

Climate Issues in Hong Kong: Mitigation and Adaptation

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7th September 2006

Foreword

This paper was written by Mr. Chan kwok-loon, an intern student, under the supervision of The Conservancy Association (the Association) during the summer of 2006. This paper does not represent the official position of the Association.

The Association appreciated Mr. Chan's hard work on the issue of climate change, which is a subject that anyone who concerned about the environment in this decade could not ignore. And the Association finds that more research on climate change should be conducted under the Hong Kong context. Mr. Chan's afford formed a good foundation for further studies in the future.

Acknowledgments

I would like to acknowledge the Yale School of Forestry and Environmental Studies (F&ES) Summer Globalization Internships Fund, which makes this research possible. I am grateful to the support of the Conservancy Association throughout the research, and supervision of Martin K.W. Wan. Martin Wan provided important background information of environmental issue in Hong Kong and suggestions in the research of climate change. I would like to thank John Y.K. Leung, the Scientific Officer of the Hong Kong Observatory, and Vincent Cheung, who is from the Environmental Protection Department, for the provision of relevant information to the study. I would also like to thank the Director of the Hong Kong Observatory for the arrangement of the meeting with John Leung.

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Abstract

Global warming becomes one of the most important environmental problems in the 21st century and the impacts of global warming are worldwide. Hong Kong should implement policies to deal with climate change. Mitigation policies manage the problem fundamentally through greenhouse gases emissions reduction. Using cleaner fuels for electricity generation and transport, importing environmental friendly vehicles, improving the efficiency of aviation, and lowering end use demand are some feasible mitigation methods in Hong Kong. However, the occurrence of global warming is very unlikely be affected by Hong Kong's own mitigation policies. Therefore while adopting mitigation policies, Hong Kong should also prepare adaptation policies to minimize the adverse effects of climate change. Vulnerabilities assessment, disaster management, enhanced structure design, institutional reform and anti extreme climate engineering are some feasible adaptation policies in Hong Kong.

1. Introduction

Since the Intergovernmental Panel on Climate Change (IPCC) published the first assessment report in 1990, more and more scientific evidences have been found to support that the average atmospheric temperature is increasing. Global warming in the recent century was caused by the sharply increased greenhouse gases emission by human activities. In the third IPCC assessment report, *Climate Change 2001*, it is found that over the 20th century, the global average surface temperature has been increased by $0.6 \pm 0.2^{\circ}\text{C}$. In the estimation in the *IPCC Special Report on Emission Scenarios* (2000), the global average surface temperature is expected to increase in the range from 1.4 to 5.8°C by 2100 relative to 1990. The impacts of climate change are worldwide. Climate change will affect energy consumption, water resources, food security, ecosystems, human health, and human settlement, etc. This paper is going to study the climate change in Hong Kong and what government should do with climate change.

2. Climate Change in Hong Kong

Climate Change induced by global warming may include the change of rainfall, the change of cloud amount, the change of visibility, and the change of frequency and severity of natural disasters, etc. This chapter gives a brief summary of the changes in temperature, rainfall, and number of typhoons in Hong Kong.

2.1 Temperature Change in Hong Kong

According to the temperature records of the Hong Kong Observatory (HKO), the rate of temperature increase in Hong Kong is higher than the rate of global temperature

increase. Figure 1 shows the temperatures of Hong Kong and the globe from 1885 to 2002. The average temperature in Hong Kong rise at rate of 1.2°C per 100 years and the warming has been significantly faster in the recent years (1989 – 2002)¹, reaching the rate of 6°C per 100 years (HKO, 2003).

The reason of why the average temperature in Hong Kong increases faster than the world average is that Hong Kong is a highly urbanized city (HKO, 2003). Buildings and other concrete surfaces in the urban areas absorb the heat from solar radiation during the daytime and release the heat in the form of long-wave radiation during the night. The long-wave radiation is also blocked by the high-rise building from escaping away. This makes temperatures fall slower at night and results in a higher minimum temperature (HKO, 2004).

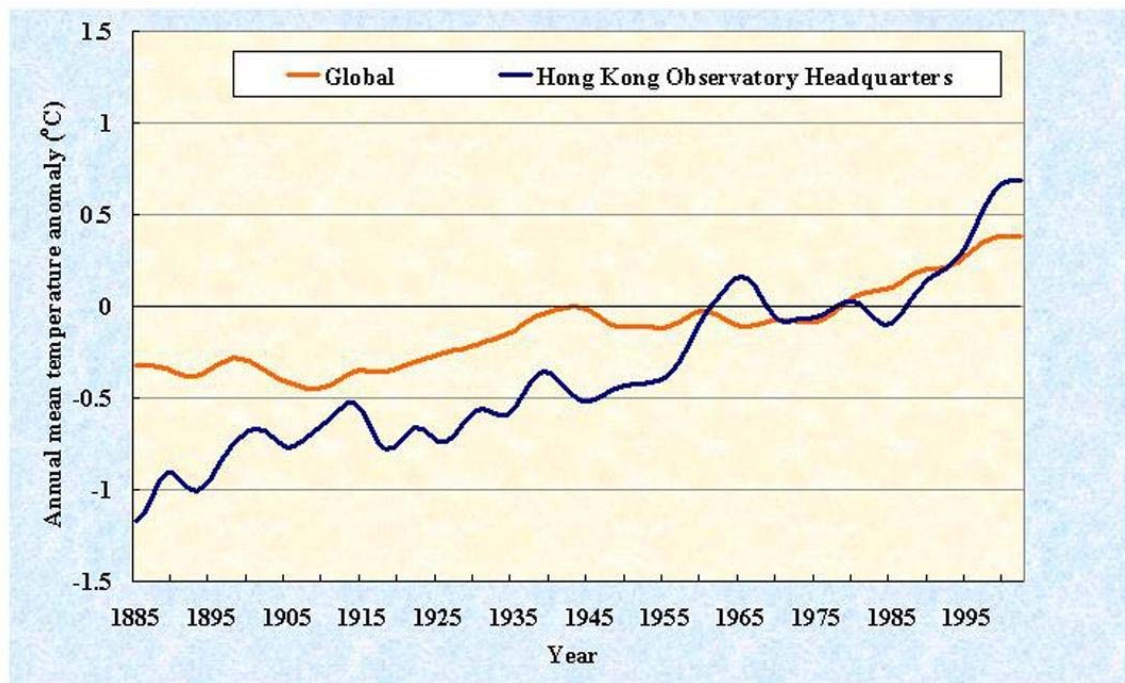


Figure 1 Temperature anomaly globally and at the Hong Kong Observatory Headquarters (HKO, 2006)

¹ The rise of temperature in Hong Kong is proved significant at 5% level in the report *Climate Change in Hong Kong* (HKO, 2004).

According to the Estimation of HKO (2004), the annual mean temperature in Hong Kong is expected to increase 3.5°C by 2090-2099. The upper limit and lower limit of the estimation are 1.7°C and 5.6°C respectively. This is close to the estimation of IPCC (2000) that the global average surface temperature is expected to increase in the range from 1.4 to 5.8°C by 2100 relative to 1990.

2.2 Rainfall Change in Hong Kong

Figure 2 shows the annual rainfall in Hong Kong from 1947 to 2002. Rainfall does not increase (not significant at 5% level) with the temperature during the same period. Figure 3 also shows that the number of heavy rainfalls also does not increase (not significant at 5% level) in the same period. But there is research found that 8 of 10 highest hourly precipitations were recorded in the post-war period (Yim, 1996). The relationship between global warming and rainfall is still uncertain, but the rise of temperature will lower the stabilities of the atmosphere and may cause more extreme rainfalls.

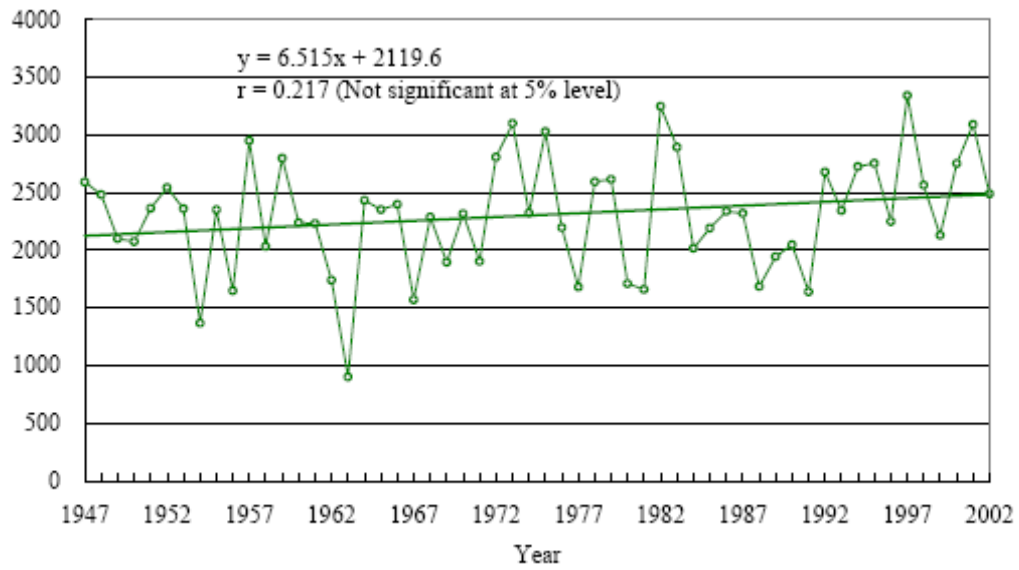


Figure 2 Annual rainfalls in Hong Kong² (HKO, 2004)

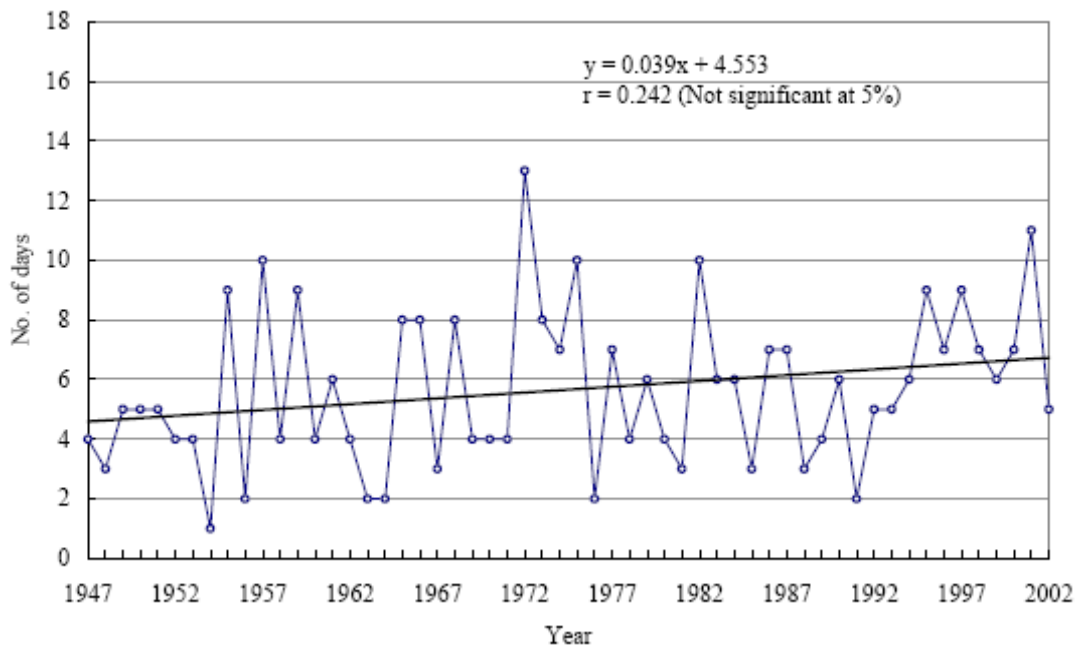


Figure 3 Number of days with hourly rainfall greater than 30 mm in Hong Kong³ (HKO, 2004)

2.3 Number of Typhoons in Hong Kong

² The data is recorded at the Hong Kong Observatory Headquarters.

³ The data is recorded at the Hong Kong Observatory Headquarters.

The number of typhoons also does not increase with the temperature. Figure 4 shows the annual numbers of typhoon landing over the coast within 300 km of Hong Kong. But the numbers only reflect the frequency of typhoon. The numbers do not reflect the strength of typhoons. It will be useful to study the relationship of the strength of typhoons and global warming.

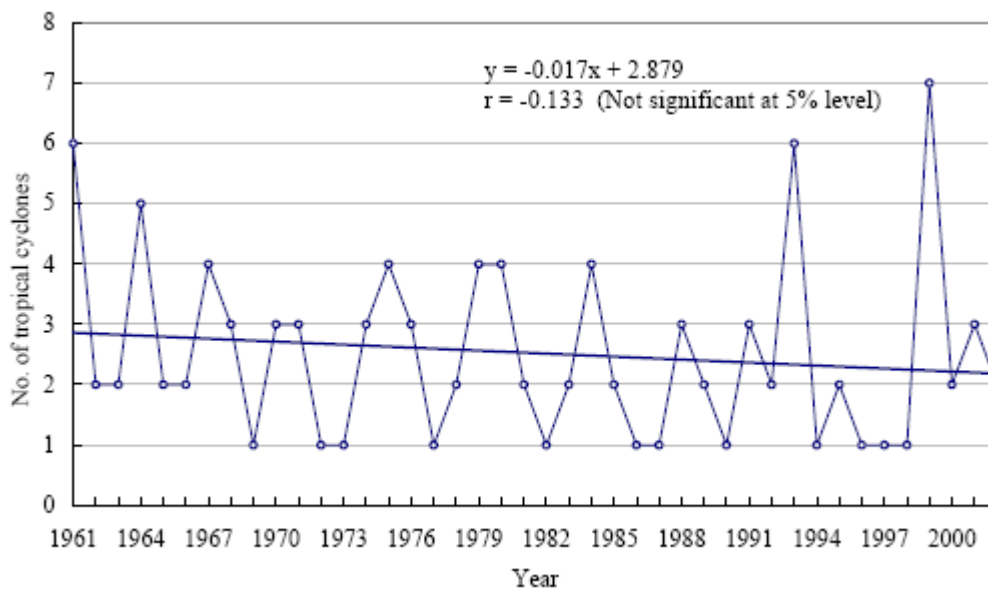


Figure 4 Annual numbers of typhoon landing over the coast within 300 km of Hong Kong (HKO, 2004)

3. The Impacts of Climate Change

Air conditioning accounted for 32% of total electricity consumption in Hong Kong in 2000. The rise of temperature will increase the electricity consumption in Hong Kong. Fung (2004) estimates that the economic impact on the electricity consumption is HKD 1.72 billion for 1°C temperature rise. Dengue Fever and Malaria will be found more likely in Hong Kong if the temperature increased (Fung, 2004). Climate change may also induce more natural disasters such as flooding and landslides. The impact of climate change on carols and migratory birds are also under concern.

4. Greenhouse Gases Emissions in Hong Kong

4.1 Historical Trend of Greenhouse Gases Emissions in Hong Kong

Figure 5 shows the carbon dioxide and greenhouse gases emissions in Hong Kong from 1990 to 2004. Recently, the greenhouse gases emissions in Hong Kong is around 6 tons carbon dioxide equivalent per capita. The greenhouse gas emissions declined in the mid and late 1990s. It was suggested that the decline was resulted from the importation of electricity from the Daya Bay Nuclear Plant in 1994, the change from coal to natural gas as the burning fuel in Black Point Power Station in 1996, and the migration of manufacturing facilities from Hong Kong to mainland China (EPD, 2001).

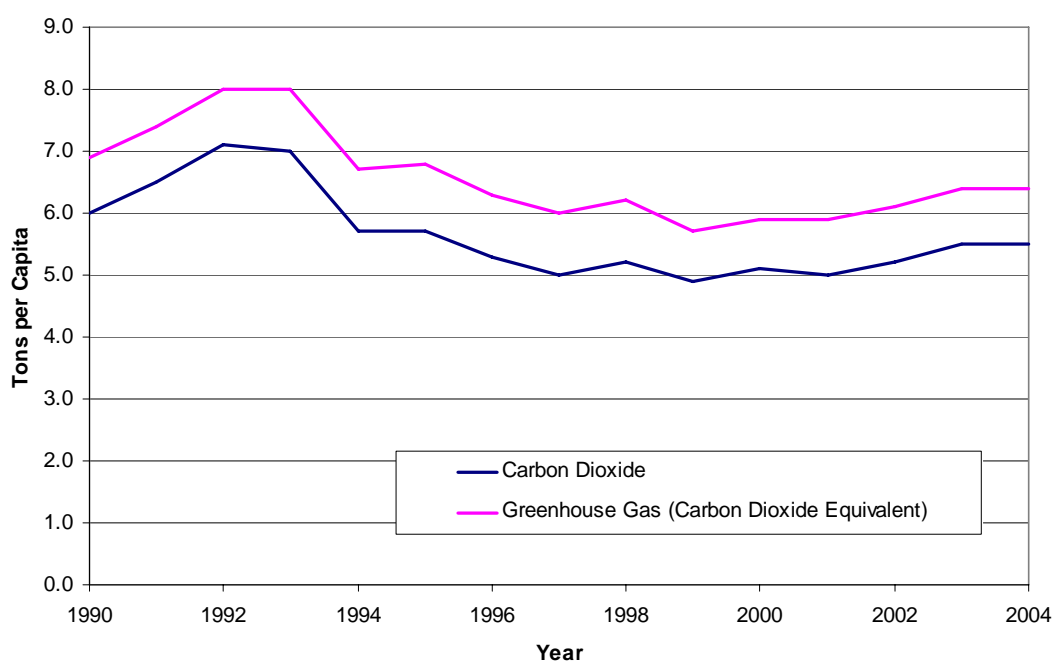


Figure 5 Carbon dioxide and greenhouse gases emissions in Hong Kong⁴.

4.2 Compositions of Greenhouse Gases Emissions in Hong Kong

⁴ The data of different greenhouse gases emissions in Hong Kong in 2004 is obtained from the *Air Pollution and Greenhouse Gas Emission Inventory (1990-2004)* of the Environmental Protection Department.

Figure 6 shows the percentage of the emissions of different greenhouse gases in Hong Kong. Carbon dioxide is the dominate greenhouse gas, making up 86% of total greenhouse gases (carbon dioxide-equivalent) emissions in 2004. Methane contributes 11% of the total greenhouse gases emissions. NO₂, HFCs, PFCs, SF₆ makes up the remaining 3% (EPD, 2005).

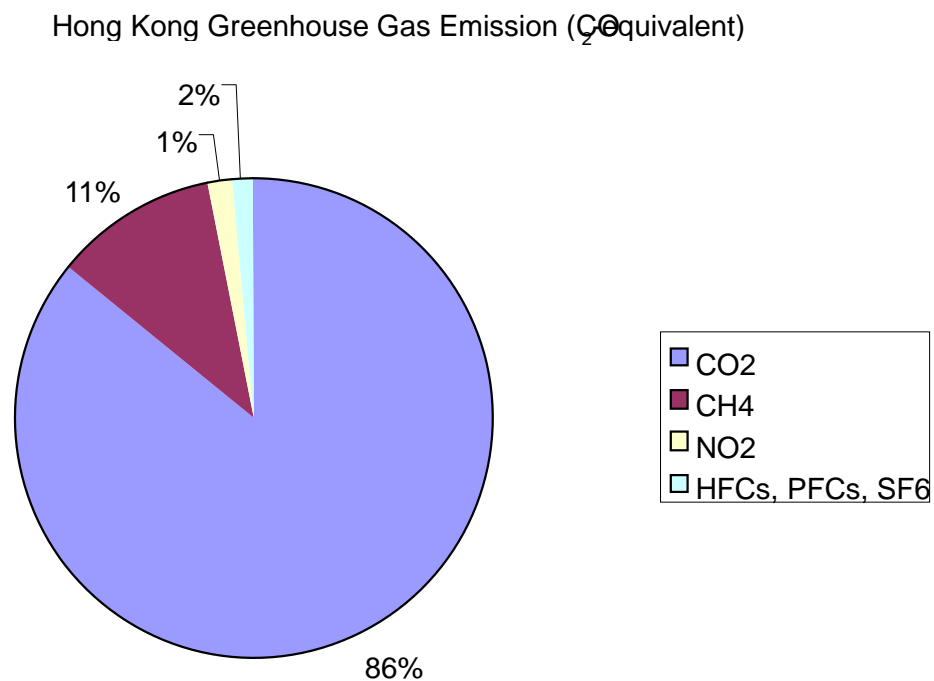


Figure 6 Different greenhouse gases emissions in Hong Kong in 2004⁵.

4.3 Sources of Carbon Dioxide Emissions in Hong Kong

Figure 7 shows the sources of carbon dioxide emissions. Energy industries, i.e. electricity generation⁶, is the major source of carbon dioxide emission in Hong Kong, more than 60% in 2004. Transportation in Hong Kong only contributes less than 20%

⁵ The data of different greenhouse gases emissions in Hong Kong in 2004 is obtained from the *Air Pollution and Greenhouse Gas Emission Inventory (1990- 2004)* of the Environmental Protection Department.

⁶ In 1997, 99% of the emissions from energy industries is from electricity generation (ERM, 2000).

to total greenhouse gases emissions (EPD 2005). This is resulted form the success of public transport in Hong Kong. 89% of total trips are taken on public transport (Hong Kong Government, 2004). About 10% of greenhouse gases emissions is come from waste, which is mainly the methane gas generated in the landfills.

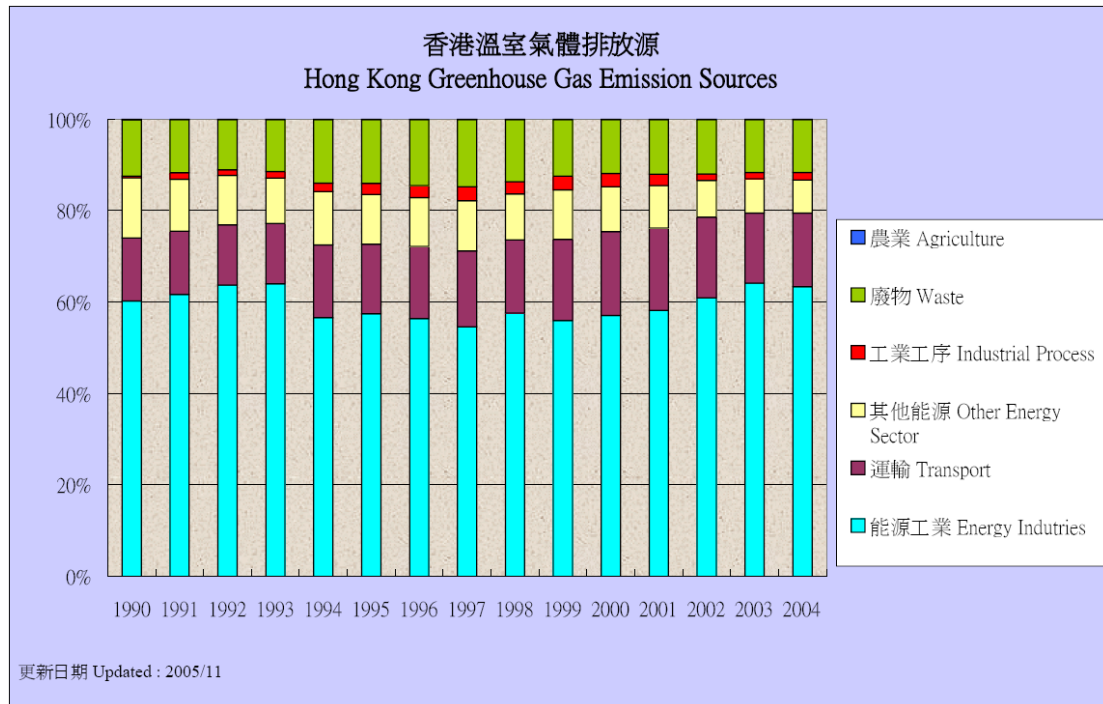


Figure 7 Sources of greenhouse gases emissions in Hong Kong (EPD, 2005)

5. Climate Policies

There are two kinds of climate policies: mitigation policy and adaptation policy. Mitigation policy reduces the likelihood and degree of climate change. It deals with the problem in the upstream and is the primary focus of public and policymakers. While mitigation policy deals with change issue in the upstream, adaptation policy deals with the problem in the downstream. Adaptation policy reduces the severity of the impacts of climate change when climate change prevails. Adaptation is a complementary policy to mitigation (Pew Center, 2004).

Mitigation policies include greenhouse gases emissions reduction, carbon capture and storage, carbon sequestration, geotechnical engineering, etc. Greenhouse gases emissions reduction is the one with major concern recently. Adaptation policies include risk management, infrastructure planning and development, institutional design and reform, and technological innovation, etc (Pew Center, 2004).

5.1 Mitigation in Hong Kong and Suggestions

The emissions of greenhouse gas from anywhere will affect climate globally, therefore the issue of climate change should be treated globally. Kyoto Protocol is the international agreement on dealing with climate change through reduction of greenhouse gases emissions. Kyoto Protocol finally came into force on 16th February 2005, 90 days after Russia ratified the Kyoto Protocol⁷. 163 Parties ratified the treaty, representing 61.6%.

Chinese Government approved the Kyoto Protocol on the 30th August 2002 and the Protocol came into force on 16th February 2005 (UNFCCC 2006). Kyoto Protocol was extended to Hong Kong Special Administrative Region (SAR) in May 2003 (EDLB, 2005). Because People's Republic of China is a non-Annex I countries in UNFCCC, Hong Kong SAR also falls in the same category and bear no obligation to meet any emission target.

⁷ According Article 25 of Kyoto Protocol, the treaty will “enter into force on the ninetieth day after the date on which not less than 55 Parties to the Convention, incorporating Parties included in Annex I which accountable for in total for at least 55 per cent of the total carbon dioxide emissions for 1990 of the Parties included in Annex I.” The ratification by Russia fulfilled the requirement of 55% of the total carbon dioxide emissions for 1990 of the Parties included in Annex I.

Historical responsibility is an important concept in burden allocation in combating climate change. Historical responsibility is scientifically justified as global warming is a function of greenhouse gas concentration in the atmosphere, which is accumulated over time (Neumyer, 2000). The historical responsibilities are manifested in UNFCCC through the introduction of two lists of countries, Annex I and Annex II. Annex I contains the industrialized countries with significant historical emission records and Annex II contains the affluent industrialized countries (Muller, 2004). According to Article 4.2 of UNFCCC, only Annex I countries have the obligations to “adopt policies and measures with the aim of returning individually or jointly to their 1990 level.” Based on the principle of historical responsibilities in UNFCCC, Hong Kong now is not necessary to reduce her carbon dioxide emissions drastically.

Figure 8 shows the carbon dioxide emissions of Hong Kong and some major countries from 1990 to 2002. The carbon dioxide emission per capita in Hong Kong is pretty low in international level. The carbon dioxide emission per capita in Hong Kong is around 5 tons per year from 1990 to 2002, which is not only significantly lower than North America (Canada and the United States), but also lower than those countries with better environmental policies, like Japan and major European countries (France, United Kingdom, Germany, and Italy).

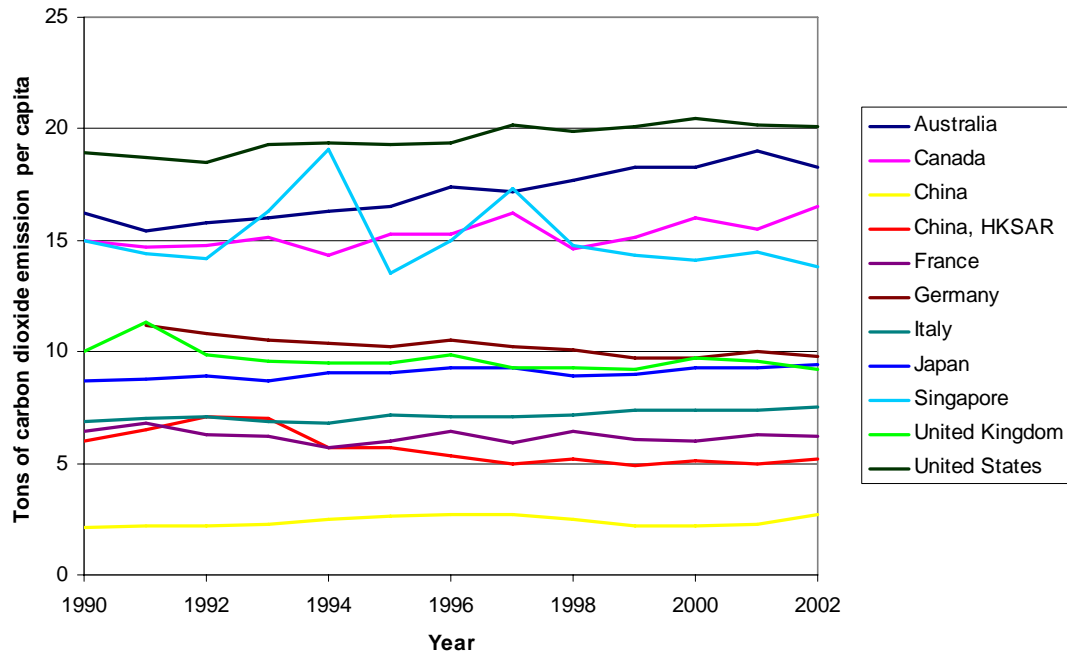


Figure 8 Carbon dioxide emission per capita in Hong Kong and some major countries⁸

Even though Hong Kong does not have historical responsibility in global warming and the current emission level is low, but as a member of the world, it is still Hong Kong's responsibility to contribute to the abatement of greenhouse gases emissions. Besides from preventing global warming, there also are other ancillary benefits such as the reduction of fossil fuel cost, and improvement in air qualities. Therefore Hong Kong Government should still endeavour to abate global warming.

5.1.1 Cleaner Fuels for Electricity Generation

86% of greenhouse gases emissions are carbon dioxide and over 60% of the carbon dioxide emissions is generated from power plants. Therefore reduction of power plant emissions is the most effective way to lower the greenhouse gases emissions in Hong

⁸ The carbon dioxide emission per capita of Hong Kong is obtained from the Environmental Protection Department (EPD) in Hong Kong while the others are obtained from the United Nations Statistics Division (UNSD). There also is record of carbon dioxide emission per capita of Hong Kong in the database of UNSD but which is different from EPD. In this study, all data of Hong Kong will be based on Hong Kong Government.

Kong. Shifting to use a cleaner fuel will drastically reduce the carbon dioxide emission. For example, using natural gas to substitute coal as the burning fuel will reduce carbon dioxide emission by 43% (EIA, 1998). In 2006, 38% of electric power provided by China Light & Power Company (CLP) is generated from coal (CLP, 2006) and Hongkong Electric Company (HKE) will only start using natural gas in 2006 (HKE, 2004). The existing Scheme of Control Agreements between Hong Kong Government and the two local power companies will expire in 2008. Hong Kong Government should take this opportunity to require the two power companies to replace coal with natural gas as a condition to renew their licenses.

5.1.2 Carbon Dioxide Capture in Electricity Generation

In addition to using a cleaner fuel to generate electricity, carbon dioxide emissions can also be reduced through carbon capture in the exhausted gas from the power plant. IPCC (2005) did a reach on carbon dioxide capture and found that post-combustion capture of carbon dioxide in power plant is economically feasible. Hong Kong Government may require the two electricity companies, CLP and HKE, to study the possibilities of the implementation of carbon dioxide capture technology in the power plants.

5.1.3 Using Cleaner Fuel and Environmental Friendly Vehicles

Because of the success of public transport in Hong Kong, the carbon dioxide emissions contributed by transportation is less than 20% of total emissions (EPD, 2005), compared to 33% in the United States (EIA, 2005). But Hong Kong can still further improve the performance by using cleaner transport.

Hong Kong Government should formulate policy to encourage the use of cleaner fuel. Similar to the replacement of diesel taxis with LPG taxis, Hong Kong Government can require all public transport, such as bus and mini bus, to use LPG instead of diesel. Hong Kong Government should also take the initial step to replace all government's diesel vehicles with LPG vehicles. Moreover, Hong Kong Government should lower the tax of importing environmental friendly vehicles, such as hybrid cars and high-fuel-efficiency cars.

5.1.4 Enhancing the Aviation Efficiency

Beside land transport, Hong Kong can further lower carbon dioxide emission by improving the aviation efficiency. Currently, there are insufficient air routes for civil aviation over the Pearl River Delta region. Because of the lack of airspace, there are congestions in the air routes over the Pearl River Delta region and civilian aircrafts have to fly at non-optimum altitudes. Tons of jet fuels are wasted for the extra flight distances. One of the reasons for the congestion is that most of the airspace is used by military. Another reason is that the airspace over Pearl River Delta region is managed by three authorities: mainland, Macau and Hong Kong. Therefore in order to improve the aviation efficiency, Hong Kong Government should discuss with the Chinese military to relinquish control of part of the airspace over Pearl River Delta region. Hong Kong airport should also cooperate with mainland and Macau airports to improve efficiency (SMCP, 2006).

5.1.5 Carbon Tax and Carbon Trading

Carbon trading and carbon tax are economically efficient method to reduce the emissions of carbon dioxide. The fundamental concept of carbon trading and carbon tax is to give the public a signal that the emission of carbon dioxide and global warming is costly. With the price signal, industries will reduce the emissions as far as the reduction cost is equal to the carbon tax or equal to the price of the carbon permit. Hong Kong Government should start studying the feasibilities of implementing carbon tax and carbon trading in Hong Kong. Hong Kong Government could even discuss with Chinese Government to implement carbon trading in the Greater Pearl River Delta Region.

5.1.6 Lowering End Use Demand and Enhancing End Use Efficiency

Public can also help to reduce carbon dioxide emissions by lowering end use demand and enhancing end use efficiency. The Electrical and Mechanical Services Department (EMSD) has several schemes to help lowering end use demand and improving end use efficiency. For examples, Energy Efficiency Registration Scheme for Buildings promote the application of the Building Energy Codes covering lighting, air conditioning, electrical, and lift & escalator installations (EMSD, 2006). Energy Efficiency Labelling Scheme⁹ provides the information of energy consumption level and efficiency ratings of appliances and equipment used both at home and office (EMSD, 2006). Pilot Scheme on Fresh Water Cooling Towers helps to reduce the electricity demand in air conditioning (EMSD, 2006). Individuals can save money from paying less for the electricity bills while reducing carbon dioxide emissions.

⁹ EMSD currently operates the voluntary Energy Efficiency Labelling Scheme. To further facilitate public in choosing energy efficient products, a mandatory energy efficiency labeling scheme is proposed (EMSD, 2006).

5.2 Adaptation in Hong Kong and Suggestions

As the carbon dioxide emission level in Hong Kong is already quite low, drastic emission reduction may not be efficient. The share of Hong Kong's contribution of carbon dioxide to world is very small, only 0.147% (UNSD, 2002), so even Hong Kong can drastically reduce her greenhouse gases emissions, it may not necessarily prevent the occurrence of global warming. Although Kyoto Protocol finally came into force on 16th February 2006, it is still not optimistic in combating global warming because of the absence of the United States' participation. Therefore while developing mitigation policies to reduce greenhouse gases emissions, Hong Kong Government should also formulate adaptation measures to prevent or reduce the degree of the adverse effect of climate change.

5.2.1 Vulnerability Assessment

Once infrastructures and buildings are constructed, they are very difficult, if not impossible, to be adjusted for future climate change. Therefore development projects should be required to carry out vulnerabilities assessment to prevent future adverse situation caused by extreme climate. For examples, the assessment should study the exposure of the buildings to extreme climate, like typhoon or flooding. The assessment should study any structure design alternative can increase the durability of buildings to climate change. Besides investigating how climate disasters will affect the building, the vulnerability assessment should also study how the construction will increase the adverse effect of climate change. For examples, the development of rural area will increase the likelihood of flooding in the New Territories.

The selection of structure design should be chosen using cost-benefit analysis. The principle of vulnerability assessment is similar to the environment impact assessment that vulnerability assessment ensures the project to have a comprehensive consideration of impacts of climate change to the constructions.

5.2.2 Disaster Managements

Government should establish a relief fund for climate disasters, such as typhoons, and floods. Insurance companies should also provide financial instruments to hedge the risks of global warming. This kind of disaster management is not purely passive measure. For example, insurance companies may conditionally require certain practices to reduce the exposure of people and property to climate disasters when the insurance is purchased. Government may also require individuals to have certain precaution measures before they are eligible to apply the fund (Pew Center, 2004).

5.2.3 Enhanced Structure Design

Like special building design in Japan can reduce the adverse effect of earthquake, the impacts of extreme climate can be reduced through infrastructure design and building codes (Toman and Bierbaum, 1996). Buildings and infrastructures' durability and resiliency to climate change can be increased through structure design.

5.2.4 Land-use Planning

In the history of development in Hong Kong, the developments have been shifted from the hillslope areas to the coastal reclamation areas. This increases vulnerability of Hong Kong to the rise of sea level. The coastal reclamation areas can be protected from sea level rise by building seawalls, but this will also increase the risk of

rainstorm flooding (Yim, 1996). The illegal rural development also worsens the flooding situation in the New Territories. Government should minimize the exposure of people and property to the adverse effect of climate change and reduce the degree of the adverse effect of climate change through land-use planning.

5.2.5 Institutional Reform

There is no centralized agency in the Hong Kong Government working on the climate issues. Different works related to climate change are done by different government agencies: Hong Kong Observatory monitors the trends of climate change in Hong Kong, such as, temperature and sea level; Environmental Protection Department reduces the emissions of greenhouse gas; Drainage Service Department prevents flooding caused by extreme climates; Water Supplies Department ensure sufficient water supplies. Agriculture, Fisheries and Conservation Department works on the preservation of biodiversities and ecosystems in Hong Kong.

A centralized agency on climate issue should be formed to coordinate all the works related to climate change in different departments. For instance, a branch on climate change can be formed under the Council for Sustainable Development (CSD). Climate change is an important topic sustainable development and CSD already studied some pilot areas related to climate change, such as renewable energy (CSD, 2005). The formation of the branch of climate issue can help CSD to do a better work on climate change and coordinate the works in different government's agencies.

5.2.6 Anti Extreme Climate Engineering

Hong Kong is a hilly city and there are a lot of steep slopes in Hong Kong. In 2004, 57000 slopes have been registered (Hong Kong Government, 2004). According to the HKO, the annual rainfall in Hong Kong will increase at a rate of about 1% per decade in the 21st century (Hong Kong Standard, 2005). As the possibilities of heavy rainfalls in the future will be increased due to the global warming, the authority should do a better work on monitoring slope and slope enforcement to prevent landslide. There is a Landslip Preventive Measure Programme in the Civil Engineering and Development Department to rectify the safety of slopes in Hong Kong. In the inspection, the increase of rainfalls in the future due to climate change should be taken into account.

There are several regions in Hong Kong are vulnerable to flooding, such as Sheung Wan and northern New Territories, For example, on 22 July 1994, the low lying area of the northern New Territories was completely inundated after the passage of Typhoon Dot (HKO, 2005). As the rainfall will probably increase in the next one hundred years, the authority should construct adequate stormwater drains and flood pumping stations in those areas vulnerable to flooding to meet the requirement of the future increased rainfall.

6. Conclusion

As a member of the world, Hong Kong should adopt mitigation policies to combat climate change. Feasible mitigation measures include using cleaner fuels for electricity generation and transport, importing environmental friendly vehicles, improving the efficiency of aviation, lowering end use demand and enhancing end use efficiency. Mitigation policy is now the primary focus of the public and the policymakers. However, the occurrence of global warming is very likely be affected

by Hong Kong's own mitigation policies. Therefore while Hong Kong Government implements the mitigation policies, the government, at the same time, should also prepare adaptation policies to minimize the adverse effect of climate change to Hong Kong. Vulnerabilities assessment, disaster management, enhanced structure design, institutional reform and anti extreme climate engineering are some feasible adaptation policies in Hong Kong. A complete climate policy should encompass both mitigation and adaptation to climate change.

Reference:

China Light & Power Company (2006). 中電就政府對香港電力市場未來的發展第二階段諮詢文件的意見.

Council for Sustainable Development (2005). *Making Choices for Our Future: Report on the Engagement Process for a First Sustainable Development Strategy*.

Economic Development and Labour Bureau (2005). *Consultation Paper on Future Development of the electricity Market in Hong Kong Stage II Consultation*.

Electrical and Mechanical Services Department (2006). *HK Energy Efficiency Registration Scheme for Buildings*. Retrieved 21st August 2006 from the World Wide Web: <http://www.emsd.gov.hk/emsd/eng/pee/eersb.shtml>

Electrical and Mechanical Services Department (2006). *Energy Efficiency Labelling Scheme*. Retrieved 21st August 2006 from the World Wide Web: <http://www.emsd.gov.hk/emsd/eng/pee/eels.shtml>

Electrical and Mechanical Services Department (2006). *Water-cooled Air Conditioning Systems*. Retrieved 21st August 2006 from the World Wide Web: <http://www.emsd.gov.hk/emsd/eng/pee/wacs.shtml>

Energy Information Administration (1998). *Natural Gas Issues and Trends 1998*.

Energy Information Administration (2005). *Emissions of Greenhouse Gases in the United States 2004*.

Environmental Protection Department (2001). *Legislative Council Panel on Environmental Affairs: Greenhouse Gas 3rd July 2001*.

Environmental Protection Department (2005). *Air Pollution and Greenhouse Gas Emission Inventory (1990- 2004)*. Retrieved 9th June 2006 from the World Wide Web: http://www.epd.gov.hk/epd/english/environmentinhk/air/data/emission_inve.html

Environmental Protection Department (2006). *Air Pollution and Greenhouse Gas Emission Inventory (1990- 2004)*. Retrieved 9th June 2006 from the World Wide Web: http://www.epd.gov.hk/epd/english/environmentinhk/air/data/emission_inve.html

Environmental Resources Management (2000). *Greenhouse Gas Emissions Control Study: Revised Executive Summary*.

Fung, W. Y. (2004). *Provision of Service for Characterizing the Climate Change Impact in Hong Kong*. Retrieved 21st August 2006 from the World Wide Web: http://www.epd.gov.hk/epd/english/environmentinhk/air/studyrrpts/air_studyrrpts.html

Hongkong Electric Company (2004). *Environment, Quality, Health and Safety Report 2004*.

Hong Kong Government (2004). *Hong Kong Yearbook 2004*.

Hong Kong Observatory (2003). *Global warming – the Hong Kong connection (1 August 2003)*. Retrieved 5th June 2006 from the World Wide Web: <http://www.hko.gov.hk/wxinfo/news/2003/pre0801e.htm>

Hong Kong Observatory (2004). *Climate Change in Hong Kong*. By Y.K. Leung, K.H. Yeung, E.W.L. Ginn & W.M. Leung. Hong Kong Observatory Technical Note No. 107.

Hong Kong Observatory (2004). *Temperature Projections for Hong Kong in the 21st Century*. By Y.K. Leung, E.W.L. Ginn, M.C. Wu, K.H. Yeung & W.L. Chang. Published in Bulletin of Hong Kong Meteorological Society, Volume 14, Number 1/2, 2004

Hong Kong Observatory (2005). Special Announcement on Flooding in the Northern New Territories. Retrieved 20th June 2006 from the World Wide Web: <http://www.hko.gov.hk/wservice/warning/flood.htm>

Hong Kong Standard (2005). Weathermen forecast a century of storms. (2005, August 27). Hong Kong Standard [Hong Kong], p. A09.

Intergovernmental Panel on Climate Change (2000). *IPCC Special Report on Emission Scenarios: Summary for Policymakers*.

Intergovernmental Panel on Climate Change (2005). *IPCC Special Report on Carbon dioxide Capture and Storage: Summary for Policymakers*.

Muller, B. (2004). Global Climate Change Regime: Taking Stock and Looking Ahead. Chapter 2, *Climate Change Five Years after Kyoto*, 29-51.

Neumayer, E. (2000). In defence of historical accountability for greenhouse gas emissions. *Ecological Economics* 33 (2000) 185-192.

Pew Center (2004). *Coping with Global Climate Change: The Role of Adaptation in the United States*.

South China Morning Post (2006). Pilots Waste Fuel under Mainland's Air-Traffic Rules. (2006, November 3). South China Morning Post [Hong Kong], p. EDT14.

Toman, M., and Bierbaum, R. (1996). An Overview of adaptation to climate change. *Adapting to Climate Change: An International Perspective*, J. Smith, N. Bhatti, G. Menzhulin, R. Benioff, M.I. Budyko, M. Campos, B. Jallow, and F.Rkjsberman (eds.) Springer-Veriag Inc. New York, NY, pp5-15.

United Nations Framework Convention of Climate Change (2006). *Kyoto Protocol Status of Ratification*.

United Nations Statistics Division (2005). *Millennium Indicator*. Retrieved 5th June 2006 from the World Wide Web: http://millenniumindicators.un.org/unsd/mi/mi_series_results.asp?rowId=751

Yim, W. (1996). Vulnerability and Adaptation of Hong Kong. *Water, Air and Soil Pollution* 92:181-190.