HONG KONG, CHINA

- *Hong Kong, China's primary energy supply is projected to grow at an average annual rate of 1.3% over the outlook period. Most of the increase is due to the demand for gas for power generation; however, coal will still be the major primary energy supply fuel in 2035 with almost 40% share of the total primary energy supply, followed by gas with a 35% share.*
- *Hong Kong, China is expected to be increasingly dependent on imported energy from mainland China, with import levels almost doubling between 2010 and 2035.*
- *CO_2 emissions are projected to increase mainly due to oil consumption which accounts for 65% of total emissions. International transport will account for over half of total emissions by 2035.*

ECONOMY

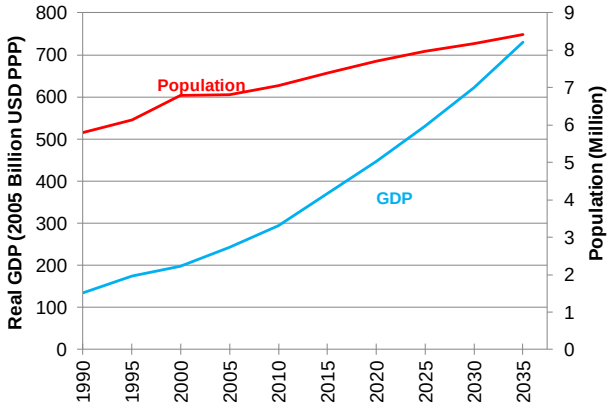
Hong Kong, China is one of the special administrative regions of the People's Republic of China. It borders Guangdong to the north and is surrounded by the South China Sea to the east, west and south. Hong Kong, China is an international financial centre, and has a highly developed free market economy.

Hong Kong, China has been transforming itself into an almost entirely services-based economy. Its GDP is expected to grow at an average annual rate of 3.7% over the outlook period (2010–2035); this is similar to the average annual growth of 3.8% between 1990 and 2009. Besides the economy's traditional strengths in the financial, logistics, property, tourism and services industries, Hong Kong, China's projected growth is based on an increase in knowledge-based and services industries (CSD, 2012).

Hong Kong, China has identified four key industries within the service sector; they are financial services, trading and logistics, tourism, and producer and professional services. These four industries contributed 58% of GDP (average annual growth rate was 5.5% from 2005–2010) and employed 48.2% of the total persons employed in 2010. Another six industries in the service sector are also identified as high potential development industries by the Hong Kong, China Government. These are cultural and creative industries, medical services, education services, innovation and technology, testing and certification services, and environmental industries. These six industries contributed 8.4% of GDP (average annual growth rate was 3.4% from 2008–2010) and employed 11.6% of the total persons employed in 2010. By 2035, it is expected that the services sector will contribute more than 95% of GDP, compared with 92.9% in 2010.

Hong Kong, China's population is expected to grow slowly at an average annual rate of 0.7% over the outlook period, reaching 8.4 million people in 2035. Among the APEC economies, Hong Kong, China ranks highly for GDP per capita and has a higher standard of living than many of the other economies. The economy has a high population density. Its high urban intensity and high-rise buildings have made it is appropriate to use advanced energy efficiency technology to reduce energy consumption in the commercial and residential sectors. However, it has also had a negative impact on the quality of the living environment, creating too much congestion and too little green space in the built up areas. A key issue for the Hong Kong, China Government will be to maintain a balanced '3-E' (economy, energy, and environment) development policy in the future.

Figure HKC1: GDP and Population



Sources: Global Insight (2012) and APERC Analysis (2012)

Hong Kong, China's economy has a firm foundation in its strong financial services sector. It is expected to continue to shift towards higher-value-added services and a knowledge-based economy. To stay competitive and to attain sustainable growth, Hong Kong, China is attempting to restructure and reposition itself to face the challenges posed by globalization and closer integration with mainland China. The Mainland and Hong Kong Closer Economic Partnership Arrangement (CEPA) is an example of the opportunities the economy has under the 'One Country, Two Systems' relationship with

mainland China. The liberalization of trade in goods under CEPA means all products of Hong Kong, China origin enjoy tariff-free access to mainland China—on application by local manufacturers, and if the CEPA rules of origin are satisfied.

The government's strategy is to move economic activity up the value chain by: speeding up structural transformation to a high-value, knowledge-based, and skill-intensive economy; pursuing reforms in education and population policy to achieve the talent pool required; and leveraging on the immense business opportunities available in mainland China. There are four economic sectors where Hong Kong, China has a competitive advantage over mainland China: trade and logistics, tourism, financial services, and professional services and other producer services.

In Hong Kong, China, the public transport systems (including rail, bus and ferry) are estimated to carry more than 90% of all person trips in 2008 (Transport Department, 2012b). The number of observed public transport boardings is about 11.65 million a day (Transport Department, 2012a). While road transport is highly visible in the city, the rail system plays a significant role in the transport sector, with more than 246 kilometres of routes and a carrying average of about 4.5 million passengers every day in 2010. Its ridership has increased at about 3% annually from 2001 to 2010, higher than the average annual growth rate of private vehicles at 2.2% (Transport Department, 2012a). The total franchised bus system has more than 578 lines with a daily ridership of about 2.3 million (Transport Department, 2012a). There are also about 7000 non-franchised buses providing transport services. This shows mass transportation is increasing in importance in Hong Kong, China.

As a regional aviation hub, as well as being the gateway to the Pearl River Delta (PRD) area of mainland China, Hong Kong, China's international airport has a significant throughput, serving more than 100 airlines and 53.9 million passengers in 2011 (Hong Kong International Airport, 2012). Hong Kong, China's energy use for international aviation is significant—petroleum products for international aviation accounted for about 89% of energy use in the whole transport sector in 2009. In the future, mainland China's increasing participation in global economic activities is expected to speed up the growth of passenger air travel between Hong Kong, China and mainland China.

The globalization of economic activities has also increased the freight volume of air and shipping transport. Hong Kong, China can handle more than 400 cargo ships a week from more than 80 international companies. The maximum handling capacity for containers is more than 2.3 million sets a year, being mainly import/export cargos for southern China. It is expected that international transport will account for the about 94.3% of the energy used in the transport sector in 2035.

Concerning final energy consumption (excluding international transport) in Hong Kong, China in 2009, the commercial sector used the most energy at 58%, followed by the residential sector at 25%. Due to its tropical climate, air conditioning is a significant part of residential energy use, accounting for about 20% of residential demand in 2009. The relatively slow growth of energy consumption by air conditioning in residential energy use (the overall growth from 1999–2009 was only 16.5%) appears to reflect market saturation for air conditioning units/systems. Similarly, there was almost no growth in air conditioning use in the commercial sector over the period 1999–2009 (EMSD, 2012).

ENERGY RESOURCES AND INFRASTRUCTURE

The absence of a domestic energy source has made Hong Kong, China a net importer of oil products (mostly from Singapore, which supplies about 80% of its motor gasoline requirements). The economy also imports natural gas—100% of this came from mainland China in 2010. Privately-owned electric and gas utilities service the economy's daily requirements.

Towngas and liquefied petroleum gas (LPG) are the two main types of fuel gas used throughout Hong Kong, China. Towngas is distributed by the Hong Kong and China Gas Company Limited. It is manufactured at plants in Tai Po and Ma Tau Kok, using both naphtha and natural gas (from October 2006) as the feedstock. LPG is supplied by oil companies and imported into Hong Kong, China through the five terminals on Tsing Yi Island.

In 2010, the total installed electricity generating capacity serving Hong Kong, China was 12 644 MW, including capacity in Guangdong, mainland China contracted to utilities in Hong Kong, China. All locally generated power is thermal fired. Electricity is supplied by CLP Holdings Limited (CLP) and Power Assets Holdings Limited (PAH). CLP supplies electricity from its Black Point (2500 MW), Castle Peak (4108 MW) and Penny's Bay (300 MW) power stations (CLP, 2012). Natural gas is the main fuel at Black Point, and coal the main fuel at Castle Peak. The natural gas is imported from the Yacheng 13-1 gas field off Hainan Island in southern China, via a

780 kilometre high-pressure submarine pipeline. CLP is contracted to purchase about 70% of the power generated at the two 984 MW pressurized-water reactors at the Guangdong Daya Bay Nuclear Power Station, to help meet the long-term demand for electricity in its supply area. It also has the right to use 50% of the 1200 MW capacity of Phase 1 of the Guangzhou pumped storage power station at Conghua, in mainland China.

Electricity for PAH is supplied from the coal and gas fired Lamma Power Station, which has a total installed capacity of 3736 MW (PAH, 2012). Natural gas used at this station is mainly imported through a submarine pipeline from the Dapeng LNG terminal in Guangdong.

ENERGY POLICIES

In its latest 2011–2012 policy address, the government of the Hong Kong Special Administrative Region (SAR) announced it will pursue two key energy policy objectives (Office of the Chief Executive, 2012). The first is to ensure the energy needs of the community are met safely, efficiently, and at reasonable prices. The second is to minimize the environmental impact of energy production and consumption, and to promote the efficient use and conservation of energy.

In keeping with the free market economic policy of Hong Kong, China, the government intervenes only when necessary to safeguard the interests of consumers, to ensure public safety, and to protect the environment. The government works with the power, oil and gas companies to maintain strategic reserves of coal, diesel, gas and naphtha. It monitors the performance of the power companies and other energy providers through the Scheme of Control Agreements, most recently revised in 2008, to encourage energy efficiency, quality services, and the use of renewable energy (Environment Bureau, 2012).

Hong Kong, China proposes to optimize its fuel mix to promote power generation with low carbon emissions. This will mean significantly reducing its reliance on fossil fuels, phasing out existing coal-fired generation units, and increasing the use of non-fossil, cleaner and low-carbon fuels, including renewable energy and imported nuclear energy. Its plan is that, by 2020, natural gas will account for about 40% of its fuel mix for power generation, coal no more than 10%, renewable energy about 3%–4%, and imported nuclear generated energy the remaining 50% (EPD, 2012). However, it faces a challenge from environmental groups, especially after the Fukushima nuclear disaster in Japan in March 2011. The role of clean energy in the future generation mix will be carefully re-evaluated to address their concerns.

Hong Kong, China will also endeavour to enhance energy efficiency, promote green buildings, encourage electricity savings, facilitate low-carbon transport and develop facilities to turn waste into energy. By implementing this strategy, the economy expects to: reduce energy intensity by 45% by 2035 and carbon intensity by 50%–60% by 2020 from 2005 levels; decrease its greenhouse gas (GHG) emissions by 19%–33% by 2020 compared with 2005; and lower its greenhouse gas emissions per capita from 6.2 tonnes in 2005 to 3.6–4.5 tonnes in 2020.

To help monitor the energy situation, Hong Kong, China has developed an energy end-use database. The database provides a useful insight into the energy supply and demand situation, including energy consumption patterns and trends, and the energy use characteristics of individual sectors and subsectors. A basic data set is publicly available on the internet. The government can use this data to analyse the current situation and to generate valuable policy/strategy revisions to implement in the future. The private sector can use the data to benchmark their energy efficiency so they can make further improvements in their energy consumption systems (EMSD, 2012).

A memorandum of understanding (MOU) signed by the Hong Kong, China Government and the National Energy Bureau of the People's Republic of China on 28 August 2008 ensures the long-term and stable supply of nuclear generated electricity, and the supply of natural gas from three different sources: offshore gas, piped gas and LNG (liquefied natural gas) from an LNG terminal built as a joint venture on a neighbouring mainland China site. Gas-fired power plants generated 28.8% of the economy's electricity in 2009. To improve air quality and to address the challenges posed by global warming, the government is exploring ways to gradually increase the use of clean energy. The inter-governmental MOU contemplates the delivery of gas for electricity generation in Hong Kong, China from three sources:

(a) New gas fields to be developed in the South China Sea.

(b) A second West-to-East gas pipeline, bringing gas from Turkmenistan through China.

(c) An LNG terminal located in Shenzhen, mainland China.

In 2009, the Hong Kong, China Government approved the extension of the contracts for CLP to purchase nuclear generated power from Guangdong

Daya Bay Nuclear Power Station from 7 May 2014 to 6 May 2034. These contracts will enable the continued supply of non-carbon emitting electricity to Hong Kong, China for another 20 years.

In Hong Kong, China, franchised buses are the major cause of roadside air pollution in busy corridors. The government's policy objective is to have zero-emission buses running across the territory in the long term. When the current bus franchises expire in the next few years, Hong Kong, China will impose additional requirements on the franchises. The bus companies will be required to switch to zero-emission buses or the most environmentally-friendly buses available when replacing existing ones, taking into account the feasibility and affordability for bus operators and passengers.

In terms of fuel consumption and other measures of environmental performance, hybrid buses are currently superior to ordinary diesel buses. In view of market availability and technical developments, hybrid buses have the potential to replace diesel buses on a large scale in the near future, before electric or fuel cell buses become available to the market. To reach its long-term goal for zero-emission buses, the government will provide financial support to bus companies that wish to test zero-emission buses, such as electric buses.

BUSINESS-AS-USUAL OUTLOOK

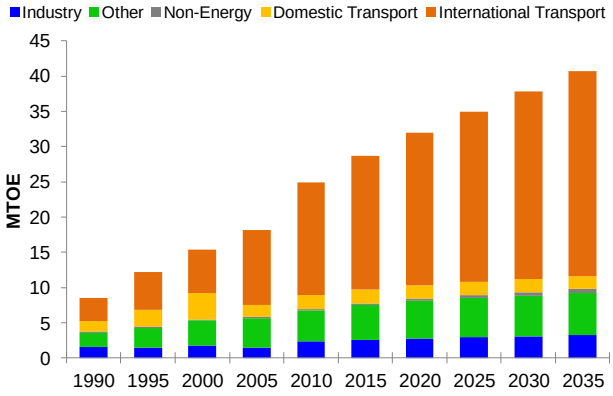
FINAL ENERGY DEMAND

In this business-as-usual (BAU) case, the new fuel mix for power generation proposed by the Hong Kong, China Government was not taken into account in our BAU simulation for the electricity supply system. This was due to the policy still being under debate, with no final decision reached at the time of this writing. The final results of our simulation may differ from those the government proposes. However, our BAU simulation does reflect the current energy policy of Hong Kong, China.

In the simulation, the final energy demand is expected to grow at only 1% a year over the outlook period (2010–2035). If the international transport sector is discounted, the 'other' sector (residential, commercial and agriculture) will account for the largest share of energy consumption at 6 Mtoe in 2035, followed by the industry sector at 3 Mtoe. However, the projection also shows international transport energy consumption has the potential to increase to about 29 Mtoe in 2035, compared with 15 Mtoe in 2009.

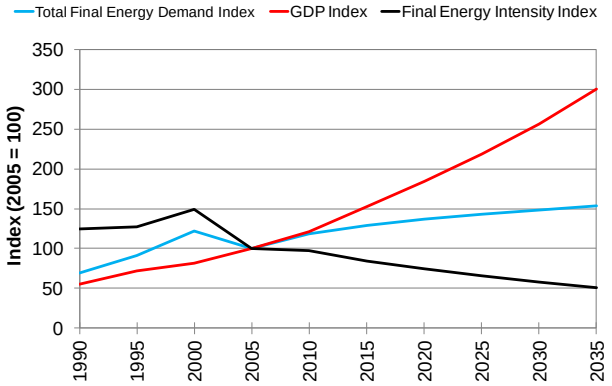
By implementing different measures for energy conservation in the building sector (including for appliances) and by continuing service-oriented GDP growth, the economy's final energy intensity is expected to decline by about 49% between 2005 and 2035.

Figure HKC2: BAU Final Energy Demand



Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

Figure HKC3: BAU Final Energy Intensity



Source: APERC Analysis (2012)

Industry

Energy demand in the industry sector is projected to grow at an average annual rate of 1.3% over the outlook period. This is lower than the average annual growth rate of 2.1% between 1990 and 2009. The slowdown in the energy demand growth rate is due to the slow growth in the value of industrial production expected in the future, and to the relocation of many industries, especially the energy-intensive and labour-intensive ones, to mainland China.

Transport

Transport sector energy demand (including international and domestic demand) is projected to increase by about 73% by 2035, based on the 2010 demand figures. Almost all the increase will come from the energy demand for international transport. Domestic demand is projected to decrease by 12.2%

in the same period. The dramatic increase of energy demand for international transport is due to Hong Kong, China's location at the gateway to the Pearl River Delta (PRD) area of mainland China and to its position as a regional aviation hub. The projection also shows international aviation demand grows by about 57% from 2010 to 2035. Marine demand grows even faster, at 95% over the same period. The result reflects Hong Kong, China's ambitions to be a regional transfer hub for both air and marine transport. The decrease in energy demand for domestic transport is probably due to a decline in vehicle numbers and the growing use of mass transport systems (both rail and bus). The policy to gradually increase the use of hybrid and electrical vehicles will also reduce energy consumption for domestic transport.

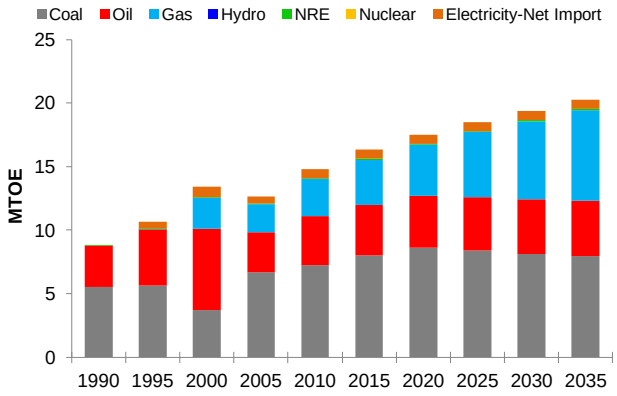
Other

The demand for energy in Hong Kong, China's 'other' sector is expected to grow at an average annual rate of 1.2% over the outlook period (2010–2035). Energy demand in the 'other' sector, which includes residential, commercial, agricultural and construction demand, is primarily driven by income growth. It appears most of the growth in the 'other' sector is commercial, reflecting the overall growth of this sector and particularly of service industries. Residential demand is growing slowly, reflecting Hong Kong, China's focus on improving energy efficiency. Energy efficiency improvements, such as the mandatory implementation of building energy codes, the mandatory/voluntary energy efficiency labeling schemes for appliances, the adoption of high-efficient lighting fixtures/systems, and the promotion and implementation of district cooling systems for the commercial sector are the major driving forces slowing down the energy demand growth rate in the 'other' sector. Electricity is expected to continue to dominate the energy mix, accounting for 76% of 'other' sector energy consumption in 2035.

PRIMARY ENERGY SUPPLY

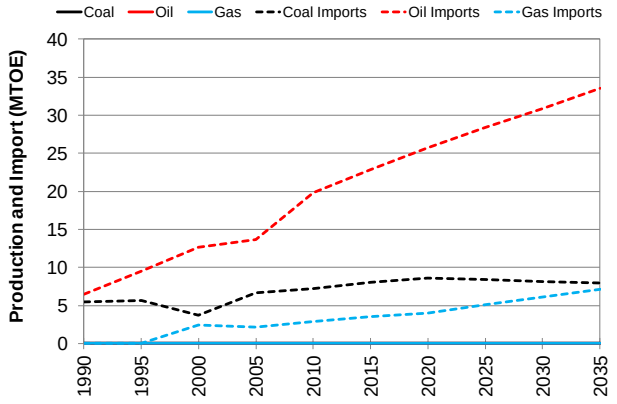
Hong Kong, China has no domestic energy reserves or petroleum refineries. The economy imports all of its primary energy needs. The total primary energy supply (excluding energy consumption for international transport) is projected to grow at an annual rate of 1.3% during the outlook period. The shift from coal to natural gas for power generation will result in a dramatic increase in the share of natural gas in the primary energy supply (excluding international transport) from 20% in 2010 to 35% by 2035. The share of coal will decrease from 49% in 2010 to 39% in 2035. During the outlook period, oil will show a minor increase, however, the share will decrease from 26% in 2010 to 22% in 2035. The results shown in Figure HKC4 do not include international transport, as fuel for international transport is not included in Primary Energy Supply. In this BAU case, the newly proposed fuel mix using an increasing amount of power imported from the nuclear energy power plant in mainland China is not included in this simulation.

Figure HKC4: BAU Primary Energy Supply



Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

Figure HKC5: BAU Energy Production and Net Imports



Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

ELECTRICITY

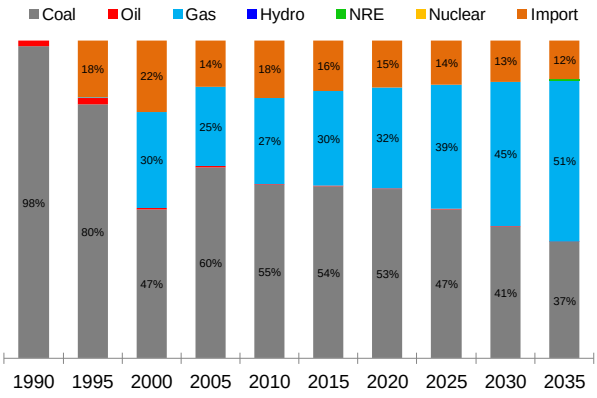
Hong Kong, China's electricity generation output is projected to increase at an average annual rate of 1.6%, reaching 61 TWh in 2035. The economy's commitment to reducing its GHG (greenhouse gas) emissions by 19%–33% by 2020 compared with 2005, means additions to the total installed electricity capacity are expected to be natural gas based, rather than coal fired. Coal's share of total electricity generation is expected to fall from 55% in 2010 to 37% in 2035.

Hong Kong, China's electricity supply is strongly dependent on power generated in mainland China.

Net imported electricity contributed to about 18% of electricity supplied in 2010. Most of the imported electricity comes from power generated at the Guangdong Daya Bay Nuclear Power Station; a small percentage comes from a storage hydropower plant in Guangzhou.

In this BAU scenario, the new proposed fuel mix for power generation is not included. The only consideration was to keep the net imported electricity amount from mainland China at the same level as in 2010, and to gradually increase the gas-fired power plants by phasing out the old coal-fired power plants. It means the increase of nuclear generated power imported from mainland China is not taken into account in this projection. Another uncertain issue in Hong Kong, China that needs to be clarified is the contribution of new renewable energy (NRE) to power generation. Considering the economy's land limitations, our BAU projection assumes NRE will be mostly demonstration projects, and its contribution will be small.

Figure HKC6: BAU Electricity Generation Mix



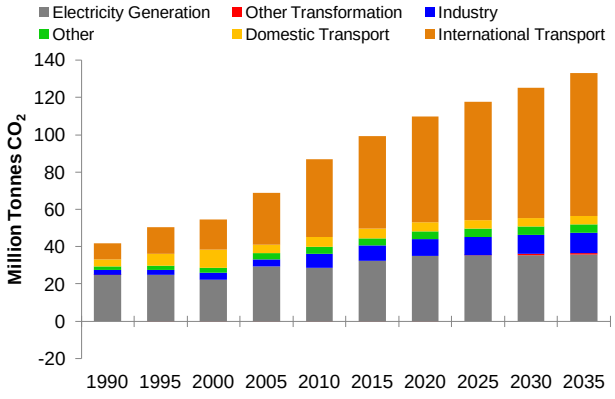
Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

CO_2 EMISSIONS

Over the outlook period, Hong Kong, China's total CO_2 emissions from fuel combustion are projected to reach 133 million tonnes of CO_2, which is 53.3% higher than in 2010 and 217% higher than the 1990 level. The results show an increase of 59% in the period from 2005 to 2020, compared to the goal set by Hong Kong, China's government to reduce GHG emissions by 19%–33% in the same period. If the emissions from international transport are excluded, the projection shows a comparatively smaller increase of 29% in the same period (2005–2020). To meet the goal of Hong Kong, China's energy policy, more efforts to implement the proposed fuel mix for the power supply system should be considered. If Hong Kong, China goes ahead with its proposal to import additional nuclear generated power from mainland China, its emissions would be significantly reduced compared to our BAU case. The other option is to adopt cleaner coal technologies or carbon capture and storage (CCS) with coal-fired power plants to reduce their CO_2 emissions. Efficient coal technologies are discussed further in Volume 1, Chapter 13.

In 2035, international transport is expected to account for the largest share of total CO_2 emissions, at 58% or 76.4 million tonnes of CO_2, followed by the electricity generation sector at 27% (35.7 million tonnes of CO_2) and the industry sector at 8% (10.9 million tonnes of CO_2).

Figure HKC7: BAU CO_2 Emissions by Sector



Source: APERC Analysis (2012)

The decomposition analysis shown in Table HKC1 below suggests the growth in Hong Kong, China's GDP will be offset by a reduction in the energy intensity of GDP (improved energy efficiency and move to a service-oriented economy) and a minor reduction in the CO_2 intensity of energy (fuel switching from coal to natural gas).

Table HKC1: Analysis of Reasons for Change in BAU CO_2 Emissions from Fuel Combustion

(Average Annual Percent Change)

	1990-2005	2005-2010	2005-2030	2005-2035	2010-2035
Change in CO_2 Intensity of Energy	-1.1%	-1.0%	-0.3%	-0.3%	-0.2%
Change in Energy Intensity of GDP	0.5%	1.7%	-1.0%	-1.1%	-1.7%
Change in GDP	4.0%	4.0%	3.8%	3.7%	3.7%
Total Change	3.3%	4.8%	2.4%	2.2%	1.7%

Source: APERC Analysis (2012)

CHALLENGES AND IMPLICATIONS OF BAU

Overall, the economy of Hong Kong, China is expected to continue to grow healthily. However, such growth will depend on energy security, as Hong Kong, China relies on imports for most of its energy supply.

With its lack of fossil energy resources, the economy is heavily dependent on imported oil, gas and electricity, especially to supply the large energy demands from both international aviation and its

residential and commercial sectors. It is critical that Hong Kong, China improve its energy security, in particular to protect itself from fluctuations in the energy market. While the lack of indigenous resources means little can be done to improve the security of the supply of fossil fuels, electricity security could be greatly improved by ensuring the continuation of the contract with the Guangdong Daya Bay Nuclear Power Station. Although Hong Kong, China is almost entirely dependent on imported energy, the fact much of this energy is imported from mainland China, with which it has close political and economic ties, should help to reduce the risk of supply.

In terms of reducing its GHG emissions, the shift away from coal to gas for power generation will make a significant difference, but the reduction will not be enough to meet the goal set by the Hong Kong, China Government. Furthermore, the increasing energy demand, especially for electricity, will pose a more serious challenge to reducing the actual GHG emissions. The economy could help to reduce its GHG emissions by shifting to more imported electricity from nuclear or renewable energy sources, or by further increasing its energy efficiency at home. Government policies to increase vehicle fuel efficiency and to implement district cooling schemes should be continued, to further reduce the overall environmental impacts.

Further study of the future fuel mix proposed by the Hong Kong, China Government should be explored, to find a strategy to implement and potentially contribute to the reduction of GHG emissions.

ALTERNATIVE SCENARIOS

To address the energy security, economic development, and environmental sustainability challenges posed by the business-as-usual (BAU) outcomes, three sets of alternative scenarios were developed for most APEC economies.

HIGH GAS SCENARIO

To understand the impacts higher gas production might have on the energy sector, an alternative 'High Gas Scenario' was developed. The assumptions behind this scenario are discussed in more detail in Volume 1, Chapter 12. The scenario was built around estimates of gas production that might be available at BAU prices or below, if constraints on gas production and trade could be reduced.

Hong Kong does not have any natural gas reserves and it is highly unlikely that any resource will be found in the economy in the future. It is also unlikely to be economic to replace coal in electricity generation with additional gas imports. Under BAU scenario, gas-fired power plants will account for more than 50% of electricity generation by 2035. Beyond this, Hong Kong, China has a long term policy to increase nuclear energy imports from mainland China. This policy is likely to be prioritized over gas power expansions.

For these reasons, the High Gas Scenario was not run for Hong Kong, China. Therefore, figures HKC8–HKC10 are not included here.

ALTERNATIVE URBAN DEVELOPMENT SCENARIOS

To understand the impacts of future urban development on the energy sector, three alternative urban development scenarios were developed: 'High Sprawl', 'Constant Density', and 'Fixed Urban Land'. The assumptions behind these scenarios are discussed in Volume 1, Chapter 5.

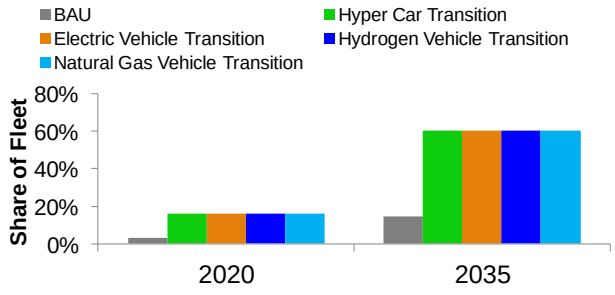
Hong Kong, China is already a compact city with high urban density and low energy consumption. Due to its natural geographical constraints, it would be impossible for Hong Kong, China to expand significantly in land area. For these reasons, the alternative urban development scenarios were not run for Hong Kong, China. Therefore, figures HKC11–HKC13 are not included here.

VIRTUAL CLEAN CAR RACE

To understand the impact of vehicle technology on the energy sector, four alternative vehicle scenarios were developed: 'Hyper Car Transition' (ultra-light conventionally-powered vehicles), 'Electric Vehicle Transition', 'Hydrogen Vehicle Transition', and 'Natural Gas Vehicle Transition'. The assumptions behind these scenarios are discussed in Volume 1, Chapter 5.

Figure HKC14 shows the evolution of the vehicle fleet under BAU and the four 'Virtual Clean Car Race' scenarios. By 2035 the share of the alternative vehicles in the fleet reaches around 60% compared to about 15% in the BAU scenario. The share of conventional vehicles in the fleet is thus only about 40%, compared to about 85% in the BAU scenario.

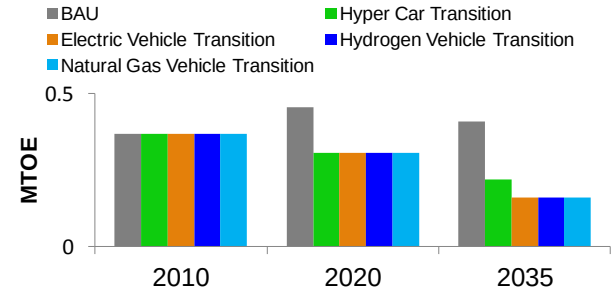
Figure HKC14: Virtual Clean Car Race – Share of Alternative Vehicles in the Light Vehicle Fleet



Source: APERC Analysis (2012)

Figure HKC15 shows the change in light vehicle oil consumption under BAU and the four alternative vehicle scenarios. Oil consumption drops by 49% in the Electric Vehicle Transition, Hydrogen Vehicle Transition, and Natural Gas Vehicle Transition scenarios compared to BAU by 2035. The drop is large as these alternative vehicles use no oil. Oil demand in the Hyper Car Transition scenario is also significantly reduced compared to BAU—31% by 2035—even though these highly-efficient vehicles still use oil.

Figure HKC15: Virtual Clean Car Race – Light Vehicle Oil Consumption

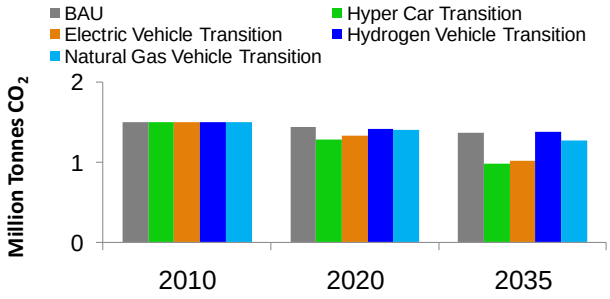


Source: APERC Analysis (2012)

Figure HKC16 shows the change in light vehicle CO_2 emissions under BAU and the four alternative vehicle scenarios. To allow for consistent comparisons, in the Electric Vehicle Transition and Hydrogen Vehicle Transition scenarios, the change in CO_2 emissions is defined as the change in emissions from electricity and hydrogen generation. The emissions impacts of each scenario may differ significantly from their oil consumption impacts, since each alternative vehicle type uses a different fuel with a different level of emissions per unit of energy.

In Hong Kong, China, the Hyper Car Transition scenario is the clear winner in terms of CO_2 emissions savings, with an emissions reduction of 28% compared to BAU in 2035. The Electric Vehicle Transition scenario is second, offering a 26% emissions reduction compared to BAU. Compared to most economies, electric vehicles do relatively well in Hong Kong, China, reflecting the economy's heavy reliance on natural gas rather than coal for electricity generation, and the economy's relatively efficient electricity generation. Natural Gas Vehicle Transition offers a reduction of about 7% while the Hydrogen Vehicle Transition does not change emissions.

Figure HKC16: Virtual Clean Car Race – Light Vehicle CO_2 Emissions



Source: APERC Analysis (2012)

REFERENCES

CLP (CLP Holdings Limited) (2012), *2010 Annual Report*, www.clpgroup.com/ourcompany/aboutus/resourcecorner/investmentresources/Pages/financialreports.aspx#tab2

CSD (Census and Statistic Department, Government of the Hong Kong Special Administrative Region of the People's Republic of China) (2012), *Hong Kong Statistic Table 036*, www.censtatd.gov.hk/hong_kong_statistics/statistical_tables/index.jsp?tableID=036

EMSD (Electrical and Mechanical Services Department, Government of the Hong Kong Special Administrative Region of the People's Republic of China) (2012), *Hong Kong Energy End-use Data 2011*, www.emsd.gov.hk/emsd/e_download/pee/HKEEUD2011.pdf

Environment Bureau (Government of the Hong Kong Special Administrative Region of the People's Republic of China) (2012), *Scheme of Control Agreement*, www.enb.gov.hk/en/resources_publications/agreement/index.html

EPD (Environmental Protection Department, Government of the Hong Kong Special Administrative Region of the People's Republic of China) (2012), *Hong Kong's Climate Change Strategy and Action Agenda*,

www.epd.gov.hk/epd/english/climate_change/consult.html

Global Insight (2012), *World Industry Services*, retrieved from IHS Global Insight Data Service.

Hong Kong International Airport (2012), 'Facts and Figures' website page, www.hongkongairport.com/chi/business/about-the-airport/facts-figures/facts-sheets.html

IEA (International Energy Agency) (2011), *World Energy Statistics 2011*, retrieved from OECD/IEA CD-ROM Service.

Office of the Chief Executive (Government of the Hong Kong Special Administrative Region of the People's Republic of China) (2012), *Policy Address 2011–2012*, www.policyaddress.gov.hk/11-12/eng/index.html

PAH (Power Assets Holdings Limited) (2012), *2010 Annual Report*, www.powerassets.com/pahWeb/IR/FinancialReports/AnnualReports/AnnualReport2010_en.htm

Transport Department (Government of the Hong Kong Special Administrative Region of the People's Republic of China) (2012a), *Annual Transport Digest 2011*, www.td.gov.hk/mini_site/atd/2011/tc/s1_p1.htm

— (2012b), *Hong Kong Transportation 40 Years (2008)*, www.td.gov.hk/filemanager/tc/publication/td-booklet-final-251108.pdf