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Hong Kong's poor air quality has become a subject of wide public concern

People are increasingly interested to learn more about various sources of air pollution so that they can judge what needs to be done. This publication deals with the facts and figures of Hong Kong's air quality, and raises specific short and long-term actions to improve the situation.

The good news is a lot can be done both locally and across the border in Guangdong. However, far-sighted, tough and determined action over a sustained period is required.

What people demand today is a clearly articulated broad strategy on how to attack the problem and then, for those who are responsible, to act expeditiously.

香港惡劣的空氣質素已成為廣大市民關心的問題

市民對認識各種空氣污染源頭的興趣越來越大, 因為唯有認識越多, 才能相應地作出更明智的判斷和決定。本小冊子彙列了各項與香港空氣質素有關係的事實和數據, 並針對有關問題, 提出一系列短期和長期的改善措施。

令人欣喜的是, 透過在香港及廣東省兩地推行措施, 相信問題可得到一定程度的舒緩, 但我們必須謹記, 成敗的關鍵在於決策者是否具備高瞻遠矚的視野、堅毅的精神和持之以恆的決心。

市民現在的要求是: 政府針對空氣污染問題提出一套清晰而全面的改善策略, 同時希望負責的官員從速落實有關政策。

BACKGROUND

Air pollution arises from the combustion of fossil fuels, such as burning coal, oil (including petrol, diesel, kerosene, jet fuel and bunker fuel) and natural gas.

There is no single source of pollution to blame. Improving air quality requires multiple actions across a variety of areas.

Understanding air quality is challenging. There are complex issues involved, including: science, meteorology, technology, standards, regulation, law, urban planning, energy, economics, finance and public health.

背景

燃燒化石燃料，例如：燒煤、燃油（包括汽油、柴油、煤油、航空燃油及船用燃油）和燒天然氣，會產生空氣污染。

空氣污染並非來自單一污染源。要改善空氣質素，我們必須採取多方面的措施。

要瞭解空氣污染問題一點也不容易，因為當中牽涉許多不同範疇的問題，包括：科學、氣象學、科技、量度標準、監管條例、法律、城市規劃、能源、經濟、財務和公眾衛生等。



▲ Aberdeen Harbour on clear day (23rd July 2004)
晴朗的香港仔港灣 (2004年7月23日)
[Photograph: Edward Stokes HKPC Foundation]
[照片提供：艾思滔，香港自然環境攝影基金會]

Double-pronged Problem

There are two distinct sources of air pollution, both of which must be addressed:

Regional air pollution from Hong Kong and the Pearl River Delta (PRD). A combination of emissions that contributes most to the haze problem that envelops much of the region.

Local air pollution, arising mainly from power plants and the vehicles on our roads. Vehicular pollution is exacerbated by the 'street canyon effect'.

一個問題，兩個源頭

香港的空氣污染來自兩個不同的源頭。我們必須瞄準這兩個源頭，對症下藥，不可顧此失彼。

香港和珠江三角洲的**區域性空氣污染**：來自兩地的多種污染物經混和後，形成煙霞，籠罩著珠三角大部分的地區。

本地空氣污染：主要由發電廠和車輛排放的污染物造成。而車輛的污染問題更因「街道峽谷效應」變得更加嚴重。

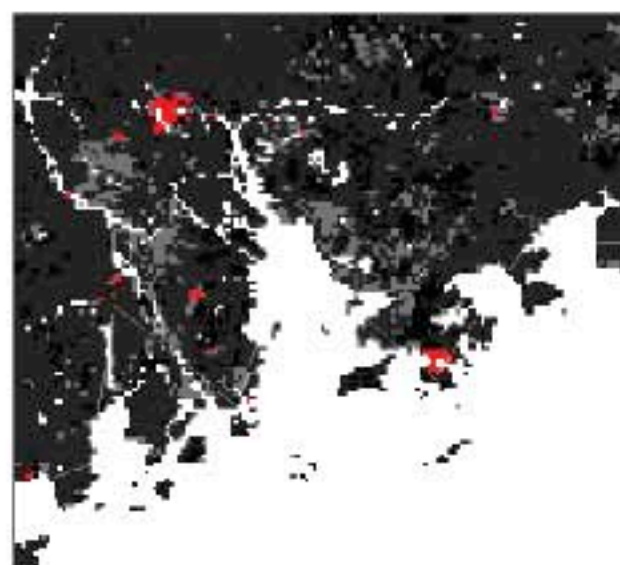
▲ Aberdeen Harbour on a smoggy day (16th September 2004)
煙霧中的香港仔港灣 (2004年9月16日)
[Photograph: Edward Stokes HKPC Foundation]
[照片提供：艾思滔，香港自然環境攝影基金會]

Regional Air Quality

Over the last 20 years the PRD has developed rapidly to become one of the world's largest manufacturing centres. Hong Kong has contributed management capability, technology and funding, and is also a significant investor in transportation and logistics including in the ports at Shekou and Yantian. Many people in Hong Kong have benefited economically, at the cost of worsening air quality.

The area encompassing Hong Kong and the PRD is in fact relatively small. It is comparable to the metropolitan regions of New York, Los Angeles, London and Tokyo.

Sources of emissions having the greatest regional impact are power plants, vehicles (numbers are rising rapidly) and factories. Due to Guangdong's electricity shortfall experts estimate that up to 90% of factories run their own generators, many of which use high sulphur fuels.



Urban Areas

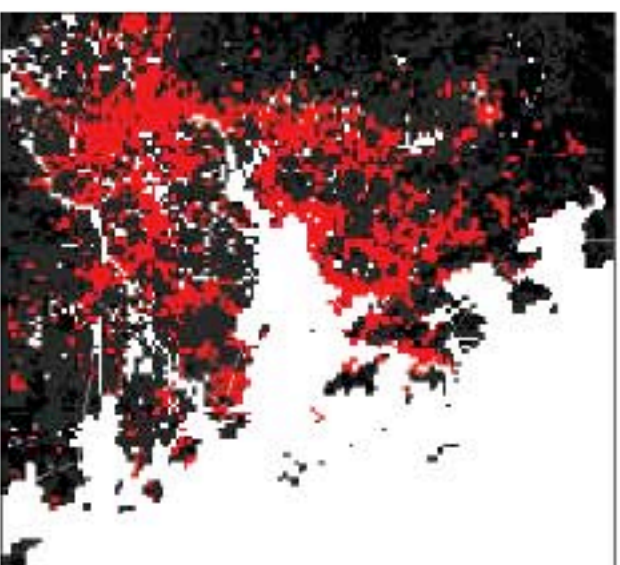
1994

區域性空氣質素

過去二十年，珠江三角洲迅速發展成為世界上其中一個最大的製造業中心。香港除了管理才能、技術和資金上有所貢獻外，亦在區內交通運輸和物流業的發展上扮演了舉足輕重的角色。投資發展項目包括蛇口港和鹽田港。不少香港人受惠於珠三角的發展，在經濟上獲利，但同時卻因為空氣質素差劣而付出代價。

包括香港和珠三角在內的整個地區，土地面積比較小，跟紐約、洛杉磯、倫敦和東京等都會相若。

珠三角地區的主要污染源當中，以發電廠、工廠和數目急速增長的汽車所帶來的區域性影響最大。專家估計，由於廣東省經常缺電，珠三角有多達90%的工廠自行發電，當中大部分使用高硫燃料。



2004

▲ Figure 1: PRD development 1994 and 2004

■ 1: 珠江三角洲於1994和2004年的發展情況

[Institute for the Environment, HKUST]

[香港科技大學環境研究所]

Meteorological Impact

Daily land-sea breezes mix regional and local emissions to produce dense smog. Studies show that due to proximity and prevailing winds emissions from Shenzhen and Dongguan have the highest impact on Hong Kong, not forgetting that Hong Kong's emissions impact Macau and Zhuhai.

Studies also show that prevailing easterly winds are no longer able to disperse pollution westward because regional emissions that are trapped by the land-sea breeze are often too dense.

One of the most harmful pollutants, particulate matter (PM), is an important contributor to the regional haze. On "typical" wind flow days, studies indicate that pollution sources from Guangdong contribute 70% of PM emissions with the rest from local sources. However on low wind and windless days PM emissions from regional sources increases to 78% with the increase largely coming from regional power plants.

氣象方面的影響

海陸風每天將區內和本地的污染物混和，形成厚厚的煙霧。有研究指出，由於地理上的鄰近及盛行風的關係，深圳和東莞排放的污染物對香港的影響最大。當然，我們不能忘記香港所產生的污染物也同樣影響著澳門和珠海。

研究又顯示，被海陸風圍困在區內的排放物十分濃密，以致盛行東風已再不能把污染物向西面吹散。

懸浮粒子是其中一種最具損害性的污染物，亦是形成區域性煙霧的主要成分。研究顯示，在平常的日子裏，在香港境內的懸浮粒子有70%是來自廣東省的，其餘則來自本地污染源。然而，在風力弱及無風的日子裏，來自區域性污染源的懸浮粒子增加至78%，額外的懸浮粒子主要來自區內的發電廠。

LAND SEA BREEZE

Land-sea breeze circulation (LSB) occurs due to the unequal heating of air over land and sea. As land heats up during the day the air near the ground is heated and expands. This less dense air rises forming an area of low pressure. The air in the middle of the Pearl River estuary heats up more slowly than over neighbouring land creating a pressure gradient that sets in motion a triangular sea breeze.

Urbanization and activities such as manufacturing, power production and transport make this triangular trapping zone more acute, allowing pollutants emitted in the PRD to be trapped, transported, cross mixed, and redistributed by the LSB circulation.

海陸風

海陸風主要是由於陸地上和海面上的空氣受熱程度不同所致。在日間，陸地的溫度因受陽光照射而上升，鄰近地面的空氣亦受熱膨脹、上升，因而形成低壓區。另一方面，在珠江口海面上的空氣受熱較鄰近陸地上的空氣慢，氣壓上的差異令空氣從珠江口流向陸地，形成呈三角形形態的海風。

珠三角地區的都市化發展以及製造業生產、電力生產和交通運輸等活動，進一步加強了這個三角區的威力，讓海陸風把區域性的排放物從污染源帶到海上混和、積累，再從不同方向吹回陸地，然後不斷循環。



▲ Figure 2: PRD Emissions Trap

■ 2: 珠江三角洲的污染物積聚點

[Institute for the Environment, HKUST]

[香港科技大學環境研究所]

Hong Kong's Local Pollution

Hong Kong's main emission sources are our power plants and vehicular fleet.

Power plants are the major contributors although their tall chimneys disperse emissions higher into the air. Most of our power is generated using coal, which is more polluting, other sources being natural gas and nuclear.

Vehicular pollution emits at street level and therefore creates not only instant impact but is also more toxic because the pollutants have not yet been diluted.

Recent studies show that although marine emissions are a small contributor to overall pollution, they create a surprisingly large public health impact because the emissions affect dense population centres.

香港的本地污染

發電廠和汽車是香港的主要污染源。

雖然高聳的煙囪可以把污染物帶到高空吹散，但發電廠仍然是本地空氣污染的主要源頭。香港主要以燒煤發電；煤是污染性較高的燃料。其他燃料則包括天然氣和核能。

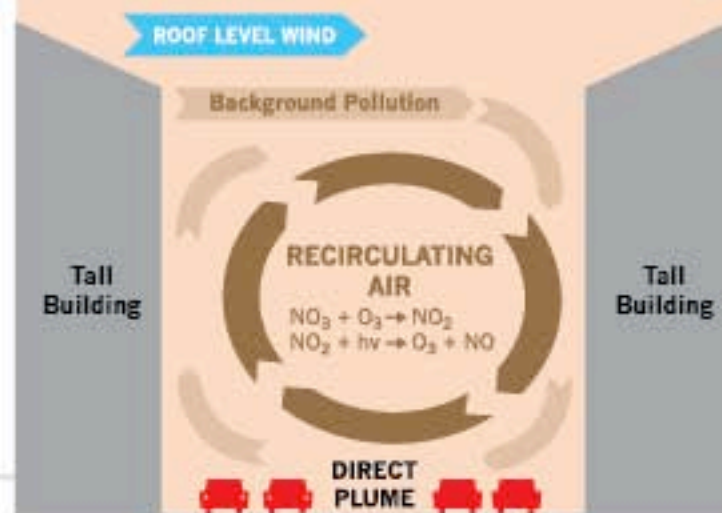
汽車在路邊排放廢氣，除了對市民構成即時影響外，污染物更因未被吹散和稀釋，毒性亦相對較強。

近期發表的研究指出，儘管船舶廢氣只佔整體空氣污染的一個很小部分，但由於它影響著人口稠密的地區，因此對公眾健康造成重大的影響。

STREET CANYON EFFECT 街道峽谷效應

Hong Kong's urban environment is extremely dense. Narrow congested streets and tall buildings trap roadside pollution for long periods. Congestion reduces traffic speed, which increases emissions. This is significant as most Hong Kong people live or work in the urban or roadside environment.

香港的都市環境十分擠迫，發展密度極高。狹窄和擁塞的街道加上高樓大廈，把路邊污染物長期圍困在街道上，久久不能吹散。此外，塞車減慢了車行速度，間接令車輛排放更多廢氣。由於香港市民大部分在都市環境居住或工作，又或經常在馬路兩旁活動，所以我們必須正視街道峽谷效應這個影響深遠的問題。

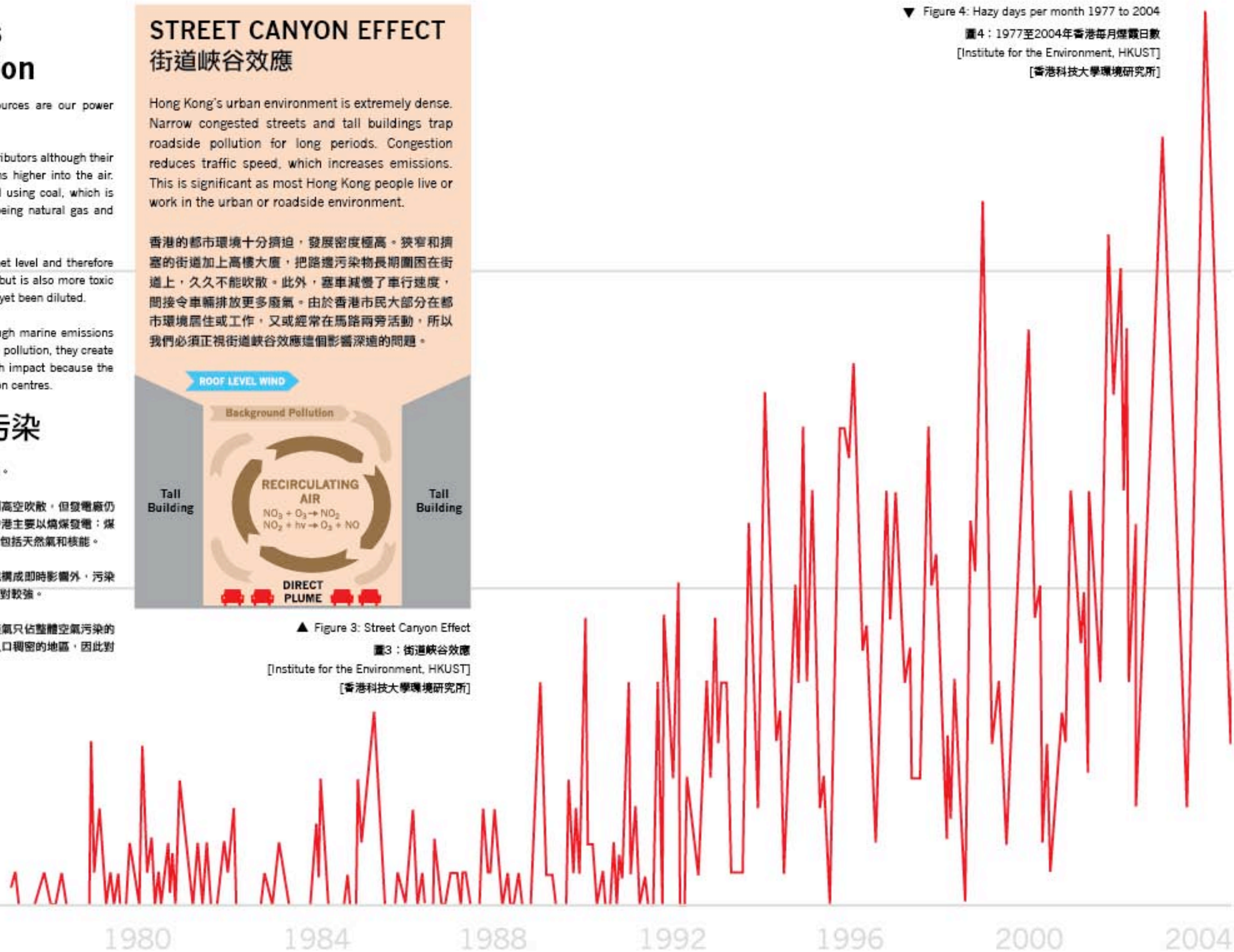


▲ Figure 3: Street Canyon Effect

圖3：街道峽谷效應
[Institute for the Environment, HKUST]
[香港科技大學環境研究所]

▼ Figure 4: Hazy days per month 1977 to 2004

圖4：1977至2004年香港每月煙霧日數
[Institute for the Environment, HKUST]
[香港科技大學環境研究所]



HONG KONG: AN INTERNATIONAL COMPARISON

Hong Kong's air is still better than Beijing, Shanghai, Mumbai and New Delhi but worse than Singapore or Tokyo. Beyond Asia, our air compares poorly with London, New York, Paris and Vancouver.

These cities have already been through development cycles where polluting industries moved away due in part to growing public awareness and government pressure, and emissions regulation for heavy combustion activities, such as power generation and vehicles, have gradually been tightened.

香港跟世界其他城市的比較

香港的空氣質素依然比北京、上海、孟買和新德里優勝，但卻不及新加坡和東京。而相比亞洲以外的紐約、倫敦、巴黎和溫哥華，香港的空氣便差得多了。

這些城市的發展已經進入了較成熟的階段。在公眾的關注度提升和政府的壓力底下，高污染的工業早已遠離城市範圍，而高燃燒量活動（如：發電和駕駛車輛）的廢氣排放條例亦被逐步收緊。

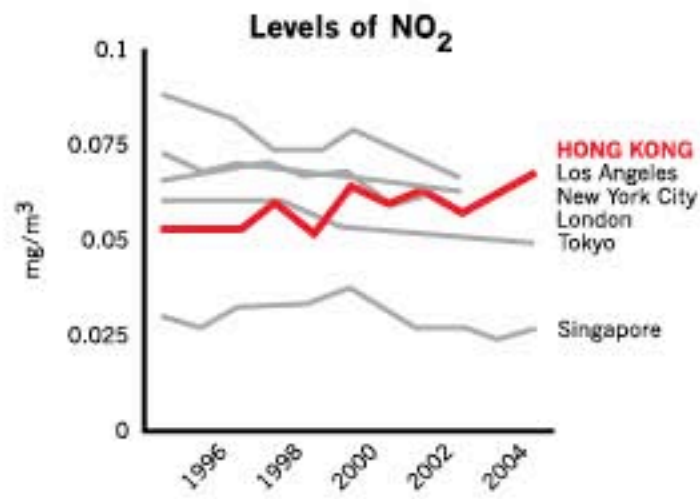


Figure 5

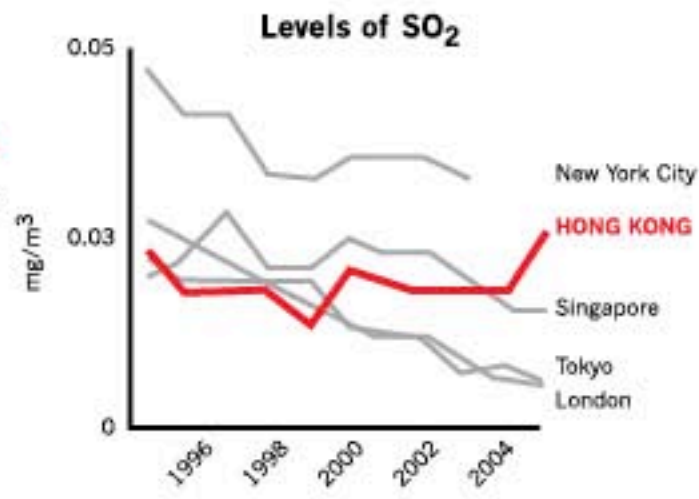


Figure 6

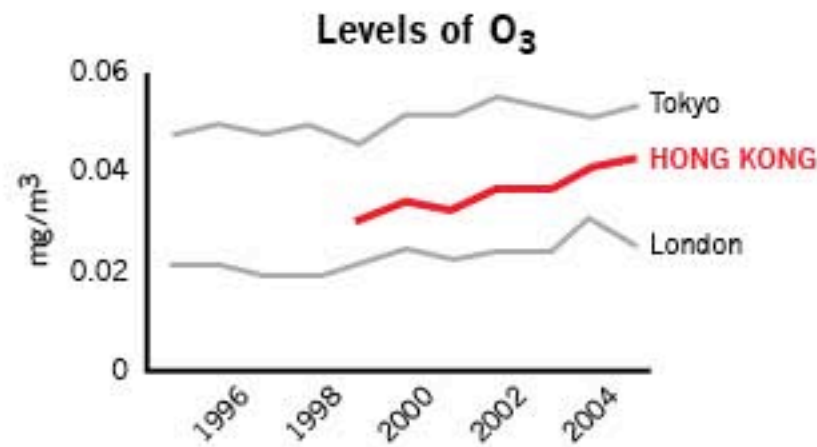
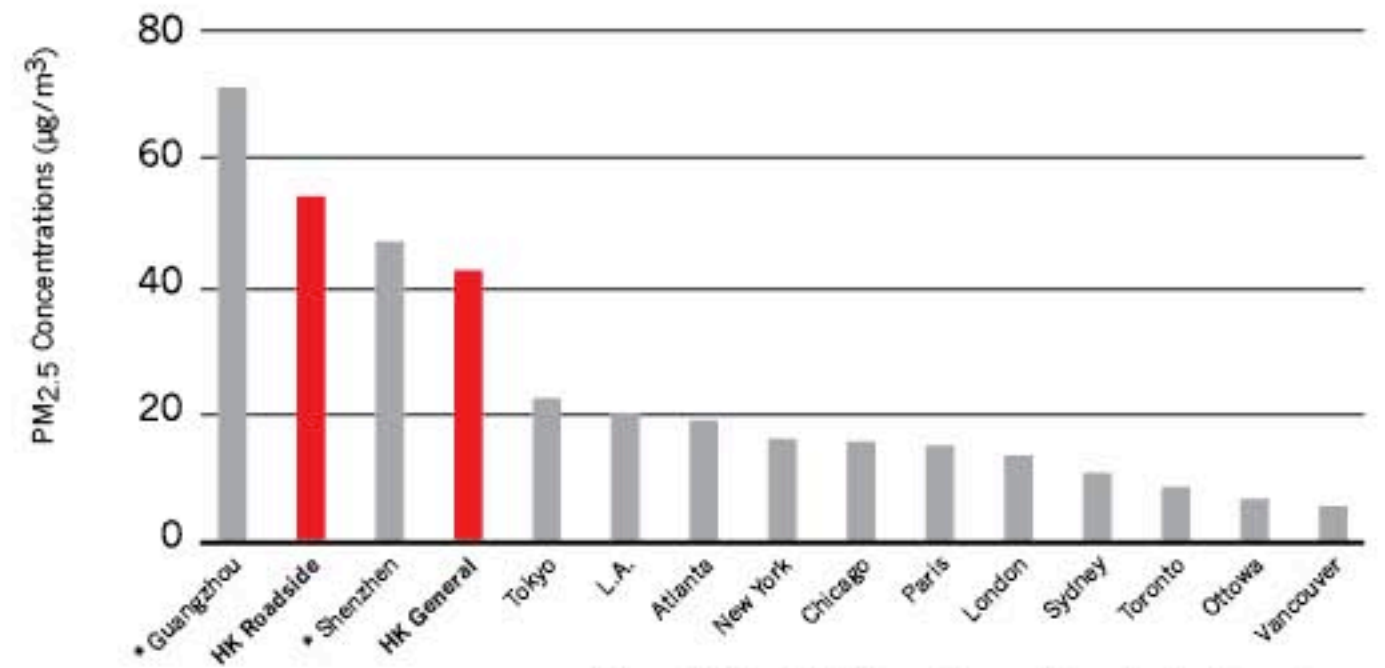


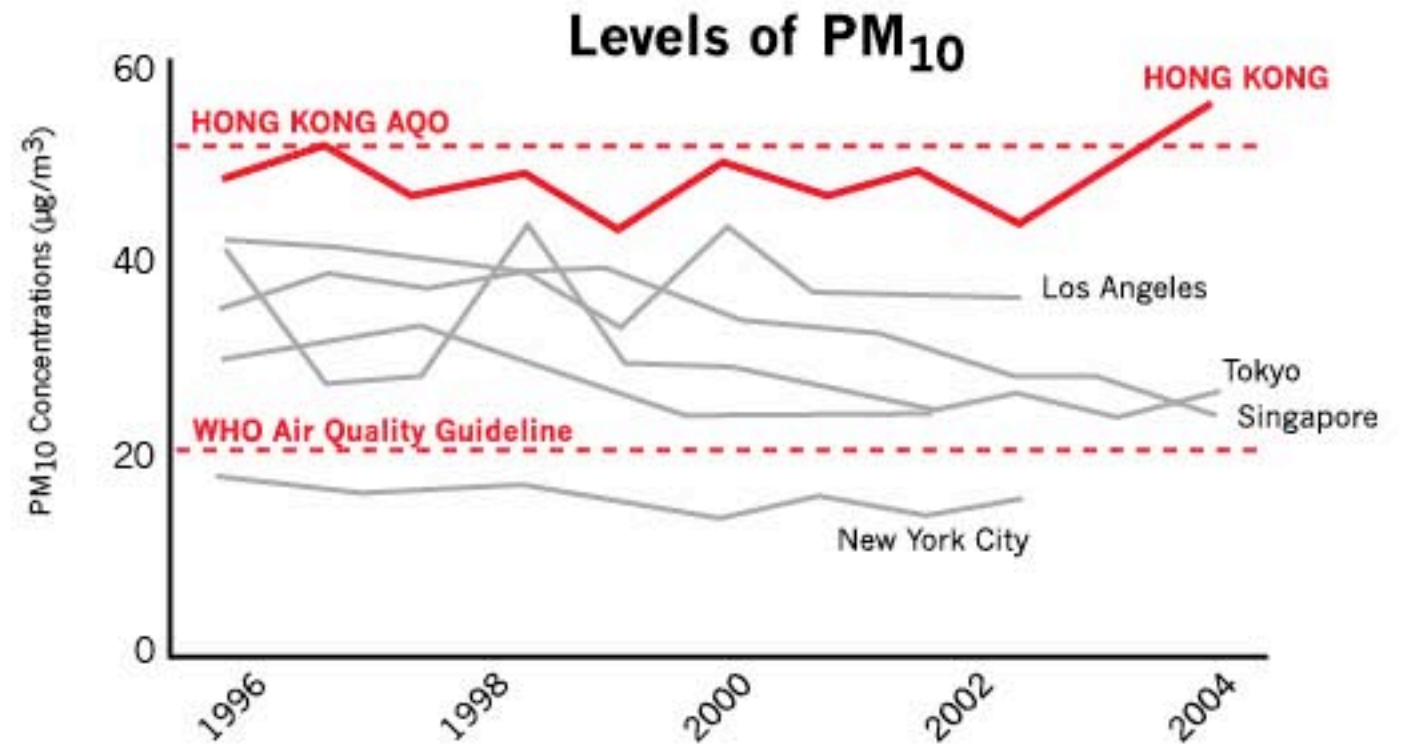
Figure 7

▲ Figures 5 - 7: Comparing Hong Kong's pollution to Singapore, Tokyo, New York, London and Los Angeles
圖5至圖7：香港、新加坡、東京、紐約、倫敦和洛杉磯的空氣污染水平比較
[Civic Exchange]
[思匯政策研究所]



▲ Figure 8: PM_{2.5} 2003 Annual Average Concentration Comparisons
圖8：2003年PM_{2.5}全年平均濃度比較
[Civic Exchange]
[思匯政策研究所]

* Annualised mean data based on 24-hr sampling for each season during October 2002 and June 2003.
* 全年平均數據根據在2002年10月至2003年6月期間收集的24小時空氣樣本推算出來的。



▲ Figure 9: Annual Mean PM₁₀ concentration comparisons
圖9：PM₁₀全年平均濃度比較
[Civic Exchange]
[思匯政策研究所]

AIR POLLUTANTS

Categories

Primary air pollutants: come directly into the atmosphere from emission sources that may be identified. These direct sources may be point sources, such as power plants and factories; or mobile sources, such as vehicles, ships and aeroplanes. The major primary air pollutants are carbon monoxide, sulphur dioxide, nitrogen oxides, volatile organic compounds (VOC), particulate matter, and lead.

Secondary air pollutants: are created in the atmosphere when primary pollutants react with each other or with atmospheric compounds such as water vapour. The chemicals that make up smog and acid rain are important examples.

Criteria air pollutants

The 4 most important pollutants (criteria air pollutants) to estimate the impact of pollution on public health are:

particulate matter (PM₁₀ and PM_{2.5})
nitrogen dioxide (NO₂)
sulphur dioxide (SO₂)
ozone (O₃)

Each pollutant has an independent effect on health. However, air pollution is also a mix of chemical pollutants and there is still medical uncertainty about the effect of all the pollutants acting together. The cumulative impact of individual pollutants may have a greater impact on our health than the sum of each individual pollutant.

空氣污染物

類別

原生空氣污染物：直接從可被確認的污染源排放到大氣層。這些污染源可以是固定的，例如：發電廠和工廠，亦可以是流動的，例如：汽車、船隻和飛機。主要的原生空氣污染物包括：一氧化碳、二氧化硫、氮氧化物、揮發性有機化合物、懸浮粒子和鉛。

次生空氣污染物：是透過不同原生污染物之間，又或是原生污染物和大氣中的化合物（如：水氣）產生化學反應而形成的。造成煙霧和酸雨的化學物質是重要的次生空氣污染物例子。

標準空氣污染物

用以估量空氣污染對公眾健康影響的四種最重要的污染物（即標準空氣污染物）為：

懸浮粒子（PM₁₀和PM_{2.5}）
二氧化氮（NO₂）
二氧化硫（SO₂）
臭氧（O₃）

每種污染物對人體的健康都有個別的影響。不過，值得注意的是，空氣污染往往是化學污染物的大雜燴，醫學界迄今仍未能確定多種污染物所產生的化學反應，會對人體健康有甚麼影響，但估計混合污染物對個人健康的累積性影響，可能要比個別污染物所產生的影響的總和為高。

Particulates, Particulate Matter and Ozone

These are terms used for a mixture of particles found in the air. Some particles are large and can be seen (soot or smoke) and some are very small (invisible to the naked eye). The size and chemical composition are the most important characteristics of such particles.

The term Total Suspended Particulate (TSP) is used to represent all particles up to 45 microns in diameter. Very small particles are referred to as Particulate Matter (PM), and PM₁₀, PM_{2.5} and ultra-fine particles (less than 10, 2.5 and 1.0 microns in diameter) indicate their respective sizes. In Hong Kong, the term Respirable Suspended Particulate (RSP) is used for PM₁₀.

PM sources may be primary, such as emitted directly from power generation or road traffic, or secondary formed in the atmosphere by chemical reaction of SO₂ and NO_x and other gases. Secondary PM is usually in the range of finer particles.

The World Health Organisation (WHO) reconfirmed in 2004 that **exposure to PM possess a significant risk to human health at concentration levels generally lower than the prevailing levels in Hong Kong.**

Ozone (O₃), a secondary pollutant, is chemically highly reactive and a strong respiratory irritant, as well as one of the main components of smog.

Recent studies have been unable to establish threshold levels for pollutants, in particular for PM and O₃. Rather, studies consistently show there are likely no safe levels for these two pollutants and smaller particles are more hazardous.

粒子、懸浮粒子和臭氧

這些名稱所指的是空氣中不同種類的粒子，它們的關鍵特徵為體積和化學成份。大的粒子為肉眼可見，如：煤屑和煙。


總懸浮粒子（TSP）是指所有直徑不超過45微米的粒子。我們一般稱體積非常微細的粒子為懸浮粒子（PM），PM₁₀、PM_{2.5}和超微細粒子等名稱用以表示不同粒子的體積（直徑分別小於10、2.5和1.0微米）。香港通常以「可吸入懸浮粒子」（RSP）來代表PM₁₀。

懸浮粒子可以來自原生污染源（例如：從發電過程或路面交通直接排出），也可以來自次生污染源（例如：在大氣層中經由二氧化硫、氮氧化物及其他氣體的化學反應而產生）。次生懸浮粒子的體積一般較小。

世界衛生組織於2004年重申，**即使暴露在低於香港現行水平的環境下接觸懸浮粒子，仍然會對健康構成重大的風險。**

臭氧是一種次生污染物，一種化學活性物質和呼吸系統刺激物，亦是煙霧的主要成分。

各地專家一直未能為不同的污染物，特別是懸浮粒子和臭氧，釐定一個可接受的濃度水平。反而不少研究均一致地顯示，似乎沒有一個懸浮粒子和臭氧濃度水平是安全的，而污染物的體積越小，危險性就越大。



Visibility is considered
a good indicator of air
pollution levels

能見度一直被視為反映
空氣污染水平的一個可
靠指標

4th January 2005

2005年1月4日

Photograph: Edward Stokes HKCP Foundation

【照片提供：艾思滔，香港自然環境攝影基金會】

Health and other rising costs from air pollution

Common health problems include chronic and acute bronchitis, pneumonia, attacks of asthma, heart attacks and strokes. Air pollutants damage clotting mechanisms and the lining cells of arteries reducing ability to deliver oxygen to vital organs.

Most at risk are persons with pre-existing illnesses, young children and the elderly.

空氣污染帶來的醫療成本和其他日益高昂的代價

常見的健康問題包括慢性和急性支氣管炎、肺炎、哮喘、心臟病和中風。空氣污染物破壞病者的血凝固功能和動脈的襯裡細胞，減低了運送氧氣到主要器官的能力。

曾患有上述疾病之人士、小童和長者面對的風險最大。

Direct health costs and productivity losses avoided by improving air quality: 改善空氣質素可減省的直接醫療開支及生產力損失共：

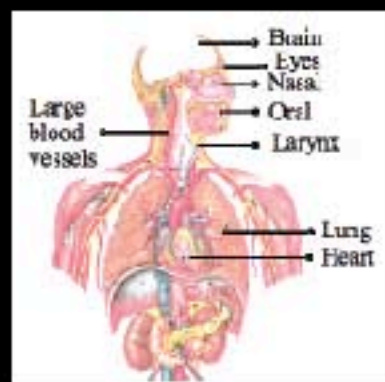
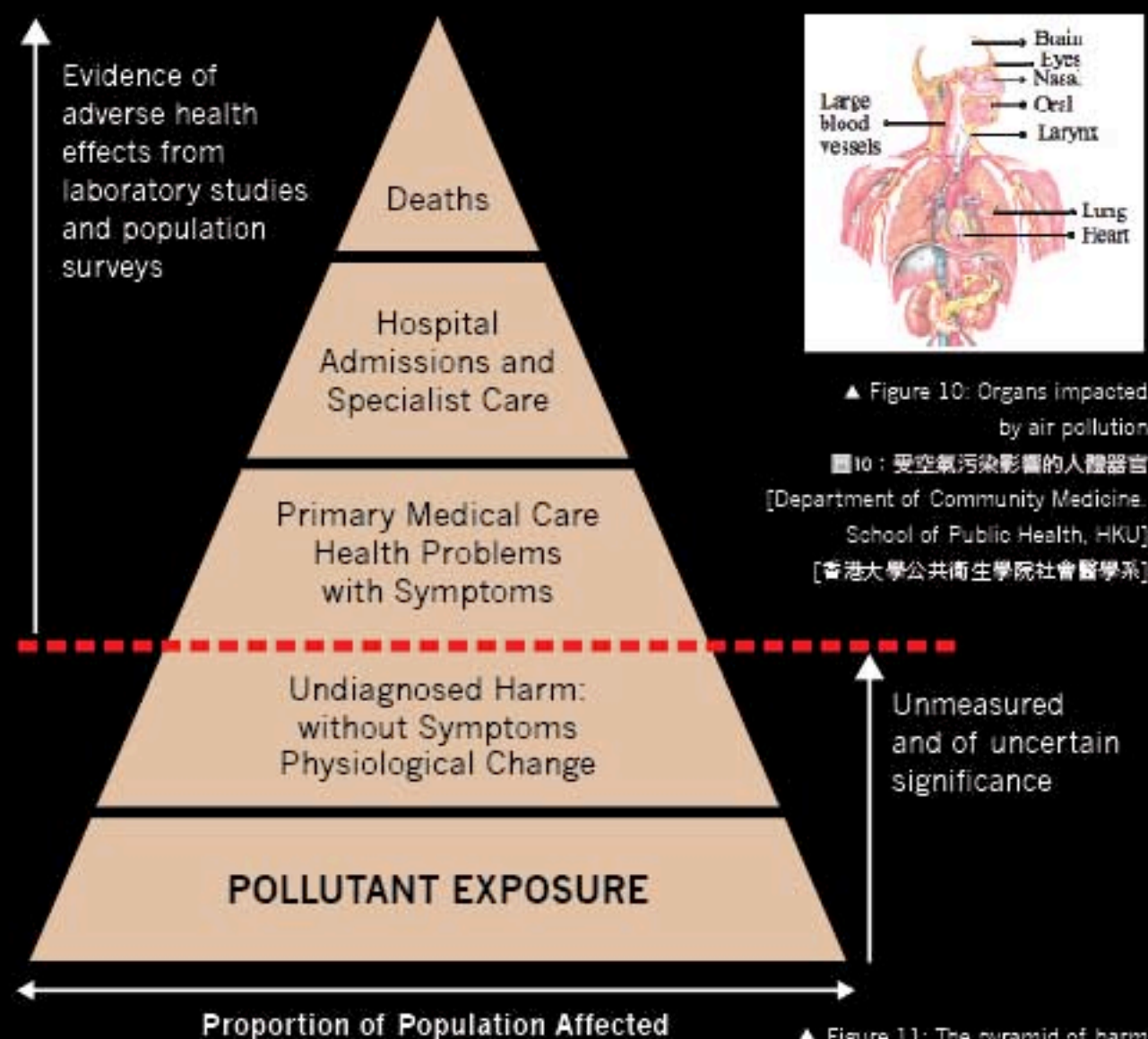
HK **\$2 Billion**

Intangible costs for pain and suffering avoided by improving air quality: 改善空氣質素可避免病者及其家人因痛苦帶來的無形代價高達：

HK **\$19.2 Billion**

Total value of harm avoided by improving air quality: 改善空氣質素可減少的禍害和損失總值：

HK **\$21.2 Billion**



▲ Figure 10: Organs impacted by air pollution

圖10：受空氣污染影響的人體器官
[Department of Community Medicine, School of Public Health, HKU]
[香港大學公共衛生學院社會醫學系]

▲ Figure 11: The pyramid of harm

圖11：空氣污染禍害金字塔
[Department of Community Medicine, School of Public Health, HKU]
[香港大學公共衛生學院社會醫學系]

Public health experts have worked out avoidable economic and financial costs to the community arising from illness, hospitalisation, workdays lost, and deaths caused by air pollution. Improvements in visibility alone from Hong Kong's 'average' levels to those which are considered 'good' would avoid 1,600 deaths, save 64,000 hospital bed days, and save over HK\$21 billion a year.

Beyond health costs, there are other economic costs relating to air pollution. For example, reduced visibility affects our overall sense of well-being, international reputation, tourism etc. although the exact costs are hard to calculate.

公眾衛生專家根據空氣污染帶來的影響和代價，包括患病、住院、損失工作時間和死亡，推算出社會可減省的經濟和財政成本。假如將香港的能見度從「平均」水平提高至「良好」水平，我們每年將可以避免1,600宗死亡個案，減少64,000個病床使用日數和節省超過210億港元的開支。

除了跟健康有關的成本外，空氣污染同時亦會令香港賠上其他無法估量的經濟代價。例如：能見度降低將會影響市民對整體生活的滿意度，令香港的國際聲譽受損和影響旅遊業發展等。

MEASURING AIR POLLUTION

Governments around the world set standards for the ambient (general) level of air pollution by establishing maximum allowable levels for various pollutants. The recommended limits are the air quality standards, and they are designed to protect public health.

Hong Kong's Air Quality Objectives

Hong Kong's Air Quality Objectives (AQOs) were set in 1987 and form the basis of all air quality management policies. With 11 general and 3 roadside air monitoring stations the Environmental Protection Department (EPD) carries out continuous air sampling to provide data to determine how often the AQOs are violated.

Figure 12: Hong Kong's AQOs

圖12: 香港的空氣質素指標

POLLUTANT	Concentration in Microgrammes per Cubic Metre (i)					HEALTH EFFECTS AT ELEVATED AMBIENT LEVELS
	1hr (ii)	8hrs (iii)	24hrs (iii)	3mths (iv)	1yr (iv)	
Sulphur Dioxide	800	..	350	..	80	Respiratory illness; reduced lung function; morbidity and mortality rates increase at higher levels.
Total Suspended Particulates	..	..	260	..	80	Respirable fraction has effects on health.
Respirable Suspended Particulates (v)	..	..	180	..	55	Respiratory illness; reduced lung function; cancer risk for certain particles; morbidity and mortality rates increase at higher levels.
Nitrogen Dioxide	300	..	150	..	80	Respiratory irritation; increased susceptibility to respiratory infection; lung development impairment.
Carbon Monoxide	30000	10000	..	..	..	Impairment of co-ordination; deleterious to pregnant women and those with heart and circulatory conditions.
Photochemical Oxidants (as ozone) (vi)	240	..	..	..	..	Eye irritation; cough; reduced athletic performance; possible chromosome damage
Lead	..	..	..	1.5	..	Affects cell and body processes; likely neuro-psychological effects, particularly in children; likely effects on rates on incidence of heart attacks, strokes and hypertension.

(i) Measured at 298K(25°C) and 101.325kPa (one atmosphere) (ii) Not to be exceeded more than three times per year. (iii) Not to be exceeded more than once per year. (iv) Arithmetic means. (v) Respirable suspended particulates means suspended particles in air with a nominal aerodynamic diameter of 10 micrometres or smaller (also called PM₁₀). (vi) Photochemical oxidants are determined by measurement of ozone only.

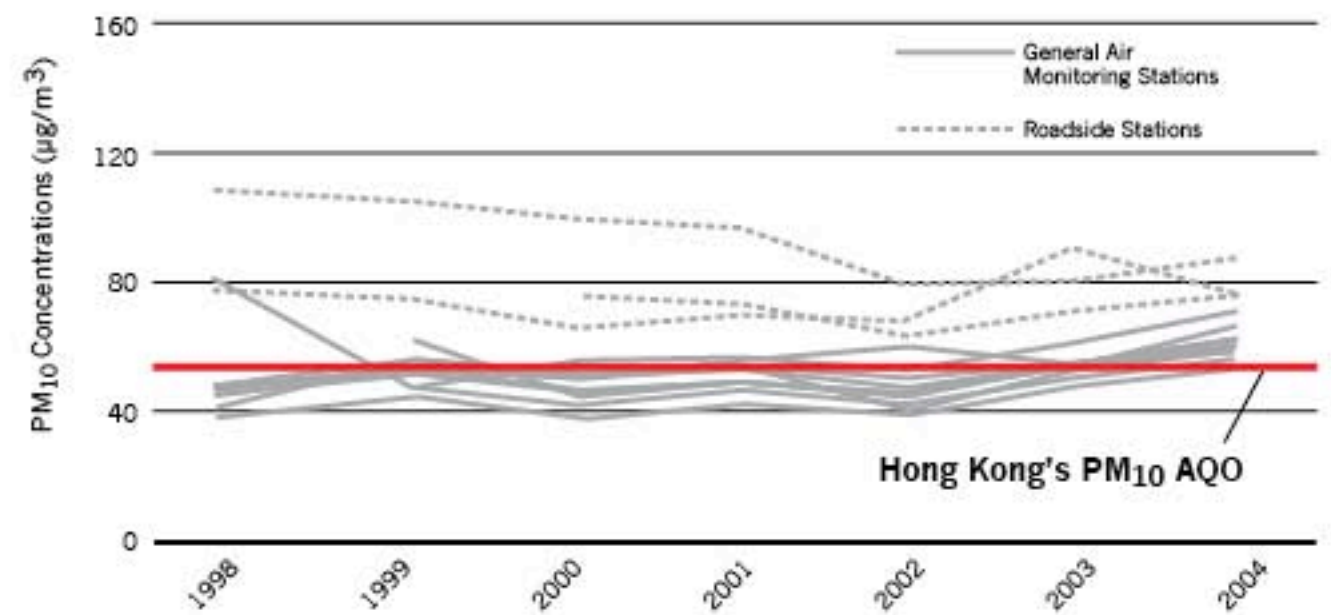
(i) 在298K (攝氏25度) 及101.325千帕斯卡 (一個大氣壓力) 下量度。 (ii) 每年不應超過三次。 (iii) 每年不應超過一次。 (iv) 算術平均數。 (v) 可吸入懸浮粒子是空氣中的懸浮粒子，標稱氣動直徑為10微米或以下 (又稱PM₁₀)。 (vi) 光化學氧化劑的數值純粹根據臭氧量數字釐定。

測量空氣污染

為訂定一般空氣污染水平的標準，世界各地政府分別為各種污染物的可接受濃度設定上限。這些設定原意為保障公眾健康的污染物上限，理所當然地成為了當地的空氣質素標準。

香港的空氣質素指標

香港政府於1987年制訂了空氣質素指標，並成為所有空氣質素管理政策的基礎。環保署在11個一般監測站和3個路邊監測站長期抽取空氣樣本，收集數據，以確定空氣質素的超標情況。

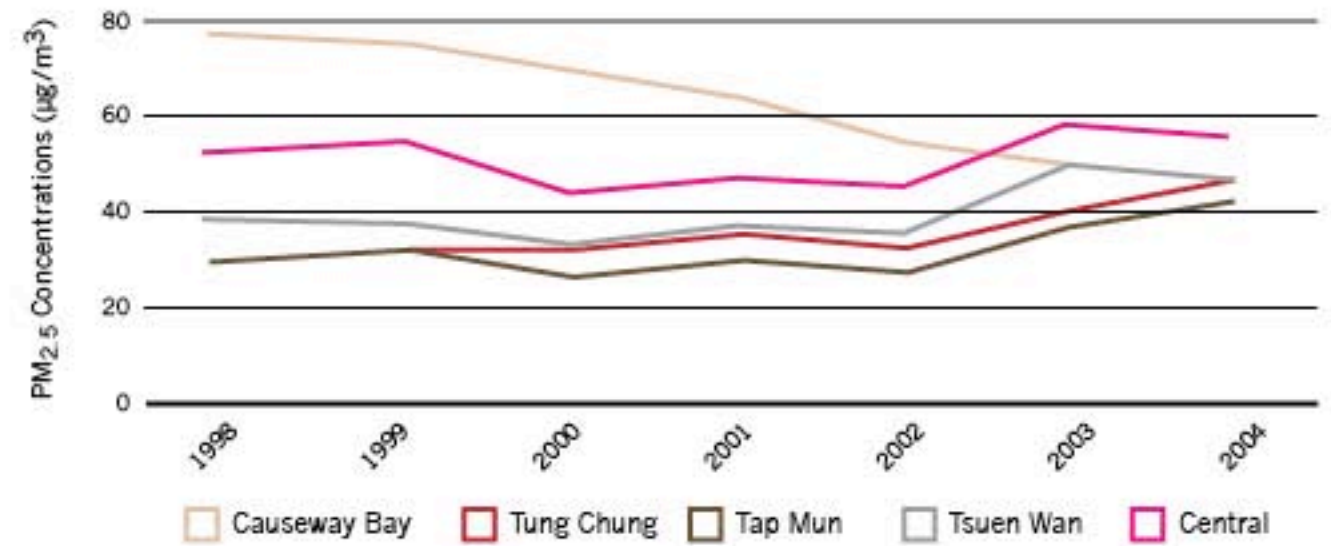


▲ Figure 13: Annual mean concentration of PM₁₀ in Hong Kong (1998-2004)

圖13: 1998至2004年香港PM₁₀全年平均濃度

[Department of Community and Family Medicine, Chinese University of Hong Kong (CUHK)]

[香港中文大學社區及家庭醫學系]



▲ Figure 14: Annual mean concentration of PM_{2.5} in Hong Kong (1998-2004)

圖14: 1998至2004年香港PM_{2.5}全年平均濃度

[Department of Community and Family Medicine (CUHK)]

[香港中文大學社區及家庭醫學系]

All roadside air monitoring stations and some general stations exceed the PM₁₀ AQO.

所有路邊監測站和部分一般監測站所錄得的PM₁₀濃度超出空氣質素指標。

While Hong Kong does not have a PM_{2.5} objective, available data allows us to compare the concentrations of this pollutant with other cities (see fig.9). Given the hazardous nature of PM_{2.5} the results are sobering.

雖然香港仍未為PM_{2.5}釐定空氣質素指標，但現有的數據容許我們把香港的PM_{2.5}濃度水平跟其他城市作比較。在已知PM_{2.5}是極具危險性的前提下，比較結果逼使我們認真思考和正視這個問題。

Hong Kong's Lax AQOs

Air quality standards should be set at limits reflecting the health risks associated with pollution levels. It is widely questioned by health experts whether Hong Kong's AQOs truly protect public health. Experts believe they are too lax when compared to standards in the US and EU, plus Hong Kong still does not have an objective for fine particulates (PM_{2.5}). Moreover, Hong Kong is still failing to meet our own objectives.

寬鬆的香港空氣質素指標

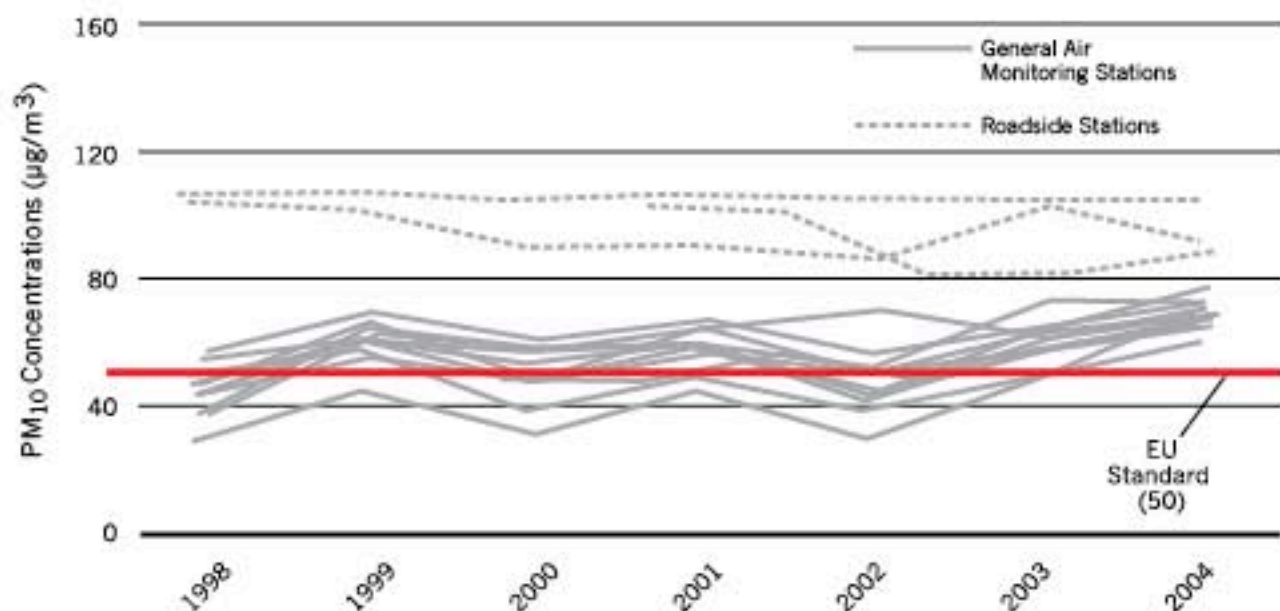
空氣質素標準應釐定在一個適當的範圍，以反映污染水平和有關的健康風險。衛生專家普遍質疑香港的空氣質素指標能否真正保障公眾健康。他們認為香港的指標與美國和歐盟的標準相比，實在過於寬鬆，而且香港亦欠缺微細粒子(PM_{2.5})的指標。更可惜的是，香港依然未能達到自己訂立的指標。

Hong Kong's Air Pollution Index (API)

The API is designed to measure the frequency and degree of air pollution in a particular city. The index level of 100 should not be exceeded more than a specified number of times a year, and air pollution alerts should be put out when the index reaches 200 or higher. During such alerts, people are advised to avoid outdoor activities. The daily API announcement, based on Hong Kong's AQOs, can be misleading. When based on standards elsewhere in the world, our 'medium' would be 'high', and our 'high' would be 'very high' or 'severe'.

香港的空氣污染指數

空氣污染指數的構思是，量度個別城市受空氣污染影響的次數和程度。每年指數到達100的日子不應超出一個特定的數目，而當指數到達200或更高時，有關當局應該發出空氣污染警報，勸籲市民避免進行戶外活動。香港每天公佈的空氣污染指數，是根據本港空氣質素指標計算出來的，空氣質素指標一旦過於寬鬆，指數便可能帶有誤導成分；若以世界其他地方的空氣質素標準計算，在香港屬於「中等」空氣污染水平的日子，在其他城市可能已屬於「偏高」水平；而香港的「偏高」日子，在其他城市可能變成了「甚高」，以至「嚴重」水平。



▲ Figure 15: Percentage of days with 24-hour mean PM₁₀ concentrations above EU Standards (1998-2004)

圖15：1998至2004年香港PM₁₀24小時平均濃度超出現時歐盟空氣質素標準的日數比率

[Department of Community and Family Medicine (CUHK)]

[香港中文大學社區及家庭醫學系]

SEVERE
API 201-500

VERY HIGH
API 101-200

HIGH
API 51-100

MEDIUM
API 26-50

LOW
API 0-25

▲ Figure 16: Hong Kong's API

圖16：香港的空氣污染指數

WHAT CAN HONG KONG DO ON ITS OWN? 香港可以推行甚麼措施？

1 Adopt an integrated energy policy

We need a clear policy driver rather than the piecemeal and often conflicting efforts we have today.

Thus, apart from the current government objectives of providing power reliably, safely and at reasonable prices, the policy must also require generating and using energy resources efficiently and protecting the environment and public health, as well as reducing climate change.

採用綜合的能源政策

我們需要一個清晰明確的政策，而不是目前既零碎而又不時互相抵觸的措施。

因此，政府除了要維持既定方針，確保提供可靠、安全和價錢合理的電力外，政府的政策還必須要求能源的生產和使用符合高效率、保護環境、保障公眾健康和減少對全球氣候變化的影響。

CLIMATE CHANGE

The fossil fuels that we burn in energy production, vehicle use and manufacturing don't just pollute our local air: they also release gases that contribute to the greenhouse effect, and so effect the climate of the whole planet.

The 'greenhouse effect' is caused by gases in the earth's atmosphere that trap the heat of the sun. Although this is a natural phenomenon, human activity has greatly increased the concentration of particular gases in the atmosphere, known as 'greenhouse gases', causing the planet to heat up. One of the most significant greenhouse gases is carbon dioxide, which is released when fossil fuels, such as coal and oil, are burnt.

Human-induced change to the atmosphere's chemical composition has wide-ranging effects on climate, from rising sea-levels to changes in precipitation. These effects are expected to intensify in the future.

氣候變化

在生產能源、使用汽車和製造業生產過程中所燃燒的化石燃料，不單只造成本地的空氣污染，排放出來的氣體同時會引發「溫室效應」，對全球氣候造成影響。

「溫室效應」的成因是大氣層內的一些氣體吸收了太陽熱能。這本來是一種自然現象，但人類活動大幅增加了個別「溫室氣體」在大氣中的濃度，令地球的氣溫不斷上升。在燃燒煤和燃油等化石燃料時產生的二氧化碳，便是其中一種主要的溫室氣體。

人為因素改變了大氣層的化學成份，為全球氣候帶來多方面的影響，包括海平面上升和降雨量改變等。專家估計，這些影響在未來將會進一步白熱化。

2 Tighten AQOs

Hong Kong's AQOs, set in 1987, are outdated and cannot protect public health. They have, in effect, become a licence to pollute.

The new WHO's recommended standards go into effect in September 2006. Hong Kong people will not fail to notice that our AQOs will then be even further behind those of developed countries. Hong Kong needs to commit to a timetable to catch up to the air quality standards of developed cities. The government publicly commented in July 2006 that it may revise Hong Kong's AQOs in the foreseeable future, and is commissioning a review.

收緊空氣質素指標

香港的空氣質素指標於1987年訂立，早已不合時宜，根本不能保障公眾健康。事實上，香港的空氣質素指標已淪為部分人肆意製造污染的「護身符」。

世界衛生組織最新建議的空氣質素標準將於2006年9月實施。香港市民一定注意到我們的空氣質素指標將進一步落後於其他先進的城市。香港政府必須承諾定出時間表，務求趕上其他先進城市的空氣質素標準。政府於2006年7月公開提到有可能在可見未來修訂本地的空氣質素指標，並已委任有關部門進行檢討。

3

Replace old vehicular fleet quickly

As Hong Kong power plants are already upgrading to reduce emissions, the focus now must be on transport. Our road density is among the highest in the world at 265 vehicles per kilometre. About 30% (131,400) of these are diesel-burning commercial vehicles contributing between 60% to 70% of the vehicle mileage in Hong Kong.

The current policy to provide financial assistance to retrofit heavy diesel vehicles with catalysts is inexpensive but sub-optimal. Even if the cleanest ultra low sulphur diesel (ULSD) fuel is used in the Euro I, II or III engines, emissions will still be higher than a Euro IV engine using ULSD.

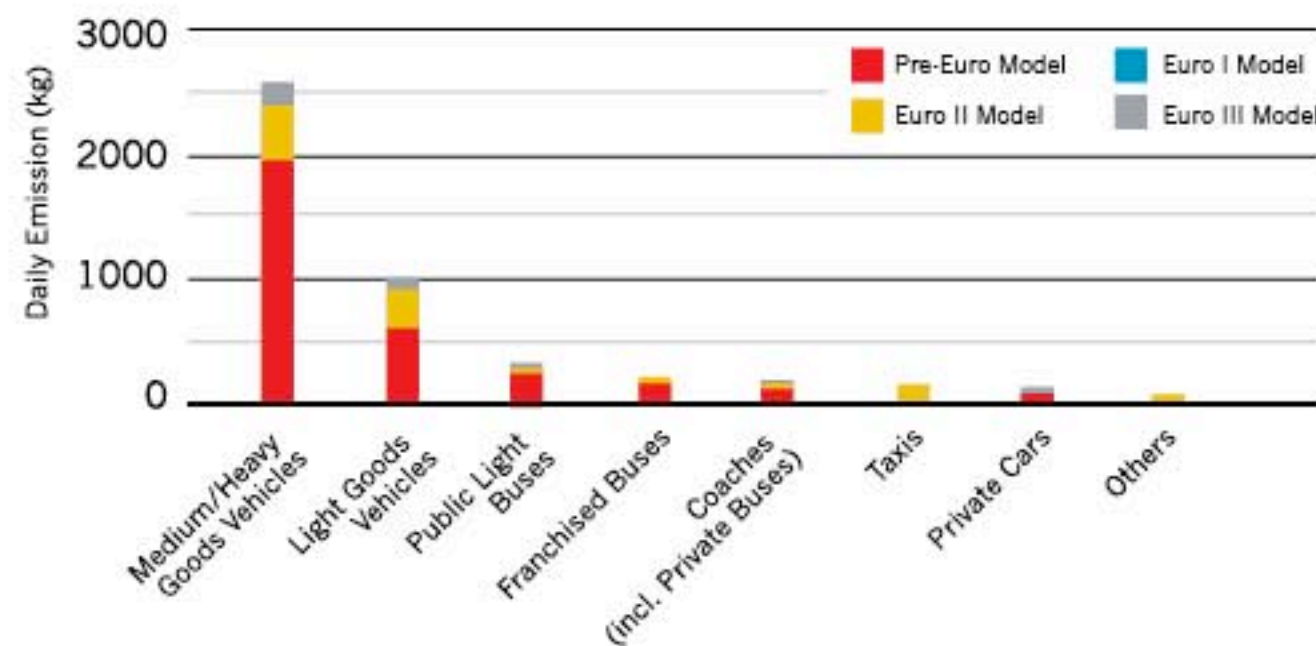
加快更替舊車隊

當香港的發電廠正在提升裝置，為減少排放廢氣做好準備之同時，交通運輸必然成為下一個我們需要關注的對象。香港每公里道路平均有265部汽車，車輛的密度位居世界第一。在所有汽車當中，約有30%（即131,400部）是燒柴油的高用汽車，佔全港車行里數約60%至70%。

政府目前的政策是向車主提供財政上的協助，為重型柴油車加裝催化器。雖然這項措施的花費不多，但成效卻不甚理想。我們即使選擇使用最潔淨的超低硫柴油配合歐盟一期、二期或三期車輛，舊車的污染物排放量仍高於使用超低硫柴油和歐盟四型引擎的車輛。

Engine	PM	Carbon Monoxide	Hydro-carbons	Nitrogen oxides
Euro I	0.36	4.5	1.1	8
Euro II	0.15	4	1.1	7
Euro III	0.1	2.1	0.66	5
Euro IV	0.02	1.5	0.46	3.5

▲ Figure 17: Exhaust emissions (gram per kw/h)
圖17: 歐盟引擎的廢氣排放量(克/千瓦時)
[The Institute for the Environment, HKUST]
[香港科技大學環境研究所]



▲ Figure 18: Daily Emission of PM by Motor Vehicles in 2004
圖18: 2004年每日汽車懸浮粒子排放量
[HK SAR Government EPD]
[香港特區政府環境保護署]

4

Operate clean ports & logistics

Bunker fuel used in shipping is high in sulphur. It is at the bottom rung of refined fuels in emissions terms. There are growing worldwide concerns over emissions when ships come to port.

Many of our pre-Euro trucks and Euro I and II vehicles are part of the logistics trade moving export-import products to and from the ports on both sides of the border.

The body of water between Hong Kong and its neighbouring ports has the highest density of shipping and logistics activities in the world. We must therefore operate the cleanest ports and logistics industries to handle such density of activities without creating unacceptable levels of pollution.

In recent years, Hong Kong's logistics industry has gotten together and successfully improved sector-wide problems. They can do so again by focussing on reducing energy intensity, using cleaner fuels and working with port and terminal owners/operators to improve their environmental impact.

經營環保的港口及物流業

船用燃料的含硫量很高，屬精煉燃料當中级別較低，而污染物排放量則偏高的產品。世界各地正日益關注船舶駛進港口時排放污染物的問題。

不少歐盟前期貨櫃車及歐盟一期與二期車輛是本港物流業的一分子，不時穿梭中港兩地港口，運送進出口貨物。

香港與鄰近港口群是全球航運和物流活動最頻繁的水域。因此，我們一定要經營最潔淨和環保的港口及物流業，才可以一方面處理如斯繁忙的港口活動，另一方面又不會製造令人難以接受的污染水平。

近年，香港的物流業團結一致，成功改善了業內不少問題。業界可以再接再厲，齊心減少物流業對能源的消耗，採用較環保的燃料，與港口及碼頭擁有者或營運商合作，改善對環境的影響。

5

Prioritise rail and coordinate road usage

Hong Kong's stated transport policy is supposedly rail-led but in reality is road-led. This must change. The best way to reduce vehicular emissions and congestion is to look at expanding rail to replace some road projects. An example is to build the North Island Line and the South Island Line on Hong Kong Island in place of various planned highways

The government's hesitation to subsidise the capital cost of rail construction creates a false economy. When the full external costs of roads are taken into account (such as healthcare costs, pollution, land wastage, congestion etc), Hong Kong heavily subsidizes road transport. The government must coordinate rail and road usage so that connecting points are well-designed for switching convenience. Policies for granting bus and mini-bus routes will also have to be re-thought. Hong Kong can also adopt demand management methods, such as road pricing, as London has done.

優先發展鐵路和協調道路的使用

香港既定的交通運輸政策原應以鐵路為主，但實際上卻以道路為主。我們必須改變這種情況。擴建鐵路系統取代部分道路工程項目，是最有效減少汽車污染和交通擠塞的做法。例如：我們可以在香港島興建北港島綫和南港島綫，代替多條計劃興建的公路。

政府對補貼鐵路的建築成本遲疑不決，實在是省錢不得其法。若將道路的所有外在成本計算在內，包括醫療保健開支、污染、浪費土地及交通擠塞等，香港實質上大幅補貼了路面運輸。政府必須協調鐵路和道路的使用，並妥善設計換車站，方便市民轉車。同時亦應重新考慮目前審批巴士和小巴新路線的做法。此外，香港可以採用交通需求管理方法，如已在倫敦推行的道路收費系統。

Compared to Tokyo, our rail network is sparse. 跟東京相比，香港的鐵路網絡覆蓋不足。



▲ Figure 19: Tokyo's railway system
圖19:東京的鐵路系統
[<http://www.tokyometro.jp/e/>]



▲ Figure 20: Hong Kong's railway system
圖20:香港的鐵路系統
[<http://www.mtr.com.hk/eng/train/intro.html>]

6

Manage development to reduce 'street canyon effect'

Hong Kong's roadside pollution is very high. Road transport in 2004 contributed: 27% of total NO_x (NO_x contributes to NO₂); 25% of total PM₁₀; and 86% of total combustion related VOCs.

Public health experts estimate that more than half the population is regularly exposed to this toxic mix: 46% of Hong Kong people live 5 minutes from a road space with heavy traffic; 26 hours per week is spent outdoors; and 12 hours (46%) near a busy road.

VOCs and NO_x combine in the presence of heat and sunlight to form ground-level ozone (O₃). Roadside station measurements have exceeded the annual average objectives for NO₂ and RSP (PM₁₀). NO₂ concentration is very high at all the roadside stations and is directly related to heavy vehicular traffic, exacerbated by the street canyon effect. Hong Kong's roadside pollution levels are often more than double those in the European Union. To correct this, the way in which we plan our city needs to dramatically change. We will need to design air flow areas to reduce the street canyon effect and approach new developments much more sensitively.

管理發展密度，以減低「街道峽谷效應」

香港的街道污染十分嚴重。在2004年，路面運輸產生的污染物，約佔氮氧化物排放總量的27%（氮氧化物會產生二氧化氮）；PM₁₀排放總量的25%；因燃燒產生的揮發性有機化合物排放總量的86%。

香港有超過一半人口經常接觸這有毒的污染物：46%香港人的住所，距離繁忙街道只有五分鐘路程；香港人每星期有26小時在戶外活動；當中12小時(46%)在繁忙街道旁。

揮發性有機化合物和氮氧化物會在有熱能及陽光的环境下結合，形成地面臭氧。路邊監測站所錄得的二氧化氮和可吸入懸浮粒子(PM₁₀)水平，都超出了全年平均濃度指標。所有路邊監測站均錄得極高的二氧化氮水平，這情況直接與繁忙的交通有關，而街道峽谷效應則令問題變得更加嚴重。香港的街道空氣污染水平經常比歐盟成員國高出一倍以上。我們必須改革目前規劃城市的方法，以扭轉局面。例如：我們需要在城市設計方面引入一些通風地帶，以減低街道峽谷效應。我們亦要周全地考慮新的城市發展項目。

7

Push energy efficiency management

Why are Hong Kong's indoor temperatures set so low so people have to wear jackets? After nearly two decades of complaint, a real commitment must be made. The government effort to set public sector office temperature to 25.5 °C (July 2006) is welcomed. The private sector must follow. Moreover it is possible to contract energy efficiency experts to be paid according to the energy they save for clients.

推動能源效益管理

為甚麼香港人把室內溫度調得那麼低，令市民需要在室內穿外套呢？經過接近二十年的投訴，政府必須作出承諾，改善問題。我們對於政府將所有部門辦公室的溫度調低至攝氏25.5度（2006年7月）表示歡迎。我們認為私人機構亦應跟隨。此外，我們大可以聘用能源效益專家提供節能的建議，並按照節省能源的幅度支付專家費用。

Working Together: Hong Kong & Guangdong

香港與廣東省攜手合作

1

Build air management framework and capacity

With a critical mass of competent air quality scientists and regulatory officials to build upon, Hong Kong and the PRD must now develop capacity such as that of the California Air Resources Board through substantial and sustained investments in research and capacity building.

Sharing air monitoring data

Hong Kong and the PRD share emission data from a series of air monitoring stations in the region. The next step is for the authorities to release full breakdowns of each pollutant, including PM_{2.5}, real-time, on-line. This will help scientists understand the impact of individual emission sources or categories of emissions as well as provide more public information.

建立空氣管理框架及強化管理能力

香港及廣東早已匯聚了一批精通空氣質量研究的科學家和擅長空氣質量規管事宜的官員。在這基礎上，兩地政府應該持續地投入更多資金，進行新的科研項目和強化管理能力，發展一個足以媲美加州空氣資源局的空氣管理框架，令香港及珠三角的空氣質量監管工作做得更好。

香港和珠三角可以共同分享區內空氣監測站所錄得的污染物排放資料。在下一階段，有關當局可以透過互聯網提供各種污染物（包括PM_{2.5}）的即時讀數。這將有助科學家瞭解個別污染源或不同污染類別的影響，同時亦可以向市民提供更多資訊。

2

Focus on manufacturing

Hong Kong is the largest source of outside investment in Guangdong's manufacturing sector. There are 53,000 to 70,000 Hong Kong-owned and managed plants in Guangdong. Manufacturing in Guangdong accounts directly and indirectly for two-thirds of all the coal burnt in Guangdong, one-third of all the fuel oil, and uses 90% as much diesel as transport.

Until the Chinese government rationalizes its fuel pricing policy, makes cleaner fuel more widely available and mandates its use, Hong Kong's plants in the PRD must focus on energy efficiency and in using the best emission control technologies. In the short-term, the Hong Kong authorities need to work with industries and their PRD counterparts to find a way for exporters to use cleaner fuels for powering their private generators.

關注製造業的污染情況

香港是廣東省製造業最大的外來投資者，全省約有53,000至70,000間由香港人開設及管理的工廠。廣東的製造業直接及間接地耗用了全省三分之二的煤和三分之一的燃油。此外，製造業耗用的柴油量已相等於運輸業柴油使用量的90%。

在中國政府仍未把燃料價格政策合理化，讓潔淨燃料變得普及和強制使用潔淨燃料之前，珠三角的港資工廠必須致力提高能源效益和應用最佳的控制排污技術。短期而言，香港政府需要與本地及珠三角的廠商攜手合作，尋求辦法協助他們使用較潔淨的燃料自行發電。

3

Focus on ports and logistics

In addition to Hong Kong's own efforts and in the longer term, regional container terminals need to use cleaner fuels within local harbours, provide grid power to ships at berth, consider building intra-port rail and using electric vehicles at port.

關注港口及物流業的污染情況

除了香港的港口及物流業付出了努力之外，長遠而言，內地貨櫃碼頭亦應使用較潔淨的燃料，並設法透過電力公司的電網，為停泊於碼頭泊位的船隻供電。同時，內地可以考慮在港口範圍內興建鐵路系統和使用電動車輛。

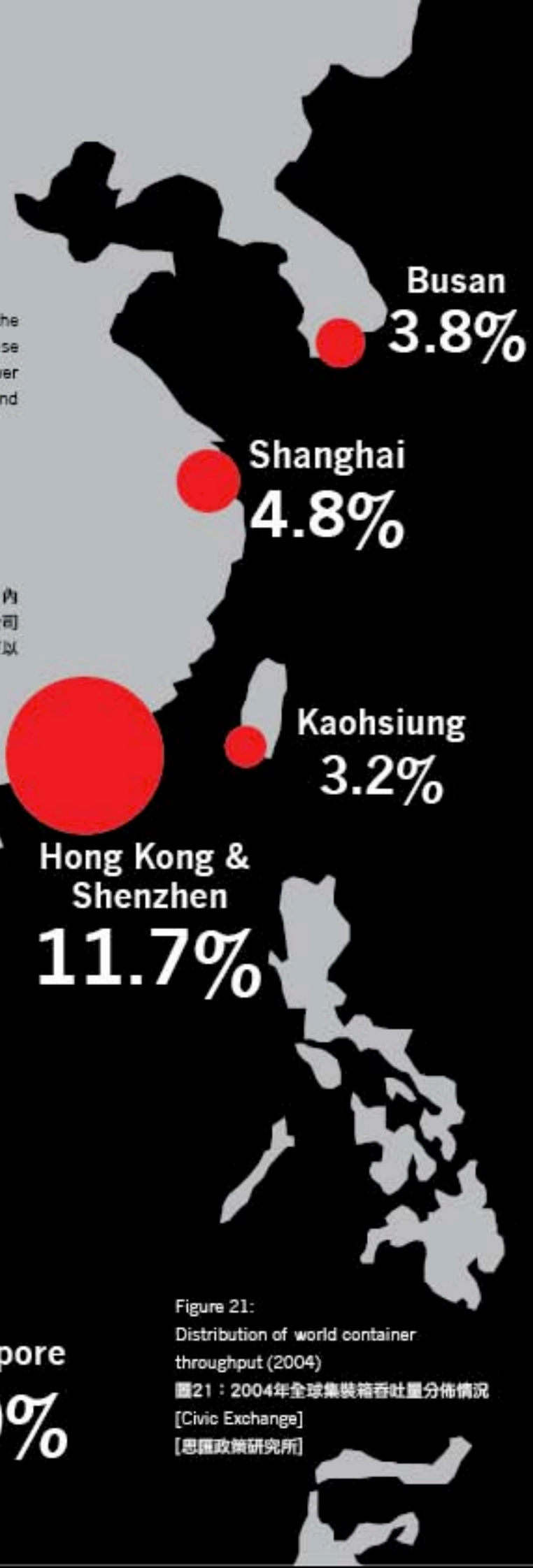
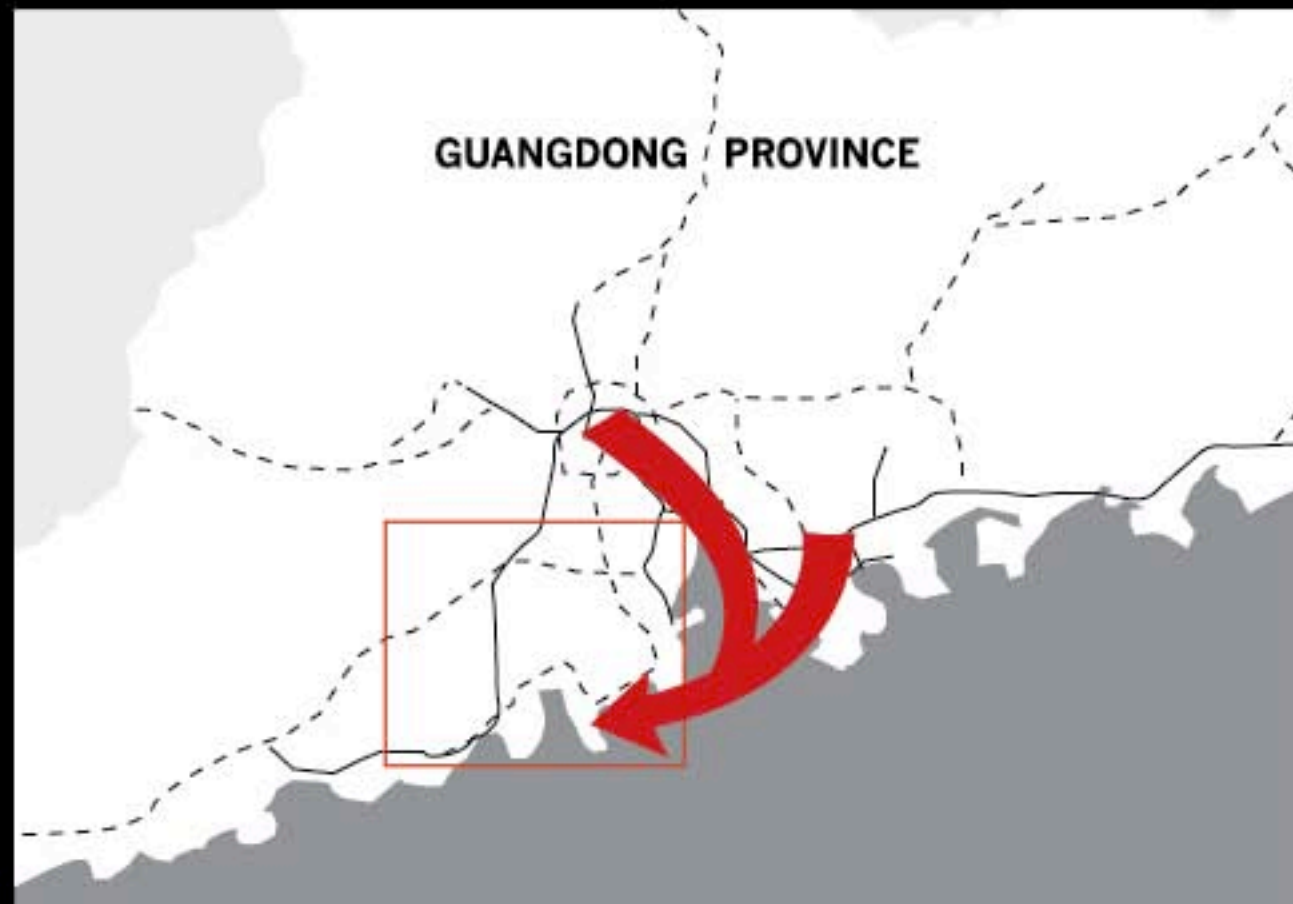


Figure 21:
Distribution of world container throughput (2004)
圖21：2004年全球集裝箱吞吐量分佈情況
[Civic Exchange]
[思匯政策研究所]



▲ Figure 22: Moving heavy polluting industries away from the Pearl River estuary
圖22：把高污染性的工業遷離珠江河口
[HKSAR Government Lands Department]
[香港特區政府地政總署]

4

Build cross-border planning and regulation framework

Hong Kong, Guangdong and Macau needs to work closely to plan the region's growth. Meteorology and air quality studies show the best sites for the more polluting industries are in Western Guangdong because the natural airflow will help to transport emissions away from the PRD. Today, heavy polluters are sited where emissions are trapped in the heart of the Pearl River estuary.

建立跨境的規劃和監管框架

香港、廣東及澳門應該緊密合作，共同為地區發展進行規劃。根據一些氣象及空氣質素研究指出，由於廣東西部有天然的氣流把污染物吹離珠三角，因此該處是高污染性工業的最佳選址。現時，高污染性的工業主要分佈在珠江河口的中心位置，即區內污染物經常積聚的地方。

The less energy we use,
the less we pollute.

The more efficiently we produce energy,
the less we pollute.

The more efficiently we deliver energy,
the less we pollute.

The cleaner the fuel,
the less we pollute.

耗用能源越少，
污染越少。

生產能源的過程效率越高，
污染越少。

供應能源的過程效率越高，
污染越少。

使用的燃料越潔淨，
污染越少。