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THE CLIMATE GROUP

A LOW CARBON VISION FOR HONG KONG

DISCUSSION PAPER

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INTRODUCTION

The °Climate Group has produced a discussion paper which gives a vision on what Hong Kong could achieve in terms of carbon reduction, with the aim to initiate discussions on the ways and means to achieve the vision, as well as Hong Kong's role in facilitating China's low carbon development.

The discussion is based on three separate but complementary parts: an analysis of stakeholders' views on how Hong Kong should meet the climate change challenge; an overview of emission targets and how far Hong Kong is from these targets; and a projection of the energy-related greenhouse gas (GHG) emissions in Hong Kong up to 2030 under the Business-as-usual (BAU) scenario and several low carbon scenarios, conducted by the Energy Research Institute of the National Development and Reform Commission of the People's Republic of China using a computer model.

This research project is sponsored by the Rockefeller Brothers Fund, along with a parallel study on the GHG emissions projection in Guangdong Province, China, up to 2030.

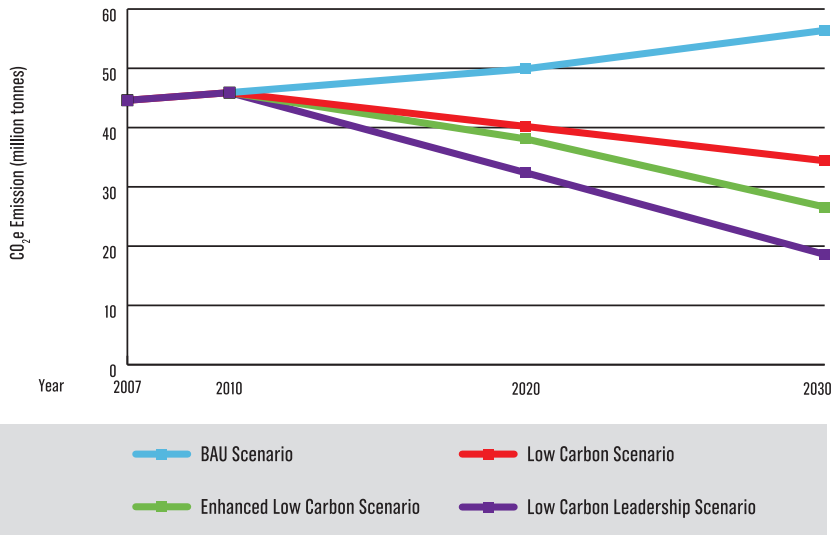
The °Climate Group also thanks the HSBC Climate Partnership for their support in this study.

EXECUTIVE SUMMARY

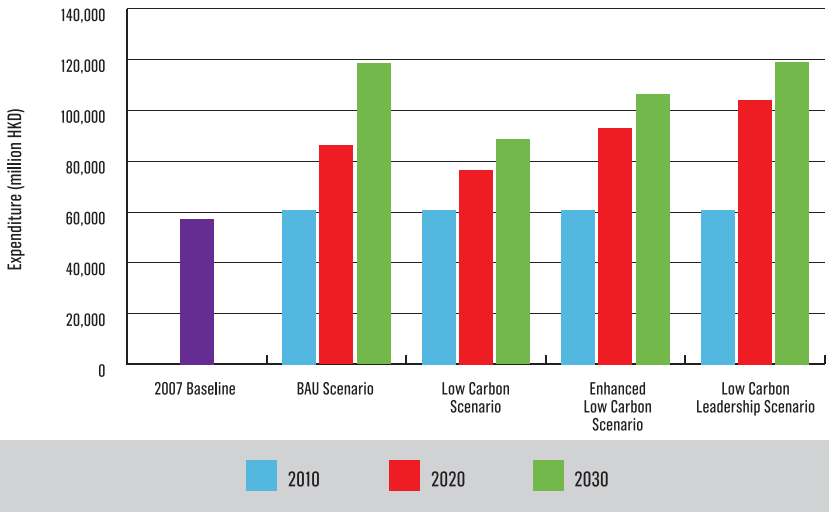
The projection of the energy-related greenhouse gas (GHG) emissions in Hong Kong up to 2030 under the Business-as-usual (BAU) Scenario and several low carbon scenarios shows that through a number of energy and low carbon policies, Hong Kong can achieve a significant reduction in its GHG emissions.

It is also found that the implementation of low carbon policies does not necessarily lead to an increased cost to the society, but can benefit the society by lowering the energy expenditure, through lowering the energy consumption and reducing the operating cost of energy supply in the long run.

Projected Carbon Emission from Energy Use in Hong Kong



Projected Energy Expenditure in Hong Kong



Currently there is not a widespread discussion on climate change issues in Hong Kong, and there seems to be a lack of consensus on the appropriate target that Hong Kong should commit to in terms of climate change mitigation.

To initiate discussions on the ways and means to achieve emission reductions, as well as Hong Kong's role in facilitating China's low carbon development, The °Climate Group is proposing a low carbon vision for Hong Kong, as outlined below:

- Hong Kong has a key role in the economy of the Pearl River Delta (PRD), which comprises Hong Kong, the nine municipalities of the Guangdong Province in mainland China and Macao. Hong Kong can contribute to low carbon development in the region through its strength in financing and innovation. With well established infrastructure, strong presence of expertise, robust university education system and comprehensive protection on intellectual property, Hong Kong should aim to position itself as the 'brain' of the region by focusing on research and development, as well as deployment of new low carbon technologies.

- As a well-developed city with mature infrastructure, Hong Kong can add value to a low carbon development of other Chinese cities. Some areas Hong Kong may excel in are the applied R&D and deployment of technologies such as electric vehicles, building energy efficiency, as well as information and communications technologies.

- In the short run, Hong Kong can reduce its emissions from power generation by changing its fuel mix and phasing out the use of coal by increasing the use of cleaner fuel, such as natural gas and nuclear. In the long run, Hong Kong should seek to increase the proportion of clean energy, by utilising renewable energy locally, or by enhancing the integration of its energy network with that of Guangdong, such as by establishing renewable energy power plants within the Guangdong Province.

- Hong Kong should aim for a more ambitious legislation on the Building Energy Codes, to enhance the overall energy efficiency standards within the building sector.

- Hong Kong should introduce policies to encourage the application of advanced technologies and elimination of inefficient equipment.

- The government and civil society should reinforce public education to raise the awareness on 'low carbon society'.

PART I: STAKEHOLDERS' VIEWS – HOW HONG KONG SHOULD MEET THE CLIMATE CHANGE CHALLENGE

PART I: STAKEHOLDERS' VIEWS – HOW HONG KONG SHOULD MEET THE CLIMATE CHANGE CHALLENGE

The business, government, and civil society all play an important role in transitioning Hong Kong to low carbon prosperity. In order to gain a consortium of local viewpoints, The °Climate Group conducted face-to-face/phone interview with a number of stakeholders representing these three key sectors in Hong Kong[1]. These interviews provide us a qualitative collection of sectoral responses identifying the primary drivers and obstructions in Hong Kong's low carbon development process[2].

It was agreed by all stakeholders that climate change is a critical issue to be tackled, and Hong Kong is not immune to the impacts of climate change. This section summarises the mostly discussed issues by the stakeholders, including power generation, energy efficiency, government policies, Hong Kong's role within China, and public awareness.

POWER GENERATION

It was widely agreed by the stakeholders that power sector is one of the most important factors in tackling climate change in Hong Kong, as it contributes to more than 60% of GHG emissions locally. To reduce carbon emissions in Hong Kong, we must lower the carbon content of the energy, through changing the fuel mix, such as developing renewable energy or using cleaner fuels.

China is already the leading renewable energy producer in the world in terms of installed generating capacity. The country plans to almost double the proportion of renewable energy it uses from 8% in 2006 to 15% in 2020. However, most stakeholders do not see a huge potential of renewable energy in Hong Kong in the near future.

Dr Jeanne Ng, Director, Group Environmental Affairs of CLP Holdings Ltd, shared that in their experience, renewable energy is commercially viable only in regions where some forms of financial incentives are available from the government. The planned offshore wind farm project in Hong Kong is no exception in that it is not a commercially viable project in itself without financial support from government and/or customers. To Dr Ng, centralised large scale onshore renewable technology is out of the question for Hong Kong due to the lack of land; distributed generation from solar panels on buildings could be a possible new source of energy; and other technologies such as tidal are for future consideration. Her view was echoed by Robert Gibson, Director, Sustainable Development at John Swire & Sons (HK) Ltd, who believes the right answer for Hong Kong would be nuclear energy.

Although the proposed offshore wind farm can potentially supply only a small percentage of Hong Kong's energy consumption (about 1-2% of CLP's capacity), the civil society generally welcome CLP's proposal. Dr William Yu, Head of Climate Programme from WWF Hong Kong, said the new offshore wind farm would carry significant symbolic value of the realisation of renewable energy in Hong Kong. This could, in turn, provide a tangible landscape from which further renewable development may continue.

One heavily discussed area was the regulation on the power sector, and the Scheme of Control (SoC) agreement between the HKSAR Government and the two utilities companies in Hong Kong. Most stakeholders see SoC as lacking the ability to effectively control emissions from utilities, due to the fact that GHGs are not included in the emissions cap. Liam Salter, Managing Director of RESET (HK) Ltd, criticised that utilities do not provide enough energy efficiency, "the SoC mandates audits but we understand they don't do much after that." Andrew Lawson, Researcher from Civic Exchange, agrees that the SoC could be stronger. "The SoC is based on the power companies being remunerated according to the capital investment they make. It is not the same as them being rewarded for encouraging energy efficiency or sourcing renewable energy, or pushing for more gas/nuclear over coal. The government could devise the scheme in a different way to get the electricity companies to go further." Dr Glenn Frommer, Head of Sustainability Development of the MTR Corporation Ltd opined that the SoC is not sufficient to encourage innovation in renewable energy, as it "eliminates any input from fringes. For example, CLP owns the generation and builds the cables, so if you want to put a windmill in your house, you may have to have a separate power system."

Linda Choy, Political Assistant to Secretary for the Environment at the HKSAR Government's Environment Bureau, maintained that a balance needs to be struck between consumer and company interests. She asserted that the SoC provides a unique approach to address the lack of a demand-driven mechanism to encourage utilities to move toward renewable energy. She said, "Having them under our charge helps us make them execute change." The government's perceived solution in the short term is an increase in the use of natural gas in replacement of coal.

1. A full list of interviews conducted can be found in Appendix IV.
2. The interviewed stakeholders were not involved in the development or review of the methodology or results of this study.

ENERGY CONSUMPTION

Instead of relying on the power sector to go green and switch to renewables in the near future, most interviewed stakeholders see energy efficiency as a low-hanging fruit and a quick-start to mitigate climate change. While in China buildings consume around 18% of the country's total energy, 89% of the electricity is being consumed by buildings in Hong Kong. The building sector naturally became the focus of the discussion.

Mary Tsang, Assistant Director of Cross-Boundary & International Division of the HKSAR Government's Environmental Protection Department (EPD), stated that the government's Building Energy Codes and Building Energy Efficiency Funding Scheme are policies specifically aimed at making buildings efficient, with the former to set a minimum efficiency standard in buildings, and the latter to encourage the adoption of efficiency measures by showcasing cost savings and providing financial assistance.

The proposed Building Energy Codes is seen as crucial by stakeholders. Dr Yu from WWF Hong Kong stated that addressing building efficiency through codes is a primary and absolutely essential requirement in order to mitigate this consumption majority. Lawson from Civic Exchange holds the view that individuals and businesses are simply not going to accept efficiency or mitigate emissions on their own: "No one player is going to go out on a limb and suddenly produce a fantastic building that is totally energy efficient and contributes to a low carbon neighbourhood…it requires strong government leadership."

Apart from making direct energy savings, stakeholders see more far-reaching implications brought by mandatory energy efficiency standard in buildings. Salter from RESET stated that effective and enforceable minimum building codes are essential to maximising efficiency. In his solution, such building codes would have a positive two-pronged and complimentary effect: primarily they would drive minimal performance in adherence to basic yet rigid standards; and secondly they would create competition at the top levels in the race to be the best. According to Salter, once 'green' buildings become attractive to tenants, voluntary initiative to either retrofit or develop new efficient buildings will be triggered. So far, as a society, Hong Kong "does not fully understand the willingness to pay for a high quality building." In fact, the push for green housing represents a significant market opportunity to many players.

Gibson from Swire enhances the idea of building efficiency standards. He suggests enhancing the existing EMSD (Electrical and Mechanical Services Department of the HKSAR Government) building energy rating system to create a star-rating system, similar to that which has apparently already been implemented in Australia. In a hypothetical scale, a rating of zero would be ascribed to inefficient buildings while a rating of five would be given to those maximising efficiency. He said the consequences of this would also be two-fold: economic and social. For example, buildings awarded a five-star rating might enjoy a lower property tax. Also, while five-stars might receive subsidies for low electricity consumption, zero-star buildings could see as much as double their normal electric bill. Therefore, building owners would have an economic incentive to change. Moreover, and perhaps more interestingly, are the social implications of a rating system. Development investors would be drawn to the five-star rating much like they are drawn to excellent views, a preferred location, and marble floors. High efficiency would become embedded in the demand side with a high standard of living.

VIEWS ON REGULATION

While emission targets are being negotiated at national levels, many cities and regions have taken proactive actions in tackling climate change despite of national targets. Dr Steve Howard, CEO of The °Climate Group, commented on the role of municipal governments: "Sub-national governments around the world have shown that it is possible to move fast to develop ambitious climate change strategies and policies that will not only protect the environment but will protect jobs and the economy as well. States and regions can play a vital role as laboratories for low carbon development."

Although Hong Kong has long adopted a laissez-faire approach regarding economic development, interviewed stakeholders in general demanded stronger government leadership in combating climate change in Hong Kong.

Barry Kwong, Senior Vice President Corporate Sustainability, Asia Pacific Region at HSBC, holds the view that the HKSAR Government, like every government, should demonstrate the action they advocate. He already sees signs of the government acting positively locally: through the promotion of carbon audit, carbon reporting, and the legislation on Building Energy Codes.

The interviewed stakeholders generally agree that regulation is needed to achieve a transition to the low carbon economy. As pointed out by Dr Yu from WWF, "Once you have regulation you will see the effects very soon…the pick-up rate is just so slow for voluntary initiative." In terms of emissions, he said, "If the government can set a cap and allocate to different sectors that would be more effective, and give more solid results."

Dr Ng from CLP asserts that the type of market structure has a bearing on how quick governments can initiate responses or actions to urgent issues like climate change. To illustrate, she said, "All the companies considered to be more socially responsible

and transparent today tend to be the regulated ones, as governments can have more direct control over them." Hence there is an opportunity in Hong Kong for the government to direct such change. On the contrary, competitive markets, such as in Australia, would likely require more time and resources to monitor and manage the market towards the desired changes. However, regardless of a regulated or de-regulated market, it is critical that governments engage businesses to understand what regulatory requirements or policies can actually be implementable and effective. Another factor that plays a role in determining what policy or regulatory measures may be more effective is the type of political regime. In her opinion, in China for instance, emissions levies can be more efficient and quicker than emissions trading, provided that all the tax money collected is hypothecated back to supporting the development and implementation of low carbon solutions, such as subsidies for developing appropriate technology or financing of energy efficiency initiatives.

David St Maur Sheil, Executive Director at The Association for Sustainable & Responsible Investment in Asia (ASrIA) noted that regulation is a key driver and that ideally the government should act to provide an appropriate policy and regulatory framework which would create a level-playing field. This should act to stimulate investment and innovation as well as encouraging higher and more responsible standards. This could be achieved through a policy mix of regulation, business standards and incentives. He pointed out that an uneven playing field currently exists and that companies which were investing in clean technology, for instance, may end up competing domestically with companies who are not doing so. Lack of a supportive policy framework, for instance, acts as a barrier to investment in green building solutions. To him, this is one key obstacle facing the intersection of climate change and business interests.

The government should also play a role in assisting the development of low carbon technology. As Dr Ng from CLP commented on carbon capture and storage (CCS) technology which is believed to be one of the important low carbon solutions, she pointed out, "CCS is not currently commercially viable. Considerable investment needs to be made in the next few years to deal with the pressing climate change issues. It is the role of governments to make and encourage such investments."

ROLE OF HONG KONG WITHIN CHINA

Climate change is a global issue, which requires concerted efforts from countries and cities for its mitigation. Our stakeholders also looked at Hong Kong's role within China and the Pearl River Delta (PRD) region in terms of climate change mitigation.

Chinese Premier Wen Jiabao pledged to the international community in Copenhagen, the 40-45% carbon intensity reduction target between 2005 and 2020 will be a domestically legally-binding target, that will cover industry, building, transport, and products. Changhua Wu, Greater China Director of The °Climate Group, expects strong policy support for local governments and business sectors to achieve the targets.

PRD is responsible for a considerable portion of the world's manufactured goods and recent trends indicate demand for carbon measurement at the supply chain level. As of 2005, Hong Kong has been a source of over 65 percent of cumulative foreign direct investment in PRD[i] and thus has a significant influence on businesses in PRD.

Our interviewed stakeholders believe that the local economy must adapt in order to maximise carbon efficiency thereby actualising financial performance, and conceding to consumer demands at the investment level that will secure Hong Kong's continued position as a financial leader. Both Salter from RESET and St Maur Sheil from ASrIA noted that some international brand names are becoming aware of the risks presented by climate change, and are moving to account for supply chain carbon emissions in places like PRD.

Kalmond Ma, Head of Pearl River Delta Regional Programme of The °Climate Group, pointed out that business can no longer escape the pressure from their customers to know where products are sourced and manufactured, and that businesses need to react to this higher quest for corporate responsibility. He said: "Managing carbon in the supply chain has proven to bring in extra cost-saving by improving energy efficiency, promoting cleaner production, minimising packaging and optimising logistics networks." He also pointed out the business opportunities brought by the low carbon development. "In terms of climate change, we have short-term problems to face and long-term challenges to overcome, but the opportunities are immense. The people who innovate first will get the biggest return," said Ma.

The °Climate Group partnered with Business for Social Responsibility (BSR) and the British Consulate-General Guangzhou from 2008 to 2009 to look at opportunities and barriers to de-carbonise the supply chains in South China. The project was able to bring together over 40 brands and their suppliers from a variety of industries with over 400 participants. It was found that the companies that have realised the most gains from energy efficiency in South China are those that have invested in their existing people and systems, not new and expensive technologies. Being an early mover also reduces the cost of compliance later and gives companies a chance to present themselves as a leader on an issue that matters increasingly to consumers.

Lawson from Civic Exchange also sees potential in

PRD: "it has the potential to set itself up as the preferred location for companies looking for green manufacturing; PRD should position itself as a green investment opportunity." Hong Kong has a very strong influence on the biggest manufacturing base in the world and renewable energy should be supported to a greater extent, if not at the generation level, then through research and innovation at the manufacturing level. According to Lawson, China recognises Hong Kong's potential catalytic effect and intelligent decisions regarding a prosperous economic future will be noted: "What happens here can be a model for the rest of China."

This view that Hong Kong can act as a showcase for other cities in China was supported by Dr Ng from CLP. One area in which Hong Kong can excel in is the use of electric vehicles, due to its compact size. China is currently the world's number one battery producer and is strategically positioned to become the leading global supplier of electric and hybrid electric vehicles in the future. The country's low carbon vehicle market is growing rapidly and produced over 79 million bicycles, 21 million electric bicycle and 1.64 million energy efficient compact cars in 2007.

Wu from The °Climate Group expects that China will further continue to build on and strengthen its commitments to improving energy efficiency, the development and deployment of alternative energy technologies, and to the roll out of carbon labelling scheme for consumer products, among others. "With clear policy in place, the market for low carbon technologies, products and services will continue to develop and expand. Hong Kong, as a financial centre can position itself as a leader not only for China but for the rest of the world," said Wu.

PUBLIC AWARENESS

One platform upon which all interviewed stakeholders agree is that of information dispensing in order to 'raise awareness' of the general public. According to all discussion, while the general public may today be concerned with local air quality, they are, on average, not yet fully understand the phrase of 'climate change'.

Kwong from HSBC recognises that change needs to come at a micro level: a general shift in individual behaviour (i.e. saving energy) and the adoption of 'greener lifestyles'. The levy on plastic bags is a step in the right direction in making the individual consumer more conscious. He added, however, that economic and financial stability always takes precedence. Only when certainty is established are citizens willing to "spare time to address the environment or try new services." Kwong thinks that the local short-term health impact arriving from pollutants in the air at street level is more of a tangible concern than long-term climate change. Public respiratory health is the primary driver in carbon reduction.

Lawson from Civic Exchange is of the view that physical effects on the environment have yet to be felt in Hong Kong. The sea level is rising, but not to an alarming height, yet. To get the scale and urgency of climate change into the minds of the general public, we could build on issues such as air quality as the primary vehicle for instigating a broader discussion, as public health will be the initial concern. Addressing mitigation and emission reductions will require collective action at a whole-of-city level.

Dr Yu from WWF said "we have tools to equip the public with how to reduce a carbon footprint at the company, factory or individual level…it's all about mitigation." He said donors prefer education for children but he is pushing for more education for adults, because we are moving to tipping points and climate change will certainly affect this generation. With education, Dr Yu hopes that the idea of low carbon will be user-friendly and internalised at the individual, industrial and business levels.

Dr Frommer from MTR added "I would like to see more education in the schools." While businesses seem to be taking the issue seriously, it's the day-to-day understanding of carbon and emissions that is lacking in terms of comprehension. To him people will pay attention as the magnitude increases. He offered examples of greater social unrest, massive flooding in the Mekong Delta, and the disappearance of Himalayan glaciers as particular attention getters.

The team at the EPD asserts that education is especially needed at the supply chain level in PRD. The best method for this would be demonstration of a low carbon system and how it can bring saving. At a local level, the government has been promoting the adoption of greener lifestyle by individuals as a way to combat climate change under the 'I Love Hong Kong, I Love Green' Campaign. The EPD has organised a series of public education activities, such as the distribution of a comic book about climate change. To them, raising community awareness will provide the catalyst for change.

From the business angles, Kwong from HSBC and Dr Ng from CLP said the role of the media is significant. To them, conscious efforts should be made to inform the public on climate change issues and related possible government policy options. However, Edwin Ginn, Senior Scientific Officer from the Hong Kong Observatory of the HKSAR Government opined that constrained by the limited time available for studying the subject, the complexity of the issues involved, and the limitation of air time on TV/radio or space in the printed media, the reporting of the various issues on the subject of climate change is often over simplified which may result in misunderstanding by the public regarding the seriousness of the issues. Global warming, unlike other catastrophes or threats, is still, by and large, something intangible. To address

this, the Hong Kong Observatory provides educational webpages for the public and established a team of meteorologists to deliver talks for schools and universities to promote awareness and understanding of climate change. Its website remains to be the one of the most popular among government agencies in Hong Kong and provides a platform in facilitating communication with the public.

PART II:
EMISSION TARGETS- WHAT DO THEY MEAN FOR HONG KONG?

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ABSOLUTE EMISSION, CARBON INTENSITY AND ENERGY INTENSITY

When talking about greenhouse gas (GHG)[3] emission reductions at a city or national level, three types of targets are usually referred to, namely absolute emission, carbon intensity and energy intensity.

Absolute Emission: it refers to the amount of GHG emitted within a defined boundary (e.g. a country, region or city) in a certain period of time (usually over the course of one year).

Absolute emission target is the most commonly used term under international negotiations. Figures on reduction levels (often using 1990, 2000 or 2005 level as the baseline) are being agreed, mainly by developed economies. The Intergovernmental Panel on Climate Change (IPCC) recommends developed nations to reduce GHG emissions by 25-40% (1990 baseline) by 2020; and by 80-95% by 2050 to avoid catastrophic climate change effects.

Under the Kyoto Protocol, only developed countries (aka Annex I parties) are required to commit to absolute emission reduction targets. China, as a non-Annex I party, currently is not required to set a limit on its absolute emission.

Carbon Intensity: it refers to the GHG emissions per unit of GDP generated, and is usually used by developing countries as a pledge to combat climate change.

Both China and India had recently announced a reduction target in carbon intensity (2005 baseline) by 2020, with China a 40-45% commitment and India a 20-25% commitment.

In 2007, Hong Kong had a carbon intensity of 28.9kg CO_2e/HKD1,000 (2007 chained dollars). For comparison, the figures for New York City, London, and Singapore are 11.6, 13.5 and 37.2[4] respectively. Although Hong Kong has lower absolute emission and per capita emissions than New York and London, its carbon intensity level is much higher due to its lower GDP value.

Energy Intensity: it refers to the consumption of energy per unit of GDP generated.

In 2007, the Hong Kong SAR Government pledged to reduce energy intensity by at least 25% (2005 baseline) by 2030, under the APEC Leaders' Declaration on Climate Change, Energy Security and Clean Development.

One of the main differences between carbon intensity and energy intensity is that the carbon content of energy is not taken into account under the energy intensity measurement. In other words, even if energy intensity falls, if energy sources with higher carbon content (e.g. coal instead of natural gas or nuclear) are used, the actual emissions as well as the carbon intensity would still increase.

3. As defined by the Intergovernmental Panel on Climate Change (IPCC), six gases are included in the calculation of GHG emission. These gases include CO_2 (carbon dioxide), CH_4 (methane), N_2O (nitrous oxide), HFCs (hydrofluorocarbons), PFCs (perfluorocarbons), and SF_6 (sulphur hexafluoride).
4. The higher figure for Singapore is partly contributed by the presence of petro-chemical industry, as well as the need to import and purify water for domestic use.

HOW FAR HONG KONG IS FROM THE BENCHMARK EMISSION TARGETS

Based on Hong Kong's recent trends in GHG emissions[5], economic growth, and energy use[6], we have made projections on Hong Kong's absolute emission, carbon intensity, and energy intensity levels up to 2030. The projected figures give us a general picture on how far Hong Kong is to achieve various targets on absolute emission, carbon intensity and energy intensity that had been discussed in the society.

During the projection period (2008-2030), it is assumed that the annual GDP growth in Hong Kong is 4% between 2008 and 2010; 3.5% between 2011 and 2020; and 3% between 2021 and 2030, as suggested in Hong Kong 2030: Planning Vision and Strategy[ii].

Here we have considered 5 benchmark figures:

5. The GHG emission figures are obtained from the Environmental Protection Department (EPD), HKSAR Government.
6. The economic growth and energy consumption figures are obtained from the Census and Statistics Department, HKSAR Government.

- **APEC Target:** assuming Hong Kong will achieve a 25% reduction below 2005 level in energy intensity by 2030. Since about 80% of Hong Kong's GHG emissions arise from the energy sector and energy consumption by transportation, it is assumed that GHG emissions rise at 80% of the rate of increase in energy use.

- **Current Trend:** assuming the GHG emissions in Hong Kong will continue to increase by 1.6% per year (10 year average from 1998 to 2007).

- **GHG Constant:** assuming the GHG emissions and energy consumption in Hong Kong would peak by 2010, and remain constant afterwards.

- **China Target:** assuming Hong Kong will start to reduce its GHG emissions from 2010 onwards, and achieve a 45% reduction below 2005 level in carbon intensity by 2020.

- **EU Target:** assuming Hong Kong will start to reduce its GHG emissions from 2010 onwards, and achieve a 20% reduction below 1990 level in absolute emission by 2020 (the lower end of reduction level as committed by the EU).

The projection results are shown in Figures 1 and 2, and Table 1.

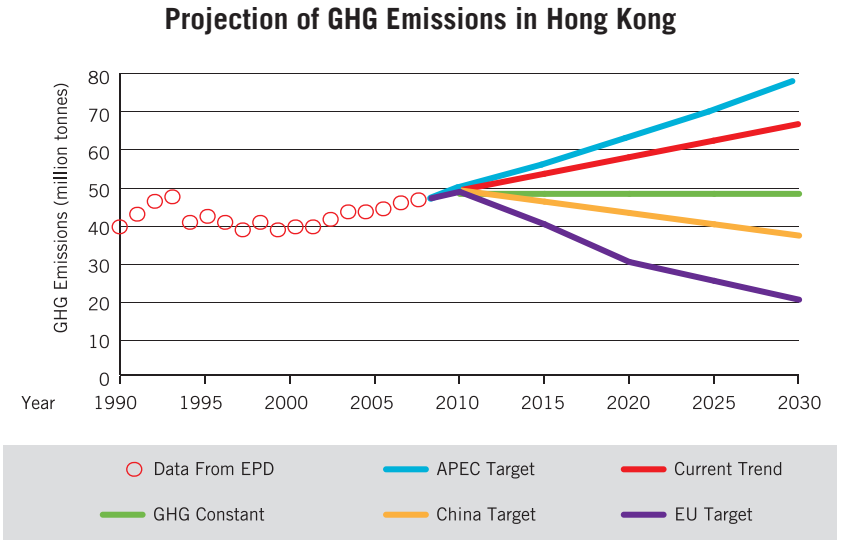


Figure 1. Projection of GHG Emissions in Hong Kong with Reference to Different Benchmark Figures

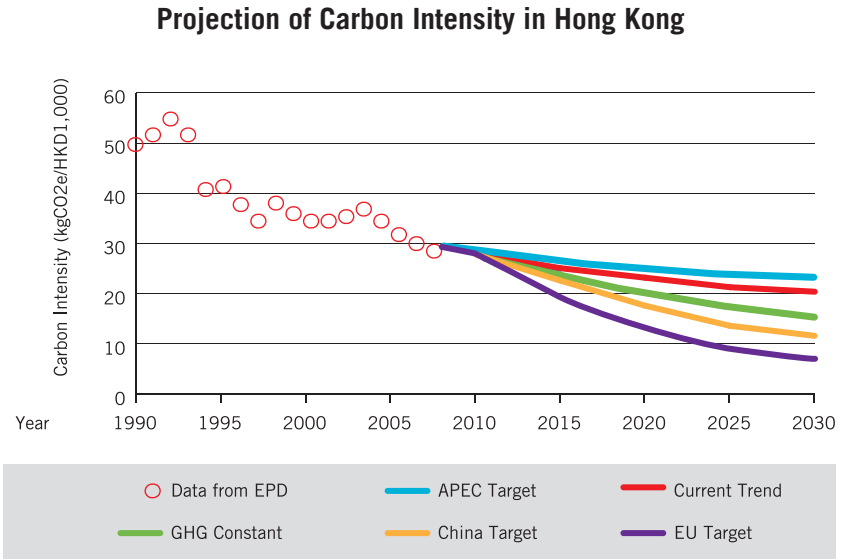


Figure 2. Projection of Carbon Intensity in Hong Kong with Reference to Different Benchmark Figures

Scenario	Absolute emission (million tonnes) [change from 2005]		Carbon intensity (kg CO_2e/HKD1,000) [change from 2005]		Year to reach 45% carbon intensity reduction	Year to reach 25% energy intensity reduction
	2020	2030	2020	2030		
APEC Target	62.4 [+40%]	78.1 [+76%]	24.8 [-21%]	23.0 [-27%]	>2050	2030
Current Trend	57.4 [+29%]	67.3 [+51%]	22.8 [-28%]	19.8 [-37%]	2040	2011
GHG Constant	49.0 [+10%]	49.0 [+10%]	19.4 [-38%]	14.4 [-54%]	2024	2011
China Target	43.6 [-2%]	38.8 [-13%]	17.3 [-45%]	11.4 [-64%]	2020	*
EU Target	31.4 [-30%]	20.1 [-55%]	12.4 [-60%]	5.9 [-81%]	2016	*

Table1. Summary of Emissions Projection with Reference to Different Benchmark Figures

* Note: Since achieving the China Target and EU Target would most likely require a combination of various means such as lowering carbon content of energy, promoting green economy and reducing energy use, it is irrelevant to determine the year to achieve a 25% reduction in energy intensity in these cases.

Baseline Figures: The introduction of nuclear energy from Daya Bay in 1994 and the commencement of gas-fired power plant in 1996 had led to significant reductions in Hong Kong's GHG emissions, resulting in a substantial drop in carbon intensity in the same year. After that, from 1997 to 2007, Hong Kong's GHG emissions had gone back to an increasing trend. However, during the same period, Hong Kong's carbon intensity had decreased in general, as the rate of economic growth exceeded the rate of increase in GHG emissions. For instance, Hong Kong's GHG emissions had increased from 44.5 to 46.7 million tonnes from 2005 to 2007 (5% increase), while its carbon intensity had decreased from 31.4 to 28.9 kg CO_2e/HKD1,000 (8% reduction).

APEC Target: Even if Hong Kong's energy consumption increases at a greater rate (2.8%) than for the past 10 years (0.3% per year on average), Hong Kong will still be able to meet the APEC Target. Since about 80% of Hong Kong's GHG emissions arise from energy sector and energy consumption by transportation, it is assumed that GHG emissions would rise at 2.2% per year during the projection period if energy consumption increases at 2.8% per year. As a result, Hong Kong's emissions will be 40% higher by 2020, and 76% higher by 2030, compared to 2005 level.

Current Trend: If both the energy consumption and GHG emissions increase at the same rate as over the past 10 years, Hong Kong will be able to achieve a 25% reduction in energy intensity by 2011, 19 years ahead of the target timeframe as set in the APEC Leaders' Declaration on Climate Change, Energy Security and Clean Development. This suggests that the APEC target is not ambitious enough for Hong Kong. By 2020 and 2030, Hong Kong's emissions will be 29% and 51% higher than 2005 level respectively.

GHG Constant: If Hong Kong can peak its emissions by 2010, Hong Kong will be able to achieve China's carbon intensity reduction target by 2021 (40%) or 2024 (45%), slightly behind China's committed timeframe of 2020. Assuming the energy use will level off after 2010 along with the emissions, Hong Kong will be able to achieve the APEC target by year 2011, 19 years ahead of the target timeframe.

China Target: If Hong Kong adopts the higher end of China's target (45% reduction in carbon intensity compared with 2005 by year 2020), Hong Kong will need to reduce its GHG emissions after year 2010, at a rate of 1.16% per annum. As a result, Hong Kong's emissions will slightly decrease by 2.1% and 12.8% compared with 2005 by 2020 and 2030 respectively. However, if we take 1990 as the baseline, Hong Kong's emissions will be increased by 11% by 2020, and decreased by 1% by 2030.

EU Target: To see how far Hong Kong is compared with other developed economies' efforts on GHG mitigation, we have also made projections based on EU's lower end target - 20% reduction below 1990 level by year 2020. In this case, Hong Kong will need to make a greater effort and reduce its emissions by 4.36% per year after 2010. If this rate of reduction is continued beyond 2020, Hong Kong will reach a reduction of 50% by 2030, and 80% by 2050 below 1990 levels. This will bring Hong Kong in line with IPCC's recommendations on developed nations' long-term emission reductions.

HONG KONG'S EMISSION TARGET

In 2007, the HKSAR Government had committed to a 25% reduction in energy intensity by 2030, taking year 2005 as a baseline. From the above projection, it can be seen that under the 'Current Trend' scenario, Hong Kong will be able to achieve its committed target much ahead of the target timeframe. This suggests that the aforementioned target does not provide a driving force for Hong Kong to strive for greater climate change mitigation efforts.

In fact, a previous analysis by Arup shows that Hong Kong's economic growth has largely been decoupled from its carbon emissions, and variations in emissions were largely caused by changes in fuel mix[iii]. Hence, energy intensity is not a good indicator to measure Hong Kong's progress in mitigating climate change.

The HKSAR Government announced in May 2010 that it would follow China's target of reducing carbon intensity by around 45% by 2020 (2005 baseline). To attain such target, Hong Kong needs to maintain a 3.5 to 4% of GDP growth, and reduce its emissions back to approximately the 2005 level.

Hong Kong, as a developed economy, can also consider setting an absolute emission target. This would allow direct comparison between Hong Kong and other developed economies on climate change mitigation efforts.

PART III: MODELLING HONG KONG'S ENERGY DEMAND AND ENERGY-RELATED EMISSIONS IN 2020 AND 2030

PART III: MODELLING HONG KONG'S ENERGY DEMAND AND ENERGY-RELATED EMISSIONS IN 2020 AND 2030

The °Climate Group has commissioned the Energy Research Institute of the National Development and Reform Commission of the People's Republic of China to project the greenhouse gas (GHG) emissions arising from energy use in Hong Kong up to 2030.

ENERGY DEMAND AND GHG EMISSIONS

The majority of GHG emissions in Hong Kong arise from power generation and energy consumption, which can be reduced through decreasing the energy demand, and by using energy sources with lower carbon content. In order to examine whether it is feasible for Hong Kong to achieve a reduction in carbon emissions, a computer modelling on Hong Kong's future energy demand and energy-related emissions was conducted.

MODELLING SCENARIOS

The energy demand and GHG emissions arising from energy consumption under four possible scenarios, namely Business-as-usual (BAU) Scenario, Low Carbon Scenario, Enhanced Low Carbon Scenario, and Low Carbon Leadership Scenario were projected using IPAC-AIM/Technology Model[7] developed by the Energy Research Institute (ERI).

BAU Scenario: Taking into account Hong Kong's social and economic development, this scenario assumes Hong Kong's economy will continue to develop for the near future. Except existing and confirmed policies, no additional low carbon policies will be implemented. Voluntary emissions reduction plans by businesses that are not yet implemented are also not included in the scenario.

Low Carbon Scenario: This scenario aims to analyse the energy saving, use of renewable energy, change of lifestyle and behaviour, and emission reductions that can be achieved through more proactive actions (policies, investments, energy expenditures, etc.).

Considering Hong Kong is a developed economy with a per capita GDP on par with OECD countries, it is assumed that Hong Kong will adopt similar low carbon development strategies as other developed countries, such as through wider deployment of energy saving technologies in buildings, transport systems and industries[8]. The main policy options considered under the Low Carbon Scenario include:

- Enhancing energy conservation within the residential sector and public services sector, and facilitating the development and adoption of energy efficient products within the market to achieve a 15% reduction in energy demand within these sectors.
- Promoting the deployment of energy efficient/ alternative-fuel automobiles and make these vehicles a mainstream option after 2020, and promoting the use of biofuel (E10 and D3 after 2010; E25, E85 and D8 after 2020). These measures will lower automobiles' oil consumption by 25% and GHG emissions by 30%.
- Harnessing renewable energy to supply local power needs, through promoting the development of renewable energy (such as wind power and solar power) both within and outside Hong Kong's territory.
- Developing a non-vehicular commute system to encourage pedestrianism and cycling.
- Promoting public education on low carbon lifestyle.

7. Please refer to Appendix I for more details on the IPAC-AIM/ Technology Model.
8. More details of the assumptions of BAU and Low Carbon Scenario can be found in Appendix II.
9. End-use energy demand refers to the final consumption of energy within a geographic territory, and excludes energy loss during energy transformation as well as export of energy.

Enhanced Low Carbon Scenario: Building on the Low Carbon Scenario, this scenario assumes Hong Kong would further enhance its efforts in low carbon development. The associated policies include the promotion of green transportation, green buildings and energy efficient consumer products, as well as an increased use of nuclear power, wind power, and other distributed renewables (photovoltaics, small-scale wind power, and energy-from-waste).

As a result, Hong Kong's end-use energy demand[9] would further decrease by 6.6% compared to Low Carbon Scenario, and the carbon emissions per unit of energy supply would decrease by 32%. In addition, Hong Kong would commence projects on carbon capture and storage, and by 2030, it is projected that 1.3 million tonnes of carbon would be captured, leading to further decrease in Hong Kong's carbon emissions.

Low Carbon Leadership Scenario: Under this scenario, Hong Kong would strive to remain as one of the most competitive cities in the world, and ride on the opportunity of low carbon development to boost its productivity and advance its research and development industries.

With both the primary energy demand[10] and end-use

energy demand remain the same as in Enhanced Low Carbon Scenario, under this scenario, Hong Kong would further boost the share of imported energy from clean sources such as nuclear energy and renewables, thus leading to a further decrease in the carbon content of its energy and consequently a decrease in carbon emissions.

10. Primary energy demand refers to the overall energy consumption within a geographic territory. It represents the total supply of energy available to the territory, which supports all the requirements for energy transformation and final consumption in that territory.
11. Please refer to Appendix III for detailed modelling results.
12. Please refer to Tables 10 to 11 for detailed modelling results on energy demand.

MODELLING RESULTS[11]

Energy Demand in Hong Kong[12]

Figures 3 and 4 show the primary and end-use energy demand modelled under the BAU, Low Carbon and Enhanced Low Carbon Scenario.

Under the BAU Scenario, it is projected that Hong Kong's energy demand will continue to increase in the next 20 years, due to social and economic development as well as population growth. However, considering Hong Kong's economic standard and the public's concern on the environment, under the Low Carbon Scenario and Enhanced Low Carbon Scenario, Hong Kong's primary and end-use energy demand can peak by 2020, through introducing a number of energy and low carbon policies as outlined above.

A summary of the projected change in energy demand in Hong Kong is provided in Table 2.

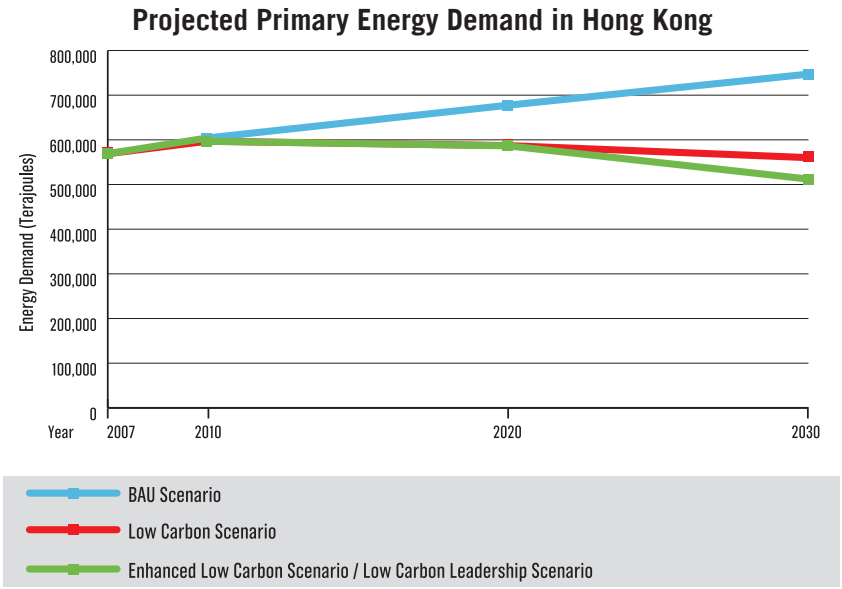


Figure 3. Hong Kong's Projected Primary Energy Demand under Different Scenarios

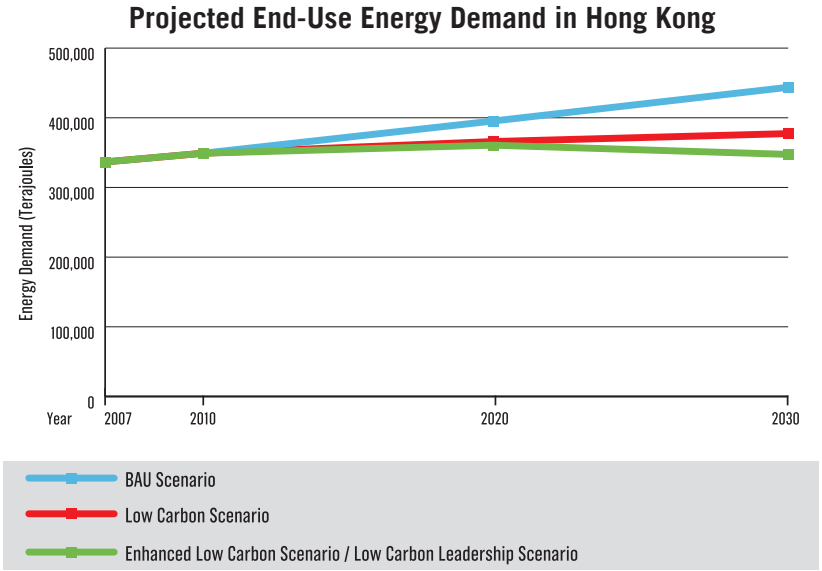


Figure 4. Hong Kong's Projected End-Use Energy Demand under Different Scenarios

	Primary Energy Demand (change from 2007)		End-use Energy Demand (change from 2007)	
	2020	2030	2020	2030
BAU Scenario	+20%	+36%	+17%	+32%
Low Carbon Scenario	+7%	+6%	+9%	+12%
Enhanced Low Carbon Scenario	+4%	-1%	+7%	+3%
Low Carbon Leadership Scenario	+4%	-1%	+7%	+3%

Table 2. Projected Change in Energy Demand in Hong Kong

Source of Energy[13]

The carbon emissions arising from energy use are directly affected by the sources of energy used to meet the energy demand.

Currently, Hong Kong's primary energy demand is met primarily by imported fossil fuels, including coal and peat (56%), oil (24%), and natural gas (16%). Hong Kong also imports electricity from mainland China (4%), which comes from nuclear and pumped storage power plants[14].

Under the Low Carbon Scenario and Enhanced Low Carbon Scenario, clean energy (i.e. low GHG-emitting energy forms) will play an increasingly important role in meeting Hong Kong's energy demand. Policies will be in place after 2010 to facilitate the use of cleaner energy such as wind power (within Hong Kong's territory), biomass electricity, ethanol and biodiesel. At the same time, energy sources with higher carbon content, such as coal and oil products, will play a decreasing role in meeting the primary energy demand in Hong Kong.

The majority of imported fossil fuels are transformed into electricity or towngas for domestic use and consumption by industry and service sectors. As for end-use energy demand, currently Hong Kong's major form of energy comes from electricity (44%), followed by oil (36%), coal (13%) and gas (7%).

Similar to the case in primary energy demand, under the Low Carbon Scenario and Enhanced Low Carbon Scenario, oil would play a smaller role in meeting the end-use energy demand in Hong Kong. Electricity will remain as the main form of end-use energy in Hong Kong under all the three modelling scenarios. This offers an opportunity for Hong Kong to reduce its carbon emissions, as the emissions per unit of electricity generated can be controlled by a change in fuel mix in power generation.

Currently, over 60% of Hong Kong's GHG emissions come from the power sector. Hence, the fuel mix used to generate electricity has a significant implication on Hong Kong's overall carbon emissions.

Under the BAU Scenario, by 2030, coal will still play a major role in local power generation, taking up 73% of the fuel mix. However, through introducing a change of fuel mix, it is projected that the percentage of coal in the energy mix can decrease to 39% under the Low Carbon Scenario and to 36% under the Enhanced Low Carbon Scenario, and the percentage of wind power can increase to 7% under the Low Carbon Scenario and to 10% under the Enhanced Low Carbon Scenario by 2030. Natural gas, as a relatively cleaner source of energy with a lower carbon content, will also play a more important role in the fuel mix under the Low Carbon Scenario and the Enhanced Low Carbon Scenario (52%), compared to the BAU Scenario (27%)[15].

13. Please refer to Figures 8 to 16 for the modelling results on sources of energy.
14. Figures from 2007 Energy Balance for Hong Kong by International Energy Agency (IEA).
15. Under the Low Carbon Scenario and Enhanced Low Carbon Scenario, 2% of energy source for power generation comes from biomass and oil.

Carbon Emissions from Energy Use in Hong Kong

Based on the projection on energy demand and sources of energy supply in Hong Kong under the modelling scenarios, the energy-related carbon emissions arising under these scenarios were projected.

Figure 5 shows the carbon emissions from energy use modelled under the BAU, Low Carbon, Enhanced Low Carbon and Low Carbon Leadership scenarios.

It can be seen that through implementing a series of energy and low carbon policies, it is possible for Hong Kong to achieve significant reductions in carbon emissions arising from energy use.

From 1998 to 2007, the amount of carbon emissions (mainly in the form of methane) arising from waste management ranged from 4.9 to 5.3 million tonnes a year (with an average value of 5.0 million tonnes a year). Assuming the carbon emission remains as 5.0 million tonnes a year under the BAU Scenario, and reduces by 10% for each progressive low carbon scenario and in every 10 years, the total GHG emissions under each modelled scenario are presented in Table 3.

Referring to the total projected emissions, the reductions that can be achieved under different scenarios are provided in Table 4.

The emission reduction achieved under the Low Carbon Scenario is approximately equal to the reduction level required under the 'China Target' as

discussed in the previous section. Although none of the low carbon scenarios leads to an emission reduction equivalent to the 'EU Target' as discussed in the previous section, the Low Carbon Leadership Scenario presents a reduction level that is comparable to other developed economies' efforts, in the degree of about 20% reduction from the baseline level by 2020.

Cost to Achieve Energy-Related Emission Reductions[16]

The costs to achieve emission reductions arising from energy consumption under different scenarios were estimated through the analysis on the investment requirement and the energy expenditure associated.

Energy investment requirement refers to the monetary cost of fixed assets incurred to the society (such as the government, power sector, and the general public) associated with certain energy policies and energy provision/consumption. This may include the costs

16. Please refer to Figures 17 to 20 for the modelling results on cost.

Hong Kong's Carbon Emissions from Energy Use under Different Scenarios

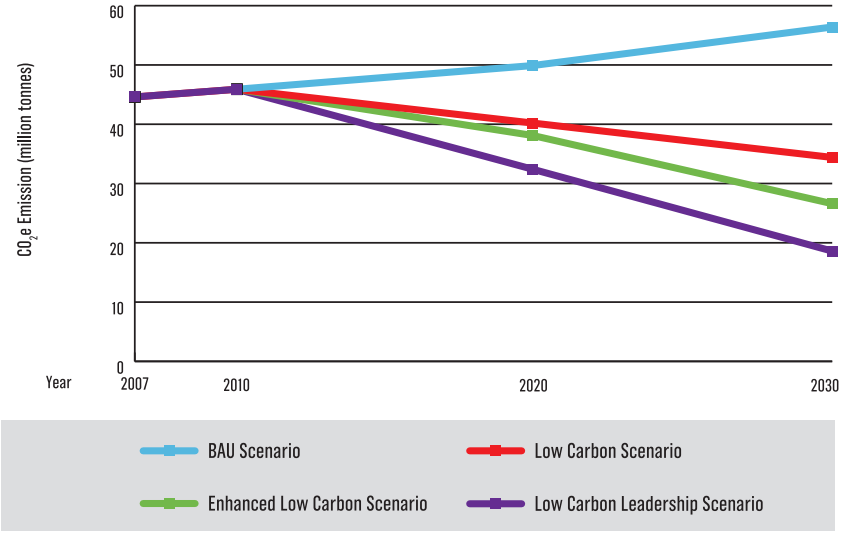


Figure 5. Hong Kong's Carbon Emissions from Energy Use under Different Scenarios

Projected Emissions (million tonnes)	BAU Scenario		Low Carbon Scenario		Enhanced Low Carbon Scenario		Low Carbon Leadership Scenario	
	2020	2030	2020	2030	2020	2030	2020	2030
From Energy Use	49.9	56.4	40.2	34.5	38.1	26.6	32.4	18.6
From Waste	5.0	5.0	4.5	4.1	4.0	3.2	3.5	2.5
Total	54.9	61.4	44.7	38.6	42.1	29.8	35.9	21.1

Table 3. Projected GHG Emissions under Different Scenarios

Baseline comparison	Low Carbon Scenario		Enhanced Low Carbon Scenario		Low Carbon Leadership Scenario	
	2020	2030	2020	2030	2020	2030
BAU	-19%	-37%	-23%	-51%	-35%	-66%
2005 level	0%	-13%	-5%	-33%	-19%	-53%
1990 level	+14%	-2%	+7%	-24%	-8%	-46%

Table 4. Projected Emission Reductions under Different Scenarios

arising from construction of supporting infrastructure, and the cost of energy efficient products to be paid by consumers or subsidised by the government.

The modelling results indicate the energy investment requirements for all the three low carbon scenarios are higher than that under the BAU Scenario, reflecting the higher investment costs for clean energy.

Although the initial investment on clean energy and energy efficient equipments is higher, the projected energy expenditure indicates that the there is potential saving for the society in the long run. Energy expenditure reflects not only the investment cost, but also accounts for the expenses occurred during the operation of the energy provision and consumption units, such as the cost for power generation, and the cost of energy consumption. The projected energy expenditure under each modelling scenario is shown in Figure 6.

The difference in investment cost and energy expenditure of the low carbon scenarios as compared to the BAU Scenario is summarised in Table 5.

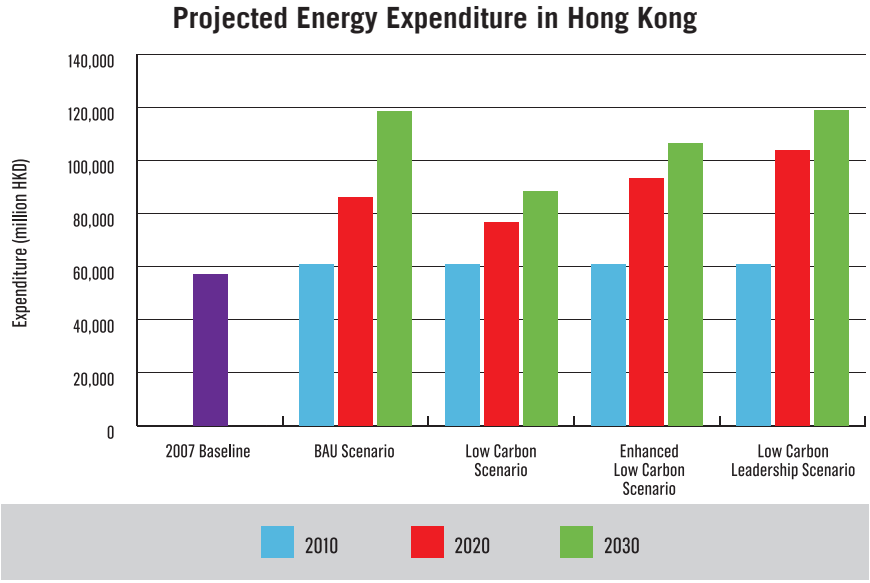


Figure 6. Projected Energy Expenditure in Hong Kong

Difference in cost (million HKD) [% difference]	Low Carbon Scenario	Enhanced Low Carbon Scenario	Low Carbon Leadership Scenario
Accumulated investment up to 2020 (excludes imported electricity & biofuel)	+7,087 [+29%]	+15,273 [+63%]	+19,497 [+80%]
Accumulated investment up to 2020 (includes imported electricity & biofuel)	+15,201 [+16%]	+30,608 [33%]	+39,462 [+42%]
Energy expenditure in 2020	-9,611 [-11%]	+6,945 [+8%]	+17,874 [+21%]
Accumulated investment up to 2030 (excludes imported electricity & biofuel)	+34,330 [+36%]	+68,412 [+72%]	+77,177 [+81%]
Accumulated investment up to 2030 (includes imported electricity & biofuel)	+64,810 [+34%]	+129,585 [+69%]	+160,700 [+85%]
Energy expenditure in 2030	-29,932 [-25%]	-11,856 [-10%]	+656 [+1%]

Table 5. Difference in Investment Cost and Energy Expenditure compared to BAU Scenario

The Low Carbon Scenario and Enhanced Low Carbon Scenario present an opportunity to reduce energy expenditure for the society in the long run compared to the BAU Scenario. Although the implementation of energy policies and development of clean energy would lead to an increased energy investment, the associated reduction in energy consumption would result in a significant decrease in energy expenditure. Currently, the cost for investing in energy efficiency is 30 to 50% lower than the development of new sources of energy. As the price for fossil fuels is anticipated to increase in the future due to diminishing supply, energy efficiency and renewable energy will become increasingly competitive in the future. By 2030, the energy expenditure for both the Low Carbon Scenario and the Enhanced Low Carbon Scenario will be lower than that under the BAU Scenario.

Referring to the modelling results, it makes economic sense for Hong Kong to pursue low carbon development as described under the Low Carbon Scenario (that is, approximately equal to meeting the target of 45% reduction in carbon intensity by 2020). Further implementation of low carbon policies, as described in the Enhanced Low Carbon Scenario, is also a viable option since the energy expenditure is projected to be lower in the long run.

Both the investment cost and energy expenditure under the Low Carbon Leadership Scenario are higher than the BAU Scenario. By 2030, the energy expenditure will be approximately equal to that under the BAU Scenario. This indicates that the extra investment under the Low Carbon Leadership Scenario either does not offer a financial return, or has a longer payback period beyond 2030.

The high investment cost is partly due to the higher costs of clean energy and low carbon technologies – which can come down significantly with an increased support in research and development. Whether or not to pursue extra efforts as outlined in the Low Carbon Leadership Scenario would depend on the cost that the society is willing to pay to mitigate climate change. Before there is a consensus in the society, perhaps one way the government can facilitate further low carbon development is to provide support in innovation of low carbon technologies.

Nonetheless, it is worthwhile to note since the use of clean energy sources would bring about other benefits such as reduced air pollution from both the power sector and roadside pollution, if the social benefits (e.g. reduced hospitalisation, loss of lives or reduced productivity arising from air pollution) are taken into account, the payback for investing in clean energy would be quicker and with a higher return rate.

EXPERIENCE FROM CHINA

A roundtable event based on the modelling study conducted by the ERI was hosted on 29 March 2010, to initiate discussion on what Hong Kong could achieve in terms of carbon reduction, and the role of Hong Kong in China's low carbon development. Representatives from government agencies, businesses and NGOs were invited to participate in the event.

The event featured a presentation by Dr Kejun Jiang, Director of Research Management and International Collaboration Division at the ERI, and principal investigator on the study. Dr Jiang shared with the participants the study results and his insights on how Hong Kong should take a lead and become a model for other Chinese cities in developing a low carbon economy.

Three other speakers from PRD were also invited to share experience and perspectives on how climate change is being addressed in the region. The speakers include:

- Dr Yaojun Lin, Director of Resource Conservation, Environment and Climate Change of the Guangdong Development and Reform Commission, who shared Guangdong's experience in implementing energy efficiency measures at a provincial level.

- Prof Wanda Guo, Vice President, China Development Institute, who shared Shenzhen's policies to encourage the city's low carbon development.

- Prof Daiqing Zhao, Director of Energy Strategy Research Centre, Guangzhou Institute of Energy Conversion, Chinese Academy of Science, who shared Guangzhou's strategy on developing new energy sources.

EXPERIENCE FROM PRD

Guangdong Province, Guangzhou city and Shenzhen city have all started looking at ways to achieve a low carbon development.

Guangdong: Dr Lin shared with the audience the efforts and progress of Guangdong Province in promoting energy efficiency during the period of the 11th Five-Year Plan (2006-2010).

According to the target set by the central government, Guangdong Province has to reduce its energy intensity by 16% between 2006 and 2010. Through implementing a series of policies, the energy intensity of Guangdong had decreased 13.7% from 2005 to 2009, reaching 84.9% of the designated target.

To encourage energy efficiency at a provincial level, Guangdong has set up an Energy Efficiency and Emission Reduction Task Force, which consists of

heads from provincial government agencies, and is led by the Governor of Guangdong Province.

In terms of legislation and monitoring, Guangdong had revised existing and proposed new regulations on energy efficiency. In addition, the progress on energy efficiency measures in each city is ranked and publicised, aiming to reinforce monitoring by the media and public. The government has also implemented various energy efficiency programmes within businesses, and specifically the building and transport sector.

In order to reduce its energy intensity, Guangdong has been undergoing vigorous restructuring of industry. The provincial government has been promoting the development of service industry, as well as advanced manufacturing and technology industry, which is characterised by low level of energy consumption and pollution. At the same time, low efficiency and energy-intensive projects are being eliminated, and new projects are required to attain high energy efficiency levels for approval.

Guangdong also provides financial incentives for energy efficiency projects and the provincial government has committed 450 million RMB per year for such projects. For example, the government is providing a subsidy of 200 RMB for each tonne of standard coal being saved for projects with an annual saving of 2,000 to 10,000 tonnes of standard coal[17].

17. One tonne of standard coal equals to 29,310 million joules.

Shenzhen: Prof Guo from Shenzhen shared that the concept of 'low carbon' is getting attention at the mayor's level. For instance, low carbon city development is the second most important research project in Shenzhen in 2010, and is being led by the Mayor of Shenzhen.

Shenzhen is working with the Ministry of Housing and Urban-Rural Development of the central government to become a pilot city in the demonstration of low carbon urban planning, at the two new districts that are being developed, namely Guangming District and Pingshan District. Regarding existing buildings, the local government is providing a subsidy for bank loan interest of up to 2 million RMB for those who wish to implement an energy management contract.

As for the development of low carbon economy, new energy industry is being designated as one of the three key focus industries in the next 5 years. The Shenzhen government has committed to provide 500 million RMB each year to support research and development of new energy projects at both businesses and universities (up to 8 million RMB for businesses and 150 million RMB for universities working on central government projects).

From Prof Guo's observation, since the introduction of the aforementioned policies, local government agencies and businesses are much more proactive in seeking opportunities to pursue energy saving initiatives or low carbon development projects. Shenzhen's experience in fact demonstrates the importance of policies in driving such development.

Regarding the national carbon reduction target of 40% to 45% by 2020 (compared to 2005), Prof Guo expressed that it would be a challenge for Shenzhen to achieve the target as the city is still undergoing a restructuring in the industry sector. A preliminary analysis shows that the carbon emissions from industry would increase by 6.4% under the BAU scenario, whereas to meet the national target, Shenzhen's industry would need to reduce emissions by 2.3%.

Guangzhou: Prof Zhao shared with the audience her team's research work on Guangzhou's strategy on developing new energy, which covers the period from 2009 to 2020. The strategy was co-launched by the Guangdong Development and Reform Commission and the Guangzhou Economic and Commerce Commission in 2009.

The Guangzhou municipal government believes that developing new energy is an important step in low carbon and sustainable development of the city. The energy strategy was formulated based on three aspects, including the utilisation, technology development, and manufacturing industry of new energy. As a city, although Guangzhou may not have a high usage of renewable energy in terms of actual consumption, the city has a potential to deliver a high impact on low carbon development, through its development on innovation and manufacturing industries related to new energy.

The new energy development strategy is focusing on 8 key areas, including solar power, heat pump, hydro-power, wind power, biofuel, alternative fuel for transportation, green building, and manufacturing of new energy equipment. The energy strategy has set Guangzhou a target to reach a 15% content in new energy sources by 2020. It is estimated that the asset value related to the development of new energy would reach 400 billion RMB by 2020.

At the implementation level, the energy strategy has identified 10 major projects, including the 'green Asian Games city' project, green building construction, new energy vehicle industry, the utilisation of new energy in agriculture (solar water heater and methane), waste-to-energy projects, renewable energy, new energy public transport systems, manufacturing industry of new energy equipment, technology innovation on new energy, as well as demonstration projects on circular economy.

When the research work was first commenced in 2007, the concept of 'low carbon' was not that popular to the

municipal government. However, Prof Zhao noticed there had been an increasing awareness on climate change issues, and the municipal government had specifically requested to reinforce the idea of 'low carbon' in the later stage of the development of the energy strategy.

The energy strategy specifically identified the government agencies responsible for each major project identified so the agencies are held responsible. Since the release of the strategy in 2009 the agencies involved have started working in their respective areas but Prof Zhao believes that the work needs to be done in a quicker pace and with greater efforts.

For the city target that Guangzhou is going to set in order to achieve the national target in carbon intensity reduction, Prof Zhao stated that it was hard to assess at the current stage, as the reduction target for particular cities would depend on each city's situation and capacity. Currently, the industry sector contributes to 60% of carbon emissions of Guangzhou but since a lot of work was already done in this sector during the 11th Five-Year Plan period, Prof Zhao foresees the building and transport sectors would be the next focus of the city.

WAYS FOR HONG KONG TO REDUCE EMISSIONS

It was generally agreed that since the sources of Hong Kong's carbon emissions are concentrated in the power sector and building sector, the greatest opportunity for Hong Kong to reduce its emissions lies in these two sectors.

Currently, the Hong Kong SAR Government deals with these two sectors through for example the promotion of a change in fuel mix in the power sector, and the proposed legislation on Building Energy Codes.

However, the achievement of carbon reduction relies not only on government policies, but also the participation by businesses and the public. Taking the emissions from power sector as an example, a proposed change in fuel mix would require the collaboration by the power companies, and since a change of fuel mix would lead to an increased fuel cost and thus a rise in tariff, ultimately actions cannot be taken without the acceptance by the public.

Dr Jiang shared with the audience that one of the ways that Hong Kong could achieve emission reductions within the building sector is through improving the energy efficiency of electrical consumer products. Consumer products such as air conditioners and refrigerators typically have a lifespan of 10 to 15 years. Hence, if Hong Kong starts setting more stringent energy efficiency standards for such products, the energy saving potential will be realised in the next 10 to 15 years. In fact, the manufacturing cost for high efficiency products does not differ significantly from inefficient models (ranges from 300 to 400 RMB for an air conditioner), thus raising the bar in energy efficiency does not necessarily impose a high financial burden on consumers. Since Hong Kong does not have a local manufacturing industry for these consumer products, Hong Kong could strive for the highest energy efficiency standard when importing consumer products. Whereas cities which have a local manufacturing industry of these consumer products, such as Shenzhen and Guangzhou, would encounter certain barriers as the interest of related industries must be considered. Hong Kong could enhance the value of the consumer products supply chain through the innovation of energy efficient products.

THE POTENTIAL OF HONG KONG

The role of Hong Kong on China's or even the world's low carbon development was discussed at the roundtable. It was widely agreed amongst the stakeholders and the speakers that the influence of Hong Kong is not limited to the mere reduction of carbon emissions within its territory.

Our speakers from Beijing, Guangdong, Guangzhou and Shenzhen acknowledged that Hong Kong has the potential in leading the development and deployment of low carbon technology, and become a role model for other Chinese cities.

Changhua Wu, Greater China Director of The °Climate Group, shared that Hong Kong can learn from Chinese cities in terms of restructuring its industry to develop a low carbon economy. At the same time, Hong Kong can become a model to other Chinese cities, even just by being very efficient itself. There

is an immense demand in China for a low carbon and efficient city operation. Hong Kong can grab the business opportunities presented and help accelerate the low carbon city development in China. More than that, Hong Kong can actually develop itself into the 'brain' of the region, providing solutions to low carbon development.

Government policies may be the primary driving force for the realisation of carbon emission reductions within the territory. However, when considering the overall influence of Hong Kong in low carbon development, the private sector plays a prominent, if not the most important role. Specifically, Hong Kong's strong financing, engineering, and technology development could be the leading sectors in contributing to Hong Kong's, as well as the region's or even the world's low carbon development.

It was also raised that the impact of Hong Kong does not fully reflect in Hong Kong's carbon emissions inventory. Hong Kong, as an investment city, has an invisible indirect carbon footprint through its commercial activities. Hong Kong's businesses, through investing heavily in PRD and other regions in the world, contribute to carbon emissions outside its physical boundary. Currently a lot of cities are reducing their carbon footprints through shifting the energy-intensive industries to other cities, which does not lead to an actual reduction in overall carbon emissions. If Hong Kong can encourage businesses to measure and reduce their carbon footprint along the whole value chain, Hong Kong can influence the carbon emissions not just at a local level, but also at a global level.

Dr Kejun Jiang specifically sees the potential of Hong Kong's university education system. With two of the universities having a higher international ranking than the most prominent universities in China, Dr Jiang raised the idea that Hong Kong could become the 'Boston of China', and exert its influence through nurturing innovation and supplying intelligence. He also challenged the idea of measuring a city's value with reference only to its GDP value. Taking Boston as an example, although it does not have a very high GDP, its Harvard University and Massachusetts Institute of Technology contribute to the development of the country through other means that cannot be measured by GDP growth. In this sense, low carbon development is not just an economic issue, but involves a deeper reflection of what a city Hong Kong would like to become, and what a lifestyle its citizens want to have.

PART IV:
A LOW CARBON VISION FOR HONG KONG AND THE WAY FORWARD

A LOW CARBON VISION FOR HONG KONG

Currently there is not a widespread discussion on climate change issues in Hong Kong, and there seems to be a lack of consensus on the appropriate target that Hong Kong should commit to in terms of climate change mitigation.

In view of this, The °Climate Group is proposing the following low carbon vision for Hong Kong, with the aim to provide a discussion platform on the role of Hong Kong, the target that can be adopted by Hong Kong, and the ways and means to realise the reduction.

ROLE OF HONG KONG

- Hong Kong's relatively low emission level is partly owing to the relocation of manufacturing industries to mainland China. If the embedded emissions of the consumables are taken into account, Hong Kong's carbon footprint will be significantly higher[18 iv]. Hence, Hong Kong's actual emission saving potential is in fact beyond the figures as reported or discussed in this paper.

- Hong Kong has a key role in the economy of PRD and can contribute to its low carbon development through its strength in financing and innovation. With well established infrastructure, strong presence of expertise, robust university education system and comprehensive protection on intellectual property, Hong Kong should aim to position itself as the 'brain' of the region by focusing on research and development, as well as deployment of new low carbon technologies.

- As a well-developed city with mature infrastructure, Hong Kong can add value to a low carbon development of other Chinese cities. Some areas Hong Kong may excel in are the applied R&D and deployment of technologies such as electric vehicles, building energy efficiency, as well as information and communications technologies.

VISION ON EMISSION REDUCTIONS

- The government should provide a long-term vision on Hong Kong's low carbon development, which would guide and facilitate formation of policies as well as actions by the private sector and the general public.

- The government should develop a comprehensive climate change policy framework, and integrate policies regarding air quality, energy efficiency, power generation, transportation, and urban planning. This would help identify and prioritise those measures or technologies that have multiple benefits in addition to climate change, which in turn could assist in maximising the effect of these related policies.

- As a step forward, Hong Kong can set a goal on its absolute emission that is more ambitious than the current trend. Our modelling work illustrates that Hong Kong has the potential to go back to the baseline level or even achieve a 5-19% reduction by 2020, and achieve a 13-53% reduction by 2030 (2005 baseline) through the implementation of various energy and low carbon policies, such as the promotion of energy efficiency and renewable energy.

ACHIEVING EMISSION REDUCTIONS

- In the short run, Hong Kong can reduce its emissions from power generation by changing its fuel mix and phasing out the use of coal by increasing the use of cleaner fuel, such as natural gas and nuclear.

- In the long run, Hong Kong should seek to increase the proportion of clean energy, by utilising renewable energy locally, or by enhancing the integration of its energy network with that of Guangdong, so as to allow for the transmission of more nuclear and/or renewable energy from Guangdong. Hong Kong could also consider establishing renewable energy power plants within the Guangdong Province. This is in line with the Outline of the Plan for the Reform and Development of the Pearl River Delta (2008-2020) published by the National Development and Reform Commission, which emphasises the development of clean energy and a comprehensive energy network within PRD. Hong Kong should strategically align its energy policy with that of PRD, with a mind to explore the potential of importing clean energy from the region.

- The building sector presents a major opportunity for Hong Kong to reduce its emissions. Hong Kong should set a more ambitious green building standard through the legislation of the Building Energy Codes. In addition, a platform should be provided to channel resources and information to encourage the uptake of energy efficiency measures.

- Air conditioning, lighting and household appliances have the greatest potential in energy efficiency in buildings. Hong Kong should introduce policies to encourage the application of advanced technologies and elimination of inefficient equipment, such as by setting market access mechanisms through raising the bar for energy efficiency standards. Hong Kong may take reference to the Top Runner[19] approach taken by Japan.

- The government and civil society should reinforce public education to raise the awareness about 'low carbon societies'.

18. A study by the Norwegian University of Science and Technology estimates that when consumption of goods and services are taken into account, Hong Kong's per capita footprint in 2001 was 29 tonnes CO_2e, the second highest in the world after Luxembourg (33.8 tonnes CO_2e).
19. Instead of setting a minimum efficiency today, Japan's Top Runner Programme searches for the most efficient model on the market for each product category, and uses it to set the standard to be attained within 4 to 8 years. By the target year, each manufacturer must ensure that the weighted average of the efficiency of all its products in that particular category is at least equal to that of the top runner model. This approach eliminates the need to ban specific inefficient models from the market. At the same time, manufacturers are made accountable and are stimulated to voluntarily develop products with an even higher efficiency than the top runner model.

THE WAY FORWARD

Despite a year of economic turmoil and the lack of a legally binding agreement in Copenhagen, the unanimous agreement on a fast-track fund of US$30 billion over the next three years and total support of US$100 billion a year for developing countries by 2020 was a remarkable achievement. That consensus was achieved on financing in Copenhagen is all the more surprising given the economic backdrop. Many of the countries that pledged new funding support are still recovering from one of the worst economic downturns in the last fifty years.

In December of 2008, a group of major international financial institutions (Crédit Agricole, HSBC, Munich Re, Standard Chartered and Swiss Re) joined with The °Climate Group to launch **The Climate Principles**, a new code to guide best practice across the sector to deal with the risks and opportunities of climate change. The adopting institutions (representing total assets of over US$5.5 trillion[20]) maintain that tackling climate change presents significant opportunities for their business and their clients, but if left unchecked, could reduce economic growth and significantly increase risks to the sector.

Dr Steve Howard, CEO of The °Climate Group and Chair of the World Economic Forum's Global Agenda Council on Climate Change, said: "The finance sector is alive to the risks and opportunities posed by climate change. This group of leading financial institutions is already charting a clear course for the low carbon economy. Policy uncertainty makes their passage more challenging, but the low carbon opportunity is so profound that banks are not waiting for government to fire a starting pistol. As the policy fog lifts over coming months, our Climate Principles will act as a crucial low carbon compass for the finance sector and allow other international institutions to follow swiftly the wake of these pioneers."

While international conglomerates are in general more aware of the risks and opportunities associated with climate change, the message is still to be distilled down to the local SMEs, which make up most of the economy of Hong Kong[21]. Few are aware of the role that Hong Kong could play in mitigating climate change and its potential contribution to China's clean development.

After three decades of unparalleled economic growth, the Greater Pearl River Delta Region, Hong Kong being part of it, is confronted by global financial recession and the challenge of dealing with climate change. The sheer scale of growth in the region will require energy resources that outstrip available conventional sources. Hong Kong, as a well developed economy, can take a more proactive role in addressing climate change issues, and become a model for other Chinese cities by developing and marketing green technology solutions.

Combating climate change would require concerted efforts from the government, the business sector and the general public. The transition to a low carbon society would require government policies that favour green investment and deployment of clean technologies, the integration of climate change into business decisions, and a change to a low carbon lifestyle.

This is the time to act. Hong Kong can reduce its emissions in 10 years' time, and grab the opportunities brought by low carbon development, if actions are taken promptly.

20. Asset value taken from 2009 2nd quarter interim results.
21. SMEs comprise over 98% of business establishments in Hong Kong and employ over 50% of the working population in the private sector.

APPENDICES

APPENDIX I: ABOUT THE IPAC-AIM/TECHNOLOGY MODEL

IPAC-AIM/Technology model – components of the Integrated Policy Assessment Model for China (IPAC) – was used to perform the quantitative scenario and policy option analysis. IPAC was developed by the Energy Research Institute (ERI) for projecting future energy use and pollutants emissions.

This model includes three modules, namely energy service demand projection, energy efficiency estimation and technology selection. The demand is divided among the industrial, agricultural, service, residential, and transportation sectors, and these sectors are further divided into sub-sectors. For both demand and supply sides, more than 500 technologies are considered, including existing as well as advanced technologies that may be used in the future. The model searches for the least-cost technology mix to meet the given energy service demand. The most up-to-date information on these technologies was collected from a large number of printed sources, as well as through direct consultation with experts[v].

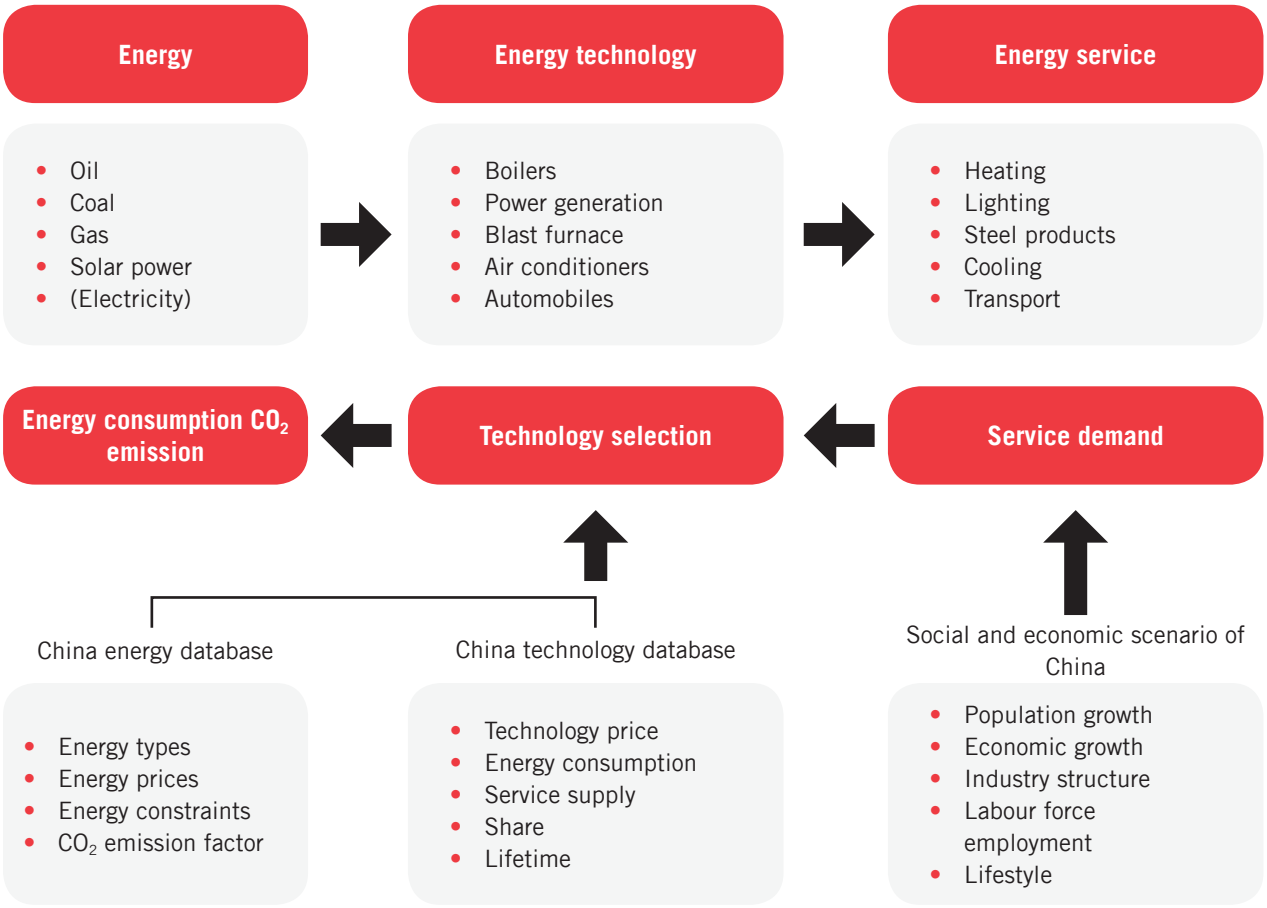


Figure 7. Structure of IPAC-AIM/Technology Model

APPENDIX II: ASSUMPTIONS IN MODELLING SCENARIOS

	2005	2010	2020	2030
Population (million)	6.6	7.09	7.7	8.3
Household (million)	2.171	2.505	2.852	3.196
Member per household	3.0	2.8	2.7	2.6

Table 6. Assumption of Population and Households Growth in Hong Kong[vi]

	2005	2010	2020	2030
Floor area per household (m^2)	37	41	43	44
Built area for service industry (1,000m^2)	37,100	41,300	42,000	45,000
Vehicles (1,000)	560	590	660	730

Table 7. Assumption of Energy Demand Growth in Hong Kong

	Baseline	Business-As-Usual		Low Carbon Scenario	
	2005	2020	2030	2020	2030
Building	6%	30%	40%	50%	70%
Refrigerator	15%	70%	85%	100%	100%
Air conditioning	15%	50%	75%	95%	100%
Washing machine	25%	-	100%	-	100%
Electrical appliances	10%	45%	65%	85%	95%
Solar water heater	5,000m^2	10,000m^2	20,000m^2	100,000m^2	300,000m^2
Vehicles	16%	55%	60%	85%	92%
Decrease in transport need	-	-	-	9%	3%

Table 8. Market Share of Energy Efficient Products within Building and Transport Sectors

Technology	Efficiency	Percentage in 2030	
		BAU	Low Carbon Scenario
Building	50% energy saving	20%	30%
Building	65% energy saving	16%	25%
Building	75% energy saving	4%	15%
Refrigerator	65% energy saving	85%	100%
A/c variable frequency air-conditioner	30% energy saving	65%	20%
D/c variable frequency air-conditioner	50% energy saving	15%	60%
High efficiency air-conditioner	68% energy saving	0%	20%
Compact fluorescent lamp	80% energy saving	100%	100%
Washing machine	30% energy saving	80%	100%
Electrical appliance	40% energy saving	65%	95%
Solar water heater		9%	15%
Decrease in Energy Use per household		3.5MJ	6.2MJ
LPG/gas stove	58% efficiency	0%	50%
Fuel-efficient vehicles	5.4 L/100 km	40%	40%
Hybrid vehicles	4.3 L/100 km	5%	30%
Electric vehicles	12 kWh/100 km	10%	30%
Public transport	Energy use = 1/7 of private car	30%	35%
Railway transport	Energy use = 1/22 of private car	35%	45%
Electric bikes	1.2 kWh/100 km	5%	18%
Ultra-super critical technology (% in coal-fired power generation)	42% efficiency	50%	0%
Integrated gasification combined cycle (IGCC) technology (% in coal-fired power generation)	45% efficiency; 54% efficiency in 2030	0%	80%
Advanced natural gas power generation	53% efficiency; 62% efficiency in 2030	0%	50%

Table 9. Technical Parameters of Energy Efficient Products within Building and Transport Sectors

APPENDIX III: MODELLING RESULTS

Energy Demand in Hong Kong

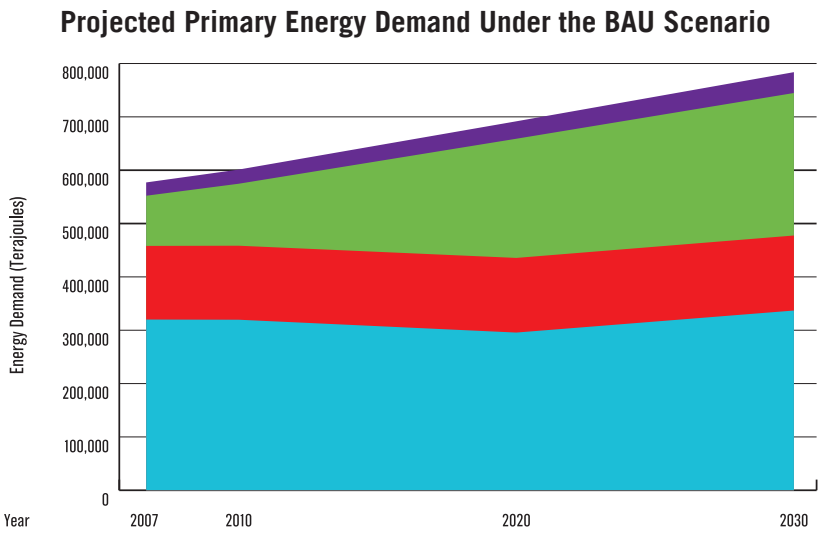
	BAU Scenario (terajoules)	Low Carbon Scenario (terajoules)	Enhanced Low Carbon Scenario (terajoules)
2007	552,720	552,720	552,720
2010	575,280	584,080	584,080
2020	661,610	586,610	569,090
2030	748,920	576,330	539,110

Table 10. Projected Primary Energy Demand in Hong Kong

	BAU Scenario (terajoules)	Low Carbon Scenario (terajoules)	Enhanced Low Carbon Scenario (terajoules)
2007	336,630	336,630	336,630
2010	349,140	349,140	349,140
2020	395,350	365,900	360,640
2030	443,740	377,300	347,420

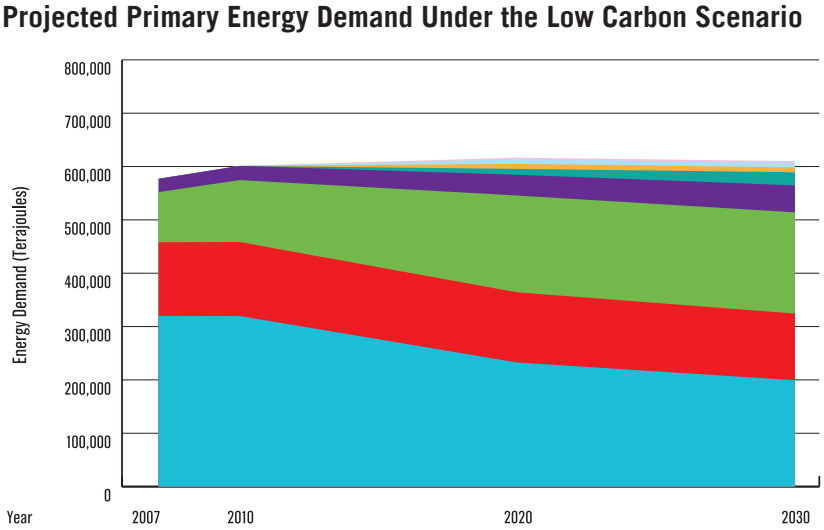
Table 11. Projected End-Use Energy Demand in Hong Kong

Source of Energy



	2007	2010	2020	2030
Imported Electricity	24,930	26,550	32,680	39,070
Natural Gas	94,060	116,210	223,440	267,150
Oil	138,020	138,710	139,900	140,620
Coal	320,040	319,710	295,630	336,950

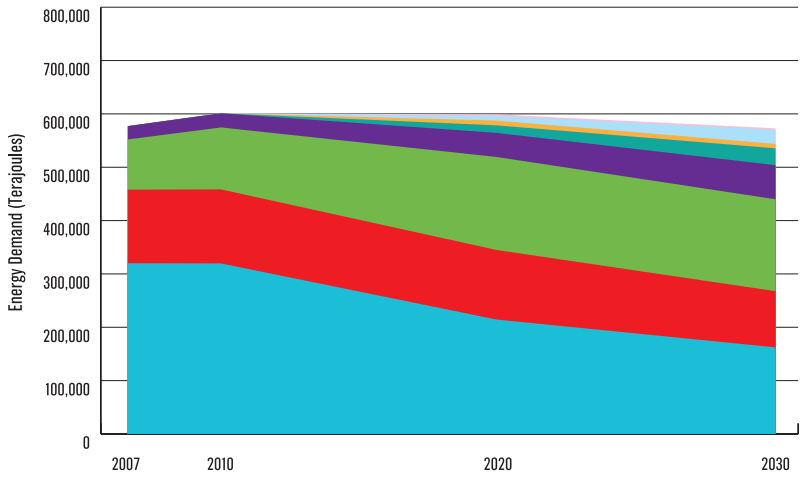
Figure 8. Hong Kong's Projected Primary Energy Demand under the BAU Scenario



	2007	2010	2020	2030
Biodiesel	-	-	2,930	2,930
Ethanol	-	-	2,930	2,930
Biomass electricity	-	-	9,290	9,180
Wind power	-	-	11,060	24,630
Imported Electricity	24,930	26,550	38,830	50,500
Natural Gas	94,060	116,210	181,420	189,800
Oil	138,020	138,710	131,550	124,940
Coal	320,040	319,710	232,780	199,410

Figure 9. Hong Kong's Projected Primary Energy Demand under the Low Carbon Scenario

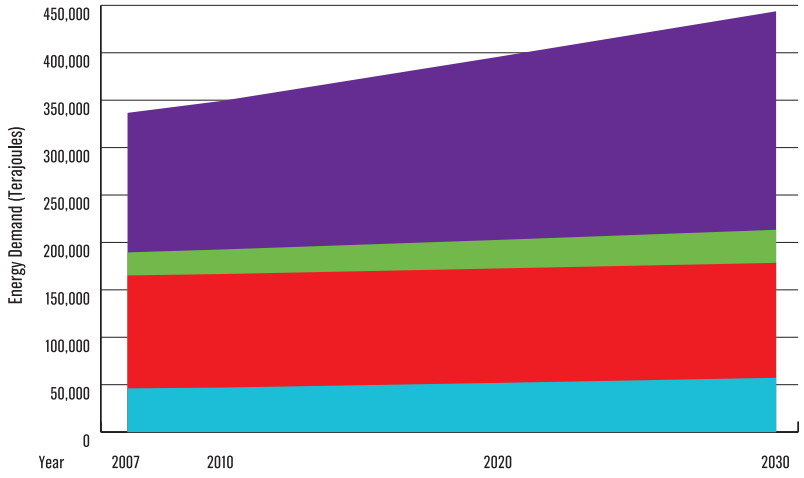
Projected Primary Energy Demand Under the Enhanced Low Carbon Scenario



	2007	2010	2020	2030
Biodiesel	-	-	2,930	2,930
Ethanol	-	-	8,790	26,380
Biomass electricity	-	-	8,900	8,240
Wind power	-	-	14,110	31,560
Imported Electricity	24,930	26,550	45,170	63,890
Natural Gas	94,060	116,210	174,370	172,300
Oil	138,020	138,710	130,380	105,350
Coal	320,040	319,710	214,480	162,320

Figure 10. Hong Kong's Projected Primary Energy Demand under the Enhanced Low Carbon Scenario

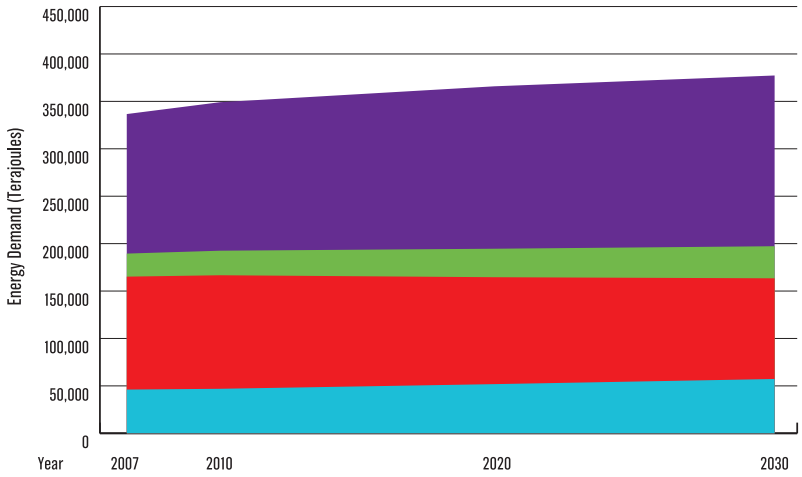
Projected End-Use Energy Demand Under the BAU Scenario



	2007	2010	2020	2030
Electricity	147,131	156,596	192,770	230,418
Gas	24,326	25,891	30,048	34,872
Oil	119,078	119,722	120,684	121,179
Coal	46,099	46,934	51,844	57,268

Figure 11. Hong Kong's Projected End-Use Energy Demand under the BAU Scenario

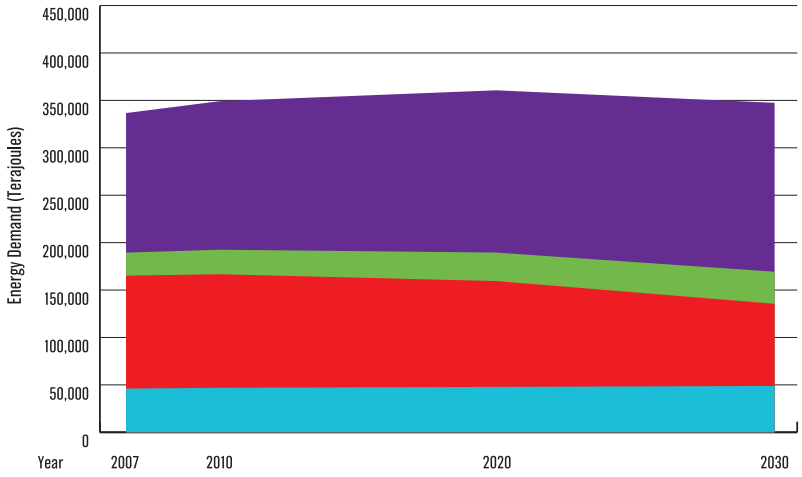
Projected End-Use Energy Demand Under the Low Carbon Scenario



	2007	2010	2020	2030
Electricity	147,131	156,596	171,275	180,034
Gas	24,326	25,891	30,048	33,855
Oil	119,078	119,722	112,730	106,146
Coal	46,099	46,934	51,844	57,268

Figure 12. Hong Kong's Projected End-Use Energy Demand under the Low Carbon Scenario

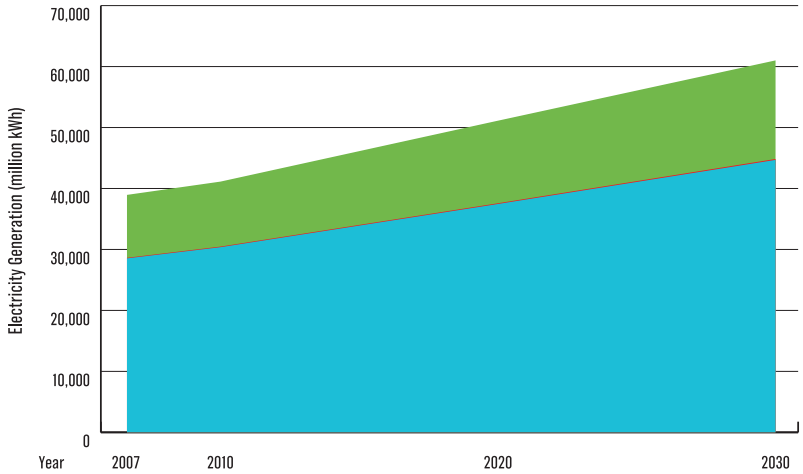
Projected End-Use Energy Demand Under the Enhanced Low Carbon Scenario



	2007	2010	2020	2030
Electricity	147,131	156,596	171,110	178,070
Gas	24,326	25,891	30,048	33,855
Oil	119,078	119,722	111,601	86,639
Coal	46,099	46,934	47,881	48,847

Figure 13. Hong Kong's Projected End-Use Energy Demand under the Enhanced Low Carbon Scenario

Projected Electricity Generation in Hong Kong Under the BAU Scenario

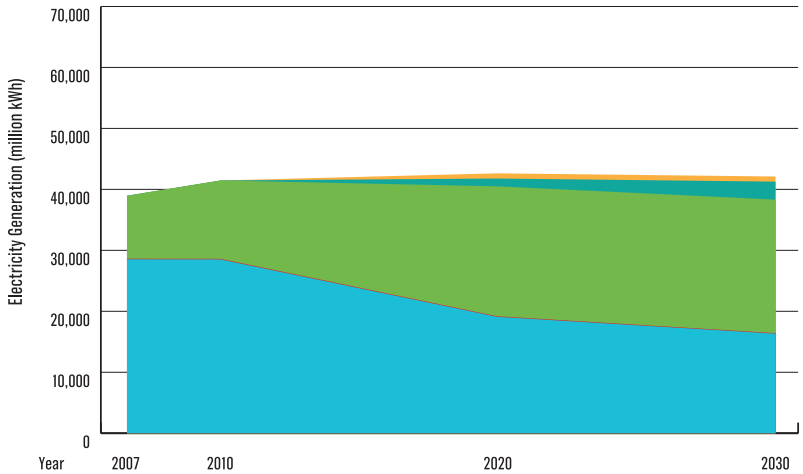


	2007	2010	2020	2030
Natural Gas	10,320	10,990	13,520	16,170
Oil	90	100	120	150
Coal	28,540	30,370	37,390	44,690

Figure 14. Projected Electricity Generation in Hong Kong Under the BAU Scenario

*Note: Imported electricity is not included in the figures.

Projected Electricity Generation in Hong Kong Under the Low Carbon Scenario

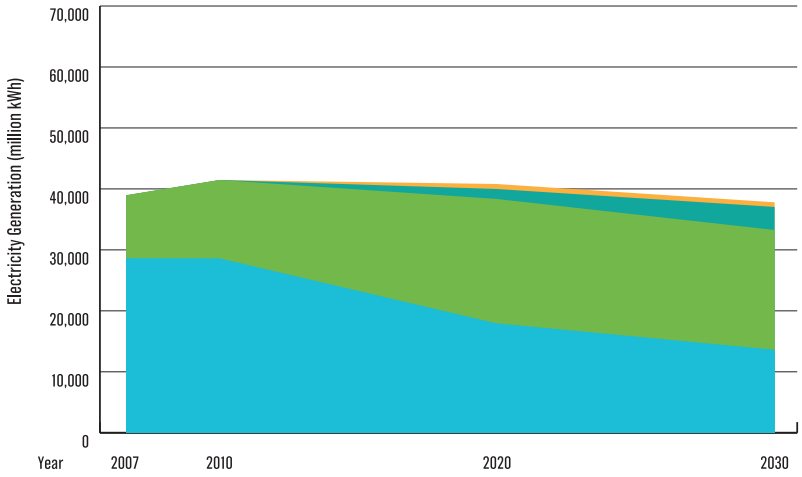


	2007	2010	2020	2030
Biomass	-	-	850	840
Wind	-	-	1,280	2,950
Natural Gas	10,320	12,850	21,310	21,900
Oil	90	100	90	80
Coal	28,540	28,510	19,100	16,340

Figure 15. Hong Kong's Electricity Generation under the Low Carbon Scenario

*Note: Imported electricity is not included in the figures.

Projected Electricity Generation in Hong Kong Under the Enhanced Low Carbon Scenario



	2007	2010	2020	2030
Biomass	-	-	820	760
Wind	-	-	1,630	3,780
Natural Gas	10,320	12,850	20,400	19,650
Oil	90	100	80	80
Coal	28,540	28,510	17,870	13,530

Figure 16. Hong Kong's Electricity Generation under the Enhanced Low Carbon Scenario
*Note: Imported electricity is not included in the figures.

Costs to Achieve Emission Reductions

Projected Energy Investment in Hong Kong (excluding Imported Electricity and Biofuel)

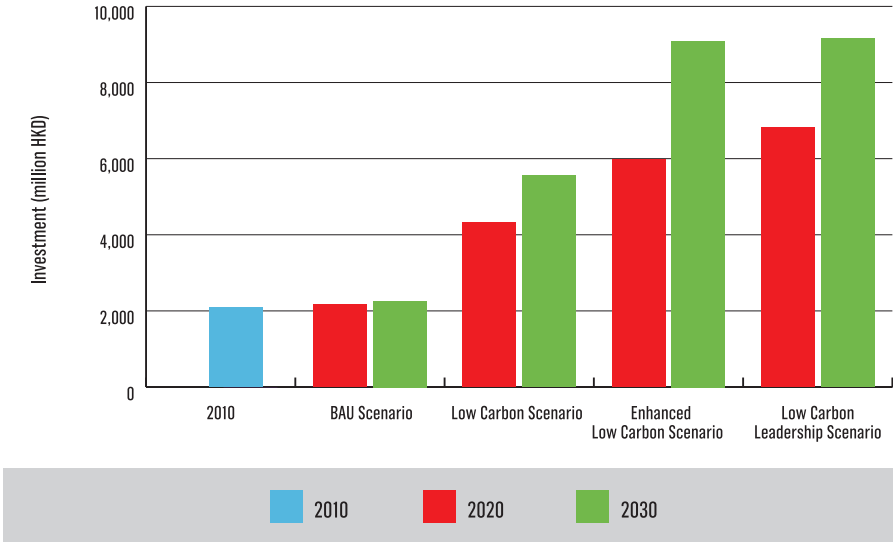


Figure 17. Projected Energy Investment in Hong Kong (excluding Imported Electricity and Biofuel)

Projected Energy Investment in Hong Kong (including Imported Electricity and Biofuel)

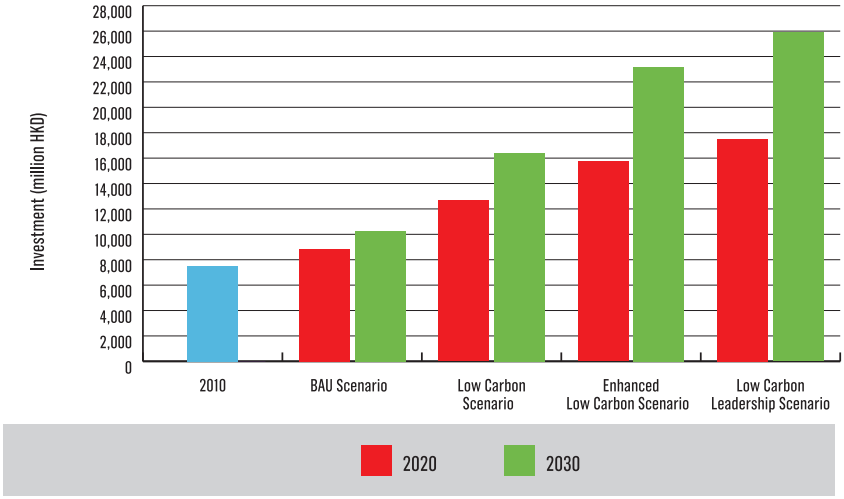


Figure 18. Projected Energy Investment in Hong Kong (including Imported Electricity and Biofuel)

Projected Accumulated Energy Investment in Hong Kong (excluding Imported Electricity and Biofuel)

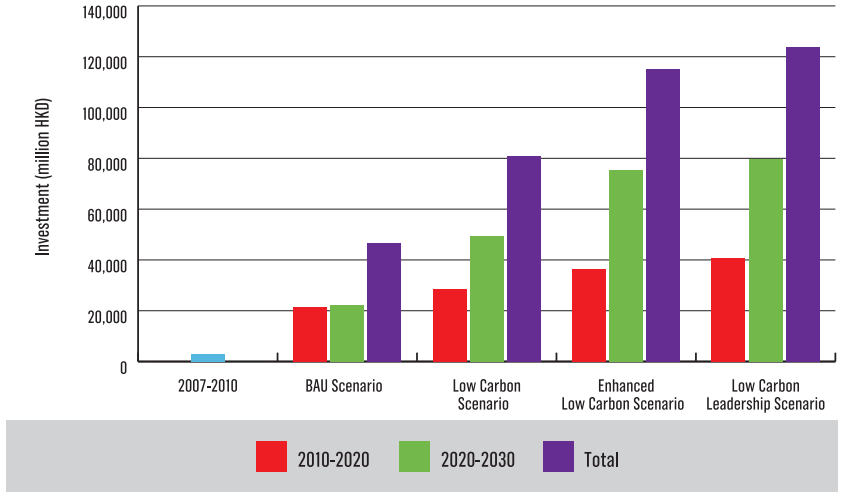


Figure 19. Projected Accumulated Energy Investment in HK (excluding Imported Electricity and Biofuel)

Projected Accumulated Energy Investment in Hong Kong (including Imported Electricity and Biofuel)

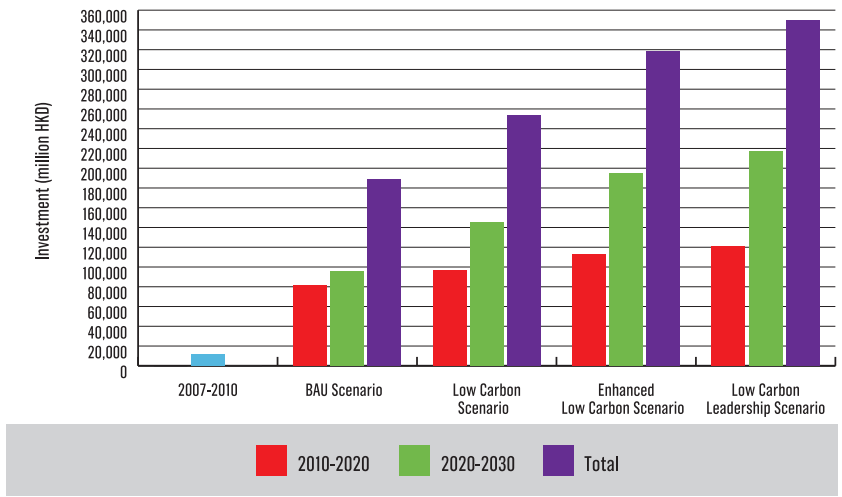


Figure 20. Projected Accumulated Energy Investment in HK (including Imported Electricity and Biofuel)

APPENDIX IV: LIST OF STAKEHOLDERS INTERVIEWED

Organisation	Name	Position	Form of Interview
John Swire & Sons (H.K.) Ltd	Robert Gibson	Director, Sustainable Development	Face-to-face interview
The Association for Sustainable & Responsible Investment in Asia	David St Maur Sheil	Executive Director and Co-Founder	Phone interview
CLP Holdings Ltd	Dr Jeanne Ng	Director, Group Environmental Affairs	Face-to-face interview
MTR Corporation Ltd	Dr Glenn Frommer	Head of Sustainability Development	Face-to-face interview
Civic Exchange	Andrew Lawson	Researcher	Face-to-face interview
RESET (HK) Ltd	Liam Salter	Managing Director	Phone interview
WWF Hong Kong	Dr William Yu	Head of Climate Programme	Face-to-face interview
Cross-Boundary & International Division, Environmental Protection Department, HKSAR Government	Mary Tsang Dr Shermann Fong Dr Vincent Cheung	Assistant Director Senior Environmental Protection Officer Environmental Protection Officer	Face-to-face interview
Hong Kong Observatory, HKSAR Government	Edwin Ginn	Senior Scientific Officer	Face-to-face interview
HSBC	Barry Kwong	Senior Vice President Corporate Sustainability, Asia Pacific Region	Face-to-face interview
Environment Bureau, HKSAR Government	Linda Choy	Political Assistant to Secretary for the Environment	Face-to-face interview

Table 12. List of Stakeholders Interviewed (Summer of 2009)

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CONTRIBUTING PARTIES

This document is the product of the valuable contributions and insights of a large number of people who participated in its development, writing and review.

ABOUT THE °CLIMATE GROUP

The °Climate Group (www.theclimategroup.org) is an independent, not-for-profit organisation working internationally with government and business leaders to advance smart policies and technologies to cut global emission and accelerate a low carbon economy. Its global coalition of companies, states, regions and cities around the world recognise the economic and environmental imperatives of taking decisive action now.

The °Climate Group was founded in 2004 and has operations in Australia, China (Beijing and Hong Kong), Europe, India and North America. The °Climate Group is registered in Hong Kong as The Climate Group (Hong Kong) Limited, Charity Registration Number: 91/9162.

ABOUT THE ENERGY RESEARCH INSTITUTE

The Energy Research Institute (ERI) (www.eri.org.cn) of the National Development and Reform Commission (NDRC) was established in 1980, and is a national research organisation conducting comprehensive studies on China's energy issues. The main focus of its research include energy economics, energy industry development, energy policies, energy demand and supply, energy security, energy and the environment, energy efficiency, as well as renewable and alternative energy. The ERI is also one of 7 research institutes administrated by the Academy of Macro-economic Research (AMR) of the NDRC.

The °Climate Group thanks Dr Kejun Jiang and his team for the contribution to this discussion paper.

ABOUT THE ROCKEFELLER BROTHERS FUND

The Rockefeller Brothers Fund promotes social change that contributes to a more just, sustainable, and peaceful world.

The Rockefeller Brothers Fund was founded in 1940 as a vehicle through which the five sons and daughter of John D. Rockefeller Jr., could share a source of advice and research on charitable activities and coordinate their philanthropic efforts to better effect. John D. Rockefeller Jr., made a substantial gift to the fund in 1951, and in 1960 the fund received a major bequest from his estate. Together, these constitute the original endowment of the fund.

The °Climate Group acknowledges the Rockefeller Brothers Fund for sponsoring the research project.

ABOUT THE HSBC CLIMATE PARTNERSHIP

Formed in 2007, the partnership brings together HSBC, The °Climate Group, Earthwatch Institute, Smithsonian Tropical Research Institute and WWF to tackle the urgent threat of climate change on people, water, forests and cities. For more information visit: www.hsbc.com.hk/sustainability.

The °Climate Group acknowledges the support of the HSBC Climate Partnership.

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