

The Environment

The government is committed to enhancing the quality of the environment. Priorities in 2015 included improving air quality, implementing a solid waste management policy, improving harbour water quality, promoting energy efficiency and conservation, and combating climate change.

Hong Kong, with only 1,104 square kilometres of land, is home to some seven million people. But it is also one of the world's largest trading economies. More than 500 sq km of land are designated as 'protected areas'. These include country parks, special areas and conservation zones. Inevitably, the heavy concentration of people and activities in a small area strains the environment, including the air quality. The impact of air pollution in the Pearl River Delta region also needs to be addressed.

Environmental protection is a major priority of the Hong Kong Special Administrative Region (HKSAR) Government. Stepping up action to improve air quality as well as water quality in Victoria Harbour, managing municipal solid waste better through sustainable use of resources, promoting energy efficiency and strengthening regional co-operation are important for improving the territory's quality of life and are government priorities.

Administrative Framework

The Environmental Protection Department (EPD), under the Environment Bureau, has overall responsibility for protecting the environment, including nature conservation. It executes environmental policies, vets environmental planning and assessment findings, enforces and reviews environmental laws, plans and develops facilities for liquid and solid waste disposal, and promotes environmental management, auditing and reporting. It also promotes environmental awareness in the community. The EPD receives professional support from several government departments and advice from the Advisory Council on the Environment, which comprises 22 members appointed by the Chief Executive, including representatives from non-governmental environmental organisations, business groups, academic institutions and professional bodies.

The bureau's Energy Division oversees Hong Kong's energy policy to provide reliable supplies of energy at reasonable prices and promote their economical and safe use while minimising the

environmental impact of energy usage and production. The Sustainable Development Division promotes sustainable development in both the government and the community and provides secretariat support to the Council for Sustainable Development.

Government spending on the environment in 2015-16 was budgeted at \$16.4 billion, or about 3.5 per cent of total public expenditure.

Sustainable Development

The Council for Sustainable Development, appointed by the Chief Executive, promotes sustainable development in Hong Kong. The Sustainable Development Fund provides grants for projects that enhance public awareness of sustainable development or encourage sustainable practices. Since 2003, 63 projects have been approved and 56 of those completed, involving grants totalling more than \$63 million.

The Sustainable Development Division oversees the government's sustainability assessment system, which aims to integrate sustainability considerations into the decision-making process. All bureaus and departments must conduct sustainability assessments of their major initiatives and programmes and set out the implications in their submissions to the Policy Committee and Executive Council.

Environmental Awareness

The EPD works closely with the government-appointed Environmental Campaign Committee to enhance public environmental awareness through campaigns and community programmes, including activities promoting waste reduction and recycling, energy conservation and other initiatives. The department's environmental resource and education centres provide the public with easy access to environmental information. By providing funding to local non-profit-making organisations to implement educational, research and other projects relating to the environment and conservation, the Environmental Conservation Fund seeks to promote behavioural and lifestyle changes to protect the environment and promote sustainable development.

Cross-boundary Co-operation

Since environmental pollution transcends administrative boundaries, Hong Kong works with Guangdong and the Macao SAR on environmental matters. Under a Co-operation Agreement on Regional Air Pollution Control and Prevention signed in 2014, the three sides began the first regional air-quality study to understand the pollution characteristics of fine suspended particulates (PM_{2.5}), which would help in the formulation of appropriate and effective policies to combat PM_{2.5} pollution in the Pearl River Delta region. This joint study will be completed in 2017. At the same time, the regional air quality monitoring network was enhanced. The total number of air monitoring stations increased from 16 to 23, including one in Macao for the first time. Results from the network show a substantial reduction in the annual concentration levels of most pollutants in the region in recent years. From 2006 to 2014, the annual concentration levels of sulphur dioxide, nitrogen dioxide and respirable suspended particulates decreased 66 per cent, 20 per cent and 24 per cent respectively. To further improve air quality, the Hong Kong and Guangdong governments in November 2012 endorsed emission reduction targets/

ranges for the Pearl River Delta region for up to 2020. The two sides have jointly embarked on a mid-term review to conclude the emission reduction results for 2015 and finalise the targets for 2020.

The Cleaner Production Partnership Programme encourages and helps Hong Kong-owned factories in Guangdong to adopt cleaner production technologies and practices. The two governments signed an agreement in November 2014 and also set up a Hong Kong-Guangdong Joint Working Group on Cleaner Production in February 2015 to strengthen co-operation in promoting cleaner production to enterprises in the region. By the end of 2015, more than 2,500 funding applications had been approved since the programme's launch in 2008. In addition, 247 enterprises held commendations under the Hong Kong-Guangdong Cleaner Production Partners Recognition Scheme, which recognises efforts to pursue cleaner production.

Hong Kong and Shenzhen are jointly implementing action programmes to protect the water quality of the adjoining waters, including Deep Bay and Mirs Bay. The two sides are conducting the second review of the joint programmes for Deep Bay to gauge their effectiveness and to draw up additional mitigation measures. Meanwhile, Hong Kong and Guangdong have assessed the pollution load-carrying capacity of the Pearl River Estuary to provide a scientific basis for water quality management of the estuary and are preparing a plan to enhance co-operation in protecting the estuary's water.

Physical Characteristics, Flora and Fauna

Topography, Geology and Landforms

Hong Kong's natural terrain is characterised by rugged uplands flanked by steep slopes. The highest point is Tai Mo Shan (957 metres above Principal Datum) in the central New Territories, and the lowest point (66 metres below Principal Datum) is in Lo Chau Mun (the Beaufort Channel) to the north of Po Toi Island. The mountains are predominantly formed of volcanic rocks, whereas the lower hills and low-lying areas are generally underlain by granite or sedimentary rocks. A layer of soft, weathered rock covers the bedrock in most places, slope debris mantles the natural hillsides, and alluvium fills many of the valleys. Offshore, the seabed is covered with marine mud, with sand sheets occurring near the coast and in channels.

The oldest exposed rocks were deposited as river sediments about 400 million years ago. From 350 to 290 million years ago, limestones (now marble) and siltstones, found in western and central New Territories accumulated in a shallow sea. From 170 to 140 million years ago, violent eruptions depositing thick ash layers occurred from several volcanic centres. Volcanism ended with a colossal eruption from the High Island Supervolcano centred in southeastern Hong Kong. Subsequent uplift and erosion have revealed a cross-section from the top of the supervolcano in Sai Kung to its underlying magma chamber in Kowloon and northern Hong Kong Island. Layered rocks seen on the island of Ping Chau are younger sediments, laid down in a lake on the edge of a desert about 50 million years ago.

The northeastern New Territories reveals the most comprehensive stratigraphy of sedimentary rocks in Hong Kong, ranging from Devonian sandstone and conglomerate aged about 400 million years to Paleogene siltstone formed 50 million years ago.

Despite its small size, Hong Kong has a great variety of coastal landforms, including sea cliffs, sea caves, sea arches, geos, tombolos, wave-cut platforms, sea stacks, notches and blowholes.

While most of the hexagonal volcanic rock columns in other regions of the world are composed of basalt lava, those in Sai Kung are made up of silica-rich rhyolitic volcanic rock. Apart from its extraordinary composition, the columns are considered unique for their size, with an average diameter of 1.2 metres, and the large area they cover, of more than 100 sq km.

A series of fifteen 1:20,000-scale geological maps and six accompanying geological memoirs have been produced by the Hong Kong Geological Survey. Two summary memoirs and a set of 1:100,000-scale geological and thematic maps have been published, in Chinese and English, synthesising and giving a popular account of local geology. Geological information can be accessed from the Civil Engineering and Development Department's website.

Flora

Hong Kong is situated near the northern boundary of the distribution of tropical Southeast Asian flora, sharing similar species and structure with the flora of Guangdong. Despite its small size, Hong Kong has a rich flora with about 3,300 species of vascular plants, of which 2,100 are native to the territory.

The major types of vegetation cover comprise woodland, shrubland and grassland. Remnants of the original forest cover can still be found in steep ravines or behind traditional villages in rural areas. They have survived as a result of their location in precipitous topography and the moist micro-climate, or because they are protected for cultural reasons.

Continual afforestation efforts coupled with conservation measures have transformed formerly bare hillsides and slopes into impressive woodlands. Besides greening and beautifying the countryside, woodlands are important habitats for wildlife and are essential to protect water catchments from soil erosion.

Fauna

Terrestrial

The climate and physical environment provide a wide range of habitats and support for a rich and varied fauna that includes more than 530 species of birds, more than 50 species of mammals, over 100 species of amphibians and reptiles, 236 species of butterflies and 123 species of dragonflies.

Besides the rich terrestrial fauna biodiversity, a number of species are endemic to Hong Kong, including the Romer's Tree Frog, Bogadek's Burrowing Lizard, Hong Kong Tusktail and Hong Kong Clubtail. Newly recorded species are discovered from time to time. Globally endangered or threatened species, such as the Three-banded Box Turtle, Yellow-breasted Bunting, Short-legged Toad, Green Turtle and Chinese Pangolin, can also be found.

The Mai Po Marshes form one of the most important wildlife conservation sites in Hong Kong. Together with the Inner Deep Bay area, the Mai Po Marshes area is listed as a 'Wetland of International Importance' under the Ramsar Convention. About 1,500 hectares of inter-tidal mudflats, fish ponds, marshes, reedbeds and mangroves provide a rich habitat for migratory and resident birds, particularly waterbirds. More than 390 species of birds have been observed in this area. Forty-nine species are considered globally threatened, including the Black-faced Spoonbill, Baer's Pochard, Nordmann's Greenshank and Spoon-billed Sandpiper. The Agriculture, Fisheries and Conservation Department implements a wetland conservation and management plan to conserve the ecological value of the area.

Traditional fung shui woods near old villages and temples and secondary forests provide important habitats for many woodland birds. Birds sighted in the wooded areas include different species of warblers, flycatchers, robins, thrushes, bulbuls and tits.

Areas around the Kowloon reservoirs are inhabited by monkeys that are the descendants of individuals released there in the early 20th century. There are breeding groups of the Rhesus Macaque and hybrids of the Rhesus Macaque and Long-tailed Macaque. Some monkeys have migrated to the forested areas of Shing Mun Reservoir and Tai Po Kau. Feeding of monkeys is prohibited to make them revert to foraging for natural food in the countryside.

Other mammals, such as the Red Muntjac and Eurasian Wild Pig, are very common in the countryside, while the Leopard Cat, Small-toothed Ferret Badger and Masked Palm Civet are relatively uncommon. Bats including the Himalayan Leaf-nosed Bat, Pomona Leaf-nosed Bat and Chinese Horseshoe Bat are found in caves and water tunnels. Sightings of rare species such as the Eurasian Otter, Crab-eating Mongoose and Chinese Pangolin are reported occasionally.

Hong Kong has more than 100 species of amphibians and reptiles. Of the 24 species of amphibians, the Hong Kong Cascade Frog, Hong Kong Newt and Romer's Tree Frog are protected under the Wild Animals Protection Ordinance. Most of the 52 species of snakes are non-venomous, and reports of people being bitten by highly venomous snakes are rare. Among the 10 native species of chelonians, the Green Turtle is of particular conservation interest as it is the only known species of sea turtle breeding in Hong Kong.

Marine

Hong Kong's subtropical marine environment supports species found in both tropical and temperate climates. Local waters contain a wide diversity of fish, crustaceans, molluscs and other marine life, of which at least 150 species are of fisheries significance. Situated on the eastern bank of the Pearl River Estuary, Hong Kong receives fresh water from the river, especially in its western waters. The waters on the eastern side, on the other hand, are little influenced by the Pearl River outflow and are predominantly oceanic in nature. This unusual hydrography contributes to the diversity of marine life.

Despite being close to the northern geographic limit for their growth, Hong Kong supports 84 species of hard corals. This diversity is quite rich by international standards. A variety of marine fish also breeds in local waters. Typical of the eastern waters is the red pargo, one of several sea bream varieties whose fry are abundant along the shore of Mirs Bay in early spring.

Two marine mammal species can be found throughout the year. The Indo-Pacific humpback dolphin, also known as the Chinese white dolphin, is the better known of the two. It prefers an estuarine environment and inhabits the western waters, while the Indo-Pacific finless porpoise lives in the eastern and southern parts, where the waters are predominantly oceanic.

To enhance inshore marine resources, the Agriculture, Fisheries and Conservation Department has installed artificial reefs to improve fishery resources and biodiversity. The Marine Parks programme is important in protecting and conserving sites of special ecological and conservation value.

Protected Areas

About 40 per cent of Hong Kong's total land area is designated as country parks and special areas for conservation and recreation. There are 24 country parks and 22 special areas covering about 44,300 hectares of scenic hills, woodlands, reservoirs, islands, indented coastlines, marshes and uplands. They are carefully protected for nature conservation, education and scientific studies.

Management responsibilities include the protection of woodland and vegetation against hill fire, control of development, tree planting, planting enhancement, litter collection, the provision of educational and recreational facilities, and the promotion of a better understanding of the countryside.

There are four marine parks and one marine reserve covering 2,430 hectares of scenic coastal areas, seascapes and important biological habitats. Marine reserves are dedicated to conservation, education and scientific studies. Fishing in marine parks is controlled through a permit system and totally banned in marine reserves. Publicity and educational activities are organised for students and other members of the public.

Besides designating protected areas, the government identifies and conserves sites of special scientific interest (SSSI), such as areas with special geological features and natural habitats of rare plants or animals, by exercising strict land use planning and development controls. There are 67 sites listed in the SSSI register.

Conservation and Biodiversity

Legislation and Conservation

The Director of Agriculture, Fisheries and Conservation, who is also the Country and Marine Parks Authority, oversees the conservation of terrestrial and marine ecological resources and the enforcement of legislation on nature conservation issues.

The Forests and Countryside Ordinance provides for the general protection of trees and vegetation. Its subsidiary Forestry Regulations control the selling and possession of certain attractive plants to deter illegal collection. These include native camellias, magnolias, orchids, azaleas and the Chinese New Year flower.

The Wild Animals Protection Ordinance prohibits the wilful disturbance, hunting, possession and sale or export of protected wild animals found in Hong Kong. It also restricts entry into three important wildlife habitats designated as Restricted Areas: the Mai Po Marshes; the Yim Tso Ha Egretty; and the Green Turtle nesting beach at Sham Wan on Lamma Island.

The Protection of Endangered Species of Animals and Plants Ordinance imposes controls on the import, export, re-export, introduction from the sea or possession of endangered species to prevent their overexploitation.

The Country Parks Ordinance provides for the designation, control and management of country parks and special areas for nature conservation, education and scientific research purposes. Country parks may be used for compatible recreation and tourism purposes.

The Marine Parks Ordinance provides for the designation, protection and management of marine parks and marine reserves for nature conservation, education and scientific research purposes. It allows recreational activities such as swimming and diving in marine parks.

The Fisheries Protection Ordinance provides for the regulation of fishing practices and the prevention of destructive fishing activities, such as those involving the use of explosives or toxic substances to catch fish.

The Genetically Modified Organisms (Control of Release) Ordinance controls the release into the environment, and the import and export, of genetically modified organisms (GMOs). It aims to protect the local biological diversity from possible adverse impacts arising from GMOs intended for release into the environment, mainly in the form of farming or field trials for scientific research.

UN Convention on Biological Diversity

The United Nations Convention on Biological Diversity, extended to Hong Kong in 2011, is an international convention aiming to conserve biodiversity, ensure the sustainable use of its components, and ensure the fair and equitable sharing of benefits deriving from the use of genetic resources. While the territory is not a contracting party to the convention on its own, the government is developing a city-level Biodiversity Strategy and Action Plan for implementation in the next five years based on the principles of the convention, taking into account local needs and priorities. This will step up conservation efforts and support Hong Kong's sustainable development.

The Cartagena Protocol on Biosafety, adopted under the convention, aims to ensure the safe handling, transport and use of GMOs resulting from biotechnology that may have adverse effects on biodiversity. Hong Kong implements the protocol through enforcing the Genetically Modified Organisms (Control of Release) Ordinance.

Climate

Hong Kong has a subtropical climate. January and February are cloudier with spells of cold weather. March and April are milder and humid with fog. From May to August, it is hot and

humid with occasional heavy rain and thunderstorms. Tropical cyclones usually affect the territory between June and October, bringing high winds, heavy rain and sometimes storm surges.

November and December are generally fine and dry with pleasantly cool weather, although on occasions, it may be relatively cold at night and in the early morning.

The Year's Weather

In 2015, Hong Kong was exceptionally warm. The annual mean temperature reached 24.2 degrees Celsius, the highest since records began in 1884, while the mean temperatures for summer and autumn were also record-breaking. In particular, the daily maximum temperature on 8 August 2015 soared to a record high of 36.3 degrees. The year was significantly drier than usual, with total rainfall about 22 per cent below the norm. Tropical cyclone warning signals were issued three times, including the No 8 Gale or Storm Signal for the passage of Typhoon Linfa in July. For the first time since 1946, no tropical cyclone warning signal was issued in August and September.

Climate Change

Impact on Hong Kong

The government attaches much importance to combating climate change, and implements various mitigation and adaptation measures to meet this global challenge. Measures to reduce greenhouse gas emissions include switching to cleaner fuels for power generation; enhancing energy efficiency, particularly in buildings; exploring the potential of renewable energy and waste-to-energy conversion; and developing an efficient and environment-friendly public transport system.

In November 2015, the government released a Hong Kong Climate Change Report 2015, which outlined the work and joint efforts of the government and the private sector in responding to climate change. It also provides an account of Hong Kong's climate change actions to give the public a more complete picture of the territory's contributions to concerted global actions.

Carbon Intensity Reduction Target

The government focuses on the power and transport sectors, which are the major contributors of local emissions, in working towards its target, set in 2010, of reducing carbon intensity by 50 to 60 per cent by 2020 from the 2005 level. During a three-month public consultation launched in March 2014, it collected views on the future fuel mix for electricity generation. The two fuel mix options presented for consultation were (a) to import more electricity by buying from the Mainland power grid; and (b) to generate local energy through using more natural gas. The option of local energy generation drew majority support among the roughly 86,000 submissions received. Having considered the public's views, the government plans to increase the percentage of natural gas generation to around 50 per cent in 2020, and to maintain the current interim measure of importing 80 per cent of nuclear output from the Guangdong Daya Bay Nuclear Power Station so that the import of nuclear energy would account for about 25 per cent of the total fuel mix. Subject to public views on the tariff implications, the government is prepared to develop more renewable energy and will also

enhance efforts to promote energy saving. The remaining demand for energy will be met by coal-fired generation. This will help Hong Kong achieve its 2020 environmental target.

In 2015, the government also completed a three-year programme that conducted energy-cum-carbon audits on 120 government buildings and public facilities to identify carbon reduction measures. To encourage companies to adopt regular carbon auditing, the government also launched the Carbon Footprint Repository in December 2014. As of December 2015, 67 listed companies had disclosed their carbon management experience and practices to the public through the repository's website.

Energy

Electricity

The Hongkong Electric Company Limited (HK Electric) supplies electricity to Hong Kong Island and the neighbouring islands of Ap Lei Chau and Lamma, while CLP Power Hong Kong Limited (CLP Power) supplies Kowloon and the New Territories, including Lantau and several other outlying islands. The electricity supply to consumers is 50 hertz alternating current while the voltage is 220 volts single-phase and 380 volts three-phase.

Both power companies are investor-owned. The government monitors them through mutually agreed Scheme of Control Agreements. These require the companies to seek the government's approval for certain aspects of their development plans, including their projected basic tariff levels, so as to ensure the continued supply of reliable, safe and efficient electricity at reasonable prices. The agreements do not give the companies any exclusive rights. They are not franchises, nor do they define a supply area for either company or exclude newcomers to the market. The permitted rate of return of the power companies on their average net fixed assets under the agreements is 9.99 per cent.

The current agreements are for 10-year terms ending in 2018, with an option exercisable by the government to extend for five more years, until 2023. On 31 March 2015, the government launched a three-month consultation to solicit the public's views on the future development of the electricity market. Having regard to the views received, the government will discuss with the power companies new agreements with improved terms to take effect after the current ones expire.

HK Electric has a total installed capacity of 3,757 megawatts at its Lamma Power Station. The Castle Peak Power Company Limited supplies electricity to CLP Power from its power stations at Black Point (2,500MW), Castle Peak (4,108MW) and Penny's Bay (300MW).

CLP Power and HK Electric own their respective transmission and distribution systems. The two transmission systems are interconnected by a cross-harbour link, which provides emergency backup and some sharing of generating capacity reserve between the two systems. The link has a total capacity of 720 megavoltamperes.

CLP Power's transmission system is also connected to the Guangdong electricity network, which facilitates the export and import of electricity to and from the province. CLP Power buys

about 70 per cent of the power generated by the Daya Bay station, which has two 984MW pressurised water reactors, to meet part of the longer-term demand for electricity in its supply area. The electricity sold to Guangdong is from CLP Power's existing reserve generating capacity. Its sale is governed by an agreement with the HKSAR Government, under which CLP Power's consumers get priority of supply and 80 per cent of the profit from the sales.

According to a memorandum of understanding signed between the HKSAR Government and the National Energy Administration on 28 August 2008, the Central People's Government supported the China Guangdong Nuclear Power Holding Company Limited in the renewal of its supply agreement with Hong Kong for a further 20 years. In September 2009, the government gave approval for CLP Power to extend the contract for the supply of nuclear electricity from the Daya Bay station for another 20 years from 7 May 2014 onwards. The quantity of electricity supply will be no less than the current level. On a temporary basis from October 2014 to 2018, CLP Power is importing some additional 10 per cent of electricity generated by the Daya Bay station. The company is also using natural gas supplies from the Mainland's Second West-East Natural Gas Pipeline through the Hong Kong Branch Line facilities.

CLP Power has the right to use up to 50 per cent of the 1,200MW capacity of Phase 1 of the Guangzhou Pumped Storage Power Station at Conghua. Off-peak period electricity from the Castle Peak Power system and the Daya Bay station is stored in the pumped storage power station, which generates hydro-electricity to meet Hong Kong's demand during peak periods.

Regulations under the Electricity Ordinance govern the registration of electrical contractors and workers and competent persons, safety of electrical wiring, supply of safe household electrical products and protection of electricity supply lines from third-party damage.

Other Fuels

Town gas and liquefied petroleum gas (LPG) are the main types of fuel gas used for domestic, commercial and industrial purposes. LPG is also used as a fuel by nearly all taxis and more than 65 per cent of public light buses, while natural gas is used for electricity generation and production of town gas. Hong Kong has about 1.84 million town gas and 0.43 million LPG customers in the domestic, commercial and industrial sectors, of which town gas and LPG respectively accounted for 87.6 and 12.4 per cent of the total fuel gas sold in these sectors in terms of heating values.

Town gas is manufactured at plants in Tai Po and Ma Tau Kok, which have daily throughput capacities of 10 million and 2.6 million cubic metres respectively. A pipe network of some 3,500km supplies town gas to customers.

LPG is imported into Hong Kong mainly by sea and stored at five terminals on Tsing Yi Island before being distributed to customers, including 67 LPG filling stations for LPG vehicles.

Natural gas is imported from the Mainland via submarine pipelines to the Black Point, Castle Peak and Lamma Power Stations for electricity generation and to the Tai Po Plant for production of town gas.

The Gas Safety Ordinance regulates the importation, manufacture, storage, transport, supply and use of fuel gas. All gas supply companies, gas installers and contractors must be registered with the Gas Authority, who is the Director of Electrical and Mechanical Services.

Energy Saving

Energy Efficiency

Energy consumption is closely related to greenhouse gas emissions. Improving energy efficiency helps combat global climate change. The total energy consumption at end-use level in Hong Kong in 2013 was 284,210 terajoules, with the commercial, transport, residential and industrial sectors consuming 42 per cent, 32 per cent, 21 per cent and 5 per cent respectively. The Electrical and Mechanical Services Department's Energy Efficiency Office runs a range of programmes and initiatives to promote efficient use of energy, including voluntary energy efficiency labelling and registration schemes; encouraging use of water-cooled air-conditioning systems and promoting effective energy management methods.

The Mandatory Energy Efficiency Labelling Scheme requires prescribed products to bear energy labels informing consumers of the products' energy efficiency performance. The scheme currently covers room air conditioners, refrigerating appliances, compact fluorescent lamps, washing machines and dehumidifiers. New grading standards for room air conditioners, refrigerating appliances and washing machines were implemented in November 2015, saving annually an estimated 300 million kilowatt-hours in electricity use and \$300 million in electricity expenses. The scope of the scheme is being reviewed to cover more electrical products in order to capture more energy-saving opportunities.

The government's district cooling system at the Kai Tak Development provides chilled water to non-domestic developments for air conditioning. It is an energy-efficient system that consumes 35 per cent less electricity compared with traditional air-cooled air-conditioning systems. Phases I and II have been completed, while Phase III (Package A) and Phase III (Package B) are under construction.

The government recognises the importance of promoting the use of renewable energy and Hong Kong's two power companies are making progress in their attempts to use clean energy to produce electricity. HK Electric has operated a 800kW wind turbine on Lamma Island since 2006. In 2013, it put in place a 1MW thin film photovoltaic system at Lamma Power Station, while CLP Power commissioned a 200kW renewable energy generation system, which consists of solar panels and wind turbines, on Town Island in Sai Kung.

Energy-Efficient Buildings

As buildings account for about 90 per cent of electricity consumed, promoting their efficient use of energy is instrumental in reducing greenhouse gas emissions. New buildings and existing buildings undergoing major retrofitting works are required to comply with the Building Energy Code mandated under the Buildings Energy Efficiency Ordinance implemented in 2012. It stipulates the minimum energy efficiency standards for major building services installations, including air conditioning, electrical installations, lighting, lifts and escalators. Commercial buildings are required to conduct energy audits at least every 10 years. The minimum energy

efficiency standards had been upgraded and were released in December 2015. It is expected that up to 2025, energy savings from all new buildings will amount to about 5 billion kWh.

The Environment Bureau published in May an Energy Saving Plan for Hong Kong's Built Environment 2015~2025+, the first-ever energy saving blueprint for Hong Kong. It set a new target of reducing energy intensity by 40 per cent by 2025, and set out the policy, strategy, targets and key actions that could help achieve the new target.

Pollution Prevention

Air Pollution

The bureau's Clean Air Plan sets out air-quality improvement measures aiming to broadly achieve by 2020 Air Quality Objectives that took effect in January 2014. The government has a statutory obligation to review the objectives at least once every five years. The bureau will embark on a review of the objectives in 2016.

The EPD has been taking action to reduce emissions from local air pollution sources. Between 1997 and 2013, emissions of sulphur dioxide (SO₂), nitrogen oxides (NO_x), respirable suspended particulates (RSP) and volatile organic compounds (VOC) dropped 24 per cent to 64 per cent.

From 2005 to 2015, ambient concentrations of RSP, NO₂ and SO₂ dropped 31 per cent, 12 per cent and 59 per cent respectively, and roadside concentrations of RSP and SO₂ fell 40 per cent and 64 per cent respectively. However, ambient ozone increased 29 per cent, reflecting worsening regional photochemical smog, and roadside NO₂ increased 3 per cent because of excess vehicle emissions and a rise in regional ozone concentration.

Land Transport

Vehicle emissions are the major source of roadside air pollution. The government's policy is to apply the most stringent practicable motor vehicle fuel and emission standards. All newly registered vehicles are required to comply with Euro V standards. Preparations are under way to tighten the emission standards to Euro VI levels.

Nearly all of Hong Kong's taxis and more than 69 per cent of public light buses now run on LPG. To encourage the use of environment-friendly commercial vehicles with low emissions, the First Registration Tax is reduced for buyers of newly registered environment-friendly vehicles. On 1 March 2014, an incentive-cum-regulatory scheme was launched to phase out by the end of 2019 some 82,000 pre-Euro IV diesel commercial vehicles. By the end of 2015, about 39,000 pre-Euro IV diesel commercial vehicles had been retired under the scheme.

To promote the use of electric vehicles, the First Registration Tax for such vehicles is waived till March 2017. Compared with 2014, the fleet grew 171 per cent to 4,198 in 2015. More than 1,200 charging points are available for public use, including some 130 quick and more than 190 medium charging points.

The government has stringent controls against diesel vehicles with excessive smoke. Such vehicles must pass a smoke test with the aid of a chassis dynamometer to ascertain whether

the defects have been rectified. In 2015, 6,312 smoky vehicles were reported, about 89 per cent fewer than in 1999. The government deploys mobile roadside remote sensing equipment to detect LPG and petrol vehicles with excessive emissions. In 2015, 3,692 such vehicles were identified by the equipment.

To promote mass transit systems that are pollution-free at street level, the government gives priority to rail over road and encourages innovation wherever practical.

Marine transport

Marine vessels are the largest emission source in Hong Kong. To control marine emissions, the government has implemented a series of measures, including introducing the requirements of the International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI, regulating marine fuel quality by capping the sulphur content of local marine light diesel vessels at 0.05 per cent from 0.5 per cent from April 2014, and requiring ocean-going vessels to use low-sulphur marine fuel, with sulphur content of not more than 0.5 per cent, from July 2015.

Hong Kong is also collaborating with the Mainland on a plan to reduce vessel emissions in the region, including the establishment of a marine emission control zone in the Pearl River Delta waters by 2019.

Power generation

Power plants are a major source of local emissions. To improve local and regional air quality, the government has progressively tightened the statutory emission caps on the power sector and encouraged the power companies to use cleaner fuels. In December 2015, the emission caps for the three key pollutants (SO₂, NO_x and RSP) were tightened from 2020 onwards by 50 to 69 per cent of the 2010 levels.

Indoor Air Quality

To promote good indoor air quality (IAQ) and public awareness of its importance, the government has introduced an IAQ Management Programme, which includes a voluntary IAQ Certification Scheme for offices and public places to recognise good IAQ management practices and to provide incentives for owners of buildings/premises or property management companies to pursue the best level of indoor air quality.

Ozone Layer Protection

The Montreal Protocol for controlling substances that deplete the ozone layer applies to Hong Kong. The Ozone Layer Protection Ordinance prohibits manufacture of these substances as well as their import for local consumption, except hydrochlorofluorocarbons. The import of these chemicals is now subject to quota control with a view to completely banning their import by 2020.

Non-road Mobile Machinery

A new regulation took effect on 1 June 2015 to control emissions from non-road mobile machinery, which includes regulated machines powered by internal combustion engines, such as crawler cranes, air compressors and excavators. New machinery supplied for use in Hong

Kong must meet statutory emission requirements, namely, the Euro Stage IIIA emission standard for regulated machines and the Euro V emission standard for non-road vehicles, both of which are the same standards applied to newly registered on-road vehicles. All machinery to be used in specified activities or locations, such as the airport, container terminals and construction sites, must bear labels issued by the EPD from 1 December 2015.

Noise Pollution

Road Traffic Noise

In Hong Kong, about 960,000 people are affected by traffic noise. Under existing policy, project proponents are required to assess traffic noise impact when planning new roads and provide direct mitigation measures to ensure traffic noise at noise-sensitive receivers stays within acceptable levels. Where direct measures are inadequate, indirect noise mitigation measures must be used.

To address traffic noise from existing roads, a programme to retrofit noise barriers on noisy road sections is being carried out in phases under the Public Works Programme. High-speed roads, of 70kmh or above, have been resurfaced with low-noise material wherever practicable. In addition, a trial programme to surface local roads with low-noise material is being implemented.

To prevent individual vehicles from producing excessive noise, all newly registered vehicles must comply with internationally recognised noise standards.

Railway Noise

The railway operators have implemented various noise reduction programmes since the early 1990s to address noise problems along railways, bringing relief to some 110,000 affected residents thus far. New railway projects are required to undergo environmental impact assessments to ensure their noise impact is properly addressed.

Aircraft Noise

The impact of aircraft noise on almost all residents in the vicinity of flight paths at the airport is within planning standards. However, there is still concern about nuisance from aircraft noise, especially during evenings and early mornings. The government continues to explore all practicable measures to mitigate aircraft noise.

Construction Noise

Noise from general construction works between 7pm and 7am and on public holidays is controlled through construction noise permits. These restrict the use of equipment in accordance with strict criteria and ban noisy manual activities in built-up areas. Percussive piling is prohibited at night and on public holidays, and requires a permit during the daytime on any day that is not a public holiday. The government has phased out the use of noisy diesel, steam and pneumatic piling hammers. The law also requires hand-held percussive breakers and air compressors for construction to meet strict noise standards and to have 'green' noise emission labels.

The EPD adopts a Quality Powered Mechanical Equipment system to promote the use of more environmentally friendly construction equipment and to facilitate the construction noise permit application process.

Noise from Industrial or Commercial Activities

Noise from industrial or commercial activities is controlled through the issuance of noise abatement notices. The department serves abatement notices requiring the owners or occupants of premises causing excessive noise to reduce it within a given period.

Waste Management

Waste Statistics

Over the past decade, the municipal solid waste that is dumped at landfills has increased 9 per cent, while the mid-year population has grown 6 per cent. Over the past five years from 2011 to 2015, the annual disposal of municipal solid waste was within the range of 3.28 to 3.71 million tonnes and the daily per capita disposal rate was between 1.27kg and 1.39kg. Food waste accounted for around 37 per cent of municipal solid waste on average over the past five years.

The territory also produced substantial quantities of construction waste, with an annual quantity within the range of 1.22 to 1.53 million tonnes disposed of at landfills over the past five years, an average 44 per cent drop on the 2.39 million tonnes in 2005 before the launch of a Construction Waste Charging Scheme in 2006.

Waste Reduction

Waste reduction and recovery play an important role in waste management. The Source Separation of Waste Programme provides waste separation facilities where people live and work and covers more than 80 per cent of the population.

Waste-to-Resources Plan and Food Waste & Yard Waste Plan

The government's 'Hong Kong Blueprint for Sustainable Use of Resources 2013-2022' maps out the strategy, policies and plans for waste management to tackle the waste problem through: (i) policies and legislation to drive behavioural changes to reduce waste at source; (ii) targeted citywide waste reduction campaigns to arouse public awareness and encourage community participation; and (iii) enhancement of waste-related infrastructure. The aim is to reduce the per capita municipal solid waste disposal rate by 40 per cent to 0.8kg or less by 2022.

'A Food Waste & Yard Waste Plan for Hong Kong 2014-2022', unveiled in February 2014, maps out a comprehensive strategy, targets, policies and action plans to manage food waste and yard waste. The government aims to reduce food waste disposal to landfills by 40 per cent by 2022 and sets out four strategies to tackle food waste: reduction at source; reuse and donation; recyclable collection; and turning food waste into energy.

To further promote waste reduction and recycling and provide outlets for recyclables of low commercial value in the community, in 2011 the government launched a Community Recycling Network and, in collaboration with the District Councils, a programme to enhance community

participation through district-based education, promotion and waste reduction and recycling activities.

International experience reveals quantity-based charging of municipal solid waste is an effective means of providing economic incentives in reducing waste. Based on recommendations made by the Council for Sustainable Development after an extensive public engagement exercise, the EPD proposed a framework in February 2015 on how to implement the charging scheme. The bureau will continue to co-ordinate the preparation work through an inter-departmental working group and support extensive community involvement projects with funding from the Environment and Conservation Fund.

In line with the polluter-pays principle, the government aims to expedite the introduction of Producer Responsibility Schemes to encourage recovery, recycling and waste reduction at source. The charging of plastic shopping bags in the entire retail sector was fully implemented on 1 April 2015. In March and July 2015, the government introduced to the LegCo legislative proposals respectively for two schemes on waste electrical and electronic equipment and glass beverage containers. LegCo funding approval to develop a treatment and recycling facility for electrical and electronic waste was obtained in February 2015 and construction is expected to be completed in 2017. The department also continues to support the expansion of a collection network for glass containers and is achieving results.

Efforts are continuing to set up a Community Green Station in each of the 18 districts, whereby the department appoints a non-profit-making organisation via open tender to operate and provide funding for each station. The first two stations started operation in Sha Tin and Eastern District in May and August 2015 respectively. The stations in Kwun Tong, Yuen Long and Sham Shui Po are expected to be commissioned in phases from the second half of 2016.

Food Wise Hong Kong Campaign

The government's Food Wise Hong Kong Campaign, rolled out in 2013, seeks to drive behavioural change and encourage the community, from individuals to households to commercial and industrial operators, to avoid and reduce food waste at source.

The campaign received an Excellence Award at the HKMA/TVB Awards for Marketing Excellence 2014 in recognition of its success in taking root in the community and promoting a 'food wise' culture. It is the first government promotional campaign to receive such an award.

Surplus Food Donation

The government has increased support to non-governmental organisations in collecting edible surplus or 'close-to-expiry' food from supermarkets, wet markets, restaurants, clubs and hotels for donation to the needy. NGOs can apply for funding from the Environment and Conservation Fund for projects to reduce food waste.

Waste Recycling

The department actively supports the recycling trade and has stepped up publicity efforts to educate the public to reduce waste at source, separate waste properly to prevent

contamination of recyclables, improve the quality of recyclables collected and lessen the burden of subsequent treatment.

In each of the last five years, the recovery rate of paper in municipal solid waste was between 57 per cent and 65 per cent and that of metal was between 86 per cent and 93 per cent. Over the same period, the recovery rate of plastics dropped from 69 per cent to 12 per cent.

More than 90 per cent of recyclable municipal solid waste is exported for recycling every year, with plastics, paper and metals contributing over 90 per cent of recovered waste. To promote local recycling, the government has developed a 20-hectare EcoPark in Tuen Mun Area 38 to provide long-term land at affordable costs for the development of the recycling industry so as to encourage investment in advanced technologies and value-added recycling processes.

Between 2010 and 2014, the overall recovery rate of solid waste, including municipal and construction waste, was between 78 per cent and 85 per cent each year, with an annual average of 22 million tonnes recovered. This annual average was 67 per cent higher than the 13 million tonnes between 2005 and 2009.

Recycling Fund

A \$1 billion Recycling Fund was launched in October 2015 and open for applications for five years. The fund aims to support projects that raise the quantity and quality of recyclables recovered, thus reducing landfill disposal, and to support projects that promote markets for recycled products and enhance the recycling industry's overall capability and capacity.

Waste Treatment and Disposal Infrastructure

Refuse Transfer Stations

Municipal solid waste is collected and delivered to refuse transfer stations by refuse collection vehicles, containerised and then taken to landfills in bulk by sea or land transport. A network of six transfer stations and seven outlying islands transfer facilities handled 2.51 million tonnes of such waste in 2015. At present, about 75 per cent of domestic waste is delivered via this network to landfills.

Landfills

All municipal solid waste is disposed of at three large strategic landfills in the New Territories, which are operated to high environmental standards. To maintain an uninterrupted waste disposal service to the public, extension works for all three landfills are necessary.

In 2015, 3.71 million tonnes of municipal solid waste were disposed of at landfills. About 64 per cent was domestic waste and the remainder was commercial and industrial waste. On average, each person disposed of about 1.39kg of municipal solid waste daily. Even with the ongoing extension of two of the three landfills, it is estimated that the limited landfill space could cope with disposal needs only up to late next decade. The department has commissioned a detailed study on how to extend the serviceable life of the remaining landfill to mid-2030s.

Hong Kong has 13 restored landfills and some of them have been developed for public use. A Restored Landfill Revitalisation Funding Scheme was launched in November 2015 to fund the development of recreational facilities or other innovative proposals.

Planned Infrastructure

Hong Kong needs state-of-the-art, cost-effective facilities to deal with the large volume of non-recyclable waste and reduce the volume that requires landfill disposal. A multi-technology approach is needed so different types of waste can be dealt with by the most suitable technology. The first phase of the government's large-scale Integrated Waste Management Facility, to be built on an artificial island near Shek Kwu Chau, will adopt advanced incineration as its core technology to reduce the waste volume by 90 per cent and to turn waste into energy, thereby reducing greenhouse gas emission. LegCo has approved the funding proposal and the facility is scheduled for commissioning in 2023. The territory also plans to build a network of five or six organic waste treatment facilities that will use biological treatment technologies to turn source-separated food waste into useful resources such as biogas, with compost as a by-product. For the first phase of a new treatment facility at Siu Ho Wan, North Lantau, the Design-Build-Operate contract was awarded in December 2014. Construction started in May 2015 and the contractor is working on the detailed design, with the project due to be commissioned in 2017. However, even with such facilities, waste reduction at source is still necessary and the residual waste will still need to be disposed of at landfills. The government has begun a study on planning future waste management and transfer facilities to identify additional strategic and regional waste facilities for handling solid waste.

A new, dedicated sludge treatment facility at Tsang Tsui near Nim Wan, Tuen Mun, has been put into operation since April 2015. It adopts advanced incineration technology to treat sewage sludge generated from sewage treatment works and can treat up to 2,000 tonnes per day. A waste-to-energy installation at the facility helps export surplus electricity generated from sludge incineration to the public power grid.

Chemical, Clinical and Special Waste

All chemical waste producers are required to pack, label and store their chemical waste properly before disposal at licensed treatment facilities. A trip ticket system tracks the movement of chemical waste from its origin to the final disposal point. In 2015, a daily average of 31.4 tonnes of chemical waste including MARPOL Annexes I and II waste from ocean-going vessels, and 6.2 tonnes of clinical waste were treated at the Chemical Waste Treatment Centre on Tsing Yi Island, which is operated by a government contractor. Waste producers using its services are required to pay part of the treatment cost.

The Low-level Radioactive Waste Storage Facility at Siu A Chau is purpose-built to meet stringent international standards for the safe storage of low-level radioactive waste. Most of such waste generated in Hong Kong has been transferred to the facility for long-term storage.

Construction Waste

The construction industry generated 24.5 million tonnes of construction waste in 2015. Of that, about 94 per cent was inert and suitable for reuse. To maximise the recovery and reuse of inert

materials and minimise their disposal at landfills, a disposal charging scheme provides an economic incentive for reducing construction waste. The government continues to deliver surplus inert materials to the Mainland for reuse in reclamation projects there.

Marine Refuse

Clearing marine refuse, including refuse that has been washed ashore, involves the Agriculture, Fisheries and Conservation Department; the Food and Environmental Hygiene Department; the Leisure and Cultural Services Department; and the Marine Department. Some of the work is outsourced to service providers. The Marine Department deploys a fleet of about 70 contractors' vessels to collect floating refuse and refuse from vessels. Nearly 15,632 tonnes of waste from the marine waters and coastal areas of Hong Kong and 4,337 tonnes of refuse from vessels were collected in 2015. In addition to law enforcement, the government uses publicity and education to tackle the problem.

In November 2012, the government set up an inter-departmental working group on Clean Shorelines to identify the sources of marine refuse, review existing measures, formulate strategic policies to prevent and reduce marine refuse, and promote public awareness of the need to keep Hong Kong's shorelines clean. The EPD completed a Marine Refuse Study and published a report in April 2015. In the light of the study findings, departments in the working group are implementing enhanced measures to improve shoreline cleanliness. The EPD also organised monthly Shorelines Cleanup Days with community groups at different locations starting from April 2015. The theme of the campaigns remained 'Protect our coast, Leave no trace', to emphasise the importance of reducing marine refuse.

Livestock Waste

The Waste Disposal Ordinance bans the keeping of livestock in new towns and environmentally sensitive areas. Where they are allowed, livestock farms must have proper waste treatment systems. The government provides a free livestock waste collection service, which collected about 22,200 tonnes of waste in 2015.

From the environmental protection perspective, livestock farming in urbanised Hong Kong is not sustainable. The government introduced voluntary licence-surrender schemes in 2005 and 2006 to encourage poultry and pig farmers respectively to cease livestock farming permanently in return for ex gratia payments. The schemes have decreased the number of farms and reduced pollution of the environment. The number of poultry farms has been further reduced by a buyout scheme launched in 2008.

Sewage Treatment and Disposal

Victoria Harbour and Harbour Area Treatment Scheme

The public sewerage system serves 93 per cent of the population and collects about 2.8 million cubic metres of waste water daily. About 75 per cent of the collected sewage receives chemical or higher levels of treatment before being discharged.

The Harbour Area Treatment Scheme Stage 1 collects sewage from the urban areas of Kowloon, Tsuen Wan, Kwai Tsing, Tseung Kwan O and the northeastern part of Hong Kong Island, and

transports it through a network of deep tunnels to Stonecutters Island for treatment. Stage 2A involves extending the deep tunnel system to take the untreated sewage from the remaining parts of Hong Kong Island to the Stonecutters Island Sewage Treatment Works (SCISTW), which will be expanded to provide centralised chemical treatment to sewage from the entire catchment under the scheme. Stage 2A works began in 2009 and the project was commissioned in December 2015. Since then, sewage from both sides of Victoria Harbour has been intercepted and diverted to the Stonecutters Island plant for centralised treatment and disinfection before discharge. The government will commission a consultancy study on further enhancing the quality of the harbour's waters in early 2016.

Since 1991, the government has spent a further \$28 billion on other sewerage schemes and will spend another \$14 billion on schemes over the next five years, including sewerage for rural villages. The Water Pollution Control (Sewerage) Regulation empowers the EPD to direct house owners to connect their waste water pipes to new public sewers. Since the regulation came into force in 1995, more than 9,000 village houses have been connected to the public sewers.

Sewage disposal facilities in rural areas

Improvements continue to be made to sewage disposal facilities in rural areas. In 2015, the government drew up plans to invest further in projects providing public sewers to convey domestic discharges from villages in rural and other un-sewered areas to treatment works. Loan and grant schemes for eligible households to connect houses to public sewers are available.

Sewage Charges

All water users who discharge their sewage into public sewers pay a basic sewage charge in accordance with the Sewage Services Ordinance. Also, 27 trades and industries whose effluent strength exceeds that of domestic sewage pay a trade effluent surcharge reflecting the additional cost of treating their stronger effluent. These charges are used to recover the operation and maintenance costs of sewage collection, treatment and disposal facilities, while the government provides funds for construction.

In support of the polluter-pays principle, in 2007 the government initiated a gradual increase in the sewage charges for handling domestic waste water over 10 years. The average bill for domestic accounts will rise from the 2007 level of \$11 per month to \$27 per month eventually.

Water Quality

Water pollution, if left unchecked, tends to increase with urban development and population growth. The lack of proper treatment for most of the sewage from older urban areas around the harbour resulted in poor water quality, but since Stage 1 of the harbour scheme went into operation in 2001, there has been a marked improvement. The dissolved oxygen level in the water has increased, while pollutants such as ammonia and faecal bacteria have decreased. With the commissioning of Stage 2A in 2015, sewage around the harbour is collected for centralised treatment, resulting in further improvement in water quality.

Pollution control at source has yielded positive results and river quality has also improved. The percentage of rivers monitored in the 'good' and 'excellent' categories increased from 34 per

cent in 1986 to 82 per cent in 2015, and the percentage in the 'bad' and 'very bad' categories fell from 45 per cent in 1986 to 7 per cent, with no river falling into the 'very bad' category in 2015.

Marine water quality objectives under the Water Pollution Control Ordinance apply to the 10 water control zones. The government is considering preliminary proposals to revise these objectives.

Bathing Beaches

To protect the health of swimmers at bathing beaches, the government adopts strict standards for water quality control which indicate the pollution level measured in terms of *Escherichia coli*, the bacterium that can indicate the presence of sewage. Beaches in the 'good' and 'fair' categories in the following table meet the government's water quality objective for bathing, and all did in 2015.

Beach water quality ranking	Bathing season geometric mean of <i>E coli</i> count per 100ml of beach water	Minor health risk cases per 1,000 swimmers	Number of beaches in 2015
Good	Up to 24	Undetectable	25
Fair	25 to 180	10 or less	16
Poor	181 to 610	11 to 15	0
Very Poor	More than 610	More than 15	0

Beach water quality gradings to denote the recent water quality of open beaches are available on the EPD's website and hotline as well as through weekly press releases.

Legislation and Environmental Protection

Ten ordinances address environmental protection: the Waste Disposal Ordinance, the Water Pollution Control Ordinance, the Air Pollution Control Ordinance, the Noise Control Ordinance, the Ozone Layer Protection Ordinance, the Dumping at Sea Ordinance, the Environmental Impact Assessment Ordinance, the Hazardous Chemicals Control Ordinance, the Product Eco-responsibility Ordinance and the Motor Vehicle Idling (Fixed Penalty) Ordinance.

The government follows a set of environmental quality objectives for better protection of public health and to preserve a natural ecosystem. The cost of imposing limits on polluting emissions is no higher than that needed to achieve conservation goals, which include making maximum use of the environment's natural capacity to absorb and recycle waste.

The EPD works with the construction, catering, vehicle repair, and property management sectors and other trades to promote good practices and compliance with environmental regulations. It runs a Compliance Assistance Centre where businesses may obtain updated

information and advice on environmental compliance, pollution prevention and environmental management.

In 2015, department inspectors made more than 53,500 visits to different locations to enforce controls on air, noise, waste and water pollution and to deal with complaints about pollution, resulting in 416 prosecutions and over \$4 million in fines.

Environmental Monitoring and Auditing

An environmental monitoring and auditing process seeks to validate assumptions made during the planning of development projects and monitors the effectiveness of mitigation measures to ensure every project meets the environmental performance promised in the environmental impact assessment. In 2015, the EPD handled 117 monitoring and auditing programmes for major projects. As required by environmental permits, these projects must set up dedicated websites to publish the results and data obtained from the process.

Meteorological and Geophysical Services

Hong Kong Observatory

Established in 1883, the Hong Kong Observatory currently provides meteorological, climatological, radiation monitoring, oceanographic, geophysical, time and astronomical services.

Weather Forecast and Information Services

Weather information is delivered to the public through the media, the mobile application MyObservatory, the Observatory website, the Windows desktop application Weather Wizard, social media platforms and the Dial-a-Weather telephone service. The Observatory produces free television weather shows regularly and an educational programme, *Cool Met Stuff*, for Hong Kong's major television networks and other media. In 2015, the Observatory's online information service, including its mobile application, registered about 68.8 billion page views.

During the year, the Observatory extended its tropical cyclone track forecast from three days to five days. It launched an 'Automatic Regional Weather Forecast in Hong Kong & Pearl River Delta Region' webpage, providing the public with rainfall forecasts for the next two hours and regional weather forecasts for Hong Kong and the neighbouring region in the following nine days. The Observatory also revamped its home page with a brand-new design and updated MyObservatory with contents catering for users' needs. It launched a 'Met on Map' web portal at the end of the year, integrating global weather and geophysical data for convenient access of information by the public.

The territory's first long-range, dual-polarisation Doppler Weather Radar was installed at Tate's Cairn in 2015. This radar monitors hail and rainfall by identifying hail areas and raindrop sizes in the clouds. The Observatory also improved its radar webpage to refresh radar images of a 64km range in six-minute instead of 12-minute intervals, to provide more timely updates of rain development.

The Observatory issues weather forecasts and warnings, and offers professional advice to the aviation, shipping, engineering and other sectors, as well as government departments. It provides aviation weather services for the Hong Kong International Airport and the Hong Kong Flight Information Region, and issues forecasts of wind, weather, waves and swells for the marine community, container terminals, fishermen and mariners. The Observatory also disseminates warnings on storm surges caused by tropical cyclones and publishes the Hong Kong Tide Table annually.

In an ongoing collaboration with the Government Flying Service, a fixed-wing aircraft is deployed under permissible conditions to undertake reconnaissance flights into tropical cyclones to collect meteorological data for better forecast and warning capability.

Climate Services and Climate Change Related Studies

The Observatory provides a wide range of climatological information and climate prediction services, including updates of phenomena such as El Niño, annual outlook on rainfall and tropical cyclones, and predictions of seasonal temperature and rainfall. It conducts research on past trends and future projections of temperature, rainfall, sea level and extreme weather in Hong Kong, based on the latest assessment of global warming by the United Nations Intergovernmental Panel on Climate Change. In 2015, the Observatory supported the government in launching the Hong Kong Climate Change Report 2015 and provided climate services to various sectors in areas including disaster risk reduction, public health, water resources, urban planning and energy. It also took part in activities connected with the UN Climate Change Conference.

Radiation Measurement and Assessment

The Observatory operates a network of 12 radiation monitoring stations to monitor the ambient radiation levels in Hong Kong and to measure the amount of radioactivity in environmental samples. In the unlikely event of a nuclear accident, the Observatory would step up its radiation monitoring activities, work with other government departments to provide decision makers with an assessment of radiological consequences, and advise on actions to take. Relevant information on radiation levels and the latest developments would be provided to the public through various channels. The Observatory continues to enhance radiation monitoring and assessment capabilities through active collaboration with its Mainland and international counterparts. In 2015, it received ISO 9001 accreditation for its Ambient Gamma Radiation Level Measurement Service.

Geophysical Services

The Observatory monitors earthquakes and tsunamis in the vicinity of Hong Kong and around the world. It provides information on earthquakes and warnings of tsunamis through its website, the media and social media, as well as via SMS and emails for special users.

Astronomical Services

The Observatory provides information about astronomical phenomena such as solar and lunar eclipses. It also publishes astronomical almanacs, providing the traditional Chinese calendar and various types of astronomical and geophysical information. In April, the Observatory

organised a joint webcast of a total lunar eclipse with the Hong Kong Space Museum, the Ho Koon Nature Education cum Astronomical Centre, the Po Leung Kuk Ngan Po Ling College and the Hong Kong Sheng Kung Hui Solar Tower.

Official Time Standard

As Hong Kong's official timekeeper, the Observatory maintains a Time Standard that is accurate to within one ten-millionth of a second per day and contributes to the determination of Co-ordinated Universal Time by the International Bureau of Weights and Measures. Time checks are available to the public through an online network time service, web clocks, the Dial-a-Weather telephone service and local radio stations. The time service handled about 13.4 billion time checks in 2015.

International Co-operation

During the year, memoranda of understanding were signed with Meteo-France and the Philippine Atmospheric Geophysical and Astronomical Services Administration to enhance collaboration in areas such as weather forecast, numerical weather prediction, aviation weather services and tropical cyclone monitoring.

Public Education

To promote the public's awareness of hazardous weather and understanding of climate change, the Observatory conducts a broad range of educational and outreach activities. In 2015, it held seminars, talks and investigative study competitions, launched a mobile version of the Educational Resources webpage and a series of online quiz games, produced educational television programmes with the Education Bureau and online short videos on the theme of climate change, and published a pamphlet titled 'Hong Kong in a Warming World'. The Observatory also produced short videos to raise awareness of mitigation measures one should take during tropical cyclones and issued two television and radio Announcements in the Public Interest on threats of thunderstorms and tropical cyclone swells.

Volunteers from 'Friends of the Observatory', which has more than 11,000 members, support the Observatory's annual open day and conduct public tours of its headquarters in Tsim Sha Tsui on Saturdays. The Observatory's Community Weather Information Network, developed jointly with Hong Kong Polytechnic University, encourages members of the public to participate in weather observation and share their experiences through its Community Weather Observing Scheme. Weather and cloud photos collected from the scheme were used to produce the Observatory's 2016 calendar.

Government Laboratory

The Government Laboratory supports the enforcement of environmental protection legislation and implementation of environmental programmes by providing comprehensive analytical and advisory services. In 2015, numerous tests on environmental samples of air, water, sediment, soil, biota, waste, and liquid fuel, including motor vehicle fuel, marine fuel and biodiesel, were conducted to furnish these programmes with the necessary data. The laboratory also offers analytical services for chemicals regulated under the Stockholm Convention on Persistent Organic Pollutants to help government departments advance the HKSAR Implementation Plan.

Websites

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Civil Engineering and Development Department: www.cedd.gov.hk
Council for Sustainable Development: www.enb.gov.hk/en/susdev/council/index.htm
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