

Activity Worksheet (1)

Activity 1: Getting to Know Greenhouse Gases and Climate Change

Source A: Causes of Climate Change

Climate change refers to long-term shifts in temperatures and weather patterns. These shifts may be natural, such as through variations in the solar cycle. But since the 1800s, human activities have been the main driver of climate change.

The heat content at the surface of the Earth is mainly derived from the sun. Part of the solar energy is reflected directly back to space by the atmosphere, clouds, land, ice and water surfaces, while the remaining solar energy absorbed by the Earth is returned to space as infrared (heat) radiation. In the process it interacts with the whole climate system – atmosphere, oceans, land surfaces and ice sheets. The main gases that make up the atmosphere, e.g. nitrogen and oxygen, do not interact with infrared radiation. However, certain gases such as carbon dioxide and methane absorb infrared radiation released from the Earth’s surface and re-radiate it in all directions, including back to the Earth’s surface. Such gases act like a blanket wrapping around the Earth that hinder the radiation of heat from the Earth to space and trap the sun’s heat energy, thereby raising the Earth’s temperature. This is called the “greenhouse effect”. Gases that interact with infrared radiation and hinder the radiation of heat from the Earth to space are called greenhouse gases.

Greenhouse gas emissions mainly come from burning of fossil fuels such as coal, oil and natural gas. Clearing forests will also release carbon dioxide. On the other hand, decomposition of wastes in landfills is a major source of methane emissions.

Carbon dioxide ranked top among the factors contributing to the Earth’s warming climate. It has a long residence time of centuries in the atmosphere. It is the most abundant among the non-condensable greenhouse gases, and its significance in preventing heat energy from escaping from the Earth is becoming more important.

Owing to human activities, the concentrations of carbon dioxide, methane and nitrous oxide have all increased rapidly since 1750. The present-day concentrations are unprecedented in at least the last 800 000 years. The increase in carbon dioxide concentration is primarily due to burning of fossil fuels and deforestation, while increases in methane and nitrous oxide concentration are due to agriculture.

Source:

- *United Nations: “What is Climate Change?”* - <https://www.un.org/en/climatechange/what-is-climate-change>
- *BBC news: “What is climate change? A really simple guide”* - <https://www.bbc.com/news/science-environment-24021772>
- *Australian Academy of Science: “What is climate change?”* - <https://www.science.org.au/learning/general-audience/science-climate-change/1-what-is-climate-change>
- *Hong Kong Observatory: “Who’s in charge of global warming?”* - <https://www.hko.gov.hk/en/blog/00000143.htm> and “Causes of Climate Change” - https://www.hko.gov.hk/en/climate_change/human_activities.htm

Question

1. **According to Source A, what do you think is the major cause of climate change? How do human activities contribute to climate change?**

Activity 2: Understanding the Threats Posed by Climate Change

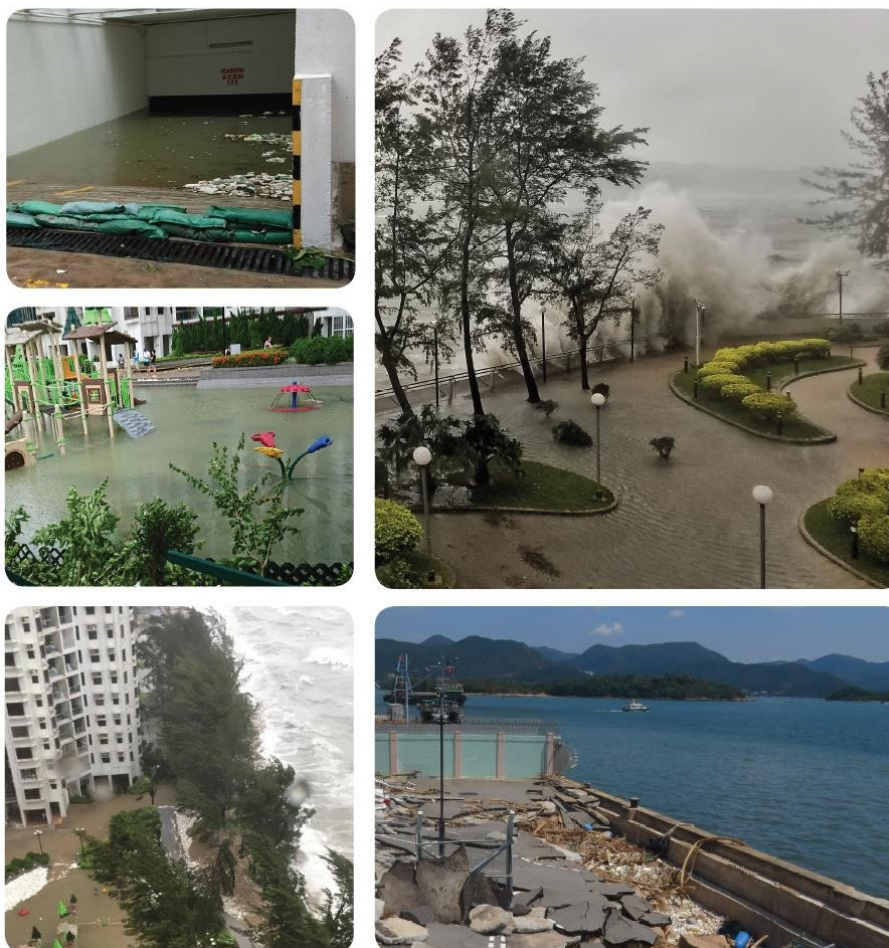
Source B: Extreme Weather Due to Climate Change

Climate change affects all regions around the world. Human activities, in particular burning of fossil fuels (such as coal, natural gas, town gas, etc.), deforestation and animal husbandry, contribute to the increase in atmospheric carbon dioxide (CO₂) concentration, resulting in a rise in global temperature.

According to the World Meteorological Organisation, 2020 was one of the three warmest years of the world. Global warming has brought about more extreme weather events and crises, such as more frequent heat waves, change in precipitation, rise in sea level, super typhoons, rainstorms, uneven distribution and scarcity of water resources, and disruption of ecological and environmental balance, etc. The heat waves in North America, as well as the floods in the Mainland and various parts of Europe that took place in 2021, show that serious impacts brought by extreme weather conditions may happen in every part of the world.

Like other cities, Hong Kong is facing problems such as rising temperatures and more extreme weather phenomena. The scenes of the damages caused by Super Typhoons Hato in 2017 and Mangkhut in 2018 to Hong Kong are still vivid in our minds. The years of 2019 and 2020 are the two hottest years in Hong Kong on record. In 2021, both the number of very hot days and the number of hot nights in Hong Kong have broken the records.

Damages caused by Super Typhoons Hato in 2017 and Mangkhut in 2018 to Hong Kong:



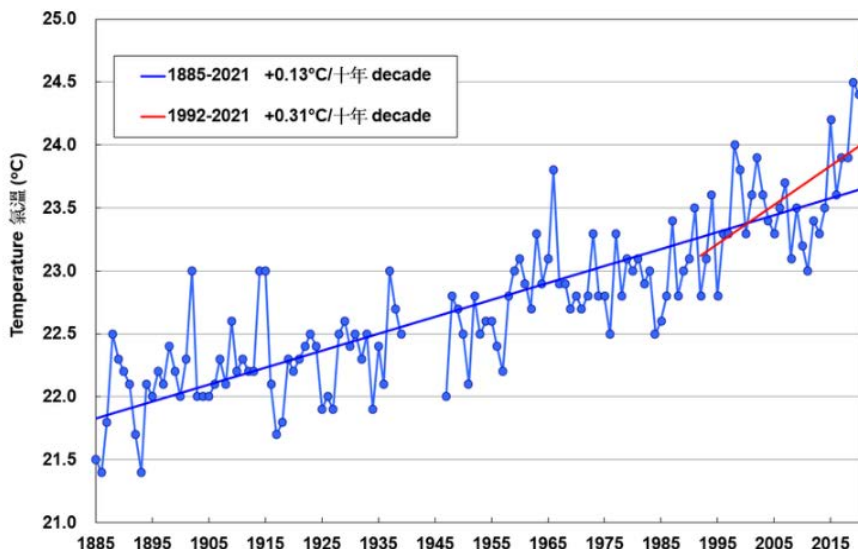
Source: Hong Kong's Climate Action Plan 2050 - https://www.climate-ready.gov.hk/files/pdf/CAP2050_booklet_en.pdf

Source C: Climate Change in Hong Kong

Temperature:

At the Hong Kong Observatory Headquarters, temperature readings have been available since 1885, except for a break during World War II from 1940 to 1946. Analysis of the annual mean temperature data showed that there was an average rise of 0.13°C per decade from 1885 to 2021. The rate of increase in average temperature became faster in the latter half of the 20th century. The average increasing rate was 0.31°C per decade during 1992 to 2021.

Note: The temperature increasing trends during 1885 to 2021 and 1992 to 2021 are statistically significant at 5% level.

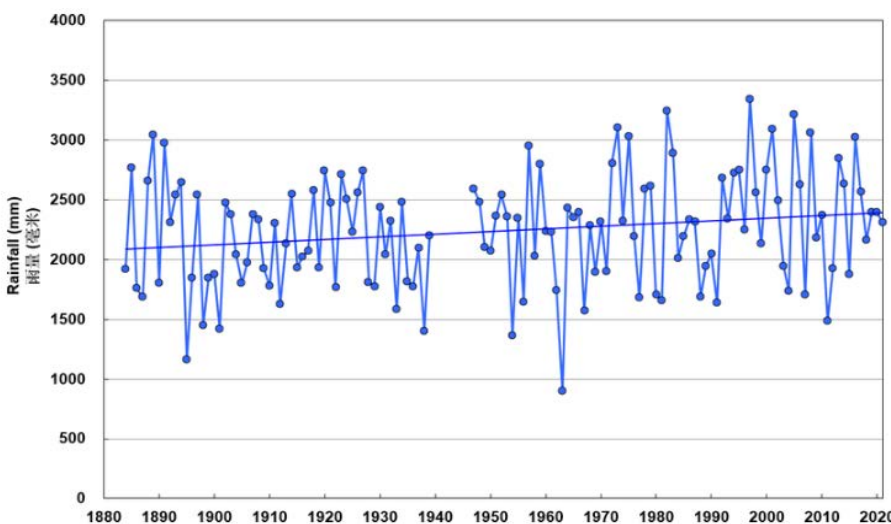


Annual mean temperature recorded at the Hong Kong Observatory Headquarters

Rainfall:

At the Hong Kong Observatory Headquarters, information for rainfall and heavy rain days (hourly rainfall greater than 30 mm) have been available since January and March 1884 respectively, except for a break during World War II from 1940 to 1946.

Analysis of the annual rainfall showed that there was an average rise of 2.3 mm per year from 1884 to 2021.



Annual rainfall recorded at the Hong Kong Observatory Headquarters (1884-2021).

Data are not available from 1940 to 1946.

Source: Website of the Hong Kong Observatory

Temperature - https://www.hko.gov.hk/en/climate_change/obs_hk_temp.htm

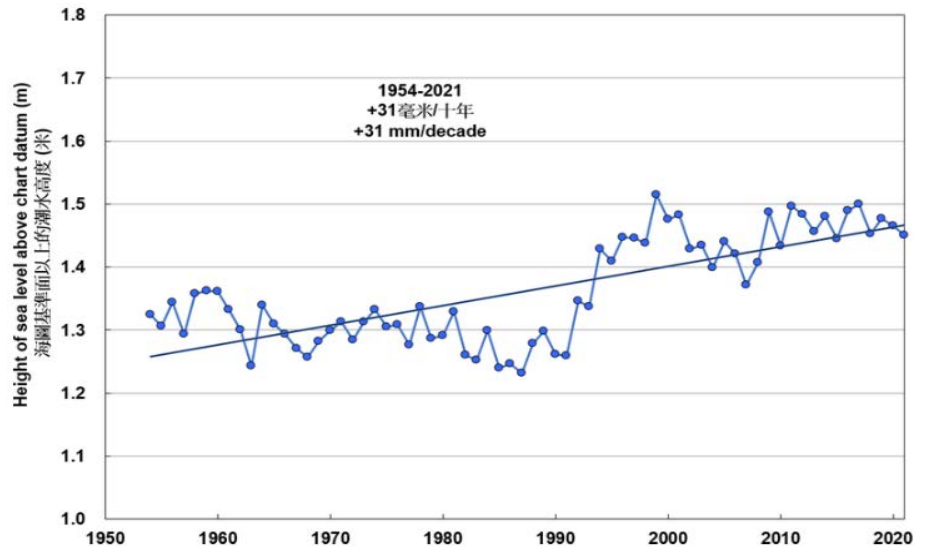
Rainfall & Heavy Rain - https://www.hko.gov.hk/en/climate_change/obs_hk_rainfall.htm

Mean sea level:

Tide gauge records in Victoria Harbour since 1954 demonstrate an unambiguous rise of the mean sea level during this period. There was a rise in the sea level from 1990 to 1999 and the rise eased off thereafter. The trend is similar to that observed by satellite remote sensing over the South China Sea and that recorded by tide gauges at other coastal stations in the region. On average, the mean sea level in Victoria Harbour rose at a rate of 31 mm per decade during 1954 to 2021.

Note:

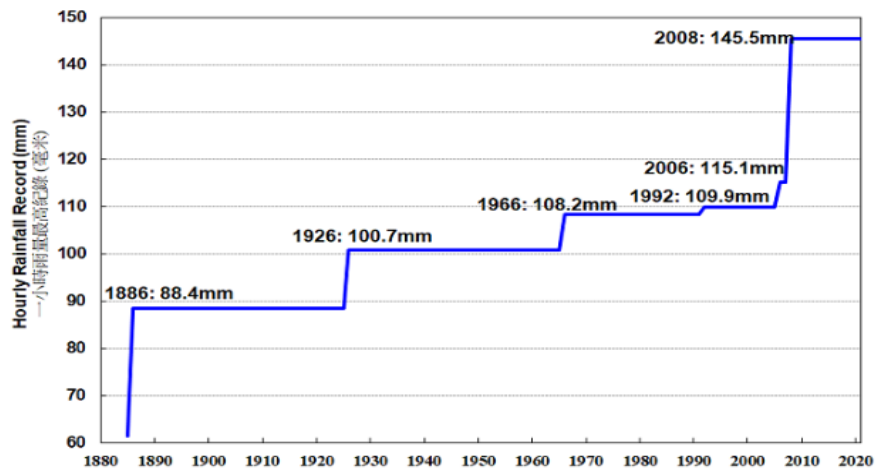
1. The increasing trend of mean sea level during 1954 to 2021 is statistically significant at 5% level.
2. Data have been corrected for land settlement for the purpose of long-term trend analysis.



Annual mean sea level at Victoria Harbour (1954-2021)

Extreme weather events:

Extreme precipitation events have become more frequent. The hourly rainfall record at the Hong Kong Observatory Headquarters was broken several times in the last few decades, whereas it used to take several decades to break the record in the past.



Highest hourly rainfall records at the Hong Kong Observatory Headquarters (1885-2021)

Source: Website of the Hong Kong Observatory

Mean sea level - https://www.hko.gov.hk/en/climate_change/obs_hk_sea_level.htm

Extreme weather events - https://www.hko.gov.hk/en/climate_change/obs_hk_extreme_weather.htm

Question

2. Based on the information from Sources B and C, briefly describe the changes in extreme weather events and climate parameters (such as temperature, rainfall and sea level) in Hong Kong in the past decades.

Activity 3: The Paris Agreement and the Targets Set by Our Country and the Hong Kong Special Administrative Region for Combating Climate Change

Source D: The Paris Agreement



Climate change is a global emergency that goes beyond national borders. It is an issue that requires international cooperation and coordinated solutions at all levels.

To tackle climate change, world leaders at the UN Climate Change Conference (COP21) in Paris reached a breakthrough on 12 December 2015: the Paris Agreement.

Key points of the Agreement:

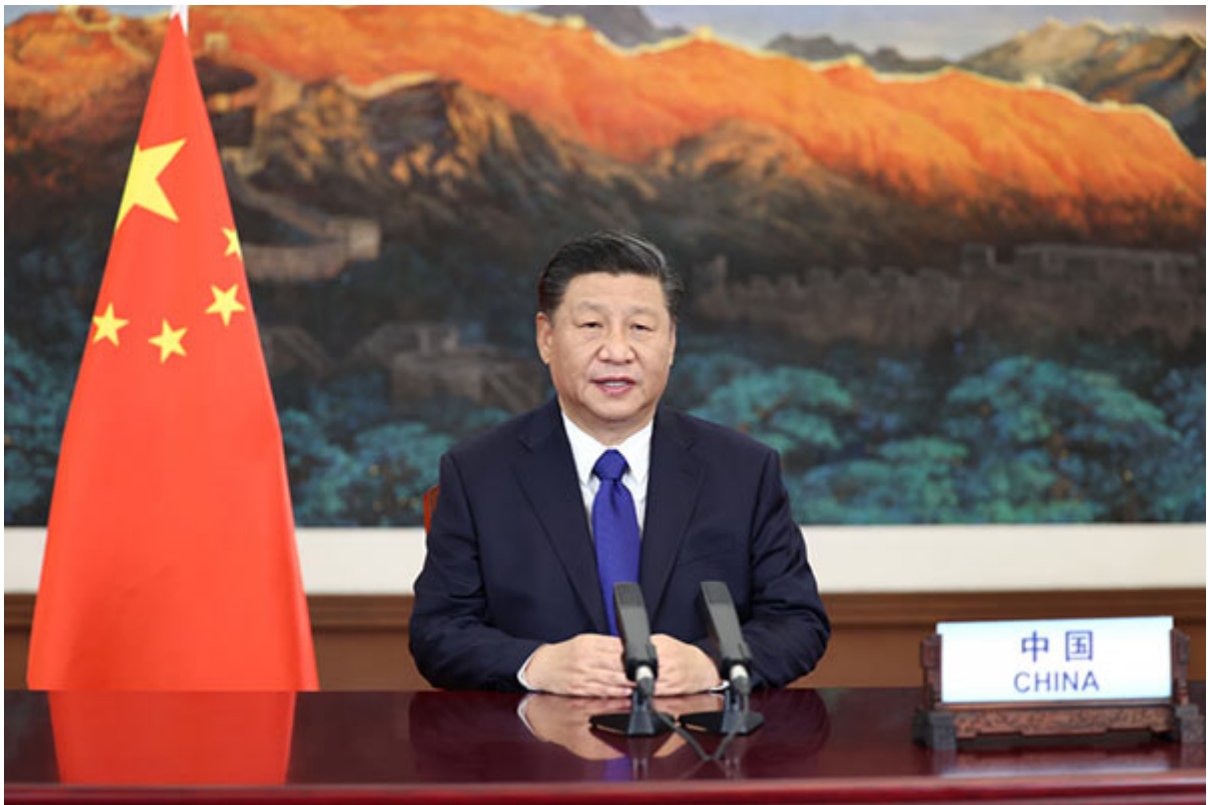
- substantially reduce global greenhouse gas emissions to limit the global temperature increase in this century to 2 °C while pursuing efforts to limit the increase even further to 1.5 °C;
- review countries' commitments every five years;
- provide financing to developing countries to mitigate climate change, strengthen resilience and enhance abilities to adapt to climate impacts.

The Agreement is a legally binding international treaty. It entered into force on 4 November 2016. Today, 193 Parties (192 countries plus the European Union) have joined the Paris Agreement.

The Agreement includes commitments from all countries to reduce their emissions and work together to adapt to the impacts of climate change, and calls on countries to strengthen their commitments over time. The Agreement provides a pathway for developed nations to assist developing nations in their climate mitigation and adaptation efforts while creating a framework for the transparent monitoring and reporting of countries' climate goals.

Source: Website of the United Nations on the Paris Agreement - <https://www.un.org/en/climatechange/paris-agreement>

Source E: Our Country's Target for Combating Climate Change



Your Excellency Secretary-General António Guterres,

Dear Colleagues,

It gives me great pleasure to join you in this Climate Ambition Summit. Five years ago, world leaders showed utmost political resolve and wisdom and adopted the Paris Agreement on climate change. Since then, the implementation of the Paris Agreement has received extensive international support and participation. At present, the international landscape is evolving more rapidly and COVID-19 is triggering deep reflections on the relationship between man and nature. The future of global climate governance is drawing greater attention. In this context, I wish to make three proposals:

First, we need to close ranks and make new advances in climate governance that features cooperation and win-win. In meeting the climate challenge, no one can be aloof and unilateralism will get us nowhere. Only by upholding multilateralism, unity and cooperation can we deliver shared benefits and win-win for all nations. China welcomes all countries' support for the Paris Agreement and their greater contribution to tackling climate change.

Second, we need to raise ambition and foster a new architecture of climate governance where every party does its part. Following the principle of common but differentiated responsibilities, all countries need to maximize actions in light of their respective national circumstances and capabilities. At the same time, developed countries need to scale up support for developing countries in financing, technology and capacity building.

Third, we need to boost confidence and pursue a new approach to climate governance that highlights green recovery. Mountains and rivers green are mountains of silver and gold. It is important to encourage green,

low-carbon ways of life and production, and seek development opportunities and impetus from green development.

China has made important contributions to adopting the Paris Agreement and has made active efforts toward implementing it. I announced in September that China would scale up its nationally determined contributions and adopt more vigorous policies and measures. We aim to peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060.

Today, I wish to announce some further commitments for 2030: China will lower its carbon dioxide emissions per unit of GDP by over 65 percent from the 2005 level, increase the share of non-fossil fuels in primary energy consumption to around 25 percent, increase the forest stock volume by 6 billion cubic meters from the 2005 level, and bring its total installed capacity of wind and solar power to over 1.2 billion kilowatts.

China always honors its commitments. Guided by our new development philosophy, we will promote greener economic and social development in all respects while pursuing high-quality development. We will take solid steps to implement the targets just announced, and contribute even more to tackling the global climate challenge.

Colleagues,

As a Chinese poem reads, “Heaven does not speak and it alternates the four seasons; Earth does not speak and it nurtures all things.” The Earth is our only and shared home. Let us build on past achievements, work together to make steady progress in implementing the Paris Agreement, and launch a new journey for global climate actions.

Thank you.

Source: Statement by President Xi Jinping at the Climate Ambition Summit on 12 December 2020 - https://www.fmprc.gov.cn/mfa_eng/wjdt_665385/zyjh_665391/202012/t20201213_678958.html

Source F: The Target of Striving towards Carbon Neutrality before 2050 in the Chief Executive's 2021 Policy Address

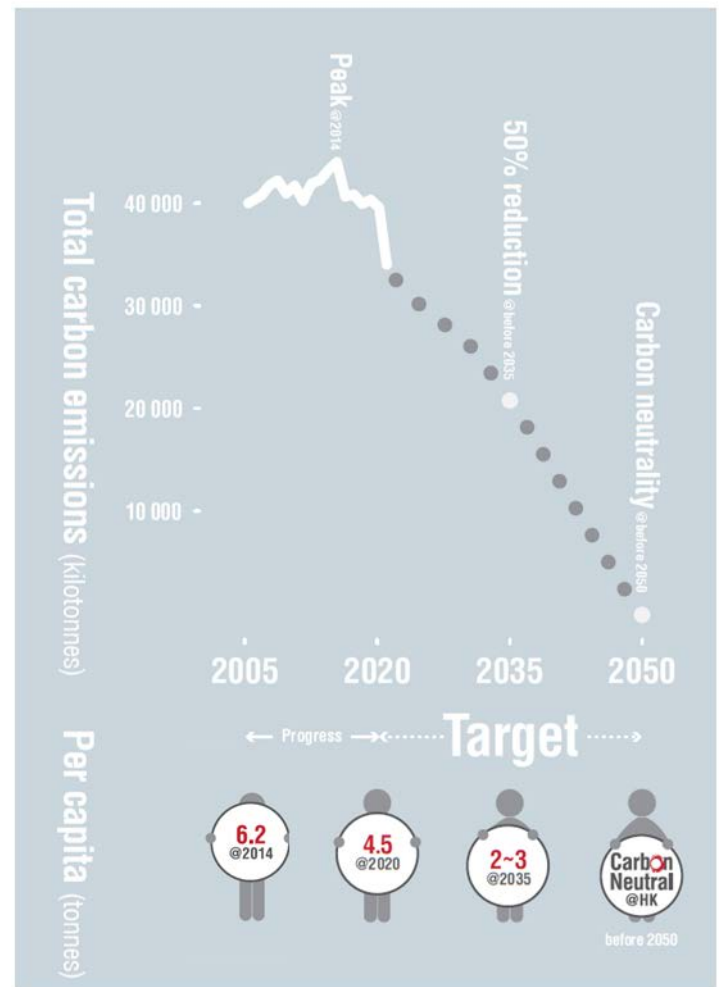
Striving towards Carbon Neutrality before 2050

As carbon dioxide is the major culprit in climate change, our country and many parts of the world have pledged to draw up timetables and roadmaps for decarbonisation. Hong Kong is no exception. As announced in my Policy Address last year, Hong Kong would strive to achieve carbon neutrality before 2050. The Steering Committee on Climate Change and Carbon Neutrality chaired by me will formulate the overall strategy and oversee the co-ordination of various actions. The Hong Kong's Climate Action Plan 2050, to be announced shortly by the Secretary for the Environment, will set out more proactive strategies and measures on reducing carbon emissions to attain carbon neutrality, and will pursue more vigorous interim decarbonisation targets to reduce Hong Kong's carbon emissions by 50% before 2035 as compared to the 2005 level (Note: i.e. from about 40 million tonnes in 2005 to nearly 20 million tonnes in 2035).

Moving Steadily towards Decarbonisation Targets

We are moving steadily towards our decarbonisation target. Hong Kong's total carbon emissions have shown a downward trend after reaching its peak in 2014 (i.e. carbon emissions will decline after reaching the peak and will not rise again), with the per capita carbon emissions reduced from 6.2 tonnes in 2014 to 5.3 tonnes in 2019. The power companies have gradually replaced coal with natural gas in electricity generation. Based on preliminary estimation, the per capita carbon emissions in 2020 would be reduced to around 4.5 tonnes.

Hong Kong's Roadmap to Carbon Neutrality



Source: The Chief Executive's 2021 Policy Address - <https://www.policyaddress.gov.hk/2021/eng/p95.html> and Hong Kong's Climate Action Plan 2050 - https://www.climate-ready.gov.hk/files/pdf/CAP2050_booklet_en.pdf

Questions

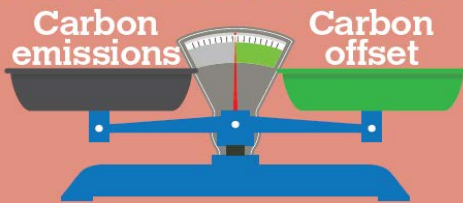
3. According to Source D, how many parties have currently joined the Paris Agreement? What commitments have the signatories made to achieve the goals of the Paris Agreement?
4. According to Sources E and F, what are the decarbonisation targets of our country and the Hong Kong Special Administrative Region?
5. How can you reduce carbon emissions at the individual level?

Extended Learning

Carbon Neutrality

What is carbon neutrality?

Carbon neutrality refers to achieving relative “zero-carbon emissions” in a place or by an organisation, etc. over a certain period of time. This can be done by replacing conventional fossil energy, conserving energy, green commuting, “use less, waste less”, planting, afforestation, purchasing renewable energy (RE) certificates and carbon trading, etc. to reduce or offset the carbon emissions generated from the activities of the place or the organisation. Achieving carbon neutrality helps limit the rise in carbon concentration and global temperature, and reduce the risks and damages caused by climate change.



Source: Hong Kong's Climate Action Plan 2050 - https://www.climate-ready.gov.hk/files/pdf/CAP2050_booklet_en.pdf