MARINE EMISSION REDUCTION OPTIONS
for Hong Kong and the Pearl River Delta Region

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PREFACE

Civic Exchange has a continuing interest in exploring air quality issues affecting Hong Kong and the Pearl River Delta region. With this part of South China being one of the world's most prominent export manufacturing and logistic hubs and an important economic engine for China, it is also vitally important that every effort is made to identify what can be done to ensure our manufacturing and logistics sectors are among the least polluting in the world.

Taking the geographically small port areas and distances of Hong Kong and Shenzhen together, we must have the densest shipping and related logistics activities in the world. The challenge is that we must operate the cleanest ports otherwise we will be overwhelmed by the sheer density of polluting activities.

This is a challenge where we still have a very long way to go. This paper which focuses on marine emissions in the region and what can be done is the first of three papers. Marine pollution is a relatively less debated issue when compared to emissions from other key emissions sources such as power plants and vehicles. However, it is time to give marine emissions the attention that is due. We hope this paper will serve that purpose. The other two papers in this series will deal with the supply of cleaner fuels in South China, and the use of fuels in manufacturing in the Pearl River Delta. Together, we hope they will help to illuminate the wide spectrum of things that can be and need to be done to improve air quality in the longer term.

We wish to thank the many people who have helped us to prepare this report. Kylie Uebergang has managed the entire project and authored Part I of the report. She was supported by the tireless work of Marcos Van Rafelghem and Caitlin Gall. We are also grateful to people and organizations who shared their expertise with us: Arthur Bowring and the Hong Kong Ship Owners Association, Alexis Lau and Simon Ng from Hong Kong University of Science and Technology, Lawrence Tse, and Ken Li who designed the report cover.

Christine Loh
Chief Executive Officer

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SUMMARY OF RECOMMENDATIONS

Immediate actions include:

The Hong Kong Special Administrative Region Government (HKSARG) and other shipping industry stakeholders should assess, develop and implement voluntary programmes to encourage the shipping industry to adopt less polluting practices.

a. These less polluting practices may include:
   - Using lower sulphur fuels (less than 1.5% sulphur content) on vessels' propulsion and auxiliary engines within local harbours and national shorelines.
   - Reducing the speed of vessels within local harbours.
   - Using latest technology in emission abatement (ie. catalytic reactors, scrubbing, slide valves and fuel additives).
   - Using shore-side power on ships while they are docked at port.
   - Using emission control technology on port handling equipment and considering other measures to reduce land-based emissions at port and around port areas.

b. The incentives that could be provided to encourage ship owners to take part in less polluting practices include:
   - Discounts in port fees and tariffs.
   - Financial grants for retrofitting of vessels/engines.
   - Commendation and recognition awards.
   - Priority berthing.

The successful implementation of these voluntary programmes requires relevant stakeholders being involved in their development and implementation including but not limited to, the shipping industry representative organisations, port terminal owners/ operators, ship owners/ operators and fuel suppliers/ oil refineries, green groups, citizens and other interested NGOs.

Mid term actions include:

Both Hong Kong and Mainland China should individually ratify MARPOL Convention Annex VI.

The ratification of Annex VI would the be the first step in the regulation of marine fuels in Hong Kong and the Pearl River Delta (PRD) region, limiting sulphur content of marine fuels to 4.5%, and would satisfy a precondition for a Sulphur Emission Control Area (SECA) application.

Longer term actions include:

Hong Kong and Mainland China should submit a joint proposal to the International Maritime Organization (IMO) to have a MARPOL Convention SECA designated in Hong Kong and Pearl River Delta waters. The designation of a SECA in Hong Kong and PRD waters would tighten the sulphur content of marine fuels to 1.5% and substantially reduce marine emissions in the region.

INTRODUCTION

Hong Kong's port has ranked number one in the world (in terms of throughput) in all years since 1995 with the exception of 1998 when it ranked number two.[1] Shenzhen's throughput also increased significantly in recent years, its overall volumes have almost tripled since 2001 and Shenzhen currently ranks the fourth busiest port in the world.[2]

One of the key external costs of increased local, regional and international shipping volumes is air pollution which is perhaps the most serious environmental problem in Hong Kong and the Pearl River Delta (PRD) region. Marine emissions contribute significantly to such a problem.[3] However, marine emissions remain largely unaddressed as both a local and regional source of pollution. This research explores possible actions that can be taken to reduce marine emissions, both at local and regional levels. These actions are grouped into two main categories: *mandatory regulations* and *voluntary programmes*. Mandatory regulations consist of, basically, legal requirements for the use of cleaner marine fuels. Voluntary programmes comprise initiatives undertaken usually at the port/ domestic level to induce the shipping industry, through particular incentives, to adopt practices that are less polluting. The ultimate aim of this research is not to find a single solution, but to present different options so that local stakeholders can be better informed as to the options available. We hope that this research will stimulate discussion that ultimately leads to the development of effective local solutions for the reduction of marine emissions regionally.

Part I of this paper provides a background information in relation to Hong Kong's rising marine pollution, a summary of the types of ships which frequent Hong Kong waters, cargo routes and port ownership and operating structure. ***Part II*** of this paper outlines conceptual regulatory issues regarding marine emissions in Hong Kong and the PRD region including Hong Kong's autonomy to pass and enforce marine emission legislation. *Part II* also outlines the jurisdictional issues at local, national and international levels that need to be considered in the design and implementation of regional regulations. ***Part III*** focuses on the MARPOL Convention[4] Annex VI which is the main international legal instrument dealing with air pollution from ships. This Annex provides special protection to particularly sensitive areas, named Sulphur Emission Control Areas (SECAs). *Part III* also outlines the steps and prospects to have Hong Kong and the PRD region declared as a SECA under MARPOL Annex VI. ***Part IV*** presents a global review of marine emissions reduction initiatives that have been implemented or are being discussed in major ports worldwide, with special emphasis on voluntary programmes. This review aims at gaining understanding of the current international trends and options for marine emissions reduction.

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[1] See "*Ranking of Container Ports in the World*" summary published by the HKSAR Marine Department, *available at:* http://www.mardep.gov.hk/en/publication/pdf/portstat_2_y_b5.pdf

[2] *Id.*

[3] *See* "New Policy Direction - Using Cleaner Fuels", published by Civic Exchange on July 2005, available at http://www.civic-exchange.org/publications/2005/cleanfuel-e.pdf.

[4] International Convention for the Prevention of Marine Pollution from Ships, 1973 as modified by the Protocol of 1978 relating thereto and its associated Annexes.

PART I: Background of Marine Emissions and the Industry in Hong Kong

1. Marine Emissions

Hong Kong's Deteriorating Air Quality

Hong Kong suffers from deteriorating air quality with the number of hazy days increasing from an average of less than 10 per month in 1990 to over 25 per month in 2004.[5] Local public health experts have concluded that every kilometre reduction in visibility below 20 km is associated with a 0.55% increase in daily deaths. This means that for an average 10km reduction in visibility (which is a typical figure given the present environment) causes premature deaths of 1,300 to 1,700 people per year in Hong Kong.[6] The intensity of these hazy days is also increasing with local Air Pollution Index (API) readings reaching record breaking levels during 2004.[7]

There are many sources of air pollution, including power generation, manufacturing, road transport, marine vessels and civil aviation. These sources create different types of pollutants including sulphur dioxide (SO2), nitrogen oxides (NOx), Particulate Matter (PM), ozone (O3) carbon dioxide (CO2), volatile organic compounds (VOCs) and greenhouse gases (Ghg). Some of these pollutants are emitted directly into the air from identifiable sources, such as SO2 from power generation, while others, once emitted into the air, such as NOx and VOCs, form chemical reactions which contribute to acid rain and smog (also referred to as ozone).[8] Among the seven pollutants, which are commonly measured by authorities, O3, PM and NOx (or Nitrogen dioxide, NO2) contribute to high Air Pollution Index (API) readings in Hong Kong, and within many cities in the Pearl River Delta region.[9]

All of these pollutants have health impacts at different levels of exposure and such impacts are influenced by many aspects such as the height level that a pollutant is emitted from, prevailing wind directions, the built environment and the character and health of the receiver. Pollution is generally known to have a greater impact on children, the elderly and those with respiratory illnesses. World Health Organisation (WHO) research has recently focussed on PM, especially the finer particulate matter (known as PM2.5) and ozone, both of which are widely considered to be complex in their nature and dangerous in terms of health and environmental impacts. WHO reconfirmed in 2004 that exposure to PM poses a significant risk to human health at

[5] A hazy day is defined as one where, visibility less than or equal to 8km and relative humidity less than or equal to 80%, at some stage of the day. See "Air Pollution in Asia - Research Primer", published by CLSA Asia Pacific Markets, April 2005, written by Christine Loh of Civic Exchange and available at: http://www.civic-exchange.org/publications/2005/CLSAA.pdf.

[6] Thach TQ, Hedley AJ, Wong CM, Department of Community Medicine, University of Hong Kong.

[7] The API reached a peak of 201 at Tung Chung in September 2004.

[8] For a summary of Hong Kong's main pollutants, see "*Air Pollution in Asia – Research Primer*" (see note 5) and "*Air Pollution – Air Quality Management Issues in the Hong Kong and Pearl River Delta Region*" published by Civic Exchange, November 2004, available at http://www.civic-exchange.org/publications/2004/airpollutionwhitepaper.pdf.

[9] See "*Hong Kong and Pearl River Delta Pilot Air Monitoring Project – Executive Summary*" published by Civic Exchange, November 2004, available at: http://www.civic-exchange.org/ publications/2004/airmonitorexsum.pdf.

concentration levels generally lower than those prevailing in Hong Kong[10]. Related epidemiological studies have shown that there is no safe level of PM and the finer particles, PM2.5, are more hazardous than PM in terms of mortality and cardiovascular and respiratory illness.[11]

Although many of Hong Kong's key individual pollutant levels have steadily declined in the past 10 to 15 years, visibility in Hong Kong continues to deteriorate. Part of the reason for increased pollution levels in Hong Kong stem from its geographic and economic relationship with the PRD region. The PRD region has become one of the world's largest manufacturing hubs with virtually all manufacturing produced for export (a significant part of it being transported through Hong Kong's ports) supporting a GDP of US$ 164 billion in 2004.[12] Hong Kong has been the source of approximately two-thirds of the cumulative foreign direct investment in the PRD region since 1979,[13] with a large percentage of the factories in the region being owned or managed by Hong Kong companies.[14] Geographically Guangdong's wind flows impact Hong Kong and moderate to strong north-westerly winds result in high pollution episodes within Hong Kong. However, worryingly, these pollution episodes are no longer limited to seasonal patterns and Hong Kong now experiences high pollution episodes regularly throughout the year.

Marine Air Pollution

In terms of absolute volumes, marine vessels contribution to overall air pollution is less than other sources such as power generation and vehicles. However, marine emissions in Hong Kong are of increasing concern on two accounts. Firstly, they are one of the only emission sources whose emissions continue to increase year on year as it is illustrated in graphs 1, 2 and 3. Secondly, marine emissions, which are emitted in the heart of Victoria Harbour, are released close to the ground level and within a few kilometres of the densely populated Kowloon peninsula. This differs from emissions such as power plants which release their pollutants at sites further away from dense populations and high into the air through the use of smoke stacks, which substantially dilutes the impact.

[10] See "*Health Aspects of Air Pollution*." Results from the WHO Project "*Systematic Review of Health Aspects of Air Pollution in Europe*". June 2004. Available at: www.euro.who.int/pdf.E83080.

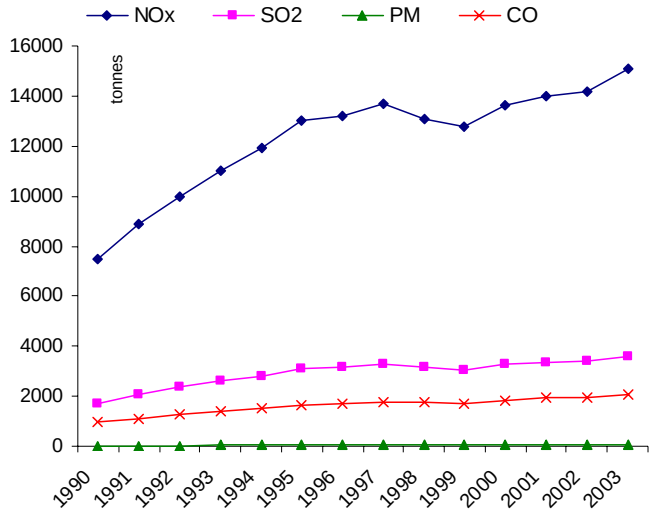
[11] For further discussions see "*Air Pollution – Particulate Matter Standards in Hong Kong and the Pearl River Delta Region"*, published by Civic Exchange, November 2004, available at: http://www.civic-exchange.org/publications/2004/airpollutionpm.pdf.

[12] Enright, Scott & Associates, "The Greater Pearl River Delta", Invest Hong Kong, 3rd Ed, October 2005, at pg 8. Report available online at: http://www.investhk.gov.hk/doc/ InvestHK_GPRD_Booklet_English571.pdf.

[13] *id.*

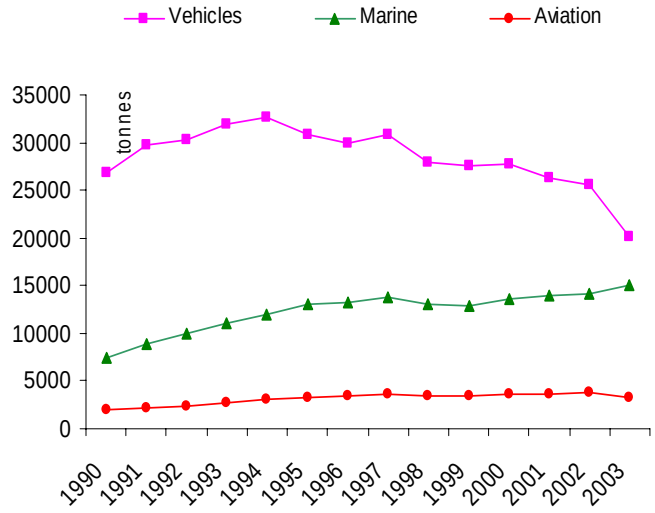
[14] The number of factories in the PRD region owned or managed by Hong Kong companies has been estimated at 70,000. *See "Dealing with Hong Kong's Air Quality Problems – New Policy Direction – Using Cleaner Fuels" published by Civic Exchange, July 2005, at page 10,* available at: http://www.civic-exchange.org/publications/2005/cleanfuel-e.pdf.

Graph 1 - Hong Kong Emissions from Marine Sources



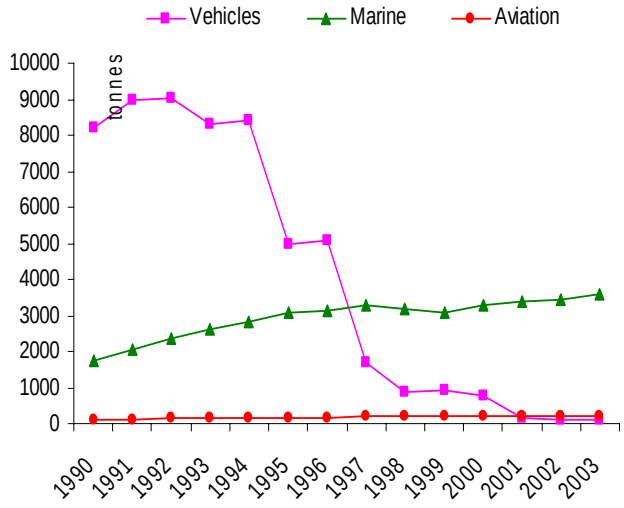
Source: Hong Kong Environmental Protection Department

Graph 2 - NOx Emissions from Mobile Sources



Source: Hong Kong Environmental Protection Department

Graph 3 - SO2 Emissions from All Sources



Source: Hong Kong Environmental Protection Department

Ocean going cargo vessels are legally able to use high sulphur fuels with sulphur content up to 4.5%, which contrasts with current requirements and availability of road vehicle fuel in Hong Kong which is 0.005% for motor diesel and petrol/ gasoline. These marine fuels which are also commonly called Heavy Oil (because of its high viscosity), Bunker Fuel (because of where it is stored on ships), Residual Oil (because it is a "leftover" or residual product of crude oil) or No. 6 Fuel Oil (the highest of six categories of fuel oil, which are labelled depending on their boiling temperature, composition and purpose) are the remains of crude oil after gasoline and distillate fuel oils have been extracted, making it the cheapest liquid fuel available. Because of its high viscosity Bunker Fuel requires heating before it can be used which means it is not suitable for use in road vehicles, boats or smaller ships as the heating equipment takes up space and adds weight to the vehicle. Bunker fuel is ideally suited to ships that can accommodate storage and heading requirements. Bunker fuel contains relatively high amounts of pollutants, particularly sulphur, which forms SO2 upon combustion.[15] Besides SO2, Bunker fuel also has substantial amounts of elemental-carbon, nickel and vanadium - all have significant health impacts for the affected population.

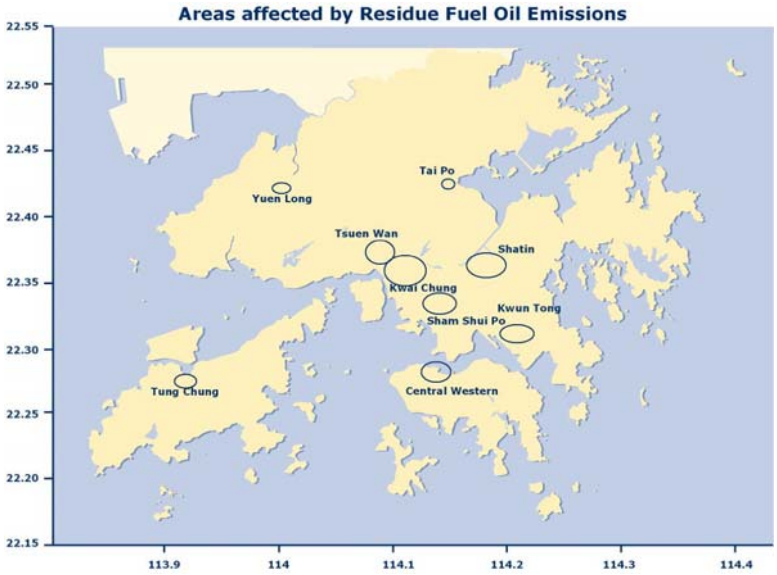
Recent scientific studies have shown that residual oil combustion from marine vessels around the Kwai Chung terminal container port is responsible for 36% of total SO2 concentrations measured at general air quality measuring stations in Hong Kong (i.e. those stations run by the Hong Kong Environmental Protection Department "HKEPD"). Surprisingly local power plants were only responsible for 7% of total SO2 concentrations across HKEPD's air monitoring stations. Furthermore, marine vessels burning high sulphur fuel appeared to be the major source of SO2 in specific locations within the heart of the urban area.[16] Figure 1 shows the areas in Hong Kong which are affected by residual oil combustion with the size of the circles indicating the relative impact. Recent studies also confirmed the impact of a regional pollution source which affects all of Hong Kong during moderate and high wind speeds from the north-west.[17]

[15] For further discussion and illustration of Bunker Oil characteristics see http://en.wikipedia.org/wiki/Residual_fuel and http://energyconcepts.tripod.com/energyconcepts/heavy_oil.htm.

[16] See "*Significant Marine Source for SO2 levels in Hong Kong*," written by Alexis Kai-Hon Lau, Wai Man Wu, Jimmy C-H Fung, Ronald Henry and Bill Barron, submitted to Atmospheric Environment, April 2005, available at: http://www.civic-exchange.org/publications/2005/MarineSO2.pdf.

[17] Although regional air pollution (i.e. pollution which travels from the PRD to Hong Kong) is not the focus of this paper Civic Exchange has long acknowledged and investigated the extent of this source and characteristic of this pollution in many of its previous research papers. For further information refer to Civic Exchange's website under publications "Conservation and Environment" November 2004 and July 2005.

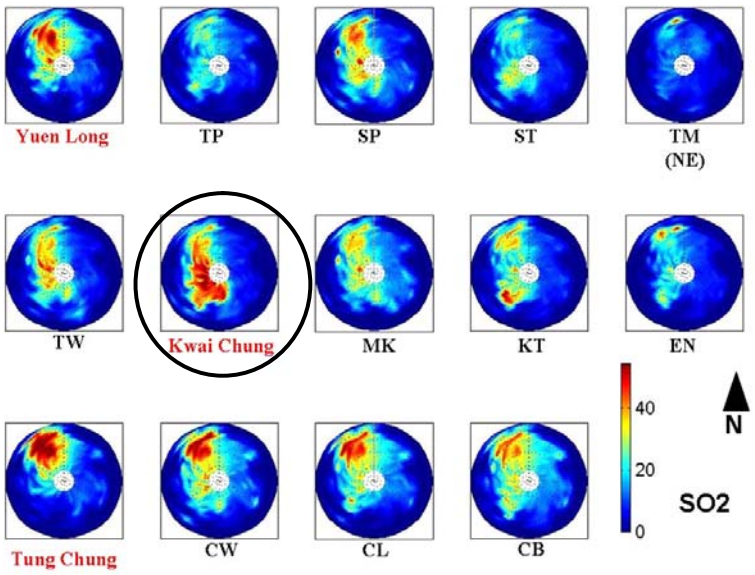
Figure 1 - Hong Kong Areas Affected by Residue Fuel Oil Emissions



Source: Hong Kong University of Science and Technology

Wind direction and strength can play a major part in understanding the source of air pollution. Figure 2 shows that SO2 is high at Kwai Chung (indicated by the deep red colour) when the winds are weak and from the west, suggesting the container terminal is the main local source of SO2. Yuen Long and other air monitoring stations also show high SO2 to the north-west at the outer part of the disc which suggests that wind from the northwest at moderate to high wind speed is also bringing SO2 emissions from within the PRD region. While the extent of the influence of PRD regional based pollution has been long known, the influence of local marine sources on local SO2 levels is relatively new information which contributes to the mounting concerns over marine emissions.

Figure 2 - Pollution Wind Map for SO2 concentrations for all HKEPD Air Quality Monitoring Stations



Source: Hong Kong University of Science and Technology

2. Hong Kong's Vessels, Volumes and Ports

Vessels

In 2004, more than 225 thousand vessels arrived to Hong Kong. Of them, almost 36 thousand (16%) were ocean vessels and 190 thousand (84%) were river vessels.[18] Among the river vessels, passenger ferries accounted for 38% and cargo vessels for 62%. The detailed figures are outlined in table 1.

Table 1: Hong Kong Vessel Arrivals 2004
(NRT – Net Registered Tonnes)

Ocean Vessels		River Vessels					
		Passenger Ferries		Cargo Vessels		Total River Vessels	
Number	Capacity ('000 NRT)	Number	Capacity ('000 NRT)	Number	Capacity ('000 NRT)	Number	Capacity ('000 NRT)
35,900	307,713	71,980	11,126	117,540	80,193	189,530	91,318

Port Throughput

Tables 2 and 3 provide a summary of Hong Kong's port throughput by port of loading and discharge (unloading). Considering the review of marine emissions reduction initiatives outlined in Part IV of this paper, this chart importantly shows that approximately 34% of Hong Kong's incoming cargo and 30% of outgoing cargo comes from and goes to ports which are planning or implementing marine emission initiatives which would put or are putting them ahead of Hong Kong's current status quo in relation to marine emissions.[19] This, in turn, means that the ships are either currently, or will be forced within the near term future to adjust their operations to operate in environments which require more environmentally friendly standards.

Table 2: Port Cargo Discharged (Unloaded) by Major Country/ Territory and Port of Loading JAN - JUN 2005

Country/ Region		Tonnes (+000)	Percentage of Total
Asia		57,108	82.5%
	Mainland China	23,432	33.8%
	PRD	16,510	23.8%
	Japan	4,914	7.1%
	Korea	3,356	4.8%
	Singapore	7,566	10.9%
North America		4,564	6.6%
	Canada	664	1.0%
	Vancouver	602	0.9%
	USA	3,900	5.6%
	Long Beach	657	0.9%
	Los Angeles	839	1.2%

[18] Hong Kong Shipping Statistics, *ibid.* Cargo throughput (measured in tonnes, as per Table 2 and 3) includes both containerized and general cargoes.
[19] These percentages were calculated considering Japan, Korea, Singapore, North America and Western Europe as countries/regions in which marine emissions are in force or being defined.

Central/South America		1,308	1.9%
Western Europe		3,622	5.2%
	Germany	728	1.1%
	Hamburg	665	1.0%
	Italy	472	0.7%
	Netherlands	739	1.1%
	Rotterdam	738	1.1%
	United Kingdom	499	0.7%
CIS and Eastern Europe		548	0.8%
Africa		368	0.5%
Middle East		654	0.9%
Australasia/Oceania		1,057	1.5%
	Australia	827	1.2%
All ports		**69,230**	**100.0%**

Table 3: Port Cargo <u>Loaded</u> by Major Country/Territory and Port of Discharge JAN - JUN 2005

Country/ Region		Tonnes (+000)	Percentage of Total
Asia		29,182	68.3%
	Mainland China	19,219	45.0%
	PRD	16,136	37.8%
	Japan	1,522	3.6%
	Korea	593	1.4%
	Singapore	689	1.6%
North America		5,837	13.7%
	Canada	552	1.3%
	Vancouver	512	1.2%
	USA	5,285	12.4%
	Long Beach	1307	3.1%
	Los Angeles	1279	3.0%
Central/South America		1,225	2.9%
Western Europe		4,021	9.4%
	Germany	740	1.7%
	Hamburg	658	1.5%
	Italy	582	1.4%
	Netherlands	606	1.4%
	Rotterdam	606	1.4%
	United Kingdom	557	1.3%
CIS and Eastern Europe		127	0.3%
Africa		688	1.6%
Middle East		831	1.9%
Australasia/Oceania		808	1.9%
	Australia	585	1.4%
All ports		**42,719**	**100.0%**

Port Ownership

Hong Kong has a unique corporate involvement in local ports as it is one of the few major international ports in the world to be financed, owned and operated by the private sector. The nine container terminals - twenty-four berths in total - at Kwai Chung are owned and operated by five different companies: Hong Kong International Terminals (HIT) owns twelve berths,[20] Modern Terminals owns seven berths[21], COSCO-HIT owns two berths,[22] DPI Terminals owns one berth[23] and Asia Container Terminals Ltd owns two berths.[24]

3. Ship Owners Perspectives

Ship owners are constantly pressured to maintain low costs in an environment where safety and environmental regulations are tightening on a world wise basis. It is therefore not surprising that ship owners respond defensively to calls to improve fuel quality and air emissions.[25] They highlight that public awareness of the role and importance of shipping needs to be better and more widely understood as ultimately it is the purchasing public who will need to support and help finance (though higher shipping and end product costs) environmental improvements including the use of cleaner fuels.

The International Chamber of Shipping (ICS)[26] which represents more than half of the world's merchant shipping tonnage argues that the shipping industry cannot function efficiently if requirements on the same ship vary from port to port, and from coastal State to coastal State. They believe that shipping regulation should be undertaken and enforced uniformly on an international basis through the International Maritime Organisation (IMO) (see Part III). In relation to specific pollution issues, such as the use of Bunker Fuel or Residue Oil they believe that petrochemical refineries need to do more to remove sulphur from fuels before they sell it to industries such as the shipping industries. They propose that the cost of removing

[20] Hong Kong International Terminals (HIT) is the flagship operation of the Hutchison Port Holdings (HPH) Group. HIT owns and operates twelve berths at Kwai Chung - half of the total berths at the port. Through a joint venture with COSCO Pacific Ltd., and under the corporate name COSCO-HIT, the HPH Group also owns and operates an additional two berths (the JV is formally between China Ocean Shipping (Group) Co. and HIT. See www.hph.com.hk). Together these berths handle 7.45 million TEUs per year, or over 50% of the port traffic at Kwai Chung. HPH is also actively invested in ports in Mainland China, Southeast Asia, Europe, Central and South America, the Middle East and Africa. *See* HIT corporate information, *available at*: www.hit.com.hk.

[21] Modern Terminals owns and operates seven berths at Kwai Chung and is also actively invested in ports in Mainland China. The majority shareholder in Modern Terminals is The Wharf (Holdings) Ltd at 68%. China Merchant Holdings (International) Co. Ltd. owns 27% and Jebsen Securities owns the remaining 5%.*See* Modern Terminals corporate information, *available at*: www.modernterminals.com.

[22] *See* note 21.

[23] DPI Terminals is the international arm of the Dubai Ports Authority (DPA) conglomerate. DPA owns and operates ports all over the world, in the Middle East, Africa, China, Australia, Europe and Latin America. In Hong Kong, DPA owns and operates one berth at Kwai Chung. The company is also the principal shareholder and operator of Asia Container Terminals Ltd. which owns an additional two container berths at Kwai Chung. *See* www.dpiterminals.com.

[24] *See* note 23.

[25] However, it is worth noting that the Hong Kong Ship Owners Association has shown an open and proactive attitude towards marine emissions reduction initiatives.

[26] See further information on the ICS *at*: http://www.marisec.org/ics/index.htm

sulphur should be spread across all refinery customers. They also stress the importance of agreeing fuel supply provisions, including in any IMO developed regulations, with the oil refining industry to ensure they are practical and affordable and that the fuel will be available in the required quantities.

4. Local Government Initiatives

As further discussed in Part III Section 3, marine air pollution is not regulated within the Air Pollution Control Ordinance which is the main regulation of air emissions emitted within Hong Kong. However this ordinance does allow authorities to specify fuel qualities to be used by vessels. The Marine Department also regulates through shipping laws against smoky vessels from a public nuisance perspective although very few warnings and prosecutions have resulted from this law to date. It appears that marine air pollution regulation, or lack thereof, is a result of the policy responsibility being shared by two separate government departments, HKEPD and the Marine Department. However recent changes within HKEPD have resulted in the Mobile Source Emissions Group including marine emissions within its policy responsibilities, although it is to be expected that both HKEPD and the Marine Department will continue to review marine air pollution issues together.

Hong Kong has recently been invited, along with Shanghai, Nagoya and Tokyo to join a Los Angeles based Pacific Rim working group which will focus on ways to reduce shipping emissions[27]. As outlined in Part IV Section I, US west coast ports have implemented an array of initiatives both on the water and at ports which aim to curb their otherwise rising trend in marine activities pollution.

Recent media reports also suggest that the Marine Department is considering implementing cleaner fuel requirements for the 900 licensed diesel vehicles in Hong Kong (which mainly consist of passenger ferries).[28] Official responses from the department confirm that proposals to improve local marine fuel quality for sea and ocean going vessels are in line with Annex VI of the IMO regulations (see Part III) which would require fuel standards for marine vehicles of not higher than 0.5% sulphur. However local media also report that the Marine Department is studying the feasibility of making passenger ferries use Ultra Low Sulphur Diesel (ULSD which has a sulphur content of not more than 0.005%) which would be equivalent of that used by on road vehicles in Hong Kong. An important distinction to draw here is that the stricter fuel regulations would only apply to passenger ferries and not ocean going vessels, which even after Hong Kong's ratification of IMO Annex VI would still be able to use fuel oil with 4.5% sulphur content. Local ferry companies confirm that they already use ultra light diesel which has 0.3% sulphur content and which costs HK$1.80 per litre less than ULSD. They believe it would be difficult to convert their fuels without passing on the costs directly to consumers as they are already running at financial losses. Star Ferry representatives estimated that the use of ULSD would at HK$5 million to its fuel bill as it currently uses 2.5 million litres per day.

[27] See Loyds List, published 23 Jan 06, available at: http://www.tmcnet.com/usubmit/2006/01/23/1307047.htm

[28] See Cheung chi-fai, "Warning of ferry fare rise in fuel row", 27 February 06, South China Morning Post, City Section, C1.

PART II: Regulatory issues regarding Marine Emissions in the PRD region and Hong Kong

1. Ships Control Systems

Jurisdiction over ships is a vast topic which has undergone many historical developments in terms of court decisions and doctrines. This section only attempts to provide a basic notion of two ways of monitoring and enforcing compliance with marine regulations; these are flag State control and port State control.

Flag State Control

A ship acquires the nationality of the State in which it is registered. The nationality of a vessel indicates which State is to exercise flag State jurisdiction over the vessel. The jurisdiction of the flag State follows the ship wherever it goes and is not limited to the territory of the flag State.[29] Under international customary maritime law, the flag State is required to take such measures for ships flying its flag as are necessary to ensure safety at sea with regard to construction, maintenance and seaworthiness, manning, labour conditions and crew training and prevention of collisions.[30] Yet, the level of exercise of that jurisdiction depends greatly on the ability and willingness of each particular State. As such, the flag State control system creates dissimilar operational standards for ships of different flags.

In addition, some States maintain *open registries* which admit the registration of vessels that have little or no connection with those States. There has been much debate in the shipping industry during the last decades about whether a genuine link between the ship and the intended State of registration must exist as a precondition for the registration, but no definitive agreement has been reached.[31] The proliferation of open registries, however, has become a significant market force in the industry and many ship owners register their ships under open registries, looking for less stringent requirements and lower costs. Presently, half of the world fleet is registered under open registries.[32] The lack of control and enforcement by some States which have maintained open registries has given unscrupulous ship owners the chance to operate substandard vessels. Therefore, the flag State control system does not provide a comprehensive and effective means of control. In response to these deficits a new control system has been developed and implemented: the port State control (PSC) system.[33]

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[29] Oya Ozcayir, Z., *Port State Control*, LLP, London & Hong Kong, 2001, at p. 81.

[30] Hare, John, "Flag, Coastal & Port State Control - Closing the Net on Unseaworthy Ships and their Unscrupulous Owners", available at http://web.uct.ac.za/depts/shiplaw/portste.htm.

[31] *See* Pamborides, G.P., *International Shipping Law – Legislation and Enforcement*, Kluwer Law International, 1999, The Hague, Boston, Athens.

[32] Beham, A., "Ending Flag State Control?", in *International Marine Environmental Law – Institutions, Implementation and Innovation*, Kirchner, A (ed), Kluwer International, Hague, Boston and New York, 2003, at p. 125.

[33] The port State control system has been particularly supported by the coastal/port States that are most directly and adversely affected by safety and environmental consequences of irresponsible operations. In addition to port state control, there were also other tools developed to address the governance deficit of the oceans including the coastal State control and the International Safety Management Code. See Pamborides, *ibid*.

Port State Control

Port State control is the inspection of foreign ships in national ports to verify that the condition of the ship and its equipment comply with the requirements of international regulations and that the ship is manned and operated in compliance with these rules.[34] PSC is also defined as "the range of control powers that may be exercised by competent authorities of a given port on ships flying a flag that is foreign in respect of the State of the visited port".[35] Port States are recognized limited powers over a foreign vessel under particular circumstances.[36] Measures implemented as part of the PSC must be reasonable, public, and not discriminatory. Notwithstanding, the powers conferred to port States are wider in relation to the protection of their environment. Many of the most important marine environmental regulations contain provisions for ships to be inspected when they visit foreign ports to ensure they meet the relevant requirements.[37] PSC has proved to be extremely effective, especially if organized on a regional basis. A ship going to a port in one country will normally visit other countries in the region before embarking on its return voyage and, if PSC is implemented, inspections can be closely co-ordinated.[38] This feature of PSC is particularly relevant to Hong Kong due to the great number of ships operating regionally.[39] It is worth noting that PSC increases significantly the number of inspections and, thus, the level of control and enforcement over ships.

2. Jurisdictional Issues in the PRD Region and Hong Kong

Jurisdiction is a key concept when evaluating regulatory options. For the purpose of this section, jurisdiction means both the authority to govern or legislate within a territory, and the territory within which power can be exercised. As such, jurisdictional issues determine *who* can pass and enforce legislation, and *where* that legislation applies. Regulatory issues in the PRD region may involve consideration of three different jurisdictions: (i) Hong Kong's jurisdiction; (ii) Mainland China's jurisdiction; and (iii) international jurisdiction.

[34] IMO website, link: http://www.imo.org/Safety/mainframe.asp?topic_id=159.

[35] Schiano di Pepe, Lorenzo, "Port State Control as an Instrument to Ensure Copliance with International Marine Environmental Obligations", in *International Marine Environmental Law – Institutions, Implementation and Innovation*, Kirchner, A (ed), Kluwer International, Hague, Boston and New York, 2003, at p. 137.

[36] Specific powers of port States are provided for by various kinds of legal instruments, including conventions (ie. United Nations Convention on the Law of the Sea, Part XII), multilateral treaties, agreements among maritime authorities of a particular region, and domestic legislation (ie. the EU Directives).

[37] Memorandum of Understanding or MOUs providing for port State control have been signed covering all oceans: Europe and the north Atlantic (Paris MOU); Asia and the Pacific (Tokyo MOU); Latin America (Acuerdo de Viña del Mar); Caribbean (Caribbean MOU); West and Central Africa (Abuja MOU); the Black Sea region (Black Sea MOU); the Mediterranean (Mediterranean MOU); the Indian Ocea (Indian Ocean MOU); and the Arab States of the Gulf (GCC MoU (Riyadh MoU)). *See* IMO website *ibid.*

[38] IMO website.

[39] *See* Part III, section 6 of this report.

Hong Kong's Jurisdiction

Hong Kong has a high degree of autonomy, albeit it is not a sovereign State. Hong Kong's autonomy extends to all matters except foreign affairs and defence. According to the Basic Law, Hong Kong has the sole capacity to pass legislation within its jurisdiction. This jurisdiction includes Hong Kong's territory which in turn comprises its territorial waters. As such, Hong Kong has the capacity to pass and enforce legislation (such as maximum sulphur limits for marine fuels) within its whole territory (ie. internal waters and port). However Hong Kong's jurisdiction is surrounded by Mainland China's jurisdiction.

Mainland China's Jurisdiction

As a sovereign State, the People's Republic of China possesses wide powers to regulate matters within its jurisdiction. The level of jurisdiction to regulate marine emissions varies in respect to (i) internal waters (such as those in the PRD region); (ii) territorial sea and (iii) exclusive economic zone (EEZ).[40] The legal regime for the territorial sea and the EEZ is provided by the United Nations Convention on the Law of the Sea (UNCLOS).

(i) The PRD region is within Mainland China's territory and the waters inside this region are subject to Mainland China's jurisdiction. This jurisdiction may be exercised by the central government or by local authorities in the PRD region (ie. local governments, port authorities, etc); this is a matter of Mainland China's governmental organization. In any case, Mainland China has full jurisdiction over the PRD region which means it may impose, for example, regulations on maximum sulphur content for marine fuels.

(ii) Mainland China's territorial sea extends up to 12 nautical miles or 22.22 km from the baseline of the State.[41] States have strong jurisdiction over their territorial sea, although subject to some limitations.[42] The question that is particularly relevant to this research is whether Mainland China may impose regulations on marine emissions in its territorial sea, which completely surrounds Hong Kong's territorial waters. Despite some disagreements among scholars,[43] the answer is affirmative.[44]

(iii) The situation is different in relation to the EEZ. The EEZ extends up to 200 nautical miles from the baseline. The EEZ is not considered part of the State's territory under UNCLOS but a zone of economic exclusivity. Under UNCLOS, environmental regulations may be enforced in the EEZ by means of the declaration of protected areas. However, States cannot unilaterally determine those areas. In order to pass enforce environmental legislation in the EEZ, a State needs to resort to the International Maritime Organization (IMO). The

[40] *See* UNCLOS, Parts II and V.
[41] Pursuant to UNCLOS, article 3 and Law of the People's Republic of China on the Territorial Sea and the Contiguous Zone of 25 February 1992.
[42] For example, a State cannot impede or obstruct the 'innocent passage' of foreign ships through its territorial sea. *See* UNCLOS, Part II, section 3.
[43] *See* Pamborides, *ibid.*
[44] *See* UNCLOS art 194 point 3, arts 212 and 222.

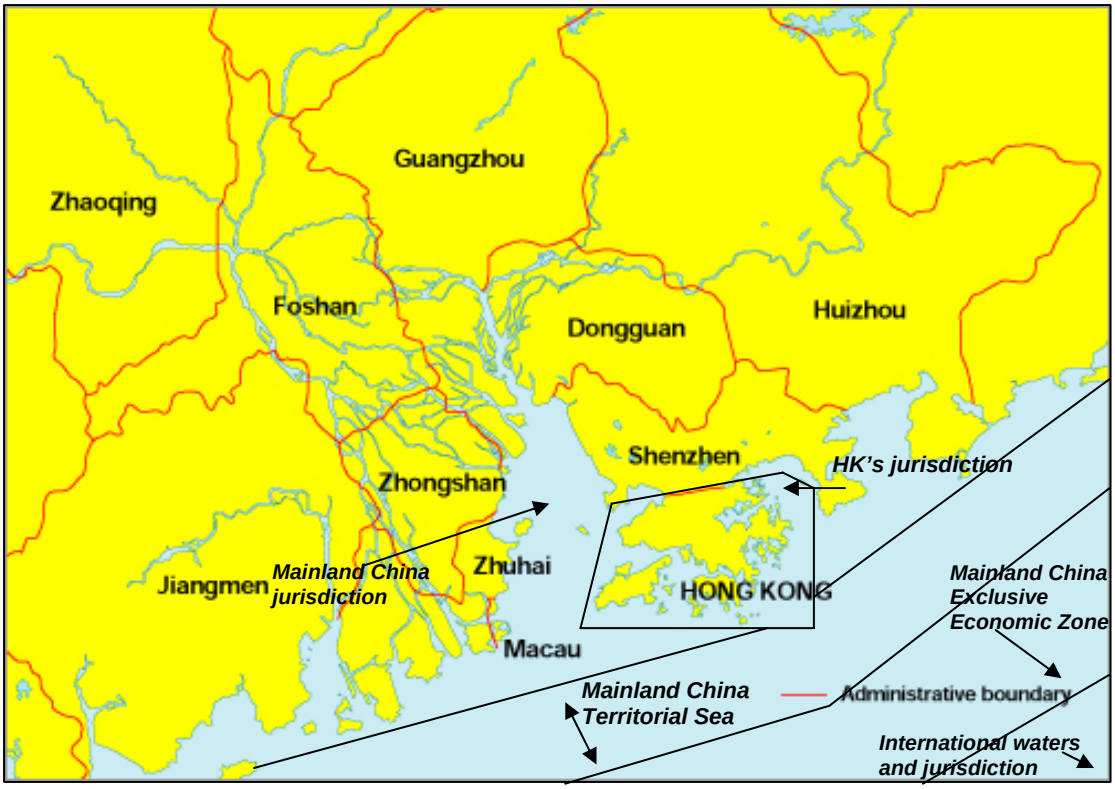
process of approval through IMO for regulations in the EEZ is rather similar to the one that needs to be followed under MARPOL Annex VI for the declaration of a SECA.[45] Further, it is not clear whether measures for the prevention of air pollution are included in the environmental jurisdiction conferred to States in regards to the EEZ. But even assuming so, it would be more convenient to apply for a SECA under MARPOL Annex VI rather than seeking to establish protected area under UNCLOS.

International Jurisdiction

International jurisdiction takes place beyond the jurisdictions of national States, for example in high sea and space. Generally, States have no sole capacity to pass or enforce legislation in international jurisdiction, except over its own nationals.[46] In order to have legislation passed in international jurisdiction, States have to resort to supranational bodies and multilateral agreements implemented through international conventions, treaties, etc.

Illustration of Jurisdictions in the PRD region

The following illustrates the jurisdictional issues regarding the PRD region as discussed above. The limits are approximate and only intend to represent the jurisdictional issues involved in the PRD region.



[45] *See* Part II of this report.

[46] For example, the flag State jurisdiction is exercised by the flag State over ships flying its flag wherever those ships are (including international waters). However, that State cannot enforce the same standards over foreign ships.

3. Implications for Hong Kong

The largest part of the PRD region waters falls within Mainland China territory and jurisdiction. Therefore, effective regulations dealing with marine emissions for the PRD region should be implemented not only by Hong Kong but also by Mainland China. Hong Kong has the power to pass and enforce legislation within its jurisdiction, for example in its port and territorial waters. However, the potential effectiveness of the regulations that Hong Kong could impose by itself is very much limited. Representatives from the shipping industry have pointed out that if Hong Kong implements more stringent regulations individually, ships may simply avoid Hong Kong port and substitute it by another port close-by. Alternatively, Hong Kong and Mainland China should develop and enforce *uniform* standards on marine emissions to be applied in the PRD region. This option requires political cooperation to be implemented. In this sense, perhaps the main option for coordinated action between Hong Kong and Mainland China regarding the regulation of marine emissions is establishing a SECA under MARPOL Convention Annex VI. This possibility is examined as follows.

PART III: The MARPOL Convention and Air Pollution

1. Overview of the MARPOL Convention (73/78)

The International Maritime Organization (IMO) is the United Nations specialized agency responsible for improving maritime safety and preventing pollution from ships.[47] To achieve these tasks, IMO develops a range of conventions, codes and guidelines which member countries then incorporate into their domestic legislation.

Pollution controls are primarily implemented thorough the International Convention for the Prevention of Marine Pollution from Ships, 1973 as modified by the Protocol of 1978 relating thereto (the MARPOL Convention) and its associated Annexes. The MARPOL Convention entered into force on 2 October 1983 and has been amended and expanded on numerous occasions. Presently, the MARPOL Convention comprises six annexes, each of them regulating different aspects of marine pollution from ships, as outlined as follows:

- *Annex I: Prevention of pollution by oil* (entry into force: 2 October 1983). It deals with operational discharges of oil from tankers.

- *Annex II: Control of pollution by noxious liquid substances* (entry into force: 6 April 1987). It details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk.

- *Annex III: Prevention of pollution by harmful substances in packaged form* (entry into force: 1 July 1992). It contains general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications for preventing pollution by harmful substances. The adoption of Annex III is optional for States ratifying the convention.

- *Annex IV: Prevention of pollution by sewage from ships* (Entry into force: 27 September 2003). It contains requirements to control pollution of the sea by sewage. The adoption of Annex III is optional for States ratifying the convention.

- *Annex V: Prevention of pollution by garbage from ships* (entry into force: 31 December 1988). It deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of.

- *Annex VI: Prevention of air pollution from ships* (entry into force: 19 May 2005). It sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances.[48]

[47] IMO website: http://www.imo.org/home.asp.
[48] IMO website, Description of the MARPOL Convention, available at http://www.imo.org/Conventions/contents.asp?doc_id=678&topic_id=258#intro.

Applicability

The MARPOL Convention applies to contracting States. The number of contracting States and the percentage of world tonnage that these States represent vary in respect to each annex of the convention. The detailed list is as follows:[49]

Instrument	Number of Contracting States	% of world tonnage
Annexes I & II	134	98
Annex III	118	94
Annex IV	104	59
Annex V	123	96
Annex VI	27	64

Compliance and Enforcement

Each contracting State is empowered to monitor the compliance with the MARPOL Convention within its jurisdiction. Any violation of the MARPOL Convention within the jurisdiction of any Party to the Convention is punishable either under the law of that Party or under the law of the flag State. Therefore, remedies for violations may vary depending on the countries in question.

2. Prevention of Air Pollution from Ships under MARPOL Annex VI

Annex VI is included within the 1997 MARPOL Protocol. Annex VI came into force internationally on 19 May 2005. This annex covers a number of different pollutants and shipboard operations which affect air quality:

- Oxides of nitrogen (NOx)
- Fuel oil quality
- Oxides of sulphur (SOx)
- Incinerators
- Ozone depleting substances
- Volatile organic compounds

Applicability of Annex VI

Annex VI applies to all ships of the flag States which have ratified the 1997 MARPOL Protocol and to ships of non-signatory States while operating in waters under the jurisdiction of parties to the 1997 Protocol.[50]

[49] IMO website, Summary of Status of Conventions as at 31 August 2005. Available at: http://www.imo.org/Conventions/mainframe.asp?topic_id=247.

[50] American Bureau of Shipping, "Understanding MARPOL Annex VI – A Guide for Ship Owners", 2005, at pg 7. Available at http://www.eagle.org/news/pubs/pdfs/MARPOLAnnexVI.pdf.

Annex VI and Fuel Quality

Annex VI includes a global cap of 4.5% m/m on the sulphur content of fuel oil and calls on IMO to monitor the worldwide average sulphur content of fuel. It also contains provisions allowing for the establishment of special SOx Emission Control Areas (SECAs) with more stringent controls on sulphur emissions. In these areas, the sulphur content of fuel oil used onboard ships must not exceed 1.5% m/m.

In the context of Annex VI, 'fuel oil' refers to any grade of petroleum derived fuel (gas oil, diesel oil or residual fuel oils (IFO/HFOs) together with any other alternative source liquid fuel used onboard. The relevant requirements often only affect supply.[51] Under Annex VI, Parties to the Protocol of 1997 are required to maintain a register of local suppliers that can supply fuel oil in compliance with Annex VI requirements.[52]

SOx Emission Control Areas (SECAs)

Annex VI provides for differentiated and stronger protection to some designated areas called "SOx Emission Control Areas". In these areas, the sulphur content of fuel oil used on board ships must not exceed 1.5% m/m (instead of the general limit of 4.5% m/m). Alternatively, ships may use an exhaust gas cleaning system, or equivalent, which results in an overall emission value of 6.0g SOx/kWh or less.[53]

The objective of SOx Emission Control Areas is to prevent, reduce and control air pollution from SOx emissions from ships and their attendant adverse impacts on land and sea areas.

The Baltic Sea (as defined in MARPOL Annex I) was the first SECA declared by the 1997 MARPOL Protocol; this designation will enter into force in May 2006. In March 2000, it was further agreed that the North Sea (as defined in MARPOL Annex V) had met the necessary criteria to be declared a SECA; this designation will enter into force in November 2007. Furthermore, there are several other areas which are expected to be proposed as SECAs in the near future (ie. areas to the west of the British Isles, west of continental Europe, US coastal waters or the Mediterranean, in total or in part).

Procedure for Declaration of a SECA

The criteria and procedures for the designation of a SECA are set out in MARPOL Appendix III to Annex VI.

According to this Appendix, "A SOx Emission Control Area should be considered for adoption by the Organization if supported by a demonstrated need to prevent, reduce, and control air pollution from SOx emissions from ships".[54]

[51] *Id.*
[52] In relation to Hong Kong, a list of suppliers who have confirmed to Marine Department that they are able to comply fully with Annex VI requirements can be found on the Marine Department website: http://www.mardep.gov.hk.
[53] Currently, this kind of abatement technology is not readily available to ships.
[54] MARPOL Convention Appendix III to Annex VI, point 1.2.

A proposal to IMO for the designation of a SECA may only be submitted by Contracting States to the Protocol of 1997. Where two ore more Contracting States have a common interest in a particular area, they should formulate a coordinated proposal. The proposal should be submitted to IMO in accordance with the rules and procedures established by the Organization. IMO shall consider each proposal submitted to it by a contracting State or contracting States. If the proposal is successful, the SOx Emission Control Area is designated by means of an amendment to Annex VI and in accordance with article 16 of the MARPOL Convention.

The Convention does not establish limits to the geographic extent of the area to be designated. Instead, it stipulates that the proposing Party or Parties support the size and extent of the proposed area by the relevant science. The most important factors in determining the offshore boundaries of the area are the meteorological conditions in the proposed area and how they influence emission transport to areas ashore and the volume and patterns of maritime traffic.[55]

Content of Proposals

Annex VI stipulates that any proposal for designation of a SECA must meet certain requirements before it will be taken under consideration by the Parties through IMO's Marine Environment Protection Committee (MEPC). The specific requirements, as set out in Appendix III to Annex VI, are:

1. A clear delineation of the proposed area of application of controls on SOx emissions from ships, along with a reference chart on which the area is marked;

2. A description of the land and sea areas at risk from the impacts of ship SOx emissions;

3. An assessment that SOx emissions from ships operating in the proposed area of application of the SOx emission controls are contributing to air pollution from SOx, including SOx deposition, and their attendant adverse impacts on the land and sea areas under consideration. Such assessment shall include a description of the impacts of SOx emissions on terrestrial and aquatic ecosystems, areas of natural productivity, critical habitats, water quality, human health, and areas of cultural and scientific significance, if applicable. The sources of relevant data including methodologies used shall be identified.

4. Relevant information pertaining to the meteorological conditions in the proposed area of application of the SOx emission controls and the land and sea areas at risk, in particular prevailing wind patterns, or to topographical, geological, oceanographic, morphological, or other conditions that may lead to an increased probability of higher localized air pollution or levels of acidification;

[55] U.S. Environmental Protection Agency, "Control of Emission from New Marine Compression-Ignition Engines at or above 30 Liters per Cylinder", available at: http://www.epa.gov/otaq/regs/nonroad/marine/ci/r03004.pdf.

5. The nature of the ship traffic in the proposed SOx Emission Control Area, including the patterns and density of such traffic; and

6. A description of the control measures taken by the proposing contracting State or contracting States addressing land-based sources of SOx emissions affecting the area at risk that are in place and operating concurrent with the consideration of measures to be adopted in relation to provisions of regulation 14 of Annex VI of the present Convention.[56]

Criteria for the Evaluation of Proposals

In assessing the proposal, IMO takes into account the content of each proposal in particular as well as the relative costs of reducing sulphur depositions from ships when compared with land-based controls. The economic impacts on shipping engaged in international trade are also taken into account. Parties which have ships navigating in the area are encouraged to bring to the Organization any concerns regarding the operation of the area.

3. MARPOL Convention in the PRD Region and Hong Kong

Status of the MARPOL Convention in Hong Kong

Hong Kong is an Associate Member (not a Member State) to IMO.[57] Hong Kong cannot become a Member State because it is not a Sovereign State. However, for the purposes of our research Hong Kong's condition as an Associate Member does not represent any particular disadvantage or limitation.[58] Hong Kong's membership with IMO is independent from that of Mainland China. Presently, Hong Kong is a party to Annexes I, II, III and V but not to Annexes IV and VI.[59]

Status of the MARPOL in other Asian Members States

The following table details the status of ratification of the MARPOL Convention in other Asian Countries. Japan and Singapore have fully incorporated MARPOL while Thailand, Vietnam and Malaysia show the lowest level of ratification. Mainland China and Macao have the same status as Hong Kong.

Country	*Annex I& II*	*Annex III*	*Annex IV*	*Annex V*	*Annex VI*
Hong Kong	X	X		X	
China	X	X		X	
Macao	X	X		X	

[56] MARPOL Convention, Appendix III to Annex VI.
[57] IMO currently has three Associate Members: Hong Kong, Macao and Faroe Islands. In regard to the legal status of an Associate Member, Article 9 of the IMO Convention provides that: "An Associate Member shall have the same rights and obligations of a Member under the Convention except that it shall not have the right to vote or be eligible for membership on the Council and subject to this the word "Member" in the Convention shall be deemed to include Associate Member unless the context otherwise requires".
[58] This was confirmed by IMO through its inquiries department which we contacted by email on 7 October 2005.
[59] IMO website, http://www.imo.org/includes/blastDataOnly.asp/data_id%3D12899/status.xls.

Japan	X	X	X	X	X
Singapore	X	X	X	X	X
Malaysia	X			X	
Thailand					
Vietnam	X				

Who Can Propose the PRD as a SECA?

Neither Hong Kong or Mainland China can currently propose the PRD waters to become a SECA because they have not ratified Annex VI. If Hong Kong did ratify Annex VI, which the HKSAR Government hopes to do within the next year[60], there would be a question of whether Hong Kong could propose the PRD as a SECA *by itself* or if it would need of Mainland China's support. The answer to this question involves two issues: (i) what Hong Kong can do in its capacity of an Associate Member; and (ii) who has a legitimate interest over the PRD waters.

Considering its capacities as an associate member, Hong Kong would have autonomy to submit a proposal for a SECA if the other requirements are met (ie. ratification of Annex VI). However, a proposal to declare the PRD region as a SECA would involve interests common to both Hong Kong and Mainland China and, therefore, would need to be jointly made by these two members.[61] Thus, the need to create consensus between Hong Kong and Mainland China regarding the declaration of the PRD as a SECA would arise not as matter of Hong Kong's limited autonomy but as a matter of a common interest shared by Hong Kong and Mainland China. Following this principle, Mainland China would also be unable to individually apply for a SECA without Hong Kong's consent.

Steps to have the PRD declared as a SECA

The general procedure for a SECA declaration is set out in MARPOL Appendix III to Annex VI and it was outlined above.[62] The specific steps that need to be taken towards declaring the PRD as a SECA are as follows:

1. *Ratification of MARPOL Annex VI by Hong Kong and Mainland China:* the ratification of the Annex VI is a precondition for the capacity of Member State to propose a SECA.

2. *Submission of a Joint Proposal to IMO by Hong Kong and Mainland China:* the PRD region concerns both Hong Kong and Mainland China and, thus, these two Members should make a joint proposal to have that area declared as a SECA.

[60] This was discussed in a meeting with the Marine Department, November 2005.
[61] In cases of common interests over the area to be declared as a SECA, IMO requires the proposal to be submitted jointly by the members which share those interests.
[62] *See* Part II, sections "Procedure for Declaration of a SECA" and "Content of Proposals".

Current Status of Marine Emissions Regulations in Hong Kong

The main regulation dealing with air pollution in Hong Kong is the Air Pollution Control Ordinance. This Ordinance regulates air pollution from many sources including vehicles and commercial premises but excludes ships. The Ordinance expressly excludes "any air pollutant emitted from any furnace or engine used in the propulsion of any *vessel*, railway locomotive or aircraft".[63] The Ordinance states that the Secretary may provide for the specification for the kind of fuel to be used by vessels, but the Ordinance does not contain any further provisions in this respect. Apart from this there is no other legislation in force in Hong Kong which sets standard for marine emissions.

4. Implications for Hong Kong

Establishing a SECA in Hong Kong and the PRD region waters would implement an internationally known option for the reduction of marine emissions. One major advantage of this is that the shipping industry already knows how to operate under this legislative framework and the specific operational difficulties they need to overcome. Notwithstanding this, establishing a SECA in the PRD region may encounter some significant hurdles. The ratification of an international legal instrument, in this case MARPOL Annex VI, is a lengthy process. Both Hong Kong and Mainland China need to undergo this process before being able to propose the PRD region as a SECA.[64] In addition, Hong Kong and Mainland China need to achieve political consensus in order to submit a joint proposal. But even having those requirements met, the proposal for a SECA needs to be admissible in IMO's criteria.

In this regard, one of the aspects that IMO evaluates is what inland measures has the proposing Member(s) taken in order to reduce sulphur emissions. The concept behind this requirement is that the proposing Member(s) needs to show a coherent approach towards sulphur emissions reduction. The inland measures adopted in Hong Kong and Mainland China may not be in line with SECA application requirements.[65] Arguably, the States that have been successful in their applications for SECAs (ie. European Union states) had done much more in terms of reducing inland emissions than it is currently being done in Hong Kong. Further research in this respect may bring better insight in order to determine the prospects for a SECA application by Hong Kong and Mainland China.

The Hong Kong shipping industry has expressed concerns regarding the declaration of a SECA in the PRD waters. They are concerned that the establishment of a SECA results in financial and operational difficulties for ships. For example, ships need to carry two lots of fuels (one of which would be at a higher cost) and begin switching fuels about 10 days before they enter a SECA.[66] Another major concern is the lack of

[63] Air Pollution Control Ordinance, section 3 which provides that: "Except to the extent provided by section 43(1)(p) nothing in this Ordinance shall apply to any air pollutant emitted from any furnace or engine used in the propulsion of any vessel, railway locomotive or aircraft".
[64] The Marine Department informed Civic Exchange that Hong Kong would ratify MARPOL Annex VI during 2006.
[65] This was noted by Dr Alexis Lau, Hong Kong University of Science and Technology.
[66] This was informed to Civic Exchange by Arthur Bowring, Managing Director of the Hong Kong Ship Owners Association.

availability of low-sulphur fuels necessary to operate in a SECA. Instead of establishing a SECA, certain Hong Kong ship owners propose that IMO work towards a global cap of 1% applicable to all oceans.[67] This is an ambitious target as it would be even better, in terms of pollution, than a SECA, which imposes a sulphur fuel limit of 1.5% applicable only to certain specified areas. This positive and receptive attitude by the Hong Kong shipping industry should be considered and properly exploited in the design of policies for marine emissions reductions in Hong Kong. On the other hand, achieving such a global cap does not appear as a realistic objective in the short or mid term as changes to IMO conventions take years of negotiation and agreement. In the original discussions for the general sulphur limit for MARPOL Annex VI (which was finally agreed at 4.5%) Member States at IMO showed incapacity to come up with a proper solution. Studies conducted at that time showed that the world average sulphur content of marine fuels was approximately 2.6-2.7%, which was well below the limit agreed for Annex VI.[68] However local shipping representatives suggest that the average sulphur content of marine fuels has worsened in recent months/ years and is currently over 3%. This worsening trend reflects both fuel availability and lack of stronger regulatory incentives to improve fuel quality. In any case, the general sulphur limit of 4.5% set out by Annex VI is not sufficiently ambitious and does not constitute a proper solution for marine emissions.

[67] *id.*

[68] See "Understanding MARPOL Annex VI – A Guide for Ship Owners", American Bureau of Shipping, 2005, at pg. 8. The studies notes that "MEPC has operated a sulfur monitoring program, in conjunction with the classification society fuel oil testing organizations (ABS, DnV and LR), since 1999. To date, this has covered nearly 300,000 deliveries representing some 280 Mt of residual fuel oil. From this the number of instances of sulfur contents in excess of 4.5 percent m/m has been negligible, the overall average sulfur value being 2.6 percent/2.7 percent m/m."

PART IV: Global Review of Marine Emissions Reduction Initiatives

In Parts I and II we addressed some of the regulatory issues related to marine emissions in Hong Kong and the PRD region, including the procedure and prospects for declaring a SECA. That discussion presented a number of regulatory options and the specific challenges that would need to be met in each case. In this section we attempt to examine what other ports and States are doing to reduce marine emissions. This section also contains a global summary of marine emission reduction initiatives (both voluntary programmes and mandatory regulations) implemented or being discussed in other ports worldwide.

1. NORTH AMERICA

1.1. The United States—California

Among the American ports, those in California are the most actively engaged with marine air pollution, and well they should be: The Greater Los Angeles area in particular, like Hong Kong and the PRD region, has a serious problem with air pollution. Los Angeles might therefore serve as a good example of what can and needs to be done in highly polluted regions.

In Los Angeles, ocean-going vessels contribute 36% of the area's NOx emissions and 86% of its SO2 emissions.[69] In Santa Barbara, such ships contribute one-third of the county's NOx emissions, which is almost as much as all land-based sources combined.[70] However, the Port Authorities in California, in conjunction with local and regional regulatory and environmental agencies, have developed and implemented many successful policies and programmes to address the issue of marine emissions. The specifics of these initiatives are described below.

A. Regulations

Sulphur Limits

The state of California and the Environmental Protection Agency (EPA) are pushing IMO to adopt more stringent standards; the EPA is committed to maintaining such stringent standards for all U.S.-flagged ships and is apparently in the process of instituting regulations which would mirror SECA requirements with respect to the allowable sulphur content of fuels. In 2005, the Port Authority of Long Beach independently adopted a resolution urging the United States to ratify MARPOL Annex VI.

Furthermore, in December 2005 the Air Resources Board (ARB) of the California Environmental Protection adopted two regulations to reduce emissions from activities related to moving goods in and out of California.[71] Aimed at reducing diesel PM and

[69] *See* Port-Wide Baseline Air Emissions Inventory, Executive Summary, *available at:* http://www.westcoastdiesel.org.
[70] *See* "Air Pollution Issues," Santa Barbara County Air Pollution Control District," *available at:* http://www.sbcapcd.org/itg/shipemissions.htm.
[71] *See* "Air Resources Board Adopts Measures to Reduce Emissions from Goods Movement Activities", *available at*: http://www.arb.ca.gov/newsrel/nr120805.htm.

NOx, both rules are the first of their kind in the US. The two parts to these initiatives include:

1. Ocean going vessels must use cleaner burning marine distillate fuels or equally effective emission controls in their auxiliary[72] diesel engines and diesel – electric engines on their ships operating within Californian waters which are defined as being 24 nautical miles from any Californian port. Fuel requirements are phased as acceptable sulphur limits are 0.2% by July 1st 2006 and 0.1% by July 1st 2010. Between 2007 and 2020 it is expected to reduce diesel PM emissions by more than 23,000 tons (or 75% of total), NOx by 15,000 tons (6%) and SOx by 200,000 tons (80%);

2. Mobile handling equipment such as yard trucks and forklifts that operate at ports and intermodal rail yards must replace or retrofit diesel engines. Retrofitting with Best Available Control Technology (BACT) or replacing of existing equipment must begin shortly and all equipment purchased or rented after January 1st 2007 must use BACT. This regulation expects to eliminate another 19,000 tons of NOx and 690 tons of PM emissions between 2007 and 2020.

These initiatives put the California coastal waters in line with SECA requirements. Indeed, in August of 2005 the California Legislature passed a joint resolution - introduced by several Congressmen as well as the Pacific Merchant Shipping Association - "calling for the creation of a North America Sulphur Emission Control Area".[73] The resolution calls on the Federal Government to ratify Annex VI of the MARPOL Convention, and to create a SECA along the West Coast of North America.

Under the Air Quality Board's (ARB) proposal, vessel owners will be allowed to apply for an extension of the timeline of up to six months if their vessels will require extensive modifications in order to meet the requirements. The proposal also requires that the ships keep detailed records regarding the time, date, and location of fuel switching, the percentage of sulphur used at each juncture, where the fuel was purchased, and in what amounts. Furthermore, ship owners/shipping companies will have to grant authorities access to the vessel for sampling purposes. One of the issues surrounding this proposal is the availability, or potential lack thereof, of low-sulphur fuel. While its proponents concede that more information is needed around this issue, they also believe that the market will respond to an increase in demand for this sort of fuel.

The ARB has outlined the following as the 'next steps' that it plans to take with regard to marine emissions reduction: 1) Pass the regulations requiring the use of cleaner fuel in auxiliary engines, 2) Pass additional requirements for frequent visitors, 3) Obtain sulphur-emission control area designation, 4) Conduct a cold-ironing feasibility study, and 5) Conduct a ship-water emulsion demonstration.

[72] Auxiliary engines provide lighting, cooling and on board power for navigation equipment. Some vessels including cruise ships also use these engines to run large electric motors that propel the vessel.
[73] *See* http://www.westcoastdiesel.org.

Also under discussion is the possibility of a mitigation fee system which would allow a ship to make payments in lieu of compliance for up to three visits. However, the ARB is clear that this option would only be available in special circumstances, such as unexpected redirection to a Californian port, finding the fuel to be non-compliant while at sea, and/or for one-time visitors whose ships require significant retrofitting in order to be compliant.

Priority Berthing for Vessels which use Low-Sulphur Fuel

A bill has also been introduced into the California Legislature - SB 763 - which would require the ports to develop a system to give priority-berthing to ships using low-sulphur fuel. Apparently there can be up to 90 ships waiting off the coast of Southern California during peak season, and this bill will reward those ships that use cleaner fuel by allowing them to go to the front of the line.[74]

Shore-Side Power

An additional initiative undertaken by the state of California, and replicated/reinforced by the various individual Port Authorities within the state (as outlined below), involves the use of shore-side power. Under the California ARB proposal, where a ship uses shore-side power while docked at a port, its travel to and from the port will be considered to have met the emissions reduction requirements. Presumably this means that the ship will be allowed to use higher-sulphur fuel on the condition that shore-side power is used while at berth. However, subsequent travel to other Californian ports where shore-side power is not utilized will then require the use of cleaner fuels.

B. Voluntary Programmes

Shore-Side Power

Los Angeles has instituted several air quality programmes aimed at the reduction of marine emissions. First is their 'Alternative Maritime Power' program, whereby container ships plug-in to shore-side electrical power while at dock - while "hoteling"- rather than use their own bunker fuel. This programme allows for a 98% reduction in SO2 emissions, a 96% reduction in NOx emissions, and a 98% reduction in particulate matter (PM).[75]

However, one downside to this initiative is that in many cases ships must be retrofitted in order to access this power, which, without further incentive, might mean that ship owners would be disinclined to voluntarily pay for the requisite retrofitting. For example, at US$320,000, the retrofit of a China Shipping container ship is on the lower-end of the spectrum with regard to retrofitting expense; at the higher-end, the retrofit of a Hatsu Marine vessel is estimated to cost upwards of US$2,000,000.[76] The

[74] For more information on Senator Lowenthal's string of bills related to marine emissions and pollution at Californian ports, *see* http://lbreport.com/news/feb05/lowbilz.htm, *see also* http://www.westcoastdiesel.org.
[75] *See* "Alternative Maritime Power at the Port of Los Angeles," PowerPoint presentation *available at:* http://www.westcoastdiesel.org.
[76] *Id.*

difference in cost is due to differences in existing infrastructure on the ships. The infrastructure at the berths themselves would also have to be upgraded in order to enable the provision of shore-side electricity. At the Port of Los Angeles, these costs are estimated to be between US$1,000,000 and $7,000,000.[77] Similarly, a 'Tugboat Retrofit Project' has been in place in Los Angeles since 1997. This involves fitting tugboats in the port with ultra-low emissions diesel engines.

The Port of Long Beach also has a shore-power program, with the goal of having 100% plug-in in the very near future. The Port hopes to achieve this by writing it into lease agreements with the ships. For ships that do not use shore power, the Port has clean fuels and exhaust requirements which are also written into the lease language. In this way, this Port has essentially taken away the "voluntary" aspect of such initiatives, given that any ship seeking to berth at Long Beach will be required to either use shore power or clean fuel.

Programmes Written into Tenants' Leases

The Port of Long Beach is not the only Californian port to mandate environmentally sound practices by contract: when the Port of Los Angeles was negotiating the lease for the China Shipping terminal it stipulated environmental performance as an essential condition for the lease. Under this program, ships berthing at the terminal are required to 'cold-iron' - use shore-side power - and to use cleaner, alternative fuel-burning trucks and other ship-serving equipment. The Port is currently proposing similar lease requirements at its other berths, such as observation of the voluntary vessel speed reduction program, use of shore-side power, use of alternative fuel and emulsified fuel in shore-side vehicles and maximized use of the on-dock rail system.

It is important to note that regulations such as this by individual ports is not only possible, but might also be a viable option for Hong Kong. The leverage of any individual port in negotiating such leases, however, depends on a high demand for space at that particular port, and ship owners may try to divert cargo if the requirements prove too burdensome or restrictive. Moreover, Hong Kong's port terminals are privately owned and operated, unlike the Californian ports. This unique corporate structure of Kwai Chung might make it more difficult to successfully implement voluntary measures or contract arrangements, as the owners may be loathe to adopt policies or contracts that threaten their bottom line.

Vessel Speed Reduction

Both the LA and the Long Beach Ports have implemented a 'Vessel Speed Reduction Program,' whereby ships coming into the harbour are asked to reduce their speed to twelve knots. This voluntary program - instituted in 2002 - as the first of its kind and has proven to have successfully reduced marine emissions at the port. For example since 2004, and as a result of this program, NOx emissions have been cut by over 1 ton/day at the Port of Long Beach.

Though voluntary compliance in Long Beach was already at 67%, the Port has coupled the speed-reduction programme with a comprehensive incentive plan in

[77] *Id*.

order to make the initiative that much more successful. Under its 'Green Flag Incentive Program' the Port rewards fleet operators and individual ships that reduce their vessel speed by offering them a discount on docking rates of 15% for doing so. Individual vessels that observe this limit for one full year are given a 'green flag' in recognition of their contribution to improving air quality. Ocean carriers - those operating the individual ships - can qualify for the discount if 90% of their vessels comply within the twelve month period. In total, the discounts will cost the Port US$2.2 million; however, a compliance rate of 100% would reduce emissions of NOx by over 550 tons/year.[78]

Grants to Fund Retrofitting of Ports' Tenants

The Port of Oakland was the first in the U.S. to develop a grant programme in order to fund diesel retrofits of cargo handling equipment. The Port has currently provided US$4.5 million in order to fund the program, which involves the installation of 151 'diesel oxidation catalysts' and 159 'diesel particulate filters' in the equipment engines.[79] Part of the Port of Oakland's programme also offers grants to retrofit, re-power and replace old and dirty trucks that serve the Port.

It is important to note, though, that the Port of Oakland implemented this grant programme as part of its larger Air Quality Mitigation Program, all of which was developed as part of a settlement agreement with various community/activist environmental groups. The programmes associated with the China Shipping Terminal at the Port of Los Angeles were developed after a similar settlement agreement with community groups was reached. Given that Hong Kong's legal culture is far less litigious than that in the United States, it may be more difficult for community groups here to exert the same degree of legal pressure on the Port owners and operators in Hong Kong. Nonetheless, and given that incentivizing the corporate players at Kwai Chung is critical to the reform process, it is interesting to note that the threat of expensive litigation may be enough to induce compliance.

The Port of Los Angeles is pursuing a similar 'Diesel Oxidation Catalyst Program'. This involves the installation of DOCs in the terminal equipment engines, and apparently leads to emissions reductions of 50%. This programme has been in place since May 2003, with the Port defraying some of the cost.

Other Programmes Aimed at Reducing Land-Based Emissions at the Port

The Port of LA has taken up an intermodal/on-dock rail project in order to reduce the amount of truck trips back and forth between the ships - it is estimated that the initiative will cut 1.4 million short-distance truck trips per year.[80] While not directly related to marine emissions, this initiative is illustrative of the robust approach that the Los Angeles area ports have adopted towards air pollution, with all sources of emissions being examined and improved. The Port of LA also has 57 ship-loading

[78] *See* The Port of Long Beach website *at:* http://www.polb.com/.

[79] *See* "Emissions Reduction Incentives for Off-Road Diesel Equipment Used in the Port and Construction Sectors," *available at*: http://www.westcoastdiesel.org.

[80] *See* "Policy Levers for Reducing Emissions from Goods Transport: State Policy Options," PowerPoint presentation available at: http://www.westcoastdiesel.org.

cranes that run on electric power, and 35% of their port fleet is converted to electric power.[81]

Incentives for Individual Ship Owners/Shipping Companies

Lastly, the Port of Los Angeles, as part of its 'Air Quality Mitigation Program,' is considering a financial incentives plan whereby ships would be given a reduction in fees or priority berthing for reducing emissions or for being otherwise environmentally friendly. One thing that is being considered is a graduated harbour or container fee system, wherein fees are levied based on the amount of pollution a ship generates. Another idea that has been proposed would award clean ships priority docking at heavily congested times.

Other incentive programs, such as that which has been combined with the vessel speed reduction program, have proven highly successful. Similar incentive programmes appear to be underway in Europe. This could also be a viable approach for the PRD.

The Port of Houston in Texas is also in the process of designing - in conjunction with the Coast Guard and the EPA - a collaborative programme to offer incentives to marine vessels that voluntarily reduce their emissions. This programme has been modelled on the 'Coast Guard Qualship 21' Program, wherein 'quality ship status' is bestowed on ships that meet certain safety standards. The Houston–based version would establish an air quality component to the Qualship program. Vessels that met the requirements might then be rewarded with a reduction in inspection frequency or in port fees.[82]

1.2. Canada—Vancouver

Regional Authority Plans

Environment Canada and the US EPA have begun work on a possible joint North American SECA application to the IMO. Overall air pollution strategies including strategies focussing on vessels have also been proposed through a Greater Vancouver Regional District (GVRD) Air Quality Management Plan[83] although one limiting factor is that the GVRD has no authority to directly regulate vessels, as marine transportation is regulated federally in Canada. Consequently the GVRD are seeking partnership arrangements (largely with other government organisations) to achieve their goals which include:

- Identifying and implement emission reduction measures for ocean-going vessels, ferries, harbour vessels and port operations. Measures may include establishing a North American SECA for ocean going vessels, installing improved engine technology, improving fuel quality and composition, and improving on and off shore operating practices; and

[81] *Id.*
[82] *See* Port of Houton website *at*: http://www.portofhouston.com/publicrelations/environment.html. *See also* note 79.
[83] See greater Vancouver Regional District website and report *at*: http://www.gvrd.bc.ca/air/planning_plans.htm

- Increasing GVRD influence with respect to marine vehicles and port operations including seeking agreements with port authorities to require lessees to obtain air quality permits similar to those required on private land.

The Port Authority of Vancouver and various local and national Canadian environmental groups and government agencies are engaged with the problem of marine emissions and are taking steps towards reduction initiatives. As of yet, however, no formal regulations or voluntary initiatives have been put in place.

Fuel Additives

One of the options that appears to be under consideration is the use of 'CombustAll' - a fuel-borne catalyst - in container-handling equipment to reduce emissions from such activities. This is a soluble chemical added to fuel and has been successfully proven to reduce the emission of pollutants. For example, the use of this additive can reduce NOx emissions by up to 30%, carbon monoxide emissions by up to 100%, and PM by over 65%.[84]

Other Initiatives—Alternative Fuel Sources, Lower Emissions Generators

The Port of Vancouver is also looking into the following options for reducing emissions: requiring ships to switch to lower emission generators while at berth, providing on-shore power sources, requiring the use of O2 diesel fuel, biodiesel, and water-injection procedures. Finally, the Port of Vancouver is eager to establish a baseline acceptable emissions figure and to then develop a corresponding process for issuing emissions credits. Presumably this could also entail several types of incentives for low-emitters and, conversely, punishments for serious polluters.

2. EUROPE

2.1. The European Union

The Western European nations have consistently been the frontrunners in the move to reduce marine emissions; in the next few years, two areas of the EU will officially become the world's first SECAs: the North Sea and the Baltic Sea. However, this is not to suggest that Europe's ports are cleaner than others worldwide: In Europe, ships now emit fifty times more SO2 than trucks and one hundred times more than aviation. By 2020 - assuming that no further action is taken - ships will emit more pollutants than all land-based sources combined.[85]

In Europe, unlike in North America and Asia, there are a number of regional regulations targeting marine emissions. This has been possible due to particular capacities of the European Union to pass legislation applicable to all EU Member States. As a result of these far-reaching and uniform standards handed down from a

[84] *See* "Report on the Use of CombustAll, a Fuel-Borne Catalyst, in Reducing Diesel Emissions from Container-Handling Equipment in the Port of Vancouver," September 2004, *at*: http://www.westcoastdiesel.org.

[85] Peter Gammeltoft, European Commission, "European Perspective on International Shipping," PowerPoint presentation *available at:* http://www.westcoastdiesel.org.

supranational body, there is now less of a need for individual EU ports to implement their own initiatives with respect to marine emissions. The next two sections will outline: i) regulations at the national and supranational levels, and ii) programmes (mostly voluntary) that have been instituted at various individual ports.

A. Regulations

Sulphur limits: MARPOL SECAs and EU Directive 2005/33

The designation of the Baltic Sea and the North Sea as SECAs under MARPOL Annex VI means that all ships operating in these areas shall use fuel that has a sulphur content of less than 1.5%. These designations will enter into force in May 2006 for the Baltic Sea, and November 2007 for the North Sea. Though this move will certainly do much to improve air quality in the region, there has been pressure from various groups to further reduce this allowable sulphur level to 0.5% in the very near future. According to the proponents of this plan, the benefits of lowering the allowable sulphur level even further - in terms of reduction in health care costs - would be 7.5 times greater than the costs to shipping industry of using lower-sulphur fuel.[86]

In July 2005, the European Union (EU) Commission issued a new directive designed to reduce sulphur emissions at European Union ports and waters.[87] The new directive mandates that all passenger vessels/ferries operating on regular services use fuel with a sulphur content of less than 1.5% *throughout the entire EU* by August 2006. In addition, ships at berth in *all EU ports* are now required to use fuel with a sulphur content of less than 0.2%; this will be further reduced to 0.1% by 2010. The overall effect of all the above is to reduce sulphur emissions by over 500,000 tons per year, starting in 2006.
This development is significant not only because it highlights the priority that EU Members place on combating air (and other) pollution, but also because these rules will reach across the EU and shape shipping within the entire continent.[88] Were the Asian nations to similarly combine their efforts, to commit to cleaning up the air in and around Asian ports, and to issue a joint ruling regarding marine pollution, the resulting drop in emissions would be much more effective than if they address the problem of marine emissions individually.

This Directive puts the EU in a leading position regarding the regulation of marine emissions; however, further changes might be expected. In this respect, the new legislation expressly provides that "This Directive should be seen as the first step in an ongoing process to reduce marine emissions, offering prospects for further emission reductions through lower fuel *sulphur limits* and *abatement technologies*, and for *economic instruments* to be developed as an incentive to achieve significant reductions." Further, the Directive encourages Member States to promote within

[86] EU business, "EU votes to reduce ship pollution," http://www.eubusiness.com/topics/Environ/ships.2005-04-14.
[87] Directive 2005/33/EC of the European Parliament and of the Council Amending Directive 1999/32/EC.
[88] In this sense, it is worthy to note that legislation adopted by the European Parliament becomes mandatory for all EU Member States which then have to incorporate that legislation into their domestic legal regimes.

IMO the consideration of more stringent limits for marine emissions addressing both SO2 and NOx emissions.

B. Voluntary Programmes

EU Clean Marine Award

This program, started in 2004, is administered by the European Commission and designed "to give publicity to environmentally responsible shipping, specifically low-emission initiatives, and to disseminate best practice."[89] There is no monetary value associated with the award, yet the surprisingly large number of applicants/entrants suggests that the prestige and/or significance attached to the award is enough of an incentive for individual ships and ports to clean-up their policies and protocols.

Awards are handed-out in three categories: 1) EU ship operator - an individual vessel operator which has a policy or procedure of low-emission shipping, beyond what is required by law, 2) EU shipper - a shipping company that has a firm-wide policy or practice of using low-emission ships to transport goods, and 3) EU authority—a port or local/national authority that has a implemented a policy or procedure to facilitate low-emission shipping or shore-side activity at the port.

C. Voluntary Programmes—Port-by-Port Findings

2.2. The Netherlands—Port of Rotterdam

The Port of Rotterdam - the EU's largest port - will become part of the North Sea SECA in 2006, which means that all vessels berthing at this Port and travelling in these regional waters will be required to use 1.5% sulphur fuel in their engines.

In 1994, and in conjunction with the Dutch Ministry of Transport, the Port established the "Green Award Foundation"[90] which grants a reduction in port dues and tariffs to ships that meet various environmental, technical and safety standards. It does not, however, relate directly to air emissions. In contrast to similar initiatives in the US, ports awarded the Dutch honour are eligible for reduced charges not only at ports in the Netherlands, but also at ports in Germany, Belgium, Lithuania, Spain, Portugal, South Africa, New Zealand and the Shetland Islands. Approximately 165 vessels have been certified to date.

2.3. Sweden—Port of Gothenburg

The Swedish ports and authorities have undertaken significant efforts to reduce marine emissions both in their harbours and from their flagged ships. One effective initiative that the ports collectively started in 1998 has been the differentiated port fee system. The Swedish model of the plan is revenue-neutral, meaning that lower fees for 'green' ships are offset by higher fees for dirty ships. It rewards ships that reduce NOx emissions, as well as those that burn lower-sulphur (less than 1.0%) fuel.

[89] *See* http://www.europa.eu.int/comm/environment/clean_marine/.
[90] For more information on this program, *see* http://www.greenaward.org/ and http://www.equasis.org /equasis_html/aide/help_ga.htm.

By 2000, the majority of ships calling on Swedish ports were using lower-sulphur fuel—that which has between 0.5% and 0.9% sulphur content. To help defray the cost of NOx retrofitting, the Swedish Maritime Association was at one point covering up to 40% of such costs. Despite this, the differentiated fee scheme has not been as successful in reducing NOx emissions as it has been in reducing SO2 emissions. Apparently, this is because the cost of the equipment modifications necessary for NOx reductions is higher than the costs of switching to lower-sulphur fuels. Regardless, by 2000 almost 50% of the vessels in Swedish ports had been outfitted with the proper NOx-reducing technology.

In 2004, the Port of Gothenburg - Sweden's main port - was awarded the EU's Clean Marine Award (*see* Section B, above, outlining initiatives at the EU-level) for its highly successful shore-side power program. Gothernburg's program, in place since 2000, is particularly remarkable because the shore-side power is sourced from wind turbines, thus negating the possibility that in switching to land-sourced power the ship merely switches from one dirty fuel to another.

A study by the European Commission on the efficacy of different reduction strategies has shown that switching to lower-sulphur fuel will reduce SO2 emissions by at least 44% for fuel that has a sulphur content of 1.5%, and even more for better quality fuel. Fuel switching does not effect NOx emissions. Shore-side electricity programs, however, allow for NOx reductions of up to 97%. Therefore Sweden has optimized emissions reductions by coupling a lower-sulphur fuel incentive programme with a shore-side power program. While one such policy is better than none, it is clear that if a port or a region wants to comprehensively target several sources of emissions, combining one or more strategies is most effective.

2.4. Finland—Port of Mariehamm

This Scandinavian port has instituted a programme whereby port fee rebates are given to vessels proven to have relatively low NOx emissions. The rebate is 1% of fees for those vessels abating NOx emissions to less than 10g/kw-hr, and it increases up to 8% for ships that emit only 1g/kw-hr. Rebates are also given to vessels using low sulphur bunker fuels. Ships using fuel with less than 0.5% sulphur will receive a 4% rebate. Ships which have both reduced NOx emissions and used low sulphur fuel can receive rebates up to a maximum of 20% of port fees.[91]

2.5. Norway

The Norwegian ports have collectively proposed a differentiated port fees scheme to address rising air pollution in the nation. The following summarizes the programme quite succinctly:

Norway proposed a scheme in 1999 that would vary business taxes on Norwegian ship owners based on environmental performance. Each ship would be scored based on seven criteria, including air emissions of NOx and SOx. Vessels that score the highest would pay reduced taxes; those that score low or elect not to participate would pay the full business tax. Because the business tax on ship owners is relatively

[91] *See* note 79.

small, the monetary incentive of this programme would likely have only limited effect. However, it was hoped that the education and recognition associated with the programme would induce ship owners to invest in emission reduction improvements.[92]

3. ASIA

3.1. Japan

Air pollution in the Greater Tokyo area is an enormous problem, one to which the shipping industry makes a substantial contribution: "Ships anchoring at Tokyo Port emit about eight times more sulphur oxides a year than the total amount emitted by automobiles in six Tokyo wards along Tokyo Bay."[93] The Metropolitan Government of Tokyo is considering instituting emissions controls at its local ports and is currently in the process of consulting with ship owners on the issue.[94] The Government is also apparently going to demand that vessels entering the Tokyo ports use better-quality, lower-sulphur fuel and/or 'Bunker A' (higher standard, lower sulphur) diesel fuel. It is anticipated that this change will result in reductions of 75% in PM and 10% in NOx and SO2, depending on the exact sulphur content of the fuel.[95] An adjusting and remodelling of vessel engines will result in a further 10% reduction in NOx.[96] In addition, Japan has ratified MARPOL Annex VI.

The Japanese authorities are also installing diesel particulate filters and other emission cleaning devices, presumably in their flagged vessels, in addition to exploring the option of shore-side power. Small-scale land-based power is already in use at Tokyo ports; however, its use is currently limited to lighting.

Importantly, the Tokyo authorities are also actively considering an incentive programme to help achieve greater compliance with voluntary measures. The plan appears to be in the early stages, as all that is known publicly to date is that the initiative will involve commendation/publication of high-achievers, reduction of financial burden, and priority loans to ship owners for retrofitting projects.[97]

3.2. Mainland China and Taiwan

It has proven difficult to find any information concerning either environmental initiatives at Chinese/Taiwanese ports more generally, or marine emissions regulations in particular - it now looks as if very little work has been done in Mainland China and Taiwan towards the reduction of marine emissions. The

[92] *Id.* at Note 85.
[93] *See* http://www.worldroom.com/pages/shippingnews/marine_pollution/marine_pollution05200516.phtml.
[94] Information from Robin Meech, given as part of his speech on global programmes concerning marine emissions at the IBIA Bunkering Conference in Hong Kong, September 2005. *See also* note 78.
[95] *See* "FY2004 Report by the Study Committee on Countermeasures for Marine Emissions and Other Air Pollutions," a report by the Air Preservation Section, Environmental Improvement Division, TMG Bureau of Environment, March 2005.
[96] *Id.*
[97] For more information on the marine emissions reduction initiatives currently being discussed in Tokyo, *see* note 79.

academic community, however, does appear to have engaged with the issues of marine emissions and the proliferation of pollutants in Mainland China's rapidly growing ports. The State Environmental Protection Administration organized a research project concerning emissions inventories with an eye to improving standards—the project was developed by many universities and other academic institutions.

Port throughput in Mainland China is growing at a rate of 8.7% per year, with air quality all-too-visibly left to suffer the consequences. The Chinese government has made some efforts to reduce emissions at its ports, but as noted above, the issue of air pollution from marine sources does not yet appear to have garnered nearly as much attention as that of air pollution from land-based sources. Nonetheless, in 1985 the Government did adopt standards to control coal dust from the process of coal loading and unloading on ships - a regulation applicable to all coal wharfs in the PRC. Then in 1988 it instituted limitations on the exhaust smoke from marine diesel engines in its ports, and in 1990 the Government instituted specifications for marine incinerators: less than 1.5 kg/h of SO2 and less than 0.5 kg/h of NOx.[98] In 2005, the Chinese government promisingly undertook an "emission inventory of air pollution from ships," to determine whether or not it is necessary to use shore-side power at the Port of Shanghai.[99] Given the success of such programmes in California and in Europe, it would seem advisable for Mainland China to institute similar programs.

3.3. Korea

The port authorities for the major Korean ports of Busan and Inchon do appear to be aware of marine environmental issues, such as the protection of marine ecology. However, the specific issue of marine emissions is not directly addressed in the official literature.[100] It was asserted at the Bunkering Conference in Hong Kong in September 2005 that the Korean ports might possibly become SECAs in 2010.[101]

3.4. Singapore

Likewise Japan, Singapore has fully incorporated all Annexes of the MARPOL Convention, including Annex VI. Also, similar to the developments in Korea, it has also been claimed that Singapore's Port may become a SECA in 2010.[102] Information to confirm this assertion has not been found.

[98] *See* Jiming Hao, "Legal and Regulation Challenges for Reducing Emissions from Goods Transport in China," April 19, 2005, PowerPoint presentation *at* http://www.westcoastdiesel.org.
[99] *Id*.
[100] *See* The Korean Ministry of Maritime Affairs and Fisheries website at: www.momaf.go.kr.
[101] This information also came from Robin Meech during his speech at the Bunkering Conference.
[102] *Id.*

4. Additional Alternatives/Technology for Reducing Marine Emissions

Scrubbing[103]

Seawater scrubbing reduces marine pollutants by filtering the fumes before they are actually emitted. It works as follows: would-be exhaust gases are pumped into the scrubbing system where they are mixed with sea water and "scrubbed" clean, the scrubbed gas is then re-heated and emitted into the air minus much of the harmful SO2 and other pollutants that would otherwise have been present. During the process, 90% of SO2 emissions are eliminated, as are 3-5% of NOx emissions and 50% of PM. Proponents of the technology argue that this alternative is not only more economic than fuel switching, but also more efficient at reducing SO2 emissions. In addition, the installation of such technology would permit ships to use cheaper fuel. However, and though the advocates of scrubbing deny such claims, some suggest that the adverse effects of pumping the sea water used in the scrubbing process back into the ocean are so undesirable as to render the option impractical. MARPOL Annex VI allows exhaust gas cleaning (scrubbing) and other equivalent methods, provided that the resulting effluent does not damage marine eco-systems or pollute the sea water. Since very few ships have actually implemented the technology, it is hard to determine at this point whether it is a viable option, or whether other efforts - such as shore-side power and vessel slowing at the ports - would be more effective. A committee in the EU is currently in the process of conducting trials of scrubbers with an eye to granting formal approval in the near future.

Skykites

A company based out of Hamburg, Germany has developed a large, kite-like product that can be attached to cargo ships in order to save fuel and thus reduce emissions. The sails fly at a height of 100-300 meters above sea level, where winds are stronger and less turbulent. The company claims that diesel emissions can be reduced by up to one-third with proper use and application of this product. Vessels would also benefit from reduced fuel costs and consumption - the company estimates that a ship will be able to recoup its investment in four to five years. To date, it does not appear that any ships have been outfitted with these sails.[104] One drawback of this initiative is that Skykites and similar sails cannot be used close to land due to manoeuvring and air draft problems, which is where marine emissions need to be particularly reduced.

Market-Based Methods

A US consultancy - National Economic Research Associates - has won a contract to examine the feasibility and logistics of market-based solutions to the problem of marine air pollution.[105] It appears that two different approaches are being explored: 1) emissions trading proposals - credits, benchmarks, cap& trade programs, and 2) fee-

[103] This technology is still under development. Although the trials conducted showed positive results, further tests need to be conducted.

[104] For more information on skykites, *see* http://www.economist.com/science/tq/displayStory.cfm?story_id=4368130.

[105] *See* Gammeltoft, note 85.

based programs - taxation, en-route charges, differentiated dues. As discussed above, ports in Europe and America already employ several of these latter strategies.

Technology to be Further Researched

Slide Valves: this technology reduces NOx emissions by 20%. It is also a relatively cheap technology, and it is relatively easy to retrofit ships in order to accommodate the valves.

In-engine controls—controlled fuel injection, waste gas circulation: Cut new engine emissions by 30%. Involve the rebuilding/re-powering of engines.

Water Injection/Humid Air Motors: Cuts emissions by 50-75%. Involve the retrofitting of existing engines, rather than the rebuilding/re-powering of new engines.

Selective Catalytic Reactors: Can reduce emissions by 90%. On-board Hydrogen-based fuel cells.

Alternative Fuels: Bio-diesel, ultra-low sulphur fuels.

5. Summary of international initiatives

This global review showed that the European Union and North America have been at the forefront in marine emissions abatement for some time now. In North America, the majority of the programmes underway have been initiated by local port authorities and then supported by more national regulatory bodies. However the recent regulations imposed by the Californian Air Resources Board are ground breaking in that they extend their authority beyond the previously recognised three mile limit that defined state jurisdiction over ocean waters.

In Europe, the pattern is opposite - the EU has been quite active in regulating allowable emissions levels at ports and in coastal waters, and the Member States and local port authorities have followed suit. Several ports in Europe, however, have nonetheless been quite active and innovative in coming up with solutions to the growing problem of marine air pollution: some of the most successful programmes are being carried out in Swedish and Dutch ports, proving that the voluntary schemes created by individual ports, when coupled with attractive incentives, can be just as effective in cleaning up marine emissions as regulations handed down from national or supra-national bodies.

On the other hand, Asian nations have yet to fully implement marine emissions reduction programs, or, in some cases, to even address the issue. Japan and possibly Singapore have made the biggest strides in this regard, and yet information pertaining to the policies and programmes of these two nations continues to prove difficult to uncover. Mainland China, on the other hand, does not appear to have made any effort thus far to reduce marine emissions at its increasingly busy ports, with one commentator remarking that "the [Chinese] government has made great efforts to reduce emissions from stationary sources and vehicle exhaust; however, emissions from ships are usually neglected."[106]

[106] *See* note 98.

Table 1 "Summary of Word-wide Shipping Initiatives" presents a summary of the options for reducing marine emissions implemented or planned.

Initiative:	Used In:	Efficacy/ Reductions: SO2	NOx	PM	Approximate Cost, if known
1) Programmes to Reduce Vessel Emissions					
Vessel Speed Reduction	Ports of LA and Long Beach, USA	Significant	550 tons/year (100% compliance)	significant	US$2.2 m for discounts associated with programme (Port of Long Beach)
Use of lower-sulphur Fuels	All jurisdictions engaged in marine emissions reduction	In the EU: 500,000 tons/year (for 1.5% sulphur fuel) = 44%	0%	In Japan: 75% (estimated)	Cost of lower-sulphur fuel is higher than that of higher-sulphur, poorer quality fuel—ships need added incentive in order to invest
Fuel Additives ie. CombustAll	Port of Vancouver, Canada		30%	65% or more	
Shore-side Power (powered by wind in Sweden)	Ports in California, USA; Port of Gothenburg, Sweden. Under consideration in Shanghai and Japan	In the Port of LA: 98%	In the Port of LA: 96%	In the Port of LA: 97.7%	Retrofitting of vessel: US$320,000-2,000,000 Retrofitting of berth: US$1,000,000-7,000,000
Scrubbing	Under consideration in EU	90%	3-5%	50%	
SkyKites		Emissions reductions of 1/3 (did not specify type)			Ships can recoup investment in 4-5 yrs
Slide valves			10-20%		
In-engine controls, ie. controlled fuel injection and waste gas circulation		~30% of engine emissions (did not specify type)			
Water-Injection, humid-air motors	Under consideration in the Port of Vancouver		40-50%		US$35,000
Selective Catalytic Reactors and other NOx reduction / retrofitting equipment	Swedish Ports		90-99%		
2) Programmes to Reduce Land-Based Emissions at the Port					
Diesel Retrofits of cargo handling equipment	Ports of California and Oakland, USA	~50%	~50%	~50%	US$4.5 million for the grants needed to fund programme (Port of Oakland)
Intra-port rail system	Port of LA, USA	Will cut 1.4 million short-distance truck trips			
Use of electric power for shore side equipment and vehicles	Port of LA, USA				

Table 2: "Summary of Award and Incentive Programs" provides a summary of awards and incentive programs used in various parts of the world to reduce emissions and improve environmental performance.

Award	**Used In:**	**Summary of requirements/ benefits:**
EU Clean Marine Award	EU	environmentally responsible shipping, low-emission initiatives / prestige and recognition; no monetary reward
Green Award Foundation	Netherlands but certified ships also able to recoup incentives in other ports such as Germany, Spain and New Zealand	Higher environmental, technical and safety standards / reduction in port dues and tariffs
Port fee rebates and incentives	Finish, Norwegian, German and Swedish Ports and in LA Port, USA	Low emissions / vessel speed reduction/ reduction in port dues and tariffs
Emission trading and credit system	Under consideration in the Port of Vancouver and the US	

6. Implications for Hong Kong

Evidence from Europe and North America has shown that while national or international regulation can play an important role in reducing marine emissions, there are also many highly effective programmes that local or regional authorities and individual ports can institute themselves. Furthermore partnerships with national authorities can also be the beginning of local strategy development. It is also clear that if a port or a region wants to comprehensively target emissions, combining one or more strategies and coupling them with incentive programs is most effective.

The EU has the advantage of being able to implement programs covering many jurisdictions of close proximity. If Asian nations similarly combined their efforts to commit to cleaning up the air in and around Asian ports the resulting drop in emissions would be much more effective than if they address the problem of marine emissions individually. While Hong Kong can take a lead, it is clear that in the longer term Hong Kong will need to collaborate with Mainland China in order to determine and implement marine emission initiatives. However in the shorter term there are many voluntary programs which Hong Kong can explore as many of them could have a direct impact on local air emissions. Initiatives such as shore-side power, vessel speed reduction, retrofitting, and fuel-switching are all feasible initiatives which are being used in other ports around the world and which could be further explored in Hong Kong and also within the PRD. What is clear though is that in order for voluntary programmes to be successful, they must be coupled with attractive incentives such as reduced port fees and/or tariffs, priority berthing, and financial grants for retrofitting. Even award schemes which specifically target local shippers and ports and which have no monetary value attached to them, thus being purely for commendation purposes, seem to have had some success in Europe and these could also be implemented in Hong Kong and the PRD region.