“CREATING A GREEN PORT CULTURE”

Leadership Strategies in Environmental Sustainability for the Port of Hong Kong

Industry White Paper from Turnkey Group

- in association with M Power Associates

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“CREATING A GREEN PORT CULTURE”

Leadership Strategies in Environmental Sustainability for the Port of Hong Kong

Introduction

The city of Hong Kong boasts a proud and historical heritage, and in Economic terms, few cities can boast the enormous growth in infrastructure and global awareness that Hong Kong has been able to enjoy since the 1950's.

From the era of the 1950's when Hong Kong was considered predominantly a trading town, the city has transformed to become one of the key tiger economies of the 20th century. This is largely related to the development of Hong Kong as a key commercial and manufacturing hub from the 1960's.

As the Hong Kong Economy enjoyed multiple decades of economic prosperity, so too was there an ever greater need to provide the strongest possible infrastructure to support the fast paced growth, hence the modernization and impressive state of the art development of Hong Kong port during this time.

During the economic boom of the 1980's, the port of Hong Kong held number one status as the world's busiest port for container movements from 1987 to 1989, and regained the number one position for TEU volume between 1992 to 1997 and also between 1999 to 2004. For nearly three decades the port of Hong Kong has been one of the key cornerstones for employment and remains an essential gateway for all of the leading regional and international shipping lines on a worldwide basis.

Hong Kong in 2009 remains one of the largest and most advanced ports in the world, currently ranked the 3rd largest port globally with container throughput at 24.5 million TEU in 2008. The continued Freeport status that Hong Kong port enjoys creates additional attractions to global shipping lines and especially for imported cargoes to the region, and thanks to significantly improved transportation networks in China, easier transhipment capability and reduced lead times assist in maintaining a competitive edge for the region. The efficiency of the port remains one of the highest in the world, with exceptionally quick berthing windows, flexible operating hours and experienced global based port operators such as Hutchison Ports and Modern Terminals ensuring that the highest levels of operational standards are maintained.

These factors continue to ensure that Hong Kong continues to remain a strategically significant hub for global carriers, despite the intense competition from the fast growing ports within the Pearl River Delta, as well as maintaining a high profile status within the region.
The Rise of China

Whilst Hong Kong remains one of the largest and most sophisticated port operations globally, the traditional values and strategic advantages that have been enjoyed are, however, gradually being eroded. The rise of China as one of the new global powers has created cross border competition which Hong Kong port has never experienced in the past. Whereas in the year 2000 Hong Kong enjoyed a market position whereby over 80% of cargo volume in the PRD came through Hong Kong, the position by 2009 shows that this figure is now at 51% in 2008. In 2010, this figure will decline to 47%.

![CHART ONE](chart.png)

The development of ports in the Pearl River Delta region have scoured the once monopolistic market positioning of Hong Kong and will continue to have a strong effect on the regions competitive edge.

With the China Government continuing to drive huge expenditure on enhancing the PRC’s capabilities in Infrastructure, particularly in road, sea and air, it can be expected that China will continue to advance strongly in its strategic competitive capabilities, especially in line with continued high expenditure in countrywide modernization of services to enhance the global positioning of the nation.

Hong Kong now faces a stern test as to how to maintain a leading edge competitive advantage over the increased competition that it now faces through these evident Economic factors. The report will evaluate these challenges, particularly in line with the potential direction that Hong Kong can take pertaining to Environmental and Sustainability strategies.
Asia's World City, but is Hong Kong Asia's World Port?

"We are not going to have kids in Long Beach contract asthma so someone in Kansas can get a cheaper television set" - Bob Foster, The Mayor of Long Beach, California

One of the key economic trends that have developed in the last few years has been that of Global sustainability, most notably in line with population growth, increasing pressure on resource scarcity, as well as Climate Change. Governments and organizations around the world are reacting strongly to this important threat, and the pressure on airlines, sea-freight carriers, port authorities and general logistics operators to operate in a sustainable fashion is growing ever stronger.

Globally, certain key ports are now taking great strides to support Environmental initiatives as part of their long term strategies. This is especially evident in Europe where the culture of environmental protection and sustainable well-being has been embedded for close to a decade, and where governmental legislation has created emphasis on controlling Green House Gas emissions (GHG), Nitrous Oxides and harmful particulate matter, as well as incorporating carbon reporting and carbon offset programmes as part of a corporate culture. Examples of organizations taking initiative include the port of Hamburg which offers incentives to carriers that burn cleaner fuel or have environmental certifications such as ISO 14001. Long Beach is now branded as a green port, further emphasizing the importance of a strong strategic initiative within a corporate Environmental strategy. Recent examples of ports continuing this road of Environmental sustainability strategies include the port of Seattle and the ports of New York with its clean truck programme in late 2009.

The rise of the Obama Administration in the United States has added further weight to the importance of Sustainability in companies and this has become one of the top priorities of the government of the USA since the inauguration of the new presidency.

Whilst we frequently hear about global initiatives to support the Environment, Hong Kong, branded as Asia's World City, continues to have a clear market niche to develop and enhance its reputation in multiple market sectors through the development of a leading edge strategy to drive a green supply chain throughout the country, especially in line with the Port of Hong Kong which remains one of the highest profile operations within Hong Kong. It is clear from the global trends associated with Environmental sustainability, that Asia remains some way behind other continents in terms of embracing global standards in Environment. Much of this has to do with limited legislative obligation to conform to Environmental standards, as well as the fact that the Global manufacturing cycle remains entrenched in countries such as China and India. Significant NGO’s and Lobby Groups such as the Civic Exchange and the Hong Kong Ship-owners Association have supported strong evidence of the growing need to support strong actionable solutions to improve the position as an Environmental leader on port and shipping standards and assist in creating a leadership position along with the support of the ports surrounding the Pearl River Delta (PRD).
Whilst it may be deemed worrying that Asian companies have in general chosen not to invest strongly on sustainability programmes and processes, it is clear that global legislation is taking on greater importance to support this important area. This provides Hong Kong port a unique opportunity to create value differentiation and brand leadership should it choose to pioneer this opportunity in Asia.

It can also be deemed a critical threat to the region if Hong Kong chooses not to react to potential legislation that affects the region until it is forced to, thus allowing other ports to create brand advantage over the city.

Benchmarking Hong Kong’s environmental initiatives and perceived capabilities against other leading ports globally, it is clear that there are substantial opportunities for the port to be Asia’s leader in this high profile area. The report will cover some key areas where Hong Kong port can become a frontrunner through the incorporation of a leading edge Environmental strategy. This in turn could lead to overall improvements throughout the PRD to enhance not only Hong Kong’s position but the entire South China profile.

It is increasingly evident that innovative environmental initiatives are needed to not only maintain Hong Kong port’s leadership position but also to create innovative solutions that support local emission reduction endeavours for the benefit of Hong Kong’s people and to enhance the reputation of the region.
Section One: Hong Kong Port Existing Operation

1.0: Hong Kong Container Port - The Current Scenario

In 2008 Hong Kong handled a total of 24.5 million Twenty-foot Equivalent Units of containers (TEUs), maintaining the status as one of the largest container ports. Despite the significant growth in South China port development, Hong Kong remains the largest port in TEU throughput in the Pearl River Delta.

Hong Kong port has continued to see annual growth in container volume, with the only regression being through the recent economic depression in late 2008 and into 2009. Independent studies from the GHK group show that container traffic is predicted to increase to 28 million TEUS by 2012, and potentially up to 40 million TEUS in 2020 if Hong Kong port continues to attract the global lines as it does at present.

Whilst the growth forecasts are impressive, it is prudent to note that the base annual growth is forecast to be only in the region of 3.4%. This is unfavorable compared to the China ports which are expected to grow in excess of 8-10% per annum during this period, and once the shipping industry rebounds from the Economic downturn. Hong Kong faces a strong challenge to maintain market competitiveness as a result of this paradigm shift, and as such will need to evaluate fresh approaches to attracting and maintaining its position among the global carriers who have increased port options in region.

Some 435,000 vessels arrived in and departed from Hong Kong during the year, carrying 260 million tonnes of cargo. This amounts to approximately 450 container liner services per week to over 500 regional and global destinations. As of 2003, the port of Hong Kong employed 110,000 jobs amounting to 4% of Hong Kong’s GDP, and 3.4% of employment for the city.

<table>
<thead>
<tr>
<th>COMPARISON WORLD CONTAINER PORTS (in '000 TEUs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Singapore</td>
</tr>
<tr>
<td>Shanghai</td>
</tr>
<tr>
<td><strong>Hong Kong</strong></td>
</tr>
<tr>
<td>Shenzhen</td>
</tr>
<tr>
<td>Busan</td>
</tr>
<tr>
<td>Rotterdam</td>
</tr>
<tr>
<td>Dubai</td>
</tr>
<tr>
<td>Kaohsiung</td>
</tr>
<tr>
<td>Hamburg</td>
</tr>
<tr>
<td>Qingdao</td>
</tr>
</tbody>
</table>

(Source: Port of Hong Kong Handbook 2009)
1.1: Hong Kong Government - 4 Pillars Economic Strategy

The Hong Kong government in the new millennium drew up a footprint for Hong Kong's future competitiveness, commonly known as the four pillar industries of the Hong Kong Economy. The key industries to support Hong Kong's future competitiveness have been deemed to be:
1. Financial Services
2. Trading and Logistics
3. Tourism
4. Professional Services - Legal, Accounting and Auditing

These industries have been pinpointed as the key stimulus for Hong Kong's long term competitiveness. As of 2003, the employment figures for these key industries showed the following statistics:

<table>
<thead>
<tr>
<th>Industry Sector</th>
<th>Value Add(Mn$)</th>
<th>GDP Share at factor cost</th>
<th>Employment numbers</th>
<th>Share in Total employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banking</td>
<td>146,700</td>
<td>12.2%</td>
<td>179,000</td>
<td>5.5%</td>
</tr>
<tr>
<td>Insurance</td>
<td>100,800</td>
<td>8.4%</td>
<td>78,100</td>
<td>2.4%</td>
</tr>
<tr>
<td>Logistics</td>
<td>57,600</td>
<td>4.0%</td>
<td>195,300</td>
<td>3.0%</td>
</tr>
<tr>
<td>Logistics incl Trading</td>
<td>319,700</td>
<td>24.5%</td>
<td>778,100</td>
<td>15.2%</td>
</tr>
<tr>
<td>Inbound Tourism</td>
<td>36,600</td>
<td>3.0%</td>
<td>127,600</td>
<td>3.9%</td>
</tr>
<tr>
<td>Professional Services</td>
<td>138,200</td>
<td>11.5%</td>
<td>338,000</td>
<td>10.4%</td>
</tr>
</tbody>
</table>

Source: HK Economic Background, 2005

These figures support the critical role that Hong Kong port and the Logistics industry has to maintain the market positioning of Hong Kong. Although the city is recognized globally as a financial centre, employment in banking amounts to only 5.5% of employment in the region. This pales in comparison to the logistics centre whereby non trading based logistics alone exceeds employment numbers in all sectors except professional services. It is important to note that once import and export based trading is included, Logistics and Trading is by far the number one employment industry in Hong Kong with almost one in five employees working in shipping or logistics related activities. This is further emphasized in GDP terms where Logistics contributes the single largest share of GDP to the area.

Logistics and Trading are one of the four key industries in the Hong Kong economy. These two pillars contributed 25.8% to Hong Kong’s GDP and provided 18.2% of total employment in 2007.

From the perspective of employment protection, market leadership and continued economic stimulus, the role of Logistics and Supply Chain related trading remains critical to Hong Kong. This essential market remains in decline however, compared to 2003, when 27% of employment was based around Logistics and Supply chain occupations in Hong Kong.
As transport and logistics is one of the pillars of Hong Kong’s economy, and its development is essential for maintaining Hong Kong’s success and prosperity, local transport and logistical operations must remain at the cutting edge to reduce the decline in market share and GDP in the region.

The key to a successful shipping and logistics industry is using a vibrant hub that offers excellent international sea and air transport connections supported by a sound infrastructure that offers a wide range of essential services.

Whilst Hong Kong continues to maintain a high standard of service, the issue is are the current business practices sufficient to maintain Hong Kong’s competitive edge or even once again excel at being Asia’s leading port for volumes and infrastructure? There is growing evidence to suggest that the port of Hong Kong is indeed losing the strong advantages it used to have, and that there is limited innovation in terms of re-engineering to re-create its previous leadership status.

1.2: The roadmap shift - Comparative advantage of Hong Kong vs. South China Ports

Whilst Hong Kong continues to maintain a high standard of service, the dilemma facing the industry remains whether current business practices are sufficient to maintain Hong Kong's competitive edge or even once again excel at being Asia's leading port for volumes and infrastructure?

Hinterland accessibility, productivity, quality, cargo generating effect, reputation and reliability are seen as the most critical factors in strengthening a port’s competitiveness.

The effects of this relate to another key question which is what is the benefit to Hong Kong port for shipping lines in terms of pricing and cost advantage? As the below table shows, there is a clear shift in operating performance between the two regions.

The following chart shows the key operational changes between Hong Kong and the China ports in the last five years.
The trading patterns have clearly shown a gradual shift in competitive improvement within South China as emphasized by the advantages highlighted in orange. Outside of the regulatory environment where Hong Kong continues to maintain a clear advantage, South China ports have either offered advantages in cost or managed to close the gap in the leading service levels associated with Hong Kong. It can be seen that Hong Kong port has reached a crossroads in operational excellence. A decision will now need to be made in terms of whether Hong Kong wants to be a leader or follower in Asia. To be an effective leader, the need to embrace some of the most important concepts such as Environmental sustainability will be critical to reforming the ports competitiveness.

1.3: Leader or Follower - Cost competitiveness and port objectives

Hong Kong port has traditionally been able to offer a number of service advantages like service frequency, high productivity, short vessel turnaround time, streamlined customs, free port status, to its customers. This has allowed the port to charge premiums to shipping lines for operational and berthing rights.

Furthermore, Ship turnaround performance is among the best in the world: container ships at terminals are routinely turned around in about 10 hours, making Hong Kong port one of the most efficient in the world.¹

Following on from the studies by the Transport Research Institute, Hong Kong port charges vs. service differentiation have been further analyzed. From independent studies from companies such as GHK, it has been recognized that the South China competitor ports have developed quickly and gradually erode Hong Kong port’s competitive advantage especially in line with cost vs. service differentiation.

---

### Table: Port Comparisons

<table>
<thead>
<tr>
<th>Factor</th>
<th>Hong Kong Port</th>
<th>Shenzhen / Yantian Port</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inland Transport Linkage</strong></td>
<td>High cross boundary costs, but Hong Kong traditionally enjoyed premium due to lack of competition</td>
<td>Shenzhen port infrastructure now modernized and internal haulage costs are lower than Hong Kong</td>
</tr>
<tr>
<td><strong>Terminal Handling charge</strong></td>
<td>Hong Kong has highest THC in the region</td>
<td>Shenzhen THC lower than HK Port, by up to 20%</td>
</tr>
<tr>
<td><strong>Port Tariffs - Container Handling Charges (CHC)</strong></td>
<td>CHC’s are converging</td>
<td>Hong Kong advantage eroding as Shenzhen CHC is converging</td>
</tr>
<tr>
<td><strong>Port Service Quality</strong></td>
<td>High quality infrastructure but gap is narrowing annually- Main advantage is turnaround times</td>
<td>Very slight difference in service levels over the last year. Can expect Shenzhen to equal service levels in the short term</td>
</tr>
<tr>
<td><strong>Regulatory Environment</strong></td>
<td>Freeport is advantageous as is simple legislation</td>
<td>Regulation is being simplified but unlikely to reach Freeport status - Disincentive for direct imports to the region</td>
</tr>
<tr>
<td><strong>Productivity</strong></td>
<td>Land and environmental constraints</td>
<td>Greater land availability and more possibilities to develop</td>
</tr>
<tr>
<td><strong>Expansion</strong></td>
<td>Limited space and although terminal expansion is earmarked, costs for expansion are extremely high</td>
<td>Container Terminal expansion costs are lower than in Hong Kong, and greater land mass is available</td>
</tr>
</tbody>
</table>

Source: Transportation Research Institute and Atkins China
Shipping lines are key players in determining port choice with increasing attention given to by them to provide logistical services on a global basis in an integrated approach. As Hong Kong continues to maintain the highest terminal handling fees in the area in spite of slowing growth patterns, innovative development such as Environmentally friendly port operations as well as incentives for ships to burn cleaner fuel need to be considered to maintain the price advantage that the port holds.

Below 2006 industry data highlights Hong Kong’s main competitive disadvantages of high road haulage tariffs and high terminal handling charges.

According to information gathered from shippers, shipping lines and trucking companies, using Hong Kong port is about 7% more expensive compared to Yantian (East PRD cargo moved inland by road via HKP to US West). ii

The next table shows that for West PRD cargoes, barging via HKP is cost competitive when compared with trucking the same cargo via Yantian. However, barging via the West Shenzhen ports of Shekou and Chiwan still offers a US$160 cost advantage versus HKP, primarily because Hong Kong’s THC is about US$100 more expensive.

<table>
<thead>
<tr>
<th>Industry data, 2006, US$</th>
<th>By Truck</th>
<th>By Barge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Via HKP</td>
<td>Via Yantian</td>
</tr>
<tr>
<td>Ocean Freight Rate (Basic) +/- $50**</td>
<td>1,850</td>
<td>1,850</td>
</tr>
<tr>
<td>Fees#</td>
<td>1,377</td>
<td>1,377</td>
</tr>
<tr>
<td>Terminal Handling Charge (THC)</td>
<td>366</td>
<td>269</td>
</tr>
<tr>
<td>Truck to Port Terminal</td>
<td>300</td>
<td>N.A.</td>
</tr>
<tr>
<td>Truck to Barge Terminal</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>Barge Freight (all-in rate)</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>Total</td>
<td>3,893</td>
<td>3,616</td>
</tr>
</tbody>
</table>

Versus HKP: -277 -277 -148
Creating a Green Port Culture – Port Environmental Sustainability

2.0: Environmental Sustainability

Environmental development has become one of the key issues affecting the Shipping and Logistics industry in recent times. The recent Eye For Transport survey showed that among over 500 Logistics companies surveyed, 82% of firms considered Environmental sustainability as either a very important or essential part of their long term strategy. 12% in 2009 considered it to be their number one priority.

2.1 The Importance of “Green” Initiatives

This shift in awareness can be attributed to continued governmental drive to reduce carbon emissions as part of their overall legislation, but the drive of large multinationals has also been an integral part of this change. Organizations such as Wal-Mart have now incorporated global Eco Rating programmes which aims at auditing all their global suppliers including logistics providers, shipping lines, trucking firms among others. Companies unable to comply with the requirements of the Eco Rating are threatened by gradual loss of client support and diminishing market returns within their product offering.

Globally Eco-Ratings have become an important part of certain global companies who wish to work on with Sustainable transportation companies around the world. One of the key areas that shipping lines have focused on is accreditation and certification models so that there is evidence of development of Environmental programmes. This has, however been less forthcoming with the ports around the world.
2.2 Environmental issues surrounding Hong Kong Port
"MARINE PORTS ARE MAJOR SOURCES OF AIR POLLUTION"

Many of the dirtiest sources of air pollution are concentrated at marine ports, often creating a veil of pollutant that carries with it all of the severe health effects of industrial and urban air pollution.

For example, marine ports such as Hong Kong attract hundreds of enormous oceangoing ships and tugboats, which burn dirty grade of diesel fuel. Cargo is moved around shipyards by fleets of highly polluting heavy-duty equipment, and it is delivered and taken away from those shipyards by container trucks.

These and other port-related sources combine to rival the worst pollution from power plants, accounting for large percentages of the air pollution in Hong Kong. Air pollutants emitted from port-related activities adversely affect the health of port workers, as well as residents of nearby communities, and contribute significantly to regional air pollution problems.

The major air pollutants related to port activities that can affect human health include nitrogen oxides (NOx), sulfur oxides (SOx), ozone (O3) particulate matter (PM), diesel exhaust, and volatile organic compounds (VOCs).

Other pollutants from port operations - such as carbon monoxide (CO), formaldehyde, heavy metals, dioxins, and even pesticides used to fumigate produce - can also be problematic. Hong Kong port has particular issues surrounding pollution issues upon the density of population around the port of Hong Kong. Central Hong Kong which supports enormous residential facilities around the centre of Hong Kong island is only 20 Mile from the Centre of Kwai Chung where over 75% of all shipping activities takes place. This results in the effects of air pollution to over 2million persons within the direct 20 Mile radius of Hong Kong, although this issue can affect the whole of Hong Kong island due to the relative density population in the area.

The issues of Maritime pollutants can be drastic, with particulate matter and other polluting emissions such Nitrogen Oxides, Sulpur Dioxide, Carbon Monoxide and Volatile Organic Compounds all strongly evident within Port Operations:

A recent Survey following 1.2million adults for 2 decades showed that exposure to pollutants such as Particulate Matter as well as Nitrogen and Sulphur Oxides is directly linked to an 8% increase in Lung Cancer Deaths.
2.3: Port Emissions and the impact on Human Health

One of the major issues challenges that Port Operators now face is the issue of growing awareness on health implications through the operation. Being the 3rd largest port in the world, Hong Kong port is confronted with huge amounts of vessel rotations in the port, all of which create pollutants in the region. The port operators have made some developments to support the reduction in Emissions such as:

1. The incorporation of 44 RTG cranes to full electric based operations as opposed to Diesel based performance.

2. The signing of the MARPOL VI agreement which ensures that vessel operators entering the port should burn fuels that emit less than 2.5% sulphur within international waters of Hong Kong and the port vicinity.

These are welcome initiatives, but there remains a significant challenge in the emissions from port and vessel operating pollutants. The key pollutants which are evident in ports such as Hong Kong include:

2.3.1: Sulphur Dioxide

Sulfur dioxide is the chemical compound with the formula SO2. It is produced by volcanoes and in various industrial processes. Since coal and petroleum often contain sulfur compounds, the combustion generates sulfur dioxide.

Sulphur Dioxide is recognized as being the cause of dangerous natural causes such as Acid Rain. Further issues to the Hong Kong population would be health dangers related to heart disease and breathing difficulties among sufferers of Asthma. (See Appendix 2)

2.3.2: Nitrogen Oxide

NOx is a generic term for mono-nitrogen oxides (NO and NO2). These oxides are produced during combustion, especially combustion at high temperatures. Scientific evidence shows that this type of oxide can create breathing difficulties to humans (See Appendix 1)

2.3.3: Particulate Matter

Particulate matter (PM) is an air pollutant consisting of a mixture of particles that can be solid, liquid or both, are suspended in the air and represent a complex mixture of organic and inorganic substances. These particles vary in size, composition and origin. Particulate matter is known to cause Lung Disease and breathing difficulty (See Appendix 3)

2.3.4: Carbon Monoxide

Carbon monoxide (CO) is a colorless, practically odorless, and tasteless gas or liquid. It results from incomplete oxidation of carbon in combustion.

This is a particularly dangerous pollutant in terms of requiring only moderate concentration to create fatigue, nausea, impaired vision and reduced brain functionality. Higher concentrations can be fatal in some instances. (See Appendix 4)
2.3.5: Volatile Organic Compounds

Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects including issues with lung issues. - Also known to create smog and poor air quality (See Appendix 5)

3.0: New Opportunities: Taking the initiative

By implementing environmental strategies Hong Kong will not only protect the viability of its port and move away from a pure cost competition argument but also significantly contribute to a friendlier and healthier environment for its community. As explained in Section 2, The implications of non environmentally friendly ports are a hazard to the health of the population and Hong Kong’s density as a city makes the country particularly susceptible to this issue.

The ports of Hong Kong, Busan and Kaohsiung have long dominated container handling in East Asia. However, the emergence of new transhipment and gateway hub candidates, which include Shanghai, Shenzhen, and Qingdao, among others, will vie with these incumbents for a greater share of container traffic. Mainland Chinese ports are increasingly attractive as direct ports of call for mainline services. Although the composition of containers handled at Mainland Chinese ports consist largely of gateway cargo, these ports are expected to handle a rising share of transhipment traffic.

According to a forecast by consultancy GHK, container terminal capacity in south China will exceed 70m TEU by 2013, up from 50m this year. There is a strong need therefore to review the importance of clean air and minimization of pollutants among all the ports in the Pearl River Delta, an area in which Hong Kong port continues to hold significant volume. Emissions from international ships are increasingly a focus for proposed regulations in local, national, and international arenas as the extent of shipping emissions health impacts become more widely documented and known.

Port expansion plans in south China, including Shenzhen, Hong Kong and Guangzhou, are considered and expansion at Yantian eastern port, Dachan Bay phase two and Nansha Port phase three are under discussion with investors.
3.1 Global Impact of Ship Emissions

The marine transport sector contributes significantly to air pollution, particularly in coastal areas. Shanghai, Singapore and Hong Kong, three of the world’s five busiest ports, were likely to suffer disproportionate impacts from ship-related emissions says a study, published in Environmental Science and Technology, a journal of the American Chemical Society.iii

Annually, ocean-going ships are estimated to emit 1.2 – 1.6 million metric tons of particulate matter, 4.7 – 6.5 million metric tons of sulfur oxides and 5 – 6.9 million metric tons of nitrogen oxides. Recent studies have estimated around 15 % of global NOx and 5 -8 % of global SOx emissions are attributable to ocean-going ships.iv
CREATING A GREEN PORT CULTURE – PORT ENVIRONMENTAL SUSTAINABILITY

Given nearly 70% of ship emissions occur within 400 km of land, ships have the potential to contribute significant pollution in coastal communities – especially for SOx.

As mentioned, an important PM-related health effect is premature mortality. In particular, increases in concentrations of PM2.5 have been closely associated with increases in cardiopulmonary and lung cancer mortalities in exposed populations.¹

Shipping and logistic companies seeking a competitive advantage or wanting to enhance their environmental credentials have much to gain by proactively pursuing environmental management strategies and sustainable business practices.

By taking a proactive approach to environmental solutions, the industry can manage and have a positive health impact on local communities in addition to creating a competitive advantage.

Port developers and operators, shipping lines and logistics companies shall aim to adopt sustainable business approaches that are environmentally friendly and commercially viable, and to foster innovation in design and operation.

3.2: Potential Solutions For Hong Kong port Environmental Competitiveness.

There are multiple solutions that could be considered as viable options for Hong Kong ports development in Green leadership in the future:

3.3. Cold Ironing

Working on Cold Ironing facilities for container vessels at Hong Kong port will create additional return of investment benefits for shipping lines embracing this technology and thus be a significant argument to drive container movement traffic through Hong Kong again.

Cold ironing refers to shutting down auxiliary engines on ships while in port and connecting to electrical power supplied at the dock.

Thus this process eliminates virtually all emissions from a ship while it is in port. Other environmental impacts like noise and vibration are significantly reduced too.

Cold ironing is also referred to as “shore power” and “alternative maritime power”. The term cold ironing comes from the act of dry-docking a vessel, which involves shutting down all on-board combustion, resulting in the vessel going “cold”.

Without cold ironing, auxiliary engines run continuously while a ship is docked, or “hotelled”, at a berth to power lighting, ventilation, pumps, communication, and other onboard equipment. Ships can hotel for several hours or several days. Hotelling emissions from ship auxiliary engines are significant contributors to particulate matter from diesel fueled engines. Low volt shore power supply is a technology successfully used in the Navy for many years due to the long port stays of military ships. Since 1988 the first low volt shore power supply solutions for commercial ships in the Baltic Sea were developed.

At the beginning of 2000 new high voltage electrical shore to ship power systems were developed which required the implementation of more equipment on board and on shore to achieve the results of a safe and reliable electrical connection.

High Voltage shore supply systems consist of the following main parts:
For container ships three interface equipment solutions have been developed.

- Barge System – High and low voltage Cable Management System, transformer and switchgear are installed on a barge floating close to the ship during the docking.
• Fully Ship Integrated System - All equipments for the shore connection (cable management system, shore connection panel, transformer, etc) are integrated in the ship design.

• Semi Fixed Container(s) - Electrical equipments for the shore connection like shore connection panel and transformer are installed in one or two containers fix on board of the ship. The cable management system can be installed on the ship or with the electrical equipment in the container(s).
(Semi Fixed Container(s): 440V ship with CMS on open deck)

(All in One Removable Container)
The Port of Los Angeles and Port of Long Beach are leading in the development of cold ironing facilities and general electrification of the piers. In November 2006 both boards of Port of Los Angeles and Port of Long Beach approved the Clean Air Action Plan and totally 2 billion U$ will be invested to reduce air pollution from the two ports. Approximately U$ 400 million will be invested to electrify the berths the coming 5 years.

The California Air Resources Board has drafted an at-berth ocean-going vessels and tugboat regulation stating that beginning January 1, 2015, no person shall operate any auxiliary diesel engine after one hour of the vessel being initially tied up to a berth at a California port for the following vessels. These engines can be operated again one hour prior to the vessel leaving port. This is the reason why shipping companies have increasingly started to retrofit vessels or include cold ironing technology in new vessel design.

As per February 2008, over 140 container ships were delivered, on order or prepared for cold ironing by the major shipping lines like NYK, Japan, CSL China, Evergreen Taiwan, MSC Switzerland, Yang Ming Taiwan etc. The more the shipping lines can plug into shore power facilities, the quicker they will enjoy a return on the investment as usually and depending on the shore electricity costs and fuel costs prevailing, cold ironing allows for significant savings – not only in monetary terms but also emission output.

Hong Kong port currently does not have Cold Ironing facilities; however the planned terminal for cruise liners at Kai Tak is going to provide such. Cruise liners mainly use diesel to generate electricity whilst the onshore power supply will be based on more environmentally friendly resources like nuclear power and natural gas. Five power substations will be built at Kai Tak which will also supply energy to the nearby government offices, the district cooling system and residential and commercial projects. The first substation is expected to be commissioned in mid 2012.

Cold Ironing will provide clear benefit in the reduction of port based pollutants and a significant reduction in toxic oxides when vessels are berthed at the port. Modern technology from companies such as Cavotec have also assisted in reducing the time taken to plug in to the vessel which means faster turnaround from main engine shut down to startup of electric based feeds from Cold Ironing.
3.4 Fuel Additives

Fuel additives are substances designed to be added to fuel or fuel systems or other engine-related systems to improve one or more properties of the base fuel. Detergents, corrosion inhibitors and storage stability improvers are examples of commonly used fuel additives. More recently, additive manufacturers have developed products that improve the engine combustion process and reduce emissions, without compromising or negatively impacting the properties of the base fuel. Some emission-reducing fuel additives employ fuel-borne catalyst (FBC) materials that use catalytic processes to reduce emissions during engine combustion.

A variety of different materials have been employed as FBCs including copper, cerium, cerium/platinum, iron/strontium, manganese and sodium. Whilst cleaner fuels and exhaust scrubbers are receiving the bulk of the shipping industry attention at present as means to reduce ship emissions, good fuel additives are a realistic solution to reducing emissions for the following reasons:

- better combustion of poor quality fuel and cleaner burning
- reduction of sludge waste and
- slower degradation of mechanical performance
- increased fuel efficiency

A study conducted to investigate the effect of fuel additives on performance and soot emissions of diesel engines by Professor Assoc. D. T. Hountalas of the Internal Combustion Engines Laboratory at the National Technical University of Athens, Mechanical Engineering Department, and Thermal Engineering Section. Analysis of the results showed the following conclusions about the effect of the fuel and lube oil additives on the performance and pollutant emissions of the MAN4054 18V engine onboard the Aptera vessel.

a) The use of the fuel additive showed a reduction of specific fuel consumption in all cylinders that where measured. An immediate reduction of 2.6% was noticeable after its first use. After using the additives for 40 days and the reduction reached 3% and remained the same when the percentage of the additive used was reduced to 0.1%.

b) A significant reduction of soot emissions when using the fuel oil additive was observed. With the first use, after 8 hours there was a reduction of soot in the order of 50% and after 40 days using a percentage of 0.3% it was about 55%.

Germanischer Lloyd performed a long-term comparison test to assess advantages of fuel additives involving the two identical sister vessels M.V. Colombus America and M.V. Colombus New Zealand.

These sister ships were equipped with similar propulsion engines (MAN 6L70MC) and burning 380 cSt fuel and operating with identical auxiliary machinery. Both served the regular liner service between the US East Coast and Australia/New Zealand. Tests were carried out over a one-year period and the vessels inspections and readings were all performed by the same surveyor.
The comparison test showed that the ship using the additive outperformed the other and the individual ship monitoring of before and after condition shows marked improvements for the treated ship.

3.5: Implementation of Environmental Management Systems (EMS) - ISO 14001

Chiwan Container Terminal - CCT signs agreement for ISO 14001 with Bureau Veritas and Shenzhen Angel Star Consulting - Full Certification is predicted by October 2009 - CCT Newsletter

In addition to the fundamental ISO 9001 quality management certification, Yantian Container Terminal (YCL) is in process and striving to obtain ISO 14001 certification for Environmental Issues. (Web Release from Shenzhen Yantian port).

As seen from the above two releases, South China ports are taking significant strides in the development of tangible and globally recognized Environmental Management Systems, especially in line with the commonly recognized certification of ISO 14001.

As outlined, ISO14001 provides companies with an overall policy of continuous environmental improvement and an opportunity for cost savings that can be translated into a powerful environmental value proposition.
An increasing number of organizations worldwide are implementing environmental management systems (EMS) which have been developed in accordance with the requirements of the international environmental management standard ISO 14001. At the end of 2007, over 154,000 organizations globally were ISO 14001 certified representing 148 economies in a wide range of industries.

ISO (International Organization for Standardization) is the world’s largest producer of International Standards for business, government and society. Out of a current total of more than 17 000 normative documents, some 570 are environment-related, including recent standards specifically developed to support greenhouse gas (GHG) emission accounting, claim verification and trading.

3.5.1 The Five Elements of ISO 14001

The ISO 14001 standard requirements are described in the following five main elements of the standard.

**Environmental Policy**

An organization’s EMS mission, goals and commitment – this is the foundation on which the entire management system is built.

**Planning**

Environmental Policy, legal and other requirements, environmental objectives/targets and programs.

**Implementation and Operation**

Structure, responsibility, training, awareness/competence, communication, environmental management system documentation, document control, operational control and emergency preparedness/response.

**Checking and Corrective Action**

Monitoring and measurement, evaluation of compliance, nonconformance, corrective and preventative action, records and environmental system audits.

**Management Review**

Continual review of EMS

Progressive companies are finding that implementing an EMS can offer real strategic value as a management tool as the ISO 14001 auditing process is more than running down a checklist.

It is a true business asset linking environmental protection with corporate goals and objectives. This can lead to productivity improvements, reduced risk and lower costs – while demonstrating your company is environmentally conscious.
3.5.2: Brand Leadership through Global Environmental Systems

Certain key global logistics and shipping brands are incorporating brand leadership and global recognition through the incorporation of effective Environmental systems. An example is Maersk Line whom have invested heavily in effective environmental management system will bring about substantial benefits for the environment and for the business.


As part of the environmental management system and policy, the employees receive environmental awareness training on board vessels and at Maersk Training Centres in Svendborg, Denmark and Chennai, India.

In addition to the fleet-wide environmental management programme, each of the individual Maersk Line vessels conducts an annual review of environmental impact and sets vessel-specific targets for environmental improvements.

Examples of such targets and achievements include refuse separation, recycling programmes and emission and energy reduction initiatives.\textsuperscript{x}

The emphasis on Environmental Excellence has also resulted in AP Moller Terminals (APM Terminals) winning the Port Operator of the year award in September 2009. The key criteria for the port operator winning the award was due to the following factors: (Global Press Release Sep 14th 2009).

1. Expand Global Network
2. Add Clients during Economic Turbulence
3. Taking the lead in port development through Environmentally Friendly Terminal operations
4. Ability to balance innovation with Corporate Social Responsibility

Two of the 4 key factors are related to their Environmental and sustainability standards. This presents port operators such as Hutchison Ports and Modern Terminals to develop effective systems to compete with the other key port operators around the globe.
3.6: Selective Catalytic Reduction (SCR)

SCR is based on a reaction between urea - decomposed to ammonia ($\text{NH}_3$) - and $\text{NO}_x$ in the flue gas over a catalyst. $\text{NO}_x$ is then reduced to nitrogen ($\text{N}_2$). Urea solution is injected into the hot flue gas after the combustion.

There are no restrictions on which type of ship that can use SCR, as long as the temperature of the exhaust gas can reach the temperature 270°C or preferably around 320°C. SCR is an add-on exhaust treatment system, working with almost any type of engine. Most experience is gained using SCR on 4-stroke medium and high speed diesel engines. On the 4-stroke engines the SCR is normally placed in the engine room casing. CR-systems have also been fitted on slow speed 2-stroke engines. In this case, the SCR is positioned in the exhaust channel before the turbocharger in the engine room.$^{xi, xiii}$

The catalyst is usually made from titanium oxide and vanadium oxide and consists of small exchangeable units (monolites of extruded ceramics). SCR is presently the most common method to reduce $\text{NO}_x$ emission from ships and is now estimated to be commercially installed on more than 300 engines world-wide.

3.6.1 Reduction efficiency for $\text{NO}_x$

Technically it is possible to reach 95 % or even higher reduction. However, the $\text{NO}_x$ reduction efficiency of the SCR is often operated to reach around 90 %.

The efficiency is dependent on the urea flow. To achieve 90 % $\text{NO}_x$ reduction approximately 15 g urea is needed per kWh energy from the engine.

The engine may be fuel-optimized, so that the fuel consumption is minimized to the cost of somewhat higher $\text{NO}_x$ emission. In this way lower fuel consumption can be combined with low $\text{NO}_x$ emissions.

3.6.2 Life time of catalyst

The life time of the catalyst depends on the fuel and is relatively long. The longest operating SCR-system has been in place for over 15 years using low sulphur (max. 0.2 %) marine diesel fuel. Other ships have reached 40 000 hours of operation using heavy fuel oil. Pollutants in the exhaust gases may deactivate the catalyst. Clean fuel will prolong the life of the catalyst and decrease the maintenance necessary.

Using a fuel with $\leq 1.5$ % sulphur, the reactor may have to be rebuilt every five years. Using average fuel containing 2.7 % sulphur the reactors may have to be rebuilt every 3 years. Ships using diesel fuel can expect a reactor lifetime of 15 to 20 years. If used in combination with an oxidation catalyst, VOC emissions can be reduced by 75 to 90% and CO emissions by 50 to 90 %.

Also, the catalyst will improve noise reduction and engine noise may be reduced up to 10 – 35 dB(A) by using SCR system.
3.6.3 Installation

Equipment installation requires space for the catalyst reactor and the urea storage tank which is usually 50 to 100 m³. The catalyst may replace the noise reduction unit. Retrofits are possible and the tank may be located in the ship hull or a ballast tank on board could be used. Time of installation – for a retrofit in a shipyard – varies between 1 and 3 weeks.

3.6.4 Costs involved with NOₓ emission reductions from ships

<table>
<thead>
<tr>
<th>NOₓ control technique cost</th>
<th>Capital cost</th>
<th>Operating cost</th>
<th>Life span</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selective Catalytic Reduction – SCR</td>
<td>40 – 60 €/kW for new built engines and 60 – 100 for retrofit.</td>
<td>Urea solution €170/tonne. = €2.6/MWh. There are indications of a lowered price- 120 – 140 €/tonne - due to several companies delivering urea. Transport of the urea may be a considerable part of the urea cost. Maintenance of equipment is required. Eutec estimated a need of cleaning equal to €8,000 per year and ship. The need for maintenance depends on the fuel used. An estimate of operating cost given for one ship (excl. financing) is €10,000 per year.</td>
<td>The catalyst is estimated to require a rebuild every 20,000 hours of operation, when using residual oil.</td>
</tr>
</tbody>
</table>

3.6.5 Overview of cost estimates for NOₓ reduction technique per tonne fuel

<table>
<thead>
<tr>
<th>Technique used</th>
<th>Installation</th>
<th>Small ship €/tonne fuel</th>
<th>Medium ship €/tonne fuel</th>
<th>Large ship €/tonne fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCR outside SO₂ ECA ships using 2.7 % S resid. oil</td>
<td>New</td>
<td>50</td>
<td>38</td>
<td>35</td>
</tr>
<tr>
<td>SCR outside SO₂ ships using 2.7 % S resid. oil</td>
<td>Retrofit</td>
<td>55</td>
<td>41</td>
<td>39</td>
</tr>
<tr>
<td>SCR inside SO₂ ECA ships using fuel 1.5 % S</td>
<td>New</td>
<td>37</td>
<td>29</td>
<td>27</td>
</tr>
<tr>
<td>SCR inside SO₂ ECA ships using fuel 1.5 % S</td>
<td>Retrofit</td>
<td>41</td>
<td>32</td>
<td>30</td>
</tr>
<tr>
<td>SCR, ships using MD</td>
<td>New</td>
<td>29</td>
<td>23</td>
<td>22</td>
</tr>
<tr>
<td>SCR, ships using MD</td>
<td>Retrofit</td>
<td>34</td>
<td>27</td>
<td>25</td>
</tr>
</tbody>
</table>
4.0: Conclusions

Hong Kong port is facing challenges that it has not faced in the past, and the traditional positioning of the port as the market leader is being eroded on an annual basis. Whilst the port continues to grow by 3-4% annually, the development of South China, including Yantian, Chiwan and Guangzhou is resulting in Hong Kong's market position being threatened.

South China port growth forecasts show that by the middle of 2015, Hong Kong port volumes will be overtaken by Yantian alone. Hong Kong position remains primarily a transhipment hub and as such will face greater competition to maintain its market status as the ports within the PRD also improve in terms of infrastructure and productivity. Hong Kong's key advantage has been its Freeport status and traditionally its ability to provide higher standards of service than China. This roadmap has shifted dramatically and now it can be seen that ports such as Shanghai have state of the art facilities in Yanshan, while the South China ports overall performance is now in line with international standards.

Hong Kong further faces issues surrounding its high terminal handling and container handling fees, which remain the highest in the region. At 2750 HKD for a 40 foot transaction in Hong Kong comparing this with 1500 HKD in China, the need to provide a strong value differentiation becomes more pronounced. Shipping lines are continuing to gain greater value in direct vessel calls in China ports, not only in terms of price but ease of direct loading, eliminating the need to truck down cargo to Hong Kong.

Manufacturers, suppliers and Supply Chain firms prefer the option of direct loading due to the cost savings in port handling and in transportation. These factors along with improved port service quality has resulted in a dramatic paradigm shift towards the South China ports. There is also growing evidence that South China ports are taking strong initiatives to develop improved sustainability programmes. Chiwan and Yantian will both be ISO 14001 certified in 2009 or early 2010 and this provides these ports with clear competitive advantage in terms of branding, but also relating to high level and long term sustainability programmes. Hong Kong port needs to innovate beyond purely service and fast lead times to compete. It is interesting to note that Hong Kong port has yet to embrace sustainability certifications, compared to port operators such as APM Terminals who have created a market leadership position in terms of Environmental port operations.

Should the government of Hong Kong still perceive the importance of the logistics sector towards the City’s overall GDP, then the need to compete more effectively in reaching Environmental leadership among globally recognized firms is paramount. It will also fall in line with Hong Kong's global marketing image as "Asia's World City". Certainly there are some concerns that Hong Kong is relatively inactive compared to the world's leading ports and operators as well as the South China port competitors towards Environmental Sustainability.

The positive side to this, is that whilst Hong Kong is losing ground in the development of sustainable ports, the overall concept of Green Logistics and Environmental ports remains in its infancy. This allows the port to quickly make up any previous lost opportunities and also create strong processes and leadership strategies that can improve the status of the port as well as increase its competitiveness to the global carriers.
Following on from the recommendations presented in this paper, Should Hong Kong be prepared to invest in its green ports approach, this process can lead to brand leadership and global recognition as a key port operator for Environmental operations. This further enhances the position of HIT and MTL as strong global operators on Environmental Sustainability which will assist these powerful Hong Kong firms to increase their standing as key global operators. It is essential that these firms take on a strong Environmental stance to match competitors such as APM Terminals, and will also create opportunities for growth and revenue as part of the global strategy.

Pollution is one of the greatest hazards that Hong Kong faces in terms of its global positioning as a leading global city. The ability of the city to get the best expatriate talent outside of the banking sector is eroded by the image of the area as a high risk location for health.

There is growing evidence of companies and expats relocating to other parts of Asia citing concerns of health to their families as a key factor. This is allowing countries such as Singapore to improve its talent pool at the expense of Hong Kong.

It is not merely expatriates that are affected. The immense density of Hong Kong as a residential conurbation, ensures that huge parts of the population are concentrated close to high pollution zones such as the port of Hong Kong. There is evidence from around the world, especially Long Beach, which clearly defines the dangerous repercussions to human well through the consumption of port based polluting particulates. The port of Hong Kong has greater challenges than most to control these particulates to maintain a healthy population.

From the key factors mentioned in this report, it is clear that Hong Kong port needs to strongly review its long term strategy for Environmental sustainability and that significantly more action can be taken. Limited legislation enforcing tight operating plans may mean that no formalized mandatory requirements will be in place for many years to come, but the result of waiting for this could be devastating to the health and wellbeing of the population of Hong Kong.

Huge opportunities lie in front of the port to lead the world both regionally and Globally, and would be essential towards maintaining the status of Hong Kong as a primary hub for Logistics, Shipping and the Supply Chain.
5.0: Recommendations

5.1: Cold Ironing and technology advances in Environmental Sustainability

Hong Kong Port to embrace the concept of Cold Ironing at least as part of a staggered introductory approach. Cold Ironing will lead to significantly reduced pollutants through the vessel berthing, loading and idle process.

With a growing number of vessel operators actively developing cold ironing facilities on their vessels themselves, the ability to reduce emission flows through this process will be hugely beneficial to the port, general public wellbeing and for the vessel owner.

Whilst initial startup costs for Cold Ironing are high, there can be savings made in terms of reduced burn on bunker fuels, as well as healthcare costs to the general public.

Currently there are over 140 vessels on the order book which will have cold ironing facilities available. This is a significant sign of intent from ship-owners to reduce emissions from their vessels wherever possible. Ports offering cold ironing facilities such as Long Beach will be met more favorably as a result of offering this facility, and clear improvements in clean air through cold ironing can be achieved.

5.2: Consider ship owner incentives to burn cleaner air as a means of offsetting higher THC charges

A key area which is reducing the competitiveness is that of port charges related to Terminal Handling Charges (THC). THC is the highest in the region, based on decades of having the leading edge services in the area. Will the dilution of this market advantage, the port has less opportunity to warrant a premium compared to countries such as China.

On method that can be used to show strong environmental support would be to provide price discount incentive programmes to carriers who are prepared to burn lighter bunker fuels within a certain radius of the port. This would again provide significant reductions in GHG Emissions and also allow the port to maintain THC charges and provide value added differentiation through an Environmental incentive programme.

One port leading the way in this focus is the port of Hamburg. Hamburg offers incentives to shipping lines who are supporting a cleaner fuel burn around the port or who have global certifications such as ISO 14001.

This strategy is extremely effective in ensuring that Hamburg has a functional clean air programme. Hong Kong would be the first of its kind in Asia if it were to consider a similar approach and would further stimulate interest from carriers who face global pressures to operate in an Environmentally friendly manner.
5.3. consider Fuel distillates for port operations, vessels and most importantly trucks surrounding the area.

The concept of using fuel distillate products within Shipping has been traditionally been met with resistance. This is due to some of the cheaper non patented products being known to corrode and damage fuel tanks and destroy operational vessels and machinery in the past.

Recent improvements in this Technology have helped to overcome this problem. Modern fuel distillates now match the hydrocarbon based qualities of bunker and trucking fuels which mean that they can be filtered into the fuel without the dangers of damaging the engine. Companies such as Force Fuel have led the way in reducing emissions in market sectors such as Power stations and trucking vehicles.

Tests have shown this type of modern day distillate can save up to 15% on fuel efficiency, dependant on the quality of fuel, as well as reducing black smoke emissions by up to 70%. This type of Technology is still met unfavorably due to traditional resistances due to bad and costly experiences in the early years of this product when it was found to be unrefined and corrosive to fuel tanks.

The Shipping industry can gain benefit from the latest versions of the product as a means of improving fuel efficiency as well as improving emission flows. This would further emphasize the port of Hong Kong commitment to reducing the carbon footprint.

5.4. Liaise with the ports of South China to develop effective practices throughout the PRD

Whilst it is understandable that competition within Hong Kong and South China will continue to increase for market share and container volumes, overall supply in the region suggests that all ports in the pearl river delta district are likely to see organic growth due to the natural increases in export requirement from the region.

The effects of having a green strategy throughout the whole of the pearl river delta would assist greatly in improving pollution levels throughout the entire region and put port logistics in the forefront of green practices.

To affect this, the port of Hong Kong could assist in liaising and working collaboratively with the China counterparts to agree on a Green strategy that supports the entire region. With HIT and MTL also increasing their operations deep into China, this would also enhance the operational practices of these 2 key Hong Kong based port operators. The ability to create a value brand to these operators would be invaluable towards increasing market competitiveness.

5.5 Incorporate Management Systems such as ISO 14001 to ensure long term sustainability strategies

With the development of Eco-ratings and increased transparency into the efforts of companies to create sustainability strategies, Hong Kong port should consider working towards a long term sustainability strategy and management system, which can be audited and assessed by a globally recognized environmental body.

One such opportunity lies in the development of ISO standards and in the case of Environment, ISO 14001. This certification is the most recognizable accreditation of a
company's commitment to environmental sustainability and ensures that the organization cannot be branded as "Green washing".

It is noted that the leading global shipping lines and ports have chosen the ISO standard as a means of creating a strong environmental strategy, and through the auditing process associated with ISO, guarantees that a certain level of long improvement needs to be maintained.

APM Terminals under the Maersk brand has now been certified with this global standard, and it is interesting to note the efforts being put in with the South China ports to also reach the ISO 14001 standard. Chiwan and Yantian will both be certified by the end of this year.

Hong Kong port should also ensure that in terms of competitiveness and long term leadership, that they too undertake the necessary operational strategies to reach the ISO 14001 standards for the future. To be overtaken by China ports in this area will result in reduced competitiveness and further erode an already reduced competitive edge.

This is an area where Hong Kong port can stamp a position of leadership, and as such suitable action should be taken to certify the ports commitments to the Environment.

5.6. The Incorporation of a Logistics Environmental Forum in Hong Kong, as part of an Advisory Group

As pinpointed in the report, Logistics remains the single largest employing industry in Hong Kong and is a critical part of Hong Kong's long term competitiveness and development as a leading edge city and economy.

The recent Policy address from Donald Tsang also included the government's vision of the emerging "breaking new ground together" programme to enhance six new emerging industry pillars. Of these emerging pillars, Environmental industries was deemed as one of the key new industries that the government would like to see develop in Hong Kong (Donald Tsang - Giving Economy priority in Policy Address, 14th October 2009, Source: Xinhua) The role of Logistics and Environment will therefore remain key areas of growth within the Government strategy to stimulate the economy and create a long term programme for job creation and industry expertise.

An area that is missing within the logistics industry is that of a green forum which can assist in creating best practice strategies for the logistics industry in Hong Kong and act as a specialized advisory party to key corporations such as HIT and MTL. This committee can also act as the party that can advise on Environmental best practices as well as Market Intelligence to the benefit of the whole Logistics community in Hong Kong.

The development of a Green Forum specifically for the Logistics industry can be considered. This would allow the whole industry to benefit from leading edge expertise and ensure that there is suitable education and innovation to enhance Hong Kong’s competitive edge.
6.0: Summary

There remain distinct opportunities for the port of Hong Kong to strongly lead the drive to incorporate Environmental Sustainability within the Pearl River Delta. Continued legislative discussions on a global basis will continue to lead higher levels of compliance within the port and shipping communities over the next 5 years. As such it is evident that port communities globally will need to incorporate higher standards of sustainability performance to meet the necessary criteria.

The incorporation of Sustainability solutions will ensure that Hong Kong can continue to maintain its competitiveness in line with global carriers who will continue to face pressure to create sustainability solutions and commit to partnering with organizations with a similar strategy. This is further necessitated by companies with high level sustainability profiles who are measured by their levels of environmental excellence. It is expected that by incorporating certain key solutions discussed in this report, that Hong Kong and the Pearl River Delta can lead the momentum in incorporating solutions that will be globally competitive.
EXECUTIVE SUMMARY

1.0: Review

Over the last two decades, the port of Hong Kong has been in the forefront of international shipping, frequently surveyed as being the largest port in the world up to the year 2004. The development of ports in South China’s pearl river delta (PRD) in the last 5 years have, however, eroded Hong Kong’s position of strength and competitive advantage, and in 2009, Hong Kong’s overall throughput slipped to 47% of all throughput for the PRD region.

The ports of Yantian and Guangzhou continue to grow substantially quicker than Hong Kong based largely to increased access and improved service levels within China’s dynamic economic environment, and it is expected that based on these existing trends, the Port of Hong Kong will continue to see further diminishing returns on market share even though volume throughput in absolute terms is expected to increase between 3-4% annually. Hong Kong’s value in the marketplace cannot, however, be underestimated in terms of operational excellence.

Organizations such as MTL and HIT are widely considered to be among the leading port operators both regionally and globally, and Hong Kong’s operational efficiencies remain the best in the business. It is through this high base of market expertise that Hong Kong can still maintain a strong competitive advantage through the advancement of new economic requirements, such as management of ports through the highest levels of sustainability strategy and implementation programmes, an area that up to this point has been explored in a limited and piecemeal fashion.

Whilst Hong Kong’s pure operational advantage is likely to be diminished, its role and opportunity to lead the PRD and Asia into a sustainable future has never been greater. Legislatory compliance and growing global awareness on the importance of dedicated Environmental best practices are areas which are likely to drive greater efforts globally to support improved levels of sustainability.

Shipping lines themselves have also started to make strong strides in the areas of Environmental best practices, with the CKYH alliance (Cosco, K_line, Yang Ming and Hanjin) forming the first carrier green alliance. Through these initiatives, long term evaluation of port strategies on environment to support these cultures.

With Hong Kong exporting their expertise in port management to other operations in China and globally, there is an essential need to bring these skills to the port of Hong Kong to lead the PRD into the new era of Environmental sustainable operations.
2.0: The Economic cost of non conformity

Hong Kong itself has in excess of 200,000 employees related to the direct Transport and Logistics sector alone, making it one of the four economic pillars. It is therefore essential that Hong Kong maintains a highly competitive logistics sector to manage the gateway advantages to China and protect this important market sector.

The skills and education of high quality logistics employees still comes largely from the high quality of university qualifications in Hong Kong and this is deemed a further spur to the economy, and is the area to which Hong Kong should remain highly focused upon, to maintain its profile as a leading hub and to exceed operational practices widely undertaken in China and around the world.

Without concerted efforts to improve the overall sustainability index profile within the port of Hong Kong and the PRD, there is likely to be genuine threats to the continued competitive advantage of Hong Kong, but furthermore will create an extreme cost to healthcare and well-being within the area. Hong Kong is now widely recognized as one of the most polluted cities within Asia, an effect that is leading to many organizations and skilled workers leaving to areas with higher levels of environmental well-being and improved global compliance and contingency planning.

Hong Kong port due to the nature of its work has a strong influence in adding to the pollution levels due to the necessity of shipping lines and operations to burn highly toxic pollutants such as Nitrogen and Sulphur dioxides, particulate matter and carbon dioxides. Recent studies show that port emissions have had a direct influence in mortality rates, with a figure of 37,000 deaths due to port and ship related emission in Asia during 2008. In areas of extreme population density such as Hong Kong, there is a definitive danger to healthcare and wellbeing associated with this issue, and an even greater requirement to support and legislate towards the highest levels of Environmental management to minimize the threat.
3.0: Processes for improvement

It is critical that Hong Kong evaluates potential methods of improvement on sustainability in the region, and also assists in taking a leadership role to support this development within the Pearl River Delta.

Hong Kong has undertaken some positive activities such as the reduction of diesel based cranes in preference to electrical operated cranes. However, there are a multitude of areas that can be evaluated to improve the environmental process, as investigated in the main report. These would include:

a) The use of both berth side and portable cold ironing facilities to support in the use of electrical power generation to vessels as opposed to bunker fuel burn to run vessel APU systems.

b) The incorporation of hydrocarbon and bio-fuel based processes to assist on the running of vehicles on the port side as well as on the vessels themselves.

c) Incentive programmes to reduce the cost of berthing for companies with ISO 14001 certifications or for vessel operators who exceed the Marpol VI guidelines for the use of lighter bunker fuels, leading to the reduction of sulphur content within Hong Kong’s waters.

d) Agreement to develop globally recognized certification programmes such as ISO 14001 which are designed to audit and monitor the process for continual improvement within the Environmental process.

e) The creation of an alliance programme with the ports of Yantian and South China ports to agree the standards of environmental best practice within the region

f) Governmental intervention to respond to the growing issues of air quality in Hong Kong and to support create necessary compliance benchmark and legislation to lead in battling pollution in Hong Kong.
4.0: Conclusions

Whilst Hong Kong may continue to see a gradual erosion of market share in the region, it’s role and skills as a market leader in environmental port practices, with reliance on Sustainability is becoming essential. As Asia continues to fall behind the best port operators globally in terms of sustainability such as Long Beach, Los Angeles and Hamburg, Hong Kong can now effectively lead the development of Environmental sustainability for ports in the PRD, which in turn will assist the whole of Asia.

This is essential to maintain the competitive advantage of Hong Kong, as well as assist in the wider issues of population healthcare and wellbeing, driving a vibrant and competitive economy for Hong Kong and protecting Logistics as one of the four pillars. The development of new technologies and certification programmes makes this opportunity a viable proposition to Hong Kong, and can assist in ensuring the long term recognition of the region as a key player in operational and environmental excellence in the long term.
CASE STUDY ONE - Mortality Rates through the Consumption of Concentrated Particulates

Cohen et al. estimated approximately 0.8 million deaths per year worldwide from outdoor urban PM2.5 air pollution, 1.2% of global premature mortalities each year. xiv

Corbett et al. modeled ambient PM concentrations from ocean-going ships using two geospatial emission inventories and two global aerosol models. Global and regional mortalities were estimated by applying ambient PM increases due to ships to cardiopulmonary and lung cancer concentration-risk functions and population models. The result indicates that shipping-related PM emissions are responsible for approximately 60,000 cardiopulmonary and lung cancer deaths annually, with most deaths occurring near coastlines in Europe, East Asia, and South Asia.

(Figure 2 & 3)
Under current regulation and with the expected growth in shipping activity, an increase in annual mortalities by 40% by 2012 is estimated. xv
Although there is no scientific, empirical research available that links the effect of ship emissions to the health status of Hong Kong’s population, it is notable though that the three main cause of death relate to the health symptoms described in the previous sections.
REFERENCES


ii Study on Hong Kong Port Cargo Forecasts 2005/2006, GHK (Hong Kong) Ltd


vi http://www.portoflosangeles.org/DOC/REPORT_Clean_Air_Overview_English.pdf

vii http://www.arb.ca.gov/homepage.htm

viii “Cruise ships to get onshore power supply”, Paggie Leung, South China Morning Post, June 12th 2009


x Hydrocarbon Asia, “Reducing the soot in diesel engines”, March 2002

xi http://www.maerskline.com/link/?page=brochure&path=/about_us/environment/environmental_management


APPENDIX 1

Nitrogen Oxides

NOx is a generic term for mono-nitrogen oxides (NO and NO2). These oxides are produced during combustion, especially combustion at high temperatures. Scientific evidence shows that this type of oxide can create breathing difficulties to humans (See Appendix 1). At ambient temperatures, the oxygen and nitrogen gases in air will not react with each other. In an internal combustion engine, combustion of a mixture of air and fuel produces combustion temperatures high enough to drive endothermic reactions between atmospheric nitrogen and oxygen in the flame, yielding various oxides of nitrogen.

The major source of NOx production from nitrogen-bearing fuels such as certain coals and oil is the conversion of fuel bound nitrogen to NOx during combustion. During combustion, the nitrogen bound in the fuel is released as a free radical and ultimately forms free N2, or NO. Fuel NOx can contribute as much as 50% of total emissions when combusting oil and as much as 80% when combusting coal. In areas of high motor vehicle traffic, such as in large cities like Hong Kong, the amount of nitrogen oxides emitted into the atmosphere can be quite significant.

NOx react with ammonia, moisture, and other compounds to form small particles. These small particles penetrate deeply into sensitive parts of the lungs and can cause or worsen respiratory disease, such as emphysema and bronchitis, and can aggravate existing heart disease.

Ozone is formed when NOx and volatile organic compounds react in the presence of heat and sunlight. Children, the elderly, people with lung diseases and people who work or exercise outside are at risk for adverse effects from ozone.

Exposure to high levels of ozone may cause chest pain, coughing and throat irritation in healthy adults. These include reduction in lung function and increased respiratory symptoms as well as respiratory related emergency department visits, hospital admissions, and possibly premature deaths.xv

Ozone pollution triggers millions of asthma attacks each year and a recent US study suggests that exposure to elevated ozone concentrations can actually cause asthma.
APPENDIX 2

Sulfur Dioxide

Sulfur dioxide is the chemical compound with the formula SO2. It is produced by volcanoes and in various industrial processes. Since coal and petroleum often contain sulfur compounds, the combustion generates sulfur dioxide.

Further oxidation of SO2 forms H2SO4 and thus acid rain which is one of the causes for concern over the environmental impact of the use of these fuels as power sources. Acid rain damages forests and crops, changes the makeup of soil, and makes lakes and streams acidic and unsuitable for fish. Continued exposure over a long time changes the natural variety of plants and animals in an ecosystem.

As of 2006, China is the world’s largest sulfur dioxide polluter, with 2005 emissions estimated to be 25.49 million tons. This amount represents a 27% increase since 2000, and is roughly comparable with U.S. emissions in 1980.

SO2 causes a wide variety of health and environmental impacts because of the way it reacts with other substances in the air. Peak levels of SO2 in the air can cause temporary breathing difficulty for people with asthma who are active outdoors. Longer-term exposure to high levels of SO2 gas and particles cause respiratory illness and aggravate existing heart disease.

Also, SO2 reacts with other chemicals in the air to form tiny sulfate particles. When these are breathed, they gather in the lungs and are associated with increased respiratory symptoms and disease, difficulty in breathing, and premature death.
APPENDIX 3

Particulate Matter

Particulate matter (PM) is an air pollutant consisting of a mixture of particles that can be solid, liquid or both, are suspended in the air and represent a complex mixture of organic and inorganic substances. These particles vary in size, composition and origin. Their properties are summarized according to their aerodynamic diameter, called particle size.

- The coarse fraction is called PM10 (particles with an aerodynamic diameter smaller than 10 μm), which may reach the upper part of the airways and lung.

- Smaller or fine particles are called PM2.5 (with an aerodynamic diameter smaller than 2.5 μm); these are more dangerous because they penetrate more deeply into the lung and may reach the alveolar region.

The size of the particles also determines the time they spend in the atmosphere. While sedimentation and precipitation removes PM10 from the atmosphere within few hours of emission, PM2.5 may remain there for days or even a few weeks. Consequently, these particles can be transported over long distances.

The major PM components are sulfate, nitrates, ammonia, sodium chloride, carbon, mineral dust and water. Particles may be classified as primary or secondary depending on their formation mechanism.

Primary particles are directly emitted into the atmosphere through combustion from ships and car engines (both diesel and petrol), solid-fuel (coal, lignite and biomass) combustion in households, and industrial activities (building, mining, manufacturing of cement, ceramic and bricks, and smelting).

Secondary particles are formed in the air, usually by chemical reactions of gaseous pollutants, and are products of atmospheric transformation of nitrogen oxides mainly emitted by traffic and some industrial processes, and sulfur dioxide resulting from the combustion of sulfur-containing fuels. Secondary particles are mostly found in the fine PM fraction.xv

Long-term exposure to PM results in a substantial reduction in life expectancy, and PM2.5 shows the strongest association with mortality, indicating a 6% increase in the risk of deaths from all causes per 10-μg/m3 increase in long-term PM2.5 concentration. The estimated relative risk amounts to 12% for deaths from cardiovascular diseases and 14% for deaths from lung cancer per 10-μg/m3 increase in PM2.5.xv
Carbon Monoxide

Carbon monoxide (CO) is a colorless, practically odorless, and tasteless gas or liquid. It results from incomplete oxidation of carbon in combustion.

Health effects associated with CO at low concentrations are fatigue in healthy people and chest pain in people with heart disease. At higher concentrations, impaired vision and coordination, headaches, dizziness, confusion and nausea can occur.

Acute effects are due to the formation of carboxyhemoglobin in the blood, which inhibits oxygen intake. At moderate concentrations, angina, impaired vision, and reduced brain function may result. At higher concentrations, CO exposure can be fatal.
APPENDIX 5

Volatile Organic Compounds

Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors and VOCs are emitted by a wide array of products.

Not only are volatile organic compounds inherently toxic, but also when they evaporate into the air, they can react with other pollutants to form ozone smog. Common VOCs produced by diesel engines include benzene, 1,3-butadiene, formaldehyde, and toluene, each of which poses significant health risks.\textsuperscript{xv}

Benzene and butadiene are known to cause cancer in humans. Formaldehyde is very irritating to the airways and is a probable carcinogen. Toluene has been associated with birth defects and miscarriages and other VOCs emitted by vehicles have also been linked to cancer, reproductive harm, asthma, or neurological disorders.\textsuperscript{xv, xv}
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Managing Director Mark Millar leverages over 20 years of global experience to provide independent Consulting, Education, Advisory and Recruitment services that create value for clients by improving performance in their logistics and supply chain activities in China and the Asia Pacific region.

With extensive experience in the mainland China market, Mark has worked with, and for, many leading companies in the Consumer Retail, High Tech Electronics and Third Party Logistics sectors.

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