

The Environment

The government's priorities in enhancing the quality of the environment include improving air quality, implementing a waste-to-resources management strategy, improving harbour water quality, promoting energy efficiency and conservation, and combating climate change.

Hong Kong, with only 1,106 square kilometres of land, is home to some seven million people. More than 500 sq km of land is designated as protected areas, including country parks, special areas and conservation zones. But the territory is also one of the world's largest trading economies. 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 cooperation 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. Its 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 2016-17 was budgeted at \$13.9 billion, or about 2.6 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, 67 projects had been approved and 58 of those completed, involving grants totalling more than \$69 million.

The Sustainable Development Division oversees the government's sustainability assessment system, which integrates sustainability considerations into the decision-making process. All bureaux and departments must conduct sustainability assessments of their major initiatives 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 and encourage the public to contribute actively towards a better environment through campaigns and community programmes that promote 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. It also administers the Environment and Conservation Fund, which promotes behavioural and lifestyle changes to protect the environment and promote sustainable development by providing funding to local non-profit-making organisations to implement educational, research and other projects relating to the environment and conservation.

Cross-boundary Cooperation

Hong Kong works with Guangdong and Macao on environmental matters. The Hong Kong and Guangdong governments are working on a mid-term review of emission reduction targets/ranges for the Pearl River Delta region that were endorsed in 2012, to conclude the emission reduction results for 2015 and finalise the targets for 2020. The three sides are also conducting the first regional air-quality study to understand the pollution characteristics of fine suspended particulates (PM_{2.5}). This joint study, to be completed in 2017, will help in the formulation of appropriate and effective policies to combat PM_{2.5} pollution in the region. There are 23 air monitoring stations, including one in Macao. Results from the network showed a substantial reduction in the annual concentration levels of most pollutants in the region in recent years. From 2006 to 2015, the annual concentrations of sulphur dioxide, nitrogen dioxide and respirable suspended particulates decreased 72 per cent, 28 per cent and 34 per cent respectively.

The Cleaner Production Partnership Programme encourages and helps Hong Kong-owned factories in Hong Kong and Guangdong to adopt cleaner production technologies and practices. In the light of environmental benefits brought by the programme, the EPD has extended it till March 2020.

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 completed the second review of the joint programmes for Deep Bay in 2016. The review indicated the programmes were progressing well, with noticeable improvement in the water quality of Deep Bay. The two sides also made recommendations to protect the water environment of Deep Bay. Meanwhile, Hong Kong and Guangdong are actively taking forward a jointly prepared water quality management plan for protecting the water in the Pearl River Estuary, based on their assessment of the estuary's pollution load-carrying capacity.

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 the

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.

The Hong Kong Geological Survey under the Civil Engineering and Development Department produces a series of fifteen 1:20,000-scale geological maps and six accompanying geological memoirs. It also publishes two summary memoirs and a set of 1:100,000-scale geological and thematic maps in Chinese and English, synthesising and giving a popular account of local geology. The department provides geological information on its 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 over 540 species of birds, 57 species of terrestrial mammals, 24 species of amphibians, 86 species of reptiles, 198 species of freshwater fish, 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 government's 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, litter collection, the provision of educational and recreational facilities, and the promotion of a better understanding of the countryside.

There are five marine parks and one marine reserve covering 3,400 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. The SSSI register lists 67 sites.

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 has developed a city-level Biodiversity Strategy and Action Plan for implementation between 2016 and 2021 based on the principles of the convention, taking into account local economic and social priorities, and aspirations of the people. 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 modern 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 cold spells, while 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 occur 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, and may on occasion be relatively cold at night and in the early morning.

The Year's Weather

In 2016, Hong Kong was warmer and much wetter than usual. An intense cold surge, bringing a few days of low temperatures in the latter part of January, was followed in June to August by the third hottest summer since records began in 1884. Overall, the annual mean temperature of 23.6 degrees Celsius was 0.3 degrees higher than normal. Annual total rainfall was 3,026.8mm, about 26 per cent above normal with record-breaking autumn rainfall of 1078.8mm from September to November. Tropical cyclone warning signals were issued nine times, including the No 8 Gale or Storm Signal for the passages of Typhoon Nida in August and Super Typhoon Haima in October.

Climate Change

Measures by Hong Kong

The government attaches great importance to combating climate change. Measures to reduce greenhouse gas emissions include switching to cleaner fuels for power generation; enhancing energy efficiency, particularly in buildings; adopting wider use of renewable energy and waste-to-energy conversion; and developing an efficient and environment-friendly public transport system.

The 2016 Policy Address, recognising the need to step up climate actions and formulate long-term strategies, announced a new inter-departmental Steering Committee on Climate Change chaired by the Chief Secretary for Administration, to steer and coordinate the climate actions of various bureaus and departments. The steering committee reviewed existing policies and the experiences of other countries, and tapped the views of stakeholders and the public. It is considering setting a carbon reduction target for 2030 and implementing measures to enhance mitigation, adaptation and resilience to climate change.

Carbon Intensity Reduction Target

The government focuses on the power and transport sectors, which are the major emission contributors, in working towards its target, set in 2010, of reducing carbon intensity by 50 to 60 per cent by 2020 from the 2005 level. To achieve the targets, the government plans to increase the percentage of natural gas generation to about 50 per cent in 2020, and to maintain the 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 accounts for about 25 per cent of Hong Kong's total fuel mix. The government is prepared to develop more renewable energy, taking account of views received during a public consultation on the future development of the electricity market in 2015, and will also do more to promote energy saving.

To identify carbon reduction measures, the government in 2015 finished conducting energy cum carbon audits on 120 government buildings and public facilities. For the private sector, it operates a Carbon Footprint Repository to encourage regular carbon auditing. As at December 2016, 70 listed companies had disclosed their carbon management experience and practices through the repository's website. The government and the Hong Kong Exchange jointly organised a carbon audit seminar during Eco Expo Asia 2016 to promote carbon audits among listed companies.

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 projected basic tariff levels, to ensure the continued supply of reliable, safe and efficient electricity at reasonable prices. The agreements do not give the companies any exclusive rights to supply electricity. 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. The government is discussing with the companies new agreements with improved terms to take effect after the current ones expire, taking into account the outcome of the 2015 public consultation on the future development of the electricity market.

HK Electric has a total installed capacity of 3,757 megawatts at its Lamma Power Station. CLP Power receives its electricity supply from the Castle Peak Power Company Limited's power stations at Black Point (2,525MW), 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 to facilitate its electricity exports and imports to and from the province. CLP Power imports about 70 per cent of the power generated by the Daya Bay station, which has two 984MW pressurised water reactors. The company also sells electricity to Guangdong from its existing reserve generating capacity. Its sales are 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.

The Central People's Government, in a memorandum of understanding signed between the HKSAR Government and the National Energy Administration in 2008, supported China Guangdong Nuclear Power Holding Company Limited in renewing its supply agreement with Hong Kong for 20 more years. In 2009, the HKSAR Government gave approval for CLP Power to extend its contract for the supply of nuclear electricity from the Daya Bay station for another 20 years from 7 May 2014. The quantity of electricity supply will be no less than the current level.

On a temporary basis from 2014 to 2018, CLP Power is importing some additional 10 per cent of electricity generated by the Daya Bay station. The company is also drawing natural gas 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 half of the 1,200MW capacity of the Guangzhou Pumped Storage Power Station phase 1 at Conghua. It stores off-peak-period electricity from Castle Peak Power's stations and the Daya Bay station in the Conghua plant, 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 by nearly all taxis and more than 70 per cent of public light buses, while natural gas is used for electricity generation and production of town gas. Hong Kong has 1.86 million town gas and 430,000 LPG customers in the domestic, commercial and industrial sectors, of which town gas and LPG respectively accounted for 87.7 and 12.3 per cent of the total fuel gas sold in these sectors in terms of heating values in 2016.

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. It is channelled to customers via a 3,600km pipe network.

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 Castle Peak Power's stations and Lamma Power Station for electricity generation and to the Tai Po plant, and onward from Tai Po to the Ma Tau Kok plant via underground pipelines, for the production of town gas.

The Gas Safety Ordinance regulates the import, 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. End users consumed a total of 289,160 terajoules in 2014, with the commercial, transport, residential and industrial sectors consuming 42, 31, 22 and 5 per cent respectively.

The Electrical and Mechanical Services Department's Energy Efficiency Office promotes efficient use of energy through initiatives including voluntary energy efficiency labelling and registration schemes, and encouraging the use of water-cooled air-conditioning systems and effective

energy management methods. Its Mandatory Energy Efficiency Labelling Scheme requires prescribed products to bear energy labels informing consumers of the products' energy efficiency performance. The scheme covers room air conditioners, refrigerating appliances, compact fluorescent lamps, dehumidifiers and washing machines of 7kg or less in washing capacity. Grading standards for room air conditioners, refrigerating appliances and washing machines, implemented in 2015, save annually an estimated 300 million kilowatt-hours in electricity use and about \$350 million in electricity expenses. The scope of the scheme will be extended to cover more electrical products.

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. Phase 3 is under construction.

The government recognises the importance of renewable energy and the two power companies use clean energy to produce electricity. HK Electric operates an 800kW wind turbine on Lamma and a 1MW thin film photovoltaic system at Lamma Power Station, while CLP Power runs a 200kW renewable energy generation system of solar panels and wind turbines on Town Island in Sai Kung.

Energy-efficient Buildings

Buildings account for about 90 per cent of electricity consumed, so 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 Buildings Energy Efficiency Ordinance's Building Energy Code, under which minimum energy efficiency standards were upgraded in 2015. 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. Energy savings from all new buildings are expected to amount to about 5 billion kWh by 2025.

The bureau's Energy Saving Plan for Hong Kong's Built Environment 2015~2025+, published in 2015, is Hong Kong's first energy saving blueprint. It sets a target of reducing energy intensity by 40 per cent by 2025, and gives the policy, strategy, targets and key actions that can help achieve that target. The bureau will work with stakeholders in the built environment sector through dialogue to foster energy saving.

Pollution Prevention

Air Pollution

The government is working to broadly attain its air quality objectives, set in 2014, by 2020. It has a legal obligation to review the objectives at least once every five years, and the bureau in 2016 embarked on a review that was expected to end in 2018.

The EPD takes action to reduce emissions from local air pollution sources. Between 1997 and 2014, emissions of sulphur dioxide (SO₂), nitrogen oxides (NO_x), respirable suspended particulates (RSP) and volatile organic compounds (VOC) dropped 28 per cent to 65 per cent.

From 2007 to 2016, ambient concentrations of RSP, NO₂ and SO₂ dropped 40 per cent, 11 per cent and 57 per cent respectively, and roadside concentrations of RSP, NO₂ and SO₂ fell 48 per cent, 15 per cent and 68 per cent respectively. Although ambient ozone increased 5 per cent during the same period, there had been initial signs of a reversal over the last two years. The department will continue to strengthen regional collaboration to further alleviate the problem of regional photochemical smog.

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 European Union V standards. Preparations are under way to tighten the emission standards to Euro VI levels.

Nearly all taxis and more than 72 per cent of public light buses run on LPG. The First Registration Tax is reduced for buyers of newly registered environment-friendly commercial vehicles, which have low emissions. An incentive cum regulatory scheme, launched in 2014 to phase out some 82,000 pre-Euro IV diesel commercial vehicles by the end of 2019, had put about 49,700 such vehicles out of service by end-2016.

Diesel vehicles with excessive smoke are subject to stringent controls. Such vehicles must pass a smoke test conducted with a chassis dynamometer to check whether defects have been rectified. In 2016, 3,798 smoky vehicles were reported, about 46 per cent fewer than in 2014. The drop in number was attributed mainly to the phasing out of pre-Euro IV diesel commercial vehicles since 2014. The government deploys mobile roadside remote sensing equipment to detect LPG and petrol vehicles with excessive emissions, and identified 2,652 such vehicles in 2016.

The First Registration Tax for electric vehicles is waived till March 2017. Compared with 2015, the fleet grew 72 per cent to 7,231 in 2016. About 1,500 charging points are available for public use, including some 220 quick and more than 340 medium charging points.

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

Marine transport

Marine vessels are the largest emission source in Hong Kong. To control marine emissions, the government regulates marine fuel quality by capping the sulphur content of local marine light diesel vessels at 0.05 per cent. Ocean-going vessels at berth were required from 2015 to use low-sulphur marine fuel that contained not more than 0.5 per cent sulphur.

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

Power generation

Power plants are a major source of local emissions. The government progressively tightens statutory emission caps on the power sector and encourages the power companies to use cleaner fuels. The emission caps for the three key pollutants, SO₂, NO_x and RSP, were tightened in November 2016, to achieve 52 to 72 per cent of the 2010 levels by 2021.

Indoor Air Quality

The government's Indoor Air Quality (IAQ) Management Programme offers a voluntary IAQ Certification Scheme for offices and public places to recognise good IAQ management practices and to provide incentives for property owners or property management companies to pursue the best 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, which are subject to import quotas with a view to banning their import completely by 2020.

Non-road Mobile Machinery

Emissions from non-road mobile machinery are controlled under a regulation that took effect in 2015, covering 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. 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 December 2015.

Noise Pollution

Road Traffic Noise

Proponents of development projects are required to assess traffic noise impact when planning new residential properties and new roads. They need to provide direct mitigation measures such as barriers and low-noise road surfacing for new roads; and to use innovative building designs such as acoustic balconies and windows to ensure traffic noise at noise-sensitive receivers stays within acceptable levels. These requirements, together with measures including the Noise Barrier Retrofitting Programme and Low Noise Road Surface Trial Programme, have reduced the number of people exposed to excessive traffic noise from 1.14 million to 960,000 over the past 10 years despite increases in the population, number of vehicles and total length of roads.

All newly registered vehicles must comply with internationally recognised noise standards to prevent individual vehicles from producing excessive noise.

Railway Noise

The MTR Corporation carries out noise reduction programmes to address noise problems along railways. New railway projects are required to undergo environmental impact assessments.

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 restrict 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 environmentally friendly construction equipment and to facilitate the construction noise permit application process.

Noise from Industrial or Commercial Activities

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

Waste Management

Waste Statistics¹

Over the past decade, the municipal solid waste dumped at landfills has increased 9 per cent, while the mid-year population has grown 6 per cent. Between 2011 and 2015, municipal solid waste totalling 3.28 million to 3.71 million tonnes annually was disposed of, with the daily per capita disposal rate at between 1.27kg and 1.39kg. Food waste accounted for about 37 per cent of municipal solid waste on average.

Regarding overall construction waste, 1.22 million to 1.53 million tonnes were disposed of at landfills annually over the same five-year period, 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.

¹ Waste statistics for 2016 will be published in the report, *Monitoring of Solid Waste in Hong Kong: Waste Statistics for 2016*, to be released in 2017.

Waste Reduction

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 (1) policies and legislation to drive behavioural changes to reduce waste at source; (2) targeted citywide waste reduction campaigns to arouse public awareness and encourage community participation; and (3) 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' maps out a comprehensive strategy, targets, policies and action plans to manage food waste and yard waste. The government has four strategies to reduce food waste disposal to landfills by 40 per cent by 2022: reduction at source, reuse and donation, recyclable collection, and turning food waste into energy.

The Source Separation of Waste Programme provides waste separation facilities where people live and work. It covers more than 80 per cent of the population.

The Community Recycling Network promotes waste reduction and recycling and provides community-level outlets to collect recyclables of low commercial value. It runs a programme with the District Councils to enhance community participation through district-based education, promotion and waste reduction and recycling activities.

The experience of other cities shows that quantity-based charging can create financial incentives to drive behavioural changes in waste generation, thus reducing the overall amount of unwanted waste. The bureau is preparing to introduce the enabling legislation in the 2016-17 legislative session. As at end-2016, it had approved more than 30 community involvement projects under the Environment and Conservation Fund to try out the implementation of municipal solid waste charging in different types of premises.

In line with the polluter-pays principle, the government continues to introduce Producer Responsibility Schemes to encourage recovery, recycling and waste reduction at source. In March and May 2016, the Legislative Council (LegCo) enacted the enabling legislation for two schemes, on waste electrical and electronic equipment and glass beverage containers. A new treatment and recycling facility being developed to underpin the first scheme is expected to be commissioned by mid-2017.

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. In 2016, tenders to operate the stations in Kwun Tong, Yuen Long and Sham Shui Po were completed and good progress was made in the construction works. These stations are expected to be commissioned progressively from early 2017.

Food Wise Hong Kong Campaign

The Food Wise Hong Kong Campaign 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.

Surplus Food Donation

The government supports 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 supports the recycling trade and educates 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.

Between 2011 and 2015, the recovery rate of paper in municipal solid waste was between 52 per cent and 64 per cent, and that of metal was between 87 per cent and 92 per cent. The recovery rate of plastics dropped from 58 per cent to 11 per cent.

Between 2011 and 2015, 81 per cent to 85 per cent of solid waste, including municipal solid waste and overall construction waste, was recovered each year, working out to an annual average of 23 million tonnes recovered. This annual average was 74 per cent higher than the 13 million tonnes recovered between 2006 and 2010.

EcoPark

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. The 20-hectare EcoPark in Tuen Mun Area 38 promotes the development of the local recycling industry by providing long-term land at affordable costs so as to encourage investment in advanced technologies and value-added recycling processes.

As at December 2016, the EcoPark had leased 13 lots to private recyclers and non-profit-making organisations to recycle cooking oil, metals, wood, electrical and electronic equipment, printed circuit boards, plastics, batteries, construction materials, glass, rubber tyres and food waste.

Recycling Fund

A \$1 billion Recycling Fund, launched in 2015, is open for applications for five years to support projects that raise the quantity and quality of recyclables recovered, as well as projects that promote markets for recycled products and enhance the recycling industry's capability and capacity. Forty-eight applications had been approved by November 2016, involving total funding of about \$54 million.

Waste Treatment and Disposal

Refuse Transfer Stations

Municipal solid waste is collected and delivered to refuse transfer stations by refuse collection vehicles, packed into containers and then taken to landfills in bulk by sea or land. A network of six transfer stations and seven outlying islands transfer facilities handled 2.51 million tonnes of such waste in 2015, delivering about 75 per cent of domestic waste 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, all three landfills need to be extended.

In 2015, the landfills handled 3.71 million tonnes of municipal solid waste. 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. With the ongoing extension of two of the three landfills, the landfill space is estimated to be able to cope with the territory's waste disposal needs up to the late 2020s. A detailed study is under way on how to extend the serviceable life of the remaining landfill space to the mid-2030s.

Hong Kong has 13 restored landfills and some of them have been developed for public use. A Restored Landfill Revitalisation Funding Scheme, launched in 2015, funds the development of recreational facilities and 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. It needs a multi-technology approach 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 cut 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 2023-24. 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. The first such facility, at Siu Ho Wan, North Lantau, is under construction and is due to be commissioned in 2017.

These high-tech facilities do not eliminate the need for waste reduction at source. Landfills are still needed to hold residual waste. A study on planning future waste management and transfer facilities is under way to identify more strategic and regional waste facilities for handling solid waste.

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. The Chemical Waste Treatment Centre on Tsing Yi Island, operated by a government contractor, treated a daily average of 31.4 tonnes of chemical waste and 6.2 tonnes of clinical waste in 2015. Waste producers using its services pay part of the treatment cost.

The Low-level Radioactive Waste Storage Facility at Siu A Chau, an uninhabited island southwest of Lantau, 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.

T•Park, a sludge treatment facility at Tsang Tsui, Tuen Mun, was launched in May 2016. The facility employs an advanced treatment process to treat up to 2,000 tonnes of sewage sludge per day; it treated a daily average of 907 tonnes in 2015. A waste-to-energy installation converts the incineration heat to electricity and exports the surplus electricity generated to the public power grid. T•Park also has a dedicated design to serve the function of public environmental education, receiving 41,900 visitors between May and end-2016.

Construction Waste

Hong Kong generated 18.8 million to 24.6 million tonnes of overall construction waste annually from 2011 to 2015. The reuse rate was 94 per cent in 2015, having remained at above 90 per cent in recent years.

A disposal charging scheme provides an economic incentive to reduce construction waste, maximise the recovery and reuse of inert materials and minimise their disposal at landfills. The government delivers excess 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, Food and Environmental Hygiene Department, Leisure and Cultural Services Department, and 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. The fleet collected nearly 16,492 tonnes of waste from the marine waters and coastal areas of Hong Kong and 4,404 tonnes of refuse from vessels in 2016. In addition to law enforcement, the government tackles the problem through publicity and education.

An inter-departmental working group on clean shorelines seeks to identify 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. Departments in the working group are carrying out enhanced measures to improve shoreline cleanliness in the light of findings from a marine refuse study published by the EPD in 2015. The EPD also organises monthly Shorelines Cleanup Days with community groups at different locations.

A Hong Kong-Guangdong Marine Environmental Management Special Panel aims to foster cross-boundary cooperation in tackling marine refuse. The theme of its campaigns remained 'Protect our coast, leave no trace' in 2016.

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 23,000 tonnes of waste in 2016.

From the environmental protection perspective, livestock farming in urbanised Hong Kong is not sustainable. The government's voluntary licence-surrender schemes, introduced in 2005 and 2006, offers ex gratia payments for poultry and pig farmers respectively to cease livestock farming permanently. These schemes, together with a buyout scheme launched in 2008, have decreased the number of pig and poultry farms from 459 in 2005 to 72 by end-2016, and reduced pollution of the environment.

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 90 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 untreated sewage from the remaining parts of Hong Kong Island to the Stonecutters Island Sewage Treatment Works, which provide centralised chemical treatment for sewage from the entire catchment under the scheme. Since the Stage 2A project was commissioned in 2015, sewage from both sides of Victoria Harbour has been diverted to the Stonecutters Island plant for centralised treatment and disinfection before discharge. In early 2016, the government commissioned a consultancy study on further enhancing the quality of the harbour's coastal waters.

The government will spend \$18 billion on sewerage schemes over the next five years, covering 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. More than 10,500 village houses are now connected to the public sewers.

Sewage Disposal in Rural Areas

Improvements continue to be made to sewage disposal facilities in rural areas. In 2016, the government drew up plans to invest further in projects providing public sewers to convey domestic discharges from villages in 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. Twenty-seven 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 monthly bill for domestic accounts will rise from \$11 in 2007 to \$27 eventually.

Water Quality

The harbour waters, once polluted by sewage from the surrounding older urban areas, have improved markedly since Stage 1 of the harbour scheme began in 2001. 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.

River quality has also improved, by controlling pollution at source. In 2016, 82 per cent of the rivers monitored fell in the 'good' and 'excellent' categories while 7 per cent belonged to the 'bad' and 'very bad' categories. No river fell into the 'very bad' category.

There are 10 water control zones, all subject to marine water quality objectives under the Water Pollution Control Ordinance. The government is considering preliminary proposals to revise these objectives.

Bathing Beaches

Strict standards apply in controlling the water quality at bathing beaches. The pollution level is 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 2016.

Beach water quality ranking	Geometric mean of E coli count per 100ml of beach water during bathing season	Cases of minor health risk per 1,000 swimmers	Number of beaches in 2016
Good	Up to 24	Undetectable	18
Fair	25 to 180	10 or less	23
Poor	181 to 610	11 to 15	0
Very Poor	More than 610	More than 15	0

Gradings of the water quality at 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, Water Pollution Control Ordinance, Air Pollution Control Ordinance, Noise Control Ordinance, Ozone

Layer Protection Ordinance, Dumping at Sea Ordinance, Environmental Impact Assessment Ordinance, Hazardous Chemicals Control Ordinance, Product Eco-responsibility Ordinance and Motor Vehicle Idling (Fixed Penalty) Ordinance.

A set of environmental quality objectives are also in place to protect public health and preserve a natural ecosystem. The cost of imposing limits on polluting emissions is no higher than that needed to achieve conservation goals, which include maximising 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 2016, department inspectors made more than 84,000 visits to different locations to enforce controls on air, noise, waste and water pollution and to deal with complaints about pollution, resulting in 722 convictions and \$6.7 million in fines.

Environmental Monitoring and Auditing

Development projects undergo an environmental monitoring and auditing process to validate assumptions made during the planning stage and monitor the effectiveness of mitigation measures, to ensure every project meets the environmental performance promised in its environmental impact assessment. In 2016, the EPD handled 99 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 provides meteorological, climatological, radiation monitoring, oceanographic, geophysical, time and astronomical services.

Weather Forecasting and Information Services

The Observatory publicises weather information through the media, mobile application MyObservatory, Observatory website, Windows desktop application Weather Wizard, social media platforms and Dial-a-Weather telephone service. It produces regular weather television programmes and an educational series, *Cool Met Stuff*, for free for Hong Kong's major television networks and other media. In 2016, its online services, including MyObservatory, surpassed 100 billion page views and its YouTube channel accumulated more than 12.8 million views.

During the year, the Observatory launched an 'Announcement on Localised Heavy Rain' service to issue alerts about potential serious flooding due to heavy rain in individual districts, and revamped the 'Weather Information for Schools' webpage to provide more regional rainfall information. It enhanced the 'Automatic Regional Weather Forecast in Hong Kong and Pearl River Delta Region' service to give automated nine-day regional weather forecasts for more

locations in Hong Kong, and improved the 'Met on Map' web portal to offer information including global satellite mosaics, visibility and relative humidity, and lightning locations.

The Observatory also launched a 'Weather Note' webpage to communicate better with the public about interesting weather issues, and 'Post of the Day' to give daily online reminders on weather, climate and related news through social media and MyObservatory, which was extended to wearable devices. The 'Weather Information for Outdoor Photography' and 'Hong Kong Weather Information for Tourists' websites were launched to provide weather photographs round the clock, including pictures taken at the Victoria Peak.

The Observatory issues weather forecasts and warnings, and offers professional advice to government departments and the aviation, shipping, engineering and other sectors. 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 in the event of storm surges caused by tropical cyclones. In an ongoing collaboration with the Government Flying Service, a new meteorological dropsonde system was deployed in 2016 to collect meteorological profile data over the South China Sea when conditions allowed, to strengthen the analysis and forecasting of tropical cyclones.

Climate Services and Climate Change Related Studies

The Observatory provides climatological information and climate prediction services, including updates of phenomena such as El Niño and La Niña, an annual outlook on rainfall and the number of tropical cyclones affecting Hong Kong, and projections of seasonal temperature and rainfall. Climate services offered to government departments and stakeholders cover disaster risk reduction, public health, water resources, urban planning and energy. The Observatory also 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, and provides the latest climate change information and assessment in support of policymaking and initiatives to combat climate change. In 2016, the Observatory jointly produced short videos and educational TV programmes on climate change and its impact in collaboration with stakeholders and partners, published the second edition of a climate change pamphlet, 'Hong Kong in a Warming World', and launched a revamped webpage on climate change.

Radiation Monitoring and Assessment

The Observatory operates 12 radiation monitoring stations to monitor ambient radiation levels and measures the amount of radioactivity in environmental samples. In the unlikely event of a nuclear incident, the Observatory will 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 will be provided to the public through various channels. A new computer system to assess nuclear accident consequences was put into operation in 2016. The Observatory also enhances radiation monitoring and assessment capabilities through active collaboration with its Mainland and international counterparts.

Marine and Geophysical Services

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

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

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 Coordinated 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, Dial-a-Weather and radio stations. These services handled about 25 billion time-check requests in 2016.

External Cooperation

During the year, the Observatory signed a tripartite agreement with the Civil Aviation Administration of China and the China Meteorological Administration to jointly establish an Asian Aviation Weather Centre, with Hong Kong serving as the backup centre.

The World Meteorological Organisation entrusted the Observatory with developing a web-based version of the *International Cloud Atlas* as an authoritative standard reference for weather observations, scheduled to be launched in March 2017.

Public Education

The Observatory promotes public awareness of hazardous weather and understanding of climate change through outreach activities. In 2016, it staged in collaboration with other government departments and partners under the 'Science in the Public Service' campaign a roving exhibition, 'Climate Change·Our Response', at more than 10 venues, attracting over 100,000 visitors. A virtual tour of the exhibition was made available online.

The Observatory works with schools and the community to promote weather education through its Community Weather Information Network, a joint initiative with Hong Kong Polytechnic University and the Chinese University of Hong Kong that encourages residents to share weather photos and observations. 'Friends of the Observatory', which had more than 11,000 members, celebrated its 20th anniversary during the year.

Government Laboratory

The Government Laboratory supports the enforcement of environmental protection legislation and implementation of environmental programmes by providing comprehensive analytical and advisory services. It conducts tests on environmental samples of air, water, sediment, soil, biota, waste, and liquid fuel, including motor vehicle fuel, marine fuel and biodiesel, 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.

Websites

Agriculture, Fisheries and Conservation Department: www.afcd.gov.hk

Civil Engineering and Development Department: www.cedd.gov.hk

Council for Sustainable Development:

www.enb.gov.hk/en/susdev/council/index.htm

Electrical and Mechanical Services Department: www.emsd.gov.hk

Environment Bureau: www.enb.gov.hk

Environmental Protection Department: www.epd.gov.hk

Food Wise Hong Kong Campaign: www.foodwisehk.gov.hk

Harbour Area Treatment Scheme: www.cleanharbour.gov.hk

Hong Kong Observatory: www.hko.gov.hk and www.weather.gov.hk

Hong Kong Observatory *Cool Met Stuff* channel: url.hko.hk/cms

MyObservatory app: www.weather.gov.hk/myobservatory_e.htm

MyWorldWeather app: worldweather.wmo.int/en/apps.html

'Science in the Public Service' campaign: www.science.gov.hk

Sustainable Development Division: www.susdev.gov.hk

World Weather Information Service: worldweather.wmo.int