

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 1,113 square kilometres of land, is home to some 7 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 2020-21 was budgeted at \$27 billion, or about 3.5 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. It is also responsible for the policy matters regarding the Sustainable Development Fund, which provides grants for projects that enhance public awareness of sustainable development and encourage sustainable practices. Since 2003, 74 projects have been approved and 69 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's Environment and Conservation Fund promotes behavioural and lifestyle changes by supporting educational, research and other projects by non-profit-making organisations 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 continuously improve regional air quality. Both governments plan to set emission reduction targets for 2025 and 2030, and 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 2011 to 2020, the average annual concentrations of sulphur dioxide (SO₂), nitrogen dioxide (NO₂) and respirable suspended particulates (RSP) decreased 71 per cent, 35 per cent and 42 per cent respectively. The concentration of fine suspended particulates (FSP) has decreased 31 per cent since the pollutant was first monitored in 2015. The ozone level increased 6 per cent over the past 10 years, indicating regional photochemical pollution must be reduced.

The Cleaner Production Partnership Programme helps Hong Kong-owned factories in Hong Kong and Guangdong adopt cleaner production technologies and practices, reducing air pollutant emissions, effluent discharge and carbon dioxide emissions, as well as saving energy and production costs. The government allocated \$311 million in the financial year 2020-21 to extend the programme to March 2025. From June 2020 to end-2021, more than 320 projects had been approved, involving over \$60 million funding support.

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 consistently good. Hong Kong and Guangdong are also pursuing 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 in Hong Kong were deposited as river sediments about 400 million years ago. Between 360 and 300 million years ago, the region was occasionally inundated by a shallow sea, during which limestones (now marble) and siltstones accumulated. From 170 to 140 million years ago, violent eruptions from several volcanic centres deposited thick ash layers. At deeper levels, molten magma intruded and slowly crystallised to form granite. Volcanism ended with a colossal eruption from the High Island Supervolcano centred in southeastern Hong Kong. Layered rocks 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. During the last 2.6 million years, several major glaciations occurred, causing successive lowering of the global sea level. Widespread river floodplains surrounded Hong Kong, and were later covered by marine mud when the sea level rose during interglacial periods.

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.

The Civil Engineering and Development Department's Hong Kong Geological Survey Section has produced a series of fifteen 1:20,000-scale geological maps and six accompanying geological memoirs. In addition, two summary memoirs and a set of 1:100,000-scale geological and thematic maps, covering various aspects of Hong Kong's geology, have been published. 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. 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 been made by the government. 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 560 species of birds, 55 species of terrestrial mammals, 25 species of amphibians, 90 species of reptiles, 194 species of freshwater fish, 245 species of butterflies and 130 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 50 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 East Asian porcupine, while the leopard cat, small-toothed ferret badger and small Indian 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 enjoys roosting 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 115 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 many 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 high 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 six marine parks and one marine reserve covering about 4,000 hectares of scenic coastal areas, seascapes and important biological habitats. The marine reserve is dedicated to conservation, education and scientific studies. Fishing in marine parks is regulated through a permit system and totally banned in the marine reserve. 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: the Mai Po Marshes, the Yim Tso Ha Egretty and the green turtle breeding site at Sham Wan on Lamma Island.

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

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 based on the convention's objectives and principles, 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

The Countryside Conservation Funding Scheme provides funding support to non-profit-making organisations for implementing conservation and revitalisation projects in remote countryside, including natural environment and habitats, non-graded built heritage and cultural and historic assets. Since its launch, the scheme had approved 27 projects with total funding of about \$140 million.

To support eco-tourism, better serve visitors and help revitalise desolate villages, the EPD's Countryside Conservation Office works with relevant bureaus and departments in developing appropriate licensing requirements and procedural guidelines designed especially for guesthouses and catering businesses in countryside areas, reflecting the special nature and restrictions of rural settings.

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

It was the warmest year in Hong Kong since records began in 1884, with an annual mean temperature of 24.6 degrees Celsius, 1.1 degrees above normal. The mean temperatures of March, May and September were 22 degrees, 29 degrees and 29.7 degrees respectively, all of which were the highest on record, as were the yearly total of 54 days with daily maximum temperatures of 33 degrees or higher and 61 days with minimum temperatures of 28 degrees or higher. The total annual rainfall of 2,307.1 mm was about 5 per cent below normal.

Eight tropical cyclones affected the territory in 2021. In October, the Hong Kong Observatory issued the No 8 Gale or Storm Signal for Tropical Storm Lionrock and Typhoon Kompasu only 60 hours 40 minutes apart, the shortest record since 1946. During the approach of Tropical Cyclone Rai, the Observatory issued the No 1 Standby Signal on 20 December, the latest tropical cyclone warning signal in a calendar year since 1946.

Climate Change

Carbon Neutrality

The government announced Hong Kong's Climate Action Plan 2050 in October. With the vision of 'Zero-carbon Emissions • Liveable City • Sustainable Development', it sets out four major

strategies and targets – net-zero electricity generation, energy saving and green buildings, green transport and waste reduction – to reduce carbon emissions by half before 2035 compared with the 2005 level, and to achieve carbon neutrality before 2050.

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, with the current ones signed in 2017. 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.

HK Electric has a total installed capacity of 3,637 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 (3,225MW), Castle Peak (4,108MW), Penny's Bay (300MW) and West New Territories Landfill (10MW).

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 which allows 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. In addition, from 2014 to 2023 it imports on a temporary basis another 10 per cent of Daya Bay's electricity.

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.

Electricity generation is the largest contributor to carbon emissions (66 per cent) in Hong Kong. One of the government's deep decarbonisation targets under Hong Kong's Climate Action Plan

2050 is to achieve net-zero electricity generation. Coal currently makes up about a quarter of Hong Kong's fuel mix for electricity generation, down from about half in 2015. Under the action plan, the government has pledged to cease using coal for daily electricity generation by 2035.

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. Hong Kong has 1.96 million gas customers in the domestic, commercial and industrial sectors, of which town gas and LPG respectively accounted for 89 and 11 per cent of the total fuel gas sold in these sectors in terms of heating values in 2021.

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 about 3,700km.

LPG is imported into Hong Kong mainly by sea and stored at five terminals in Tsing Yi before being distributed to customers, including 70 auto-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 286,488 terajoules in 2019, with the commercial, transport, residential and industrial sectors taking up 43, 31, 21 and 4 per cent respectively.

The bureau's Energy Saving Plan for Hong Kong's Built Environment 2015~2025+ sets a target of reducing energy intensity by 40 per cent by 2025, and outlines the policy, strategies, targets and key actions to 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. New energy efficiency grading standards for single package type room air-conditioners, dehumidifiers and compact fluorescent lamps

under the scheme were fully implemented in December. They are expected to bring an energy saving of about 300 million kWh per year.

The E&M InnoPortal, launched in 2018, promotes energy-related innovation and technology. It lists the service needs of various government departments, public organisations and the trade. Universities and start-ups can propose solutions to meet these service needs. At end-2021, the portal had collected more than 370 service needs and more than 850 suggested solutions. More than 140 field trials have started, with 31 of these related to energy efficiency and renewable energy.

Buildings served by the government's district cooling systems at the Kai Tak Development (being completed in phases to provide chilled water to non-domestic developments for air-conditioning) include Kai Tak Cruise Terminal, Trade and Industry Tower, Hong Kong Children's Hospital, schools and shopping centres. The government will construct district cooling systems at Tung Chung New Town Extension (East) and Kwu Tung North New Development Area. Upon full utilisation, the systems in these districts will reduce annual electricity consumption by 211 million kWh, equivalent to a carbon reduction of 147,000 tonnes, compared with traditional air-cooled air-conditioning systems.

Renewable Energy

As pledged in the Climate Action Plan, the government will drive the development of renewable energy, aiming to increase its share in the fuel mix for electricity generation to 7.5-10 per cent by 2035 and to 15 per cent thereafter through facilitating local public and private renewable energy projects and developing more advanced waste-to-energy facilities.

For the public sector, the government continues to lead in developing renewable energy, including large-scale projects in reservoirs, landfills and water channels. Building on the pilot projects of floating solar energy generation systems at Shek Pik Reservoir and Plover Cove Reservoir, each with a capacity of 100kW, another 100kW system is planned at Tai Lam Chung Reservoir. These will pave the way for larger systems generating about 5-10MW, while a study is exploring the feasibility of a system capable of generating more than 100MW.

To assess the feasibility of generating solar energy at restored landfills, a pilot solar farm project with a capacity of 1MW is in progress at the South East New Territories Landfill in Tseung Kwan O. The government is also exploring the feasibility of installing floating or other types of solar energy generation systems in water channels through two pilots in Shing Mun River and San Tin Polder.

The government has also developed advanced waste-to-energy facilities at O • Park1 (Organic Resources Recovery Centre Phase 1) and T • Park (Sludge Treatment Facility) which generate surplus electricity from organic waste and sludge respectively.

Aside from large-scale renewable energy systems, the government has earmarked \$3 billion to install small-scale systems at government premises since 2017-18, with more than \$1.5 billion approved for about 130 projects which can generate about 21 million kWh of electricity per annum.

As for the private sector, the Feed-in Tariff scheme provides financial incentives for the installation of private renewable energy systems. Between 2018 and 2021, the two power companies approved over 17,000 applications. Systems already approved could generate about 270 million kWh of electricity each year, equivalent to the demand of all households in North Point, Quarry Bay and Tai Koo.

Solar energy generation systems have been installed at more than 260 schools and non-governmental welfare organisations under the government's support scheme, Solar Harvest. Other measures to facilitate the development of renewable energy by the private sector include relaxing restrictions on installing solar energy generation systems in New Territories Exempted Houses and legislative amendments relevant to Feed-in Tariff payments.

Both power companies use renewable energy. HK Electric operates an 800kW wind turbine on Lamma and a 1MW thin film solar energy generation 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 and a 10MW landfill gas power generation system at West New Territories Landfill.

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. The code is reviewed every three years and the latest edition was gazetted at end-2021, improving the energy efficiency standards by more than 15 per cent compared with 2015.

The government's earlier target of a 5 per cent reduction in electricity consumption from 2015-16 to 2019-20 was met one year ahead of schedule, with a final saving of 7.8 per cent. The Green Energy Target for the whole government, announced in the 2019 Policy Address, targeted further improving energy performance by 6 per cent by 2024-25.

For private buildings, the capital cost of buying renewable-energy installations and building energy-efficient installations is tax deductible.

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. Since 2019, \$215 million has been earmarked to retro-commission government buildings and work was in progress at over 150 buildings as at end-2021.

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 has been implementing measures to reduce air pollutant emissions from local electricity generation, vehicles and vessels. Between 2010 and 2019, emissions of SO₂, nitrogen oxides (NO_x), RSP, FSP, carbon monoxide and volatile organic compounds dropped by between 27 per cent and 76 per cent.

In 2021, the ambient concentrations of major air pollutants broadly complied with the government's air quality objectives (AQOs). The government also completed legislative amendments to tighten the 24-hour AQO for SO₂ and the annual and 24-hour AQOs for FSP, which will take effect on 1 January 2022.

From 2012 to 2021, ambient concentrations of RSP, FSP, NO₂ and SO₂ dropped 36 per cent, 46 per cent, 29 per cent and 55 per cent respectively, while roadside concentrations of the same fell 38 per cent, 44 per cent, 41 per cent and 50 per cent respectively. Regional ozone background, however, remained relatively high, indicating that the regional photochemical smog problem remains challenging. The EPD is collaborating with the Guangdong and Macao governments on a three-year joint regional ozone study 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. Further to the phasing out of about 80,000 pre-Euro IV diesel commercial vehicles, an incentive-and-regulatory programme has been implemented to phase out some 40,000 Euro IV diesel commercial vehicles by 2027.

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, 780 diesel vehicles with excessive smoke were reported and 2,956 petrol and LPG vehicles with excessive emissions were identified by roadside remote sensors. Such vehicles must pass a chassis dynamometer emission test within 12 days to prove the problem has been rectified.

To promote the use of electric vehicles (EVs), the government announced in March the first Hong Kong Roadmap on Popularisation of Electric Vehicles, setting out the long-term policy objectives and plans for the adoption of EVs and their associated supporting facilities. The key measures include ceasing new registration of fuel-propelled and hybrid private cars in 2035 or earlier, promoting trials for electric public transport and commercial vehicles, expanding and promoting the EV charging network, training for technicians and mechanics on EV maintenance, formulating a producer responsibility scheme for retired EV batteries, and establishing a task force to examine the high-end development of new decarbonisation technologies globally.

In February, the government announced the adjustment of the first registration tax concession cap under the One-for-One Replacement Scheme for electric private cars from \$250,000 to

\$287,500 to promote the use of EVs, while the concession cap in general was maintained at the current level of \$97,500. At end-2021, the number of EVs, including government and special-purpose vehicles, was more than 28,000 – a 51 per cent increase on 2020 – while 4,694 public chargers were available, including 809 quick and 2,465 medium chargers. To encourage people to switch to EVs, the government in 2020 introduced a \$2 billion EV-charging at Home Subsidy Scheme for the installation of charging-enabling infrastructure in car parks of existing private residential buildings, aiming to cover more than 60,000 parking spaces in three years. The government received more than 550 applications involving over 115,000 parking spaces by end-2021.

The trial and application of green commercial transport technologies is subsidised under the New Energy Transport Fund. Around 230 trials have been approved since the fund's inception.

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. All vessels in Hong Kong waters are required 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 further develop and utilise more zero-carbon energy to reduce air pollutant and emissions. In 2021, the emission caps of three key air pollutants, SO₂, NO_x and RSP, from the power sector in 2026 and beyond were further reduced by 71 per cent to 89 per cent compared with 2010 levels.

Indoor Air Quality

The government's voluntary Indoor Air Quality Certification Scheme for Offices and Public Places encourages 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. The import of hydrochlorofluorocarbons for local consumption has been banned since January 2020, with only a small amount permitted to service refrigeration and air-conditioning equipment.

Non-road Mobile Machinery

Non-road mobile machinery newly supplied for use in Hong Kong is required to meet statutory emission requirements, namely the Euro Stage IIIA emission standard for machines such as

crawler cranes, air compressors and excavators. The statutory emission standards for newly approved non-road vehicles have been tightened in phases since 2019 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 128 road sections enhanced through these efforts as at end-2021.

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 Statistics

Over the past five years, the municipal solid waste dumped at landfills has increased 4 per cent, while the mid-year population has grown 2 per cent. Between 2016 and 2020, municipal solid waste totalling 3.79 million to 4.17 million tonnes annually was dumped, translating into a daily per capita disposal rate of between 1.41kg and 1.53kg. The rate in 2020 was 1.44kg. About 60 per cent of 3.96 million tonnes dumped at landfills in 2020 was domestic waste, with the remainder being commercial and industrial waste. Food waste accounted for 30 per cent of the total municipal solid waste in 2020.

During the same five-year period, overall construction waste disposed of at landfills has dropped by 23 per cent. Overall construction waste of 1.25 million to 1.62 million tonnes was dumped annually.

Waste Reduction

The government announced the Waste Blueprint for Hong Kong 2035 in February. Setting out the vision of 'Waste Reduction • Resources Circulation • Zero Landfill', the blueprint outlines the strategies, goals and measures to tackle waste management up to 2035. The government will work with the industry and the community to move towards two main goals. The medium-term goal is to reduce the per capita municipal solid waste disposal rate by 40 to 45 per cent and raise the recovery rate to about 55 per cent by implementing municipal solid waste charging, alongside other policies and legislation, while the long-term goal is to move away from the reliance on landfills for direct waste disposal by developing adequate waste-to-energy facilities. To achieve the goals, the government will promote six major areas of action: waste reduction, waste separation, resources circulation, industry support, innovation and cooperation, and education and publicity.

The Waste Disposal (Charging for Municipal Solid Waste) (Amendment) Bill was passed in August. Municipal solid waste charging is central to the government's waste reduction strategy which aims to provide incentives to the public and enterprises to practise waste reduction at source and clean recycling, thereby reducing overall waste disposal. The preparatory period of 18 months as a basic arrangement has commenced to enable the government, stakeholders and the public to prepare for the implementation of municipal solid waste charging.

From the 2019-20 financial year, the government has been providing additional recurrent resources to strengthen support for waste reduction and recycling. When municipal solid waste charging is implemented, the additional provision will increase to no less than \$800 million every year.

Various producer responsibility schemes (PRSs) have been introduced to reduce waste at source and facilitate the development of a circular economy, including the Plastic Shopping Bag Charging Scheme and PRSs on waste electrical and electronic equipment (WEEE) and glass beverage containers. In 2021, over 23,900 tonnes of WEEE were treated and recycled. During the year, the government conducted public consultations on a PRS for plastic beverage

containers and on the regulation of disposable plastic tableware, and launched a one-year pilot scheme to assess the application of reverse vending machines to collect plastic beverage containers.

Waste Recycling

The government supports the recycling industry and educates the public to reduce and separate waste at sources, so as to improve the quality of the recyclables collected and to streamline the subsequent treatment process.

The government launched a larger scale food waste collection service in 2021, aiming to collect 250 tonnes of food waste per day by 2022. The first contract began in September, with collection services covering Hong Kong Island and the Islands District. A second contract that will cover Kowloon, Kwai Tsing, Tsuen Wan and Tseung Kwan O is expected to start in 2022.

The Programme on Source Separation of Waste covers over 80 per cent of the population. Residents can contribute recyclable items to waste separation facilities close to their homes and workplaces.

Community participation is encouraged through district-based education and recycling support. The community recycling network promotes waste reduction and recycling, and provides local collection points for recyclables of low commercial value. In 2021, two more recycling stations began operations, taking the city's total to 11.

The network also includes 22 recycling stores and over 100 mobile recycling spots operating on a weekly schedule at fixed locations. Green Outreach, which provides on-site assistance and support on recycling to property management companies and residents, has extended its coverage to the entire territory.

Between 2016 and 2020, an annual average of 41 per cent of paper and 90 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 79 per cent of solid waste, including municipal solid waste and overall construction waste, was recovered each year, working out to an annual average of 20 million tonnes recovered. This annual average was 3 per cent lower than the 23 million tonnes recovered between 2011 and 2015.

EcoPark

More than 80 per cent of recyclable municipal solid waste is delivered outside Hong Kong for recycling every year, with plastics, paper and metals contributing more than 90 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 to encourage investment in advanced technologies and value-added recycling processes. Private recyclers in EcoPark carry out operations to recycle cooking oil, scrap metal, wood, WEEE, plastics, construction materials, glass, rubber tyres and batteries.

Recycling Fund

The \$1 billion Recycling Fund promotes sustainable development of the local recycling industry. In 2021, an additional \$1 billion was injected into the fund and the application period extended to 2027, aiming to improve the capability and efficiency of small and medium enterprises in meeting the needs of local and non-local markets and to promote the application of technology for higher value-added products. As of end-2021, about \$650 million had been approved.

Waste Treatment and Disposal

Refuse Transfer Stations

Municipal solid waste is collected and delivered to refuse transfer stations where it is packed into containers and taken to landfills by sea or land. Six stations serve the urban areas and new towns, while seven smaller facilities serve the outlying islands. In 2021, the network handled about 3.14 million tonnes of such waste, about 76 per cent of Hong Kong's total, in an efficient and environmental friendly manner.

Landfills

Hong Kong has three strategic landfills meeting international standards, with different approaches to reduce the impact on the environment. They are the final disposal sites for the city's large amount of solid waste. With the South East New Territories Landfill accepting only construction waste, all municipal solid waste is disposed of at the other two landfills in the northeast and western New Territories.

All three landfills need to be extended to ensure an uninterrupted waste disposal service to the public. With different waste reduction and recycling initiatives, the municipal solid waste charging scheme, and the development of other infrastructure and waste-to-energy facilities, the extensions are expected to be able to meet Hong Kong's needs up to the 2040s. The initial work on the South East New Territories Landfill Extension has been completed and it started to receive construction waste in November.

Hong Kong has 13 restored landfills. The government promotes the development of restored landfills into recreational facilities such as playgrounds, parks and sports facilities.

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. A facility being built on an artificial island near Shek Kwu Chau will use advanced incineration to reduce waste volumes by 90 per cent and turn waste into energy, so as to reduce greenhouse gas emissions. It is expected to begin operating in 2025, capable of treating 3,000 tonnes of municipal solid waste daily.

The government is building a network of organic resources recovery centres, using biological technology to turn food waste into useful resources. The first such facility, O • Park1, opened in 2018 with a capacity of 200 tonnes daily. It treated 45,000 tonnes of food waste, generated

10.9 million kWh of electricity and produced 2,600 tonnes of compost in 2021. O • Park2, with a capacity of 300 tonnes daily, is under construction for commissioning in 2023.

An anaerobic co-digestion trial scheme launched in 2019 at the Tai Po Sewage Treatment Works can process about 50 tonnes of food waste a day. The trial will be extended to the Sha Tin Sewage Treatment Works for commissioning in 2023, with a similar treatment capacity. In the longer term, the government will look into expanding the food waste treatment capacity at the Tai Po Sewage Treatment Works and extending the technology to other sewage treatment works.

Another recycling centre, Y • Park, in Tuen Mun began operation at the end of June, turning suitable yard waste into products such as wood chips and wooden boards. Y • Park's handling capacity will be about 11,000 tonnes (an average of about 30 tonnes per day) in the first year and increase to an annual average of around 22,000 tonnes. The government also awarded a contract in December to set up and operate a pilot biochar production plant in EcoPark for turning woody waste into biochar. The plant is expected to process around 6,000 tonnes of woody waste and produce about 1,200 tonnes of biochar a year.

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 in Tsing Yi, operated by a government contractor, treated a daily average of 29.3 tonnes of chemical waste and 12.4 tonnes of clinical waste in 2021. Waste producers using its services pay part of the treatment cost.

The government's policy is to return radioactive waste to the original suppliers as much as possible, hence only some low-level radioactive waste needs to be transferred to a dedicated facility on Siu A Chau, an uninhabited island southwest of Lantau, for long-term storage. The 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 about 410,000 tonnes of sewage sludge and exported 5.3 million kWh of electricity in 2021. Its premises, designed for environmental education and recreation, have attracted over 280,000 visitors since its opening in 2016.

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 20.1 million tonnes of overall construction waste was generated from 2016 to 2020. The reuse rate was 94 per cent in 2020, having remained above 90 per cent in recent years.

Marine and Shoreline Refuse

Marine refuse in Hong Kong waters is cleared by the Marine Department, which deploys about 80 vessels to scavenge for floating refuse and collect domestic refuse from vessels in the anchorages and typhoon shelters. In 2021, the department collected about 2,500 tonnes of such refuse.

Shoreline refuse is cleared by the Agriculture, Fisheries and Conservation Department; the Food and Environmental Hygiene Department; the Leisure and Cultural Services Department; and other government bodies.

The Inter-departmental Working Group on Marine Environmental Management coordinates the efforts of different departments in handling marine refuse and marine environmental incidents. In addition, the government leverages community efforts to protect the marine environment through the Clean Shorelines Liaison Platform.

Since 2015, over 2,800 participants from schools, non-profit-making organisations and commercial companies have been engaged in the Shorelines Cleanup Day programme through the platform. There have also been more than 2,000 coastal clean-up activities carried out by voluntary groups and activists in the past six years. To support these activities and boost public awareness on marine and shoreline protection, the Shoreline Wardenship Programme, funded under the Green Employment Scheme, recruited 100 frontline workers in 2021 to arrange clean-ups, carry out surveys and produce promotional videos for the platform.

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 actions.

Livestock Waste

The Waste Disposal Ordinance bans the keeping of livestock in new towns and environmentally sensitive areas. Where they are allowed, livestock farms must have proper waste treatment systems. The government provides a free livestock waste collection service, which collected about 27,000 tonnes of waste in 2021.

Sewage Treatment and Disposal

The public sewerage system covers the entire urban area and serves over 93 per cent of the whole population. It collects about 2.8 million cubic metres of waste water daily, 99 per cent of which receives chemical or higher levels of treatment before being discharged. The government plans to spend about \$24 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 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-2021, more than 16,000 village houses had been connected to public sewers. Eligible households can apply for loan and grant schemes to help them connect their buildings to 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 2021, the harbour's overall compliance with the statutory water quality objectives was 100 per cent.

By controlling pollution at source, river water quality has also improved. During the year, 81 per cent of the river monitoring stations were categorised as 'good' or 'excellent', while 10 per cent belonged to the 'bad' or 'very bad' categories.

Bathing Beaches

Beach water quality is assessed through an established system which ranks a beach according to the level of the *Escherichia coli* bacteria in its water, to reflect the corresponding swimming-associated health risks. In 2021, all 42 gazetted beaches met the statutory bacteriological water quality objective. Thirty beaches were ranked as 'good' and the remaining 12 were ranked as 'fair'. No beach fell into the 'poor' or 'very poor' categories.

Legislation and Environmental Protection

Eleven 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, Motor Vehicle Idling (Fixed Penalty) Ordinance and Mercury Control 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 703 convictions and \$2.45 million in fines in 2021.

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 2021, the department handled 107 monitoring and auditing programmes.

Meteorological and Geophysical Services

The Hong Kong Observatory provides meteorological, climatological, radiation monitoring, oceanographic, geophysical, astronomical and time services.

Weather Forecasting and Information Services

The Observatory provides weather information through a variety of channels, including the media, social media, its website, mobile application MyObservatory, and the Dial-a-Weather telephone service. It also produces regular weather television programmes and an educational series, *Cool Met Stuff*. As at year end, there were around 270,000 and 49,000 followers for its Facebook page and Instagram accounts respectively, and its website and MyObservatory had 142 billion page views in 2021.

The Observatory's personalised weather website began to support eight ethnic minority languages to enhance weather information services in 2021. The Observatory also launched the nine-day Probability of Significant Rain forecast and the Localised Heavy Rain Advisory service, enabling the public to better prepare for potential high-impact weather; and a trial feature 'My Weather Observation' on MyObservatory, allowing users to report and share weather information.

The Observatory issues weather forecasts and warnings, and offers professional advice to government departments and the aviation, shipping, engineering and other sectors. For instance, it provides aviation weather services to the airport and the Hong Kong Flight Information Region, offers flight crew the latest inflight weather information through its MyFlightWx mobile application, and issues forecasts of wind, weather, waves and swells for the marine community and container terminals. When the Asian Aviation Meteorological Centre's main centre in Beijing was closed for relocation in October, the Observatory, as the backup centre, took over to provide en-route hazardous weather warning services for the Asia-Pacific region.

Climate Services and Studies

The Observatory provides government departments and those involved in areas such as disaster prevention and risk reduction with climatological information and predictions. It also conducts research on past trends and future projections of temperature, rainfall, sea level and extreme weather in Hong Kong and provides the latest climate change information and scientific input to government departments in support of initiatives to combat climate change. In 2021, the Observatory updated its Climate Change and Climate Projections webpages based on the *Sixth Assessment Report* of the United Nations Intergovernmental Panel on Climate Change, and compiled a new set of 30-year climatological normals for Hong Kong from 1991 to 2020. The Observatory's upper air observing station also became the world's first centennial upper air observing station accredited by the World Meteorological Organisation (WMO).

Radiation Monitoring and Assessment

The Observatory monitors ambient radiation levels in Hong Kong 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 would step up its radiation monitoring activities, work with other government departments to provide decision makers with an assessment of radiological consequences and advise on actions to take. Information on radiation levels and the latest developments would be provided to the public through various channels. In 2021, replacement of the Liquid Scintillation Counting System at the King's Park Radiation Laboratory was completed and the communication facilities of the Monitoring and Assessment Centre were upgraded to enhance operational efficiency.

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, MyObservatory, the media and social media, as well as via SMS and email for registered users. In 2021, the Observatory recorded three locally felt earthquake tremors, and the earthquake of magnitude 3.7 which occurred on 2 April in Heyuan, Guangdong received the most public reports. An interactive webpage displaying details of locally felt earthquake tremors since 1979 was launched.

Time Services

As Hong Kong's official timekeeper, the Observatory maintains a time standard 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 the Observatory's online network time service, web clock, Dial-a-Weather and radio stations. The Observatory's internet time service drew a record high of more than 91 billion visits in 2021.

Cooperation with Other Meteorological Services

The Observatory participated in the Extraordinary Session of WMO Congress in 2021 to discuss various global meteorological strategic issues, and advised on the formulation of policy for the international exchange of earth system data.

Public Education and Engagement

The Observatory promotes public awareness of hazardous weather, climate change and radiation. During the year, it launched an e-book for children titled *A Tour of Tropical Cyclones*, produced more panoramic virtual tours to the Observatory's facilities at outstations, and renovated some exhibits in the exhibition hall at the Observatory Headquarters.

To enhance public understanding and awareness of extreme weather and climate change, the Observatory organised the public online polling campaign '2016-2020 Top 10 Mind-boggling Weather and Climate Events Selection'. In view of the COVID-19 epidemic, the Observatory's annual open day was held online for the first time.

Other than producing educational videos, the Observatory conducts school and online talks on climate change and radiation, and disseminates the latest developments and international research findings on global climate change via its website and MyObservatory. In 2021, it launched a documentary television programme showcasing the application of science and technology by various government departments, and continued to engage students and young people through various outreach events including the newly launched 'Gamma-Go' workshops and activities related to the Community Weather Information Network.

Some of the more than 13,800 'Friends of the Observatory' help support public education events organised by the Observatory.

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

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