DEALING WITH HONG KONG'S AIR QUALITY PROBLEMS

New Policy Direction

USING CLEANER FUELS

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CIVIC EXCHANGE

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Using Cleaner Fuels

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Civic Exchange is a non-profit organisation that helps to improve policy and decision-making through research and analysis.

PREFACE

We are grateful to the The Fan Family Charitable Trust for providing the funding for this report. Without this funding we would not have been able to capitalise on the air quality management research work that Civic Exchange has undertaken over the past three years. The integration of these findings was key in developing what is hopefully a new, coherent policy direction. We believe our policy and project work dovetails with the measures that the HKSAR Government and the Guangdong Authorities are promoting, and that it provides a focus for manufactures and industry controlled by Hong Kong companies to take action. Many stakeholders need to take action to clean up air pollution in Hong Kong and the switch to cleaner fuels is a measure that Hong Kong companies can control and implement in the near future.

We would like to thank a number of people who contributed to this report. The authors are Bill Barron, Christine Loh and Kylie Uebergang. We are also grateful of people who shared their expertise with us - Arthur Bowring, Molly Bersani, Lisa Hopkinson, Alexis Lau and Nina Trautman. We also thank the South China Morning Post and Moody's for allowing us to present their data.

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We especially wish to thank Henry Fan and Lily Fan for their personal support in Civic Exchange's environmental work.

Christine Loh
Chief Executive Officer

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Executive Summary

The deterioration of Hong Kong's air quality reached record levels in 2004. In a worrying development, the months of June to October, normally a time when sea breezes provide relief from harmful pollutants in Hong Kong, provided no reprieve. Various HKSAR Government reports confirmed that 2004 experienced the worst visibility on record and the Secretary for Environment, Transport and Works stressed that Hong Kong's scope to impact local air quality was limited.[1] Understandably, community, academic and business groups are increasingly concerned about local air quality and the sustainability of Hong Kong as a healthy place to live and do business. Building on previous air quality management work undertaken within the Pearl River Delta (PRD) region[2] and responding to heightening public awareness, Civic Exchange has developed a new policy direction which attacks the root of the regional air quality problem – the use of high emission fuels to produce and move goods from the PRD to the rest of the world.

Civic Exchange collaborated with various Hong Kong-based, Mainland and overseas institutions from 2002-2004 on a regional air quality management project.[3] The direct air quality data derived from that project, as well as taking into account available air quality data for Hong Kong and the PRD, paints a grave picture. Civic Exchange has also considered the efforts and plans of the HKSAR Government and the Guangdong authorities to improve air quality.[4] While these official efforts are very important, they are unlikely to be sufficient. There are constraints to what the HKSAR Government can achieve in relation to cross-border pollution arising from PRD sources, and realistically, it will take a very long time for Guangdong to make and enforce regulatory changes which significantly reduce air pollution from all of the various polluting sources.

Therefore, Civic Exchange believes that civil society's efforts should be aimed at areas where there are not yet any official foci but which could make a real impact through voluntary measures and advocacy of using cleaner fuels. In collaboration with academics, NGOs, government officials and businesses, Civic Exchange has considered what may be the best approach to achieve progress against air pollution in the short to medium term. In determining this new policy direction, Civic Exchange has focused on steps which can be implemented without excessive costs, are not currently targeted through government initiatives *and* likely to make a real impact on existing pollutant levels.

A very large portion of air pollution is derived from combustion of fossil fuels. Air quality is thus intimately tied to the use of energy as energy is still largely derived through fossil fuel combustion. Different combustion processes emit different pollutants dependent on many factors including the type of fuel and equipment used. For instance all combustion processes emit Oxides of Nitrogen (NOx). Combustion of high sulphur fuels, which include certain types of coal and diesel (used in power generation, marine and aircraft vessels and industrial fuel combustion) also emit significant levels of Sulphur Dioxide (SO_2) as well as direct emissions of particulate matter (PM). NOx and SO_2 also react in the atmosphere to form additional PM, often a long distance from the source. All of these pollutants have negative health impacts in themselves. Recent reports released by the World Health Organisation reconfirmed that PM poses a significant risk to human health at concentration levels far below those prevailing in Hong Kong.[5] The use of cleaner (i.e. low sulphur) fuels will thus result in less SO_2 and PM pollution which will have a positive impact on the health of the 50 million residents in the PRD region[6].

Civic Exchange proposes a new policy direction to improve Hong Kong's air quality through fully understanding the existing usage of low quality fuels, determining the availability of higher quality cleaner fuels and understanding the issues which fuel users consider in the process of switching to use cleaner fuels in their energy production. At the same time, Civic Exchange is also working on other projects that look at how to improve energy efficiency,[7] as well as combat climate change.[8]

The policy proposal outlined below complements existing policies of the HKSAR Government and Guangdong authorities in emissions control, yet it is an area where both authorities are not currently focused in terms of strategy implementation. We hope that the totality of these various projects will add substantially to Hong Kong's and Guangdong's understanding of what can be done to improve regional air pollution in the short to medium term and with this policy proposal, the effort in fact moves beyond "thinking" to "doing". The proposal requires the engagement of businesses operating in the PRD to change their energy practices, which will hopefully also provide a sustained effort to broaden awareness building about the vital nexus between energy production and air quality.

There are THREE aspects to our policy proposal:

1. **Current usage of fuels in industry.** The first task focuses on working with the Hong Kong owned manufacturing industry operating in the PRD to understand the usage and availability of low quality fuel with the ultimate aim of promoting voluntary fuel substitution to cleaner fuel.

2. **Availability of cleaner industrial and shipping fuel supplies.** The second task examines possible constraints and opportunities for supplying adequate volumes of cleaner fuel for use in industry and marine transport (which are further considered in tasks 1 and 3).

3. **Marine fuels review.** The third task summarises the current and future impact of marine transport emissions within Hong Kong and PRD ports. This task also explores ways to control SO_2 concentrations which are emitted by marine transport and considers the options for future regulation of fuel quality in PRD waters.

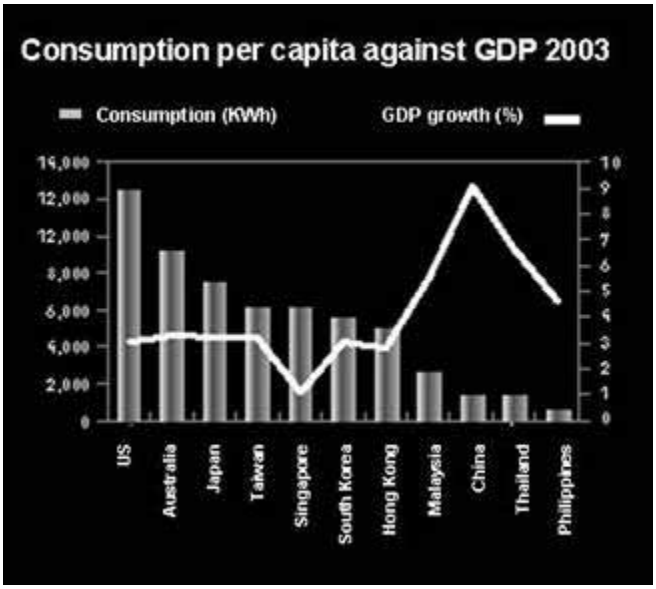
Upon completion of these tasks Civic Exchange will have a deeper understanding and solid supporting data to develop a strong Voluntary Fuel Switching Campaign targeted at both industry and shipping operating within the PRD region. While this policy document highlights Civic Exchange's intention to develop a Fuel Switching Campaign, the details of such a campaign cannot be formulated until the research component of this new policy is undertaken.

1.0 Background

1.1 Threats to sustained economic development

In recent years cross boundary air pollution has become a major problem for Hong Kong, threatening to undermine the territory's position as a desirable location for Asia Pacific headquarters of international firms. In addition, chronically poor air quality over the entire PRD is seriously damaging the health of about 50 million people and impacting visibility. The combination of poor fuel quality, inefficient power generation and overall energy use is also contributing to high and unnecessary emissions of greenhouse gases[9] and local and regional air pollution.

Figure 1 – Power consumption per capita versus 2003 GDP for selected countries



Source: Moody's Investors Service, March 2005

As shown in Figure 1, China's energy usage per capita is much lower than other countries. The enormity of China's potential growth in energy demand per capita compared to countries such as Australia will contribute massively to the world's stock of greenhouse gases and to local and regional air pollution. Developing China's energy supply in a sustainable way is therefore critical.

The PRD has developed rapidly during the past 20 years and now has a GDP in excess of HK$ 2,430 billion.[10] With manufacturing for export being its main business, Hong Kong plays an important role in transporting those exports to their ultimate destinations. The ability of the authorities in Hong Kong and Guangdong, the richest areas in China, to manage and improve air quality in the future represents a proxy discussion about how China can develop in a sustainable manner.

1.2 Who is paying the real cost of air pollution?

The real cost of air pollution includes not only financial costs, which are easily identified, but also environmental and health costs which are harder to identify; they occur over a long period of time and are usually overlooked completely in determining the 'cost' of producing a good or service. In effect, the severe damage to the environment, public health and well being of tens of millions of people in the PRD are currently being treated as *external costs*. For instance, the value of the damage to the health of the people of Hong Kong and the PRD is not being factored into the monetized cost of goods produced in the region. While locating production in the PRD results in competitive export advantages for the goods and services being produced there, the people living in the PRD region, including Hong Kong, are in fact subsidising the external costs of the buyers and consumers in places such as North America, Europe and other parts of Asia.

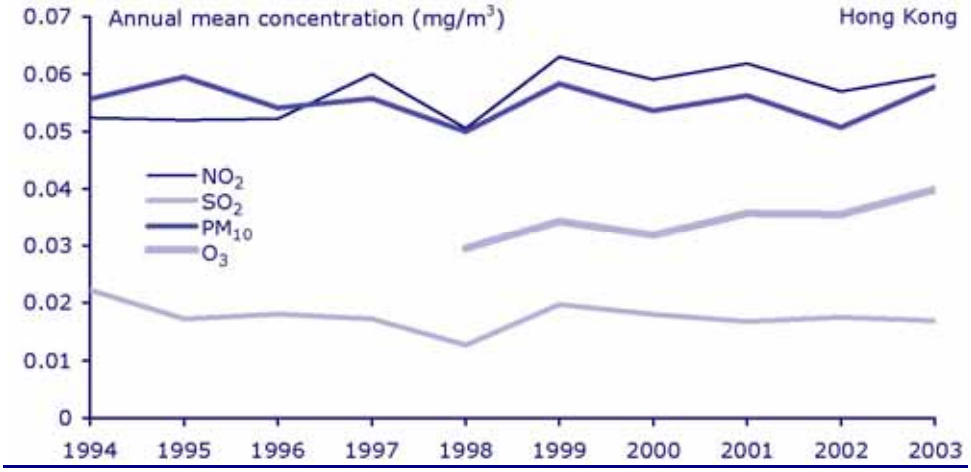
1.3 Sources of pollution

While identifying the sources of Hong Kong's air pollution is complex, data collection and analysis undertaken by the Hong Kong Environmental Protection Department (HKEPD), local scientists and a collaborative multi-stakeholder team led by Civic Exchange (including experts from Hong Kong, China, the Netherlands and the US), provides a telling picture as to the types and locations of emissions affecting Hong Kong. Many of these sources originate from outside Hong Kong's jurisdiction in neighbouring PRD areas. The impact of meteorological conditions, geographical characteristics and the man-made built environment are also important factors which influence local air quality.

Various key emission sources play a role in contributing to poor air quality in both Hong Kong and the wider PRD region. Energy generated by industrial factories in Guangdong using heavy fuel oil, the coal-burning power plants in both Guangdong and the HKSAR's own coal-burning power plants, are all major sources of pollution. Vehicles in both Hong Kong and Guangdong are other major sources. While marine and air transport may not be major contributors in terms of absolute volumes of emissions, the geographic dispersion of pollutants from air and marine transport contributes to higher emissions in specific locations which are often already sensitive, such as Tung Chung downwind of Shenzhen and Dongguan, and Kwai Chung in the heart of Kowloon, an area that houses over 3 million residents.

Total air emissions in Hong Kong decreased between the period 1994 to 2002 (Figure 2). However emissions in 2003 began to reverse this trend and although not yet officially available, figures for 2004 have continued to worsen.

Figure 2 – Air emissions in Hong Kong (1994-2003)



Source: HKEPD

A summary of Hong Kong's major pollutants NO_2 (Nitrogen Dioxide), SO_2 (Sulphur dioxide), PM_{10} (Particulate Matter or Respirable Suspended Particulates), and O_3 (ozone), including their sources in 2003 and known health effects are included in Appendix A.

It is tempting to look for a single source on which to blame Hong Kong's worsening pollution problem but the truth is that cleaner air for Hong Kong and the larger PRD region will require action on several fronts. While there has been recent media coverage suggesting that deteriorating air pollution and visibility are due to changes in the fuel mix of Hong Kong power plants given certain meteorological conditions, there is in fact overwhelming evidence to show that for Hong Kong the transportation of pollutants from the PRD region has a great impact. Long term data also shows that although emissions from Hong Kong's power companies have decreased significantly in the past 10 to 15 years, this has also been a time of declining air quality in Hong Kong. The fact is that working on any one emission source alone, such as power plants in Hong Kong, will not be sufficient to result in clear blue skies. To make an impact, action needs to be taken in all areas of energy production and transport, both within Hong Kong and across the border

1.4 Government efforts

The HKSAR Government's efforts in combating local pollution have focused on local power plants and vehicles during the past 5 to 10 years and most recently targeting other sources such as harmful types of printing, paints and solvents.[11] The Guangdong authorities' pollution strategies, which are outlined in the Regional Air Quality Management Plan, also focus on building cleaner power plants and cleaning up the old ones along with vehicle emission strategies and replacement of harmful paints and solvents. While the Guangdong energy sector control measures propose the use of cleaner fuels which are defined in terms of

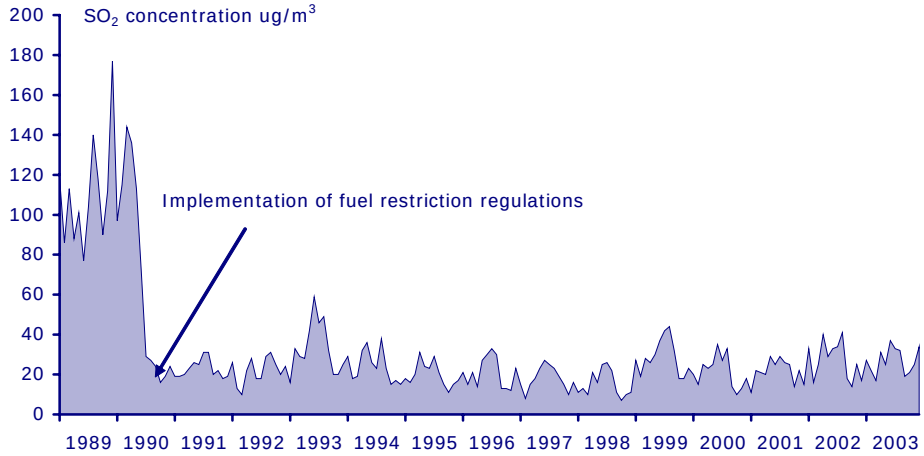
maximum sulphur contents; 1% for coal and 1.5% for fuel oil[12]; cleaner fuel measures have not been specifically identified for the industrial sector. Instead industrial sector control measures advocated in the joint government's "Study of Air Quality in the Pearl River Delta Region" (the Joint Study, which forms the basis of the Regional Air Quality Management Plan), focus on the use of cleaner production technology and the enforcement of emission regulations for industry. Industrial sector strategies also focus on industrial boilers and processes including the phasing out of small coal-fired boilers in cities and the adoption of pollution control systems in larger industrial boilers.

Although there have been no control initiatives to date which focus on improving the fuel quality of generators used by most industrial manufacturers in the PRD, the use of cleaner fuels has been suggested in the Joint Government Study as an effective control measure for other polluting sources including the energy sector (power production), domestic fuel usage and commercial fuel usage, thus the principle of using cleaner fuels is one that is supported by both governments. Perhaps issues such as the supply of cleaner fuels or the massive and fragmented scale of industrial generation has hampered enthusiasm to develop and implement regulatory or even voluntary cleaner fuel programs for industry.

Fuel regulation in Hong Kong

In July 1990 the Hong Kong Government banned the sale and use of high sulphur fuel in industry. Before the ban the average sulphur content was about 2.5%, and this was reduced to not more than 0.5% by weight. As shown in Figure 3, there was an immediate 80% drop in SO_2 emissions in the Kwai Chung district and an average of 50% drop in SO_2 emissions across Hong Kong.

Figure 3 - Benefit from fuel regulation in Hong Kong (1990)



Data for the chart was based on measurements of Kwai Chung Monitoring Station. Source: HKEPD

In monitoring the health impacts of this new fuel regulation, local public health experts recorded a marked improvement of lung function and reduction of clinical symptoms of bronchitis in children aged 8 to 10 years and a reduction in bronchitic symptoms in their mothers.[13] The University of Hong Kong researchers also concluded that mortality across the whole population declined by an average of 2.2% which is equivalent to about 600 deaths per year.

The combustion of high sulphur fuels produces SO_2 which plays an important role in the formulation of PM, a pollutant that contributes to the development of smog and further causes respiratory problems in adults and children.

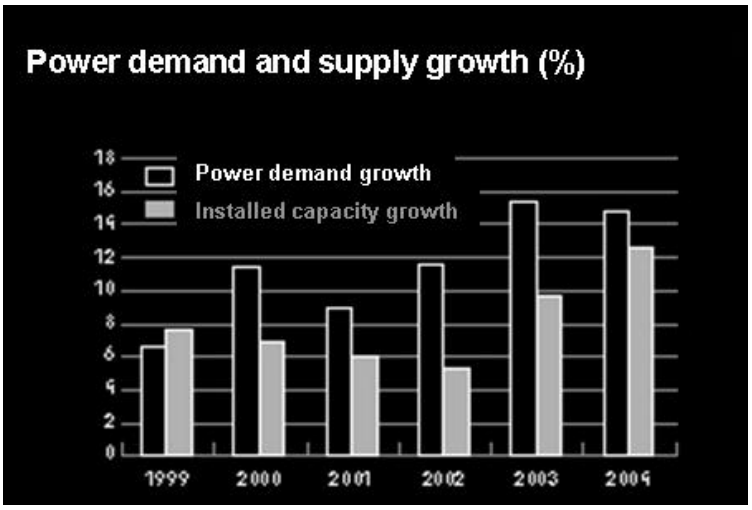
1.5 Energy supply and fuels

One of the most significant sources of pollution comes from manufacturing plants throughout the PRD.[14] Every day, over US$300 million worth of goods are produced by tens of thousands of factories in the PRD.[15] Guangdong exports in fact make up 98% of its GDP.[16] Problems arise as many of the factories (up to 90%)[17] run small "back yard" generators which industry commentators estimate to be currently contributing up to one third of available power. The problem is that these small generators have little or no emission controls and yet they have become the required energy crutch for Guangdong factories striving to fulfil energy needs to continue driving economic growth.

The energy shortage

Grid power supply in China, especially in Guangdong, has been a problem for many years as economic growth rates have exceeded the ability of local authorities to supply power. This supply shortage was exacerbated by a three-year moratorium on the production of power plants beginning in 1998 resulting from the onset of the Asian Financial Crisis.[18] Continuing double-digit economic growth rates in Guangdong have rapidly absorbed all increases in capacity. As shown in Figure 4, China's power demand growth has exceeded installed capacity/ supply growth for the past several years. Experts predict that overall China will experience power shortages through to at least 2006-07, after which there may be a period of over-supply in some areas.[19] There is however no guarantee that in two years time, Guangdong's grid power will truly be solved because many other factors are involved.

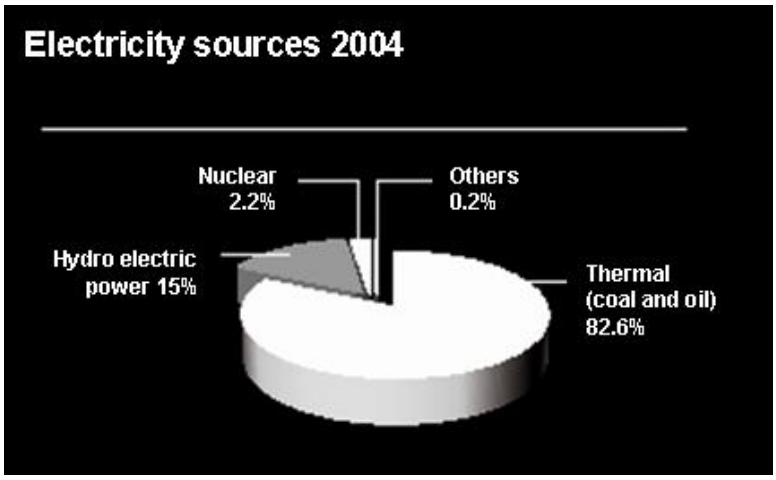
Figure 4 – China's power demand and supply growth (1999 – 2004)



Source: Moody's Investors Service, Special Comment, March 2005

Published reports indicate that the state-owned Southern Power Grid, which supplies five provinces including Guangdong, is expected to face shortages in 2005 of more than 7,000 megawatts (MW), which is roughly equivalent to the entire installed capacity of Singapore. Overall China's power shortage was estimated at 25,000 – 30,000 MW in 2004.[20] Even though mainland power plants may have generating capacity, they are also facing shortages of fuels; over 80% of power is generated by coal and oil (see figure 5). In mid-March 2005 alone, 13 power plants supplying the Southern Power Grid reported that their output was restricted due to having insufficient supplies of coal.[21] It is also widely speculated that unregulated (illegal) power plants which are usually smaller and highly responsive to market demand have switched to heavy oil with higher sulphur content amid higher coal prices.[22]

Figure 5 – China's electricity sources (2004)



Source: Moody's Investors Service, Special Comment, March 2005

Guangdong's overall economic growth is being affected by energy shortages. For example, Guangzhou reported the worst power shortage in a decade during the first three months of 2005 when on 716 occasions power had to be restricted in specific areas. Those periods cost the city RMB 10 billion in industrial output. [23]

Self power generation

As a result of these persistent and increasing power shortages, local producers of diesel and oil power generators have increased generator production capacity by several fold in recent years to meet heavier demands, and expect 2005 to be their busiest sales year to date. Generators are being used both for process heat and as back up to cope with repeated power shortages. A 1,000 kW generator can sell for approximately RMB 1.9 million while larger generators of 7,000 kW and 18,000 kW's have been reported to cost HK$60 million and HK$80 million, respectively. Hong Kong-based agents of foreign-made generators have also reported brisk business over the past several years, including the more expensive models. Media reporting of the cost of grid power versus self-generation is mixed with some factories reporting grid electricity to be almost 70% cheaper than diesel run generators[24] and other companies reporting self-generation to be 30% cheaper than grid supply.[25]

Low quality fuels

These industrial generators usually run on liquid fuels such as diesel, reported by industry insiders to have a sulphur content of up to 4.0% (this compares with a legal limit for sulphur fuels in Hong Kong of 0.05%). Fuel shortages for generators have also been reported,[26] which has likely increased demand for lower quality fuels. Emissions from these self-owned generators powered with low quality fuels, add substantially to the air pollution already reaching Hong Kong from Guangdong's electric power plants.

Fuel supply

The fact that in 2002 (most recently available data) about two thirds of Guangdong's fuel oil was imported indicates that much of the problem of highly polluting liquid fuel could be dealt with quickly, if acceptably prices alternative fuels were available and the supply of these fuels was supported by local market regulations.

1.6 Hong Kong's manufacturing leverage in the PRD

An important potential point of leverage is the fact that a large portion of factories in the PRD are owned and managed (in whole or large part) by Hong Kong-based firms. In 2001, it was estimated there were 53,000 factories located in Dongguan, Shenzhen, Zhongshan, Guangzhou and Huizhou alone that had some form of Hong Kong investment.[27] More recent estimates report that the number of factories operating in the PRD

region which have some form of Hong Kong investment are around 70,000.[28]

Given Hong Kong investment influence in the PRD, there could be a significant near-term opportunity to address Hong Kong's air pollution imports from nearby Guangdong through the development of private sector *voluntary* initiatives among Hong Kong owned or managed businesses with factories there. It may be possible to get enough of these firms to pledge to use relatively clean fuel (e.g., begin by replacing heavy fuel oil with low sulphur fuels such as 0.5% sulphur). Hong Kong's business people are now directly concerned about the level of air pollution in Hong Kong and they appear to be more interested in both understanding what can be done and being involved in the changes needed. By helping them to understand the connection between air quality and energy usage, they can be made to see that their energy choices in the PRD have a direct impact on Hong Kong, and that if enough of them switch to using cleaner fuels for their private generators that this is a fast way to make a difference.

Such a campaign can be carried out and sustained with the help of local and international chambers of commerce and industrial federations and associations. There must be a substantial effort to raise the awareness of businesses through various means so that those owning and managing the factories in Guangdong know that they can (and indeed for their own sake must) become an active part of the solution to the PRD's chronically unhealthy air quality. However, these firms must be convinced that the cleaner fuel will be readily available at an acceptable increase in cost above that for lower quality fuel. In time, a pledge to avoid the use of low quality fuels by Hong Kong owned industries in Guangdong could be extended to include coal and biomass as well as heavy fuel oil.

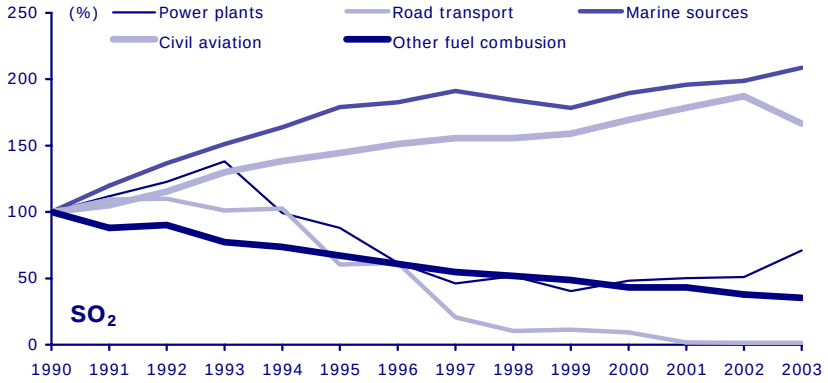
To the extent such efforts are successful, it is likely to put pressure on more firms in Guangdong (i.e., those not managed from Hong Kong) to follow suit. Such an effort has the benefit of being complementary to (i) plans by the Guangdong authorities to increase the reliability of the power grid (and as far as possible to do so with relatively clean fuels such as natural gas); and (ii) development of a comprehensive air monitoring system for the PRD.

1.7 The far reaching impacts of shipping

Another important local industry that urgently needs to clean up is shipping. Together Hong Kong and Shenzhen have more ships in their waters than anywhere else in the world and ships within these waters can currently use fuel with up to 4.5% sulphur content, as well as containing other toxic pollutants. Indeed, it appears that oil companies use the shipping industry to dump their poor quality products and residues. While this level of fuel quality is within existing legal limits, published information shows that sulphur from marine vessels has been steadily increasing during the past 10 years (see Figure 6) and emerging scientific research

suggests that specific areas within Hong Kong have higher SO_2 emissions arising from the combustion of residue oil by marine sources.[29]

Figure 6 - Percentage change in SO_2 emissions (1990 as base year)



Source: HKEPD

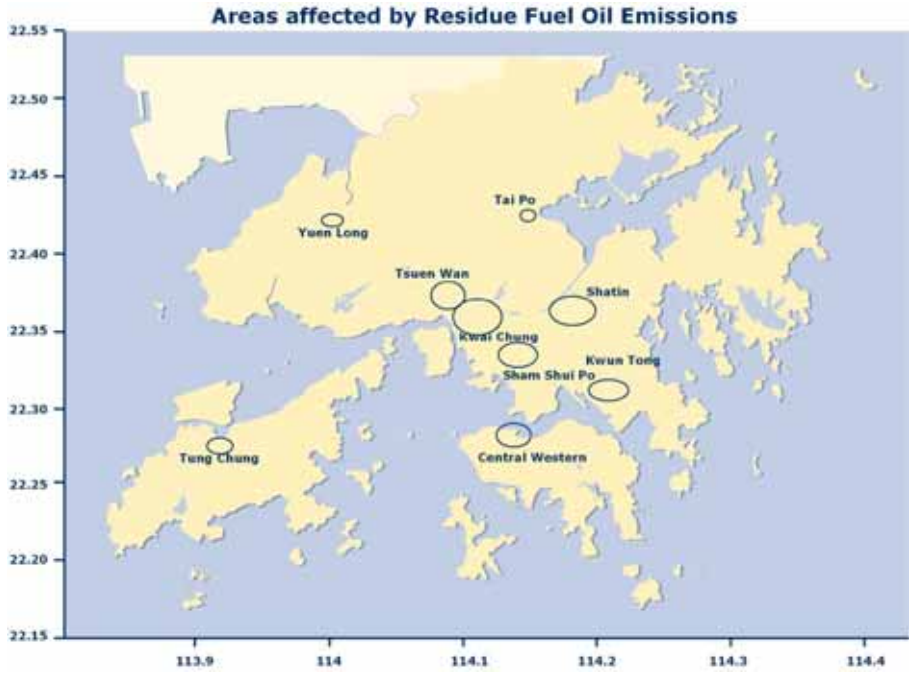
Increasing demand for local ports

In terms of container throughput volumes, Hong Kong currently ranks 1st in the world,[30] and Shenzhen, with a growth rate of a phenomenal 67.4% in 2002/03, now ranks 4th. In addition, with the continued expansion of manufacturing capability within the PRD, sizeable growth in port capacity is being projected around the PRD region. It is likely that the ports in the region (particularly Hong Kong and Shenzhen) will have by far the heaviest container traffic in the world for many years to come.

1.8 Impact of port activities in Hong Kong

While the level of SO_2 in Hong Kong is overall within allowable air quality objectives and has in fact been declining, analysis of air quality in Hong Kong reveals that marine residual oil combustion is related to high concentrations of SO_2 in the western part of the Victoria Harbour, especially in and around the Kwai Chung container terminal (see Figure 7).[31] The environmental management concern stems from the fact that, in addition to SO_2, there are many other toxic pollutants (e.g. nickel, vanadium and elemental carbon) which have significant health impacts associated with residual oil emissions, and over three million people reside in the affected area around the Harbour in Hong Kong. Indeed it is the combustion of low quality fuel in areas of relatively large populations that exacerbates the environmental health implications; these are likely to be far more serious than the absolute output level of pollutants might otherwise suggest[32].

Figure 7 – Areas affected by Residue Fuel Oil Emissions in Hong Kong



Source: Hong Kong University of Science and Technology

Considering the huge population in such a small region (9 to 17 million in Hong Kong and Shenzhen combined, and over 50 million in the whole PRD region) and the distinct coastal land-sea breeze trapping air around the Pearl River mouth, it is critical for the health of residents that the ports are run as cleanly as possible.

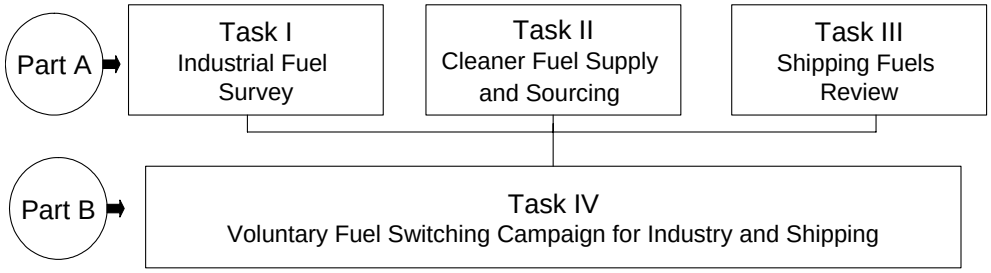
1.9 International trends in shipping

Options to clean up shipping emissions are varied and emerging. In some cases local ports are being forced to clean up through direct local government incentives and regulation whereas other places are applying to have their ports declared Sulphur Emission Control Areas (SECAs) under the Convention for the Prevention of Pollution from Ships (MARPOL Convention). The MARPOL Convention limits sulphur in fuel to 1.5% for vessels in SECAs, which currently includes the Baltic and North Seas. The UK government is considering adopting the same fuel limits in the English Channel. Other more localised efforts to improve emissions include fuel regulations within certain harbours and ports such as the European Union and US West Coast ports. In these harbours ships must also switch to on-board reserves of lower sulphur fuel and in some cases, vessels parked at terminals must also plug into land-based electric grids rather than burn fuel to generate power while at the dock.

2.0 New policy approach

With private sector funding, Civic Exchange has been able to develop a "think" and "do" research project to implement this approach. Over the last several months, Civic Exchange has connected with many businesses and organizations in Hong Kong to discuss ideas and to determine how to engage Hong Kong companies to help improve air quality across the border. Sufficient traction has now been generated to develop a detailed funding proposal to move ahead. With funding becoming available, the tasks below are expected to take approximately 12-18 months to complete. The Project tasks in Figure 8 are further detailed below.

Figure 8 – Summary of Civic Exchange Project Tasks



2.1 PART A: Fuel demand and supply

Task I Industrial sector fuels survey

In order to implement this new policy approach, research needs to be undertaken to obtain firmer data on Guangdong's industrial fuel demand and supply. While strong anecdotal information indicates that among industrial establishments in Guangdong the use of high sulphur fuel oil and other very polluting fuels is widespread (and quite possibly the norm), real data is needed to fully understand the extent and impact of such circumstances on Hong Kong's local air quality.

Critical assessment upfront

It is critical to develop a firmer and more detailed picture of which types of Hong Kong-owned industries are the major users of polluting fuels (particularly in Shenzhen and Dongguan from which air emissions have the most direct impact on Hong Kong), and how this fuel is being used.

Steps to be undertaken

1. Determine which industries to survey

It will be necessary to survey relevant factories from Guangdong, such as a number of industrial facilities in Shenzhen, Dongguan and possibly a

few other nearby cities with large industrial bases. In order to find appropriate factories to be surveyed an assessment is necessary of the industrial sub-sectors that are the highest users of polluting fuels and where they are located. This assessment will involve determining:

(1) which particular industrial sub-sectors (e.g. textiles, food production and processing, etc.) are the heaviest users of fuel oil, coal and other highly polluting fuels (by city); and

(2) the number of such firms in each sub-sector (i.e. the survey 'population size') and their total usage of low quality or high emission fuels.

This information and any other available resources or publications will be used to determine the approximate preferred weighting (by industrial sub-sector and location) for the interviews described below.

2. Develop the interview questionnaire

Develop a preliminary semi-structured questionnaire for Hong Kong owned or managed firms in Guangdong to gather both quantified and non-quantified information on such things as:

(1) what form of energy the firm is using, and for what purposes,

(2) the price and local availability of cleaner fuels,

(3) the overall cost implications to the firm of using higher quality fuel, and

(4) what the firms themselves see as the opportunities and constraints in making the switch to much cleaner fuel.

3. Identify and survey participants

Identify factories to be interviewed by working with cooperating Hong Kong business associations, chambers of commerce, etc. to identify their members with factories in Guangdong, and in particular, to obtain the organizations' help in identifying members willing to be interviewed. Those prospective interviewees of principal interest will be ones operating in the sub-sectors with the highest fuel oil use (and other high emission fuels such as coal) and those in cities with the greatest impact on Hong Kong's air quality (such as Shenzhen and Dongguan).

4. Undertake Interviews

After pre-testing the interview survey, undertake interviews with factory managers (and as appropriate others) of a broad range of Hong Kong-owned or managed factories in Guangdong (with weightings for the number of interviews in specific industry sub-sectors as noted above in (1)). It is expected that 30 to 50 interviews will be undertaken in total.

Task II Cleaner fuel supply and sourcing

Whereas Tasks I and III focus on demand issues for fuels used by Hong Kong owned or managed factories in the PRD and ships operating in local waters, this section examines issues of the availability (and possible constraints) on the supply side.

Anecdotal information indicates that some industrial firms are not convinced that they can take the availability of adequate supplies of low sulphur fuel for granted. In order to address these concerns upfront, we need to provide a better understanding of not only the current fuel supply system for industries and shipping in Guangdong, but also an initial assessment of sourcing options for additional cleaner fuel.

Steps to be undertaken

1. Understand the PRD fuel oils supply industry

Review available information and conduct interviews to further understand Guangdong's oil refining capabilities and obtain a thorough understanding of the oil and fuels import and distribution infrastructure within Guangdong.

2. Identify potential fuel sources and conditions for supply

Conduct interviews with all major fuel providers at the wholesale level in Hong Kong and elsewhere to identify potential sources for low sulphur fuels (such as 0.5% sulphur fuel for industry and 1.5% for shipping). This will also involve discussions and interviews with fuel suppliers and traders located in Mainland China and elsewhere to determine what it takes for them to supply cleaner fuels and the economics involved.

3. Understand constraints on supply

Understand the supply infrastructure in Hong Kong of bunker and other shipping fuels and consider likely supply constraints for switching Hong Kong's ferry's tug/lighters and coastal vessels from the high emission fuels currently used to cleaner fuels.

Task III Impact of marine fuels

The overall objective of this task is to review the current and potential air quality problems related to marine emissions in Hong Kong and the PRD, and to lay down clearly the justifications and necessary steps to have the region be declared as a SECA under the MARPOL Convention.[33] Once established as a SECA a specified cap on sulphur levels in marine fuels (for sale or combustion) can be stipulated.

Steps to be undertaken

1. *Consolidate existing information*

1.1: Review and consolidate existing information on marine emissions in various parts of Hong Kong (and from Shenzhen and other southern Guangdong ports). Given the marine emissions problem around Hong Kong's port areas, it is likely that other Guangdong ports face similar risks.

1.2: Collect and assess data on marine shipping in Hong Kong (and as available from other southern Guangdong ports); this will include not only volumes of freight and passengers and numbers of vessels, but to the extent feasible, information on the type and quantity of fuel they burn while in port.

1.3: Review the projected changes and trends in container throughput in Hong Kong, Shenzhen and the PRD, and develop an initial assessment of marine emissions in the next few years, with or without sulphur emission control. This assessment will look at 3 broad types of marine vessels: (i) Ocean-going cargo ships, (ii) Local tugs, lighters and ferries (Hong Kong), and (iii) Coastal transhipping vessels (river trade).

2. *Undertake sampling and modelling*

2.1: Work with collaborating ship owners and the HKSAR Government, and if allowed, take source emissions samples and analyze the source profiles for various types of marine emissions.

2.2: Collect air samples at strategically chosen sites, and apply source receptor modelling to ascertain the relative significance of marine emissions as compared to other pollution sources.

2.3: Based on the location and amount of marine emissions estimated above, use models to estimate the potential impact of the emissions for Hong Kong and the PRD (in terms of area and concentrations of impact). Particular focus will be placed on the impact of emissions from Hong Kong and Shenzhen. The latter is particularly important because it is located in Hong Kong's northeast – i.e. generally an upwind location.

3. *Assess health risks*

From the modelling results, estimate the population exposure and potential health risk associated with the projected marine emissions in Hong Kong and Shenzhen.

4. *Review international trends and treaties*

4.1: Survey marine fuel and emissions control regulations currently enforced or being discussed in other major ports around the world.

4.2: Review and clearly outline the justification and necessary steps to have the PRD coastal zone be declared as a SECA under the MARPOL Convention.

2.2 PART B: Outreach programme

Task IV Voluntary fuel switching campaign

When the research side of the proposal is completed, Civic Exchange will be able to assist business groups in Hong Kong in designing voluntary programmes among their members with factories in Guangdong to pledge to refrain from using low quality fuel oil and diesel fuel (likely to be above 0.5% sulphur content) or use other low sulphur fuel sources. This forms an essential part of the 'doing' aspect of this new policy direction.

Working with local business networks

Drawing on research findings, Civic Exchange will assist with the development of campaigns and other activities to reduce or eliminate in the near term (e.g., less than 2 years) use of highly polluting fuels by Hong Kong owned factories in Guangdong. Already certain business organisations such as the Business and Professionals Federation, the Swiss Business Council and the French Chamber of Commerce, have expressed an interest to work together in such a campaign. Access to factory owners in Guangdong will largely come through these and other Hong Kong business associations, chambers and federations. During the research phase of the project Civic Exchange will also collaborate with a local Chinese think tank operating in Guangdong, China Development Institute, that will also be able to assist in the development and delivery of this outreach campaign.

Collaborating and supporting other environmental programs

Civic Exchange's efforts will dovetail with the efforts of the Hong Kong Federation of Industries' new environmental campaign "One-One-One", which advocates companies to implement one environmental project, in one year, in any one factory.[34] Incentivised through certificates and competitions, this programme encourages factories to cumulatively implement environmental improvements in seven specified categories. Of the seven categories of focus areas listed, energy conservation and air emissions are directly related to the fuel switching campaign. Other concerned business groups, including the Business Coalition on the Environment (BCE) and the Business Environment Council (BEC), are also in the process of launching environmental performance and improvement pledges and promoting best environmental practices for their members and other Hong Kong owned factories operating within the PRD. Civic Exchange's fuel switching campaign will also complement these emerging campaigns through providing campaign organisers with strong data to persuade businesses to improve their environmental performance through improving fuel quality.

The need for thorough research to build a successful campaign

While some business groups have called for the immediate development of such a campaign, Civic Exchange is aware of the dangers in fostering campaigns without sufficient data and analysis. For instance, while Hong Kong experience has shown us that industry can indeed switch to using cleaner fuels with minimal costs and obvious health benefits (see Section 1.3), the availability of such fuels in the PRD is currently unknown and the market and regulatory laws pertaining to the supply of cleaner fuels in Mainland China is not fully understood. In order to build a successful campaign Civic Exchange aims to undertake this research in a way that will maximise input from the different stakeholders involved so as to address different perspectives and develop, where possible, consensus based solutions.

Hong Kong Key Pollutants including Sources and Health Effects

Pollutant	Sources	Major Source in 2003	Known Health Effects
Nitrogen Dioxide (NO_2 which creates NOx)	Fuel combustion.	NOx: Power generation (46%); Vehicles (particularly diesel) (30%); Marine Vessels (16%); Aircraft (3%); Fuel combustion (industrial/ commercial/ domestic) (3%)	Lowers a person's resistance to respiratory infections and aggravate existing chronic respiratory diseases.
Sulphur Dioxide (SO_2)	Combustion of sulphur containing fossil fuels.	Power generation (92%); Marine Vessels (4%); Fuel Combustion (industrial/ commercial/ domestic) (4%);	Impairment of respiratory function and aggravation of existing respiratory disease causing sever respiratory distress and cardiac illnesses.
Particulate Matter or Respirable Suspended Particulates (PM_{10})	Combustion sources, in particular diesel vehicle exhaust and emissions from power plants. RSP can also be formed by atmospheric oxidation of SO_2 and NO. Dust and marine aerosols are also significant sources.	Power generation (46%); Vehicles (28%); Non-combustion (dust, construction etc.) (16%); Marine Vessel (6%)	Chronic and acute effects on pulmonary function (deep penetration into the lungs) causing respiratory problems. Effects are enhanced if high PM_{10} are associated with higher levels of other pollutants such as SO_2. Smaller particulates in PM_{10} also impact visibility.
Photochemical Oxidants (Ozone) (O_3)	Ozone is not directly emitted from pollution sources. It is formed by chemical reactions of nitrogen oxides (NOx) and volatile organic compounds (VOC) in the presence of sunlight and warm temperature.	See breakdowns of sources of the two ozone precursors; NOx and VOCs	At low concentrations: cause irritation to the eye, nose and throat. At high concentrations: increase susceptibility to respiratory infections and aggravate pre-existing respiratory illnesses such as asthma.

Source: Hong Kong Environmental Protection Department

Endnotes and References

[1] Cheung Chi-fai, "HK's scope to reduce bad air is limited: minister", *South China Morning Post,* 26 October 2004.

[2] The PRD region includes Guangdong Province, Hong Kong and Macau.

[3] The results of this study are summarised in "Hong Kong and the Pearl River Delta Pilot Air Monitoring Project - Executive Summary", *Civic Exchange*, November 2004 and two full technical project reports are also available for download at http://www.civic-exchange.org, under publications November 2004.

[4] A summary of HKSAR and Guangdong Authorities Joint Regional Air Quality Management Plan (the Regional Plan), published in April 2002, which outlines strategies to control regional air pollution is included in Appendix D of "Air Pollution. Air Quality Management Issues in the Hong Kong and the Pearl River Delta Region: Civic Exchange White Paper", *Civic Exchange*, November 2004 (available at http://www.civic-exchange.org under publications November 2004). These strategies are based on findings in the report "Study of Air Quality in the Pearl River Delta Region (Agreement No. CE 106/98)", CH2M HILL China Limited, April 2002, published by the Environmental Protection Department, see http://www.epd.gov.hk/epd/english/environmentinhk/air/studyrpts/study_pearl.html
Since publishing the Regional Plan no official progress report has been provided, however the HKSAR Government Environmental Transport and Works Bureau provided an update on Hong Kong's air pollution control strategies to the Legislative Council Environmental Affairs Panel which is available at: http://www.legco.gov.hk/yr04-05/english/panels/ea/papers/ea1025cb1-79-4-e.pdf

[5] For further discussion of Particulate Matter and the impact of SO_2, see, Hopkinson, "Air Pollution – Particulate Matter Standards in Hong Kong and the Pearl River Delta Region", *Civic Exchange*, November 2004.

[6] The best estimate of the PRD's population is from the census in 2000 indicating a population of 40.77 million. The population of HK and Macau together is approximately 7 million; hence the PRD region's population is estimated at 50 million.

[7] Civic Exchange and Rocky Mountain Institute (US) joint response to the Economic Development and Labour Bureau (EDLB) "Consultation Paper on Future Development of the Electricity Supply Market in Hong Kong – Stage 1 Consultation" includes much discussion of the need for enhance energy efficiency. A copy of this paper, which was submitted to the EDLB in April 2005, is available at: http://www.civic-exchange.org/publications/2005/EDLB%20Consultation.pdf.

[8] Civic Exchange is currently exploring opportunities to work on climate change projects with Third Generation Environmentalism (E3G), a UK based organisation that aims to design, create and activate the networks and coalitions needed to build a new environmentalism fit for 21st century challenges.

[9] China produced about 12.5% of the world's carbon dioxide emissions in 2000 which represented about 0.6kg of carbon dioxide per US dollar of GDP (Arctic Climate Impact Assessment Report; 2003). Carbon dioxide is the main emission which causes climate change.

[10] Guangdong Statistical Yearbook, Guangdong Provincial Government, 2003

[11] See endnote 4.

[12] A review of the regional air quality management control options is outlined in the "Study of Air Quality in the Pearl River Delta Region (Agreement No. CE 106/98)", CH2M HILL China Limited, April 2002 are summarized in Technical Annex 6. Details pertaining to the Guangdong energy sector control options; specifically those relating to cleaner fuels are included in paragraphs 2.2.38 to 2.2.40, see http://www.epd.gov.hk/epd/english/environmentinhk/air/studyrpts/files/prd_tech_ann6.pdf

[13] Various papers published by local public health experts reviewed different aspects of fuel intervention and its impact on pollutant levels and health. A summary of key results is included in: Hedley AJ, Chau YK, Wong CM. "The change in sub-species of particulate matter (PM_{10}) before and after an intervention to restrict sulphur content of fuel in Hong Kong." Poster presented at *Better Air Quality (BAQ) Conference*, Agra, India, December 6-8, 2004.

[14] According to published HK Environmental Protection Department reports (undertaken by CH2Mhill), based on 1997 data, industry contributed to 60% of regional Respirable Suspended

Particles (RSP or PM_{10}), 39% of Sulphur Dioxide (SO_2), 13% of Nitrogen Dioxide (NO_2) and 11% of Volatile Organic Compounds (VOCs). However recent expert scientific discussion suggests that these figures may be significantly underestimated.

[15] Hong Kong Trade Development Council, 2003. The current figure will be higher as exports have increased.

[16] Neil Gough, "Backyards fill void in power game", *South China Morning Post,* 25 March 2005.

[17] CLP Group, *A World Class Electricity Supply for A World Class City – Powering Hong Kong's Future,* January 2005.

[18] Neil Gough, "Backyards fill void in power game", *South China Morning Post,* 25 March 2005.

[19] Anthony Wilkinson reporting on conversations with Prof. Tomas Heller (Stanford University), "CLSA U Speaker Series – Chinese Power Whispers", *CLSA Asia Pacific Markets,* Nov 2004.

[20] Estimate provided by The State Electricity Regulatory Commission as reported by *Moody's Investor Service,* Special Comment "China Electricity Power Generation: Strong Demand Underpins Credit Profiles but High Coal Prices Pressure Profitability", March 2005.

[21] Neil Gough, "Backyards fill void in power game", *South China Morning Post,* 25 March 2005.

[22] *Moody's Investor Service*, Special Comment (March 2005) reported that since 2002 coal prices have jumped up with an accumulated average increase of over 50% in January – September 2004. Coal reserve constraints, fuelled by transportation bottlenecks continue to drive coal prices higher.

[23] Olivia Chung, "Shortage of power costs city 10B yuan", *The Standard*, p.A3, 15 April 2005.

[24] Neil Gough, "Backyards fill void in power game", *South China Morning Post,* 25 March 2005.

[25] Toh Han Shih, "New power generator to trim costs at Kam Hing", *South China Morning Post*, 22 April 2005.

[26] Neil Gough, "Backyards fill void in power game", *South China Morning Post,* 25 March 2005.

[27] Of the 53,000 factories estimated in 2001, 21,000 were foreign funded enterprises and 32,000 were based on various contractual arrangements. These activities employed 10 million workers in Guangdong Province as a whole where 4.7 million worked in foreign funded enterprises and 5.59 million worked for factories with contracts with Hong Kong companies. See *Made in PRD: The Changing Face of HK Manufacturers,* Federation of Hong Kong Industries, November 2002.

[28] See HK Federation of Industries website: http://www.fhki.org.hkl

[29] Kai-hon Lau, Wai Man Wu, Jimmy C. H. Fung, Ronald C. Henry and Bill Barron "Significant Marine Source for SO2 levels in Hong Kong", *Hong Kong University of Science and Technology,* April 2005

[30] In terms of container throughput, Hong Kong has been the number 1 port in the world for eleven of the past twelve years (except 1998 when it was number 2). Shenzhen (Yantian) is catching up very fast, ranking number 8, 6 and 4 in 2001, 2002 and 2003, respectively.

[31] Kai-hon Lau, Wai Man Wu, Jimmy C. H. Fung, Ronald C. Henry and Bill Barron "Significant Marine Source for SO2 levels in Hong Kong", *Hong Kong University of Science and Technology,* April 2005.

[32] *Ibid* (Kai-hon Lau).

[33] The Convention for the Prevention of Pollution from Ships (MARPOL Convention) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively and updated by amendments through the years.

[34] Further information on the HK Federation of Industries "One-One-One" programme can be found at: http://www.fhki.org.hk/TripleOne/fs_one.html

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