

# Energy Scene of Hong Kong

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## Abstract

*In Hong Kong, three major types of energy carriers play their respective roles in serving the final energy demand - electricity, gas, and oil products. In this paper, the electricity demand and supply situation of Hong Kong is described. Overall energy consumption pattern of Hong Kong is outlined. A comparison of energy intensity figures between Hong Kong and other economies is also made. The results of a recent study on benchmarking of energy consumption indicators of office buildings and retail premises are highlighted.*

*The Government of HKSAR has completed a study on the potential applications of renewable energy in Hong Kong. Some study results are presented.*

*Since the early 90s, the Government of HKSAR has been actively promoting energy efficiency and conservation, in order to reduce energy demand. The scope and extent of impact of these initiatives are briefly described.*

## Keywords

*Energy demand and supply, energy intensity, benchmarking, renewable energy, energy efficiency and conservation.*

## 1. INTRODUCTION

Of the 1098 km<sup>2</sup> land area of Hong Kong, built-up areas occupy only 1/6 of it, the rest being woodlands, grass and shrubs areas, swamp and mangrove areas, and so on. In such a small area live 6.8 million people (at end 2002). Given such extremely high population density, energy is of utmost importance to the proper functioning of the city.

Hong Kong does not have any indigenous production of fuels. All primary fuels, be it coal, oil products, or natural gas, are imported.

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riers play their respective roles in serving the final energy demand - electricity, gas, and oil products. These three types of energy carriers serve quite different end-uses, with limited degrees of competition amongst them. For the energy supply sector, the private sector is relied upon to supply Hong Kong's energy requirements. These are a number of power stations and town-gas plants. There are no refineries in Hong Kong.

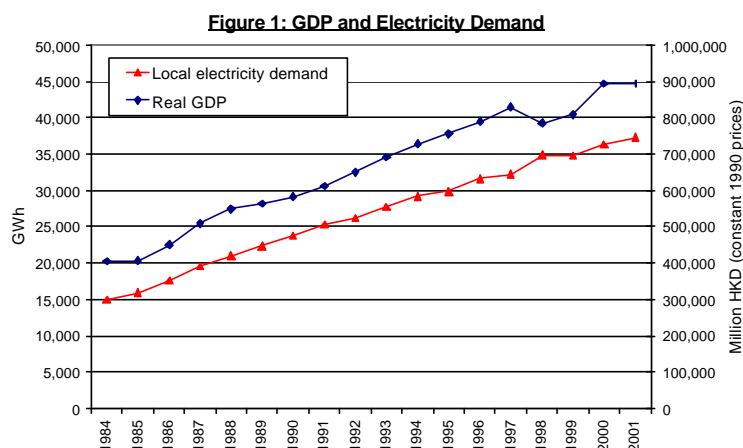
Carbon dioxide emissions account for over 99% (by weight) of the greenhouse gas emissions of Hong Kong, and the energy sector is the major contributor to Hong Kong's carbon dioxide emissions. Electricity generation alone accounts for over 60% of all carbon dioxide emissions.

Being fully aware of the importance of energy to the city and the associated environmental issues, the objectives of the energy policy of Hong Kong are stated as follows:

- to ensure that the energy needs of the community are met safely, efficiently and at reasonable prices; and
- to minimise the environmental impact of energy production and use and promote the efficient use and conservation of energy.

## 2. ELECTRICITY DEMAND & SUPPLY

### 2.1 Electricity Demand



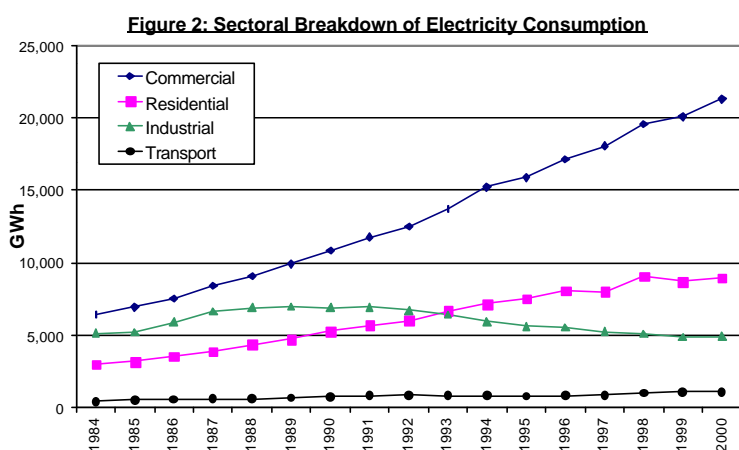
Electricity demand grew almost in pace with GDP. Figure 1 illustrates this point.

Total local electricity demand in 2001 was about 37261 GWh. Table 1 compares the per-capita electricity consumption figures of selected APEC economies, using data from the APEC Energy Statistics 2000. The per-capita electricity consumption is modest as compared to the advanced economies like Japan and US. Low level of industrial activities is probably one of the reasons.

Economy	kWh/person/annum
Hong Kong	5338
Japan	7622
Malaysia	2630
Chinese Taipei	7207
Thailand	1448
United States	12861

Table 1. Per-capita electricity consumption figures of selected APEC economies for year 2000

Figure 2 shows the breakdown of electricity consumption



tion into contributions of Residential, Commercial, Industrial, and Transport Sectors, according to the Hong Kong Energy End-use Database.

The amounts of electricity consumption of Commercial, Residential, and Transport Sectors are all increasing. The fastest growth occurs in the Commercial Sector, with average annual growth rate of 7.8% over the period concerned.

The electricity consumption of Industrial Sector is made up of two opposite trends - declining consumption of manufacturing industries and increasing consumption of non-manufacturing industries (e.g. container terminals, water and sewage pumping). The overall trend is a declining one.

The largest end-use of electricity is space-conditioning, accounting for about 1/3 of total electricity consumption.

## 2.2 Electricity Supply

There are two electricity supply companies in Hong Kong - CLP Power Hong Kong Limited (CLP Power) and the Hongkong Electric Company Limited (HEC), both of which are investor-owned. They do not have a franchise. On a de facto basis, CLP Power supplies electricity to Kowloon and the New Territories, including Lantau, Cheung Chau and several outlying islands, whereas HEC supplies electricity to Hong Kong Island and the neighbouring islands of Ap Lei Chau and Lamma.

The local power generation facilities are made up of coal-fired steam plants (the Lamma Power Station and the Castle Peak Power Station), natural gas combined-cycle plants (the Black Point Power Station), and oil-fired gas turbines. CLP Power also imports electricity from the Guangdong Nuclear Power Station at Daya Bay and the Guangzhou Pumped Storage Power Station.

The total installed electricity generating capacity is 11,683 MW, including local facilities as well as parts of the capacity of the Guangdong Nuclear Power Station at Daya Bay and the Guangzhou Pumped Storage Power Station. The per-capita installed capacity is about 1.7 kW/person. Table 2 compares the per-capita installed capacity figures of selected APEC economies, using data from the APEC Energy Statistics 2000.

Economy	kW/person
Hong Kong	1.70
Japan	1.81
Malaysia	0.59
Chinese Taipei	1.56
Thailand	0.37
United States	2.91

Table 2. Per-capita installed generation capacity figures of selected APEC economies for year 2000

In the 70s, the main power plant type was oil, being replaced by coal-fired units in the 80s. In the 90s, nuclear, gas-fired combined cycle and pumped storage plants all took part in the picture. In terms of power plant types, the mix for installed power generation capacity is shown in table 3. Coal-fired units still account for over half of the installed capacity.

Plant type	Percentage
Coal fired	57.1 %
Oil fired	9.6 %
Natural-gas-fired	16.2 %
Nuclear	11.9 %
Pumped storage	5.2%

Table 3. Plant mix of total installed generation capacity

In year 2001, total equivalent primary fuel input to local power plants is about 374,000 TJ, making up of: coal 48%, natural gas 25%, thermal-equivalent of nuclear 27%.

### 3. GAS AND OIL PRODUCTS DEMAND & SUPPLY

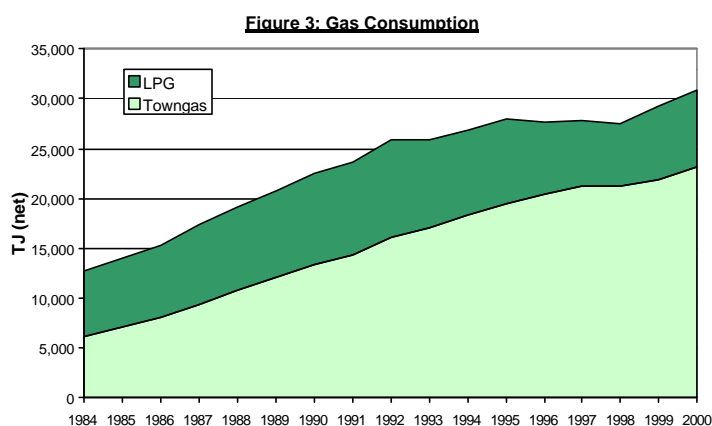
#### 3.1 Gas

Towngas and liquefied petroleum gas (LPG) are consumed by end-users. Natural gas is used solely for electricity generation, and not for final consumption.

Towngas is the major piped gas in Hong Kong. The main elements in the gas are hydrogen

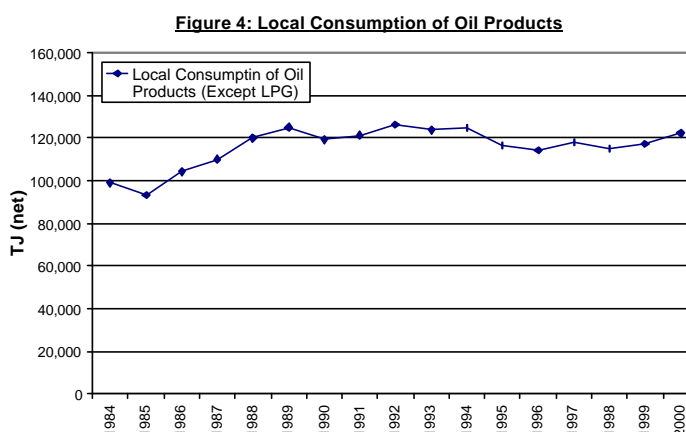
(49%) and methane (28.5%). It is supplied by the Hong Kong and China Gas Company Limited, which is also an investor-owned company. The raw material for manufacturing towngas is naphtha. The Tai Po Plant, being the main production plant, has maximum capacity of 8.4 million standard cubic metres per day. Penetration rate of towngas amongst households in Hong Kong is about 66% in 2001.

LPG is imported. Some housing estates are provided with central liquefied petroleum gas (LPG), supplied by



the oil companies. Bottled LPG is used in homes and other types of premises.

Towngas and LPG are two competing fuels. Figure 3 shows the past gas consumption trend (data from the Hong Kong Energy End-use Database). LPG consumption has been declining since the early 90s. In recent years, due to the implementation of the LPG taxi scheme, with the switch from use of diesel to LPG, LPG consumption has rebounded. The majority of the total 18,000 taxis has already been converted from using diesel to using LPG. Further trials on the use of LPG and electric public and private light buses have also been successful. Another incentive scheme has started since August 2002 to encourage diesel light buses to be replaced with ones using electricity or LPG.



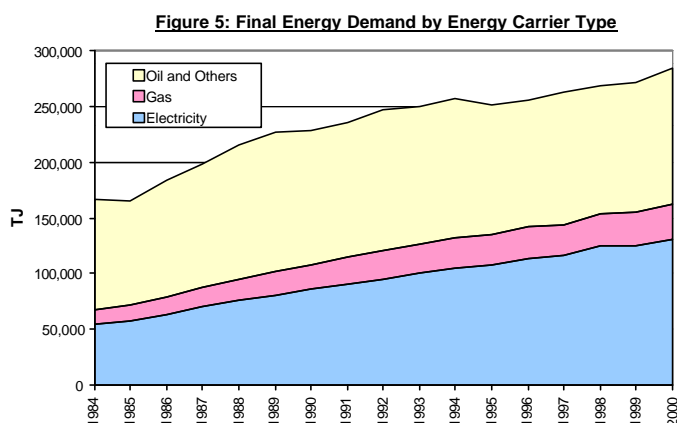
### 3.2 Oil Products (Other than LPG)

Hong Kong does not have any oil refineries. All oil products are imported by the oil companies. Locally we consume the following oil products other than LPG - kerosene, petrol, diesel, and fuel oil. Figure 4 shows the local consumption trend for oil products (other than LPG) consumed within Hong Kong (data from the Hong Kong Energy End-use Database). The consumption level was rather constant for the 90s as there were two opposite trends - declining industrial consumption and increasing transport consumption. However, it should be noted that port-to-port uses (for marine vessels and planes travelling between Hong Kong and other ports) consume huge quantities of oil products, which is not reflected in the local consumption trend show above.

The fuel quality standards have been further tightened in recent years. From April 1999, only unleaded petrol can be sold in Hong Kong. From April 2002, ultra-low sulphur diesel has become our statutory standard for local automotive diesel.

## 4. OVERALL ENERGY DEMAND

Local final energy demand (excluding all fuels consumed by marine vessels and planes travelling between Hong Kong and nearby ports) increased at a rate of about 2.2% per annum over the decade from 1990 to 2000. Figures 5 and 6 illustrates the trend and the



compositions.

The share of electricity has been increasing. Not evident from the figure is the rising amount of "bunker fuels" (for outgoing/incoming marine vessels and planes) sold in Hong Kong.

Sector-wise, the commercial sector is the one with highest growth in energy consumption.

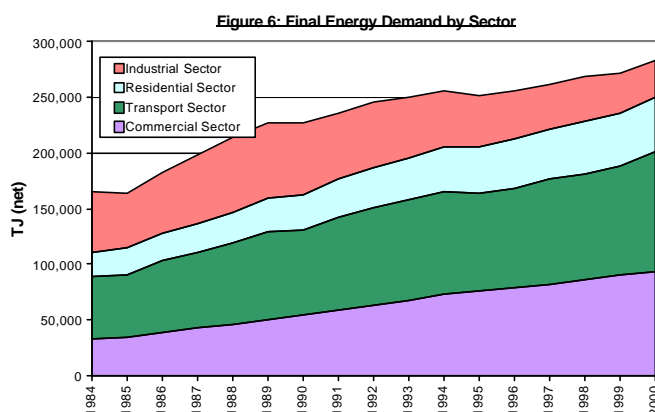


Table 4 shows some TPES (total primary energy supply)/GDP(PPP) figures compiled by the International Energy Agency.

Economy	TPES/GDP(PPP) (toe/000 95 US\$PPP)
Chinese Taipei	0.20
France	0.19
Hong Kong	0.13
Malaysia	0.26
Singapore	0.27
U.K.	0.18

Table 4. TPES/GDP for Year 2000

Such figures though informative, should be treated with care. As the economic structure and climatic conditions are different from one place to the other, such energy intensity figures by themselves may not be sufficient for us to make apple-to-apple comparisons. The energy intensity figure of Hong Kong is low because of the low level of industrial activities, the temperate climate, the high population density, as well as our efforts in energy efficiency and conservation.

## 5. ENERGY CONSUMPTION BENCHMARKING

The Government has developed energy consumption benchmarks for selected energy consumption groups. Such benchmarks can facilitate energy managers and users to compare the energy consumption levels of their premises or vehicles with others in Hong Kong, to

establish their percentile positions within the respective energy consuming groups. Currently, benchmarks have been developed for private offices, commercial outlets, private cars, and light goods vehicles. A benchmarking software is put on EMSD website (<http://www.emsd.gov.hk>) for public use. More energy consumption groups will be benchmarked.

## **6. RENEWABLE ENERGY**

Renewable energy, mainly PV panels and solar water heating, has been exploited on small scales around Hong Kong. Recognising the importance of building a sustainable energy system, the Government of HKSAR has commissioned consultants to study the potential applications of renewable energy in Hong Kong. Stage 1 of the study has been completed. The full report has been posted on EMSD website. In the study report, the consultants have assessed the potential resources in Hong Kong of the conventional renewable energy types and other energy sources such as waste-to-energy, outlined the issues related to implementation of renewable energy projects in Hong Kong such as policy and legislative framework, grid access, market framework, financial viability. The consultants have also proposed a strategy and action plan to support the development of renewable energy in Hong Kong, and made some projections to enable targets to be set upon contribution of renewable energy for then next two decades.

Amongst the different renewable energy types, solar and wind are considered suitable for wide scale adoption in Hong Kong.

For exploitation of solar energy, building-integrated photovoltaic (BIPV) system is considered one suitable form of PV system for Hong Kong. In a BIPV system, PV panels or arrays are mounted on or fully integrated into the roofs, facades, and walls of residential, commercial, institutional, or industrial buildings. One impediment to adoption of such system is cost. The "levelised cost of electricity" of PV system is still one order of magnitude higher than that of conventional fossil fuel power generation. Other than BIPV, PV power station is another possibility for Hong Kong.

To gather local experience and data, a demonstration BIPV system has been installed at Wanchai Tower (a government office building), involving 500 m<sup>2</sup> of PV panels (with total rated power output of 55kW). The performance of the system is being monitored to yield actual production data for Hong Kong. PV system will also be installed in the new EMSD Headquarter, which is currently under construction.

For wind energy, the following types are considered feasible choices for Hong Kong:

- rural wind farms in a linear arrangement on mountain ridges
- individual machines in urban areas (on top of buildings)
- near-shore wind farms
- offshore wind farms

Of these types, the rural wind farms and the near-shore wind farms have "levelised cost of electricity" figures comparable to conventional generation. The other two types having cost-of-electricity figures much higher. To explore the possibility of installing wind turbines at selected locations, the government is planning a wind measurement programme to obtain site-specific data for those locations.

Besides solar and wind, there are other energy options for Hong Kong. Huge quantities of municipal solid waste (MSW) are generated each year. Currently, landfilling is the way to dispose of the MSW. Landfill gas has been used to generate electricity on landfill sites for on-site use. Larger-scale exploitation of landfill gas can generate significant amount of electricity. Thermal treatment such as combustion and gasification can produce electricity, and in the case of combustion can reduce the need for more landfill sites.

## **7. PROMOTION OF ENERGY EFFICIENCY**

### ***7.1 Energy Efficiency Office***

The Energy Efficiency Office of the Electrical Mechanical Services Department, set up in 1994, is entrusted with the responsibility to implement energy efficiency initiatives and to promote energy efficiency and conservation in Hong Kong. Some of its activities are highlighted below. More information can be obtained from EMSD website. The latest issue of the energy efficiency newsletter "EnergyWits" can also be downloaded from the website.

### ***7.2 Energy Efficiency Labelling Scheme***

The Energy Efficiency Labelling Schemes (EELS) is implemented on voluntary participation basis. First launched in 1995, the EELS now covers eight types of domestic appliances, three types of office equipment and include a vehicle label for passenger cars. More appliances and vehicle types will be incorporated into the EELS in the coming years.

### ***7.3 Building Energy Codes***

Building energy consumption makes up a large portion of the electricity consumption of Hong Kong. In view of this, a series of Building Energy Codes (BECs) and Guidelines on building services installations has been published, including 4 prescriptive codes for lighting, air-conditioning, electrical, and lift and escalator respectively, and a performance-based code. These codes are implemented mainly through the voluntary "Hong Kong Energy Efficiency Registration Scheme for Buildings" which was launched in 1998. So far, more than 70 buildings have been registered under the scheme.

The Performance-based Building Energy Code, launched in March 2003, offers flexibility for building design and provides an alternative compliance path to the prescriptive BECs. It adopts a comprehensive building energy budget concept, in which the energy consumption of the designed building (one that the designer will be free to select energy efficient building components and equipment options) will be compared with that of a hypothetical reference building (one complying with all the prescriptive BECs). In arriving at the comprehensive building energy consumption in the design, computer simulation is required. The simulation result also provides a breakdown of the energy consumption figures for different design options, giving the designer a clear picture of the control parameters leading to energy efficiency.

#### ***7.4 Water-cooled Air-conditioning Systems***

In 2000, a pilot scheme was launched to promote the wider use of fresh water for water-cooled air-conditioning in non-domestic buildings in designated in Hong Kong. So far, applications for converting to the use of cooling towers have been received for 19 installations, involving a total floor area of one million square metres with an estimated annual electricity saving of 11,400MWh.

The results of a consultancy study on the implementation of district cooling system (DCS) in South East Kowloon Development have recently been published on EMSD website. According to the development plans prevailing at the time of the study, the consultants proposed to install two chiller plants of 158MW and 74MW cooling capacity respectively in the area. The proposed DCS design is expected to give a significant saving in energy in comparison with the traditional standalone air conditioning systems. It can reduce overall energy consumption by 19% and 35% respectively when compared with the standalone air condi-

tioning systems operating on cooling towers and air-cooled chillers. The DCS will also reduce the overall requirement for plant rooms in individual buildings.

#### ***7.5 Publicity and Promotion***

Public education and promotion to stakeholders are considered important ways to promote energy efficiency and conservation. Publicity materials including newsletters, pamphlets and videos are distributed to various parties. An Energy Efficiency Centre has been set up in the Hong Kong Science Museum. Seminars have been organised for secondary schools, property management companies, suppliers and retailers, government departments, and the general public. A Forum on Energy Efficiency and Conservation was held in January 2003. An interactive website targeted at students, the EnergyLand, has just been launched. The website address is:

<http://www.energyland.emsd.gov.hk>

## **7. CONCLUSION**

The energy system of Hong Kong is well-diversified. The impact of the use of energy on the environment has been properly addressed through fuel switching, tightening of fuel quality standards and air pollution legislation, and promotion of energy efficiency and conservation. In spite of this, continual developments in the energy system are expected in terms of fuel diversification, energy efficiency, and legislation.