

## 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. Improving 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 quality of life and are government priorities.

Government spending on the environment in 2017-18 was budgeted at \$14.8 billion, or about 2.8 per cent of total public expenditure.

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; promotes environmental management, auditing and reporting; and raises environmental awareness in the community.

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 the government and the community. All bureaus and departments must conduct sustainability assessments of their major initiatives and present the implications to the Policy Committee and Executive Council.

This division also renders secretariat support to the Council for Sustainable Development, which is appointed by the Chief Executive to promote sustainable development in Hong Kong. Another major role is to administer the Sustainable Development Fund, which provides grants for projects that enhance public awareness of sustainable development or encourage sustainable practices. Since 2003, 67 projects had been approved and 63 of those completed, involving grants totalling more than \$69 million.

The EPD works closely with the government-appointed Environmental Campaign Committee to encourage the public's contribution to a better environment through campaigns and community programmes. The department's environmental resource and education centres provide the public with easy access to environmental information. The government administers the Environment and Conservation Fund to promote behavioural and lifestyle changes by supporting local non-profit-making organisations to conduct educational, research and other projects about the environment and conservation.

### **Cross-boundary Cooperation**

Hong Kong works with Guangdong and Macao on environmental matters. In 2017, the Hong Kong and Guangdong governments completed a mid-term review of emission reduction targets and ranges for the Pearl River Delta region and finalised the targets for 2020. All three sides also concluded the first regional air-quality study to understand the pollution characteristics of fine suspended particulates (PM<sub>2.5</sub>). This joint study helped formulate appropriate and effective policies to combat PM<sub>2.5</sub> 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 concentrations of most pollutants in the region in recent years. From 2006 to 2016, the annual concentrations of sulphur dioxide, nitrogen dioxide and respirable suspended particulates decreased 74 per cent, 24 per cent and 38 per cent respectively.

The Cleaner Production Partnership Programme helps Hong Kong-owned factories in Hong Kong and Guangdong 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 implementing joint action programmes to protect the quality of adjoining waters. The programmes are progressing well. The water quality has shown noticeable improvement in Deep Bay and has remained consistently good in Mirs Bay. Separately, Hong Kong and Guangdong are taking forward a joint water quality management plan to protect the Pearl River Estuary 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 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 presenting an account of local geology.

### *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, 199 species of freshwater fish, 236 species of butterflies and 124 species of dragonflies.

Among the rich terrestrial biodiversity, some species are found only in Hong Kong, including the Romer's tree frog, Bogadek's burrowing lizard, Hong Kong tusk-tail and Hong Kong club-tail. Hong Kong is also home to a number of globally threatened species, such as the three-banded box turtle, yellow-breasted bunting, short-legged toad, Chinese pangolin and Chinese tiger dragonfly.

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. Around 400 species of birds have been observed in this area. Fifty species are considered globally threatened or near 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. Warblers, flycatchers, robins, thrushes, bulbuls and tits are among the birds that have been sighted.

Areas around the Kowloon reservoirs are inhabited by monkeys descended from individuals released there in the early 20th century. These monkeys include the rhesus macaque and hybrids of the rhesus macaque and long-tailed macaque. Some have migrated to the forested areas of Shing Mun Reservoir and Tai Po Kau. The feeding of monkeys is prohibited, to make them forage for natural food in the countryside.

Other mammals that are very common in the countryside include the red muntjac and Eurasian wild pig, while the leopard cat, small-toothed ferret badger and masked palm civet are relatively

uncommon. Cave-dwelling bats such as the Pomona leaf-nosed bat and Chinese horseshoe bat are found in caves and water tunnels, while the short-nosed fruit bat roosts under the Chinese fan palm. Sightings of rare species, such as the Eurasian otter, crab-eating mongoose and Chinese pangolin, are reported occasionally.

More than 100 species of amphibians and reptiles make Hong Kong home. 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 five species of sea turtles recorded in Hong Kong waters, only the green turtle is known to be breeding locally.

### *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.

The government's Marine Parks programme is important in protecting and conserving sites of special ecological and conservation value. In addition, artificial reefs are deployed in suitable waters to improve inshore fishery resources and biodiversity.

### *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 44,312 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, such as farming or field trials.

### ***UN Convention on Biological Diversity***

The United Nations Convention on Biological Diversity, which covers Hong Kong as part of China, aims 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. The government has developed a city-level Biodiversity Strategy and Action Plan for implementation between 2016 and 2021 based on the objectives and 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 that may affect biodiversity adversely. 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***

The year 2017 was rather warm. Hong Kong registered an annual mean temperature of 23.9 degrees Celsius, 0.6 degrees above normal and among the third warmest since records began in 1884. The maximum temperature of 36.6 degrees recorded at the Hong Kong Observatory headquarters on 22 August was the highest on record, while the annual total rainfall of 2,572.1mm was 7 per cent more than normal.

Tropical cyclone warning signals were issued seven times, with five tropical cyclones necessitating the issuance of warning signals No 8 or above. The strongest of the warnings, the No 10 Hurricane Signal, was issued during the passage of Super Typhoon Hato in August and was the first since Severe Typhoon Vicente hit Hong Kong in July 2012. The storm surge brought by Hato raised water levels in Hong Kong generally by one to two metres. It coincided with the high water from the astronomical tide, causing an aggregated effect that flooded many low-lying areas. Quarry Bay waters rose up to 3.57 metres above Chart Datum, the second highest in Quarry Bay since instrument records began in 1954, surpassed only by the record associated with Super Typhoon Wanda in 1962.

## **Climate Change**

### *Measures by Hong Kong*

The Paris Agreement, which came into force in November 2016, applies to Hong Kong. The government is fully committed to joining hands with the international community in combating climate change and, in January 2017, released Hong Kong's Climate Action Plan 2030+, which sets out a series of key measures on mitigation, adaptation and resilience. The Chief Secretary for Administration chairs the Steering Committee on Climate Change to steer and coordinate the actions of bureaus and departments.

### *Carbon Intensity Reduction Target*

Hong Kong targets reducing its carbon intensity by between 65 per cent and 70 per cent by 2030 compared with the 2005 level. To do so, most of the coal-fired generating units, which are due for decommissioning by 2030, will be phased down and replaced with cleaner energy sources. The government will also promote renewable energy, waste-to-energy conversion and energy efficiency and conservation, and develop an efficient and environment-friendly public transport system.

From 2017, bureaus and departments are required to improve carbon management by conducting regular carbon audits on major government buildings that use more than 500,000 kilowatt-hours annually, with a view to disclosing their carbon emission data and exploring ways of carbon reduction. In parallel, the Environment Bureau has published a set of nine carbon audit guidebooks covering different types of premises, to help bureaus, departments and the private sector carry out carbon audits. For the private sector, it operates a Carbon Footprint Repository to encourage regular carbon auditing. As at December, 79 listed companies had disclosed their carbon management experiences and practices through the repository's website. The government also worked with Hong Kong Exchanges and Clearing Limited 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. 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. In April 2017, the government entered into post-2018 Scheme of Control Agreements with each power company. Key terms of the new agreements include reducing the permitted rate of return from 9.99 per cent to 8 per cent with a term of about 15 years, introducing mechanisms to encourage the power companies to do more to promote energy efficiency and conservation and renewable energy, improving the charging arrangement for fuel costs, improving incentive and penalty schemes on the companies' operational performance, and setting out requirements for the necessary preparatory work to pave the way for introducing potential new suppliers when the requisite market conditions are present.

HK Electric has a total installed capacity of 3,507 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).

HK Electric and CLP Power 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, supports 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 hydroelectricity 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 about 10 million and 2.6 million cubic metres respectively. It is channelled to customers via a pipe network of some 3,600km.

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.

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.

### Energy Saving

Energy consumption is closely related to greenhouse gas emissions. Improving energy efficiency helps combat global climate change. End users consumed 287,986 terajoules in 2015, with the commercial, transport, residential and industrial sectors taking up 43, 31, 21 and 5 per cent respectively.

The bureau's Energy Saving Plan for Hong Kong's Built Environment 2015~2025+ is the city's first energy-saving blueprint. It sets a target of reducing energy intensity by 40 per cent by 2025, and outlines the policy, strategies, targets and key actions that can help achieve that target. The bureau is also working with the built environment sector to promote energy saving measures.

The Electrical and Mechanical Services Department's Energy Efficiency Office promotes efficient use of energy through legislation and public education initiatives. 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. Coupled with an upgrading of grading standards for room air conditioners, refrigerating appliances and washing machines in 2015, the scheme would save annually an estimated 400 million kWh in electricity use. The scheme will be extended to cover more electrical products<sup>1</sup> and is expected to save more than 600 million kWh a year after the extension.

The government's district cooling system at the Kai Tak Development provides chilled water to non-domestic developments for air conditioning. It is being completed in phases and now

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<sup>1</sup> Televisions, washing machines with a washing capacity of 7kg to 10kg, room air conditioners for heating and cooling, electric storage water heaters and induction cookers.

provides chilled water to buildings including the Kai Tak Cruise Terminal and Trade and Industry Tower. Upon full completion, the system would consume 35 per cent less electricity than traditional air-cooled air-conditioning systems. The government will consider implementing district cooling systems in other New Development Areas and Redevelopment Areas.

### *Promotion of Renewable Energy*

The Paris Agreement highlights the need for wider promotion of renewable energy. The government has set a target for providing renewable energy in new schools, educational buildings, open space and public parks. For existing government buildings undergoing major renovation works, renewable energy technologies must be incorporated where technically and financially practicable. A sum of \$200 million has been set aside for bureaus and departments to provide renewable energy installations at government premises and infrastructure.

The two power companies have an important role to play in promoting the adoption of renewable energy. 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. New measures introduced in the post-2018 Scheme of Control Agreements, such as a Feed-in Tariff Scheme, aim to encourage both companies to step up their renewable energy efforts.

### *Energy-efficient Buildings*

Buildings account for about 90 per cent of the electricity consumed, so promoting their efficient use of energy is of paramount importance in reducing greenhouse gas emissions. The Building Energy Code under the Buildings Energy Efficiency Ordinance stipulates the minimum energy efficiency standards for major installations, including air conditioning, electrical installations, lighting, lifts and escalators. Commercial buildings are required to conduct energy audits every 10 years. Energy savings from all new buildings are expected to total about 5 billion kWh by 2025.

The government is taking the lead to save energy in buildings. It is working to save 5 per cent of electricity use in government buildings from 2015-16 to 2019-20 under operating conditions comparable to 2013-14. To achieve this target, energy audits for about 350 major government buildings have been completed, and at least \$600 million earmarked to implement energy-saving projects identified in the audits.

Retro-commissioning is a cost-effective and useful means of saving energy in existing buildings. The Electrical and Mechanical Services Department published technical guidelines in June and organised seminars to help building owners and relevant trades carry out retro-commissioning.

Under the post-2018 agreements, the power companies will further promote energy efficiency and conservation via measures including introducing new energy-saving funds and expanding existing energy-efficiency funds and energy-saving loan funds.

## Pollution Prevention

### Air Pollution

The government is working to broadly attain its air quality objectives by 2020. The EPD is collecting views on possible new air quality improvement measures and expects to complete its review of the objectives in 2018.

The department takes action to reduce emissions from local air pollution sources. Between 2007 and 2015, emissions of sulphur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), respirable suspended particulates (RSP) and volatile organic compounds (VOC) dropped 27 percentage points to 76 per cent. From 2008 to 2017, ambient concentrations of RSP, fine suspended particulates (FSP), nitrogen dioxide (NO<sub>2</sub>) and SO<sub>2</sub> dropped 31 per cent, 42 per cent, 25 per cent and 60 per cent respectively, and roadside concentrations of RSP, FSP, NO<sub>2</sub> and SO<sub>2</sub> fell 43 per cent, 37 per cent, 12 per cent and 70 per cent respectively. Ambient ozone increased 31 per cent during the same period, indicating that the regional photochemical smog problem remains challenging. The department will continue to strengthen regional collaboration to tackle the problem.

### 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. The emission standards for newly registered vehicles, except diesel private cars, buses with a design weight of not more than 9 tonnes, light buses with a design weight of more than 3.5 tonnes, motorcycles and tricycles, were tightened from Euro V to Euro VI in phases starting from 1 July, and those for newly registered diesel private cars were tightened from California LEV II to LEV III from 1 October.

Nearly all taxis and about 74 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 and 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 60,200 such vehicles out of service by end-2017.

The Smoky Vehicle Control Programme and the Strengthened Emissions Control for Petrol and LPG Vehicles Programme aim to control excessive smoke from diesel vehicles and excessive emissions from petrol and LPG vehicles due to poor maintenance. In 2017, 3,122 diesel vehicles with excessive smoke were reported and 2,988 petrol and LPG vehicles with excessive emissions were identified by roadside remote sensors. Such vehicles must pass a chassis dynamometer emission test at a test centre within 12 days to prove the emission problem has been rectified.

The government offers first registration tax concessions for electric vehicles. Between 1 April 2017 and 31 March 2018, the tax on electric commercial vehicles, motorcycles and tricycles is fully waived, and that on electric private cars is waived up to \$97,500. The fleet grew 53 per cent from 2016 to 11,099 in 2017. About 1,860 charging points are available for public use, including some 330 quick and 600 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 a major air emission source in Hong Kong. To control marine emissions, the government caps the sulphur content in locally supplied marine light diesel at 0.05 per cent and requires ocean-going vessels to switch to low-sulphur fuel while at berth.

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

### **Power Generation**

Power plants are a major source of local emissions. The government tightens statutory emission caps on the power sector progressively and encourages the power companies to use cleaner fuels. The emission caps for the three key pollutants, SO<sub>2</sub>, NO<sub>x</sub> and RSP, were tightened in 2017 to achieve cuts of 59 per cent to 79 per cent in 2022 compared with 2010 levels.

### **Indoor Air Quality**

The 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**

Regulations controlling non-road mobile machinery emissions require new machinery supplied for use in Hong Kong to meet statutory emission requirements, namely the Euro Stage IIIA emission standard for machines such as crawler cranes, air compressors and excavators, 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 EPD-issued labels.

### **Noise Pollution**

#### **Road Traffic Noise**

Proponents of development projects are required to assess traffic noise impact when planning new roads and residential developments, provide direct mitigation measures such as noise barriers and low-noise road surfacing for new roads, and adopt noise mitigation designs such as acoustic balconies and windows. All newly registered vehicles must comply with internationally recognised noise standards. In addition, the government mitigates the impact of traffic noise on nearby residents by installing noise barriers and laying low-noise road surfacing

materials, with 90 road sections enhanced through these efforts as at end-2017. All these requirements and measures have reduced the number of people exposed to excessive traffic noise from 1.14 million in the past to about 900,000 despite increases in the population, number of vehicles and total length of roads.

### *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 will continue to explore all practicable mitigation measures.

### *Construction Noise*

The department issues construction noise permits to control noise from general construction works between 7pm and 7am and at all times on public holidays. Strict criteria under these permits restrict the use of equipment and the conduct of noisy manual activities in built-up areas. Percussive piling is prohibited at night and on public holidays, and requires a permit during the day on non-public holidays. The use of noisy diesel, steam and pneumatic piling hammers is generally banned, while hand-held percussive breakers and air compressors used in construction must meet strict noise standards and be issued with noise emission labels. Apart from these legal controls, the department also promotes quiet construction equipment and technologies to the construction industry.

### *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 tone down within a given period.

## **Waste Management**

### *Waste Statistics<sup>2</sup>*

Over the past decade, the municipal solid waste dumped at landfills has increased 13 per cent, while the mid-year population has grown 6 per cent. Between 2012 and 2016, municipal solid waste totalling 3.4 million to 3.79 million tonnes annually was disposed of, with the daily per capita disposal rate at between 1.30kg and 1.41kg. Food waste accounted for 36 per cent of municipal solid waste on average.

During the same five-year period, landfills took in 1.26 million to 1.62 million tonnes of construction waste annually, an average 40 per cent drop on the 2.39 million tonnes in 2005 before the launch of a Construction Waste Charging Scheme in 2006.

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<sup>2</sup> Waste statistics for 2017 will be published in the report, *Monitoring of Solid Waste in Hong Kong: Waste Statistics for 2017*, to be released in 2018.

### **Waste Reduction**

The Hong Kong Blueprint for Sustainable Use of Resources 2013-2022 details the strategy, policies and plans to reduce the per capita municipal solid waste disposal rate. The government will set out policies and legislation to drive behavioural changes to reduce waste at source, undertake targeted citywide waste reduction campaigns to raise public awareness and encourage community participation, and enhance waste-related infrastructure.

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 the disposal of food waste in landfills by 40 per cent by 2022: reduction at source, reuse and donation, recyclable collection, and waste-to-energy conversion.

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.

Quantity-based waste charging creates financial incentives that aim to drive behavioural changes in waste generation and hence reduce overall waste disposal. The government is committed to introducing municipal solid waste charging as a key policy tool and expects to implement a charging scheme towards the end of 2019 at the earliest.

The government continues to introduce producer responsibility schemes to encourage recovery, recycling and waste reduction at source. In 2017, subsidiary legislation for the scheme on waste electrical and electronic equipment was enacted, while a new treatment and recycling facility, WEEE • Park, was completed and put into initial operation to handle regulated waste equipment.

### **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.

The Community Recycling Network promotes waste recycling by providing community-level outlets to collect recyclables of low commercial value. Community participation is encouraged through district-based education, promotion and waste reduction and recycling activities. A publicity programme is undertaken to enhance awareness of clean recycling, which would in turn increase the recyclability and economic value of recyclables.

The network of community green stations is being expanded across the territory to strengthen support for recycling at the community level. In 2017, the stations in Kwun Tong, Yuen Long and Sham Shui Po were commissioned.

Between 2012 and 2016, an annual average of 56 per cent of paper and 90 per cent of metal in municipal solid waste was recovered. The recovery rate of plastics was 14 per cent.

During the same period, an average of 83 per cent of solid waste, including municipal solid waste and overall construction waste, was recovered each year, working out to an annual

average of 24 million tonnes recovered. This annual average was 60 per cent higher than the 15 million tonnes recovered between 2007 and 2011.

### *EcoPark*

More than 90 per cent of recyclable municipal solid waste is exported for recycling every year, with plastics, paper and metals contributing about 95 per cent of the recovered waste. The 20-hectare EcoPark in Tuen Mun promotes development of the 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, the EcoPark had leased 11 lots to private recyclers to recycle cooking oil, metals, wood, electrical and electronic equipment, 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. As at end-December, 115 projects were either in progress or ready to start, involving total funding of about \$90 million. In view of the Mainland's expected tightening of requirements in early 2018 on the imports of recyclables, new measures were launched under the fund to help Hong Kong recyclers process recyclables, particularly paper and plastics, to tackle the challenges ahead.

## **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 13 transfer facilities handled 3 million tonnes of such waste in 2016, delivering about 85 per cent of domestic waste to landfills.

### *Landfills*

With the South East New Territories Landfill accepting only construction waste since 6 January 2016, all municipal solid waste is disposed of at the other two large strategic landfills in the New Territories. All three landfills are operated to high environmental standards. To maintain an uninterrupted waste disposal service to the public, all three landfills need to be extended to serve as the final repositories for a considerable amount of residual solid waste.

In 2016, the landfills handled 3.79 million tonnes of municipal solid waste. About 62 per cent was domestic waste and the remainder was commercial and industrial waste. On average, each person disposed of 1.41 kg 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 funds the development of recreational facilities and other innovative proposals at the restored landfills. In 2017, the high-level Steering Committee on Climate Change shortlisted two non-profit-making organisations to draw up detailed revitalisation proposals for the Tseung Kwan O Stage I Landfill and Ma Yau Tong Central Landfill.

### *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. An 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 waste volumes by 90 per cent and to turn waste into energy, thereby reducing greenhouse gas emission. It is scheduled for commissioning in 2024. The territory also plans to build a network of five or six organic waste treatment facilities that will use biological technologies to turn food waste separated at source into useful resources such as biogas, with compost as a byproduct. The first such facility, at Siu Ho Wan in North Lantau, is due to be commissioned in 2018.

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 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 34.9 tonnes of chemical waste and 6.6 tonnes of clinical waste in 2016. Waste producers using its services pay part of the treatment cost.

The government's policy is to return low-level radioactive waste to the original suppliers as far as possible, hence only some of the waste will be transferred for long-term storage to the Low-level Radioactive Waste Storage Facility at Siu A Chau, an uninhabited island southwest of Lantau. This facility is purpose-built to meet stringent international standards for the safe storage of low-level radioactive waste.

T • Park, a sludge treatment facility at Tsang Tsui, Tuen Mun, employs an advanced treatment process to treat up to 2,000 tonnes per day of sewage sludge generated from sewage treatment works. It has waste-to-energy facilities to convert the incineration heat to electricity and export the surplus electricity generated to the public power grid. In 2016, 418,757 tonnes of sewage sludge were treated and 2.2 million kWh of electricity was exported. The many ingeniously designed facilities for environmental education and recreation attracted 79,785 visitors in 2017.

### **Construction Waste**

An annual average of 23.7 million tonnes of overall construction waste was generated in Hong Kong from 2012 to 2016. The reuse rate was 93 per cent in 2016, having remained at above 90 per cent in recent years.

A disposal charging scheme provides economic incentives to reduce construction waste, encourage the recovery and reuse of inert materials, and reduce their disposal at landfills. The charges were adjusted in April to maintain their effectiveness in encouraging less waste disposal.

### **Marine Refuse**

Clearing marine refuse, including refuse that is washed ashore, involves a number of government departments, including 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 contractors' vessels that was expanded to 80 from about 70 in October 2017. The fleet comprises various types of vessels to scavenge floating refuse and collect domestic refuse from vessels in the anchorages and typhoon shelters. It collected nearly 11,600 tonnes of marine refuse from the waters and coastal areas of Hong Kong and 4,400 tonnes of domestic refuse from vessels in 2017.

Member departments of the Inter-departmental Working Group on Clean Shorelines implement improvement measures to keep the shorelines clean, and promote the importance of reducing marine refuse under the theme, 'Protect our coast, leave no trace'. The EPD also co-organises monthly Shorelines Cleanup Days with community groups.

The Hong Kong-Guangdong Marine Environmental Management Special Panel developed a notification and alert mechanism in 2017 to enhance mutual responsiveness to the marine refuse issue in the region.

### **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 23,612 tonnes of waste in 2017.

### **Sewage Treatment and Disposal**

The government will spend \$18.4 billion on public sewerage infrastructure projects over the next five years, covering sewerage for rural villages.

### *Victoria Harbour and Harbour Area Treatment Scheme*

The public sewerage system serves over 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 full commissioning of stages 1 and 2A of the Harbour Area Treatment Scheme in 2015 has enabled all sewage from both sides of Victoria Harbour to be intercepted and conveyed through a network of deep tunnels to the Stonecutters Island Sewage Treatment Works for chemical treatment and disinfection before discharge. As a result, the overall water quality in the harbour has improved significantly. A two-year study is under way to develop measures that will alleviate pollution problems caused by the discharge of residual pollutants through the storm water systems, so as to further enhance the coastal water quality and environment of the harbour.

### *Sewage Disposal in Rural Areas*

As at end-2017, more than 12,100 village houses were connected to public sewers. Resources are also allocated in the form of loan and grant schemes to help eligible households connect their buildings to the public sewers.

### *Sewage Charges*

All water users who discharge their sewage into public sewers pay a basic sewage charge under 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. Under a 10-year increment scheme for sewage charges launched in 2007, the latest prescribed rate is \$2.92 per cubic metre of water supplied.

## **Water Quality**

The water quality of Victoria Harbour has improved markedly since stages 1 and 2A of the Harbour Area Treatment Scheme were fully commissioned in 2015. In 2017, the harbour's overall compliance with water quality objectives was as high as 83 per cent.

By controlling pollution at source, river water quality has also improved. In 2017, 87 per cent of the river monitoring stations were categorised as 'good' or 'excellent', 6 per cent belonged to the 'bad' category, and none fell within the 'very bad' category.

### *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. All gazetted beaches meet the government's water quality objective for bathing.

| <b>Beach water quality ranking</b> | <b>Geometric mean of E coli count per 100ml of beach water during bathing season</b> | <b>Cases of minor health risk per 1,000 swimmers</b> | <b>Number of beaches in 2017</b> |
|------------------------------------|--|--|----------------------------------|
| Good                               | Up to 24   | Undetectable   | 23                               |
| Fair                               | 25 to 180  | 10 or less   | 18                               |
| 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, hotline and 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 emission caps 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.

Departmental inspectors conduct site visits to enforce controls on air, noise, waste and water pollution and to deal with complaints about pollution, resulting in 754 convictions and \$5.97 million in fines in 2017.

### **Environmental Monitoring and Auditing**

Development projects undergo an environmental monitoring and auditing process to validate assumptions made during the planning stage and to monitor the effectiveness of mitigation measures, so as to ensure every project meets the environmental performance promised in its environmental impact assessment. These projects are required under their environmental permits to publish the results and data obtained from the process on dedicated websites or the Environmental Impact Assessment Ordinance site. In 2017, the EPD handled 109 monitoring and auditing programmes for major projects.

## **Meteorological and Geophysical Services**

### **Hong Kong Observatory**

Established in 1883, the 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 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 2017, the online information services, including MyObservatory, exceeded 160 billion page views and the YouTube channel accumulated more than 18 million views.

During the year, the Observatory enhanced the Hong Kong Heat Index information service by providing real-time data collected at Beas River in Sheung Shui, in addition to data collected at King's Park. Weather outlook services were extended to give probability forecasts of daily minimum and maximum temperatures for the next 14 days and of tropical cyclone tracks up to nine days ahead. The 'Met on Map' web portal began publishing additional weather information, including the heat index and high-resolution satellite images.

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 and container terminals. Warnings are disseminated when tropical cyclones cause storm surges. In an ongoing collaboration with the Government Flying Service, a meteorological dropsonde system collects meteorological profile data over the South China Sea when conditions allow, to strengthen the analysis and forecasting of tropical cyclones. At the end of 2017, the Observatory launched MyFlightWx, the world's first electronic flight bag weather application developed by a meteorological authority to provide flight crews with the latest weather information. It marks the first time that graphical meteorological data can be transmitted directly to aircraft in flight.

### **Climate Services and Climate Change Related Studies**

The Observatory provides climatological information and predictions, 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 2017, the Observatory published wet-bulb temperature projections on its climate change webpage and worked with Radio Television Hong Kong (RTHK) to produce and broadcast a 13-episode live radio series, *Climate Watcher*. In recognition of the work, the World

Meteorological Organisation (WMO) accredited the Observatory headquarters as a Centennial Observing Station for long-term climate monitoring.

### **Radiation Monitoring and Assessment**

The Observatory monitors ambient radiation levels and measures the amount of radioactivity in environmental samples, enhancing its monitoring and assessment capabilities through collaboration with Mainland and international counterparts. 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. In 2017, a second radiological survey vehicle and an online gamma spectroscopic analyser network were put into operation. The Observatory also participated in the Daya Bay Contingency Plan inter-departmental exercise.

### **Marine and Geophysical Services**

The Observatory monitors earthquakes and tsunamis in the vicinity of Hong Kong and round the world. It provides earthquake information and tsunami warnings through its website, the media and social media, as well as via SMS and email for registered 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 publishes astronomical almanacs, providing the traditional Chinese calendar and various types of astronomical and geophysical information. In August, the Observatory organised a joint webcast of a partial lunar 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, attracting more than 80,000 page views.

### **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 26 billion time-check requests in 2017.

### **External Cooperation**

In 2017, the Observatory continued to work with the Civil Aviation Administration of China and the China Meteorological Administration to prepare for the commissioning of the Asian Aviation Meteorological Centre in 2018. A memorandum of understanding was signed with the Thai Meteorological Department to strengthen collaboration in areas such as aviation meteorological services, thunderstorm nowcasting and the training of meteorological personnel. In March, the Observatory launched the online version of the updated *International Cloud Atlas* as commissioned by the WMO for use by the public and the media worldwide. The Observatory's internally developed Short-range Warning of Intense Rainstorms in Localised Systems helped meteorological agencies on the Mainland and overseas carry out rainfall nowcasting.

### **Public Education and Engagement**

The Observatory promotes awareness of hazardous weather and the impacts of climate change and radiation. A series of outreach events, riding on the 100th anniversary of the introduction of numbered tropical cyclone warning signals in Hong Kong in 2017, promoted public understanding of tropical cyclone-related hazards and disaster prevention. The activities included a campaign with RTHK to collect historical materials of tropical cyclones from the public, a video series on typhoon hazards and cooperation with Hongkong Post to issue stamps on numbered tropical cyclone signals.

Volunteers from Friends of the Observatory, with more than 12,000 members, supported the events, including by conducting public tours at the Observatory headquarters.

The Observatory works with schools and the community to promote weather education through its Community Weather Information Network (Co-WIN), a joint initiative with Hong Kong Polytechnic University and the Chinese University of Hong Kong that encourages residents to share weather photos and observations. During the year, Co-WIN launched a new-generation microclimate station to promote community engagement and smart city development. The Observatory also released its first e-book, 'Cloud Appreciation by Dr Tin', and rolled out a crowd-sourcing campaign, 'Cloud-sourcing: in Touch with Weather from Land, Sea and Air', to collect and share weather photos and videos from members of the public and the aviation and marine communities.

### **Government Laboratory**

The Government Laboratory supports the enforcement of environmental protection legislation and implementation of environmental programmes by providing analytical and advisory services. It conducts tests on environmental samples of air, water, sediment, soil, biota, waste and liquid fuel 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](http://www.afcd.gov.hk)  
 Civil Engineering and Development Department: [www.cedd.gov.hk](http://www.cedd.gov.hk)  
 Climate Action Plan 2030+: [www.climateready.gov.hk](http://www.climateready.gov.hk)  
 Council for Sustainable Development:  
[www.enb.gov.hk/en/susdev/council/index.htm](http://www.enb.gov.hk/en/susdev/council/index.htm)  
 Electrical and Mechanical Services Department: [www.emsd.gov.hk](http://www.emsd.gov.hk)  
 Environment Bureau: [www.enb.gov.hk](http://www.enb.gov.hk)  
 Environmental Protection Department: [www.epd.gov.hk](http://www.epd.gov.hk)  
 Food Wise Hong Kong Campaign: [www.foodwisehk.gov.hk](http://www.foodwisehk.gov.hk)  
 Harbour Area Treatment Scheme: [www.cleanharbour.gov.hk](http://www.cleanharbour.gov.hk)  
 Hong Kong Observatory: [www.hko.gov.hk](http://www.hko.gov.hk) and [www.weather.gov.hk](http://www.weather.gov.hk)  
 Hong Kong Observatory *Cool Met Stuff* channel: [url.hko.hk/cms](http://url.hko.hk/cms)  
 MyObservatory application: [www.weather.gov.hk/myobservatory\\_e.htm](http://www.weather.gov.hk/myobservatory_e.htm)  
 MyWorldWeather application: [worldweather.wmo.int/en/apps.html](http://worldweather.wmo.int/en/apps.html)  
 'Science in the Public Service' campaign: [www.science.gov.hk](http://www.science.gov.hk)  
 Sustainable Development Division: [www.enb.gov.hk/en/susdev/su/index.htm](http://www.enb.gov.hk/en/susdev/su/index.htm)  
 World Weather Information Service: [worldweather.wmo.int](http://worldweather.wmo.int)