Environment economics and policies

EC 506

Chapter 7: Global Climate Change

Learning objectives

- *What are the impacts of global warming/ global climate change?*
- *What consequences can we expect in the future?*
- *Can economic theory help evaluate the impact of climate change?*
- *How can we model the long-term impacts of climate change?*

Climate change

Concerns and issues

Global climate change- the changes in global climate, including temperature, precipitation, storm frequency and intensity, and changes in carbon and water cycles, that result from increased concentrations of greenhouse gases in the atmosphere.

Global warming- the increase in average global temperature as a result of emissions from human activities.

Putting climate change into the framework of economic analysis, we can consider greenhouse gas emissions, which cause planetary warming and other changes in weather patterns, as both a cause of environmental externalities and a case of the **overuse of a common property resource**.

The atmosphere is a **global commons** into which individuals and firms can release pollution.

If indeed the effects of climate change are likely to be severe, it is in everyone's interest to lower emissions for the common good.

Climate change can be viewed as a public good issue.

Climate change: Causes

Increased GHGs emissions

Greenhouse effect- the effect of certain gases (Clouds, water vapor, and the natural greenhouse gases carbon dioxide (CO2), methane, nitrous oxide, and ozone) in the earth's atmosphere trapping solar radiation, resulting in an increase in global temperatures and other climatic impacts.

The global greenhouse effect, in which the earth's atmosphere acts like the glass in a greenhouse, was first described by French scientist Jean Baptiste Fourier in 1824.

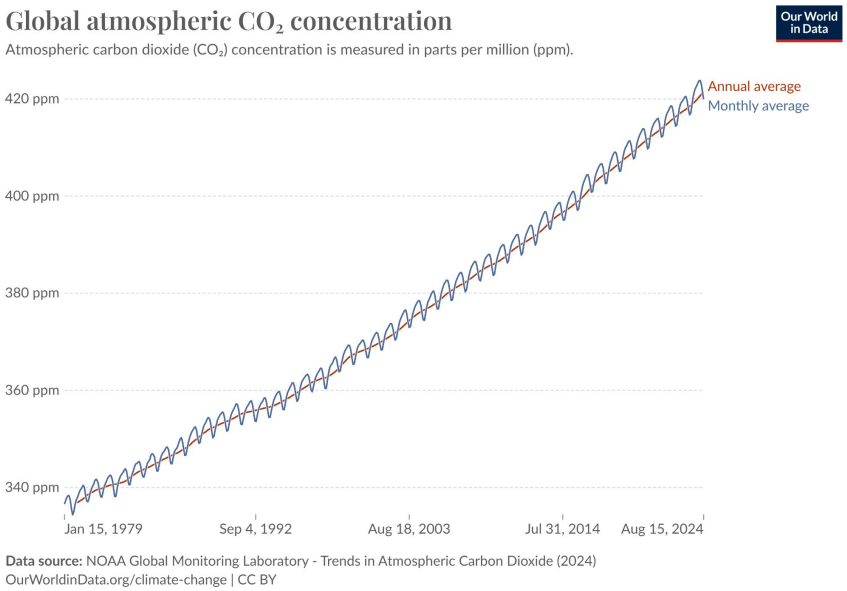
The possibility of an **enhanced or human-made greenhouse effect** was introduced by the **Swedish scientist Svante Arrhenius in 1896**. Arrhenius hypothesized that the increased **burning of coal**, which had paralleled the **process of industrialization**, would lead to an increased **concentration of carbon dioxide** in the atmosphere and **warm the earth**.

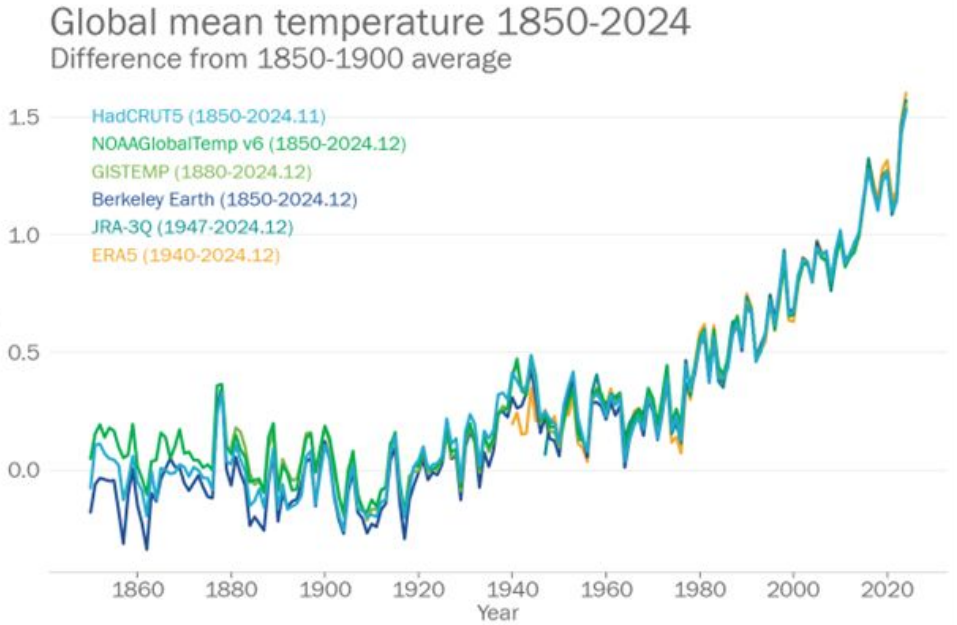
Since Arrhenius's time, the emissions of greenhouse gases have grown dramatically. CO2 concentrations in the atmosphere have increased by over 40% compared to pre-industrial levels

The year 2024 was the warmest year since global records began in 1850 at 1.29°C (2.32°F) above the 20th century average of 13.9°C (57.0°F).

Climate change: Causes

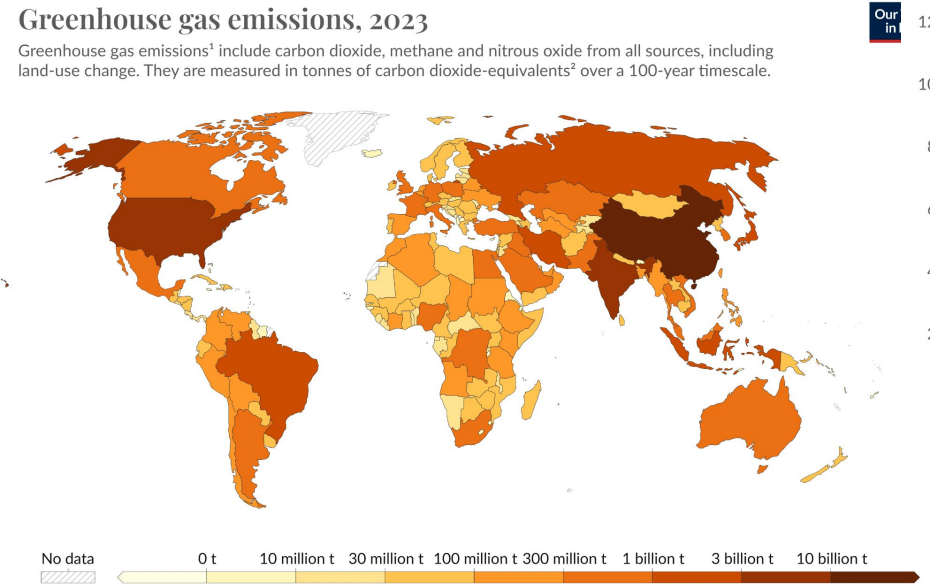
Increased GHGs emissions

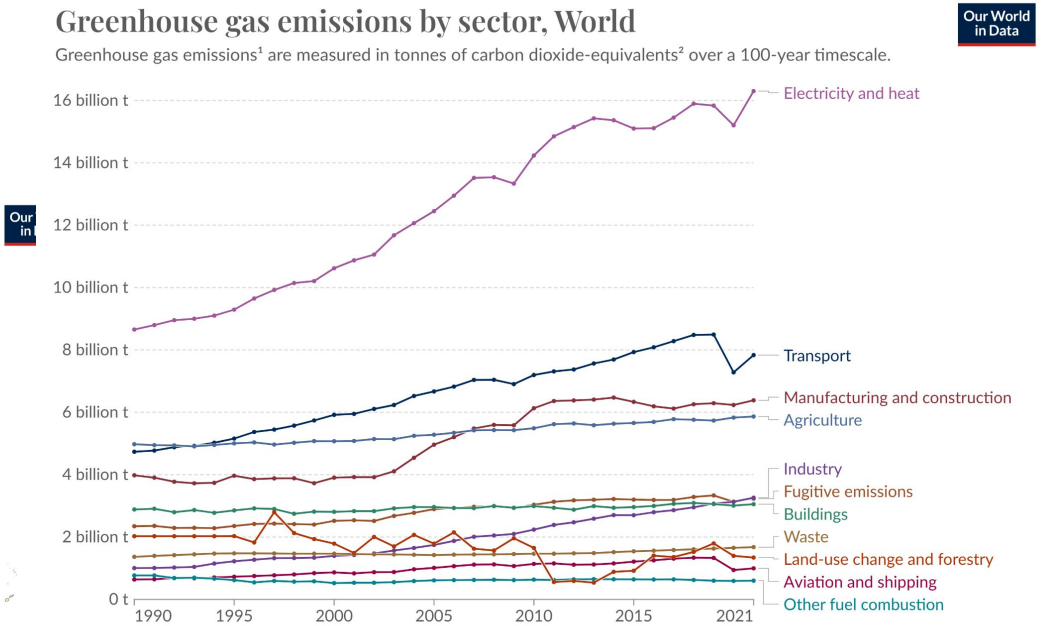




Climate change: Causes

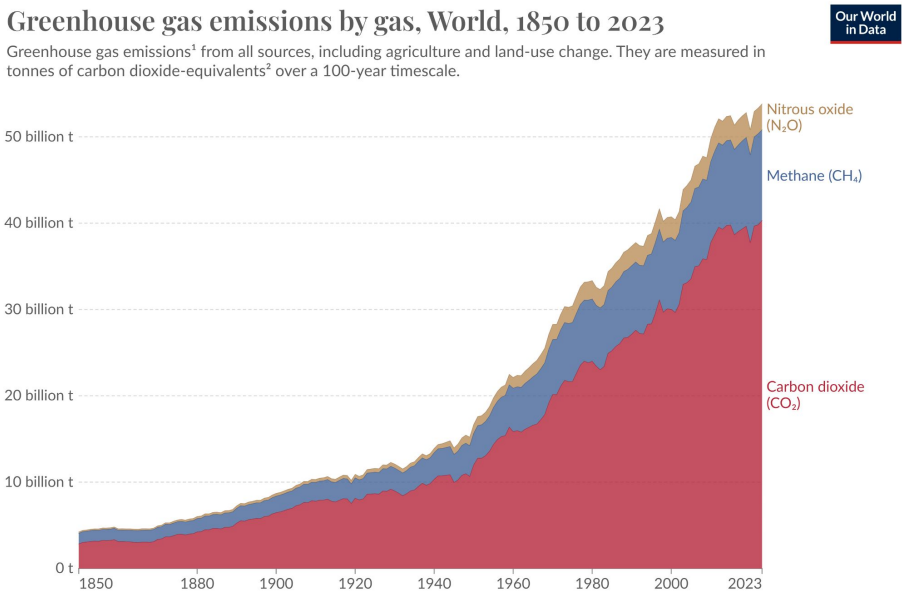
Increased GHGs emissions

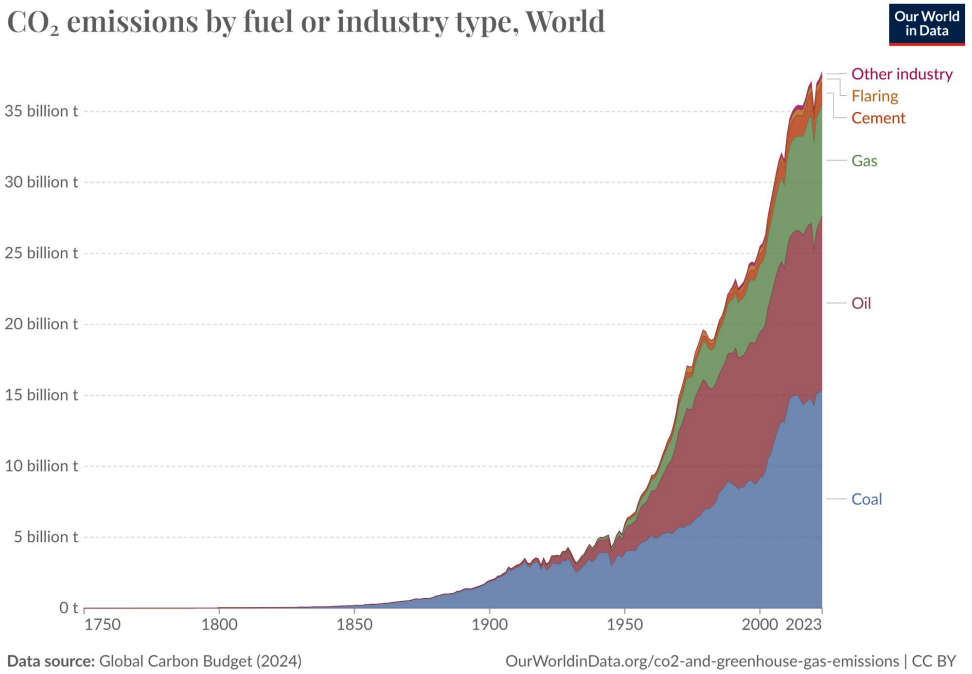




Climate change: Causes

Increased GHGs emissions

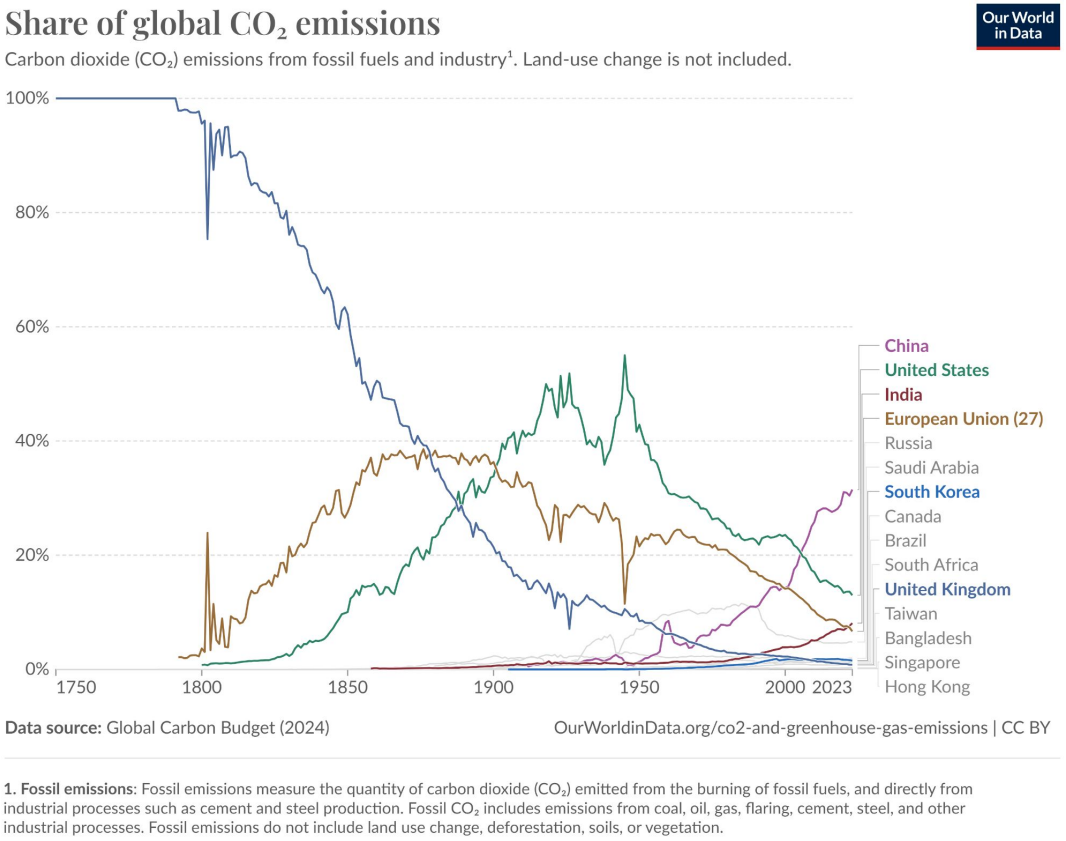




Climate change: Causes

Increased GHGs emissions

China and India ↑



1. **Fossil emissions**: Fossil emissions measure the quantity of carbon dioxide (CO_2) emitted from the burning of fossil fuels, and directly from industrial processes such as cement and steel production. Fossil CO_2 includes emissions from coal, oil, gas, flaring, cement, steel, and other industrial processes. Fossil emissions do not include land use change, deforestation, soils, or vegetation.

Climate change: consequences

In 2021 IPCC Working Group 1 issued Climate Change 2021: The Physical Science Basis, its contribution to the Sixth Assessment Report, According to this report, human-induced climate change is expected to bring:

- More intense rainfall and associated flooding, as well as more intense drought in many regions.
- Continued sea level rise in coastal areas, contributing to more frequent and severe coastal flooding in low-lying areas and coastal erosion.
- Amplified permafrost thawing, and the loss of seasonal snow cover, melting of glaciers and ice sheets.
- Changes continuing throughout at least the rest of this century that affect both ocean ecosystems and the people that rely on them.
- Amplified heat waves.

Climate change: consequences

Projected doubling of accumulated carbon dioxide in the earth's atmosphere and the predicted effects:

- Loss of land area, including beaches and wetlands, because of sea-level rise.
- Loss of species and forest area.
- Increased intensity of storms, hurricanes, and other extreme weather events.
- Increased occurrence of severe drought and flooding.
- Disruption of water supplies to cities and agriculture.
- Health damage and deaths from heat waves and spread of tropical diseases.
- Loss of agricultural output due to extreme weather variability.
- Increased air conditioning costs.

Climate change: consequences

Beneficial outcomes might include:

- Increased agricultural production in cold climates.
- Lower heating costs.
- Fewer deaths from exposure to cold.

Geographical impact

Winners

- Canada
- Northeastern U.S.
- Russia
- Northeastern Europe

Losers

Africa, Asia

US – Midwest, SW

Low lying areas

Bangladesh

Indonesia

US – Atlantic, Gulf coast

Climate change: consequences

Winners	Losers
Developed countries	**Developing countries**
Can afford the costs to avoid damage (mitigation) or to adapt to new climate (adaptation)	Cannot afford costs of mitigation or adaptation Often also the most vulnerable due to location or reliance on agriculture

Climate change: consequences

Winners	Losers
Agriculture: CO2 can increase crop productivity, shift of crop or prime yield (Ex: wheat to corn Grapes/wine making) Tourism increase Property values increase	Agriculture: crop failures due to extreme heat or lack of water Less tourism Property values decrease Extreme weather

Climate change: strategies

Three broad strategies have been identified: (1) sequestration, (2) adaptation, and (3) mitigation.

Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide. It reduces the amount of carbon dioxide in the atmosphere by trapping carbon dioxide before it ends up there.

Natural processes of sequestration include carbon dioxide uptake by oceans and plants.

Policy can become involved in such diverse ways as encouraging planting new forests or scrubbing gases from power plants. Captured carbon dioxide can be stored in geological formations.

Researchers and start-ups are also exploring ways to use carbon dioxide to produce alternative fuels, building materials, and other products or to develop new materials that capture and store carbon dioxide before it can enter the atmosphere.

Climate change: strategies

Three broad strategies have been identified: (1) sequestration, (2) adaptation, and (3) mitigation.

Adaptation strategies involve efforts to modify natural or human systems to reduce or eliminate harm from climate change impacts.

Adaptation planning focuses on enhancing the resilience of damage-prone areas.

Strategies include relocating transportation systems and waste treatment facilities away from areas vulnerable to sea level rise, preparing public health facilities to handle the larger burdens resulting from the changing disease impacts of a warmer climate, making forests less vulnerable to massive wildfires, and making the electric grid more resistant to climate-enhanced storms.

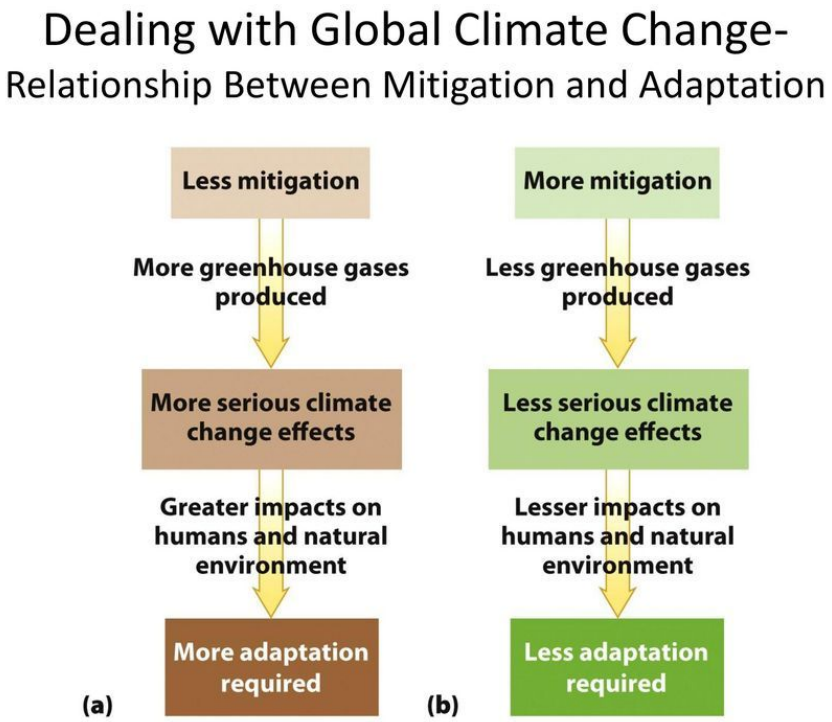
Climate change: strategies

Three broad strategies have been identified: (1) sequestration, (2) adaptation, and (3) mitigation.

Mitigation attempts to moderate the temperature rise by using strategies designed to reduce the GHG emissions that drive it.

These include such market-based policy choices as carbon taxes or cap-and-trade, as well as traditional regulations that seek to speed up the transition to low-carbon energy sources.

Climate change: strategies



International climate governance

International climate negotiations are the processes developed to create agreements between countries to promote and ensure ambitious action against climate change and its effects.

Negotiations within the international framework are important because they set out the guidelines to be followed at the global level under the principle of common but differentiated responsibilities aimed at ensuring sustainable development

The principle of common but differentiated responsibilities is a fundamental principle of the UNFCCC that recognizes countries' different capacities and responsibilities in the face of climate change.

International climate governance

UNFCCC

This is made up of all the countries that are part of the UNFCCC. It is the supreme body which regulates the implementation of the Convention and any related instruments.

IPCC

This consists of scientists and experts from around the world on issues related to climate change. The IPCC is not part of the UNFCCC; it provides scientific information to countries to strengthen the global response to climate change

Financial mechanisms

Financial assistance is available from countries with more resources for countries with fewer resources that are more vulnerable to the impacts of climate change. To facilitate this, the UNFCCC established a Financial Mechanism which is also a response to the financing established by the Paris Agreement. These mechanisms are implemented or overseen by constituted bodies such as the SCF, the Adaptation Fund Board, the GEF and the GCF.

All countries can participate in the climate negotiations. Countries that have signed and deposited the official UNFCCC document only intervene in decisions or agreements once they have carried out the corresponding ratification process. Countries that have not done so can only participate as observers. Countries meet through the **Conference of the Parties (COP)**. They are divided into five regional groups: › Africa › Asia › Central and Eastern Europe › Latin America and the Caribbean › Western Europe along with other countries (Australia, Canada, Iceland, New Zealand, Norway, Switzerland and the United States).

Climate change: climate governance

The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 Parties at the UN Climate Change Conference (COP21) in Paris, France, on 12 December 2015. It entered into force on 4 November 2016.

Its overarching goal is to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels" and pursue efforts "to limit the temperature increase to 1.5°C above pre-industrial levels."

Implementation of the Paris Agreement requires economic and social transformation, based on the best available science. The Paris Agreement works on a five-year cycle of increasingly ambitious climate action -- or, ratcheting up -- carried out by countries.

Since 2020, countries have been submitting their national climate action plans, known as nationally determined contributions (NDCs). Each successive NDC is meant to reflect an increasingly higher degree of ambition compared to the previous version.

In their NDCs, countries communicate actions they will take to **reduce their greenhouse gas emissions** in order to reach the goals of the Paris Agreement. Countries also communicate in their NDCs actions they will take to **build resilience to adapt** to the impacts of climate change.

Climate change: climate governance

The Net Zero Emissions by 2050 Scenario (NZE Scenario) is a normative scenario that shows a pathway for the global energy sector to achieve net zero CO2 emissions by 2050, with advanced economies reaching net zero emissions in advance of others.

The NZE Scenario is *a* path, and not *the* path to net zero emissions.

This scenario also meets key energy-related Sustainable Development Goals (SDGs), in particular universal energy access by 2030 and major improvements in air quality. It is consistent with limiting the global temperature rise to 1.5 ° C (with at least a 50% probability), in line with emissions reductions assessed in the Intergovernmental Panel on Climate Change (IPCC)’s Sixth Assessment Report.

Climate change: policies

Carbon tax
Emission Permit Systems
Emission Standards
Subsidies, transfer
Technology transfer

Climate change: what you should do