

The Environment

The government's priorities in enhancing the quality of the environment include improving air quality, implementing a waste-to-resources and waste-to-energy 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 city 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 2018-19 was budgeted at \$17 billion, or about 2.9 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 studies; enforces and reviews environmental laws; plans and develops facilities for 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 and encourage sustainable practices. Since 2003, 74 projects had been approved and 64 of those completed, involving grants totalling about \$76 million.

The EPD works 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 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 2018, the HKSAR and Guangdong governments started implementing various measures to meet emission reduction targets for 2020. Both governments established a joint scientific research group to study the post-2020 emission reduction targets and concentrations of regional air pollutants, and to collaborate on forecasting air quality.

The Guangdong-Hong Kong-Macao Pearl River Delta Regional Air Quality Monitoring Network comprises 23 air monitoring stations. Results from the network showed substantial reductions in most pollutants in recent years. From 2009 to 2018, the average annual concentrations of sulphur dioxide (SO₂), nitrogen dioxide (NO₂) and respirable suspended particulates (RSP) decreased 69 per cent, 21 per cent and 32 per cent respectively. The ozone level increased 4 per cent, indicating alleviation of the regional photochemical pollution is required.

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 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 water quality of the Pearl River Estuary.

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 south-eastern 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 north-eastern 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 Section 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 provides two summary memoirs and a set of 1:100,000-scale geological and thematic maps in Chinese and English. Geological information is available on the department's website.

Flora

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

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 550 species of birds, 55 species of terrestrial mammals, 25 species of amphibians, 90 species of reptiles, 184 species of freshwater fish, 245 species of butterflies and 128 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-three 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 and crab-eating mongoose, are reported occasionally.

More than 110 species of amphibians and reptiles make Hong Kong home. Of the 25 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 53 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. Sixty-seven sites are listed on the SSSI Register.

Conservation and Biodiversity

Legislation and Conservation

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

The Forests and Countryside Ordinance provides for the general protection of trees and vegetation. Its subsidiary Forestry Regulations control the selling and possession of certain rare and attractive indigenous plants to deter illegal collection. These include 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. Amendments to the ordinance were passed by the Legislative Council on 31 January and the Protection of Endangered Species of Animals and Plants (Amendment) Ordinance 2018 came into effect on 1 May to enhance regulations on the import and re-export of ivory and elephant hunting trophies, phase out the local ivory trade and increase the maximum penalties on illegal trade in endangered species.

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.

United Nations Convention on Biological Diversity

The UN Convention on Biological Diversity, which covers Hong Kong, 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 is implementing a Biodiversity Strategy and Action Plan (2016-21) based on the objectives and principles of the convention, taking into account local circumstances. The plan steps up conservation efforts and supports 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 2018 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 monthly mean temperature of 28.3 degrees and monthly mean minimum temperature of 26.1 degrees recorded at the Hong Kong Observatory headquarters in May were the highest ever on record for May.

Six tropical cyclones affected the territory in the year. Among these storms, Super Typhoon Mangkhut necessitated the issuance of the highest tropical cyclone warning, the No 10 Hurricane Signal, for 10 hours on 16 September. This was the second longest duration of the No 10 signal since 1946, just next to the record 11 hours set by Typhoon York in 1999. The maximum 60-minute mean wind speeds recorded at Waglan Island and Cheung Chau were 161 and 157 kilometres per hour respectively, both the second highest on record at the corresponding stations, just below those set by Super Typhoon Ellen in 1983. The severe storm surge brought by Mangkhut raised the water level in Hong Kong generally by more than two metres, resulting in record-breaking storm surges in many places. Victoria Harbour's water level at Quarry Bay rose to a maximum of 3.88 metres above Chart Datum in the afternoon of 16 September, the second highest since instrument records began in 1954, surpassed only by the record associated with Super Typhoon Wanda in 1962. The destructive winds, severe storm

surge and heavy rain brought by Mangkhut caused the most serious and extensive damage to Hong Kong in the recent three decades, since Ellen in 1983.

Climate Change

Long-term Decarbonisation Strategy

The Paris Agreement applies to the HKSAR. Pursuant to the agreement, the HKSAR will formulate and communicate by 2020 a long-term decarbonisation strategy up to 2050. In 2018, the government invited the Council for Sustainable Development to conduct a public engagement exercise in 2019 so as to tap and gauge community views on developing the strategy. Hong Kong is also involved actively in international cooperation and exchange on climate action. The city is a member of the C40 Cities Climate Leadership Group, where it also sits on the Steering Committee.

A set of nine carbon audit guidebooks, covering different types of premises, is provided by the EPD to help bureaux, departments and the private sector carry out carbon audits. Bureaus and departments started conducting carbon audits on major government buildings in 2017-18 and will disclose their audit results. For the private sector, the EPD operates a Carbon Footprint Repository to encourage regular carbon auditing. As at December, more than 80 listed companies had shared their carbon management experiences and practices on the repository's website. The government also works 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 companies receive a return on their average net fixed assets at the permitted rate of return specified in the agreements.

Post-2018 Scheme of Control Agreements, which the government signed with each power company in 2017, reduce the permitted rate of return from 9.99 per cent to 8 per cent and carry a term of about 15 years, up to 2033. Other key terms of the agreements include introducing mechanisms to encourage the companies to further 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 preparatory work necessary for the introduction of potential new suppliers when the requisite market conditions are present.

HK Electric has a total installed capacity of 3,257 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 (2,575MW), Castle Peak (4,108MW) and Penny's Bay (300MW).

Each company owns its respective transmission and distribution systems. The two transmission systems are connected by a cross-harbour link, which provides emergency backup and some sharing of generating capacity reserves 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. The company imports about 70 per cent of the power generated by the Daya Bay nuclear power station, which has two 984MW pressurised water reactors. On top of the 70 per cent, it is importing on a temporary basis another 10 per cent of electricity generated by the Daya Bay station from 2014 to 2023.

CLP Power sells electricity to Guangdong from its existing generating capacity reserves. Its sales are governed by an agreement with the HKSAR Government, under which CLP Power's consumers in Hong Kong get priority of supply and 80 per cent of the sales profit.

The Central People's Government, in a memorandum of understanding signed between the HKSAR Government and the National Energy Administration in 2008, supported the extension of nuclear electricity supply from the Daya Bay station to Hong Kong for another 20 years from 7 May 2014.

CLP Power also 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 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 79 per cent of public light buses, while natural gas is used for electricity generation and the production of town gas. Hong Kong has 2.3 million gas customers in the domestic, commercial and industrial sectors, of which town gas and LPG respectively accounted for 88.3 and 11.7 per cent of the total fuel gas sold in these sectors in terms of heating values in 2018.

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 in Tsing Yi before being distributed to customers, including 67 LPG filling stations.

Natural gas is imported from the Mainland via submarine pipelines to Black Point Power Station 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. Separately, CLP Power draws natural gas from the Mainland's Second West-East Natural Gas Pipeline through the submarine Hong Kong Branch Line facilities.

Energy Saving

Energy consumption is related closely to greenhouse gas emissions. Improving energy efficiency helps combat global climate change. End users consumed 289,219 terajoules in 2016, 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 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. Its Mandatory Energy Efficiency Labelling Scheme requires prescribed products to bear energy labels informing consumers of the products' energy efficiency performance. Phase 3 of the scheme was launched in June, covering indoor televisions, electric storage water heaters, induction cookers, indoor air conditioners with both cooling and heating functions, refrigerators, compact fluorescent lamps, dehumidifiers and washing machines of more than 7kg but less than 10kg in washing capacity.

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 provides chilled water to buildings including the Kai Tak Cruise Terminal, Trade and Industry Tower, schools and shopping centres. Upon full completion, the system would reduce annual electricity consumption by 85 million kilowatt-hours, equivalent to a carbon reduction of 60,000 tonnes, compared with conventional air-cooled air-conditioning systems.

Renewable Energy

The Paris Agreement highlights the need for wider promotion of renewable energy. New schools, educational buildings, open space and public parks are subject to the government's target for providing renewable energy. Existing government buildings undergoing major renovation must incorporate renewable energy technology where technically and financially practicable. Bureaus and departments can draw on a \$1 billion fund to provide small

renewable-energy installations at government premises and infrastructure. The government is exploring the installation of large solar photovoltaic systems at suitable reservoirs and landfills.

Both power companies adopt the use 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. In 2018, the government and the two power companies introduced a Feed-in Tariff Scheme under the post-2018 Scheme of Control Agreements to encourage the private sector to invest in distributable renewable energy.

Energy-efficient Buildings

Buildings account for about 90 per cent of the electricity consumed, so promoting their efficient use of energy is paramount to 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. It requires commercial buildings 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 takes 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 340 major government buildings have been completed, and at least \$900 million earmarked to implement energy-saving projects identified in the audits. The government saved 4.9 per cent of electricity use in the first three years and is on track to meet the target in 2018-19. For private buildings, the capital expenditure incurred in buying renewable-energy installations and building energy-efficiency installations is eligible, starting from the 2018-19 year of assessment, for a full tax deduction in the first year of purchase instead of having the tax cut spread over five years.

Retro-commissioning is a cost-effective and useful means of saving energy in existing buildings. The Electrical and Mechanical Services Department organises seminars to help building owners and relevant trades carry out retro-commissioning. In 2018, it published technical guidelines and launched an online resources centre.

Under the post-2018 agreements, the power companies will promote energy efficiency and conservation. Each company manages its own energy-efficiency fund to support the retrofitting and retro-commissioning of private buildings. In 2018, the companies increased the amounts in their funds and extended the coverage to a wider range of buildings.

Pollution Prevention

Air Pollution

The government is working to improve air quality with a view to broadly attaining its air quality objectives by 2020. The EPD completed a review of the objectives in 2018 and will consult the public on the review outcome.

The department takes action to reduce emissions from local polluting sources. Between 2009 and 2017, emissions of SO₂, nitrogen oxides (NO_x), RSP and volatile organic compounds dropped 25 percentage points to 74 per cent. From 2009 to 2018, ambient concentrations of RSP, fine suspended particulates, NO₂ and SO₂ dropped 30 per cent, 35 per cent, 22 per cent and 57 per cent respectively, while roadside concentrations of the same fell 36 per cent, 29 per cent, 25 per cent and 50 per cent respectively. Ambient ozone increased 21 per cent, indicating that the regional photochemical smog problem remains challenging. The department engages in 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 motor vehicle fuel and emission standards practicable.

Nearly all taxis and about 79 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 66,800 such vehicles out of service by end-2018.

Controls are in place to curb excessive smoke from diesel vehicles and excessive emissions from petrol and LPG vehicles due to poor maintenance. During the year, 2,923 diesel vehicles with excessive smoke were reported and 5,784 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 concessions in the first registration tax of electric vehicles. The tax on electric commercial vehicles, motorcycles and tricycles is fully waived until 31 March 2021. From 28 February 2018 to 31 March 2021, the tax concession for electric private cars is capped at \$97,500 and a One-for-One Replacement Scheme is in effect. Under the scheme, owners of eligible private cars who arrange to scrap and de-register their cars and then register a new electric private car are granted a higher tax concession, of up to \$250,000. In 2018, the number of electric vehicles increased 3.5 per cent year on year to 11,600, including government and special-purpose vehicles, while 2,166 public chargers were available for public use, including 498 quick and 824 medium chargers.

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. 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 by establishing 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 fuel. It aims to achieve cuts of 59 per cent to 79 per cent in the three key pollutants, SO₂, NO_x and RSP, in 2022 compared with 2010 levels by tightening the emission caps.

Indoor Air Quality

A voluntary certification scheme recognises good indoor air quality management practices in offices and public places, and provides incentives for property owners and 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 the manufacture of these substances and their import for local consumption, except hydrochlorofluorocarbons, which are subject to import quotas with a view to imposing a blanket import ban by 2020.

Non-road Mobile Machinery

Non-road mobile machinery newly supplied for use in Hong Kong are required 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 Hong Kong International Airport, container terminals and construction sites, must bear EPD-issued labels.

Noise Pollution

Road Traffic Noise

To mitigate the impact of traffic noise on residents, 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 innovative noise mitigation designs such as acoustic balconies and windows. All newly registered vehicles must comply with internationally recognised noise standards. As regards existing roads, the government installs noise barriers and lays low-noise road surfacing materials, with 93 road sections enhanced through these efforts as at end-2018.

Railway Noise

The department will request the MTR Corporation Limited (MTRCL) to make improvements if the noise emitted by the trains exceeds the standards. The MTRCL carries out noise reduction programmes and must subject new railway projects to statutory environmental impact assessments.

Aircraft Noise

The impact of aircraft noise on residents in the vicinity of flight paths at the airport is within planning standards, notwithstanding concerns about nuisance from aircraft noise during

evenings and early mornings. The government will continue to explore 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 techniques 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 Statistics¹

Over the past decade, the municipal solid waste dumped at landfills has increased 19 per cent, while the mid-year population has grown 6 per cent. Between 2013 and 2017, municipal solid waste totalling 3.48 million to 3.92 million tonnes annually was disposed of, translating into a daily per capita disposal rate of between 1.33kg and 1.45kg. Food waste accounted for 36 per cent of municipal solid waste on average. About 60 per cent of 3.92 million tonnes dumped at landfills in 2017 was domestic waste, with the remainder being commercial and industrial waste.

During the same five-year period, landfills took in 1.31 million to 1.62 million tonnes of overall construction waste annually, an average 38 per cent drop on the 2.39 million tonnes in 2005, before the launch of a Construction Waste Charging Scheme in 2006.

Waste Reduction

In line with the Hong Kong Blueprint for Sustainable Use of Resources 2013-22, the government is implementing policies and legislation to drive behavioural changes to reduce waste at source, undertake targeted citywide waste reduction campaigns to raise awareness and encourage community participation, and enhance waste-related infrastructure.

Positioned at the centre of Hong Kong's overall waste reduction strategy, municipal solid waste charging will provide the necessary financial incentives to drive behavioural and cultural changes, and to encourage the public to proactively practise waste reduction at source and

¹ Waste statistics for 2018 will be published in the report, *Monitoring of Solid Waste in Hong Kong: Waste Statistics for 2018*, to be released in 2019.

clean recycling. The EPD introduced the bill on municipal solid waste charging into LegCo in November.

In the 2018 Policy Address, the government pledged to provide additional recurrent resources to strengthen the preparation and complementary measures of municipal solid waste charging implementation, and to better support the public in practising waste reduction and recycling more actively. As a start, an additional \$300 million to \$400 million will be provided for the 2019-20 financial year. The funding, to be granted annually, will increase to no less than between \$800 million and \$1 billion from the financial year when municipal solid waste charging is to be implemented, and would be commensurate with the estimated gross revenue to be generated from municipal solid waste charging in the initial period so as to achieve the purpose of allocating dedicated funding for dedicated use.

The Food Waste and Yard Waste Plan for Hong Kong 2014-22 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 Programme on Source Separation of Waste covers over 80 per cent of the Hong Kong population. Residents can contribute recyclable items to waste separation facilities close to their homes and workplaces.

Quantity-based waste charging creates financial incentives that aim to drive behavioural changes in waste generation and thereby 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 implements producer responsibility schemes to promote waste reduction at source and create a circular economy. In 2018, the scheme on waste electrical and electronic equipment (WEEE) was fully implemented, with WEEE • PARK, a treatment and recycling facility developed to underpin the scheme, fully commissioned in March. The facility had processed over 11,700 tonnes of WEEE by the year end. As regards the scheme on glass beverage containers, the government had appointed glass management contractors to provide collection and treatment services and subsequently recorded a total collection of about 60 per cent more waste glass containers in 2018 compared with 2017. The government also decided during the year to take forward the scheme on plastic beverage containers.

Waste Recycling

The department supports the recycling trade and educates the public to reduce waste at source and carry out proper source separation of waste and clean recycling to avoid contamination of recyclables, so as to improve the quality of the recyclables collected and to streamline the subsequent treatment process.

The Community Recycling Network promotes waste reduction and recycling, and sets up collection points at the community level to receive recyclables of low commercial value.

Community participation is encouraged through district-based education and promotion on waste reduction and recycling. A clean recycling campaign is conducted to promote community awareness and thereby improve the recyclability and value of recyclables.

The network of community green stations is being expanded to strengthen support for community-level recycling. In 2018, the stations in Tuen Mun and Kwai Tsing were commissioned, bringing the number of operating stations to seven.

In 2018, the department formed new outreach teams to step up public education efforts with on-site guidance and hands-on demonstration, and to disseminate updated and key green messages in the community through regular visits. These efforts enhance support to waste reduction at source and clean recycling on the ground, and prepares the public for the implementation of municipal solid waste charging at the community level.

Between 2013 and 2017, an annual average of 53 per cent of paper and 91 per cent of metal in municipal solid waste was recovered. The annual average recovery rate of plastics was 15 per cent.

During the same period, an average of 82 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 27 per cent higher than the 18 million tonnes recovered between 2008 and 2012.

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 rents so as to encourage investment in advanced technologies and value-added recycling processes. As at December, 12 lots were leased to private recyclers to recycle cooking oil, scrap metal, wood, WEEE, plastics, construction materials, glass, rubber tyres, food, batteries and paper.

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, 170 projects were either in progress or ready to start, involving total funding of about \$130 million. In view of the Mainland's tightening of requirements on imported recyclables in early 2018, the Recycling Fund rolled out new measures to help local recyclers process recyclables, particularly waste paper and plastics.

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 three million tonnes of such waste in 2017, delivering about 79 per cent of municipal solid waste to landfills.

Landfills

Three large strategic landfills are operated to high environmental standards in the New Territories to serve as the final repositories for the city's considerable amount of residual solid waste. With the South East New Territories Landfill accepting only construction waste since 2016, all municipal solid waste is disposed of at the other two landfills.

All three landfills need to be extended to maintain an uninterrupted waste disposal service to the public. With the ongoing extension of two of the landfills, the landfill space is estimated to be able to cope with the city'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 2018, approval was granted in principle to a non-profit-making organisation to proceed with its proposal to revitalise the Tseung Kwan O Stage 1 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. The first 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. The facility is capable of treating 3,000 tonnes of municipal solid waste daily and is scheduled for commissioning in 2024 after design and construction work began in December 2017. The city also plans to build a network of five or six organic waste treatment facilities that will use biological technology 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, was commissioned in 2018. It can treat 200 tonnes of food waste each day. In addition, the government is exploring the use of existing sewage treatment plants for the anaerobic co-digestion of food waste and sewage sludge. It will launch the first trial scheme in 2019 at the Tai Po Sewage Treatment Works, expected to process about 50 tonnes of food waste a day.

These high-tech facilities do not eliminate the need for waste reduction at source or for landfills to hold residual waste.

Chemical, Clinical and Special Waste

All chemical and clinical waste producers are required to pack, label and store their chemical and clinical waste properly before disposal at licensed treatment facilities. A trip ticket system tracks the waste movement 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 38.5 tonnes of chemical waste and 7.1 tonnes of clinical waste in 2018. 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 if possible, hence only some of the waste is transferred for long-term storage to the Low-level Radioactive Waste Storage Facility at Siu A Chau, an uninhabited island south-west 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. The plant treated 386,208 tonnes of sewage sludge and exported 2.5 million kWh of electricity in 2017. Its premises, ingeniously designed for environmental education and recreation, attracted 79,185 visitors in 2018.

Construction Waste

A disposal charging scheme provides economic incentives to reduce construction waste, recover and reuse inert materials, and reduce their disposal at landfills. An annual average of 22.6 million tonnes of overall construction waste was generated from 2013 to 2017. The reuse rate was 92 per cent in 2017, having remained at above 90 per cent in recent years.

Marine Refuse

Clearing marine refuse, including refuse floating in the sea and being washed ashore, is carried out by a few government departments, including the Agriculture, Fisheries and Conservation Department; Food and Environmental Hygiene Department; and Leisure and Cultural Services Department. The Marine Department deploys about 80 vessels to scavenge for floating refuse and collect domestic refuse from vessels in the anchorages and typhoon shelters. In 2018, it collected nearly 11,500 tonnes of marine refuse from the waters and coastal areas of Hong Kong and 4,550 tonnes of domestic refuse from vessels.

In January, the Inter-departmental Working Group on Clean Shorelines was revamped and renamed Inter-departmental Working Group on Marine Environmental Management. The working group seeks to strengthen inter-departmental collaboration in handling marine refuse and marine environmental incidents. It coordinates improvement measures that keep the shorelines clean and maintains a common platform to leverage community efforts in protecting the marine environment.

The Hong Kong-Guangdong Marine Environmental Management Special Panel is a platform to examine ways of cooperating over regional marine environmental incidents. It is conducting the trial operation of a notification and alert system on marine refuse.

Livestock Waste

The Waste Disposal Ordinance bans the keeping of livestock in new towns and environmentally sensitive areas. Where they are allowed, livestock farms must have proper waste treatment

systems. The government provides a free livestock waste collection service, which collected 23,726 tonnes of waste in 2018.

Sewage Treatment and Disposal

The public sewerage system serves over 93 per cent of the population and collects about 2.8 million cubic metres of waste water daily, 92 per cent of which receives chemical or higher levels of treatment before being discharged. The government plans to spend about \$19 billion over the next five years on public sewerage infrastructure projects, including sewerage provision to rural villages.

Victoria Harbour and Harbour Area Treatment Scheme

Under the Harbour Area Treatment Scheme, all sewage from both sides of Victoria Harbour is intercepted and conveyed through a network of deep tunnels to the Stonecutters Island Sewage Treatment Works for chemical treatment and disinfection before discharge. This has improved the overall water quality in the harbour significantly. More measures are being implemented to alleviate pollution caused by the discharge of residual pollutants through the storm water systems. These measures include rectifying misconnected sewers, installing dry-weather flow interceptors in some storm water culverts and rehabilitating ageing sewers.

Sewage Disposal in Rural Areas

As at end-2018, more than 13,000 village houses were connected to public sewers. Eligible households can apply for loan and grant schemes to help them connect their buildings to the public sewers.

Sewage Charges

Under the Sewage Services Ordinance, all water users who discharge their sewage into public sewers pay a sewage charge of \$2.92 per cubic metre of water supplied. 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, whose construction is government-funded.

Water Quality

The water quality of Victoria Harbour has improved markedly under the Harbour Area Treatment Scheme. In 2018, the harbour's overall compliance with the statutory water quality objectives was 97 per cent.

By controlling pollution at source, river water quality has also improved. During the year, 83 per cent of the river monitoring stations were categorised as 'good' or 'excellent', while 8 per cent belonged to the 'bad' or 'very bad' categories.

Bathing Beaches

A well-established methodology is applied to monitor 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 statutory water quality objective for bathing.

Beach water quality ranking	Geometric mean of <i>E coli</i> count per 100ml of beach water during bathing season	Cases of minor health risk per 1,000 swimmers	Number of beaches in 2018
Good	Up to 24	Undetectable	26
Fair	25 to 180	10 or less	15
Poor	181 to 610	11 to 15	0
Very Poor	More than 610	More than 15	0

Gradings of the water quality at all public beaches are available through 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.

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. Its Compliance Assistance Centre responds to enquiries from businesses 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 759 convictions and \$5.59 million in fines in 2018.

Environmental Monitoring and Auditing

Major development projects undergo environmental monitoring and auditing 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 data and results on dedicated websites or the Environmental Impact Assessment Ordinance website. In 2018, the department handled 103 monitoring and auditing programmes.

Meteorological and Geophysical Services

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 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 March, the Observatory launched its Facebook and Instagram platforms to enhance the provision of weather services and public communication via social media, attracting over 120,000 and 12,000 followers respectively as at end-2018.

During the year, the Observatory also launched a Regional Information on Heavy Rain and Thunderstorm webpage to display regional rainfall and lightning locations in Hong Kong, and provided Clear Water Bay temperatures, West Kowloon weather photos and weather satellite imagery covering the western Asia region on the Observatory's website.

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 to the airport and the Hong Kong Flight Information Region, and works with airlines to promote and improve MyFlightWx, a mobile application which gives flight crew the latest inflight weather information electronically. The Observatory 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.

Climate Services and 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 UN Intergovernmental Panel on Climate Change, and provides the latest climate change information and assessment in support of policymaking and initiatives to combat climate change.

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 2018, the Observatory continued to work on replacing a monitoring system and equipment as well as enhancing emergency communication and data management systems. Its ambient gamma radiation measurement service was accredited with ISO 9001:2015 certification.

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 Hong Kong Tide Table is published annually.

Astronomical Services

The Observatory provides information about astronomical phenomena such as solar and lunar eclipses. It publishes astronomical almanacs, which contain the traditional Chinese calendar as well as astronomical and geophysical information. In January and July, the Observatory organised joint webcasts of two total lunar eclipses with 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 about 70,000 page views in total.

Official Time Standard

As Hong Kong's official timekeeper, the Observatory maintains a time standard that is accurate to within one-hundred-millionth of a second per day and contributes to the determination of Coordinated Universal Time by the International Bureau of Weights and Measures. Public users can check the time through an online network time service, web clocks, Dial-a-Weather and radio stations.

External Cooperation

In 2018, the Observatory signed a Memorandum of Understanding with the World Meteorological Organisation (WMO) to strengthen meteorological cooperation, including supporting the WMO's initiative to establish a Global Multi-hazard Alert System (GMAS) for users round the world. The Observatory also launched the WMO's GMAS for Asia, an online platform developed jointly with the China Meteorological Administration to aggregate weather warnings in Asia. The Observatory was designated by the WMO as a Regional Specialised Meteorological Centre for Nowcasting and a Testbed for Doppler Light Detection and Ranging Systems for aviation application.

The Observatory also signed memoranda on meteorological cooperation with Cambodia, Myanmar and Vietnam. In July, the Asian Aviation Meteorological Centre, established jointly with the Civil Aviation Administration of China and China Meteorological Administration, started operation to support en-route hazardous weather warning services and improve aviation safety and efficiency.

Public Education and Engagement

The Observatory promotes awareness of hazardous weather and the impacts of climate change and radiation. A special series of short videos on typhoon-related hazards, urging the public to take precautions, was broadcast before Mangkhut battered Hong Kong in September.

The Observatory conducts school talks on climate change and publishes articles and research findings about global climate on its website. During the year, it worked with the Ho Koon centre to produce a curriculum-based climate change education package for secondary schools. It also organised a photo and video exhibition, 'Cloud-sourcing: In Touch with Weather from Land, Sea and Air', at the airport jointly with the Airport Authority Hong Kong.

Volunteers from 'Friends of the Observatory', with more than 13,000 members, support the public education events, including by conducting public tours at the Observatory headquarters.

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 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

Climate Action Plan 2030+: www.climateready.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

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 application: www.weather.gov.hk/myobservatory_e.htm

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

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

World Weather Information Service: worldweather.wmo.int