reduce the health burden caused by air pollution. Apart from these major health impacts, we also see the effects of air pollution, which are at their most unsightly when smog/haze blankets the city. Smog is particularly prevalent during September and October when the sunlight conditions are ideal for the photochemical conversion of the pollutant chemicals in the air. These smoggy events have brought Hong Kong notoriety in the worldwide press and bears heavily on the city's reputation as an international travel destination, a fitting host for major events, or a favoured place of business for overseas companies.

Hong Kong's Problems

Hong Kong's situation is not unique by any means. Many major Asian cities face air pollution problems due to the types of fuels used by power stations and vehicles and from the impacts of industrialisation. However, in Hong Kong we must not forget that our situation is not just confined to local air pollution but also involves regional effects generated in the Mainland. As a result, the control practices that we employ in Hong Kong cannot screen out all of the air pollution.

Trans-boundary air pollution is not new. Other countries, notably in Europe and the Americas, have faced problems such as acid rain arising in one country and falling in another. In such cases governments have instituted bilateral or even multilateral agreements and measures to curb the pollution. What gives Hong Kong's situation greater urgency is that we are on the doorstep of the world's fastest growing developing centre of the past decade, the Pearl River Delta (PRD). Economically, Hong Kong has benefited enormously from its proximity to the PRD but this has come at a price, since we share the same air shed. The challenge we face is, while striving for economic progress, how to minimize the associated negative impact on our air quality with, for example, state-of-the-art technology. Needless to say we will need to partner with the authorities in the PRD to reduce pollution arising from such economic activities there but we cannot expect to see quick results.

So where do we start? We know that there is a problem that is affecting us now and will worsen in the long term if nothing is done. The impacts are insidious and cumulative, so we must deal with them now rather than delay any further to avoid a legacy of damaged public health and opportunity costs such as inability to attract talent and loss of tourism revenues. We should not procrastinate on tackling air pollution, as was the attitude a decade ago, for the results are now here for all to see. It is no longer acceptable to resign ourselves to saying nothing more can be done and – in spite of the initiatives already undertaken – many more measures can be taken to rectify our situation, but we must seek political leadership to make major breakthroughs, be open to change and willing to make sacrifices in our lifestyles, in order to see tangible and immediate results. We must take action, stop the endless debate and swallow the medicine.

2.2 Defining Good Air Quality

Air Quality Objectives

Many in Hong Kong have different views on what good air quality is and it is important to get definitions correct. Hong Kong's air quality standards are based on research carried out in the USA². These are defined as a set of Air Quality Objectives (AQO) covering seven air pollutants: sulphur dioxide (SO₂), nitrogen dioxide (NO₂), carbon monoxide (CO), photochemical oxidants, lead, total suspended particulates (TSP), and respirable suspended particulates³ (RSP).

Although the thresholds covered by the AQO are similar to those used in the US, some argue that they are less stringent than in other countries, and we have set air quality conditions that we consider acceptable but which would be rejected elsewhere. Meanwhile, the Government has embarked on a review of the AQO, in light of the WHO's new guidelines on air quality which were announced recently, to account for emerging scientific information and standards regarding the nature of fine atmospheric particulates⁴. The Government will examine the local situation and come up with suitable targets and strategies for the future. A summary of pollutants, their sources and causes, and sources of generations in Hong Kong appears in Table 2 on page 12.

Air Pollution Index

To inform the Hong Kong citizenry on the state of air quality, the concentrations of five of these pollutants are measured on an hourly basis at 11 general and 3 roadside monitoring stations, as shown in Figure 2 below.

² Hong Kong's air quality standards are similar to the National Ambient Air Quality Standards of the US Environmental Protection Agency.

³ RSP are also known as PM₁₀, denoting that they are composed of micro-particles of less than 10 microns diameter, or 10 millionths of a metre.

⁴ Fine particulates are PM_{2.5}, denoting that their size is less than 2.5 microns.



Figure 2. Hong Kong's Air Monitoring Network (circles denote "General" and squares "Roadside" stations).

These readings are calculated and collated as Air Pollution Indexes (API) and are used as indicators of the level of air pollution in the vicinity of each monitoring station. Each day, a composite of the five pollutants is taken and reported on. The air in areas recording API readings of over 100 is generally regarded as potentially injurious to health. For many, this information is helpful but there are some who believe for the reasons stated earlier that the API is an inappropriate measure and does not reflect the seriousness of the problem. Critics also base their views on research findings which show that air pollution levels have a direct relationship with increased public health costs and that Hong Kong could do better to establish new thresholds. Whilst this is an important debate, the effectiveness of any review has to be linked to actions to reduce current pollution loads.

These arguments are logical and reinforce how dire the problem is. Quantifying the health impact on the population is not an easy exercise but we must move towards actions rather than more debate if we are to achieve real meaningful and lasting reduction in pollution loads.

Smog

More tellingly, we can also see the effects of air pollution as much of Hong Kong's majestic skyline is, on certain days, shrouded in smog. Much like the infamous Los Angeles smog and the London "pea-soupers" in the 1970s and 1960s respectively, we have a latter-day version that features in worldwide media coverage of Hong Kong.



Figure 3. Cover of Time magazine (December 2004)

Most recently, poor air quality was given as one reason that was making Western expatriates think twice about moving to Hong Kong to work. ECA International, a human-resources consultancy that compiled the location-ranking survey report, suggests poor air, food scares and the threat of infectious diseases may have been responsible for Hong Kong's slide and that companies would have to pay incentives to entice executives to the SAR.⁵ Another press report states that expatriates are being paid a “hardship allowance” but in some cases these offers are not high enough to compensate for the worsening air pollution.⁶ Further news comes from a survey conducted by the American Chamber of Commerce which states that “companies see future investors turning away from Hong Kong and four out of five professionals are thinking of leaving or know of people who do so⁷”. It is clear that if we do not spend on measures to improve air quality now, it will be costly and expensive to the community in the long term both for our economy and well as our health.

⁵ “HK slides down list of best cities for expats”, South China Morning Post, 3 April 2006, page A3.

⁶ “Expats are paid extra because of smog”, Sunday Morning Post, 25 June 2006, page 3.

⁷ “Executives worry about city's bad air”, South China Morning Post 28 August 2006, page 3

Causes of Smog

Smog is formed when air pollutants generated by vehicular emissions, and industrial and commercial operations react with sunlight. It is at its worse when there are weak northerly winds from the PRD area or when the region is under the influence of subsiding air at the periphery of an approaching typhoon.

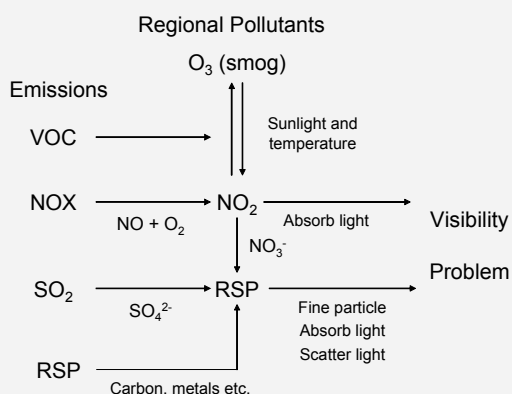


Figure 4. Formation of Smog (Source: Environmental Protection Department)

Smog is often regarded as a surrogate indicator of air quality, rather than the API. It should not, though, be confused as a replacement, since visibility or its lack does not give an accurate reflection of the air quality; one can have clear skies but still be exposed to fine-particulate matter. However, smog does serve as a useful reminder of our quest for clean air.

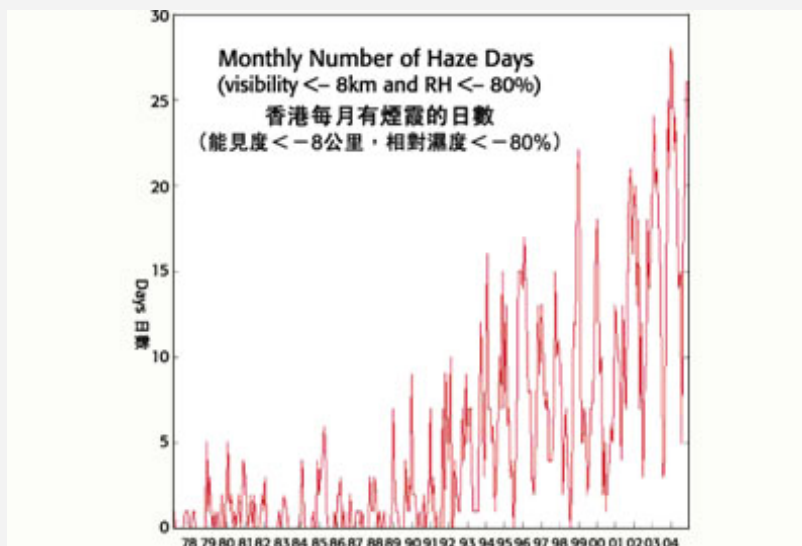


Figure 5. Number of Hazy Days (Source: Centre for Coastal and Atmospheric Research, HKUST)

Declining visibility of below 8 kilometres reached a high of 16 per cent of all days in 2004, as Figure 5 shows. That means almost 60 days of smog masking many of city’s landmarks from view.

Box 1. Causes of Smog

What are We Currently Doing in the Event of Bad Air Quality?

For general API readings of over 100, the Government advises “persons with existing heart or respiratory illnesses (such as coronary heart and cardiovascular diseases, asthma, chronic bronchitis and chronic obstructive airways diseases) to reduce physical exertion and outdoor activities”.

For roadside API readings of over 100, a similar warning, but with specific references to length of exposure, is issued: “... Persons with existing heart or respiratory illnesses (such as coronary heart and cardiovascular diseases, asthma, chronic bronchitis and chronic obstructive airways diseases) are advised to avoid or minimise their stay in areas with heavy traffic. If it is necessary to stay in streets or roads with heavy traffic, they are advised to reduce physical exertion as far as possible.”

The following Figure 6 shows the annual average API from 1999 to 2004.

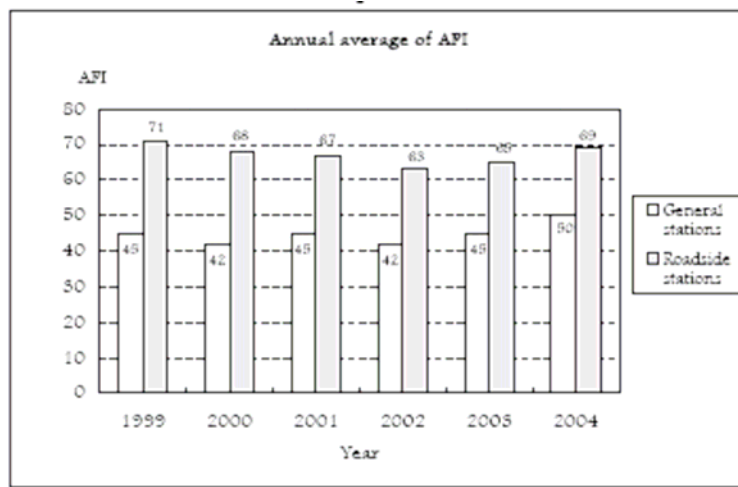


Figure 6. API Levels in Hong Kong (1999 to 2004) (Source: Environmental Protection Department)

Even though the figures have been less than 100 but constant around the high 60s and mid-40s for roadside and general levels as a result of Government efforts in the past to lower air pollution, this nonetheless raises two urgent questions: what constitutes a safe threshold and, if we accept that the API is our best means of measuring air pollution, what actions can be specifically taken to achieve lower readings?

Impacts of Poor Visibility

Poor visibility clearly has an obvious effect on various sectors, like tourism and transport. Emotively, the inability to see clear views of landmarks like Victoria Harbour is disturbing for all. Importantly, visibility also plays a strong role in the perceptions of Hong Kong as a world city. Major sporting events, tourism attractions and foreign investment could potentially be affected if Hong Kong’s image is tarnished by lack of visibility.

The following Figure 7 shows how visibility in Hong Kong has declined since 1991. Significantly, the readings are taken for a given level of humidity, indicating that these measurements are of smog rather than fog, which is naturally formed⁸.

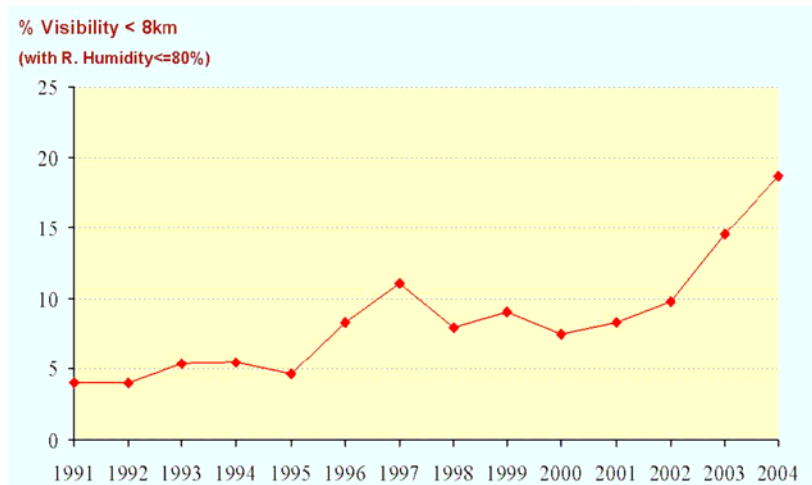


Figure 7. Trends of Visibility Impairment (Source Environmental Protection Department)

Visibility is a crucial factor in the transport sector, particularly in aviation and marine operations. In 2005, loss of visibility surpassed 2,400 hours at the Hong Kong International Airport at Tung Chung, an almost 150 per cent increase over the eight years of records.

Year	Annual Total No. Hours
1997	960
1998	951
1999	1142
2000	899
2001	965
2002	815
2003	1317
2004	2071
2005	2438

Table 1. Hours of low visibility at Hong Kong International Airport (Source: Hong Kong Observatory)

⁸ Fog is a cloud in contact with ground or water. It occurs when moisture from the surface of the Earth evaporates. As this evaporated moisture rises, it cools and condenses into fog. Fog differs from cloud only in that fog touches ground or water, while clouds do not. It can form in several ways, depending on how the cooling that caused the condensation occurred.

The reasons for loss of visibility at Tung Chung are in part due to the topography of the area as well as the proximity to the Mainland. However, scientific evidence linking these factors to visibility is not available. Clearly, the signals presented to travellers arriving at Hong Kong airport are not good.

On the marine side, there is no strong proof as yet that attributes collisions or lost operations to reduced visibility; reported incidents may be due to fog and not necessarily air pollution alone.

2.3 Causes of Air Pollution

In identifying the sources of air pollution in Hong Kong, it has been shown that the majority of pollutants come from the combustion of fossil fuels to produce energy and to meet transport needs: stationary sources include power plants, and mobile sources include vehicles, shipping and aircraft. Fossil fuels include coal, oil and gas, which are the commonest forms of fuel for power generation. Oil-based fuels commonly used in Hong Kong for transport include petrol, diesel and liquefied petroleum gas⁹ (LPG).

Volatile organic compounds – VOC – are another important group of pollutants that are non-fossil fuel based. These arise from man-made activities involving the use of solvents and chemicals, such as the printing, transport, furniture-making, manufacturing and property sectors, which on evaporation emit these pollutants to the atmosphere. There, under sunlight conditions, they form photochemical ozone, a measurable pollutant on the API. Ozone is also a major component in the formation of smog, which is linked to Hong Kong’s visibility problems.

The following Table 2 shows the sources of air pollutants and associated health impacts.

Pollutant	Caused by:	Major Sources in HK (2004)	Health Impacts
SO ₂	Combustion of sulphur-containing fossil fuels.	Power generation (92%), marine vessels (4%), fuel combustion (industrial/ commercial/ domestic) (3%) and others (1%).	Impairment of respiratory function and aggravation of existing respiratory disease causing severe respiratory distress and cardiac illnesses. Particulate sulphur also contributes to loss of visibility as smog.
Particulates (TSP and RSP)	Combustion of diesel and emissions from power plants. Can also be formed by sulphur particulates.	Vehicles (25%), power generation (50%), non-combustion (dust, construction etc.) (15%), marine vessels (6%) and others (4%).	Chronic and acute effects on pulmonary function (deep penetration into the lungs) causing respiratory problems. Effects are enhanced if high RSPs are associated with higher levels of other pollutants such as SO ₂ . Smaller particulates in RSPs also impact visibility. Particulates smaller than PM _{2.5} can damage lung tissue, aggravate existing respiratory

⁹ Compared with diesel, vehicles running on LPG emit 1/20th the amount of NO_x, 1/120th of particulates, and 1/50th of CO₂.

Pollutant	Caused by:	Major Sources in HK (2004)	Health Impacts
			and cardiovascular diseases and some particulates can cause cancer.
NO _x	Incomplete fuel combustion.	Power generation (49%), vehicles (including diesel, petrol and LPG) (26%), marine vessels (17%), aircraft (5%) and fuel combustion (industrial/commercial/ domestic) (3%).	Lowers a person's resistance to respiratory infections and aggravates existing chronic respiratory diseases. Also a contributory factor to smog.
CO	Vehicular emissions, but a small amount may also come from incomplete combustion of fuels from power stations.	Vehicles (90%), power stations (4%) and others (6%).	Mixes with blood cells to prevent oxygen uptake. Prolonged exposure may cause asphyxiation.
VOC ¹⁰	Combustion and evaporation processes associated with transportation, industry, applications of paints and other surface coatings and general solvent use.	Non-combustion (consumer products, paints, printing etc.) (80%) and vehicles (17%) and others (3%).	VOC are precursor pollutants contributing to the formation of ground-level ozone (smog) and particulate matter.
O ₃	O ₃ is not directly emitted from pollution sources. It is formed by chemical reactions of NO _x and VOC in the presence of sunlight and in warm temperatures.	See breakdowns of sources of the two ozone precursors, NO _x and VOC.	At low concentrations, causes irritation to the eye, nose and throat. At high concentrations, increases susceptibility to respiratory infections and aggravates pre-existing respiratory illnesses such as asthma.

Table 2. Common Air Pollutants in Hong Kong and their Characteristics
(Source: Environmental Protection Department)

¹⁰ According to the US Environmental Protection Agency, a VOC is any compound of carbon (excluding CO, CO₂, carbonic acid, metallic carbides or carbonates, and ammonium carbonate) which participates in atmospheric photochemical reactions.

2.4 Community Choices

Most of us living in Hong Kong are aware that the air we breathe has a direct bearing on our health and well-being. However, unlike some environmental issues where we can take direct action, like recycling waste or treating our water supplies, we cannot treat air pollution in the same way due to its pervasive nature. Thus, while none of us would choose to drink contaminated water, we all appear to be left with no choice when it comes to breathing polluted air. This underpins why we have a serious problem that has crept upon us over the years and that we now cannot resolve without taking bold measures.

Hong Kong is Asia's so-called "World City". We should be mindful that Hong Kong's position has been predicated on efficient and effective energy and transport systems and we need to maintain this high standard to be a modern city. But it would be fair to say that the provision of all these facilities for the betterment of the quality of life is negated if the environment is so degraded that it endangers health.

Hong Kong is also our home. The actions taken today will have significant consequences in the future, so we must act, and we must act now, for the generations to come.

These are concerns shared by all stakeholders. Even though they may have different viewpoints, the parties all share a common goal – better air quality. For instance, suggestions from green groups such as more stringent policies on energy and transport are important, as are measures such as curbing emissions from power stations and cutting the number of vehicles on the roads. In addition, health issues and visibility are major indicators of the impact of air pollution as highlighted in Table 2 on page 12. Whilst deteriorating air quality can be reflected in rises of API readings, the public are reacting in any discussion on air quality by pointing out the obvious signs of damage that are in front of them. These views, as well as the advice of experts in health, energy and environmental management, should be taken into consideration by the Government.

In short, the direction is clear: we must find some solutions and we need to decide how bold we want to be in tackling a problem that has only got worse and will continue to do so unless we collectively act.

Role of the Council

The role of the Council is to articulate the choices to be made by stakeholders – which includes the people in the community, business, Government and civil society – to define the right options and strategies to tackle air pollution. Given its remit the Council must also draw upon the collective knowledge of its members, who come from many different walks of life, to advise the Hong Kong SAR Government on what policies to pursue so that air quality problems are tackled with sustainable solutions.

This is in keeping with the role of the Council and the expectation of the public, thereby further legitimising its existence as a bridge between the Government and the community.

There will clearly be costs to be borne and compromises to be made in changing existing lifestyles and business models. Not everyone will agree to the options suggested. The Council has therefore deliberated on these matters based on the information prepared by

the Study Group to provide all the necessary mechanisms to capture stakeholder views and forge a way forward.

In the concluding section, the Council has recommended:

- **actions that the Government should immediately consider for implementation or for further study .**
- **a list of issues for further public engagement.**

3. Our Environment

3.1 Regional Context

It is vital to take this regional context into account. In 2005, the Regional Air Quality Index (RAQI) was set up to record the air quality indexes in specific locations in the Pearl River Delta region. Hong Kong provides three of 16 monitoring locations. The indexes are used to rate the three stations in Hong Kong and the other 13 against each other, indicating large-scale regional air pollution levels.

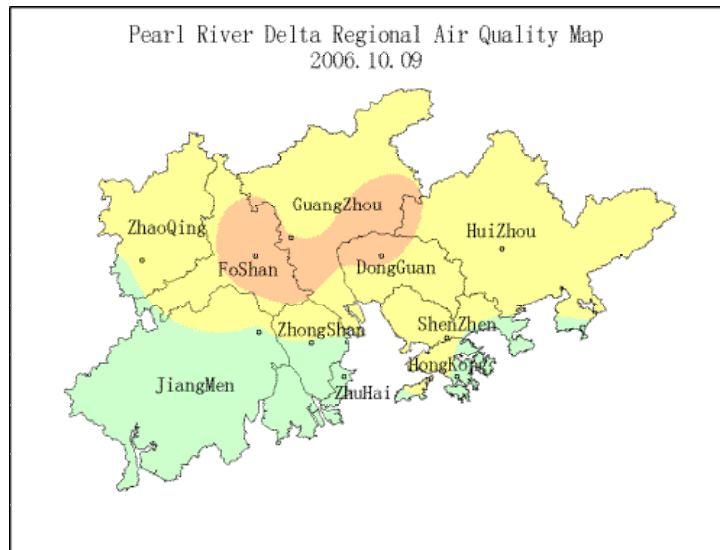


Figure 8. Regional Air Quality Index Monitoring Network
(Source: Guangdong Environmental Protection Bureau)

The purpose of the RAQI is to compare the levels of air quality across the region. In general this is a helpful means of showing how the different locations are performing and the patterns that are created in air pollutant formation and flow. However, the absolute index employed is based on a different calculation than that used to derive the API scales used in Hong Kong and hence has to be treated separately.

In general, the RAQI is a sign of joint cross-boundary co-operation that is crucial for any regional air quality improvement to take place. Agreement to use the RAQI is key to measuring the results of policy formulation and, whilst it is still too early to comment on its accuracy and consistency, the RAQI is a major step forward for tackling regional air pollution.

Hong Kong's Unique Position

Hong Kong experiences a combination of geography and wind currents that can trap pollution in a cycle giving the impression that Hong Kong generates more pollution than it actually does. This phenomenon is called the “urban land-sea breeze circulation”, and it has a profound effect on the PRD – and thus Hong Kong’s air quality.

The “urban land-sea breeze circulation” effect.

Hill and mountain ranges separating the PRD from its immediate Mainland neighbours create a mini-system and localise the region’s pollution. Studies by the Centre for Coastal and Atmospheric Research at the HK University of Science and Technology have shown that the air pollution affecting Hong Kong remains confined to the region because of the effect of “urban land-sea breeze circulation”. Its cause is described as follows:

Energy used for everyday business and household activities will have by the afternoon warmed the air over urban areas a few degrees above the air in surrounding areas, most of which is water. This is called the “urban heat island effect”, and it is magnified by the fact that temperature of water varies only slightly.

During the day, as warm air rises from the urban areas, it leaves an area of low pressure that sucks air in from the surrounding areas to replace the rising air. This air is also warmed and in turn rises, typically to about one or two kilometres’ altitude, and then spreads out horizontally before falling as it drifts out over the cooler ocean.

The closed cycle that develops of vertical and lateral movement over the city is the so-called “urban land-sea breeze circulation”. Its significance in determining Hong Kong’s air quality cannot be over-stated. Usually, pollutants are carried up and away from cities, but this phenomenon draws the pollutants back into Hong Kong, re-circulating them in a seemingly endless cycle – until a stronger off-shore breeze blows the pollution beyond the draw of re-circulation.

Until this does occur, pollutants from different areas within the PRD can mix together and be brought into different urban areas in the re-circulation. The significance is that without stronger background winds to break the cycle, the pollution remains trapped, as Figure 9 shows.

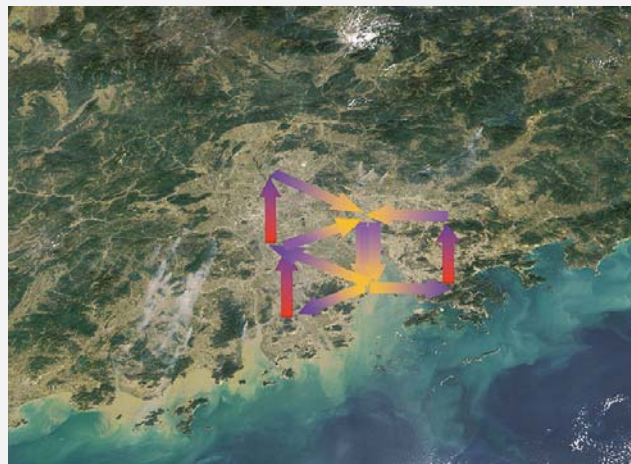


Figure 9. The Urban Land-Sea Breeze Circulation Effect, as seen over the PRD.

Box 2. The “Urban Land-Sea Breeze Circulation” Effect

The Joint Government 2010 Targets

The Hong Kong SAR Government's "Study of Air Quality in the PRD" (2002), carried out in conjunction with the Guangdong Government, shows that Hong Kong contributed 13 per cent of the overall air pollutant emissions in 1997, based on total tonnage of all of the main pollutants. Much of the balance of the pollutants from elsewhere in the PRD arose from burning low-grade coal to generate electricity and from factories and vehicles burning low-grade fuels. Factories using diesel generator sets were also presumed to have contributed to this load as they were called into action to make up for the occasional losses in mains power. In addition, certain industries such as furniture, electronics and light appliances makers became principal emitters of VOC as they used solvent-based processes like painting and parts assembly.

This confirms concerns that Hong Kong is experiencing some of the air pollution emanating from the PRD. Since 1997, the total contribution of the PRD may have increased, given the region has grown in population, industry and power demands and in the number of vehicles.

2010 Targets

The study produced several agreed actions to improve air quality. The most important was to reduce four key emissions by specific percentages from their 1997 levels by 2010. These were:

- **RSP by 55 per cent;**
- **VOC by 55 per cent;**
- **SO₂ by 40 per cent; and**
- **NO_x by 20 per cent.**

Both governments are committed to achieving these targets through various measures aimed at specific industry sectors.

Box 3. 2010 Targets set in the joint-Government report, Study of Air Quality in the PRD (2002)

Since the Pearl River Delta Regional Air Quality Management Plan, which aims to help both governments to meet the targets, came into effect from December 2003, Guangdong is implementing a number of initiatives to reduce air emissions. These include:

- The construction of four large natural gas power plants in phases from 2006 and natural gas trunk pipelines to supply a number of cities in PRD;
- The retrofitting of flue gas desulphurisation (FGD) systems to power generation units of 125MW capacity and above in existing power plants, anticipated to result in reductions of 225,000 tonnes of SO₂ emissions each year from 2007 onwards;
- The closure of small thermal generation units of 50MW and below by 2007;
- The phasing out and cessation of operation of coal-fired boilers of less than 2 tonnes/hour in the urban areas of cities in the region;

- The phasing out of various industrial processes and facilities with high SO₂ and dust emissions;
- Introduction of motor diesel with sulphur content of less than 500 ppm since 2004;
- Adoption of National II emission standards (on a par with Euro II standards) since 1 July 2005 and a goal to adopt National III standards (on a par with Euro III standards) by end 2006;
- Operation of LPG public buses and taxis and other forms of public transport that are compliant with National III standards in large cities in the region.

At the Ninth Plenary Session of the Hong Kong/Guangdong Co-operation Joint Conference held on 2 August 2006, both governments reconfirmed their determination to achieve the agreed emission reduction targets by 2010, and agreed to continue working closely to implement a series of specific measures aiming to fulfill the commitment.

Challenges

In moving towards the 2010 targets, Guangdong faces many challenges:

First, the PRD's rapid development over the past decade has overburdened its power industry, leaving Guangdong province about 10,000MW short of the capacity needed to run its industries. Hong Kong's power supply is, by contrast, reliable and stable.

Should cleaner sources of energy be found, much of what is generated from these, such as gas-fired power plants, or transmitted from western provinces of China will go towards meeting the shortfall. The existing power stations will most likely remain operating, thus there is an urgent need to install pollution control equipment for these stations if any intended improvement in air quality by 2010 is to be achieved.

Second, the PRD's transport infrastructure network is expanding: more goods and passengers need more roads within the region and that means more vehicles. While "cleaner" diesel fuel of 0.05 per cent sulphur has been available in the PRD since 2004, it still has ten times more sulphur than diesel sold in Hong Kong.

Also crucial are the higher-sulphur-containing grades of diesel that are still available in the PRD and, though they are not available in Hong Kong, which are still burned in Hong Kong in those vehicles involved in cross-boundary business. Notable among these are heavy- and medium-goods vehicles that transport products and passengers to and from the Mainland.

Third, the PRD is a key source of VOC, by-products in the many light-manufacturing factories that produce consumer products such as furniture, electronic appliances and white goods. The organic compounds, normally under high pressure, vaporise from paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials and furnishings, and some constituents of petroleum fuels such as gasoline and natural gas. They then enter the atmosphere and are enveloped in the air-flow patterns that shift across the region, where, in sunlight, they react with other pollutants to form smog. Cleaner production methods are therefore imperative for these factories to meet 2010 targets.

Fourth, there will be further development in the PRD with the building of petrochemical facilities in the region's less-used west. The addition of these industrial facilities will help economic development but may place even further demands on the region's energy supplies resulting in further air pollution impacts.

Time to Pay Our Debts

The PRD has a wide range of pollutant sources and it would be naïve to assume that Hong Kong will be able to control these pollutant sources directly or that the PRD will slow current economic development because of air quality concerns in Hong Kong. However, Hong Kong has many business interests in the PRD – reportedly 70,000 factories are owned and approximately 11 million employees are hired by Hong Kong companies – and therein lies an irony. Attracted by lower operating costs and abundant, cheap labour, many Hong Kong factory owners moved their manufacturing facilities to the PRD in the 1980s.

Now the time has come for Hong Kong owners of businesses in the PRD to pay for the economic advantages earned through the move. They must help fix the environmental problems – or “externalities” – that were not factored into the cost equations of the past and are of their creation. Promotion of clean production by Hong Kong-owned businesses and development of procurement and investment codes by local and foreign chambers of commerce can be effective in reducing emissions across the boundary.

We must remember that Hong Kong's development through the utilisation of resources and location of its industries within the PRD has contributed its share of pollution. It is important to tackle the regional issues to the best of our ability whether through government channels or business practices but we must first focus on our own air quality problems by taking all the necessary precautionary measures.

In conclusion, Hong Kong can influence the PRD to tackle air pollution in many ways, through investment and access to technologies. However, we must address air quality issues here initially, as the emissions in our immediate vicinity are the ones that affect us first and have direct impacts on our health.

3.2 Our Own Backyard

Sources

Data gathered in 2004 by the Hong Kong SAR Government show that certain sectors are the main sources of pollutants in our air: power generation; road transport; navigation and civil aviation; and others. The breakdown of sectors and pollutants is shown in Table 3 below.

	Breakdown in tonnage			
	SO ₂	NO _x	VOC	RSP
1997				
Public electricity generation	54,400	56,100	357	3,750
Road transport	1,690	30,800	13,000	5,230
Navigation	3,290	13,700	224	406
Civil aviation	182	3,550	541	41
Other fuel combustion	4,950	5,630	202	436
Non-combustion			40,100	1,380
Total	64,512	109,780	54,424	11,243
2004				
Public electricity generation	87,500	44,900	384	4,090
Road transport	112	24,600	7,060	2,000
Navigation	3,750	15,800	289	483
Civil aviation	241	4,290	378	56
Other fuel combustion	3,170	2,880	108	240
Non-combustion			33,700	1,180
Total	94,773	92,470	41,919	8,049
	+47%	-16%	-23%	-28%
2010				
Proposed targets	38,707	87,824	24,491	5,059
	-40%	-20%	-55%	-55%
Remaining reductions to be made	56,066	4,646	17,428	2,990

Table 3. Breakdown of Air Pollution in Hong Kong (Source: Environmental Protection Department)

The Government has in fact taken a number of measures to improve air quality. Compared with 1997, NO_x output fell by 16 per cent in 2004, RSP by 28 per cent, and VOC by 23 per cent. However, SO₂ emissions rose by 47 per cent, because much of the effort has been vitiated by the increase in power plant emissions. The actions taken by the Government are summarised in Appendix B.

While attributing pollution to the listed sectors is one way of directing improvement efforts, spurious arguments over whether one is more responsible than others should not be a focus for debate at the expense of taking action. Challenges in every sector should be addressed as necessary through the appropriate means, but, importantly, we must look

at how we can achieve better air quality, as gauged by API and other readings, whilst maintaining the systems and services for Hong Kong's smooth performance as a world city: we must also be aware of the economic considerations of measures, which is discussed in Section 4.

For now, we look at the following sectors in more detail:

- Electricity generation
- Road transport
- Navigation and civil aviation
- Industry (which covers “other fuel combustion “and “non-combustion”)

3.3 Electricity Generation

Keeping Hong Kong's Lights On

Hong Kong's electricity comes from two privately owned companies, CLP Power (CLP) and Hong Kong Electric Company (HEC). CLP operates Black Point Power Station (2,500 MW), Castle Peak Power Station (4,108 MW) and Penny's Bay Power Station (300 MW) in Hong Kong. In addition, CLP has 1980MW generation capacity of nuclear and pumped storage in Guangdong.. HEC is responsible for Lamma Power Station (3,756 MW).

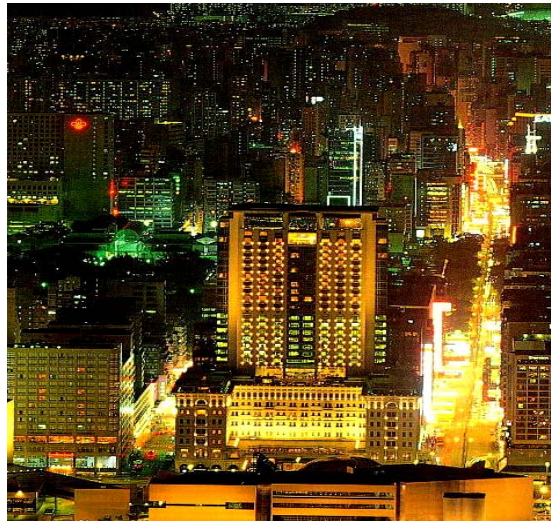


Figure 10. Hong Kong's burning need

Hong Kong's power stations are licensed to operate under the Air Pollution Control Ordinance, which requires the use of best practicable means to control emissions and allows the Government to set emission limits. Institutionally, the two power companies have entered a 15-year Scheme of Control Agreement (SCA) with Hong Kong SAR Government. The current scheme permits them a return of 13.5 to 15 per cent of the value of their asset base. Future proposed arrangements will likely tie the rate to each company's success in achieving emissions targets, introducing economic penalties where they are not met. This is part of ongoing discussions to establish the new SCA after 2008.

SO₂ is by far the biggest pollutant from the power industry¹¹ because of the sulphur content of the coal that is burnt to produce electricity. The power companies have been introducing a series of measures over the years to lower emission levels. In general, the power companies have chosen to adopt the following measures: burning cleaner fuel; adjusting the fuel mix; and improving pollution abatement.

However, at present the public and the Government are not satisfied with the effectiveness of the measures taken by the power companies.

¹¹ In 2004, about 87,500 tonnes of SO₂ came from the power sector. See Table 3, page 21.

Achievements to date:

- ***Burning clean fuel*** – coal is the main fuel being burnt by the two power companies to generate electricity. Hong Kong’s coal supplies come from a variety of source nations including Australia, Indonesia, and China. The properties of the coal and its sulphur content are very much dependent on the source and there is a premium for cleaner coal with little sulphur. By switching to this type of coal, the power companies can reduce SO₂ emissions¹². Natural gas is the cleanest fossil fuel option. With combined-cycle gas technology, converting gas to energy is highly efficient, emits virtually no sulphur and fewer other pollutants. Natural gas, though, comes at a cost. CLP has been burning at its Black Point Power Station gas sourced from Hainan, but has recently reduced its use because of its view that gas reserves are diminishing. In the future, to meet emissions standards both power companies will be relying on liquefied natural gas (LNG) shipped from overseas sources either directly to Hong Kong or via LNG terminals or other sources in the neighbouring areas.
- ***Fuel mix*** – a mix of fuels is maintained in Hong Kong to keep energy secure and for economic reasons: coal, nuclear, gas, oil (for stand by), and renewable sources (some minor solar and wind pilot projects). This issue of fuel mix and its economics is a further factor to be considered in the development of a clean fuel policy.
- ***Pollution abatement*** – a conventional method of removing sulphur from emissions is flue-gas desulphurisation (FGD). These facilities consist of a scrubbing system that converts SO₂ passed through with exhaust gases into gypsum, a material that can be used for making plaster-board. HEC has had FGD systems installed in three of its eight units at Lamma Power Station since 1992. CLP has announced plans to install FGD to four units at its Castle Peak “B” Power Station, scheduled to be commissioned between late 2009 and late 2011. Other technologies that abate further pollutants are planned for both companies’ power stations. These include low NO_x burners and catalytic reduction equipment to reduce the emission of NO_x.

Next steps

The Government has formally requested the power companies to reduce their emissions to achieve the 2010 reduction targets (see Box 3, page 18). Since it takes time to plan for and implement emission reduction projects, the two power companies were informed of the emission reduction targets in 2003.

To date, the power companies have responded with initiatives such as:

- *CLP burning natural gas; and ultra-low-sulphur coal, which it plans will make up one third of its coal profile by 2007.*
- *HEC plans to retrofit FGD units to two more generating units. It will need,*

¹² Low-sulphur coal, with a maximum sulphur content of 1 per cent, is already used by CLP in power generation. The actual average sulphur content of coal delivered to CLP in 2005 was 0.36 per cent. In 2005, CLP secured a five-year contract for ultra-low-sulphur coal, with a sulphur content of only 0.1 per cent. This represents 30 per cent of its total coal requirement over this period.

however, to take additional measures such as speeding up the work programmes, adding gas-fired combined-cycle gas turbines, emission reduction, and participating in emissions trading (see below).

The Government is exploring options to avoid as far as possible having the costs of installing emissions-reduction facilities being passed on to and burdening consumers.

The power companies, on the other hand, believe the cost of environmental improvement should be borne by the consumer and not their shareholders.

Other Power Issues

Power supplies to the Mainland – Hong Kong sells some electricity to the Mainland. In 2005, CLP sold 4,497 GWh to Guangdong – or 13.2 per cent of its total sales – through a contract it holds with the town’s authorities. Eighty per cent of the profits of these sales go back to CLP customers in Hong Kong. Much of this electricity was coal generated, using reserves in its installed generation capacity. CLP argues that the export sales frees Guangdong from using more polluting fuels to generate its own power, and Hong Kong from exposure to that pollution. The question is: should any power company be allowed to do this given the dire local air quality in Hong Kong?

Emissions trading – the Hong Kong and Guangdong governments are exploring ways to set up an emissions trading pilot scheme in 2006 for thermal power plants in the Pearl River Delta region, so that prospective power plants can identify their trading partners and draw up emissions trading contracts. Any station that achieves lower levels can register the saved pollutant loads as credits, which can be sold to stations with higher levels.

A possible scenario would be for Hong Kong companies – not just the two power companies – to invest in projects to upgrade Guangdong power plants and in doing so accrue credits that can be traded on a national or the international market. The mechanisms for this have yet to be worked out but there has been interest expressed by the private sector, such as financial institutions, in developing this concept. Emissions trading has been tried elsewhere (notably in the US and in Europe) and has had varying successes as a market tool to involve the private sector in air pollution control.

Demand Side Management – last but not least, we must consider the demand side, and minimising any excessive levels of energy consumed in Hong Kong. Ultimately, the consumer drives the amount of fuel burnt by the power companies, and this is also a factor in pollution. Our buildings and infrastructure are largely responsible for this demand, much of which could be avoided through better energy efficiency and conservation practices. The implementation of Hong Kong’s energy efficiency programmes are currently piecemeal and could be better addressed by establishing clear policy objectives.

3.4 Road Transport

Moving Hong Kong's People and Goods

The transport sector is a crucial part of Hong Kong's economy, from the cross-boundary lorries that form a key logistics link to the supply chains of many corporations to the forms of public and private transport that move people and goods to meet the needs of business and society.

Motor vehicles are a major cause of street-level air pollution. Hong Kong has 540,000 licensed vehicles on its roads and, with about 277 vehicles per kilometre of road, one of the highest densities of road traffic in the world. About one-fourth of these vehicles use diesel fuel that is responsible for 96 per cent of RSP and 88 per cent of NO_x vehicular emissions. The tall buildings on Hong Kong's streets form corridors along which pollutants such as SO₂, particulates and NO_x from the combustion of fuel, especially diesel, are often trapped¹³ – this is the “canyon effect”.



Figure 11. Hong Kong on the move

There are a number of ways to tackle air pollution from vehicles. In line with developments in emission control technologies, emission standards are continuously tightened up. From January 2006, Hong Kong has started tightening in phases the statutory emission standards for newly registered vehicles from Euro III to Euro IV in tandem with the European Union. As compared with Euro III emission standards, a Euro IV heavy duty diesel vehicle emits about 80% less particulates and 30% less nitrogen oxides. Its particulates and NO_x emissions are less than those of a pre-Euro model by 95% and 60% respectively. In regard to fuel standards, the statutory requirements are at Euro IV level with the current sulphur content in both unleaded petrol and diesel being less than 0.005 per cent. These are the only motor fuels available at petrol filling stations in Hong Kong.

In addition to implementing tighter vehicle and fuel emission standards, Government policy has been to adopt cleaner alternatives to diesel where practicable and control emissions from the remaining diesels with devices that trap pollutants. LPG, being

¹³ In 2004, road transport was responsible for 2,000 tonnes of particulate matter, 112 tonnes of SO₂, 24,600 tonnes of NO_x and 7,060 tonnes of VOC. See Table 3, page 20.

sulphur-free and much cleaner than diesel, is one such clean alternative fuel and is used widely for light vehicles such as taxis and some mini-buses. Larger vehicles, however, require higher-performance fuels.

Hence, large and medium vehicles will continue to use diesel but are adopting technologies that can be fitted to exhaust systems – like catalytic converters and continuous regenerating traps (CRT) particulate traps – until they are phased out in favour of models that meet required standards.

Achievements to date

- ***Passenger vehicles:*** Almost all of Hong Kong's 18,000 taxis run on LPG, which has resulted in a significant drop in sulphur emissions from the transport sector. In addition to LPG, another form of cleaner fuel mix is used in the hybrid electric vehicle. A popular model is the Toyota Prius. There are about 440 or so hybrid passenger vehicles on Hong Kong roads. Such cars use no more than half the amount of fuel as petrol-driven cars to cover the same distance, promising major economic and environmental benefits, including cutting NO_x emissions by up to 50 per cent.
- ***Light diesel vehicles:*** There are about 72,500 light goods vehicles in Hong Kong. Roughly one-third of these are pre-Euro vehicles and most have been retrofitted with particulate traps or catalytic converters, which can cut particulates emission from a pre-Euro light diesel vehicle by about 30 per cent. From December 2003, a regulation requiring all pre-Euro diesel light vehicles up to 4 tonnes to be installed with suitable particulate reduction devices has been implemented. Public light buses (mini-buses) which run on diesel are also considered as light vehicles; about 2,400 have switched to LPG. About 2,000 public light buses still use diesel.
- ***Heavy and medium diesel vehicles:*** There are 3,500 heavy goods vehicles and 42,850 medium goods vehicles registered in Hong Kong. In addition, there are 5,900 franchised and 7,200 non-franchised buses, and some 490 private buses. These run on ultra-low-sulphur diesel (0.005 per cent sulphur diesel) that was introduced in 2001. In addition, retrofitting non-long idling pre-Euro diesel vehicles over 4 tonnes with catalytic converters to remove particulates has been made mandatory since April 2006. About 28,000 heavy and medium diesel vehicles are now fitted with catalytic converters, which reduces particulate emission from pre-Euro diesel heavy vehicles by about 30 per cent. All of the franchised bus companies have also retrofitted their older buses (pre-Euro or Euro I models) with catalytic converters. In addition, these bus companies are conducting a trial of retrofitting particulate traps to their buses of Euro II and Euro III emission standards. Particulate traps can reduce particulate emissions from diesel vehicles by up to 90 per cent.

Next steps

Government has introduced all the laws for the introduction of Euro IV emission standards for all newly registered vehicles in 2006. The remaining 3,800 mini-buses, when retired, will be replaced by LPG or Euro IV or more advanced diesel light buses.

Other Road Transport Issues

Cross-boundary diesel – there are 1.2 million vehicles making cross-boundary trips back and forth each month between Hong Kong and Shenzhen. Many are filling with cheaper, lower-grade diesel (0.1-0.2 per cent sulphur) in Shenzhen, and driving back to Hong Kong burning this fuel. So, despite efforts by Hong Kong to reduce vehicular sulphur emissions, cross-border diesel continues to influence higher levels of pollutants, notably SO₂ in the air.

Having said that, the Mainland has in recent years tightened its requirement for motor diesel. Its current limit on motor diesel sulphur content is 0.2% nationwide. Neighbouring cities in the mainland such as Shenzhen and Guangzhou have further made available on their market diesel of sulphur content not more than 0.05%. Moreover, the Mainland has plans to further reduce the motor fuel sulphur content.

Rail transport – railways are a clean form of public transport. Hong Kong has 204 km of railway. This total includes new railways built over the past five years, including the West Rail, the Ma On Shan to Tai Wai Rail Link, the East Rail Extension to Tsim Sha Tsui and extensions to accommodate locations such as the Disneyland Resort on Lantau and the AsiaWorld-Expo convention and exhibition centre at Chek Lap Kok, adjacent to the airport. There are by contrast 1,955 km of road. Railways (including trams) draw on only 3.5 per cent of the electricity generated in Hong Kong, hence, from the position of energy consumption, the operation of trains as a means of public transport is cheaper and better for the environment than road vehicles. The capital costs of building railways, though, are substantially higher.

Tramlines – there are just over 30 km of tramlines in Hong Kong, all along northern Hong Kong Island. Trams are inherently less emitting than petrol and diesel vehicles, although the overall environmental performance depends on other factors like engine maintenance. Space constraints along roads and the interference of overhead lines with other services or building obstructions like signs have prevented the expansion of the tramline network.

Traffic congestion – exhaust emissions are a very visible sign of pollution at areas of traffic congestion. Hong Kong has several notable locations where traffic jams commonly foul the air quality in the local vicinity, especially in the access areas of the cross-harbour tunnels.

Road pricing – this is a charge imposed on motorists, and has been used effectively in countries like Singapore and the United Kingdom to deter them from using roads at certain times. A 2001 government study indicated that the need for an electronic road pricing system would be governed by factors such as vehicle growth, traffic speeds and infrastructure development. It estimated that road pricing for peak periods might divert 40 per cent of car trips to public transport and 10 per cent to different travelling times, thus alleviating traffic congestion.

Tunnel traffic – there are three sub-harbour tunnels linking Kowloon and Hong Kong Island: the Cross-Harbour Tunnel operated by the government (124,000 vehicles daily, with tolls from \$8 to \$30); the Eastern Harbour Crossing operated by the New Hong

Kong Tunnel Company Limited (61,000 vehicles daily, with tolls between \$13 and \$75); and the Western Harbour Crossing operated by the Western Harbour Tunnel Company Limited (43,000 vehicles daily, with tolls from \$22 to \$110). The difference in the tolls charged and the convenience of each tunnel's location clearly affect which is used more, and this is borne out by the congestion at the Cross-Harbour Tunnel entrances at Causeway Bay and Hung Hom, which adds to air pollution in both areas.

3.5 Navigation and Civil Aviation

Navigating a Way Forward

Hong Kong's port is one of the world's busiest, and the container terminals at Kwai Chung and Tsing Yi have, consequently, raised concerns about the sulphur-heavy fuel (4.5 per cent) that are used by the ships and its impact on air quality. The Air Pollution Control Ordinance regulates air pollution from power stations and vehicles but excludes ocean-going vessels. The ordinance states that the Secretary for the Environment, Transport and Works may specify the kind of fuel to be used by marine vessels, but does not contain any further provisions in this respect. The Government can, as a result, directly regulate the emissions from local shipping such as ferries and small private boats operating in Hong Kong waters.

There is, however, no other legislation in force in Hong Kong that sets standards for emissions from the larger, ocean-going vessels such as container ships and cruise liners.



Figure 12. Port works

For Hong Kong to tackle this problem, the improvement measures can only be taken from a regional perspective. Under international maritime law countries can propose their waters to be designated as a “sulphur emission control area” (SECA), in which ships will be required to burn low-sulphur fuel. Since the movement of international vessels covers a vast area, the stretch of Hong Kong waters and its vicinity are too small for becoming a SECA. To establish a SECA in this region will require agreement by other ports in the entire Pacific Rim. Hong Kong is in preliminary discussions with some ports in the Pacific Rim on collaborating to improve air quality. If the efforts bear fruits, the collaboration can be taken as a platform to examine the feasibility of establishing a SECA. Meanwhile, Hong Kong is preparing the legislation for implementing MARPOL Annex VI.

One area that the Hong Kong SAR Government can legislate, though, is the use of industrial-grade diesel oil by ferries, port vehicles, generators and pleasure vessels.

Next steps

To further tighten the control on marine emissions, particularly those from ocean-going vessels, the Government is now preparing a new regulation to implement MARPOL Annex VI international regulations. The key requirements are:

- *prohibit deliberate emissions of ozone depleting substances;*
- *set limits on NO_x emissions from diesel engines;*
- *impose a cap on the sulphur content of marine fuel; and*
- *ban onboard incineration within Hong Kong waters.*

The Government is closely monitoring overseas development of marine emission control measures and, if applicable, will consider introducing relevant control measures into Hong Kong and setting up a SECA for the region.

Aviation Pollution

The contribution of civil aviation to air pollution, in 2004, was about 2 per cent by weight. Although the contribution of aviation to air pollution seems insignificant, given that the problem is localised to the airport and surrounding areas, its contribution may be much larger in that area.



Figure 13. Hong Kong International Airport

Most air pollution due to aviation is produced during landing and take-off. This includes climb-out, final approach, and taxiing in. Incomplete combustion of jet fuel produces particulates but, in general, airlines try to save fuel as much as possible by improving engine efficiencies, which produces fewer particulates. However, the trade-off with this is that the higher temperature of improved engine performance produces more NO_x. Newer engines that produce less NO_x are now available, though. Another method of reducing NO_x is to adjust combustion temperatures during different phases of flight to minimise NO_x emissions while having the least effect on engine performance. Better air-traffic control can help to reduce how much time planes are circling before landing and thus help cut fuel burn.

Next steps

The Government is exploring ways to optimise approach and departure flight procedures to better suit efficient vertical flight profiles of aircraft, which will help to reduce power settings and exhaust emissions from aero-engines. It is also looking into means to optimise aircraft departure sequence strategies that will assist in reducing taxiing delays and minimising emissions during the most inefficient phase of flight.

3.6 Industry

A critical factor in the pursuit of clean air in Hong Kong is the influence that local businesses have in both the SAR and the PRD. Hong Kong businesses have a large manufacturing presence across the boundary and through decisions on energy use, production methods, efficiency measures, and the transport of goods and materials, can make a sizeable contribution to the overall effort – with visible results at home.



Figure 14. VOC-containing materials

One particular area is VOC emission. Non-combustion sources, such as solvent-based paints, printing inks and consumer products, are major emission sources of VOC, amounting to roughly 80 per cent of total VOC emissions in Hong Kong¹⁴.

Achievements

Since 1997, a series of measures has resulted in a 23 per cent reduction in VOC due to a combination of environmental legislation and control of emissions from motor vehicles. The Government has introduced regulations since 1999 requiring petrol filling stations and petrol delivery tankers to install equipment to recover VOC released during unloading. In addition, all new stations since March 2005 are required to have recovery system to capture the petrol vapour released during refuelling of vehicles. Existing stations have three years to retrofit with this vapour recovery system (i.e. till March 2008).

Consultation between Government and stakeholders has set limits for some of the largest emitting sources of VOC among paints, printing inks and six selected consumer products, based on VOC levels and trade sectors. The Government plans to introduce new legislation this year to stipulate VOC limits for paints, printing inks and selected consumer products. The implementation of these limits will put Hong Kong among the very few places in the world with the most stringent VOC control requirements. The first

¹⁴ In 2004, 33,700 tonnes of VOC were emitted in Hong Kong from non-combustion sources. See Table 3, page 21.

batch of limits will come into effect in 2007. In the interim, paint suppliers have agreed to affix warning labels on paints that exceed proposed limits.

Next steps

To promote energy efficiency and cleaner production among Hong Kong-owned factories in the PRD region, the Government intends to commission in the fourth quarter of 2006 the Cleaner Production Technical Support Pilot Project. The project aims to encourage manufacturing industries in the PRD region to practise cleaner production through technology demonstration. On the other hand, the private sector is also developing various initiatives to tackle air pollution in the PRD.

In Hong Kong, the Government will consider implementing measures to control the use of other VOC-containing products to further reduce the VOC emissions.

4. Aspirations and Realities

4.1 A Better Living Environment

We all aspire to a better living environment. The desire for good air quality is one of the primary factors behind this. Hong Kong's air quality, however, is poor and is worsening in spite of the Government's and others' efforts to tackle the problem. Hong Kong may well be a modern city, but unless we do something it will be one with the choking air of an industrial developing nation. The question Hong Kong must ask itself frankly is whether it has done enough, and, if the answer is that it has not, whether it is willing to act now.

Hong Kong must embrace a long-term vision of improved air quality that must include better public health and clear air that embodies the image of a world-class city for its residents and visitors. In the future, say 20 years down the road, this could be incorporated in urban planning and people's way of living could be shaped accordingly.

4.2 Stakeholder Views

Different viewpoints offered by stakeholders all point towards a common goal – better air quality – and that achieving this needs urgent action. Action must replace debate. Suggestions from green groups such as more robust policies on energy and transport are important, as are measures such as curbing emissions from power stations and reducing the number of vehicles on the roads. These, as well as the advice of experts in health, energy and environmental management, need to be taken into consideration by the Council. These are discussed below.

Health experts use a “willingness to pay” scale to estimate how much illnesses related to air pollution cost in direct use of health services and in productivity losses. This estimates how much people are willing to pay to avoid illness or death. Recent studies¹⁵ have shown that an increase of 10 ug/m³ in the concentration of each of four criteria pollutants – NO_x, SO₂, RSP, and O₃¹⁶ – raises the incidence of respiratory, chronic pulmonary and cardiovascular heart diseases by between 0.2 to 3.9 per cent. Drawing on the levels of respiratory and cardiovascular diseases alone in the year 2000, this figure is \$1.3 billion. While there may be discrepancies between estimation and actuality, it remains unquestionable that deteriorating air quality is harming our people's health and having a significant economic impact. Applying precautionary principles we should act to reduce local air pollution, which is most likely to have direct impact due to proximity.

Green groups have a range of views on how to achieve better air quality. They generally agree on advocating energy conservation, efficiency, and adopting cleaner transport means to avoid pollution. Some are critical of Government's policies on energy and transport and would like the industries involved to be more aggressive in reducing emissions. Others present a strong stance on increasing the use of renewable energy

¹⁵ Environmental Protection Department, “ Study of short-term health impact and costs due to road traffic-related air pollution” (2004)

¹⁶ According to Hong Kong's AQO, the stated levels of pollutants in units of ug/m³ over 24 hours are: SO₂, 350; RSP (PM10), 180; NO₂, 150; and O₃, 240 (only for 1 hour).

technology, especially wind power. Still more would like a review of the API thresholds to derive an alternative indicator for safe levels of air quality levels and the addition of “smog days” as another index of pollution determination.

Industries are looking to voluntary measures. These include the Clean Air Charter, a joint initiative comprising the Hong Kong General Chamber of Commerce, the Hong Kong Business Coalition on the Environment, the Greater Pearl River Delta Business Council, the China Council for the Promotion of International Trade – Guangdong Sub-Council, and the Guangdong Association of Environmental Protection Industry. Signatories to this charter are expected to operate to an appropriate air quality standard by first monitoring their emissions and reporting on their findings, and, second, by incorporating appropriate measures (including energy efficiency) in their operations. At present around 500 companies (out of the over 560,000 registered companies in Hong Kong) have signed up¹⁷, though it is difficult to pinpoint how many have acted as disclosure is voluntary.

Cross Boundary Matters

1-1-1 Scheme – Hong Kong companies own about 70,000 factories in the PRD, involved in a vast range of activities from producing high-volume plastic items to the most intricate of electronic equipment. They all have solid and chemical waste to dispose of, waste water to treat and air emissions to curb. To meet this range of challenges, the Federation of Hong Kong Industries has established the One Factory-One Year-One Environmental Scheme. Under the scheme, companies take part in at least one environmental project to be implemented in one year from a range of categories, including reducing air emissions. Upon successful and cumulative completion of three or more environmental projects, the participating company is recognised with a Green Medal for its efforts and if the project is adjudged to be outstanding, the company will be selected to be the Green Industrialist of the Year. Only 100 companies are taking part in this scheme and there is little information available to judge the effectiveness of this campaign.

4.3 Trade-offs

Hong Kong judges how good its air is in two ways, in API readings and with visibility. Although different sectors have made significant reductions in emissions, we must work to reflect these improvements in lower API readings, clearer skies and better health. A widely held view is that we should do even more.

Government has pledged to reduce emissions of key pollutants – SO₂, NO_x, VOC, and RSP – by 2010 (see Box 3, page 18). Although, compared to 1997, NO_x, RSP and VOC were reduced by 16 per cent, 28 per cent and 23 per cent respectively in 2004, a widely held belief is that we should do even more and with great urgency, given the growing community concern on our air quality. But to take measures over and above those currently planned by the Government will entail additional price. Are we prepared to pay it and, if so, how much are we willing to pay? These are the trade-offs between “business as usual” and urgent actions to provide a better living environment for all.

¹⁷ Out of 562,946 local companies registered in Hong Kong as of May 2006. See Companies Registry website viewed 26 June 2006: www.cr.gov.hk/en/statistics/statistics_01.htm

Our problems are not solely of our own making. Industrial and commercial activities in the PRD, together with physical and meteorological conditions, produce and combine pollutants with those that we generate and keep them cloaking our city. In seeking ways to reduce emissions in the PRD, we have to be mindful of the PRD's need for continued developments, especially on the manufacturing front that fuels economic development there.

But, as stated earlier, that is not to say we should not face up to our own situation. While continuing to work with the PRD Government, we must also clean up our own activities at the same time. More can be done in Hong Kong by using cleaner fuel to generate power as well as cleaner fuel in transport, in conjunction with cleaner power generation and transport technologies. We should curb excesses and wasteful habits, and inculcate better local corporate behaviour to reduce energy wastage.

This example could eventually be translated into clean practices across the boundary, and may well set the benchmark for others to follow. The Central Government has publicly acknowledged the seriousness of the issues and is committed to action.

The following section presents the options and choices available for cleaner air and better health.

5. Options and Choices

We have reached a crossroads.

For Hong Kong to breathe healthy air and see blue skies, our options and choices are as follows:

- Institutional choices
- Electricity generation choices
- Road transport choices
- Industry choices

We have carefully chosen the topics for discussion where there is scope for improvement and where there will be significant benefits if implemented in a bold manner. This is not to suggest that all of the results will be instantaneous. The nature of air pollution is that some changes in air quality may be gradual despite cutting off the emissions. However, in the medium and the long term it is likely that the improvements such as API measurements and visibility will become more apparent¹⁸.

There is a direct correlation between measures in discrete sectors and the resulting overall reduction in specific pollutants. For example, tackling SO₂ emissions from the power sector will have a marked effect on the overall SO₂ levels, as would tackling VOC from non-combustion sources. We would logically expect to see fewer days of low visibility as a result, as these are two of the main contributors to smog. We must remind ourselves that even though still other sources within the PRD exert a regional influence, our focus must be to clean up our own activities.

We have focused on the power, transport, and industry sectors. Although marine emissions are a substantial area, this needs to be addressed elsewhere, as these will require agreement between the Mainland, Hong Kong and other ports in the region to begin the dialogue on a coastal emissions regime. It is common knowledge that the maritime industry is working on this problem on a global scale and the Hong Kong government is closely monitoring overseas development and is prepared to introduce relevant marine emission control measures where applicable.

On another topic, we have only touched on the discussion on aviation emissions. While these emissions are not regarded as pressing and immediate compared to the concerns about emissions from road vehicles, it is an opportunity for the Government to demonstrate initiative in this area through the planned flight measures at Hong Kong Airport.

¹⁸ As an overseas example, the US Clean Air Act, which did not levy taxes but placed meaningful restrictions on emissions, has had a very significant impact on air quality in places like Los Angeles. The number of smog alerts in the present day (which are triggered by measurable pollutants) declined substantially from levels of the 1950s and 1960s.

In the following sections, both incremental and bold choices are presented with their projected outcomes. This is not to imply that one is right and the other wrong – they represent choices that we can take.

It would be naïve to make decisions without understanding the implications of each measure suggested. The Council is mindful of the economic costs and implications of the choices. Whilst some costs¹⁹ have been provided in Chapter 6, more accurate costs and emission benefit analyses for each initiative must be conducted where possible, but this is for a later stage: this is not an opportunity for delay. We must not let prevarication stand in the way of action – there will be economic costs inevitably but the trade-off is better air quality.

¹⁹ All cost figures in this paper are in HK dollars.

5.1 Institutional Choices

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>1. <u>Review of AQO</u> Aim is to align HK's AQO with other world standards.</p>	<p>The public and professional perception of the AQO is that the levels do not reflect the true potential damage to public health.</p> <p>The Government announced a plan in July 2006 to conduct an 18-month comprehensive study to support the review of HK's AQOs. The study will be commissioned in early 2007 and will be completed by the third quarter of 2008. Government's plan is to launch a public engagement process in late 2008 for finalising action on the new AQOs and the required long-term strategy on air quality within 2009.</p>	<p>Government to set up task force to review AQO with minimal revision within next 12 months.</p>	<p>Same threshold levels more or less as before.</p> <p><u>Pros</u>: Little adjustment needed.</p> <p><u>Cons</u>: HK's API readings (which are taken from AQO) may not reflect potential impacts to public health.</p>	<p>Government to set up task force to review and revise the AQO to reset thresholds within next 12 months.</p> <p>Government to incorporate new WHO rulings on particulates as required.</p>	<p>Revised threshold levels within next 12 months.</p> <p><u>Pros</u>: Health experts will support revised AQO and API.</p> <p><u>Cons</u>: Revision of AQO will require major review of thresholds both present and past.</p>

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>2. <u>Taking actions during high API and low visibility</u> Aim is to reduce air emissions (and hence the API) immediately to a safe level and to reduce smog.</p>	<p>During high API and low visibility readings the public are warned but there is no other action that is taken. Some cities like London and Toronto have specific smog alerts to advise citizens on actions to take during periods of high air pollution.</p>	<p>Government to keep current public warning system to alert vulnerable groups and if necessary bring day-to-day items like food to households where occupants cannot go out.</p>	<p>No change to air quality. <u>Pros:</u> No adjustment needed. <u>Cons:</u> HK's API readings remain high and vulnerable members of the public will be at risk.</p>	<p>Government to take appropriate actions during high API and low visibility days such as restricting vehicle usage through premium road pricing fees, reducing the use of oil-based paints, solvents and cleaners, and stopping the use of diesel-powered equipment</p>	<p>Lowering of emissions and thus API readings and smog. <u>Pros:</u> API and smog should come down as localised emissions recede. <u>Cons:</u> Effect on traffic of goods and people – some economic impacts.</p>
<p>3. <u>Conducting ongoing studies on regional aspects of air pollution</u> Aim is to identify sources of regional air emissions and track how these impact on local API.</p>	<p>Little has been done to update the previous 2002 study regarding the sources and end-points of regional air emissions. If these sources and impacts can be more accurately identified, tracked and correlated then it would be easier to make policy decisions on which source to tackle for maximum impact.</p>	<p>The two governments to conduct further work on new measures like the regional monitoring network to gather data and review periodically.</p>	<p>N/A</p>	<p>The two governments to take active involvement and fund the necessary resources to extend the 2002 study as a priority.</p>	<p>Eventual benefits as information on the key sources and their related impacts in HK are updated leading to better policies.</p>

5.2 Electricity Generation Choices

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>1. Clean coal Aim is to reduce SO₂ emissions through cleaner fuel.</p>	<p>Burning high sulphur coal is causing SO₂ emissions.</p>	<p>Power companies to purchase a mixture of low and ultra-low sulphur coal to be approved by the Government²⁰.</p>	<p>Electricity supply to HK remains unchanged. <u>Pros</u>: Some reduction in SO₂ emissions. <u>Cons</u>: Costs of more expensive coal will be passed to consumers but depending on proportion used.</p>	<p>Power companies to purchase only ultra-low sulphur coal as soon as possible.²¹</p>	<p>Electricity supply to HK remains unchanged. <u>Pros</u>: Significant reduction in SO₂ emissions. <u>Cons</u>: Costs of more expensive coal may be passed to consumers depending on Government approval.</p>

²⁰ Technical feasibility of using ultra-low sulphur coal in HEC's coal units have to be confirmed by HEC.

²¹ Technical feasibility of all power generation units using ultra-low sulphur coal and the availability of sufficient ultra-low sulphur coal in the market will need to be assessed by power companies.

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>2. FGD Pollution Control Aim is to reduce SO₂ emissions.</p>	<p>FGD will reduce SO₂ emissions by over 90%. HEC has incorporated FGD in some of its units. CLP Power has not.</p>	<p>HEC and CLP to install FGD at all Lamma and Castle Peak Power Station units respectively.</p>	<p>Electricity supply to HK remains unchanged. <u>Pros:</u> Lower SO₂ emissions eventually. <u>Cons:</u> Public to endure SO₂ emissions for a further 7-8 years as the planning and construction processes take the normal course. Consumers may need to pay capital and operating costs.</p>	<p>HEC and CLP to accelerate installation of FGD at all Lamma and Castle Peak Power Station units respectively by 2010.</p>	<p>Electricity supply to HK remains unchanged. <u>Pros:</u> Lower SO₂ emissions by 2010 as planning and construction processes are accelerated. <u>Cons:</u> Consumers may have to pay capital and operating costs. Electricity supply is subject to the risk of interruption as many coal units are required to be taken away from service at the same time to facilitate the installation of FGD.</p>

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>3. Use of LNG Aim is to shift from coal to gas which is cleaner.</p>	<p>Gas is the preferred clean fuel option. Both power companies must import LNG to meet imposed emission standards. HEC has already begun the conversion of its gas turbines for LNG burning as well as commissioning a new generation unit for this purpose. CLP has gas turbines at Black Point Power Station.</p>	<p>By 2010, both power companies to burn a mixture of ultra-low sulphur coal and LNG²².</p>	<p>LNG is burnt to generate electricity together with ultra-low sulphur coal. Implications include the cost of land space and LNG facilities. <u>Pros</u>: Lower emissions. <u>Cons</u>: Higher costs passed to consumers for the use of more expensive gas as fuel. Security of supply issues.</p>	<p>By 2010, LNG becomes the main fuel burnt to generate electricity with coal and oil standby by both power companies²².</p>	<p>Implications include costs of power plant conversion, land space and LNG facilities. <u>Pros</u>: Overall much lower emissions as LNG is cleanest fossil fuel. There will be higher efficiency of electricity generation as well. <u>Cons</u>: Reliance on single fuel has serious impact on power supply security. Higher costs passed to consumers for the use of more expensive gas as fuel. Part of the coal units have to be retired earlier to give way for new gas units. The scrapping cost of coal units and capital cost of new gas units have to be borne by the consumer.</p>

²² Technical feasibility on burning ultra-low sulphur coal and the availability of sufficient ultra-low sulphur coal and LNG in the market have to be studied.

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>4. <u>Selling electricity to China</u> Aim is to stop pollution in HK arising from generating activities that provide power to Guangdong.</p>	<p>CLP sells electricity to Guangdong under an existing agreement. Assuming that CLP will continue this arrangement and not shut off completely as this will burden Guangdong with having to find alternative sources of power, some of which will be based on dirty fuel.</p>	<p>CLP to sell electricity produced from a <u>mixture</u> of ultra-low sulphur coal and LNG²³.</p>	<p>Guangdong continues to receive electricity from HK. <u>Pros</u>: Guangdong does not have to burn its own fuel to produce electricity which would be more polluting. Hence, lower emissions as well as revenues to HK. <u>Cons</u>: Costs of ultra low sulphur coal passed to consumers as increased tariffs.</p>	<p>CLP to sell electricity generated <u>only</u> from LNG.</p>	<p>Shekou continues to receive electricity from HK. <u>Pros</u>: Shekou does not have to burn its own fuel to produce electricity. Even lower emissions as well as revenues to HK. <u>Cons</u>: Costs of LNG passed to consumers as increased tariffs and possibility that Shekou may consider sourcing its electricity elsewhere which may result in increased emission.</p>

²³ Technical feasibility of all coal units using ultra-low sulphur coal and the availability of sufficient ultra-low sulphur coal in the market will need to be studied.

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>5. Encouraging more renewables Aim is to seek cleaner non-fossil fuel related energy.</p>	<p>Both power companies as well as private companies to introduce more renewable energy technologies to reach 1-2% target by 2012. This achievement will lead to 1,400 tonnes reduction of SO₂ per year. The costs of renewable energy are as follows: Solar power (photovoltaic) - \$ 2.23 to \$ 4.10 per kWh; Wind power (marine based) - \$ 1.00 to \$ 2.00 per kWh. HEC tariffs are: \$0.87 to \$1.41 per kWh (domestic) and \$1.14 to \$1.22 per kWh (commercial) CLP tariffs are: \$0.86 to \$1.08 per kWh (domestic) and \$0.96 - \$0.97 per kWh (commercial)</p>	<p>Power companies and private companies to conduct pilot projects on wind and solar</p>	<p>Pilot projects raise awareness of renewable energy. <u>Pros:</u> Some reduction in emissions. <u>Cons:</u> Costs passed onto consumers but these would be minor. Power companies have little incentive to be involved.</p>	<p>Power companies to open up grid to private companies (both within and outside HK) for renewable power sources. Government to provide incentives to power companies to set up wind farms and solar facilities in the PRD as well as Hong Kong and import energy from the former within next 3 years.</p>	<p>Grid opened up so that all have access to renewable energy within next 2 years. The latter is also imported from HK-owned sources in the PRD within next 3 years. Implications include technical issues concerning the opening up of the grid, cost of land space for wind turbines, cost of solar and wind facilities and costs of interconnecting with PRD. <u>Pros:</u> Overall lower emissions. <u>Cons:</u> Potential cost implications to consumers.</p>

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>6. Demand Side Management Aim is to avoid consumption of electricity in the first place.</p>	<p>Companies should practice more demand side management and energy efficiency.</p>	<p>Government to encourage best energy practices amongst companies within next 6 months.</p>	<p>Minor costs for companies but little energy saved. <u>Pros:</u> Some reduction in emissions. <u>Cons:</u> Companies have little incentive to be involved.</p>	<p>Government to mandate best energy practices e.g. 25.5°C settings for all offices in private sector within next 6 months. Power companies to implement DSM within next 1-2 years. Government to also impose energy tax on users to discourage peak time usage of electricity.</p>	<p>Some impact on energy savings, also cost savings for private companies. <u>Pros:</u> Lower emissions and potential savings Also revenue from energy tax. <u>Cons:</u> Loss of earnings from implementing DSM incurred by power companies passed on to taxpayers/ consumers or incorporated in institutional arrangements.</p>

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>7. Emissions trading Aim is to encourage the power companies to deploy flexible strategies and use market mechanisms for management of their emission reduction programme and to achieve the reduction target at the minimum cost.</p>	<p>Trading scheme for SO₂, NO_x and particulates to be set up between HK and Guangdong power companies; report is due in 2006.</p>	<p>Government to encourage HK power companies to participate as a way of directing investment for cleaner energy in PRD by 2010.</p>	<p>Gains in regional air quality improvement will be small. <u>Pros</u>: No major costs for power companies. <u>Cons</u>: No incentives for power companies to participate.</p>	<p>Government to mandate HK power companies to participate and to lay down clear framework so that the private sector can set up the appropriate business models by 2010.</p>	<p>Active market in traded emission credits resulting in overall reduction of emissions in the region by 2010. <u>Pros</u>: Overall lower emissions. <u>Cons</u>: Costs of incentives for the power companies and private sector companies initially passed to taxpayers/ consumers until business models are operating.</p>

5.3 Transport Choices

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>1. <u>Converting light vehicles to cleaner fuel</u> Aim is to reduce emissions from light vehicles.</p>	<p>Most light vehicles are pre-Euro, Euro I and II. LPG is cleaner than diesel. In August 2002, The government provided an incentive of \$60,000 or \$80,000 for public light bus owners to replace their diesel vehicles with LPG. The programme was completed by the end of 2005. By August 2006, 56 per cent of the public light bus fleet (i.e. 2,425 light buses) and 8 per cent of the private light bus fleet (i.e. 144 light buses) are LPG vehicles. At present, there are 55 LPG filling stations in Hong Kong, with 12 being dedicated to LPG. These LPG filling stations are sufficient to support all the taxis and light buses to use LPG.</p>	<p>Government to provide incentives for only light bus owners to shift to LPG within next 2 years.</p>	<p>Increased number of LPG light buses on Hong Kong roads. <u>Pros</u>: Further reduction in emissions. <u>Cons</u>: Cost of incentives for mini-bus owners borne by taxpayer. (It will cost about \$369,000 per mini-bus.) Price of LPG passed to vehicle owners. Private sector to provide additional LPG stations to facilitate the light bus trade, or mobile filling points that can be moved when not in use.</p>	<p>Government to provide incentives for all light goods vehicle owners to convert to Euro IV as well as conversion of light buses to LPG within next 2 years.²⁴</p>	<p>More light vehicles are Euro IV or LPG within 2 years. <u>Pros</u>: Significant reduction in emissions. <u>Cons</u>: Cost of incentives for light goods vehicle owners, similar to taxis and public light buses, borne by taxpayer (\$250,000 per vehicle to convert) in addition to costs of mini-buses. Price of LPG passed to vehicle owners. Private sector to provide additional LPG stations or mobile filling points to facilitate the light bus trade.</p>

²⁴ There might be constraint in providing adequate LPG supporting infrastructure. There may not be suitable sites for setting up new terminals in particular on the Hong Kong Island and there are safety concerns involved in setting up LPG filling stations, especially mobile filling points.

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>2. <u>Fitting catalytic converters and particulate traps onto medium and heavy vehicles</u> Aim is to reduce particulate emissions from medium and heavy vehicles.</p>	<p>Many heavy and medium vehicles have catalytic converters (mainly pre-Euro) but not CRT particulate traps. The addition of a catalytic converter and CRT particulate trap will reduce the emission of particulates by 30 per cent and 90 per cent respectively</p>	<p>Government to provide incentives for remaining older (Euro I, II, and III) heavy and medium vehicle owners to fit catalytic converters within next 2 years.</p>	<p>All heavy and medium vehicles will have catalytic converters within next 2 years. <u>Pros:</u> Reduction in particulate and other emissions. <u>Cons:</u> Cost of incentives borne by taxpayer: it costs about \$13,600 to fit a catalytic converter to a vehicle.</p>	<p>Government to provide incentives for all heavy and medium vehicle and non-franchised bus owners to fit catalytic converters as a minimum and CRT particulate traps as applicable to older versions within next 2-3 years.</p>	<p>All heavy and medium vehicles have fitted CRT particulate traps within next 2-3 years. <u>Pros:</u> Significant reduction in particulate emissions. <u>Cons:</u> Cost of incentives borne by taxpayer. This is in addition to the costs of catalytic converters for the older vehicles.</p>
<p>3. <u>Fitting particulate traps onto buses</u> Aim is to reduce particulate emissions from buses.</p>	<p>The franchised bus companies may fit particulate traps that will reduce particulate emission up to 90%. Currently there are about 3,500 Euro II and III franchised buses without particulate traps. All pre-Euro buses (1,500) are incompatible with the traps.</p>	<p>Government to instruct franchised buses to fit CRT particulate traps and allow them to charge higher fares to cover costs by 2009.</p>	<p>All franchised buses have particulate traps by 2009. <u>Pros:</u> Reduction in particulate emissions. <u>Cons:</u> Increased fare charges to passengers. Cost of incentives borne by taxpayer. It costs \$60,000 per bus to fit particulate traps.</p>	<p>Government to instruct franchised buses to fit CRT particulate traps and allow them to charge higher fares to cover costs. Government to accelerate phasing out of all pre-Euro buses within next 2 years.</p>	<p>All franchised buses have particulate traps by 2009. No more pre-Euro buses. <u>Pros:</u> Significant reduction in particulate emissions. <u>Cons:</u> Increased fare charges to passengers which is highly politicized. Cost of incentives borne by taxpayer. The cost of upgrading a franchised bus is \$3.1 million.</p>

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>4. <u>Prevent the importing of high sulphur diesel from Shenzhen</u> Aim is to stop cross-boundary vehicle pollution.</p>	<p>Some cross-boundary vehicles are filling up with high sulphur diesel (0.1 to 0.2 per cent) in Shenzhen and using the fuel to run their vehicles in Hong Kong. The costs of diesel are:</p> <ul style="list-style-type: none"> • HK: \$8.86 per litre • SZ: RMB4.22 per litre 	<p>Government to <u>limit</u> the use of Mainland fuel in Hong Kong by setting up monitoring systems for cross-boundary vehicles within next 12 months. Also some reduction in price of HK diesel to match price in Shenzhen.</p>	<p>Some cross-boundary vehicles using HK diesel only. <u>Pros:</u> Some reduction in SO₂ and other emissions. <u>Cons:</u> Cost of technology to monitor cross-boundary vehicles to be passed to vehicle owners. Losses in duty revenue from sales of diesel.</p>	<p>Government to <u>ban</u> the use of Mainland fuel in Hong Kong by setting up monitoring systems for cross-boundary vehicles and clean fuel outlets at the boundary crossing. Remove duty on diesel for cross-boundary vehicles but charge for road usage (using technology to track vehicle movement)</p>	<p>All cross-boundary vehicles using HK diesel only. <u>Pros:</u> Significant reduction in SO₂ and other emissions. Possible revenue from road charges. <u>Cons:</u> Cost of technology to track and monitor cross-boundary vehicles to be passed to vehicle owners. Losses in duty revenue from sales of diesel. Cost of land for fuel outlets borne by taxpayer.</p>
<p>5. <u>More hybrid vehicles</u> Aim is to increase number of hybrid vehicles and reduce fuel consumption.</p>	<p>There are about 440 hybrid vehicles in Hong Kong. Hybrid vehicles use less fuel and hence are environmentally and economically viable. The cost of a hybrid car is about \$219,990.</p>	<p>Government to <u>encourage</u> vehicle owners to shift to hybrids by introducing incentives and product promotions.</p>	<p>A few more hybrids on HK roads. <u>Pros:</u> Some reduction in emissions. <u>Cons:</u> Cost of promotion passed to taxpayers.</p>	<p>Government to <u>provide tax incentives</u> to purchase more hybrid vehicles by the public and especially for fleets. Government to issue tender for fleet vehicles to identify suppliers with next 12 months.</p>	<p>Many hybrids on HK roads. <u>Pros:</u> Some reduction in NO_x and other emissions. <u>Cons:</u> Cost of incentive may be passed to taxpayers. Cost of new vehicles to owners.</p>

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>6. <u>Reduction of traffic</u> Aim is to reduce traffic congestion and emissions as a result.</p>	<p>There are a number of ways to reduce traffic in Hong Kong other than a ban on traffic during high API days.</p>	<p>Government to limit the number of buses in busy areas during off-peak time. Government to discourage private vehicle traffic at certain times in congested areas.</p>	<p>Less traffic congestion. Some economic impacts on businesses. <u>Pros:</u> Some reduction in emissions. <u>Cons:</u> Economic impacts on businesses.</p>	<p>Government to set up road pricing to charge motorists for using certain roads at peak hours. Government to prohibit the number of buses in busy areas during off-peak time. Government to restrict private vehicle traffic at certain times in congested areas. Government to level out tunnel charges so that motorists are not influenced in their choice of routes by cheaper tunnel fares.</p>	<p>Marked reduction of private vehicle and bus traffic. Maybe some uptake by other modes e.g. rail. <u>Pros:</u> Overall lower emissions. Likely revenue stream from road pricing charges and tunnel charges which could be put to finance other measures. <u>Cons:</u> Costs of road pricing technology passed to taxpayers; eventual running costs passed to vehicle owners. Levelled tunnel toll charges to passed to vehicle owners. Economic impacts on businesses from disruption to deliveries and other supply chain efficiencies.</p>

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>7. <u>Encouraging more use of rail</u> Aim is to use rail as a cleaner form of transport.</p>	<p>To encourage more usage of rail, passengers must be offered affordable prices, convenience and choices of destinations.</p>	<p>Government to <u>encourage</u> more use of rail where possible.</p>	<p>Some shift of road users to rail. <u>Pros:</u> Some reduction in emissions. <u>Cons:</u> Users to choose between road and rail based on cost of fares.</p>	<p>Government should set up inter-modal (bus-rail) interchanges together with a railway feeder hub network so that franchised and mini-buses carry passengers to train stations. Railway companies to work with Government to develop more rail projects linking up populated parts of HK, e.g. Island South. Tram companies to work with Government to build tram lines in congested areas like the Nathan Road Corridor and new green field areas like SE Kowloon.</p>	<p>Higher utilisation of rail. <u>Pros:</u> Overall lower emissions. <u>Cons:</u> Substantial cost of acquiring land space to align railway stations with inhabited areas to optimize hub positions. Cost of financing of new railway projects. Cost of space and overhead cables for trams.</p>

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>8. <u>Adopting cleaner forms of transport</u> Aim is to use as many forms of clean transport as practicable.</p>	<p>Pedestrianisation and cycling are two of the cleanest forms of fossil-fuel free transport.</p>	<p>Government to limit number of delivery vans in congested areas.</p>	<p>Reduction of vans in congested areas. <u>Pros:</u> Some reduction in emissions. <u>Cons:</u> Some economic impacts on retail businesses.</p>	<p>Government to ban idling engines as well as delivery vans in congested areas as well as pedestrianise these areas and enforce legislation. Delivery vans can make trips at designated hours to supply retail shops. Government to build cycle tracks to encourage cleaner transport forms e.g. in urban areas.</p>	<p>Vehicle free areas. More pedestrians and cyclists. <u>Pros:</u> Overall lower emissions. <u>Cons:</u> Economic impacts on retail businesses.</p>

5.4 Industry Choices

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>1. Clean Air Charter Aim is engage HK companies to tackle air pollution.</p>	<p>Around 500 HK companies have signed up to the Clean Air Charter.</p>	<p>Business coalitions to make reporting a visible and active part of the Charter.</p>	<p>Some reporting taking place. <u>Pros:</u> Some reduction in emissions. <u>Cons:</u> Some costs associated with emission reduction and reporting.</p>	<p>Business coalitions to make reporting a requirement as a condition for signing up.</p>	<p>High level of reporting taking place. <u>Pros:</u> Significant reduction in emissions provided companies are genuinely engaged. <u>Cons:</u> Added expense from dealing with externalities.</p>
<p>2. Reduce use of VOC Aim is seek non-polluting alternatives for VOC.</p>	<p>Industries in HK are responsible for two-thirds of the emission of VOC. These include printing inks, solvents, paints etc.</p>	<p>Government to encourage companies to seek VOC-free alternatives where possible e.g. water based paints.</p>	<p>Some substitution of VOC-containing materials. <u>Pros:</u> Some lower VOC emissions. <u>Cons:</u> Some economic impacts on businesses.</p>	<p>Government to ban the use of certain solvents and VOC-containing products with viable substitutes.</p>	<p>Substitution of VOC-containing materials. <u>Pros:</u> Overall lower VOC emissions. <u>Cons:</u> Costs of seeking alternative materials borne by companies, which they then pass on to consumers. Some additional operational costs incurred by retail businesses. (Costs of solvent-based and water-based paints are \$36 and \$59 per litre respectively).</p>

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>3. <u>Shifting from industrial diesel to ultra-low sulphur diesel</u> Aim is engage companies to use cleaner fuel to reduce (SO₂) emissions</p>	<p>Many companies use industrial grade diesel for commercial purposes e.g. catering, construction, port, ferry activities and pleasure boats.</p>	<p>Government to <u>encourage</u> businesses and boat owners to switch to cleaner diesel.</p>	<p>Some switching. <u>Pros:</u> Some lower emissions. <u>Cons:</u> Minor added expense to companies to use cleaner diesel.</p>	<p>Government to <u>mandate</u> businesses and boat owners to switch to cleaner diesel.</p>	<p>All industries using cleaner fuel. <u>Pros:</u> Reduce about total SO₂ emission in Hong Kong by about 3.3 per cent. <u>Cons:</u> Additional operating costs of less than 1 per cent to the industry, on the basis of an 8 per cent price differential between industrial diesel and duty-free ULSD.</p>
<p>4. <u>Promotion of Cleaner Production</u> Aim is engage PRD companies to tackle air pollution.</p>	<p>HK-owned companies in Guangdong Province can be encouraged to adopt cleaner production methods including energy efficiency to reduce pollution that could be transmitted to HK. A form of business-led assistance could be set up to these companies that will nurture cleaner production and not hamper competitiveness.</p>	<p>Business coalitions and trade associations to <u>encourage</u> companies to adopt cleaner production and energy efficiency practices.</p>	<p>Some changes in environmental performance of companies. Costs borne by companies. <u>Pros:</u> Some lower emissions. Some benefits to companies in energy savings. <u>Cons:</u> Some economic impacts on business</p>	<p>Business coalitions and trade associations to set up a Greater PRD Fund which can be based on a levy for each company and the money can be used for R&D purposes to identify technologies for cleaner production. An independent body would be appointed to administer the fund.</p>	<p>Levy set up to help PRD companies. <u>Pros:</u> Overall lower emissions. Access to technologies for cleaner production. <u>Cons:</u> Cost of levy borne by companies. Cost of setting up and administering PRD fund.</p>

Topics	Current Situation	Incremental	Outcome	Bold	Outcome
<p>5. <u>Code of Conduct on regional sourcing</u> Aim is to engage foreign companies to use supply chain pressure on polluting companies.</p>	<p>Many companies in the PRD are supplying foreign companies who have regional offices in HK. The environmental performance of some of these companies is poor in regard to air emissions and energy consumption.</p>	<p>Foreign Chambers of Commerce to conduct survey of their member companies who use polluting supplier companies in PRD.</p>	<p>Higher level of awareness amongst foreign companies. <u>Pros:</u> Some lower emissions if foreign companies begin requesting environmental conditions on their suppliers. Some benefits to suppliers in energy savings. <u>Cons:</u> Some economic impacts on businesses.</p>	<p>Foreign Chambers of Commerce to conduct survey of their member companies who use polluting supplier companies in PRD. Chambers to name members who continually source from polluting suppliers.</p>	<p>Foreign companies will adopt code of conduct on regional sourcing. <u>Pros:</u> Significant reduction in emissions if foreign companies begin imposing environmental conditions on their suppliers. Some benefits to suppliers in energy savings. <u>Cons:</u> Potential economic impacts on businesses.</p>

6. Costs versus Benefits of Proposed Measures

6.1 Air Improvement Targets

Much of the Hong Kong Government's efforts towards improving air quality are based on the 2010 reduction targets. Established in 2002, these quantities were derived from detailed scientific assessment of the level of reduction needed to maintain the region's air quality at a livable standard through a comprehensive study conducted jointly between Hong Kong and Guangdong, taking into account PRD's imminent growth.

However, as stated earlier, the API and visibility measurements are not directly correlated to the local emission tonnages. Hence, in determining the costs and subsequent benefits of the choices outlined in the previous section, there is a level of uncertainty in simply expecting air quality improvement just through local emission reduction.

Rather than focusing on the 2010 targets alone, we should not stop there but should rather look beyond the year 2010. For Hong Kong to be a world-class city, its environment must be world-class as well; this means clean air and blue skies. It is not sufficient to solely state that policies and measures will address our problems, it is more a matter of focusing our efforts and changing our attitudes so that Hong Kong's air quality will continue to improve.



Figure 15. Blue skies at last

6.2 The Costs of Cleaner Air

In calculating the costs – in other words, how much needs to be spent to improve Hong Kong's air quality – the obvious method would be to directly multiply “unit costs” by the number of “units” required to be converted. In general what this means is that air quality could be improved by the addition of environmental technology “units” like FGD or particulate traps for the power and transport sectors respectively. However, this precludes costs like opportunity costs to industry (such as the loss of possible business), or inconvenience costs for the public (i.e. paying more for road pricing or energy management).

Another common method of estimating the costs of cleaner air is the “willingness to pay” approach favoured by economists in quantifying the value of natural resources. Whilst this is a powerful means of garnering public inputs, it is often subjective and not always that accurate.

For the measures concerned in Chapter 5, the one-off costs for each item were taken, even allowing for the inaccuracies from not including opportunity and inconvenience costs as stated earlier. Whilst this is not perhaps the ideal method nor is it always possible (e.g. considering the unit costs of items like fuels), this represents the best means available. Where applicable, a base timeline of a year is taken to address issues like the costs of fuel consumed over this period. In addition, where possible the costs for each measure are quantified as like with like, especially in comparing the costs of incremental and bold options. We have calculated rough cost estimates for improving air quality for electricity generation, transport and industry.

Electricity Generation Sector

Financial costs for implementing the incremental or bold measures include power companies’ expenditure on low and ultra-low sulphur coal and LNG, the capital cost for installing FGD equipment at all Lamma and Castle Peak Power Station units, the setting up of renewable energy facilities, and conversion costs of coal-fired plants for burning gas. It is estimated that the cost for implementing the incremental measures would be about \$20.5 billion, whereas for bold measures it would be about \$27 billion plus significant capital cost for converting all the existing coal-fired plants to gas-fired plants. Besides, there will be additional recurrent costs involved. It should be noted that these estimates are subject to many factors such as fuel price fluctuations, costs of land space and LNG facilities, and technical feasibility, as well as Government’s energy policy. Additional factors such as demand and supply patterns on the LNG plant, project lead/construction time and site constraints could also affect the actual project cost. Any extra costs may be borne by power companies, or they may be passed to consumers in the form of higher electricity bills; alternatively if the Government were to provide financial incentives for the power companies, the cost burden would be borne by taxpayers. There may also be compensation sought by the power companies from loss of earnings from implementing Demand Side Management, which might then be passed on to taxpayers or consumers.

Transport Sector

The financial costs for implementing the incremental or bold measures include capital costs for fitting catalytic converters onto medium and heavy vehicles and non-franchised buses, as well as fitting particulate traps onto buses, operating costs of monitoring system for cross-boundary vehicles to limit or ban the use of Mainland fuel in Hong Kong. There would also be administrative costs if the Government were to implement measures such as setting up road pricing, using legislative means to discourage private vehicle traffic at certain times in congested areas, or adopting various measures to promote pedestrianisation or cycling. It is estimated that the cost for implementing the incremental measures would be about \$7 billion, whereas for bold measures it would be about \$24 billion.

Similar to the electricity generation sector, such costs may be borne by vehicle owners and bus companies, or passed to consumers as higher fare charges; or these may be borne by taxpayers if the Government were to provide financial incentives to encourage these practices. For measures aimed at reducing traffic, there would be economic impacts on trade and businesses from disruption to deliveries and other supply chain efficiencies.

Industry Sector

The implementation of incremental or bold measures, such as using VOC-free alternatives and shifting from industrial diesel to low sulphur diesel, may impose additional operating costs to businesses, which may be passed on to consumers. There would be additional expenditure for businesses in dealing with externalities and adopting cleaner production and energy efficiency practices. This will require much regional effort and cooperation. It is estimated that the cost for implementing the incremental measures would be about \$0.2 billion, whereas that for bold measures would be about \$0.4 billion.

6.3 Benefits

As explained above, the accruing benefits are represented in tonnes of reduced emissions. This is helpful in understanding the absolute amount of reduction but not the **actual** air quality given in concentrations, which needs more analysis work to assess and quantify.

This argument is pertinent in deciding whether a choice is justified or not: for instance, when roadside air quality is concerned, a reduction in power-sector emissions may not be as effective as a smaller but more proximate reduction in vehicle emissions at roadside, however, the reduction in emission from power-sector emissions will have a more direct effect on regional smog and visibility than reducing same amount of emissions from road vehicles.

This is also relevant from a perceptual point of view as well. Reduced local emission tonnage should in theory result in better API readings and reduction in smog, but in reality this may not be the case. Hence when trying to quantify benefits, just looking at reductions in local emissions by tonnage only provides part of the overall set of benefits. The air quality benefits of each measure should be individually assessed for comparison purposes through more in-depth analysis work, which is not part of this study. That said, we should be mindful that the choice is not whether to promote cleaner energy, or alternatively to put in place stringent transport-related pollution control measures, but that only a concerted set of measures can produce the desired overall improvements, both on “street level” as well as in general. Nevertheless, certain observations can be drawn from empirical calculations, such as:

- Significant reductions in SO₂ and NO_x can be achieved in the electricity sector, particularly once LNG is used as the fuel of choice. It is estimated that a combination of using emission reduction facilities, more natural gas and lower sulphur coal should be capable of reducing the power generation emission of RSP, NO_x and sulphur dioxide by 50 per cent, 20 per cent and 70 per cent respectively or more.

- The costs of achieving reductions per tonne of pollutant is on average 30 and 70 times more expensive for the transport sector than the power sector for incremental and bold choices respectively. This suggests that only marginal benefits will arise - although please note the point above that roadside levels are more affected by the transport sector so reduction here could have a significant impact at the roadside.
- The costs are the lowest for industry largely because the measures are cost only for Hong Kong-based activities; if the regional costs are taken into account, there would be a significant increase, for instance, the cost to upgrade many thousands of Hong Kong-owned factories in the PRD. In addition, there is the question of the costs of finding alternative suppliers for businesses if they decide to make environmental performance mandatory within their supply chains and reject their traditional but polluting suppliers.

In summary, costing the different choices yields interesting results but should not be the only means of making decisions. The Government will still have to decide on:

- The expediency with which a choice must be implemented – should measures be undertaken on the basis that API and visibility must be improved immediately to regain Hong Kong's confidence as a world-class and livable city;
- The political arguments to support certain choices – the vested interests of the different parties need to be reconciled into a common understanding that if Hong Kong' environmental quality subsides, then all of Hong Kong's economic interests will decline as well;
- Whether a particular measure will have the desired impact or will there be overriding regional implications, such as the continued growth of the PRD and the burgeoning power shortages the region is facing which is forcing power stations and independent generators to use whatever fuel is available; and
- Whether the chosen option is sustainable – should these be a one-off consideration like FGD or should the option be ongoing such as the availability of clean fuel like gas.

From the benefits perspective, it is necessary to find accurate means of correlating emission reductions to concentrations in order to determine whether health, business and tourism prospects are improved as well as achieving air quality objectives.

In general, the following long-term benefits would accrue:

Health

The direct benefits would be prevention of the incidence of acute and chronic health effects of air pollution, such as asthma attacks, chronic and acute bronchitis etc. Health care costs would be averted by health care providers through decreasing the number of emergency room visits, primary health care required (e.g. care for asthma cases), and hospitalisation cases; in addition, out of pocket costs from patient requiring medical care could be reduced.

Indirect benefits would include improved economic productivity due to improved health and prolonged life expectancy, decreased number of restricted activity days or work loss days and reduction in time receiving medical care; similarly, costs for avoiding effects of air pollution (e.g. moving home or job) could be reduced.

Tourism

Hong Kong is a tourism hub where visitors from all over come specifically to undertake leisure activities, shop and enjoy the sight seeing. As an important source of income, the tourism industry and, by association, Hong Kong’s natural resources need to be protected. Scenes of Hong Kong’s harbour shrouded by smog would not augur well for attracting visitors. A long-term improvement in air quality will help this industry both in terms of income as well as reputation.

Business

Hong Kong’s positioning as a world-class city would require that the quality of its environment be commensurate with this image. If air quality standards are allowed to decline, then Hong Kong will suffer and no longer be the magnet for business in the region. In the long term, having clean air means that Hong Kong can boast of a quality of life that other Asian cities would aspire towards; businesses would find Hong Kong an attractive place to invest in as well as one where living conditions are ideal for their workforce. These benefits might outweigh any financial or other costs incurred to the businesses from implementing the proposed measures.

A summary of costs and some of the implications of the proposed measures is presented as follows:

Sectors	Costs (\$m)		Implications	
	Incremental	Bold	Incremental	Bold
Power	\$20,500 and additional recurrent costs	\$27,000 plus significant capital cost for converting all the existing coal-fired plants to gas-fired plants, as well as additional recurrent costs.	Reductions in emissions. Issues to be considered include security of supply of clean coal as well as LNG.	Overall much lower emissions as LNG is the cleanest fossil fuel. . Issues to be considered include security of supply of LNG.
Transport	\$7,400	\$23,600	Reduction in emissions but marginal gains. Parties affected would be transport companies e.g. bus	Reduction in emissions but marginal gains. Issues of passing costs like road pricing, railways and pedestrianisation to taxpayers and vehicle

			companies as well as transport and logistics companies such as cross-boundary freight carriers.	users.
Industry	\$200	\$400	Some reduction in emissions.	More reduction in emissions. However, further effort would be required on the part of Hong Kong-owned factories in the PRD to make a significant difference.

Table 4. Summary of costs by sector and some implications

Other than the tangible cost and benefits, one should also bear in mind the opportunity costs if nothing were to be done or only small steps taken. These include health cost, Hong Kong’s image as a world city, the city’s attractiveness as a service hub, our quality of life, to name a few. No one can predict with unfailing accuracy how well actions taken today will have improved the air in several years’ time – but it would be difficult to argue that they fail to bring any benefit. The costs to our home city and citizens should be best addressed now to avoid the significant costs incurred when trying to fix the problem in the future.

7. Clean Air and Blue Skies – The Choice is Ours

7.1 Next Steps

Foremost in the minds of the Council is the need to respond to growing public expectations and support bold actions. Although there are several measures in place to curb air pollution, more are needed now to tackle the worsening situation. As a course of priority, the following actions have been identified by the Council for Government to undertake as a matter of urgency:

7.2 Council's Advice

Institutional Issues

Hong Kong must have air quality objectives (AQO) that reflect appropriate critical thresholds which, if exceeded, represent potential damage to public health. As the public and professional perception of Hong Kong's AQO is that it must be reviewed in line with other international standards, the Council urges the Government to carry out the following priority action:

- Review Hong Kong's AQO against existing and new World Health Organisation guidelines, with specific reference to particulates, and revise, if necessary, into short-term, medium-term and long-term objectives through a special task force dedicated to this issue.

Electricity Generation Sector

Hong Kong must have a reliable supply of electricity, and it must be clean; it is not one or the other. To achieve clean air emissions, Hong Kong power companies must aim for pollution abatement in the short term, a clean fuel mix in the medium term and clean power generation technologies in the longer term. The Council advises the Government to undertake the following as priorities:

- The sourcing and combustion of ultra-low-sulphur coal to meet Hong Kong's electricity needs until appropriate pollution abatement controls can be installed or cleaner fuels sourced, such as natural gas.
- The reduction of SO₂ emissions by accelerating the installation of necessary FGD equipment for coal burning units owned by CLP and HEC to before 2010.
- Facilitating the use of liquefied natural gas (LNG) as a clean fuel for Hong Kong's power needs in the long term.
- Developing a clear policy on the transmission of electricity across the boundary to ensure in particular that there are no adverse impacts on Hong Kong's air quality through the burning of low-grade fuel in Hong Kong to meet these demands.

The estimated purchase cost for ultra-low sulphur coal would be about \$2 billion per year subject to fuel price fluctuation. On the other hand, significant reduction of SO₂ by a third could be expected²⁵.

The estimated capital cost for installing FGD equipment would be about \$5-6 billion although factors such as demand/supply of the plant, project lead/construction time and site constraints could affect the actual project cost. Annual operating and maintenance costs of these facilities would be about 3-4 per cent of the relevant capital costs. Reductions of SO₂ by 90 per cent would be achievable while particulate emissions would be further reduced²⁶.

Implications of using LNG include the cost of land space and LNG facilities (about \$6 billion). Nevertheless, natural gas is the cleanest fossil fuel option. With combined-cycle gas technology, converting gas to energy is highly efficient, and emits virtually no sulphur.

There are various considerations in implementing these measures, but they should be expedited to maintain public interests in reducing emissions, while allowing the power companies to continue to operate successfully within an agreed regulatory regime. Their acceleration in certain instances hinges on all parties involved in the current SCA negotiations recognising them as key priority actions and incorporating them in their deliberations to arrive at an agreement as soon as possible, since the public interest is at stake and there are long-term cost implications. It is also recognised that in accelerating implementation other factors, such as planning, site search, land resumption, environmental impact assessment, and works programmes, must be taken into account.

Transport Sector

Hong Kong must have an efficient and clean transport system for both public and private purposes. Air pollution from road vehicles should be tackled by using clean fuel, which is readily available, an accelerated uptake of the latest engine standards for older vehicles, and appropriate exhaust treatment according to vehicle type. The Council advises the Government to undertake the following as priorities:

- Accelerate the conversion of light vehicles to cleaner fuels such as LPG and more modern upgrades to the more efficient and cleaner Euro IV standard.
- Ensure all applicable medium and heavy vehicles and non-franchised buses are equipped with catalytic converters as a minimum and particulate traps as applicable to older vehicle versions.

²⁵ According to a presentation made by CLP to the LegCo Panel on Environmental Affairs in September 2005, it is suggested that if ultra-low sulphur coal could make up one-third of the coal used by Castle Peak Power Station by 2007, a reduction of SO₂ emissions by 33% as compared to 2004 could be achieved.

²⁶ According to the same presentation by CLP, it is suggested that the installation of FGD and SCR plant at the four coal-fired units at CLP's Castle Peak "B" Power Station could help reduce the emissions of SO₂ by 90 per cent while particulate emissions would be further reduced from the current 99 plus per cent removal level.

- Accelerate the retrofitting of particulate traps on franchised buses and phase out old versions.
- Prevent Hong Kong vehicle owners from filling their tanks with low-grade, high-sulphur diesel in the Mainland, and then running their vehicles on Hong Kong roads.
- Encourage the uptake of hybrid vehicles through appropriate financial incentives for dealers and buyers, as well as leading by example in purchasing vehicles for Government fleets.

In addition, the Government should find the optimum mix of transport mode to balance transport convenience and clean air. Using Hong Kong's excellent railway resources as a major form of public transport, Government should set up inter-modal (bus-rail) interchanges together with a railway feeder hub network to maximise the use of the existing rail system as well as develop new rail projects. On a related point, if the use of private vehicles is reduced during high-API days, the public transport options must be readily available.

It should be noted that the above measures do not come without a cost. It is estimated that the costs for implementing the above measures may amount to over \$10 billion. Such additional costs may be borne by vehicle owners, bus companies or be passed to passengers or taxpayers. The benefits in terms of total emission reduction on a territory-wide basis would be marginal, and hence little effect on improving regional smog and visibility but such a smaller but more proximate reduction in vehicle emissions would have a more direct impact at roadside level where members of the public are in direct exposure to passing vehicles.

Industry Sector

Hong Kong's industry sector must adopt practices that will lead to improved emissions and sound environmental performance. The Council considers that the following measures must be taken as the immediate priorities:

- Accelerating the proposed cap on the VOC content in materials in Hong Kong.
- Mandating the switch from industrial-grade diesel to ultra-low-sulphur diesel for industry, catering, construction, port and ferry activities in Hong Kong and promoting a similar change in the PRD region.
- Promoting cleaner production methods for Hong Kong-owned businesses in the PRD.
- Development of a green procurement, merchandising and investment code for business activities in the PRD by local and foreign chambers of commerce.

Depending on the actual implementation, the above measures may cost as much as \$400 million to the industry including costs of seeking alternative for VOC-containing materials, expenditure on cleaner diesel and other operating costs incurred by retail businesses. It is estimated that the impact on the operating cost of the industries for replacement of industrial diesel with ultra-low sulphur diesel (ULSD) would be less than 1 per cent, on the basis of an 8 per cent price differential between industrial diesel and

duty-free ULSD. On the other hand, the switch to ULSD would help reduce SO₂ by 3 per cent against the total emission in 2004.

The Council will also consider suitable ways to work with the Greater Pearl River Delta Business Council. The Greater PRD Business Council is set up under the Hong Kong Guangdong Cooperation Joint Conference to facilitate collaboration of the private sector in enhancing cooperation between Hong Kong and Guangdong. It provides an additional platform for the business sector to provide input and complement government efforts in forging closer ties between Hong Kong and Guangdong.

The setting up of a fund to look at cleaner production methods for Hong Kong-owned factories in the PRD should be studied and administered jointly by Government²⁷ and a suitable body.

7.3 Stakeholder Engagement

Achieving cleaner air is undoubtedly the primary objective for all of us. To this end, we need to take concrete actions in both the supply and demand ends. While Government's policy support is of utmost importance, the Council reckons that certain issues, in particular those concerning demand side management which has a wide impact on the community, clearly require deeper debate in order to build consensus and public support before the Government can formulate appropriate policies. The following issues have been identified as being for stakeholders to offer their views.

Central tenets to the arguments of whether or not to proceed with certain options are:

- How difficult will it be; is it practicable?
- How much will it cost?
- Who will pay the cost?
- How much are we willing to pay?
- Is the option sustainable?

Issues where the scope for stakeholder engagement would be appropriate are provided as follows:

- Deciding on appropriate actions to be taken during high API days, such as discouraging vehicle usage by premium road pricing fees, reducing the use of oil-based paints, solvents and cleaners, and stopping the use of diesel-powered equipment.
- Putting into practice demand side management to foster energy efficiency and conservation measures through the most effective means. Examples include

²⁷ The Hong Kong Government has already embarked on setting up pilot projects since September 2006 to look at cleaner production methods for Hong Kong-owned factories in the PRD and has invited the GPRDC to be a participant member in this worthwhile initiative.

25.5°C settings for all offices and schools in the private sector or more use of off-peak electricity through use of suitable incentives or, conversely, tax penalties. As the demand for electricity is price inelastic, this may be done through a mixture of legislation or incentives. Other possible means include mandatory energy codes, mandatory green building codes for new buildings etc.

- Banning idling engines.
- Use congestion charging mechanisms such as road pricing to reduce traffic congestion.

All said the responsibility must be down to each Hong Kong citizen. We breathe the air that we pollute. We – each of us – must be prepared to take the hard path towards cleaner air.

The choices are clear.

Appendix A. Composition of Study Group on Better Air Quality

Chairman : Dr Edgar Cheng (Vice-Chairman, Council for SD)

Members : Dr Lily Chiang

Mr Michael Jebsen

Mr Michael Lai

Professor Lam Kin-che

Ir Otto Poon

Representative from Environmental Protection Department

Representative from Economic Development and Labour
Bureau

Representative from Transport Department

Mr Chandran Nair (co-opted member)

Appendix B. Government's Control Efforts in Hong Kong

a. Early Efforts on Controlling Air Pollution

Hong Kong witnessed the environmental health benefits of reducing the use of dirty fuels when the Government banned high-sulphur fuel in industry in July 1990. Reducing the sulphur content from about 2.5 per cent to not more than 0.5 per cent by weight cut at least 37,000 tonnes of SO₂ emissions per year – with dramatic consequences for health.

The effects were clearly evident in July and August 1990: SO₂ levels dropped by 80 per cent in Kwai Chung district and by 50 per cent on average across the whole of Hong Kong.

A study by the Department of Community Medicine, University of Hong Kong measured the health gains of the low-sulphur fuel intervention in Hong Kong by comparing the situation between 1989 and 1990. The study found:

- A marked improvement in lung function and a reduction in clinical symptoms of bronchitis in primary school children (aged 8-10 years) and a reduction in bronchitic symptoms in mothers.
- The annual trend in mortality across the whole population declined by an average of 2.2 per cent (more than 4 per cent in older people) reflecting a reduction of about 600 deaths per year.
- These avoided deaths were mainly from heart and lung disease and associated with an increase in life expectancy.

These positive signs show the marked benefits that arise from simple measures once applied rigorously across Hong Kong.

Figure A1 below shows the decreasing trends of air pollutants in Hong Kong since 1990. However, it should be noted in taking 1997 as a base year, as the Joint Study in 2002 indicated, that while Hong Kong has been making good progress towards the 2010 targets for NO_x and RSP, much of the effort in reducing SO₂ has been vitiated by the increase in emissions from the power plants.

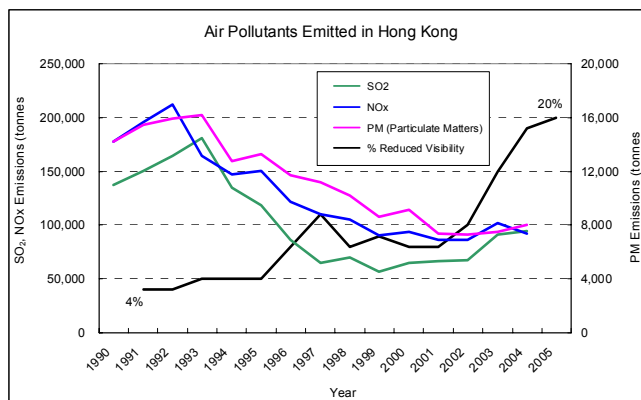


Figure A1. Air Pollution Trends in Hong Kong (1990 to 2005)

Clearly, Hong Kong's air quality has faced two challenges since 1997: from the regional influence of the PRD, and from local impacts arising from economic development within Hong Kong.

b. Current Issues and Efforts

The Hong Kong Government has introduced a comprehensive package of measures to address vehicle emissions, emissions from power plants and VOC. Compared with 1999, roadside concentration of particulates and NO_x have come down by 14% and 17% in 2005. Emission caps have been imposed on the two local power companies. In overall terms, the number of days and hours with API exceeding 100 was reduced from 87 days and 1,250 hours in 2004 to 49 days and 485 hours in 2005.

Vehicles

To tackle emissions from motor vehicles, particularly diesel vehicles, in 2000 the Government embarked on a comprehensive motor vehicle emission control programme to reduce the RSP by about 80 per cent and NO_x emissions by about 40 per cent in the urban area by end 2005. The key measures included:

- Replacing diesel taxis and light buses with LPG vehicles;
- Introducing Euro III emission standards in tandem with European Union trends;
- Retrofitting pre-Euro diesel vehicles with particulate traps or catalytic converters and mandating their installation;
- Deploying chassis dynamometers to test diesel vehicle smoke and take stronger enforcement actions against smoky vehicles; and
- Introducing ultra-low-sulphur diesel and mandating its use in February 2002;

Other measures include:

- Limiting the benzene content in petrol to 1 per cent and tightening the petrol specifications;
- Rationalising bus routes in busy corridors and re-organising bus stops in busy districts;
- Introducing bus-bus interchanges to promote efficient use of bus resources and reducing the number of buses on the road;
- Promoting the use of more buses of Euro II or above in busy corridors;
- Implementing pedestrian schemes in over 30 streets in busy districts; and
- Doubling the fines for smoky vehicles to \$1,000 and stepping up enforcement.

Future measures included:

- Implementing the Euro IV petrol standard (effected in January 2005);

- Introducing Euro IV emission standards for newly registered vehicles (effective in phases from January 2006);
- Controlling emissions from petrol and LPG vehicles by remote-sensing technology;
- Implementing the incentive scheme to encourage the replacement of diesel light buses with LPG or electric models; and
- Completing the programme on the retrofitting of pre-Euro heavy diesel vehicles with catalytic converters by financial incentives and making the installation mandatory afterwards.

Power

Electricity generation remains the biggest source of air pollution in Hong Kong. It accounts for 92 per cent of the SO₂ and half of the NO_x and RSP emissions. The Government has recognised the impacts from the power sector and has tightened the caps on the emissions of power plants upon renewal of their “specified process licences”, so that emissions from these sources are kept to the practical minimum. This will lead to power companies having to install effective emissions reduction devices and making appropriate choices in their fuel mix to meet emission targets imposed by the caps. Other measures include:

- Requiring power companies not to build new conventional coal-fired generating units for meeting the new electricity demand;
- Requiring power companies to install desulphurisation and de-NO_x facilities; and
- Asking power companies to maximise the use of natural gas for power generation.

Future measures include:

- Putting forward the proposal to link the power companies’ permitted rate of return on all fixed assets with their achievement of those caps in the post-2008 regulatory regime;
- Tightening the emissions caps gradually for power companies to meet the 2010 emission reduction target;
- Asking power companies to use renewable energy to generate electricity and to implement demand side management measures in the post-2008 regulatory regime; and
- Working with Guangdong on an emission trading pilot scheme for thermal power plants in the Pearl River Delta region.

Other Fronts

In addition to vehicles and power, the Government has also implemented a series of measures on other fronts to address the air quality problem. Some key measures include:

- Requiring major air polluting activities under licensing control and using best practicable means to reduce emissions;
- Banning the use of high-sulphur heavy oil since 1990;
- Requiring oil depots to install floating roof oil tanks to reduce VOC emissions;
- Requiring petrochemical terminals to minimise emission during transfer, handling and storage of VOC;
- Prohibiting open burning of construction waste, tyres, and open burning for the salvage of metal since 1996;
- Requiring petrol filling stations and petrol delivery tankers to have equipment to recover VOC released while unloading since 1999, and all new stations to have systems that recover petrol vapour while vehicles are being refueled since March 2005;
- Requiring construction activities to control dust emissions since 1997;
- Requiring employment of registered professionals for carrying out work involving asbestos-containing materials, and banning the import and sale of amosite and crocidolite asbestos since 1996; and
- Requiring recovery of perchloroethylene, a kind of VOC, for dry-cleaning operations since 2001.

Future measures include:

- Introducing a scheme to limit the VOC emissions from paints, printing inks and selected consumer products; and
- Implementing the Pearl River Delta Regional Air Quality Management Plan with Guangdong with a view to meeting the 2010 emissions reduction target.

c. Way Forward

Hong Kong has been making good progress towards achieving the 2010 targets for NO_x, RSP and VOC. For SO₂, however, much of the effort has been vitiated by the increase in emissions from the power plants. Details are presented in the table below:

	1997 Emission (tonnes)	2004 Emission (tonnes)	Changes 1997- 2004	2010 Target
SO ₂	64,500	94,800	+47 %	-40 %

NO _x	110,000	92,500	-16 %	-20 %
RSP	11,200	8,040	-28 %	-55 %
VOC	54,400	41,900	-23 %	-55 %

Table A1. Progress in Achieving the 2010 Emissions Reduction Target

For SO₂, the trends can be seen in Figure A2 below.

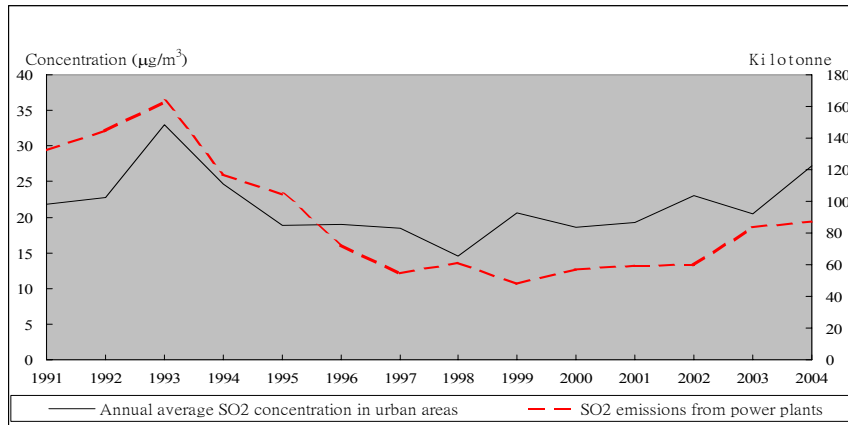


Figure A2. SO₂ Emissions from Power Companies and Levels in Urban Areas

As indicated in the graph, the SO₂ emissions by local power plants are highly correlated to the SO₂ concentration in our urban areas. Therefore, to achieve the 2010 emissions reduction targets and sustained improvement in our air quality, the power sector must substantially reduce its emissions.