7.5 How can we respond to the impacts of climate change?

This section first introduces the international cooperation in tackling climate change, including two international agreements, the Kyoto Protocol and the Paris Agreement. It then discusses actions in respect of mitigation, adaptation and resilience, as well as individual efforts to combat climate change.

1 International cooperation

2 Government actions

3 Individual actions

1 Impacts on the natural environment

The Intergovernmental Panel on Climate Change (IPCC) was established by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) in 1988. The IPCC regularly reviews most up-to-date scientific literature on climate change and prepares assessment reports, providing clear scientific perspectives and objective information to the world, including the scientific basis and causes of climate change, its potential environmental and socio-economic consequences, and the adaptation and mitigation options to respond to the impacts.

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted at the Rio de Janeiro Earth Summit in 1992. It is an international environmental agreement which aims at stabilizing the level of atmospheric greenhouse gas concentrations in order to prevent dangerous human-induced interference with the climate system. To achieve this goal, two important international agreements were adopted by the United Nations, namely, the Kyoto Protocol in 1997 and the Paris Agreement in 2015.

1.1 The Kyoto Protocol

In 1997, the 3rd session of the Conference of the Parties (COP3) of the UNFCCC was held in Kyoto, Japan and adopted the Kyoto Protocol. However, the Protocol did not enter into force until 2005.

More Information

What is the Kyoto Protocol?

1.1.1 Content

The Kyoto Protocol recognizes the principle of "common but differentiated responsibilities", meaning that combating climate change is a shared obligation among all nations. However, since more developed countries are principally responsible for the current high levels of atmospheric greenhouse gas concentrations due to over a century of industrial activities, the Protocol places a heavier burden on more developed countries than less developed countries in emission reduction. A top-down approach was adopted in negotiating the emission reduction targets among the more developed countries. It is difficult to implement the agreement as each country has to consider its own circumstances and economic interests.

The emission reduction commitment period of the Kyoto Protocol was from 2008 to 2012. The European Union and 37 more developed countries pledged to reduce at least 5% greenhouse gas emissions against 1990 levels.

In 2012, the Doha Amendment to Kyoto Protocol was adopted at the 18th session of the Conference of the Parties (COP18) of UNFCCC, established the second commitment period for emission reductions from 2013 to 2020. Relevant Parties committed to reduce their greenhouse gas emissions by at least 18% against 1990 levels. The Doha Amendment entered into force on December 31, 2020.

1.1.2 Effectiveness

There are criticisms of the effectiveness of the Kyoto Protocol, citing the lack of participation from some more developed countries. For example, the United States in 2001 declared that it had no intention of implementing the Kyoto Protocol, and Canada formally withdrew in 2012. Japan, Russia, and New Zealand chose not to participate in the new emission reduction targets under the Doha Amendment.

During the first commitment period from 2008 to 2012, some more developed countries achieved the emission reduction targets while others did not. Further criticisms focus on the principle of "common but differentiated responsibilities", as less developed countries are not required to share the responsibility of emission reduction. However, increased emissions from less developed countries have offset the reductions made by more developed countries.

Parties (selected)	Emission reduction pledges for the 1st commitment period (relative to 1990 levels)	Actual emissions (average value from 2008 to 2012)	Target achieved
European Union (15 countries)	-8%	-18%	✓
Japan	-6%	+4%	✗
Canada	-6%	+24%	✗
Croatia	-5%	-15%	✓
New Zealand	0%	+38%	✗
Russia	0%	-50%	✓

During the second commitment period from 2013 to 2020, the average annual emissions of participating developed countries decreased by 22% compared to 1990 levels, while the European Union saw an average reduction of 23%. 10 countries (9 EU member states and the United Kingdom) reduced their emissions by more than 30% relative to 1990 levels, but 7 countries recorded an increase in their average annual emissions.

1.2 The Paris Agreement

In 2015, the 21st session of the Conference of the Parties (COP21) of UNFCCC took place in Paris, France and adopted the Paris Agreement.

1.2.1 Content

The main goal of the Paris Agreement is to contain global average temperature rise by the end of this century well below 2° C relative to pre-industrial levels and to pursue efforts to limit the temperature rise to 1.5° C in order to avoid the dangerous impacts of climate change. The Paris Agreement entered into force in November 2016 and was later ratified by 195 parties as of 11 March 2025.

Unlike the Kyoto Protocol, the negotiation in the Paris Agreement adopts a bottom-up approach. Each country sets its own Nationally Determined Contribution (NDC), outlining its greenhouse gas emission reduction target and timeline according to its national circumstances. Each country will conduct a review every 5 years and update its own NDC with a more ambitious emission reduction target. Since the countries determine their own emission reduction targets, it is easier to implement the agreement.

1.2.2 Effectiveness

Parties (selected)	Nationally Determined Contribution (NDC) emission reduction targets
China	Carbon dioxide emissions are targeted to peak before 2030, with efforts to achieve carbon neutrality before 2060. By 2030, carbon dioxide emissions per unit of GDP will be reduced by more than 65% compared to 2005 levels.
Japan	Greenhouse gas emissions in fiscal years 2035 and 2040 will be reduced by 60% and 73% respectively, compared to fiscal year 2013 levels.
European Union	Greenhouse gas emissions in 2030 will be at least 55% lower than 1990 levels.
India	Carbon intensity in 2030 will be 45% lower than 2005 level.

1.3 Comparison of the Kyoto Protocol and the Paris Agreement

The Kyoto Protocol	The Paris Agreement
Timeline: ▼ Adopted in December 1997 ▼ Entered into force in 2005 ▼ The 1st Commitment Period 2008–2012 ▼ The 2nd Commitment Period 2013–2020 ▼ Expired in 2020	Timeline: ▼ Adopted in December 2015 ▼ Entered into force in November 2016
Negotiation: • Top–down	Negotiation: • Bottom–up
Approach: • Countries negotiate with one another to set the emission targets.	Approach: • Each country sets its own Nationally Determined Contribution (NDC), outlining its greenhouse gas emission reduction target and timeline.
Targets: • The 1st Commitment Period: The European Union and 37 more developed countries to reduce greenhouse gas emissions by at least 5% against 1990 levels. • The 2nd Commitment Period: Participating parties to reduce greenhouse gas emissions by at least 18% against 1990 levels.	Targets: • To contain global average temperature rise by the end of this century well below 2° C relative to pre–industrial levels and to pursue efforts to limit the temperature rise to 1.5° C in order to avoid the dangerous impacts of climate change. • Each country will conduct a review every 5 years and update its own Nationally Determined Contribution (NDC) with a more ambitious emission reduction target.

IPCC Special Report on Global Warming of 1.5° C (SR15)

In response to one of the decisions made at the United Nations Climate Change Conference in Paris (COP21), the IPCC published the Special Report on Global Warming of 1.5 ° C in October 2018. The Special Report makes an urgent call for policymakers that limiting global warming to 1.5°C would require rapid, far–reaching and unprecedented changes in all aspects of society. The Special Report clearly outlines the multiple benefits of limiting global warming to 1.5° C compared to 2° C, for example:

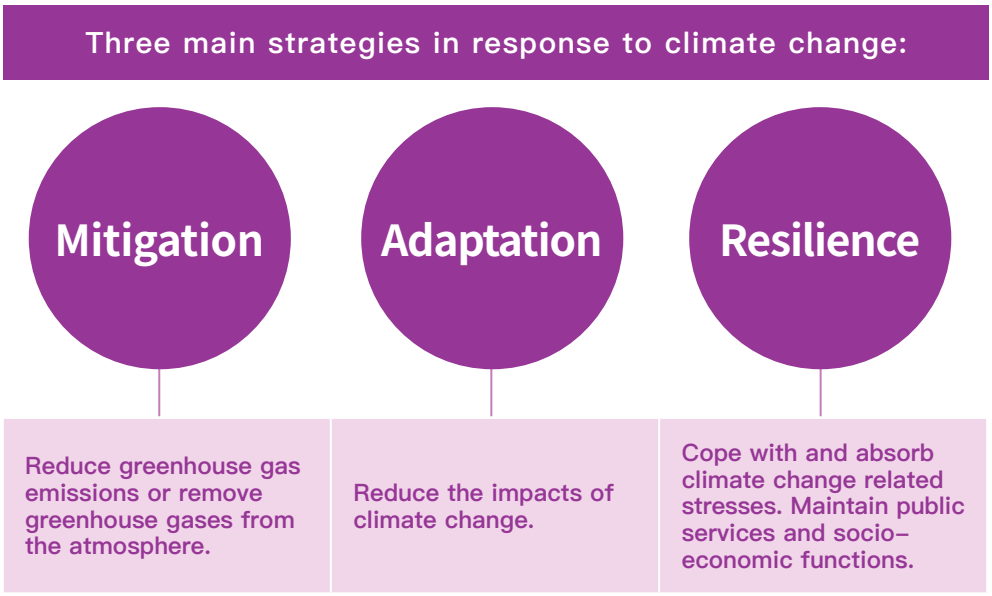
1. a slower rate of sea level rise which enables greater opportunities for adaptation in the human and ecological systems of small islands, low–lying coastal areas and deltas;
2. lower impact on terrestrial, freshwater and coastal ecosystems which helps retain more of their services for humans;
3. less ocean warming and acidification, hence lower risks to marine biodiversity and ecosystems;
4. fewer climate–related risks to health, food security, water supply, human security and economic growth; and
5. reduced adaptation needs.

Human activities have already caused approximately 1° C of global warming above pre–industrial levels and we are already witnessing its consequences through more extreme weather, rising sea levels and diminishing Arctic sea ice. To contain global warming to 1.5° C, human–caused carbon emissions have to decline by about 40% from 2010 levels by 2030, reaching net zero around 2050. Current national pledges of emission reductions under the Paris Agreement would not suffice to achieve the goal. The goal can only be achieved if global carbon emissions start to decline well before 2030. Based on the Nationally Determined Contributions (NDCs) for reductions in greenhouse gas emissions made by the countries at the Paris Agreement, a global warming of around 3° C would be more likely by the end of this century#.

Information as of the compilation of this special report

2 Government actions

Each country has to implement emission reduction measures according to its Nationally Determined Contribution (NDC) in order to mitigate climate change. At the same time, the country also has to be prepared to adapt to impacts of climate change and to strengthen resilience.



2.1 Mitigation

Mitigation measures may include the following:

2.1.1 Replace fossil fuels with renewable energy

Reduce the use of fossil fuels and increase the share of solar power, wind power and hydro-electric power in the energy mix.

2.1.2 Improve energy efficiency

Improve energy efficiency. For example, use energy-efficient electrical appliances and fuel-efficient vehicles, install intelligent energy-saving systems in buildings.

2.1.3 Improve waste management

Develop waste-to-energy technologies to efficiently manage urban waste and reduce dependence on fossil fuels.

2.1.4 Afforestation and urban greening

Afforestation increases carbon sinks. Roof greening or vertical greening on buildings provides cooling effects and therefore can reduce energy consumption from air conditioning and alleviate the urban heat island effect by reducing heat absorbed by building surfaces.

2.1.5 Carbon capture and storage

Scientists have been developing technologies to capture atmospheric carbon dioxide and store it underground, in deep oceans or in biomass for the long term. Most of the technologies are still in early stages and not yet ready for large-scale implementation.

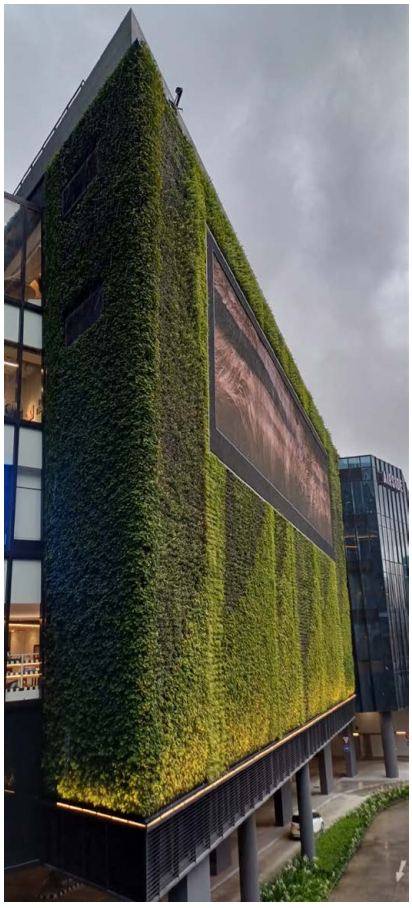


Fig 1 Building with vertical greening

Fig 2 Solar panels

Fig 3 Hydro–electric dam
Source: American Public Power Association

2.2 Adaptation

Adaptation measures may include the following:

2.2.1 Coastal and drainage projects

a. Coastal protection structures

Raise the height of seawalls or construct sluices to defend against extreme water levels caused by storms.

b. River channel improvement

Enhance the drainage capacity of river channels.

c. Drainage system planning

flood prevention strategies and improve existing systems. Maintain the systems in good condition and perform preventative maintenance.

Fig 4 Coastal protection structures in Japan
Source: Pekachu

Fig 5 Sluice in River Thames, England and its operation
Source: Kleon3

2.2.2 Building design

Highly reflective materials can reflect more sunlight, reducing the amount of heat absorbed by buildings. Flood–resilient or floating houses can reduce the loss of life and property.

Fig 6 Flood–resilient house
Source: Infrogmation

2.2.3 Land use planning

Proper land use planning can avoid building important infrastructure such as hospitals in high–risk areas like coastal areas and slopes. Buffer zones such as parks, waterfront promenade should be built in these areas to replace high–density developments. River revitalization and roof greening can alleviate the urban heat island effect effectively.

2.2.4 Food supplies

Develop new crop varieties which are more resistant to high temperature and drought.

More Information

The Future is Ours

Floating houses

2.3 Resilience

By strengthening climate resilience, we can better cope with the stresses caused by climate change. The table below outlines the steps for strengthening climate resilience as suggested by the U.S. National Oceanic and Atmospheric Administration (NOAA).

Steps for strengthening climate resilience		Example from Houston, US (Fig. 7)
I. Explore hazards	• Form a group • Examine past and future extreme weather events for the region • List the "assets" that could be affected, including people, resources, ecosystems, and infrastructure	• Houston, the United States faces extreme rainfall and storm surge inundation • More frequent extreme rainfall and a higher threat of storm surge are projected
II. Assess vulnerability and risks	• Determine which assets are exposed to impacts of extreme weather • Assess each asset's vulnerability • Estimate the risk to each asset	• The team paid special attention to Houston's petrochemical industry and the Johnson Space Centre
III. Investigate options	• Consider all possible solutions • Study similar cases • Identify feasible solutions	• The team cooperated with various government departments to compile climate data and conducted research using several resilience enhancement tools
IV. Prioritize and plan	• Evaluate costs and benefits of each solution and resilience of all departments • Select the best solution	• Based on the research results, they built a climate change website and developed 9 guidelines
V. Take action	• Implement the solution • Gain public support • Monitor effectiveness, and revise the resilience plan when necessary	• Provided relevant information to the public • Continue to enrich the website

Fig 7 Houston, the United States faces extreme rainfall and storm surge inundation
Source: Michael Slaten

More Information

Climate Resilience website

2.4 Case study: Hong Kong (City level)

Fig.8 shows Hong Kong's progress in mitigating global warming. In 2023, Hong Kong's total greenhouse gas emissions were about 34.5 million tonnes of carbon dioxide equivalent, showing a decrease of about 20% compared to 2005 when the Kyoto Protocol entered into force, and a reduction of around one-quarter from Hong Kong's peak level of emissions in 2014. The same year, the per capita greenhouse gas emissions were about 4.58 tonnes of carbon dioxide equivalent, which was the lowest since 1990, showing a decrease of nearly 30% compared to 2005 and 2014. As for the local greenhouse gas emissions, electricity generation remains the main source which accounting for about 61% of the total emissions in 2023. Other major sources include transport (18%) and waste management (8%).

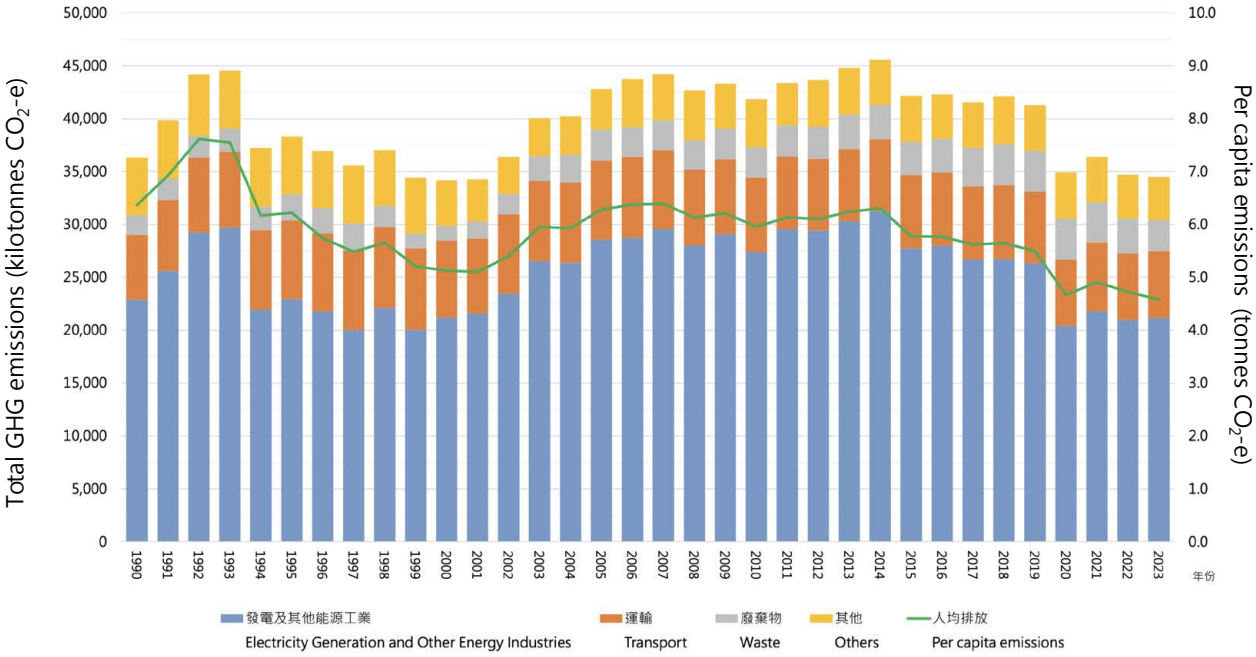


Fig 8 Greenhouse gas emissions trends and carbon emissions sources in Hong Kong
Source: Carbon Neutrality and Sustainable Development, GovHK

More Information

Greenhouse Gas Emissions in Hong Kong

Greenhouse Gas Emissions and Carbon Intensity in Hong Kong

Records show emissions fell in 2023

GHG Emissions and Trends

As part of China's commitment to the Paris Agreement, the Hong Kong SAR Government will strive to achieve carbon neutrality before 2050 and has established the Steering Committee on Climate Change and Carbon Neutrality to formulate an overall strategy. The Hong Kong's Climate Action Plan 2050 has set out more ambitious decarbonization strategies and measures, and strengthened the mid-term target, striving to reduce Hong Kong's carbon emissions by half from the 2005 level by 2035. To achieve this goal and respond to climate change, Hong Kong is taking action in three key areas: carbon reduction, adaptation, and resilience.

2.4.1 Carbon reduction

In recent years, the government has allocated substantial resources to implement various carbon reduction measures, and the two power companies have also invested in decarbonization projects.

a. Net-zero electricity generation

Cease using coal for daily electricity generation; increase the share of renewable energy in the fuel mix for electricity generation to 7.5% to 10% by 2035, and to 15% subsequently; and try out the use of new energy and strengthen co-operation with neighbouring regions to achieve the long-term target of net-zero electricity generation before 2050.

b. Energy saving and green buildings

Reduce the overall electricity consumption of buildings through promoting green buildings, improving buildings' energy efficiency and promoting a low-carbon lifestyle. The goal is to reduce the electricity consumption of commercial buildings by 30% to 40% and that of residential buildings by 20% to 30% from the 2015 level by 2050, and to achieve half of the above targets by 2035.

c. Green transport

Achieve the long-term target of attaining zero vehicular emissions and zero carbon emissions in the transport sector before 2050, through the electrification of vehicles and ferries, development of new-energy transport and measures to improve traffic management. The Government will cease the new registration of fuel-propelled and hybrid private cars in 2035 or earlier. Apart from promoting electric buses and commercial vehicles, the Government also collaborates with the franchised bus companies and other stakeholders to test out hydrogen fuel cell electric buses and heavy vehicles.

d. Waste reduction

To achieve the long-term target of carbon neutrality in waste management before 2050, the Government will strive to develop adequate waste-to-energy facilities by 2035, so as to move away from reliance on landfills for municipal waste disposal.

2.4.2 Adaptation and resilience

a. Strengthen infrastructure

- Establish the Climate Change Working Group on Infrastructure.
- Update infrastructure design standards.
- Undertake studies on strengthening infrastructure under climate change.

b. Combat sea level rise and coastal protection

- Conduct studies on storm surges, waves, and shoreline management.
- Formulate coastal management and improvement measures.

c. Combat extreme rainstorms and tropical cyclones

- Adopt appropriate flood prevention and drainage management measures. (Fig. 9)
- Implement the Inter-reservoirs Transfer Scheme.
- Enhance slope safety.
- Strengthen the flood prevention and drainage capacity of railway and road infrastructure.

d. Combat extreme droughts and safeguard water supply

- Contain fresh water demand growth.
- Build resilience in the fresh water supply with diversified water resources.

Fig 9

Tai Hang Tung Stormwater Storage Tank reduces the surface runoff discharged into the downstream drainage system during heavy rainstorms
Source: Dr. T.C. Lee

Fig 10

Examples of enhancing architectural design to combate extreme heat: Evaporation of water in a fountain

e. Combat extreme heat

- Enhance building design. (Fig.10)
- Promote urban forestry.

f. Contingency plan for natural disasters

- The Chief Secretary for Administration chairs an inter-departmental Steering Committee to handle natural disasters of a substantial scale.
- When necessary, activate the Emergency Monitoring and Support Centre to provide a holistic support.
- Conduct regular exercises of various forms.

g. Warning and monitoring

- Disseminate messages via an emergency alert system during emergency situations to remind the public to adopt contingency measures quickly.
- The HKO closely monitors severe weather and storm surges, issues related warnings and bulletins when needed. (Fig.11)
- Monitor data such as water levels in various locations to facilitate speedy analysis of the flooding situations.

h. Transport system

- Update contingency plans to handle emergency situations at major transport infrastructure.
- In the event of an emergency, the Transport Department's Emergency Transport Coordination Centre will activate the relevant contingency plan.

i. Raise community awareness of climate change

- The government collaborates with commercial, professional, academic and community organizations to organise activities related to climate change.
- The HKO conducts studies and makes long-term projections about the impacts of climate change in Hong Kong, providing this information through its website.
- HKO also organizes regular school and public talks, along with other public educational activities, to promote understanding of climate change. (Fig. 12)

Fig 11

HKO weather radars provide round-the-clock monitoring for severe weather, including rainstorm and tropical cyclones
Source : HKO

Fig 12

HKO enhances public understanding of climate change through outreach activities like open days
Source : HKO

More Information

Government announces Hong Kong's Climate Action Plan 2050

2022 Policy Address: policy measures of Environment and Ecology Bureau: Environmental Protection Legislative Council Panel on Environmental Affairs @31 October 2022

Hong Kong's Climate Action Plan 2050

Hong Kong West Drainage Tunnel

Coastal enhancement

3 Individual actions

Just as mankind has played an undeniable role in bringing about climate change, each of us has an inescapable responsibility to mitigate its impact. Regardless of the pledges made by governments under the Paris Agreement, it ultimately falls on us, as citizens of the planet, to achieve the targets set through changes in mindset, lifestyle and consumption behaviour.

Low Carbon Living Tips

What can you do to help combat climate change?

The tips below help us practise low-carbon living and reduce greenhouse gas emissions:

(Source: Carbon Neutral@HK, GovHK)

3.1 Clothing

3.1.1 Choose a washing machine with Grade 1 energy label.
3.1.2 Choose a washing machine with capacity that meets your household's needs.
3.1.3 Wait until there is a full laundry load before using the washing machine.
3.1.4 Use fast cold wash programme to save water, electricity and time.
3.1.5 Hang-dry washed clothes under sunlight to save energy and kill germs. (Fig. 13)
3.1.6 Hand washing clothes is a low-carbon choice.
3.1.7 Rethink before buying new clothes. (Each adult clothing generates around 8 kg CO2-e)
3.1.8 Choose clothes that do not require ironing.
3.1.9 Donate unwanted clothes to those in need or charity organizations.

Fig 13 Hang-dry washed clothes under sunlight to save energy and kill germs.
Source : Canva Education

3.2 Food

3.2.1 Avoid purchasing food more than needed.

3.2.2 Buy regional and seasonal food.

3.2.3 Buy food with no or minimal packaging.

3.2.4 Avoid using one–off disposable containers and utensils.

3.2.5 Consume food that is purchased earlier and is close to the expiry date first (first–in–first–out (FIFO) system).

3.2.6 Make the best use of leftovers and unconsumed food, such as using leftover food to make new dishes.

3.2.7 Allow hot/warm food to cool down to room temperature before putting it in the refrigerator.

3.2.8 Avoid setting the refrigerator temperature unnecessarily low.

3.2.9 Leave enough space between refrigerators and the walls or cabinets. Trapped heat increases energy consumption.

3.2.10 Eat more vegetables. (Shifting from high meat diet to vegetarian diet could reduce your carbon emissions on food up to 80%)

3.2.11 Eat more organic food! Organic food produces less carbon emissions by avoiding energy used in producing chemical pesticides and fertilizers.

3.2.12 Think about the portion required before cooking/ordering food.

3.2.13 Reheat food by using slow–cook pot or simmer burners rather than ovens.

3.2.14 Food cooks faster if pots and pans are covered with lids.

3.2.15 Bring containers when dinning out or ordering takeout. (Fig.14)

Fig 14

Bring containers when dinning out or ordering takeout.
Source : Canva Education

3.3 Living

3.3.1 Bring your own shopping bags.

3.3.2 Avoid purchasing unnecessary items and choose more durable products.

3.3.3 Adopt simple packaging and avoid gift wrapping.

3.3.4 Turn off lights and electrical appliances when they are not in use.

3.3.5 Avoid leaving electrical appliances on standby mode.

3.3.6 Choose electrical appliances with Grade 1 energy label.

3.3.7 Choose gas appliances with “Voluntary Energy Efficiency Label".

3.3.8 Install solar panels on roof and join the Feed–in–Tariff Scheme.

3.3.9 Use energy saving LED lighting.

3.3.10 Wear light, open the windows and use fans instead of air conditioners.

3.3.11 Set the temperature of air conditioners at 24 – 26 °C for comfort and energy conservation.

3.3.12 Keep windows and doors closed when the air–conditioner is turned on and use curtains or blinds to block sunlight.

3.3.13 Clean the filters of air conditioners regularly.

3.3.14 Install a low–flow shower head and take shorter showers.

3.3.15 Use instantaneous water heaters as far as practicable. Otherwise, use storage type water heaters with Grade 1 energy label. (Fig.15)

3.3.16 For storage type water heater, choose one with the right storage capacity and temperature control that meet the family's needs.

3.3.17 Set the water temperature of the water heater at the lowest acceptable level, especially in summer.

3.3.18 Switch the water heater off after use.

3.3.19 Install low-flow controller in the water tap.

3.3.20 Turn off the tap while brushing teeth, applying soap or shaving.

3.3.21 Repair water leaks – a dripping faucet can waste up to 76L of water per day.

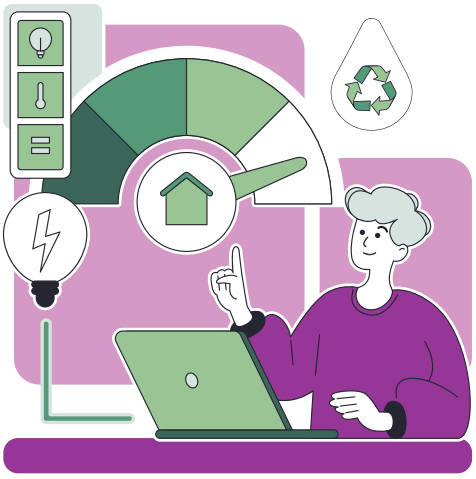
3.3.22 Reduce waste. (3L garbage could generate around 1 kg CO_2-e)

3.3.23 Donate unwanted gifts to the needy through relevant organizations.

3.3.24 Support clean recycling.

More Information

Recyclable materials in Hong Kong



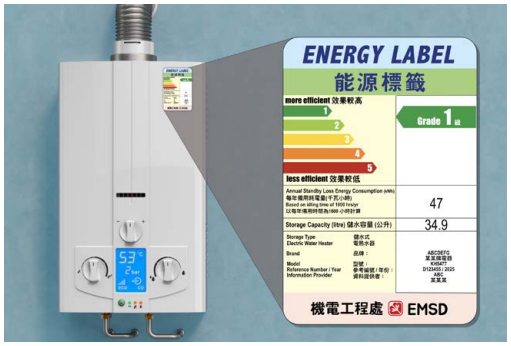


Fig 15 Storage type water heater with Grade 1 energy label.

3.4 Travel

3.4.1 Use stairways instead of lift.

3.4.2 Walk or use public transport.

3.4.3 Carpooling when using private cars.

3.4.4 Drive less.

3.4.5 Drive at proper speed.

3.4.6 Keep your vehicle well maintained.

3.4.7 Maintain proper tire pressure.

3.4.8 Use electric vehicles.

3.4.9 Replace overseas business trips by video conferencing or emails. (A round-trip flight from Hong Kong to Tokyo could generate over 400 kg CO_2-e)

3.4.10 High-speed rail's carbon emissions are only about 15% of aircraft and 25% of buses.

3.4.11 Opt for low-carbon local tours, such as visiting the country parks and the Hong Kong UNESCO Global Geopark. (Fig.16)

Fig 16 The Hong Kong UNESCO Global Geopark is an ideal destination for a low-carbon local tour

7.5 Chapter Summary

How can we respond to the impacts of climate change?

1 International cooperation

- Intergovernmental Panel on Climate Change (IPCC): Established in 1988, IPCC regularly reviews climate change–related literature and produces reports. These reports cover the scientific basis and causes of climate change, its potential impacts, and strategies for addressing those impacts.
- United Nations Framework Convention on Climate Change (UNFCCC): Established in 1992, its goal is to stabilize greenhouse gas atmospheric concentrations and prevent dangerous human interference with the climate system.
- The Kyoto Protocol and the Paris Agreement are two major international agreements aiming to reduce greenhouse gas emissions. The Kyoto Protocol emphasizes "common but differentiated responsibilities", while the Paris Agreement adopts a system of Nationally Determined Contributions (NDC), encouraging countries to set their own emission reduction targets based on their national circumstances.

2 Government actions

- Each country has to implement concrete measures based on its emission reduction commitment and enhance its resilience to adapt to the impacts of climate change.
- Main strategies include mitigation (reducing greenhouse gas emissions), adaptation (improving infrastructure and land use), and resilience (strengthening societal response).

3 Individual actions

Everyone has a responsibility to reduce carbon emissions by changing their lifestyle. Concrete actions include:

- Clothing: Choose energy–efficient appliances and washing machines; air–dry clothes whenever possible.
- Food: Reduce food waste, buy locally sourced ingredients, and avoid using disposable containers and utensils.
- Living: Use energy–saving devices, adjust air conditioning settings, reduce waste at the source, and support recycling.
- Travel: Use public transport more often, drive less, and consider ride–sharing options.