

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 and the water quality of 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 2019-20 was budgeted at \$22 billion, or about 3.4 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 67 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. The HKSAR and Guangdong governments have been implementing various measures to meet the 2020 reduction targets for regional air pollutant emissions. Both governments are conducting a study on post-2020 reduction targets and concentration levels, and collaborating 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 its environmental benefits, it was proposed in the 2019 Policy Address to extend the programme for five years up to March 2025.

Hong Kong and Shenzhen are implementing joint action programmes to protect the quality of adjoining waters. The water quality in Deep Bay has shown noticeable improvement, while that in Mirs Bay has remained good consistently. 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 (66m 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 rhyolitic volcanic rock. Apart from the extraordinary composition, the columns are considered unique for their size, with an average diameter of 1.2m, 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 provides a series of fifteen 1:20,000-scale geological maps and six accompanying geological memoirs. It also offers 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 south-east 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, 187 species of freshwater fish, 245 species of butterflies and 128 species of dragonflies.

Among the rich terrestrial biodiversity, some species, such as the Bogadek's burrowing lizard, have been recorded only in Hong Kong. The territory 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, reed beds and mangroves provide a rich habitat for migratory and resident birds, particularly waterbirds. Around 400 species of birds have been observed in this area. About 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 less commonly seen. 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.

The territory is home to more than 110 species of amphibians and reptiles, of which the Hong Kong cascade frog, Hong Kong newt, Romer's tree frog and Burmese python 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.

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 the Hong Kong 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, seeks 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.

Countryside Conservation

Remote areas in the countryside are rich in ecological, architectural and cultural resources. The Countryside Conservation Office, established in July 2018, aims to protect the natural ecology of the countryside and revitalise the architectural environment of villages by coordinating conservation projects that promote sustainable development of the remote countryside.

Of the \$1 billion earmarked for the office, \$500 million is meant for implementing minor improvement works, with Lai Chi Wo and Sha Lo Tung as pilot areas. The other half of the funds will support non-profit-making organisations to cooperate with villagers in organising diverse and innovative conservation activities and revitalisation projects through the new Countryside Conservation Funding Scheme launched in October 2019.

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 2019 was the warmest in Hong Kong since records began in 1884, with the annual mean temperature reaching 24.5 degrees Celsius, 1.2 degrees above normal. The annual mean maximum and minimum temperatures of 27.1 degrees and 22.6 degrees respectively were also the highest on record, while the annual total rainfall of 2,396.2mm was near the normal level.

Five tropical cyclones affected the territory. The No 8 Gale or Storm Signal was issued during the passage of Tropical Storm Wipha, the highest tropical cyclone warning issued in 2019.

Climate Change

Long-term Decarbonisation Strategy

Hong Kong is seeking to formulate a long-term decarbonisation strategy in line with the goals of the Paris Agreement. In 2019, the Council for Sustainable Development completed a public engagement exercise. The government will take into account both the views collected during the exercise and the council's recommendations.

Hong Kong participates actively in international cooperation and exchanges on climate action. It is a member city of the C40 Cities Climate Leadership Group and also sits on the group's Steering Committee.

A set of nine carbon audit guidebooks, covering different types of premises, is provided by the EPD to help the public and private sectors carry out carbon audits. Bureaus and departments are conducting carbon audits on major government buildings and will disclose their audit results. For the private sector, the EPD operates a Carbon Footprint Repository to encourage regular carbon auditing. More than 80 listed companies share 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.

The current 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 to introduce 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 (2,600MW), 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.

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 around 80 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 and 12 per cent of the total fuel gas sold in these sectors in terms of heating values in 2019.

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 286,270 terajoules in 2017, with the commercial, transport, residential and industrial sectors taking up 44, 31, 21 and 4 per cent respectively.

The bureau's Energy Saving Plan for Hong Kong's Built Environment 2015~25+ 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. By end-2019, the city had lowered its energy intensity by more than 30 per cent. The bureau will continue to work 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. It will consider suitable products for inclusion in phase 4 of the scheme.

The E&M InnoPortal, launched in June 2018, promotes energy-related innovation and technology (I&T). It lists the service needs of various government departments, public organisations and the trade. Universities and start-ups can propose I&T solutions to meet these service needs.

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, Hong Kong Children's Hospital, 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. In view of the further increase in the projected demand for cooling services, plans are under way to build an additional district cooling system.

Renewable Energy

The Paris Agreement highlights the need for wider promotion of renewable energy. In Hong Kong, the government takes the lead in renewable energy development. New schools, educational buildings, open space and public parks are subject to its target for providing renewable energy. Existing government buildings undergoing major renovation must incorporate renewable energy technology where technically and financially practicable. The government has also earmarked \$2 billion to implement projects at government premises, and

is actively considering the development of large-scale projects at suitable locations in reservoirs and landfills.

To encourage the private sector to develop renewable energy, the government and the two power companies provide a Feed-in Tariff (FiT) scheme and implement facilitation measures, including relaxed restrictions on rooftop installations at village houses. While there were only some 200 private renewable energy systems connected to the power grids in the last decade, the two power companies approved over 5,000 FiT applications from 2018 to end-November 2019. In March, the government launched Solar Harvest to help eligible schools and non-governmental welfare organisations install solar photovoltaic systems. Over 210 applications were received within three months.

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.

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. The ordinance also requires commercial buildings to conduct energy audits every 10 years. By end-2028, the enforcement of the ordinance is expected to bring about total energy savings of some 27 billion kWh from new and existing buildings, equivalent to the total annual electricity use of about 5.8 million households and a reduction in carbon dioxide emissions of about 19 million tonnes.

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 by 2018-19, energy audits for about 340 major government buildings were completed, and at least \$900 million earmarked to implement energy-saving projects identified in the audits. 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 2019, it started to conduct retro-commissioning in over 200 major government buildings.

Under the current Scheme of Control 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.

Pollution Prevention

Air Pollution

The government implements control measures to improve air quality, aiming to broadly attain its air quality objectives in 2020. The EPD conducted a three-month public consultation in 2019 about its recommendations on tightening the objectives. Having considered the public's views and various other factors, the government will proceed with the legislative process in 2020 to tighten the objectives.

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 2010 to 2019, ambient concentrations of RSP, fine suspended particulates, NO₂ and SO₂ dropped 29 per cent, 34 per cent, 27 per cent and 58 per cent respectively, while roadside concentrations of the same fell 37 per cent, 31 per cent, 32 per cent and 50 per cent respectively. Ambient ozone increased 54 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 80 per cent of public light buses run on LPG. An incentive and regulatory scheme, launched in 2014 to phase out some 80,000 pre-Euro IV diesel commercial vehicles, had put about 78,000 such vehicles out of service by end-2019. The programme will be completed by 30 June 2020.

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, 1,856 diesel vehicles with excessive smoke were reported and 5,332 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, which have low emissions. Up to 31 March 2021, the tax on electric commercial vehicles, motorcycles and tricycles is fully waived, the tax concession for electric private cars is capped at \$97,500 and a One-for-One Replacement Scheme is in effect. The scheme grants a higher tax concession, of up to \$250,000, to people who arrange to scrap and de-register an eligible old private car and then register a new electric private car. In 2019, the number of electric vehicles increased 20.4 per cent year on year to 13,970, including government and special-purpose vehicles, while 2,929 public chargers were available for public use, including 588 quick and 1,108 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 pollutant emission source in Hong Kong. The government caps the sulphur content in locally supplied marine light diesel at 0.05 per cent. To dovetail with the implementation of marine air pollutant emission control areas in the Mainland's coastal waters, from 2019 the government required all vessels in Hong Kong waters to use compliant fuel, such as fuel with sulphur content not exceeding 0.5 per cent and liquefied natural gas.

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. In 2019, the emission caps of three key air pollutants, namely SO₂, NO_x and RSP, from the power sector in 2024 and beyond were further reduced by 69 per cent to 87 per cent compared with 2010 levels.

Indoor Air Quality

On 1 July, the government revised indoor air quality objectives under a voluntary certification scheme for offices and public places. The scheme encourages participating property owners and management companies to enhance indoor air quality at their premises.

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. Starting from 1 January 2019, the statutory emission standards for newly approved non-road vehicles have been tightened in phases to Euro VI, which is in line with the emission standards for newly registered 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 106 road sections enhanced through these efforts as at end-2019.

Railway Noise

In planning new railway projects, the MTR Corporation Limited must comply with a statutory environmental impact assessment. The department will request the company to make improvements if the noise emitted from existing railways exceeds the standards.

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 five years, the municipal solid waste dumped at landfills has increased 17 per cent, while the mid-year population has grown 3 per cent. Between 2014 and 2018, municipal solid waste totalling 3.57 million to 4.17 million tonnes annually was dumped, translating into a daily per capita disposal rate of between 1.35kg and 1.53kg. The rate in 2018 was 1.5kg if the data from September to November, when the disposal quantity was affected significantly by Super Typhoon Mangkhut, was excluded. About 59 per cent of 4.17 million tonnes dumped at landfills in 2018 was domestic waste, with the remainder being commercial and industrial waste. Food waste accounted for 31 per cent of the total municipal solid waste in 2018.

During the same five-year period, landfills took in 1.44 million to 1.62 million tonnes of overall construction waste annually. This translated into an annual average of 1.52 million tonnes, an

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

average 36 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 implements 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 clean recycling, and thereby reduce overall waste disposal. The Legislative Council was scrutinising the bill in 2019.

In the 2019-20 financial year, the government began providing an additional \$300 million to \$400 million to better support the work on waste reduction and recycling. The funding will be granted annually and 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. It 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 effect of allocating a dedicated fund 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.

Various producer responsibility schemes are in place, such as the Plastic Shopping Bag Charging Scheme and the schemes on waste electrical and electronic equipment (WEEE) and glass beverage containers, to promote waste reduction at source and create a circular economy. The government is preparing to introduce a scheme on plastic beverage containers, at the same time encouraging less use of plastic packaging in collaboration with the retail trade. In 2019, the treatment and recycling facility WEEE • PARK processed nearly 24,000 tonnes of waste.

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.

Community participation is encouraged through district-based education. 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. In 2019, another community green station was commissioned in Tai Po, bringing the number of operating stations to eight.

During the year, the department stepped up its outreach initiative in the Sha Tin, Kwun Tong and Eastern districts, providing on-site guidance and hands-on demonstrations, and disseminating key updated green messages through regular visits. These efforts support waste reduction at source and clean recycling on the ground, and prepare the public for the implementation of municipal solid waste charging at the community level.

Between 2014 and 2018, an annual average of 49 per cent of paper and 91 per cent of metal in municipal solid waste was recovered. The annual average recovery rate of plastics was 11 per cent.

During the same period, an average of 80 per cent of solid waste, including municipal solid waste and overall construction waste, was recovered each year, working out to an annual average of 22 million tonnes recovered. This annual average was 4 per cent higher than the 21 million tonnes recovered between 2009 and 2013.

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. Twelve lots are 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. Enhancement measures were rolled out in 2019 after a mid-term review of the fund's operation. The measures included launching a new rental subsidy scheme, increasing the maximum upfront payment, simplifying the application procedures, and raising the funding amounts and duration of funded projects for recycling enterprises. As at end-December, 247 projects were either in progress or ready to start, involving total funding of about \$247 million.

Waste Treatment and Disposal

Refuse Transfer Stations

Municipal solid waste is collected and delivered to refuse transfer stations by refuse collection vehicles, packed into containers and then taken to landfills in bulk by sea or land. A network of 13 transfer facilities handled about 3.2 million tonnes of such waste in 2018, delivering about 77 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. The government promotes the development of recreational facilities and innovative after-uses at the restored landfills, some of which have been developed for public use. A non-profit-making organisation selected in 2018 under the Restored Landfill Revitalisation Funding Scheme is carrying out site investigation and detailed design to develop a campsite at 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 amount that requires landfill disposal. The first Integrated Waste Management Facility, being 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 turn waste into energy so as to cut greenhouse gas emission. It is capable of treating 3,000 tonnes of municipal solid waste daily and is scheduled for commissioning in 2024.

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. Construction of the second such facility, at Sha Ling in North District, began in 2019 after the commissioning of the first one, at Siu Ho Wan in North Lantau, in 2018. The two facilities can treat 500 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 launched the first trial scheme in 2019 at the Tai Po Sewage Treatment Works, which can 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 35.8 tonnes of chemical waste and 7.4 tonnes of clinical waste in 2019. 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 in Tuen Mun, employs an advanced treatment process to treat up to 2,000 tonnes per day of sewage sludge generated from sewage treatment. 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 392,221 tonnes of sewage sludge and exported 2.5 million kWh of electricity in 2018. Its premises, ingeniously designed for environmental education and recreation, attracted 65,840 visitors in 2019.

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 21.5 million tonnes of overall construction waste was generated from 2014 to 2018. The reuse rate was 92 per cent in 2018, having remained at above 90 per cent in recent years.

Marine Refuse

Marine refuse is cleared by the Marine Department; Agriculture, Fisheries and Conservation Department; Food and Environmental Hygiene Department; Leisure and Cultural Services Department and other government bodies. 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 2019, it collected nearly 11,006 tonnes of marine refuse from the waters and coastal areas of Hong Kong and 4,572 tonnes of domestic refuse from vessels.

The Inter-departmental Working Group on Marine Environmental Management coordinates collaboration among the departments in handling marine refuse and marine environmental incidents. In addition, a liaison platform maintained by the government leverages community efforts to protect the marine environment. In May and June, the EPD organised and supported over 120 coastal clean-up activities through the liaison platform to celebrate World Oceans Day.

Hong Kong cooperates with Guangdong through a trial notification and alert system on marine refuse. Notifications on any potential surge of marine refuse in Hong Kong, the Pearl River Estuary and its neighbouring waters are issued by the Hong Kong-Guangdong Marine Environmental Management Special Panel to facilitate follow-up action. In 2019, the two sides organised the first joint coastal clean-up activities to promote the message of keeping shorelines clean and joining hands in protecting the ocean.

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 24,855 tonnes of waste in 2019.

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, 93 per cent of which receives chemical or higher levels of treatment before being discharged. The government plans to spend about \$22 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. The government is implementing more measures 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-2019, more than 14,000 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 2019, 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, 85 per cent of the river monitoring stations were categorised as 'good' or 'excellent', while 6 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 bacteriological 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 2019
Good	Up to 24	Undetectable	21
Fair	25 to 180	10 or less	20
Poor	181 to 610	11 to 15	0
Very Poor	More than 610	More than 15	0

Gradings of the water quality at all open 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 781 convictions and \$4.82 million in fines in 2019.

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 monitoring data and auditing results on dedicated websites or the Environmental Impact Assessment Ordinance website. In 2019, the department handled 99 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 TV networks and other media. Through social media, the Observatory communicates with and engages the public, attracting around 180,000 and 23,000 followers for its Facebook and Instagram accounts respectively as at end-2019. It revamped the design of its website in 2019 to better support mobile users and improve user experience. The online information services collectively drew a record high of about 187 billion page views in the year.

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. MyFlightWx, a mobile application developed by the Observatory to offer flight crew the latest inflight weather information electronically, was put into operation by two local airlines in 2019. 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. During the year, the Observatory also deployed drifting buoys in the South China Sea and western North Pacific, and launched a new MyOceanWx Automatic Sea State Forecast webpage giving detailed four-day forecasts of the wave and swell conditions over the South China Sea, western Pacific Ocean and Indian Ocean.

The Observatory's achievements in nowcasting are widely recognised. The nowcasting system developed in-house, named Short-range Warning of Intense Rainstorms in Localised Systems (Swirls), won the Smart Business Grand Award and the Smart Business (Solution for Business and Public Sector Enterprise) Gold Award at the Hong Kong ICT Awards in April, and two awards in the 'Public Sector and Government category – Government and Citizen Services' and 'Technology category – Artificial Intelligence' at the Asia Pacific Information and Communications Technology Alliance Awards in November. Swirls provides effective short-term forecasts of rainfall and lightning, supporting the Observatory's rainstorm forecasting and warning services.

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 forecasts of seasonal temperature and rainfall. Climate information is offered to government departments and stakeholders involved in areas such as disaster prevention and 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 scientific input to government bodies 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. Information on radiation levels and the latest developments will be provided to the public through various channels. In 2019, the radiation monitoring webpages were revamped to facilitate public access. The Observatory's radiation laboratory and ambient gamma radiation measurement services both successfully passed the annual surveillance audit under ISO 9001:2015 certification.

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, and publishes the *Tide Tables for Hong Kong* annually. On 5 December, a local earthquake of magnitude 1.4 occurred near Cheung Chau. The Observatory received over 10 reports from members of the public.

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. Joint webcasts of the partial lunar eclipse in July and the partial solar eclipse in December were organised 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 over 40,000 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. Users can check the time through an online network time service, web clocks, Dial-a-Weather and radio stations. In 2019, the Observatory upgraded its network time service system to provide a more stable and accessible service.

Cooperation with other Meteorological Services

In 2019, the Observatory launched the weather website for the Guangdong-Hong Kong-Macao Greater Bay Area in collaboration with meteorological services in Guangdong and Macao to provide weather forecasts and warnings for more than 60 regions in the 11 cities within the Greater Bay Area. The Observatory, as a Regional Specialised Meteorological Centre for

Nowcasting designated by the World Meteorological Organisation, also shared its award-winning nowcasting software, Swirls, with overseas weather services to foster the development and enhancement of forecast and warning services related to high-impact weather.

Public Education and Engagement

The Observatory promotes awareness of hazardous weather and the effects of climate change and radiation. It launched a new set of TV and radio clips on storm surges in November to raise awareness of disaster prevention. The Observatory mascot, Dr Tin, made his first appearance on the TV clips.

The Observatory conducts school talks on climate change, and publishes articles and the latest international research findings about global climate change on its website. In March, the Observatory released a new song, *Climate and Life*, jointly produced with a local singer. It also worked with the Agriculture, Fisheries and Conservation Department during the year to publish a book titled *Climate Change and Biodiversity in Hong Kong*, and collaborated with the Ho Koon centre to produce a curriculum-based climate change education package for secondary schools. The Observatory's 'Science in Public Service' campaign and Community Weather Information Network served to engage students and young people through outreach events including workshops on building community weather stations. It provided meteorological data to students from the School of Creative Media at the City University of Hong Kong to create sculptures, movies, animations and other works that demonstrated the power of extreme weather.

Volunteers from 'Friends of the Observatory', with more than 13,400 members, support public education events organised by the Observatory, 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

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

Climate Ready: www.climateready.gov.hk

Low Carbon Living Calculator: www.carboncalculator.gov.hk

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

Hong Kong Observatory: www.hko.gov.hk

Hong Kong Observatory *Cool Met Stuff* channel: url.hko.hk/cms
MyObservatory mobile application: www.hko.gov.hk/en/myobservatory.htm
MyWorldWeather application: worldweather.wmo.int/en/apps.html
'Science in Public Service' campaign: www.science.gov.hk
World Weather Information Service: worldweather.wmo.int