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the Russian Federation



CLIMATE BOOK

— Introduction to Climate Change —



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www.climate-box.com

2026

About the CLIMATE BOOK

Climate change is one of the most urgent challenges facing our planet today. Although its effects vary from place to place, it concerns us all. Whether we live in a higher-income or lower-income country, a city or a village, we all experience the effects of the changing climate. Climate change affects the air we breathe, the water and food we depend on, our health and livelihoods, and the places where we live. Extreme heat, droughts, floods, storms, and other climate-related events can disrupt our everyday lives. At the same time, our activities and choices influence this change. The energy we use, the food we eat, the way we travel, and the goods we consume can help reduce or increase greenhouse gas emissions and, as a result, influence the pace of climate change.

Helping young people understand climate change is an essential part of building a sustainable future. With this goal in mind, the United Nations Development Programme (UNDP), with the financial support of the Government of the Russian Federation, developed the Climate Box, a comprehensive climate education toolkit created by a multidisciplinary team of climate scientists and educators.

The Climate Book builds on this foundation, bringing together the key climate knowledge in a more concise and accessible format. It introduces readers to what is happening to our climate, why it matters, how it affects people and nature, and what can be done to address these challenges.

Readers will learn how the Earth's climate has changed over geological time, what makes today's changes different, and how a changing climate affects ecosystems, water resources, agriculture, cities, human health, and communities. The book also explores ways to respond, from adapting to changes already underway, reducing greenhouse gas emissions through

cleaner energy and greater energy efficiency to protecting and restoring ecosystems. It also looks at the actions individuals and communities can take in their everyday lives.

Through real-world examples and illustrations, the book makes complex topics easier to understand. It is intended primarily for teenagers and young people, but can also be a useful resource for teachers, parents, and anyone looking for a concise introduction to climate change. The book can be read from beginning to end or explored topic by topic.

We hope the Climate Book will help readers better understand the changes taking place around them and recognize how individual and collective choices can contribute to a more sustainable and resilient future.

More educational materials and interactive resources on climate change, as well as digital versions of the Climate Book and the full Climate Box educational toolkit, are available at **www.climate-box.com.**

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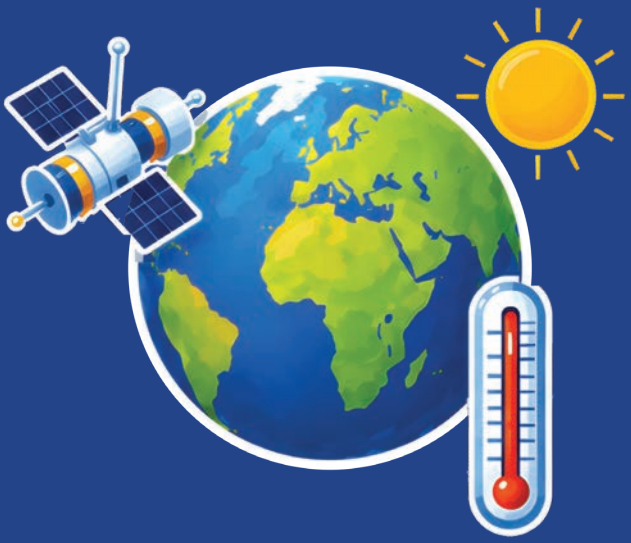
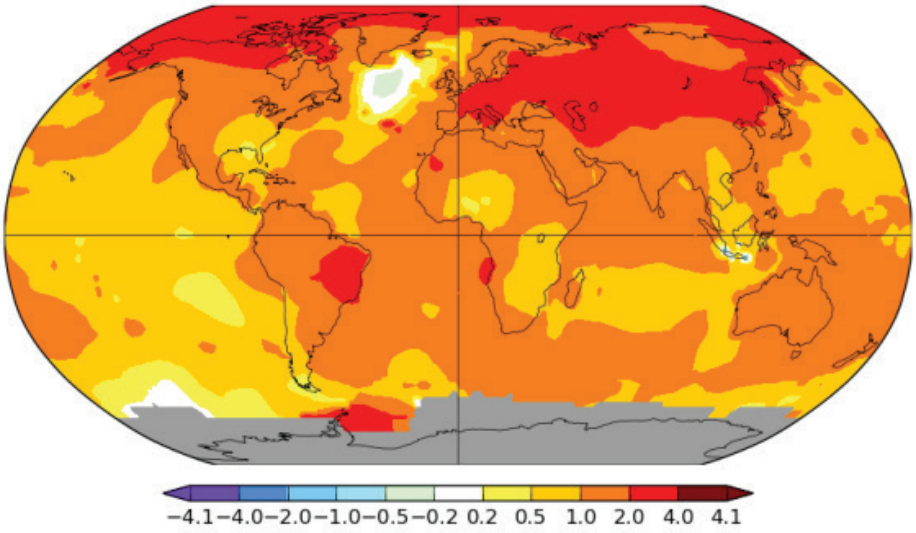


1

The problem of climate change

1 The problem of climate change

Climate change is one of the most serious challenges our world faces today. It affects every continent, every country, and every community. Although Earth's climate has changed many times throughout history, today changes are happening much faster than ever before. Over the past century, the average global temperature has risen by about 1.2°C - a process known as global warming.



Observed changes in Earth's surface temperature, 1901–2022

This may seem like a small number, but even such a slight increase in temperature can cause major disruptions. As the planet warms up, the balance of natural systems is disrupted. This extra heat affects the whole planet. Its impacts are already

visible around the world. Glaciers that feed our rivers are shrinking, reducing freshwater supplies for millions of people. Sea levels are rising and threatening coastal cities and islands. Warmer air and oceans are also causing more frequent and intense extreme weather events. These include heatwaves, heavy rainfall, prolonged droughts, floods, and powerful cyclones that are becoming more intense.

These changes do not only cause more frequent and extreme weather events, they are also long-term shifts that can impact how people live, grow food, and use natural resources. That is why climate change is not only an environmental issue - it is also a social and economic challenge that requires cooperation among nations and generations.

The Earth is getting hotter

Scientists around the world measure Earth's temperature every year. Their measurements show that **2024 was the hottest year ever recorded**. And on average, the planet was about **1.5 °C warmer** than it was in the late 1800s, before people began using lots of coal, oil, and gas.

1.1 | Climate and weather

When you're getting ready for school in the morning, you might look outside and wonder: "Do I need my raincoat today, or can I just wear a shirt?" That's the weather. But when your family thinks about where to live, they look at the bigger picture. They care about the climate: "Is this city usually hot and sticky, or cool and breezy most of the year?"
So, what is the difference between weather and climate?

Weather is what is happening around us right now - sunshine, wind, rain, snow, warmth, or cold. It can change in a few minutes or from one day to the next.

Many elements determine the weather we experience daily:


Air temperature – how warm or cold the air is.



Humidity – how much water vapour is in the air.


Clouds – tiny drops of water or ice floating high above us.


Precipitation – water that falls from the sky (rain, snow) or forms on the ground (dew, frost).


Visibility – how far we can see clearly.


Fog – a cloud that forms close to the ground, making it hard to see.


Atmospheric pressure – the weight of the air pressing down on the Earth at any given spot.


Wind – moving air caused by differences in pressure.

Climate describes what the weather is usually like in a place over many years. You can't see the climate by looking out of the window once - you need long-term observations. For example, summers in the Mediterranean are hot and dry, and winters are mild with very little snow. That is its climate.

The main features that describe a climate are:

- air temperature and how it changes during the year,
- how much rain or snow falls and when,
- which direction winds usually come from and whether they bring warm or cold air.

The same elements that shape our daily weather — such as temperature, rain, and wind — also shape the climate. The only difference is time. A simple way to remember is: weather is what happens today and climate is what usually happens every year.

Weather is what's happening right now, while climate is the pattern we see over many, many years in each region of the world.



1.2 | Types of climate and climate zones

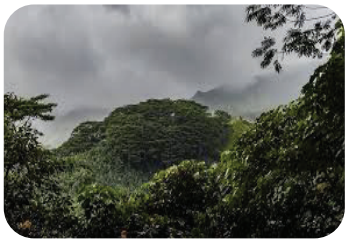
Different parts of the Earth have very different climates. In some northern countries winter brings deep snow and freezing winds, while in tropical regions people have hot temperatures all year round.

Why do climates differ?

Climates are different because **the Sun heats the Earth unevenly**. Near the equator the sun stays high in the sky and gives strong heat all year round. As we move farther from the equator the sunlight reaches the Earth at an angle and provides less heat, so the climate becomes cooler. Mountains, winds, oceans, and how much rain or snow falls during the year matter too.

Over time, scientists created systems to describe the world's climates. They needed a clear way to compare different regions, because climate is too complex to understand without organising it. By looking at long-term temperatures, rainfall, winds, and the seasons, they grouped places with similar conditions into climate types. These groups make it easier to study how the climate works, how it differs from place to place, and how it changes or might change in the future.

Hot and rainy climate zones



Near the equator, the climate is hot all year round. Days and nights are warm or hot, and the temperature changes very little during the year. Warm air rises high into the sky where it cools

down, forming thick clouds. This causes frequent and heavy rain. Many of these regions are covered with thick green forests, with lush plants and have many different kinds of animals.

Hot climates with wet and dry seasons



In some warm regions, the year is divided into a rainy season and a dry season. During the rainy months, warm winds bring moist air, and rain falls often. During the dry months, winds change direction, rain becomes rare, and the land dries out. Grasslands and savannas are common here. Plants, animals, and people are adapted to these regular changes between wet and dry conditions.

Dry climate zones



Some parts of the Earth receive very little rain. In these dry climate zones, winds often bring dry air, and clouds rarely form. Days can be very hot, especially in summer, while nights may become much cooler. Deserts and semi-deserts are found in these regions, and plants and animals have special ways to save water or survive long dry periods.

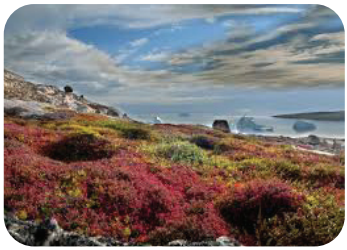
Mild climate zones



Mild climate zones have clearly defined seasons and moderate temperatures. Summers are warm, winters are cool or mild, and rain usually falls during many months of

the year. Winds often bring moist air from the oceans, helping forests, fields, and gardens grow.

Cold climate zones



Farther from the equator, climates become colder. Winters are long and cold, while summers are short and cool. Cold winds are common, especially in winter. Snow often covers the land for many months. Plants and animals must survive long winters and grow or feed quickly during short summers

Polar climate zones



Near the Earth's poles, the climate is extremely cold. The sun doesn't rise at all for months in winter. Even in summer, the sun stays low in the sky, so its rays are too weak to warm the air. Very little new snow falls, but because it is so cold, it does not melt easily. Instead, ice and snow pile up and cover the land for most of the year. Strong winds blow across wide frozen plains. Only a few specially adapted plants and animals can survive in these harsh conditions.

Why climate zones matter

Climate zones help us understand:

- why some places are rainy and others dry,
- why winds and seasons differ around the world,
- how climate shapes nature and human life,
- how climate is changing and how these changes affect people and ecosystems in different parts of the Earth.

1.3 | How and why the climate changed in the past

The Earth's climate has often changed before. Millions of years ago, when dinosaurs lived, the planet was much warmer, with lush tropical forests covering many regions. At other times, the Earth was so cold that huge glaciers, as tall as buildings, covered parts of North America and Europe. These warm and cold periods happened long before people existed.

How do we know what the climate was like long ago?

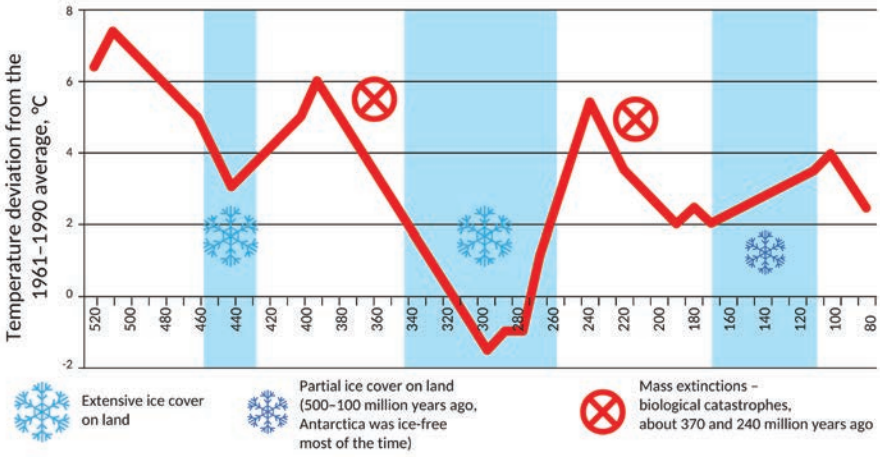


Scientists, much like detectives, combine many types of evidence to understand what climate was like in the past. Rocks and fossils tell us what kinds of plants and animals lived millions of years ago and what temperatures they needed to survive. Sediments from the bottom of lakes and oceans store signs of ancient climates.

In Antarctica, scientists drill deep into the ice and bring up long ice columns that contain tiny bubbles of air trapped hundreds of thousands of years ago. These bubbles show what the atmosphere was like then and help estimate past temperatures. Even tree rings hold information: trees grow wider rings during warm years and thinner rings during cold ones. All these clues help scientists recreate the story of Earth's climate.

Climate changes over millions of years

Over the last 500 million years, Earth's temperature changed many times - sometimes by as much as ten degrees. This happened mainly because the continents slowly moved. The Earth's outer layer is made of giant plates that drift a little each year. Long ago, all continents were joined into one, a supercontinent called Pangaea. As these plates moved apart, continents slowly drifted to new positions. Where a continent sits on the planet changes its climate. Near the equator, it is too warm for ice to grow. Near the poles, ice sheets form easily. Ice reflects sunlight, keeping the planet cooler, while dark oceans and land absorb sunlight and warm the planet.



The temperature on Earth over the past 500 million years

When continents drifted toward the poles, more ice formed and the whole world cooled down. When they moved away, the climate warmed back up. The rise of the Himalayas, changes in ocean gateways, and the movement of continents over geological time all contributed to major changes in Earth's climate.

These changes happened very slowly, giving animals and plants time to adapt. But when the climate changes too quickly, ecosystems and food chains are disrupted, and some species disappear.



Pangaea as a single supercontinent

Beginning of division into Laurasia and Gondwana

Separation of South America from Africa and breakup of Laurasia

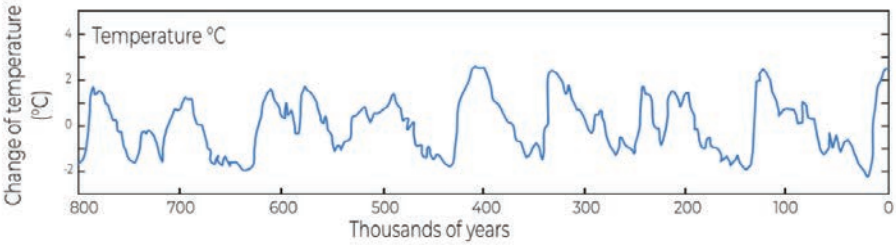
Continental drift over the past 500 million years

For the past million years, Earth has gone through a cycle of cooling down and warming up. Every 100,000 years or so, the climate warms up. The warm period lasts for 20,000–40,000 years and then the Earth slowly cools into an ice age.

While another ice age will eventually happen, it is still at least 15,000 years away! This means the natural 'cooling' won't help us with the climate change happening right now. The warming we see today is happening much faster than these natural cycles, and it will continue to affect our planet over the next few hundred years.

Climate changes over hundreds of thousands of years

During the last 800,000 years, Earth has switched many times between ice ages and warmer periods. Today, we live in one of those warm periods. These big changes happen because of slow variations in Earth's orbit and tilt, which slightly affect how much sunlight reaches the poles. When the poles get less sunlight, the summers stay cool and the winter snow doesn't melt away. Year after year the snow piles up turning into giant glaciers, which triggers an ice age. When conditions shift again, the extra sunshine melts the ice and the planet warms up again.



Change in temperature on Earth over the last 800,000 years relative to the average temperature

Sea levels also changed during these times. In colder periods, the oceans dropped by 50–100 meters because so much water was "locked up" in ice sheets. These falling sea levels even created "bridges" between continents, allowing ancient people to walk from Asia to North America across ground that is now deep underwater. In warmer periods, the ice melted, the water flowed back into the oceans and the oceans rose again.

Climate changes over centuries and decades

Even in the last thousand years, the climate has not stayed completely the same. Some decades were warmer, others noticeably colder. Scientists can study and confirm these changes by analyzing old tree rings, going through written records, and natural sediments – layers of mud at the bottom of lakes.



Several natural factors caused these shorter-term changes. One is the Sun itself: its activity changed slightly over time. Between about 1645 and 1715 it was less active, so a little less heat reached Earth.

This helped cause the "Little Ice Age", a cold period lasting several centuries, when Europe had some very harsh winters. Rivers and canals froze so solid that people skated on them, a scene that appears in many paintings of that period.

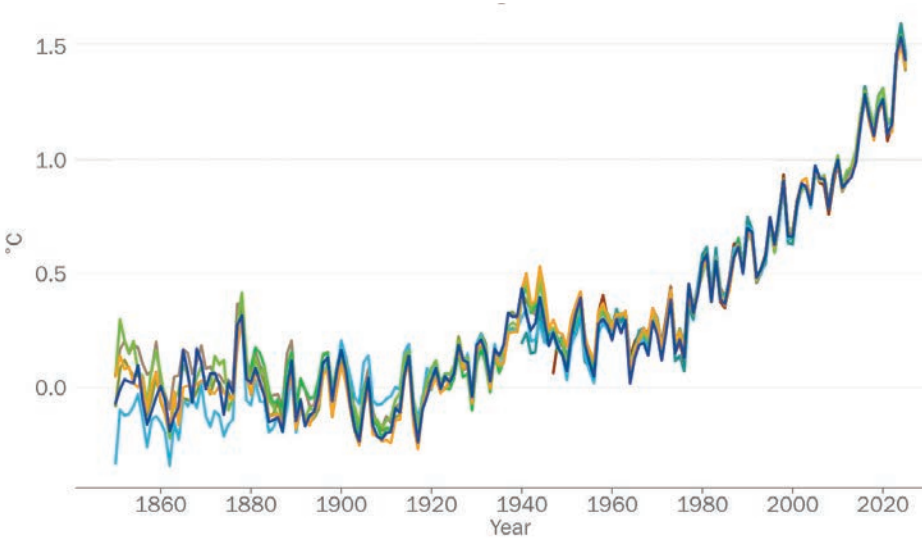


Large volcanic eruptions can also cool the planet for up to a few years. During such eruptions, gas and ash shoot high into the atmosphere. The gas forms a thin haze that reflects sunlight back into space. It takes a while for the haze to clear, and while it lingers, the Earth cools down.

Ocean currents play a big role, too. When currents bring warm water to a region, the local climate becomes milder and when they weaken, the climate becomes much colder.

1.4 | Climate change today

Over the past century, the Earth has warmed in a way that natural processes alone cannot explain. Scientists around the world now agree that the main reason for this rapid warming is **human activity**. In just over one hundred years, the planet's average surface temperature has risen by about **1.2°C**, and the last few decades have warmed faster than any period in the past **2,000 years**. The land is heating up faster than the oceans. In the Arctic, temperatures are rising almost **four times** quicker than the global average.



Increase in the global mean temperature on Earth between 1850 and 2023 as shown by different meteorological centres

The effects of this warming are already being seen all over the world. The last eleven years (2015–2025) are the eleven warmest on record. Weather patterns are shifting: storms are growing more powerful, rainfall is becoming heavier in many regions, and heatwaves are lasting longer, and cold spells appear unexpectedly. In many regions, temperatures swing sharply from warmer than usual to much colder within a short period, surprising people who are used to more stable seasons.

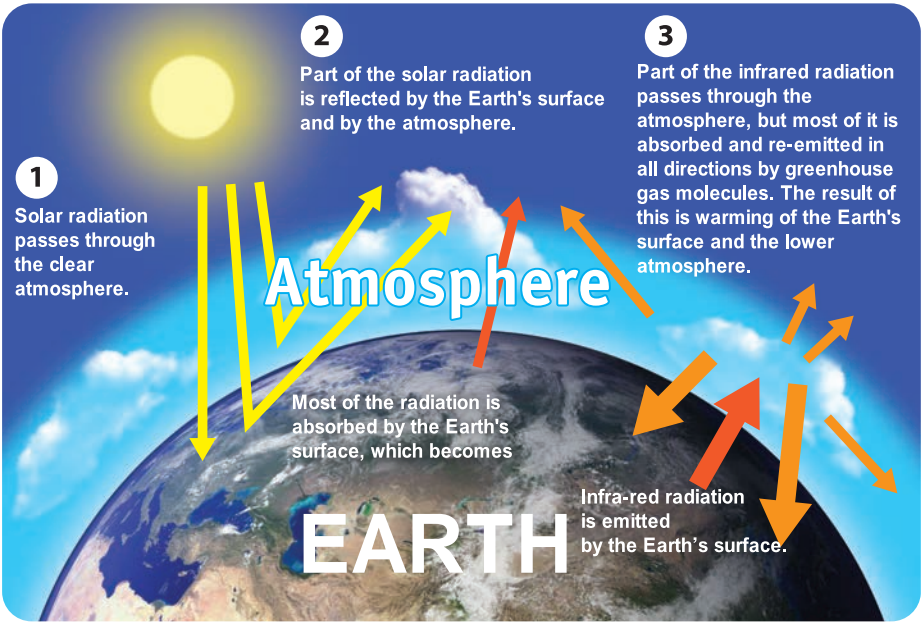
Why is the Earth getting warmer?

Understanding the greenhouse effect

To understand these changes, we need to look at something called the **greenhouse effect.** This effect is natural and very important. When sunlight reaches the Earth, the ground and oceans absorb some of that energy and warm up. The Earth then releases part of this heat back into the air. If all this heat escaped straight into space, our planet would be a frozen ball of ice - far too cold for humans, animals, or plants to survive.

Luckily, the atmosphere contains special gases, called greenhouse gases, that act like a warm blanket around the Earth. These gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and water vapour. They trap some of the outgoing heat and send it back toward the surface, keeping our planet at a comfortable average temperature of about 15 °C. Without this blanket, Earth would be a frozen world with an average temperature of around −18 °C.

This natural warming is essential for life. The problem is that today, human activities are adding extra greenhouse gases, making the warming stronger than ever before.



The Earth's energy balance and the greenhouse effect

Why is the Earth warming today?

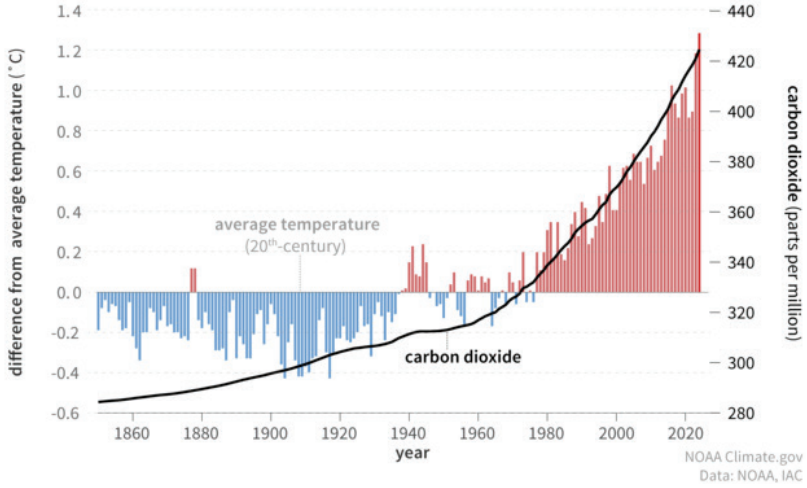
Human activities - especially burning coal, oil, and natural gas for energy - release large amounts of additional greenhouse gases into the atmosphere. Cutting down forests makes the problem even worse, because trees absorb and trap CO_2. When we cut them down, the carbon they were holding is released back into the atmosphere.

These additional amounts of greenhouse gases make the natural greenhouse effect much stronger. They act like extra layers in a blanket, trapping more heat near the Earth's surface and preventing it from escaping into space. This changes the planet's energy balance: more heat enters the climate system than leaves it.

Most of this extra heat does not stay in the air. The oceans absorb more than 90% of it, slowly warming over time. This is why a cold winter or a cool day does not mean global warming has stopped. Even if the air feels chilly for a moment the total amount of heat stored in the Earth system continues to increase.

Because we are adding greenhouse gases much faster today than nature ever did in the past, the Earth is heating up at an unusually rapid rate.

Nature helps us by absorbing part of the carbon dioxide we release. Oceans, forests, and soils act like giant sponges that take in about half of human-made CO_2 each year. But these natural helpers have limits. When emissions increase and forests are destroyed or stressed by heat and fires, they cannot keep up, and more carbon stays in the atmosphere.



Increases in atmospheric carbon dioxide and global temperature (1850-2024)

How do we know humans are responsible?

Scientists use many types of evidence to understand what is causing today's climate change. One of the most important clues comes from Antarctica. There researchers drill deep into ancient ice and study tiny air bubbles trapped in it for hundreds of thousands of years. These bubbles reveal what the atmosphere was like in the past - including how much carbon dioxide (CO_2) it contained.

The results are striking: CO_2 levels today are far higher than anything seen in the past 800,000 years. Scientists can even identify the "chemical fingerprints" of these molecules, showing that the extra CO_2 comes mainly from burning fossil fuels rather than natural sources like volcanoes.

By combining this ice evidence with data from satellites, weather stations, and climate models, scientists see that natural factors alone cannot explain the rapid warming observed today. This strong and consistent evidence allows us to conclude that human activity is the main cause of current climate change.

What do scientists predict for the future?

Scientists use powerful computer models to explore how Earth's climate might change in the future. How much the planet warms by 2100, compared with the late 1800s, depends on how much greenhouse gas the world releases.

- If we cut emissions quickly, warming could be limited to about 1.5–2 °C. This would help protect people, animals and nature.
- If countries keep their current climate policies, the Earth could warm by about 2.8 °C. This would bring more heatwaves, droughts and floods.

- If emissions rise sharply, the Earth could warm by 4 °C or more. Scientists now think this is less likely, but it would make life much harder for people and nature.

As the planet warms, the land will heat up faster than the ocean and the poles will feel the heat more than the tropics. Some places will get much more rainfall and flooding, while others will suffer from long droughts. Sea levels will continue to rise as the oceans are getting warmer and as the ice on Greenland and Antarctica melts adding more water to the ocean. The oceans will also keep absorbing part of our CO_2. The more CO_2 they take in, the more acidic the water becomes, which makes it harder for corals, oysters and other shell-building animals to grow. Together these shifts will disrupt ecosystems on both land and sea, making it harder for plants, animals, and even people to adapt to their changing environments.

What does all this mean for us?

Almost all climate scientists agree that human activity is the main cause of the rapid warming we see today. They also agree that the choices we make in the next decade will determine how much the planet will warm in the future. Every fraction of a degree matters, because even small increases in temperature cause big changes in weather, water, and ecosystems.

Reducing greenhouse gas emissions now gives us the best chance to keep the climate stable. By working together, through science, technology, policies, and everyday actions, people can help limit warming and protect our future.



2

How climate change affects the natural world and human beings

Can we adapt to the inevitable consequences of climate change?

2 How climate change affects the natural world and human beings

Can we adapt to the inevitable consequences of climate change?

Everything on Earth is connected like a giant puzzle. Forests, oceans, rivers, animals, plants, weather, and people all depend on each other. When one part changes, many other parts change too. Today, Earth is getting warmer because of climate change, and this is affecting both nature and human life around the world.

As temperatures rise, glaciers and snow melt faster, sea levels rise, and weather patterns change. Some places are becoming hotter and drier, while others are experiencing heavier rainfall and stronger storms. Heatwaves, floods, droughts, and wildfires are becoming more frequent in many regions.

Climate change affects nature in many ways. Animals and plants need certain temperatures and habitats to survive. When these conditions change too quickly, some species struggle to adapt. Forests can dry out and burn more easily. Coral reefs are damaged by warmer oceans. In some places, rivers and lakes shrink during droughts, leaving less water for wildlife and people.

These changes also affect human beings. Climate change can damage homes, roads, farms, and schools. Farmers may lose crops because of droughts, floods, or changing seasons. Some communities face water shortages and may not have enough clean water for drinking or growing food. Hotter

temperatures can also increase health risks, especially for children, older people, and those living in poor conditions.

Scientists warn that climate change is becoming a serious danger for people and nature. Every increase in global temperature makes these problems worse. Even a small increase in heat can lead to more frequent extreme weather events, food and water shortages, and greater risks for future generations.

But there is also hope. While we work to slow climate change and prevent Earth from getting even hotter, we also need to adapt to the changes that are already happening. **Adaptation** means preparing for climate impacts and finding ways to live more safely and comfortably in changing conditions. It helps us stay strong and recover more quickly when challenges come our way.

For example, communities can plant trees to reduce heat, save water to use during droughts, build homes that are safer against storms, and protect forests, rivers, and wetlands. Farmers can grow crops that need less water or can better survive heat.

These actions help build **resilience** — the ability to stay strong, adapt, and recover from challenges. By working together and acting early, people can help protect both the planet and future generations.



2.1 | How climate change affects the weather

Weather is becoming more extreme

Over the past 50 years, in many regions, extreme weather events have become more frequent or more intense. We see this in the news every day: strong typhoons in the Philippines, devastating floods in Thailand, long droughts in Australia, and huge wildfires in the United States and Canada. Some places are even experiencing weather that is very unusual for them, like snow falling in the deserts of Egypt and Saudi Arabia. These aren't just one-time accidents. These are signs that our planet's climate is out of balance, and the weather patterns we used to rely on are changing.



Scientists call unusual weather events like these **weather anomalies**, meaning weather that is very different from what is considered normal for a certain place or region.

When these unusual events threaten people's lives, health, daily activities, the economy, or infrastructure, they are called **extreme weather events**.

Climate change is increasing the likelihood and intensity of many extreme weather events. As the planet warms:

- Higher temperatures mean more water evaporates from oceans, lakes, rivers, and even the soil;

- Warmer oceans act like batteries, adding extra energy to the climate system and making storms stronger and rainfall more intense in many parts of the world;
- In dry regions, that extra evaporation dries out soils, raising the risk of droughts and wildfires;
- In other regions, that extra water vapor in the atmosphere leads to much heavier rainfall and flooding.

Often, different extreme events happen at the same time. Heatwaves can make droughts even worse, making the ground drier and more fire-prone. Meanwhile, heavy rains make rising sea-levels and high tides even more dangerous.

What are extreme weather events?

Extreme weather events are weather conditions that are significantly stronger, longer, or more intense than the typical patterns of a region. They can cause damage to people, infrastructure, and ecosystems. Climate change is increasing the frequency and intensity of many of these events and is altering precipitation patterns — bringing heavier rainfall in some regions and reduced rainfall in others.



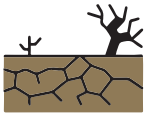




Heatwaves: at least five days in a row when temperatures are 5°C higher than normal. They can increase health risks, dry out soil, reduce water supplies, and stress animals, crops and ecosystems. As global temperatures rise, heatwaves are becoming more frequent, longer, and more intense.



Wildfires: uncontrolled fires that spread through forests, grasslands, or shrublands. They often occur during hot, dry, and windy conditions. Rising temperatures and prolonged droughts increase vegetation dryness, making wildfires more frequent and more severe in many regions.



Droughts: extended periods of below-average rainfall that lead to water shortages in soil, rivers, reservoirs, and groundwater. Droughts can reduce agricultural production, damage ecosystems, and limit drinking water availability.



Heavy rainfall: intense precipitation occurring over a short time, often during storms. When heavy rain falls quickly, the soil may not absorb the water, increasing the risk of surface runoff and flooding. Warmer air can hold more moisture, which increases the likelihood of heavy rainfall.



Floods: the overflow of water onto land that is normally dry. Floods can result from heavy rainfall, rapid snowmelt, river overflow, or storm surges. Even regions experiencing drought can face floods if rain falls too intensely to be absorbed.



Severe storms: strong weather events that bring powerful winds, heavy rain, lightning, and sometimes hail. In tropical regions, they can grow into cyclones (also called hurricanes or typhoons). Climate change is warming ocean waters and increasing moisture in the atmosphere. These changes are making many storms more intense, bringing heavier rainfall, stronger winds, and causing greater damage.

Can we predict extreme weather?

Predicting extreme weather far in advance is very difficult. Weather forecasts are usually reliable for about a week, and become much less certain by ten days. Short-term forecasts, such as predictions for tomorrow or the next few days, are much more accurate. Long-term forecasts can only describe general trends (like, “this summer will be hotter than usual”), not exact events.

Weather anomalies vs. climate change

It is important to remember that one unusual event like a single cold winter or a heatwave does not mean the climate has changed. Scientists study data over long periods (about 10 to 30 years) before they can conclude that the climate is shifting. However, more frequent unusual events like this can signal that the climate system is getting out of balance.

Extreme weather events in recent years

Extreme weather is no longer just a “future” challenge. It is affecting people, nature, our cities, and economies right now. In recent years, extreme weather events have become more frequent and more intense in many parts of the world.

In **Libya**, in September 2023, during Storm Daniel, heavy rain caused two old dams to collapse near the city of Derna. The flooding destroyed neighborhoods, damaged roads, and buildings. This tragic event showed that extreme weather becomes even more dangerous when our “protective structures” are not strong enough to handle new, record-breaking storms.

In **Vietnam**, severe droughts in 2023–2024 hit the Mekong Delta, leaving river levels dangerously low. Without enough freshwater flow, seawater from the ocean pushed deep inland. Many farmers struggled to protect their rice fields and fruit farms, and some communities faced shortages of clean drinking water.



In the **Arabian Peninsula**, in 2024 unusually heavy rainfall caused serious flooding, including in the United Arab Emirates. Because desert cities aren’t built for heavy rain, roads and homes flooded quickly. These events showed regions not used to heavy rain are often less prepared for sudden floods.



The Amazon rainforest faced a record-shattering drought and heatwave in 2023-2024. River levels dropped so low that entire villages were cut off from food and medicine. In some lakes, the water reached 41°C - hotter than a spa bath - causing many deaths among rare pink river dolphins and fish.



In November 2025, a powerful monsoon cyclone dumped record rain on **Southern Thailand**. Over 3 million people were affected across several provinces. The relentless torrential rain, described as the worst in 300 years, forced thousands of families to relocate as their homes became unsafe.



Heatwaves have also affected many regions. In **Southern Europe**, record-breaking heatin in 2023 and 2024 led to wildfires in Greece, Italy, and Spain. High temperatures disrupted tourism, and made outdoor activities unsafe, especially for children and older people. In 2025 temperatures hit a national record of 50.5 °C in Türkiye and a June record of 46.6 °C in Portugal. The heat was so intense that some nuclear power plants had to shut down because the river water used to cool them became too hot to work.



These examples show that extreme weather events are happening more often, in many different regions, and in new ways. Climate change does not affect all places equally, but everywhere it increases risks for people and nature. Learning from recent events helps societies prepare better, reduce damage, and adapt to the changing climate.

What we can do

Extreme weather cannot be completely avoided, but people can take important steps to reduce risks and stay safer.



Early warning systems: early warning systems help people prepare for dangerous weather before it happens. They provide alerts about heatwaves, floods, storms, or droughts, giving people time to protect themselves, their homes, and their belongings. The United Nations supports the "Early Warnings for All" initiative, which aims to make sure that by 2027 everyone in the world receives such warnings and knows what to do.

Adaptation and preparedness: communities can adapt to the changing climate by strengthening buildings, roads, and drainage systems. This means making our settlements "tougher" so they can better withstand floods, heat, or strong winds. People need to be ready too. Local emergency plans, safe shelters, and clear instructions help save lives during extreme weather.



Schools and hospitals play an important role in teaching people and preparing them for emergencies.

What individuals can do

Everyone can take simple but important steps to stay safe. Learning how to behave safely during extreme weather is especially important for children and teenagers.



- During hot days and heatwaves, drink plenty of water even when not thirsty. Avoid heavy physical activity in the hottest hours, wear light and breathable clothes. Help younger children or older people to make sure they are staying cool too.
- Knowing how to swim is a great life skill. If a flood happens, always follow evacuation orders immediately. Never play in floodwater – it can be fast-moving, hide sharp objects, or be very dirty.
- Pay attention to weather alerts on the phone and TV. By staying informed, and supporting friends and neighbors, you help your whole community stay strong and cope better with the changing climate.

2.2 | How climate change affects plants and animals

Climate change affects plants and animals. It changes the conditions they need to survive. When temperatures rise, rainfall patterns shift, or habitats change many plants and animals have to adapt to new conditions, otherwise they may not survive. Nature works like a network, with many connections between species and their environment, so changes in one place can spread to others. Areas where plants and animals live and interact with air, water, and soil are called ecosystems. When these living systems include many different species - known as **biodiversity** - they can adapt and recover more easily from climate change. In this chapter, we will explore how climate change affects nature, and why protecting biodiversity helps the whole planet adapt to the changing climate.

Understanding biodiversity

What is biodiversity

Biodiversity is the variety of all life on Earth. It includes different plants, animals, fungi, and even tiny microorganisms. It also includes various environments where they live, and the small differences between individuals of the same species.

Scientists distinguish three main types of biodiversity:

Genetic diversity: this refers to differences between members of the same species. Just like some people are faster runners or better at puzzles, some animals or plants may have unique traits - a better memory, or the ability to stay cool in high heat. These differences help populations survive challenges like

changes in climate, diseases, and predators. Over a long time, as these traits are passed through generations, they can even lead to the formation of entirely new species.

Species diversity: this type describes the variety of species living in an ecosystem and the different roles they play. Think of the African savanna: zebras, antelopes, wildebeest, gazelles, and warthogs eat different parts of the grass. Because they don't all want the exact same thing, there is enough food for everyone, and the ecosystem stays healthy.



Ecosystem diversity: this refers to the variety of natural environments on Earth, like forests, wetlands, coral reefs, mangroves, and grasslands. Each one provides essential resources like food, water or shelter. Having many types of ecosystems ensures that even if one area is struggling, life can continue and thrive in others.

Tropical rainforests are a great example of high biodiversity. While they cover less than 7% of Earth's land, they are home to over half of the plant and animal species in the world.

Why is biodiversity so important?

People have always depended on nature for food, shelter, medicine, and energy – and we still do today. Scientists still explore rainforests to discover new medicines, farmers use hardy wild plants to make our crops stronger against droughts and heat. Engineers even copy designs from the natural world to create new technologies; for example, making helicopters

fly more smoothly by copying the wings of dragonflies or creating sticky tape inspired by the feet of geckos.

One of the most important roles of biodiversity is helping to keep Earth's natural systems working properly. For millions of years, life has evolved to thrive in a precise balance of atmospheric gases. Even small changes in oxygen levels would seriously harm people and animals; green plants play the key role in keeping our habitat breathable and stable.



Imagine our planet as a spaceship where every species is a vital piece of equipment tuned to work in harmony. If we lose too many of these "parts" to extinction, we risk the collapse of the entire ship. Every organism has a specific job: some convert sunlight into energy, some manage populations by eating plants or animals, and others break down waste to return nutrients to the soil. We do not know how much damage this intricate system can handle, but human activity is already pushing nature to its limits through irreversible species loss.

Biodiversity also serves as a measure of the planet's health. When many species thrive, ecosystems like forests and coral reefs remain stable and strong. A world with fewer species would be less stable, less beautiful, and less safe for people.

What are the threats to biodiversity

Human activity is the greatest threat to nature. To feed a growing population and expand our cities, we cut down forests, drain wetlands, overfish, and deplete water resources. In the process, we also cause pollution and contamination of natural habitats. These actions destroy the “homes” species need and break the delicate balance that keeps our ecosystems healthy.

This impact is even worsened by the unprecedented speed of climate change. Over millions of years, plants and animals have evolved to handle slow shifts in conditions. Today’s changes, however, are happening much faster than many species can adapt. Because we have already fragmented their habitats with roads, agricultural fields and settlements, many animals have nowhere to go. Nature simply cannot move or change fast enough to keep up, putting many species at risk of disappearing forever.

Mass extinctions and climate change

There have been five major mass extinctions in the last 450 million years. The best known happened about 66 million years ago, when an asteroid hit the Earth and most dinosaurs died out.

While it is natural for some species to die out and new ones to appear, these mass extinctions were caused by major changes on our planet:

Continental drift: as landmasses moved over millions of years, they reshaped mountain ranges and changed ocean currents, radically altering global temperatures and oxygen levels.

Ice Age cycles: periods of extreme cooling led to the formation of massive polar ice caps. This pulled water from the oceans, causing sea levels to drop, destroying coastal habitats.

When the climate changes too quickly, it breaks the balance of nature. Life eventually recovers, but it takes millions of years, and species that went extinct almost never come back.

How animals are affected by climate change

While mass extinctions happened in the distant past, today's climate change is happening so fast that we can see its effects in our own lifetimes. Small animals often react first because they have short life cycles and depend heavily on their environment. Larger animals also respond, but much slower.

Here is how animals around the world are being affected by climate change:

- In Central Europe, warmer weather lets swallowtail butterflies raise an extra generation each year. This can upset the balance with the plants and animals they depend on. Warmer, drier weather also helps spruce bark beetles spread to new areas, killing many spruce trees.



- Climate change makes parasitic mold stronger than the yellow-striped pygmy eleuth (a small frog) it lives on. As the mold grows faster in the heat, entire frog populations are put at risk.



- When ocean water gets too hot, corals lose the tiny algae that live inside them. These vital algae feed the corals using sunlight and give them their bright, vivid colors. This is called coral bleaching, leaving once vibrant reefs looking a ghostly white. As the corals struggle to feed and the reefs perish, thousands of other sea creatures lose their homes and breeding grounds, causing life in the ocean to disappear.
- Melting sea ice destroys the home of phytoplankton (tiny plants). As a result, krill disappear, animals like penguins and whales go hungry and their numbers drop, while jellyfish-like "salps" take over. With less ice, seals have nowhere to raise their pups, and Polar bears are forced to change how they hunt, leaving no leftovers for Arctic foxes or birds.
- Warmer winters cause rain to fall on snow, which then freezes into a hard crust of ice. Reindeer cannot dig through this thick ice to find the lichen they need to eat.
- Lemmings' underground homes are flooded too early in the year, causing their numbers to drop. This leaves birds of prey and foxes with nothing to hunt. As lakes dry up, forest and grass fires become common, while birds, wolves, and antelopes are forced to migrate long distances to find water.

Protecting biodiversity

People can help reduce the negative impacts of climate change on biodiversity by protecting nature and helping damaged ecosystems recover. Healthy forests, wetlands, grasslands, rivers, and coastal ecosystems are more resilient

and can better support plants, animals, and people. Important approaches include creating protected areas, protecting endangered species, and using ecosystem-based adaptation — nature-based solutions that help both people and the environment adapt to the severe long-term effects of climate change.

Protected Areas

One important way to conserve ecosystems and species is creating protected areas — special places where nature is kept safe, and human activities are carefully managed. These include:

National parks: these allow visitors to explore and enjoy nature, but human activities are regulated to prevent damage. These play an important role in public education, helping us to better understand global environmental challenges and learn how to behave responsibly in the wild.



Yellowstone National Park (USA)



Jasper National Park (Canada)

Nature reserves: these areas are more strictly protected, with minimal human disturbance. Scientists use these to monitor ecosystems and study natural processes and the effects of climate change.

Biosphere reserves: these unique areas combine nature protection with sustainable human activities. They allow us to study long-term environmental changes, such as the gradual and steady shift of forest lines further up the mountain slopes caused by higher temperatures.

Other protected areas: some focus on a single goal, like protecting specific habitats, species, or unique rock formations, with human activity restrictions applied only when necessary.

These areas don't just protect animals and plants, they are our allies in fighting climate change by:

- Storing carbon in forests, soils, and wetlands;
- Protecting healthy ecosystems that are strong enough to adapt to changing conditions;
- Reducing risks from floods, droughts, and other extreme weather events;
- Providing safe habitats for species affected by environmental changes.

However, climate change also threatens protected areas. Rising temperatures, droughts, melting glaciers, and more frequent wildfires are putting pressure on the very species we are trying to save. To encourage change, many protected areas are now reducing their own "footprint" by using renewable energy, sustainable transport, and environmentally friendly tourism practices.

Protecting species: The Red List

Protecting biodiversity also means protecting individual species. The Red List is a global system that identifies rare, endangered, and extinct species of animals, plants, and fungi. It helps scientists and governments understand which species need protection.

The list uses different categories to show the level of risk:



Extinct: species that have already completely disappeared from the Earth.

Critically endangered: facing an extremely high risk of extinction in the wild very soon.

Vulnerable: species that are likely to become endangered unless the circumstances threatening their survival improve.

Scientists don't just add species to this list randomly. They investigate where the animals live, exactly how many are left in the wild, and what specific threats they face.

Species become endangered due to direct pressures such as hunting or habitat loss, and indirect factors, like environmental shifts and the growing threat of climate change.

Because every region is unique, many countries also create national Red Data Books. These help governments focus on specific plants and animals that are most important to their own forests, rivers, and mountains and guide local conservation efforts.

Ecosystem-based adaptation

Ecosystem-based adaptation helps people adapt to climate change by working together with nature. These solutions do more than just protect animals and plants, they can improve our health, make sure we have enough food, and create new jobs. Healthy ecosystems, such as forests, wetlands, grasslands, and coastal areas, can reduce climate risks and help communities stay safer.

For example, forests can reduce heat and absorb carbon, wetlands help prevent floods, and mangroves can protect communities from storms and soil erosion.





Ecosystem-based adaptation includes the following approaches:

- Protecting natural habitats before these are lost;
- Restoring damaged ecosystems, like replanting forests and restoring wetlands;
- Healing the soil so it can hold more water and grow healthier plants;
- Using sustainable farming practices that work well with local conditions.

These approaches work best when local communities are actively involved in planning and caring for their own environment.



Ecotourism — harmony between people and nature



Ecotourism is a special way of travelling that respects nature, reduces environmental impact, and supports local communities. It helps protect biodiversity by:

- Promoting responsible travel and low-impact activities, like walking, cycling, or small-group tours;
- Supporting conservation projects and sustainable resource management;
- Providing income for local communities, while reducing pressure on natural habitats;
- Teaching visitors about ecosystems and climate change.

Ecotourism combines the enjoyment of nature with its protection. It creates a positive cycle where visitors learn, local communities earn income, and biodiversity is kept safe.





2.3 | How climate change affects forests

What is a forest

Many people think of a forest simply as a place with many trees. In reality, a forest is a complex ecosystem where trees grow together with plants, animals, fungi, and microorganisms. All these living things interact with the air, water, soil, and climate conditions, forming a balanced natural system.

While we all know a forest when we see one, there are actually over 800 different definitions used around the world. The most recognized one, used by the Food and Agriculture Organization (FAO), uses a specific "rule of three" to define a forest:

- Height: trees must be at least 5 meters tall;
- Cover: the canopy (all the tree leaves) must cover at least 10% of the ground;
- Size: the area must be at least 0.5 hectares (about the size of a professional football field).

Forests play an important role in supporting life on Earth. They help regulate the climate, clean the air and water, protect soil from erosion, and provide habitats for countless species. Forests also contribute to the global water cycle and influence local weather conditions. For people, forests are sources of natural resources, recreation, and cultural value.

Globally, forests cover about one third of the Earth's land surface. They grow in very different climates — from cold northern regions to tropical areas near the equator. Each type of forest has its own characteristics and biodiversity.

Types of forests

Forests can be grouped into different types depending on the climate and their geography.

Temperate forests grow in regions with four clear seasons. Some trees lose their leaves in autumn, while others remain evergreen. These forests are common in Europe, parts of Asia, and North America. Key Fact: These forests have rich soil because of all the leaves that fall and decompose on the ground.



Boreal forests, known as Taiga, grow in cold northern regions. They are dominated by "conifers" - trees with needles and cones, like pine, spruce, and fir. Winters are long and cold, so there are fewer types of animals and plants compared to warmer regions. The Taiga is the largest land-based ecosystem on Earth!



Tropical forests grow near the equator in warm climates with lots of rain. They are known for extremely rich biodiversity and are home to more than half of all the world's plant and animal species.



These forests act as the planet's 'thermostat,' helping regulate the global climate.

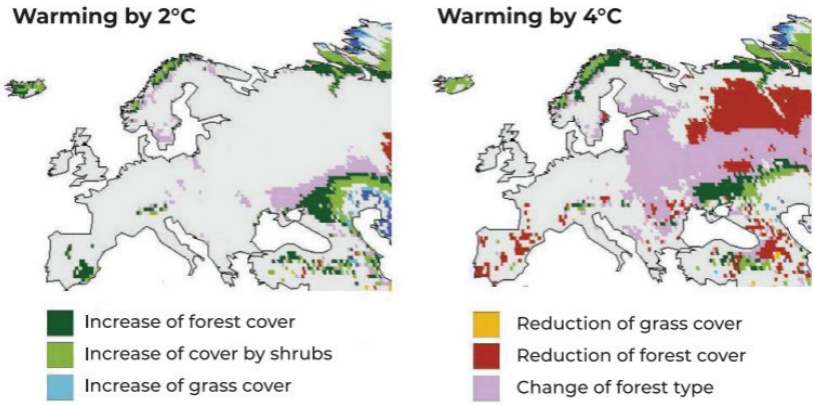
The impact of climate change on forests



The survival of forests depends mainly on two things: air temperature and precipitation. Climate determines where forests can grow and how trees develop. If temperatures are too low, forests cannot survive and gradually turn into tundra landscapes (mostly mosses and shrubs). If rainfall decreases and droughts become more frequent, forests shrink and are replaced by grasslands or steppes (treeless grassland plains).

Climate also influences how trees grow, reproduce, and survive. Because climate zones change gradually, you will often see transition areas where a forest slowly blends into a different ecosystem. However, climate change is now forcing these zones to move faster than ever. Scientists observe that forest zones are shifting as temperatures rise. In some regions, trees and shrubs are spreading into higher altitudes (climbing mountains) or moving northward to stay cool. In other places, forests are declining because conditions are becoming too dry or too hot.

Scientific climate models show that even a seemingly small increase in average global temperature (like 2°C or 4°C) could significantly change forest distribution in many regions, including Europe.



Forecast changes in forest cover in Europe by 2100, assuming global warming of 2°C and 4°C

Climate change acts like an "amplifier", making natural problems more frequent and much more intense. These disturbances can damage or even destroy healthy forests:

Forest fires: hot, dry weather turns leaves, needles, and fallen branches into dry fuel. This makes it much easier for fires to start and spread. However, the most dangerous are crown fires, which spread through the tops of trees and move incredibly fast.



Extreme weather: strong winds, heavy snow, ice, or hail can easily break branches, uproot entire trees, and weaken fragile forest ecosystems.



Insect outbreaks: just like humans can get sick when they are stressed, trees weakened by heat or drought become easy targets for pests like bark beetles. When millions of beetles attack at once, they can destroy extensive forest areas, leaving many animals homeless.



These changes affect not only individual trees but entire ecosystems. When forests change, animal habitats shift. Some species may adapt, others migrate, as a result biodiversity may decrease, and ecological balance can be disrupted.

The carbon cycle: why forests matter

Forests are affected by climate change, but they also have the power to influence it. Through photosynthesis, trees absorb carbon dioxide (CO_2) from the atmosphere and store carbon in their trunks, branches, roots, and the soil. By locking this carbon away, forests help reduce the increased concentration of greenhouse gases that cause global warming.

Forests also influence local climate conditions. They provide shade, retain soil moisture, and release water vapor into the air, which can make surrounding environments cooler and more humid.

Young, growing forests absorb carbon actively, while older forests store large amounts of carbon accumulated over long periods. Both types of forests are important for maintaining climate balance.

Human impact and conservation



Forests are strong, however, they are also vulnerable to human activities. Today human impact is the main reason we are losing forests around the world. In tropical regions like South America and Southeast Asia, vast areas are cleared for cattle farming, palm oil plantations, and mining. This is a double blow for our planet: on one hand, animals and plants lose their natural habitat, on the other, deforestation releases massive amounts of carbon. In fact, tropical deforestation accounts for roughly 10% of global CO_2 emissions.

Losing forests worsens climate change, which in turn increases stress on the forests that remain.

How can we help protect the forests?

We have tools to protect and restore our forests. Here are the most effective ways to help:

Sustainable forest management: instead of planting just one type of tree, we can plant a mix of species. This makes the forest more "resilient", meaning it can recover quicker from disease or heat.



Fire prevention: many forest fires result from human carelessness. We can save thousands of hectares by simply being careful with campfires and never burning dry grass.

Restoring peatlands: peatlands are swampy areas that store incredible amounts of carbon. Restoring them and keeping them healthy helps keep carbon stored safely in the ground.

Economic incentives and community support: we can protect forests by making them valuable to the people living nearby. We don't need to cut down trees to have a strong economy. By supporting traditional activities, like harvesting nuts, herbs, and berries, local communities can earn a living while keeping the forest, and its carbon, safe.

Conservation and restoration: we can't only stop cutting trees, we must plant new ones and help damaged ecosystems recover. Protecting existing forests, restoring damaged areas, and supporting biodiversity conservation help maintain carbon storage and strengthen ecosystems against climate risks.

By caring for forests, people support both biodiversity and climate stability, helping ecosystems remain healthy for future generations.



2.4 | How climate change affects water resources

Water in nature

Water is the foundation of life on Earth and one of the most important substances in nature. It is everywhere: in rivers, lakes, oceans, glaciers, underground reservoirs, and even in the air as the invisible water vapor.

Water is commonly found in three different states: solid (ice and snow), liquid (rain, rivers, oceans), and gas (water vapor in the atmosphere). It continuously shifts between them.

People have studied water for thousands of years. Ancient civilizations, like those along the Nile River, carefully observed seasonal flooding to support agriculture and daily life. Today, the scientific study of water is called hydrology, and it helps us understand how water systems function and how they respond to environmental change.

Water on Earth never stays still. It is constantly moving through a natural process called the water cycle. This cycle is powered by the sun and follows a continuous path. Water evaporates from oceans, lakes, and soil, rises into the atmosphere, forms clouds, and returns to the surface as rain or snow. Some water flows across land into rivers and oceans, while some is absorbed in the ground and becomes groundwater. The water cycle is very sensitive. Temperature, wind, and precipitation levels determine how fast water moves through the cycle and where it ends up.

Although water covers 70% of our planet, only a small portion is easily available for human use:

Oceans: more than 97% of Earth's water is salty ocean water and cannot be used directly for drinking.

Ice and glaciers: about 2% of the world's water is freshwater locked in glaciers and polar ice.

Accessible freshwater: less than 1% of all water is found in rivers, lakes, and underground reservoirs. This is the water that people actually rely on daily.



Freshwater isn't distributed evenly around the world. Some countries, such as Brazil, Russia, and Canada, have large freshwater reserves, while other regions face increasing water scarcity. For example, Asia is home to about 60% of the world's population but has access to only about one-third of the global freshwater supply.

Rapid population growth, urbanization, agricultural expansion, and changing lifestyles continue to increase global water demand. Agriculture alone accounts for about 70% of freshwater use worldwide. Access to safe drinking water remains one of the most important global environmental and social challenges, affecting food production, health, and economic development.

Climate change adds additional pressure to water resources. By altering precipitation patterns, increasing evaporation through higher temperatures, it changes when and where water is available. This makes access to safe drinking water one of the most critical environmental and social challenges

of our time, directly affecting global health, food security, and the development of our economies.

The impact of climate change on water

Water systems are closely linked to the climate. Changes in temperature and precipitation directly affect rivers, lakes, glaciers, groundwater, and soil moisture.



One major impact of climate change is the growing contrast between wet and dry regions. In many places, heavy rainfall is becoming more intense and frequent, increasing the risk of floods. At the same time, other regions experience longer and more frequent droughts.

These changes look different depending on where you are:

- In parts of the Mediterranean region, southern Africa, and western North America, decreasing rainfall and rising temperatures are leading to severe water scarcity.
- In South and Southeast Asia, stronger monsoon rains cause more frequent flooding and landslides.
- In Arctic and alpine regions, warming causes glaciers and snowpacks to shrink. This changes seasonal river flows that millions of people depend on.

As snow and glaciers melt earlier in the year, rivers may carry too much water in spring, causing floods, and too little during summer, when farmers and cities need it most. This shift disrupts agriculture, hydropower production, and natural ecosystems. Scientists call this **water scarcity** - a situation where water demand is higher than the supply. Today, billions

of people experience severe water shortages for at least part of the year. Climate change is expected to increase this risk, especially in already dry regions.



Climate change also threatens the quality of our water. Flooding can contaminate drinking water sources. Droughts leave less water to dilute chemicals, making pollutants more concentrated and dangerous for people, animals and plants. These changes disrupt the "ecological balance", harming everything from wetlands to the migration and breeding cycles of fish. Ultimately, water scarcity also affects food security, energy production, and public health.

Solutions: how can we adapt

Adapting to changing water conditions requires a combination of technology, nature-based solutions, and better habits. Experts highlight several key approaches.

Improved monitoring and forecasting: better observation systems, including satellites and climate models, help predict floods, droughts, and other hydrological hazards in advance, allowing communities time to prepare and reduce risks.



Efficient water management: we can reduce pressure on freshwater resources by using water more wisely. This includes rainwater harvesting, reusing wastewater for gardens or farms, and using drip irrigation, which delivers water directly to plant roots to prevent waste.

Engineering and infrastructure solutions: dams and reservoirs help regulate river flows and store water for dry periods. In some coastal regions, desalination plants are used to convert seawater into freshwater, although these systems require a lot of energy and careful management.



Nature-based solutions: healthy ecosystems can help regulate water naturally. Wetlands store excess water and prevent severe flooding, forests protect vital watersheds, while urban green spaces absorb rainfall and reduce surface water runoff. Cities such as Copenhagen and New York are already integrating such nature-based solutions into their climate-resilient planning.



2.5 How climate change affects agriculture

Agriculture is closely connected to natural conditions and the climate. Farmers depend on temperature, rainfall, soil quality, and water availability to grow crops and raise animals. Because of this strong relationship, agriculture is one of the sectors most sensitive to climate change. At the same time, agricultural activities can influence ecosystems and contribute to climate change.

Climate change brings both risks and potential opportunities for agriculture. In some cooler regions, longer growing seasons or warmer conditions may allow farmers to introduce new types of crops that could not grow there before.



However, these potential benefits are often outweighed by challenges such as unsuitable soils for new crops, water shortages, new pests and diseases, and unpredictable weather events.

Regions that have traditionally supported farming may become much hotter or drier. This makes it more difficult to grow the same fruits and vegetables that families have cultivated there for generations. Because weather patterns are becoming less predictable, the risks farmers face are increasing globally. As a result, while agriculture may see some small benefits in certain northern regions, it faces serious challenges in many other parts of the world.

The impact of climate change on agriculture

Climate change affects agriculture in different ways across the globe. Rising temperatures, changing precipitation patterns, and more frequent extreme weather events are already altering growing conditions in many regions. Higher temperatures increase heat stress on crops and reduce soil moisture through faster evaporation. Unpredictable rainfall may lead to droughts in some regions and flooding in others. Extreme events, such as heat waves, storms, and unexpected frosts, can damage crops and reduce harvests.

In coastal regions, rising sea levels allow saltwater to enter agricultural land. This damages the soil and destroys essential crops like rice, which is often grown in low-lying river deltas. Together, these changes make farming more challenging and increase the risk of crop losses.



Many studies project that climate change will increasingly reduce yields of major crops, especially in tropical and already vulnerable regions.

Africa: in many regions, higher temperatures and reduced rainfall are drying out the soil and shortening the growing seasons. Crops like maize and millet, which are important food sources for millions of people, may no longer grow successfully in many areas of the continent. Scientists estimate that suitable farmland for these crops could shrink by 40-80% by 2040.

Asia: in the Mekong Delta, rising sea levels push salt water into rice fields. Even a 30 cm rise could cut harvests by 11%.

South Asia: stronger and more unpredictable monsoon rains lead to frequent flooding that washes away crops, damages the soil, and disrupts planting schedules.

Central Asia: fast melting glaciers initially cause more river flow, which can result in flooding. Later in summer, the water becomes scarce, making irrigation more difficult when crops need water most.

By disrupting agricultural processes climate change threatens **food security -** the reliable access to sufficient and nutritious food.

The impacts of climate change extend beyond food production. Agriculture is the main source of income for about one-third of the global workforce. When harvests decline, farmers' incomes decrease, which can lead to poverty and social instability. Because millions of people rely on farming for their livelihoods, these climate impacts can also affect economic stability of entire countries and regions.

Solutions: climate-smart adaptation

To maintain food production under changing climate conditions, agriculture must adapt. Adaptation means adjusting farming practices to reduce risks and make agriculture more resilient to climate impacts.

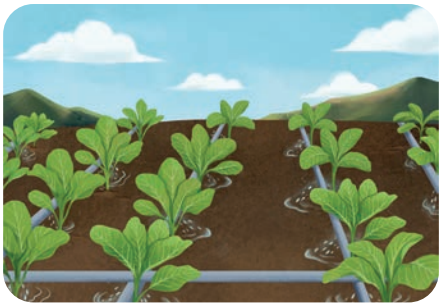
Water management

Many adaptation strategies focus on using water more efficiently, since water availability is one of the most important factors affected by climate change.

In some regions, farmers adapt to changing precipitation patterns by shifting from rain-fed agriculture to managed irrigation systems.

Improved irrigation systems, such as drip irrigation, help deliver water directly to plant roots and reduce water loss;

Covering soil with plant materials (mulching), such as straw, dry leaves, or grass, helps keep moisture in the soil and reduce water loss from evaporation;





Collecting rainwater and storing it for later use can also help farmers cope with irregular rainfall;

Watering crops during cooler hours (early morning or evening) to reduce evaporation.

Crop selection and diversification

Farmers are also changing what crops they grow to address the impacts of the changing climate. They may plant crop varieties that are better adapted to heat and droughts.

In parts of Southeast Asia, rising sea levels allow saltwater to enter agricultural land. Farmers here are adapting by planting salt-tolerant rice varieties and adjusting their planting schedules.

Diversifying crops also can help reduce climate risks. Different plants respond differently to heat, drought, heavy rain, or pests. If one crop fails due to extreme weather, others may survive and still provide a harvest, helping farmers avoid total losses.

Other adaptation approaches include:

- **Using greenhouses** to control growing conditions and protect plants from extreme weather events.
- **Installing anti-hail nets** and other protective systems to reduce damage from storms or sudden temperature changes.
- **Planting trees alongside fields** (agroforestry) to protect crops from strong winds and help conserve soil moisture.



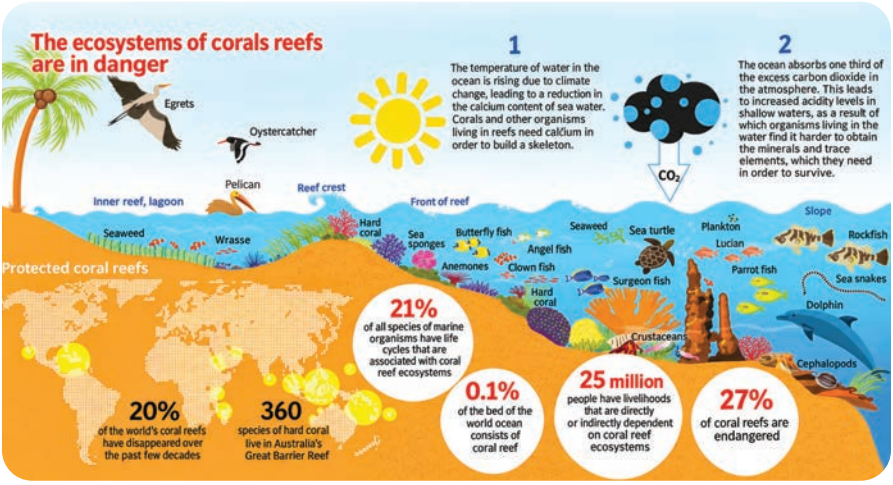


By understanding climate change impacts and risks and adjusting their practices and habits, people can support more resilient agriculture and help ensure stable food production in the future.

2.6 | How climate change affects coastal regions

Coastal regions — the areas where land meets the sea — are some of the most important places on Earth. About 40% of the world's population lives near coastlines. Many of our largest cities, busiest ports, fishing communities, and popular tourist destinations are located along the sea.

Today, climate change is creating new challenges for coastal regions. Rising sea levels, stronger storms, and changing ocean conditions are transforming coastlines and increasing risks for people, nature, and infrastructure.



The impact of climate change on coastal regions

Sea level rise

For over 100 years, global sea level has been slowly rising, and in recent decades this rise has become faster. Two main processes cause this change:

- **Thermal expansion:** as the ocean water gets warmer, it expands and takes up more space.
- **Melting ice:** higher global temperatures are causing glaciers in Greenland and Antarctica to melt, which adds huge amounts of "new" water to the global ocean.

Even a small increase in sea level can have a big impact on the coastal areas. Low-lying areas may flood more often, especially during high tides and storms. By the end of this century, sea level could rise by around one meter in some scenarios, putting many islands, coastal cities and communities at risk.

Threats to people and communities

Many famous coastal cities, such as Miami, Shanghai, Bangkok, and Jakarta, already face increasing flood risks. Rising sea level can damage homes, roads, and ports, and may eventually force people to move away from vulnerable areas.

Some countries are especially exposed to these changes. In parts of Egypt and Bangladesh, rising water could flood vital farmland and threaten food production. Small island states, like the Maldives, are particularly vulnerable because many of their islands are only slightly higher than current sea level.

Another growing problem is saltwater intrusion. As sea level rises, salty ocean water can enter and contaminate groundwater and rivers. This makes freshwater much harder or impossible to use for drinking purposes and agriculture.



Finally, these changes affect our food supply. Fish are an important

source of protein for billions of people, especially in coastal and island countries. The rapid changes in marine ecosystems affect both nature and human food security.

Impact on nature and fisheries

Coastal ecosystems are rich and diverse. Coral reefs, mangrove forests, and salt marshes provide habitats for many species and help protect coastlines from waves.



Warmer ocean temperatures can damage coral reefs. When water becomes too warm, corals lose tiny algae that gives them color and energy. This process, called **coral bleaching**, can lead to the death of reefs if high temperatures continue.

Climate change also affects fish populations. As ocean temperatures change, many fish species move toward cooler waters. This affects fishing communities because fish may become less available in traditional fishing areas.

Destruction from storms and erosion

Climate change is also making some coastal storms significantly more dangerous. During powerful storms, strong winds can push seawater toward land and cause a sudden rise in water levels. This is called a storm surge. Storm surges can flood coastal towns within a short time and cause severe and widespread damage.



A tragic example occurred in the Philippines in 2013, when a powerful storm caused widespread destruction and coastal flooding. Events like this show how vulnerable coastal communities can be to the changing climate.

At the same time, waves and rising seas gradually corrode the coastline. This process, called **coastal erosion**, causes beaches and cliffs to retreat. In some Arctic regions, coastlines are shrinking rapidly because warming has reduced protective sea ice, allowing stronger waves to reach the shore.

How coastal regions can adapt to climate change

Although climate change creates serious challenges, several strategies can help protect coastal communities:

Engineering and infrastructure: some countries build strong coastal defenses, like dams, dikes, and sea barriers. The Netherlands is a well-known example. Here people have developed advanced systems to protect low-lying coastal lands from rising sea levels.



Nature-based solutions: protecting and restoring natural ecosystems - such as mangroves or coastal wetlands - can reduce wave energy and protect shorelines naturally.



Early warning systems: early warning systems help communities prepare for storms by giving people time to prepare or move to safety.

Scientific tracking: tools like the OCEANADAPT help scientists and fishers track the movement of nearly 650 marine species. This information helps decision makers develop timely strategies to manage fisheries as fish migrate to new, cooler waters.

Relocation: in some cases, adaptation may even involve relocating communities away from areas that are no longer safe. The community of Newtok in Alaska is moving to a new site, Mertarvik, because of erosion and thawing permafrost. Kivalina also plans to move.



The future of coastal regions depends on the choices made today. Through science, cooperation, and smart adaptation, communities can reduce risks and help coastlines remain safe, resilient, and vibrant places to live.



2.7 How climate change affects mountain regions

Mountains play a crucial role in shaping the climate. They act as barriers that influence the movement of air masses, creating different weather conditions on opposite slopes. As a result, one side of the mountain may receive heavy rainfall, while the other remains dry.

Climate conditions also change with altitude, forming different climate zones as you go higher. On average, the temperature decreases by about 6°C for every 1,000 meters of elevation. This explains why snow can be found on mountain peaks even in tropical regions.

Mountains affect the climate, but they are also highly dependent on it. In fact, mountain regions are among the first to respond to changes in climate conditions. One of the clearest indicators of climate change in the mountains is glaciers, which shrink or grow depending on whether the climate is becoming warmer or colder.

While glaciers have naturally advanced and retreated throughout history, scientists observe that over the last 70 years, many glaciers have been shrinking much faster than expected. This rapid melting is a direct signal that the climate is warming beyond its natural cycles.



Accelerated glacier melting

Glaciers around the world are retreating as global temperatures rise. This trend is visible across many mountain regions:

Asia (the Himalayas): the Gangotri Glacier, one of the sources of the Ganges river, has retreated by about 1.7 kilometres since 1935.

Europe (the Alps): glaciers are melting very fast. In Switzerland, they lost about 10% of their remaining ice in just two years (2022–2023), as much as in the 30 years from 1960 to 1990. Scientists estimate that the Alps could lose about half of their glacier ice by 2050.

Africa (Mount Kilimanjaro): the iconic ice cap on Mount Kilimanjaro has shrunk by about 90% since the 1800s, almost completely vanishing.

North America (the United States): in Glacier National Park, the number of glaciers has declined from about 150 in the mid-1800s to only 25 today.

Similar changes are observed in the Andes, the Caucasus, and the Altai Mountains.

The impact of climate change on mountain regions

Scientists warn that this accelerated melting threatens ecosystems, economies, and water supplies, affecting both the people in the mountain regions and those living in nearby lowlands. Communities in these regions rely heavily on stable climate conditions for agriculture, tourism, and water supply. Even small changes in temperature or rainfall can seriously affect their livelihoods.

Tourism under threat: tourism, especially winter sports, is a major source of income for people living in mountain regions. In the Alps, skiing and snowboarding provide 20% of local income. Due to the decrease in snowfall in recent years, many resorts have been forced to close or use expensive artificial snow.



Increasing natural disasters: climate change is increasing the frequency and intensity of hazards. As glaciers melt and retreat, they form unstable lakes that can suddenly burst or overflow, causing floods that devastate communities downstream. This is currently a serious risk in countries like Nepal and Bhutan. Warmer temperatures, heavier rainfall, and rapid snowmelt are making the ground unstable. This leads to more common landslides and avalanches, which can destroy villages, infrastructure, and lives within minutes.



Loss of freshwater: glaciers act as the world's "water towers", feeding many of the planet's largest rivers. As they shrink, water supplies become less reliable. This threatens agriculture, hydropower, industry, and drinking water for millions of people. In some areas, water shortages are already leading to political tensions between neighboring regions.

Scientists warn that some of these changes, especially glacier loss and shifts in mountain ecosystems, may not be fully reversible, even with strong adaptation efforts.

How mountain regions can adapt

Although some impacts cannot be avoided, many communities are finding ways to reduce risks and adapt to changing conditions.

Adapting tourism: to cope with less snow, mountain regions are shifting toward year-round activities. Instead of relying solely on winter sports and entertainment, they are diversifying into hiking, wellness tourism, and nature recreation. This ensures that the local economy stays strong even during warmer winters, and tourist flows remain consistent.

Reducing disaster risks: communities are increasing safety by monitoring glacial lakes and building protective infrastructure. Early warning systems are now used to alert people about potential floods or avalanches, giving them time to evacuate or prepare.

Cooperating on water use: since mountains provide water for everyone, mountain and lowland communities are working together more closely. By sharing resources, they can better plan and manage irrigation, drinking water, and energy production, at the same time, preventing conflicts over water shortages.

Mountains bring together weather, water, and human life in one place. When climate patterns shift, both mountain ecosystems and mountain economies must adjust at the same time. The earlier these changes are planned, the more options communities keep for the future.

2.8 How climate change affects the Arctic region



The Arctic is Earth's northern polar region. It includes the Arctic Ocean, surrounding seas, islands, and the northernmost parts of Eurasia and North America. The region includes territories belonging to Russia, the United States (Alaska), Canada, Norway, Sweden, Finland, Iceland, and Denmark (Greenland).

Over the last decades, the Arctic has been warming nearly four times faster than the global average. As the climate warms and snow and ice melt, they reveal ocean water or bare ground underneath. Unlike white snow cover, these darker surfaces absorb more solar energy rather than reflecting it back into space. This, in turn, accelerates the warming and leads to even further melting.

Another important process involves clouds and moisture. As ice melts and open water areas increase, evaporation rises forming more clouds. These clouds trap heat, especially during long polar nights, preventing warmth from escaping into space and further increasing temperatures.

Weather conditions in the Arctic are also becoming more unstable. Sudden temperature changes can reach up to 20°C, and strong winds make the cold feel more severe. As the ground freezes and thaws repeatedly, infrastructure like roads and buildings can weaken and deteriorate more quickly.

The impact of climate change on the Arctic region

Rapid climate changes affect ice, land, oceans, wildlife, and the lives of people who depend on Arctic ecosystems.

Wildlife under pressure

Many Arctic animals depend on sea ice for hunting, resting, or raising their young. When ice disappears or becomes unstable, their survival strategies are disrupted.

Polar Bears Rely on sea ice to hunt seals. As ice retreats, some bears must travel much longer distances to find food, exhausting their energy. Even if adults are strong enough to make this journey, many cubs aren't.



Walruses rest on sea ice during migration. As ice shrinks, they are forced to gather on land. This overcrowding makes them more vulnerable to predators and can lead to deadly stampedes if they are startled.



Seal pups are at risk when meltwater forms pools on the ice. While their white fur keeps them warm, it does not protect them from getting wet - if they get soaked in meltwater, they can freeze.



Reindeer face a different problem called "rain-on-snow" events. Frequent freeze–thaw cycles create a hard layer of ice over the vegetation, making it hard for animals to reach the plants they need for food.



Melting ground: permafrost



Large parts of the Arctic are covered by permafrost, ground that has remained frozen for thousands of years. Rising temperatures cause this frozen soil to thaw. When permafrost melts unevenly, the ground can collapse or sink. Roads, railways, pipelines, and buildings may crack or tilt as the ground shifts beneath them. Furthermore, thawing permafrost releases greenhouse gases such as methane, which further strengthens global warming.

Economic and cultural threats

Indigenous peoples, including Nenets, Inuit, and other Arctic communities, have developed ways of life closely connected to nature. Hunting, fishing, and reindeer herding depend on predictable ice conditions and seasonal patterns.

Thinner ice, shifting and disappearing migration routes, and unstable weather make travel and traditional activities more dangerous and less reliable. As a result, some communities must adapt their livelihoods or seek new economic opportunities to survive in a changing landscape.

How people can adapt to changing Arctic conditions

Because climate change cannot be stopped quickly, the focus has shifted toward practical engineering and social adaptation measures to survive these new conditions in the Arctic region.

Engineering and infrastructure



Engineers use innovative methods to protect buildings and roads from thawing ground. For example, thermosiphons (vertical tubes filled with cooling substances) help transfer winter cold into the soil to keep permafrost frozen. Buildings are often raised on piles driven deep into the more stable frozen ground, while roads are built on elevated embankments with ventilation ducts to keep the soil beneath them cool.

Infrastructure can also be designed to support wildlife. Elevated pipelines, for instance, may include special passages that allow reindeer to continue their traditional migration routes.

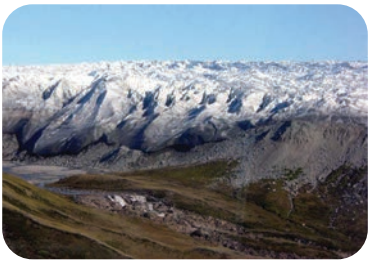
Managing risks for wildlife and people

Some adaptation measures focus on reducing conflicts between humans and animals. In certain Arctic settlements, food waste is stored far from villages so that hungry polar bears are not attracted to human areas. Monitoring animal movements and using non-lethal deterrents (like lights or noise) help prevent dangerous encounters.

As Arctic shipping increases due to longer ice-free periods, new safety rules become essential. Ships may need special

equipment, rescue systems, and updated navigation routes to avoid drifting ice and sensitive wildlife habitats.

Supporting communities



Social adaptation is equally important for the people living in the North. Expanding healthcare access, improving energy systems, developing eco-tourism, education and providing climate information can help Arctic residents adjust to changing conditions. In extreme cases, where coastal erosion or ground collapse becomes too severe, entire communities may need to relocate to safer areas.

Changes in the Arctic show how quickly the climate system can transform when temperatures rise. Melting ice, shifting landscapes, and new challenges for wildlife and people reveal a region in transition — one that is closely connected to environmental changes across the entire planet.

2.9 How climate change affects cities and human health

For most of human history, people lived in rural areas or small towns, while cities developed as centers for trade, government, and protection. From the late 19th century onward, a rapid shift called urbanization began as millions of people moved to cities in search of industrial jobs and new opportunities.

Today, more than half of the world's population lives in cities. These urban centers continue to act as hubs of safety, innovation, and trade, attracting people from rural areas across the globe. The global urban population reached the 50% mark in 2008. By 2024, over 4.7 billion people -nearly 57.7% of humanity - lived in urban areas, and this number continues to grow.

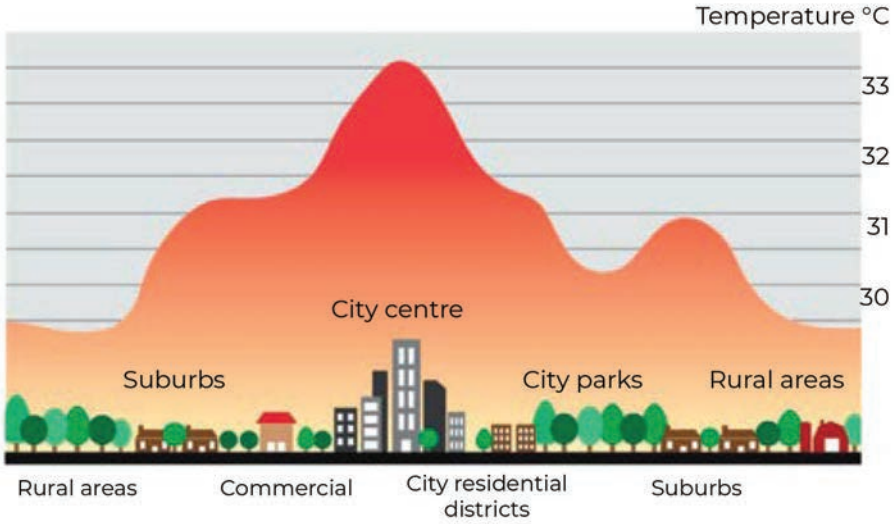
Because so many people now live in cities, understanding how climate change affects urban areas is increasingly important.

Urban heat island

Cities are often warmer than the surrounding countryside. This effect is known as **the urban heat island**. Many people notice it in everyday life — for example, city streets may stay hot long after sunset, while nearby rural areas cool more quickly.

Urban heat islands form because of how cities are built and how people use energy. Buildings, roads, and dark roofs absorb sunlight during the day and slowly release heat at night. Traffic, industry, and air conditioning add extra warmth to the air. At the same time, cities usually have fewer trees, soil, and open water than natural landscapes, which reduces shade and natural cooling.

Because of these factors, temperatures in city centers are often about 1–4°C higher than in nearby rural areas. During the night, this difference can reach as much as 5–8°C. As global temperatures rise, this effect becomes stronger, making hot days and nights more difficult for city residents and increasing risks to health and infrastructure.



Air temperature distribution over a city (urban heat island)

The impact of climate change on human health and daily life

Climate change affects health by changing the conditions we live in, often making people sick or unsafe. Because of the heat island effect, cities are warming faster than the global average, making urban populations particularly vulnerable. Beyond direct heat, warming temperatures cause a range of interconnected issues:

Heatwaves: heatwaves are becoming more frequent, intense and lasting longer. Nights remain warm, preventing the body

from recovering from daytime heat. High temperatures combined with urban heat islands create dangerous conditions, particularly for older people, children, and people with chronic illnesses. In the summer of 2022, extreme heat caused approximately 62,000 deaths in Europe, primarily among those over age 65.



Air quality: climate change also affects the quality of the air people breathe in cities. During very hot days, there is often less wind, and the air moves slower. Tall buildings can also block airflow, reducing air circulation between streets. As a result, pollution from traffic and other sources may build up instead of being carried away, making the air harder to breathe. Warmer temperatures can also extend the flowering season of many plants, increasing the amount of pollen in the air. This may lead to stronger allergy symptoms and breathing difficulties for some people, especially children, older adults, and those with asthma or other respiratory conditions.



Spread of infectious disease: climate change allows disease-carrying organisms, such as mosquitoes and ticks, to expand into new regions. Diseases like dengue fever, malaria, and tick-borne encephalitis are appearing in areas where they were previously rare or unknown.

Water safety and food security: floods can damage sewage systems and contaminate drinking water, increasing the risk of diseases. At the same time, climate impacts on agriculture

may affect food availability and prices, indirectly influencing nutrition and health.

Economic strain: heat, floods, storms, and other extreme events can damage transport systems, power grids, and buildings. Rising temperatures accelerate wear on roads and infrastructure, increasing maintenance costs, and disrupting everyday life.

How people and cities can adapt

To continue living comfortably in this warming world, we must adapt. Solutions combine individual actions, urban planning, and nature-based approaches.

Simple habits help reduce risk during hot weather:

- Wear light, breathable clothing and drink plenty of water throughout the day.
- Limit exposure to direct sun, especially during peak hours (usually from 12:00-17:00).
- Seek shaded or cooled spaces whenever possible to give your body a break from the heat.
- Choose lighter foods, like fruits and vegetables, over heavy meals which can be harder to process in the heat.





- Reduce heavy physical activity during extreme heat to avoid heatstroke or exhaustion.

To combat the “urban heat island” effect, cities around the world are using new designs and technologies:

Nature-based solutions: parks, trees, and urban forests cool cities by providing shade and releasing moisture into the air. Green roofs and vertical gardens act as a layer of “living insulation,” preventing buildings from soaking up solar heat. Water features, like fountains and artificial ponds, also contribute to local cooling when designed sustainably.

Smart infrastructure: reflective building materials (light roofs) and better insulation reduce overheating. Cities are also improving drainage systems to handle heavy rains and designing energy-efficient housing that stays cool without needing constant air conditioning.



Living in cities means that our everyday choices can help people stay safe and reduce climate risks. During hot weather, choosing shaded routes, drinking enough water, and checking on younger or older family members can make a real difference. Walking, cycling, or using public transport, when possible, helps keep city air cleaner and cooler. Caring for green spaces, planting trees, and saving energy at home are small actions that, together, help cities become healthier places to live as the climate continues to change.

2.10 | How climate change affects social problems

Global inequalities: different worlds

There are about 200 countries in the world, and all of them differ in geography, climate, population, economy, history, and living standards. To understand how climate change affects different parts of the world, we need to look at how countries are grouped based on their economies and resources:

Developed countries are places with strong, stable economies. Most people here have access to steady jobs, safe housing, clean water, schools, and modern hospitals. Because they have more resources, they often find it easier to build resilience against climate change.

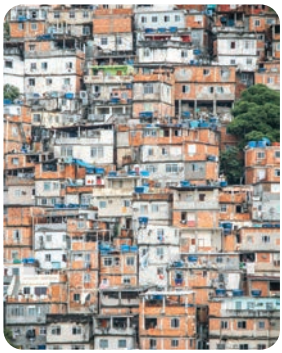
Developing countries are still building their economies and improving life for their citizens. In these areas, many families may still lack access to high-quality healthcare, stable jobs, or modern infrastructure. Finding resources for adaptation may be challenging for them.

Emerging economies are developing countries that are growing very fast. They are rapidly building new factories, businesses, and cities. Because of this fast growth, they are becoming very important players in the global economy. However, in general these growing activities emit a lot of greenhouse gases contributing to climate change.

Least developed countries are the most vulnerable countries in the world. Many of these are located in Africa and Asia, or are small island nations. In these regions, many people struggle daily to access basic needs like nutritious food, clean water, and medical care. These countries often have the fewest resources to deal with climate disasters.

Inequality and climate responsibility

By 2023, the world's population exceeded eight billion. However, there is a massive difference in how resources are used across the globe:



The population gap: about 83% of the world's population lives in developing countries, while only 17% live in developed countries.



The consumption gap and carbon footprint: despite being a small minority, people in wealthier countries consume a much larger share of the world's energy and resources. The world's highest energy consumers include Iceland, Norway, Canada, the USA, and wealthy Middle Eastern states such as Oman, Saudi Arabia, and Qatar. In these countries, the average person may consume up to 100 times more resources than someone in a poorer country. This means people in developed countries have a much larger carbon footprint and bear greater historical responsibility for greenhouse gas emissions.

This situation is sometimes described as climate injustice. It highlights the fact that the people who have contributed the least to global warming, often those in the least developed countries, are frequently the ones who suffer the most from its effects, such as droughts, floods, and food shortages.

Climate injustice: making social problems worse

Climate injustice means people who are least responsible for global warming often suffer the most from its effects. Some regions are naturally more at risk than others, such as coastal areas, the Arctic, mountain regions, and agricultural regions. However, social factors also play a huge role in vulnerability.

In many lower-income countries, people rely heavily on farming for survival. When climate disasters strike, their income and food supply are often affected immediately:

- Droughts can destroy an entire season of crops, leading to hunger and economic losses;
- Floods can wash away homes, livestock and fertile soil;
- Storms can destroy basic infrastructure (roads, wells, power lines), isolating communities.



Even within a single community, some people are affected more than others:

Women: especially in rural areas of developing countries, women are often responsible for growing food, collecting water, and managing the household. When water sources dry up or crops fail, their workload increases and their security is threatened.



Children and older people: these two specific groups are often more physically vulnerable. Extreme heat, poor air quality, and waterborne diseases spread through floods affect their overall health much more severely than healthy adults.



People with disabilities: during severe disasters like floods or storms, people with limited mobility or other disabilities may often find it much harder to safely evacuate or access vital emergency services, making them particularly at risk.

Displacement: climate migration and new conflicts

Climate change is already forcing many people to leave their homes. Rising sea levels, droughts, and stronger storms can make some areas difficult or even impossible to live in. Scientists estimate that by 2050, hundreds of millions of people could become climate migrants.





What can cause people to move

Coastal flooding: low-lying river deltas and coastal regions may be permanently flooded as sea levels rise, forcing millions to move inland.

Disappearing islands: some small island nations face the risk of losing their entire land area to the ocean. If sea levels continue to rise, citizens of these nations will have to find new places to call home.



Agricultural failure: frequent and severe droughts can make farming impossible, pushing many rural families to move to larger cities in search of work and food.



When people are forced to move, they often face new challenges in the places where they arrive. It may be difficult to find safe housing, stable work, or access to schools and healthcare. Local communities may also need time and resources to support newcomers. If this process isn't managed well, it can increase social pressure and sometimes lead to inequalities for both new and existing residents.

Climate change can also increase tensions between people, communities, and even countries. Competition for water, fertile land, or energy resources may grow stronger as environmental conditions change. Regions already facing economic or political challenges may experience increased instability if climate impacts reduce food production or access to resources.

Solutions and international cooperation

Reducing the social impacts of climate change requires strong international cooperation. Vulnerable populations need support through job creation, education and retraining, disaster preparedness, climate-resilient agriculture, and early warning systems.

However, lower-income countries often lack financial means to implement these measures on their own. For this reason, international climate funds, development aid, and assistance from developed countries, global institutions, and the United Nations are essential. This assistance helps ensure that progress in poverty reduction continues and that sustainable development is accessible for everyone, regardless of their wealth.

By working together, countries can share knowledge, technology, and financial support, helping reduce social risks and protect vulnerable populations.

Young people can also play an important role in promoting fairness and supporting climate action. You can help build a more resilient world by:

- Learning how climate change affects different regions and communities beyond your own.
- Using resources, like water and energy, wisely, and reducing waste.
- Showing empathy and respect toward people affected by environmental changes.
- Participating in school or community projects that promote sustainability.

Small actions, when multiplied by many people, can help build a more just and resilient world for everyone.



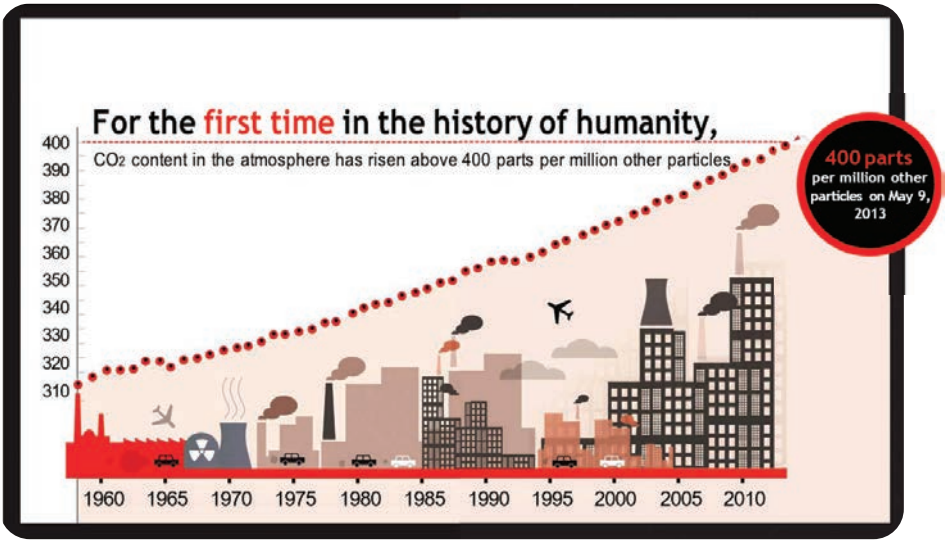
3

How to prevent dangerous climate change

3 How to prevent dangerous climate change

You already know that the amount of greenhouse gases in the atmosphere has been increasing rapidly in recent decades. This increase is mainly caused by human activities, especially the burning of fossil fuels, such as coal, oil, and natural gas.

Carbon dioxide (CO_2) is one of the main greenhouse gases. Over the course of Earth's history, its amount in the atmosphere changed slowly and stayed within a natural range. In recent decades, however, this balance has been broken. The concentration of CO_2 has risen to levels not seen in the past hundreds of thousands of years, and this increase continues.



Growth of CO_2 concentrations in the atmosphere since 1960

People around the world constantly use massive amounts of energy to produce electricity, build houses, travel, grow food, and manufacture consumer goods. Most of this energy still comes from burning fossil fuels. Greenhouse gases continue to accumulate in the atmosphere because the amount we release each year is greater than the amount that forests, soils, and oceans can naturally absorb.





Leading global scientists warn that the rate of current climate change is unprecedented, and average temperatures are now very close to levels that are considered highly dangerous for both nature and people.

To prevent the most dangerous impacts of the changing climate, we must quickly and significantly reduce our greenhouse gas emissions to the amount that nature can absorb. Scientists agree that to limit global warming to 1.5°C, the world needs to greatly reduce CO_2 emissions and reach net zero around 2050. This means cutting emissions as much as possible and removing the remaining CO_2 from the atmosphere, so that we take out as much as we release. Although many countries have begun reducing emissions, the progress is still too slow. Major changes are needed in energy systems, industry, transport, and even our daily lifestyles.

There are three main ways to reduce the amount of greenhouse gases in the atmosphere:

1. Switch to clean energy.



Renewable sources such as solar, wind, and hydropower produce far less emissions than fossil fuels. Nuclear energy can also help if used safely.

2. Use energy more efficiently.



Improving building insulation, using more efficient technologies in industry, expanding electric cars and buses, and saving energy and water in daily life help decrease energy consumption.

3. Remove CO_2 from the air.



Forests, soils, oceans and wetlands naturally absorb carbon dioxide. Protecting and restoring these ecosystems, improving farming practices, and developing technologies that allow capturing and storing carbon dioxide may help remove some of the carbon that has previously been emitted.

Climate change is a global challenge that requires cooperation among governments, businesses, and citizens. Only through collective action can we reduce risks and protect the planet for future generations. In the following sections, we will explore these solutions.

3.1 | Where does the energy come from?

What is energy?

Have you ever wondered where electricity comes from when you turn on a light, charge your phone, or switch on a computer? Most of us rarely think about it — energy simply feels like something that is always there. But behind every glowing lightbulb, moving train, or working machine is a system that uses energy. For example, to make a chocolate bar, energy is needed to grow cocoa beans, transport them to the factory, mix, mold and wrap the chocolate.

We use energy to heat our homes, cook food, travel, build cities, and produce everything from clothes to smartphones. Our own bodies also need energy to grow, move and stay healthy. We get it from food.

For many years, people relied mostly on fossil fuels for their energy supply. But there is a problem: burning these fuels releases a large amount of greenhouse gases that warm the atmosphere and accelerate climate change. As our lives change, and we use more and more energy every day, how we make that energy matters more than ever.

Today, scientists, engineers, and communities around the world are working to change how we produce energy. They are developing cleaner solutions that can reduce emissions and slow global warming. These solutions are often called green energy.

Main sources of energy

Energy comes in many forms, like heat, electricity, movement, and light. Around the world, we use energy to light and heat homes, power transport, and run factories.

This energy comes from two main types of sources: **non-renewable and renewable.**

Non-renewable energy sources include coal, oil and natural gas. These resources formed over millions of years from ancient plants and tiny organisms that were transformed by heat and pressure underground. Because they take such a long time to form, once used they cannot be replaced quickly.

For more than a century, fossil fuels have been the main sources of energy in most countries. They have provided powerful and reliable energy for electricity, heating, transport, and industry. However, as we already know burning these fossil fuels releases large amounts of carbon dioxide, contributing to climate change.

Another important non-renewable source is nuclear energy. Instead of burning something, this energy comes from tiny particles called atoms. Inside a nuclear plant, these atoms are split to make huge amounts of heat and electricity, without releasing carbon dioxide. However, nuclear power brings big challenges. The process requires much water to prevent overheating. These plants create radioactive waste that stays dangerous for thousands of years, so it must be carefully stored and watched to keep everyone safe.

Renewable energy comes from natural processes that are constantly renewed by nature itself. These valuable sources include clean power from the Sun, wind, flowing water, and heat from inside the Earth.

Because these sources are naturally replenished and generally produce far fewer greenhouse gases than fossil fuels, renewable energy is becoming increasingly important around the world.

What makes energy “green”?

Even “green” energy isn’t perfect – every single way we make power affects nature in some way. Solar panels require raw materials and take up a lot of space, huge wind turbines change landscapes and affect local wildlife, and dams can affect river flows and fish habitats.

The key difference is that green energy produces much less pollution and emits far fewer greenhouse gases than fossil fuels. This makes it one of the most important tools for reducing climate change.

Non-renewable energy

Fossil fuels

Fossil fuels - coal, oil, and natural gas - formed millions of years ago from the buried remains of ancient plants and tiny organisms. Over time, heat and pressure deep underground transformed these remains into the fuels we use today.



In power plants, fossil fuels are burned to heat water and produce steam, which turns turbines to generate electricity. Some plants also supply heat to nearby buildings, increasing efficiency.

For more than a century, fossil fuels have been the main source of energy for modern societies. Because they contain large amounts of energy and are relatively easy to store and transport, fossil fuels helped power the Industrial Revolution and the rapid development of modern economies.

However, fossil fuels have two major disadvantages:

1. **Fossil fuels are finite.** They take millions of years to form and are being used faster than they can be replaced.
2. **Burning fossil fuels releases carbon dioxide (CO_2)** and other pollutants into the atmosphere. Carbon dioxide is one of the main greenhouse gases that trap heat around the Earth. While the natural greenhouse effect keeps our planet warm, adding too much CO_2 strengthens this effect and contributes to climate change. Air pollutants from burning fossil fuels can also harm ecosystems and affect human health.

You might wonder why people rely heavily on fossil fuels despite their serious impacts. They provide reliable energy whenever needed. Since many power systems, industries, and transport networks were built around them, switching is difficult and costly.

However, reducing reliance on fossil fuels is essential for protecting the climate. For this reason, many countries are working to gradually replace them with cleaner and more sustainable sources of energy.

Nuclear energy



Another important source of energy is nuclear power. Unlike fossil fuels, nuclear power plants do not burn fuel. Nuclear power plants use energy stored inside atoms to produce heat. The heat is then used to generate electricity.

A small amount of nuclear fuel can produce a very large amount of energy. Nuclear power plants generate electricity without releasing greenhouse gases during operation, which makes nuclear energy an important option for countries trying to reduce climate change.

However, nuclear energy also presents important challenges. Nuclear power plants require strict safety measures, and the radioactive waste they produce must be carefully stored for long periods of time. Although accidents are rare, they can have serious consequences for people and the environment.

Renewable energy

Renewable energy comes from abundant natural sources that are constantly renewed by nature itself. These include sunlight, wind, flowing water, geothermal heat, and organic materials such as plants and agricultural waste. They are often called green energy because they produce far fewer harmful greenhouse gas emissions and play an increasingly important role in global efforts to slow climate change.

In 2025, renewable sources produced about 34% of global electricity, more than coal for the first time, and in many regions they are now more affordable than fossil fuels.

Solar Energy



The Sun is a huge natural source of heat and light, and every day it sends enormous amounts of energy towards Earth. People have learned how to use this energy to produce electricity and heat. Technology called **solar panels** collects sunlight and converts it into electricity. These panels are often placed on the roofs of buildings, but they can also be installed on the land or even on water.

Solar energy has many advantages. Because it comes directly from the Sun, it is clean and safe to use, and it is available in many parts of the world. By using solar panels, homes, schools, and communities can produce their own electricity, reduce energy costs, and rely less on fossil fuels.

However, solar energy also has some challenges. Solar panels work best when the Sun is shining. On cloudy days, and especially at night, they produce very little electricity or none at all. To solve this problem, solar systems often use large batteries to store the extra energy produced during sunny periods. This way, we can still turn on the lights and heat our water after the Sun goes down! Solar energy can also be combined with other sources of energy to make sure we always have enough.

Today solar power is one of the fastest-growing sources of electricity in the world. As technology continues to improve, solar panels are becoming more efficient and affordable, helping more countries move toward cleaner and more sustainable energy. However, we also face the challenge of what to do with solar panels when they get too old to work. Because they are made of glass, metal, and special materials, scientists are working hard to find better ways to recycle them so they don't become wasted trash.

Wind Energy

Wind energy comes from moving air. People have used the power of wind for centuries, for example to move sailing ships or turn windmills.

Today, we use huge wind turbines to produce electricity. When the wind blows it turns the turbine's blades, which in turn spin the generator inside, which produces electricity. Wind turbines are often built in groups called wind farms, which can be located on land or out in the sea.



Wind energy is clean and renewable, and it does not produce any harmful greenhouse gases during operation. In many places, it is one of the cheapest ways to make electrical power. However, wind turbines mostly spin during strong and steady winds, so we often need batteries or other backup energy sources to help us when the air is still.

We also have to be careful where we build them. Because the spinning blades are so large, they can sometimes get in the way of bird migration routes and building them in the sea can affect marine habitats.

Water Energy



Both rivers and waterfalls contain a lot of energy, as water flows from higher to lower places. People have used the power of water for hundreds of years to turn water wheels and operate various mills.

Today hydropower plants use flowing water to spin large turbines that generate electricity. Hydropower is currently the largest source of renewable electricity in the world. It produces around one-seventh of global electricity and almost half of all electricity from renewable sources.

Hydropower can generate large amounts of electricity with low greenhouse gas emissions. However, building dams can change river ecosystems and affect fish and other wildlife. Today, this is even more of a challenge, as climate change affects where and when it rains or snows and reduces river flows. For this reason, new hydropower projects must be carefully planned to reduce environmental impacts.

Geothermal Energy

Geothermal energy comes from the heat inside the Earth. Deep below the surface, the Earth's interior is extremely hot. In some places this heat warms underground water, creating hot water and steam.

People can use this heat to produce electricity or to heat many different types of buildings. In geothermal power plants, hot water or steam from underground is brought to the surface and used to spin large turbines that generate electricity. In some regions geothermal heat is also used directly to heat local homes, greenhouses, and swimming pools.

Geothermal energy is reliable because heat from inside Earth is always available. It produces very little greenhouse gas emissions and can provide energy day and night. However, geothermal power plants can only be built in places where underground heat is close enough to the surface.

Biomass Energy

Biomass energy comes from organic materials, like wood, leftover crops, even manure, and food waste. These materials store energy from the Sun because plants use sunlight to grow, storing that power inside them, much like a battery.



We can also use different types of biomass to produce heat, electricity, or fuels. For example, we can burn wood and everyday agricultural waste to generate heat and electricity. Food waste and manure can be processed to produce biogas, a useful fuel that can be used for cooking, heating, or generating electricity.

Using biomass is a great way to recycle waste! However, it must be used carefully. If we cut down too many trees we can harm our forests and all its wildlife. It's much more sustainable

to use food scraps, farm waste and crop leftovers that would otherwise just be thrown away.

Ocean Energy (Wave and Tidal Energy)

Oceans also contain large amounts of energy. Wave energy comes from the movement of waves on the surface of the sea, while tidal energy is produced by the daily rise and fall of ocean water caused by the powerful gravity of the Moon and the Sun.



Special technology placed in the sea can capture this constant movement and convert it into electricity. This is a great way for countries with long coastlines to get clean power. Ocean energy is renewable and does not produce greenhouse gases during operation. However, the technology is still expensive and can be difficult to install and maintain in these harsh ocean conditions.

Why do we use different energy sources?

No single energy source works perfectly everywhere. Some regions receive a lot of sunshine but have little wind. Others have strong rivers that can be used for hydropower, or underground heat suitable for geothermal energy. In some areas, biomass from agriculture or forests is also available.

Because of these natural differences, countries usually use a combination of several different energy sources. This helps ensure that electricity is always available whenever people need it. For example, solar panels produce energy during

sunny days, wind turbines work when the wind blows, and other extra sources can provide electricity when renewable energy is temporarily limited.

There is no single "perfect" energy source. Each option has advantages and limitations. When planning energy systems, countries must consider several key factors:

- **Reliability and stability.** Can the energy source provide a steady supply when needed?
- **Cost.** What are the expenses of building, operating, maintaining, and eventually closing the system? Are there hidden long-term costs?
- **Environmental and social impact.** How does the energy source affect air, water, land, wildlife, and local communities over time?
- **Safety.** What are the risks of accidents, pollution, or long-term harm to human health?
- **Resource availability.** Are the necessary resources available locally, or does the country depend on imports?

For all these reasons, modern energy systems usually use a mix of different energy sources. Because electricity supply must always match demand, countries combine sources such as solar, wind, hydropower, nuclear energy, and fossil fuels to ensure that electricity is available at all times.

New technologies are also helping to improve energy systems. Energy storage, such as batteries, allows electricity produced during sunny or windy periods to be stored and used later. Smarter electricity grids help manage the flow of power and make energy supply more stable.

Energy choices also depend on geography and economic capacity. Each country develops an energy system that reflects its natural resources, economic possibilities, and environmental responsibilities.

The future of energy is not about choosing a single “best” source. Instead, it is about building a balanced and flexible energy mix that provides reliable electricity while reducing pollution, emissions and protecting the environment.



3.2 | Energy Efficiency and Energy Saving

In the previous section, we looked at different energy sources and how some of them can reduce harm to the environment and the climate. However, choosing cleaner energy sources is only part of the solution. Another important step is reducing the amount of energy we use.

In this chapter we will explore two closely related ideas: **energy efficiency and energy saving.**

Energy efficiency means using less energy for the same task. For example, two lamps give equal brightness, but one uses less electricity, making it more efficient.

Energy saving means changing behavior to reduce energy use. Many simple everyday actions help save energy, including:

- Turning off lights when they are not needed.
- Using energy-efficient bulbs, such as LEDs.
- Walking or cycling instead of driving.



- Closing taps while brushing your teeth, (pumping water to our homes, requires energy too!).
- Switching off devices, instead of leaving them on standby.

Small actions may seem unimportant, but when millions of people do them every day, the results are significant. For example, leaving a tap running wastes both water and the

energy required to pump and deliver that water to homes. Electronic devices like our TVs, computers, and chargers continue using electricity when they are left on standby mode, even though they appear to be turned off. When such habits are multiplied across millions of households, the amount of total wasted energy becomes enormous.

Although energy-efficient technologies already exist, they are not always widely adopted. Replacing older appliances requires time, money, and motivation. Despite these challenges, improving energy efficiency brings many benefits. It helps families reduce electricity bills, allows companies to save energy and resources, and helps countries reduce greenhouse gas emissions.

Environmentally friendly transport

Transport is an important part of modern life, but it also has a strong impact on the climate. Cars, trucks, ships, and airplanes burn large amounts of fuel. As a result, transport produces about 15% of global greenhouse gas emissions.

Burning one liter of petrol releases about 2.3 kg of CO_2 into the atmosphere. Over a year, an average car emits several tonnes of CO_2, along with pollutants that affect air quality and human health. When emissions from fuel extraction, refining, and transport are included, the total environmental impact becomes even greater.

Different types of transport emit varying amounts of greenhouse gas. Rail travel is among the most climate-friendly options, while air travel produces the highest emissions per passenger/kilometer. Road transport is a major source of transport emissions, and passenger cars and vans account for a large share of road emissions.

There are several ways to reduce emissions from transport:



Use public transport. Use public transport whenever you can. Trains, buses, and the metro are like “giant carpools”. They carry many passengers at once and use much less energy per person than private cars.



Walk or cycle when possible. Walking and cycling are the most environmentally-friendly ways to travel around the city. Replacing some car trips with bicycle journeys can significantly reduce greenhouse gas emissions while also improving health.

Meet online. Video calls and digital communication can sometimes replace business and even personal trips.

Adopt eco-driving practices. Driving smoothly, maintaining proper tire pressure, avoiding sudden acceleration and braking, and turning off the engine during long stops help reduce fuel consumption and thus emissions.

Share rides: Carpooling is when several people ride in one car instead of everyone taking their own. This reduces emissions per person. Plus, fewer cars on the road means lighter traffic. When cars aren’t stuck in traffic jams, they don’t waste as much fuel.

Choose cleaner vehicles: Electric and hybrid cars and buses produce fewer emissions than traditional petrol or diesel ones.

By choosing more sustainable ways of travelling, people can help reduce pollution, protect the climate, and make cities cleaner and healthier places to live.

Household appliances and electrical devices

Many household appliances use electricity every day. Refrigerators, washing machines, televisions, computers, and lighting require energy to operate. Choosing more efficient appliances can reduce electricity consumption at home.











To help people make better choices, many countries use energy efficiency labels. These labels show how much electricity an appliance uses and how efficient it is compared to similar products. In the European Union, such labels have been required for many household appliances and light bulbs since 1995. Other countries use similar labels, such as Energy Star in the United States. They identify products that meet high energy-efficiency standards and help consumers select appliances that work well while using less energy.

Appliances with higher efficiency ratings use much less electricity than older or less efficient models. Imagine, an old refrigerator may use twice as much electricity as a modern energy-efficient model!

Over time, these programs have helped reduce electricity consumption, lower household energy costs, and decrease greenhouse gas emissions. Today, energy-efficiency labeling systems exist in over 120 countries and play an important role in climate and energy policy.

However, when new technologies are introduced, scientists also study their possible effects on human health and the environment.

This does not mean that new technologies should be avoided. Instead, they should be carefully tested and improved as scientific knowledge develops. When used responsibly, energy-efficient appliances help reduce energy consumption, protect the climate, and make our homes more sustainable.

Green construction: passive and active buildings

Everyone needs a safe place to live, but our buildings consume a large share of global energy. Heating, cooling, lighting, and using electrical appliances all require energy. Designing energy-efficient buildings is therefore essential.

Long before modern technology existed, people already built homes adapted to the local climate. Traditional houses were designed to keep heat inside during cold weather or stay cool in hot climates using natural materials and simple techniques.

Interest in modern energy-efficient buildings increased sharply after the oil crisis of the 1970s, when energy prices

rose sharply. Architects and engineers began developing new technologies to reduce the amount of energy buildings need.

Today, green construction aims to reduce use of energy and other resources throughout a building's life — from construction to everyday use and even demolition. Although green buildings may cost more to build, the extra cost can often be recovered over time through lower energy bills.

Energy-saving buildings are often classified as **passive and active buildings.**

Passive Buildings

One of the main goals of a passive building is to reduce energy loss, especially in colder climates. A well-designed passive house keeps heat inside so effectively that it needs very little additional heating. In some cases, the heat produced by household appliances or sunlight can provide much of the warmth inside the building.

Passive buildings use very good thermal insulation in their walls, floors and roofs. This effectively prevents indoor heat from escaping during the cold winter months and keeps the building much cooler during the hot summer.

Windows are an important part of passive design. Modern windows are double or triple glazed and tightly sealed. Window size, orientation and shading are designed according to the local climate — to use sunlight for warmth where helpful and reduce overheating where necessary.

Passive buildings use efficient ventilation systems. In winter, warm air leaving the building warms the cooler air coming

inside through a special device called a heat exchanger. This helps keep air fresh without having to turn up the heater.

Today, people use these ideas in many countries around the world. Although the designs may differ depending on climate, the main goal remains the same: to create comfortable buildings that use as little energy as possible.

Active Buildings

Active buildings combine the ideas of energy-saving design with technologies that produce clean energy.

Like passive buildings, they use good insulation, efficient windows, and careful building design to reduce energy loss. However, active buildings also include systems that generate energy from renewable sources, such as solar panels, solar water heaters, or geothermal heat pumps.



In some cases, active buildings can produce as much renewable energy as they use, or even more. When this happens, extra electricity can be stored or sent back to the power grid, generating income.

Modern active buildings often use smart technologies to manage energy use. Sensors and control systems can automatically adjust heating, cooling, lighting, and ventilation. This helps keep the indoor environment comfortable while reducing energy consumption.

Many countries are working to improve building efficiency. For example, new European regulations aim for all new buildings to produce very low emissions by 2030, and for most buildings to become climate-friendly by 2050.

Green cities

Cities play a crucial role in addressing environmental challenges because more than half of the world's population already lives in urban areas, and this share continues to grow. As a result, many cities are now being designed and developed with environmental goals in mind. This type of city is called "green" cities. Imagine a city designed in harmony with nature, where people use resources carefully and work together to protect the environment.

A green city aims to reduce overall environmental impact while providing a high quality of life for its residents. Energy is produced mainly from clean renewable sources, waste is recycled and reused, and buildings are designed to use as little energy as possible. Public transportation, walking, and cycling are highly encouraged to reduce emissions, pollution and traffic. Although transforming an entire city takes time, many places around the world are already moving in this direction.



Sherford, UK. This large eco-town merges sustainability with traditional design. Local materials reduce emissions, the walkable layout promotes car-free travel, and solar energy powers affordable, sustainable housing.



Vancouver, Canada. The city has set an ambitious goal to become the world's greenest city. It is expanding green spaces, improving public transportation, and working toward incorporating renewable energy sources.

Samsø, Denmark. This remarkable island community transformed its entire energy system within a span of just ten years. By installing both onshore and offshore wind turbines and utilizing biomass for heating, Samsø now produces more electricity than it consumes and uses renewable energy for much of its heating.



Masdar City, UAE. Located in the heart of the harsh desert, Masdar is a true model of sustainable urban living. The city relies on clean electric vehicles and walkable streets. Its unique architecture focuses on natural cooling, using shading and wind-flow design to combat the extreme desert heat.



Singapore. Often called the “Garden City”, it features parks, green roofs, and urban forests that improve air quality and reduce heat. The state also promotes public transport and vehicle regulations to cut traffic and pollution.



These examples show that sustainable urban development works across diverse climates and cultures. With careful planning, modern technology, and strong government-citizen cooperation, green cities can become a reality.

3.3 | Carbon footprint and how to reduce it

Carbon footprint



Everything we do, from traveling in a car to watching TV, cooking dinner, or even buying a new pair of jeans, uses energy and natural resources. When this energy comes from fossil fuels, it releases greenhouse gases into the atmosphere. These emissions directly contribute to global climate change. The total amount of greenhouse gases produced by our activities is called “carbon footprint”.

A carbon footprint includes emissions from the energy we use, the food we eat, the products we buy, and the way we travel. Carbon footprints can be calculated for individual people, products, companies, cities, or even entire countries.

For example, the carbon footprint of an apple eaten directly from the tree where it grew is almost zero. An apple grown locally and eaten in season has a relatively small carbon footprint. However, an apple imported from another country and transported over long distances has a much larger carbon footprint.

To make emissions easier to measure and compare, all greenhouse gas emissions are converted into carbon dioxide equivalents (CO_2e). This allows different gases to be expressed using a single common unit.

Examples of carbon footprints

Greenhouse gases from everyday life, in CO_2 equivalent (CO_2e)

FOOD — kg CO_2e to produce 1 kg of food (farm to shop)

Beef	100 kg
Dark chocolate	47 kg
Cheese	24 kg
Pork	12 kg
Chicken	10 kg
Rice	4.5 kg
Beans and lentils	1.8 kg
Potatoes	0.5 kg

1 kg of beef ≈ the footprint of 200 kg of potatoes

TRANSPORT — g CO_2e per passenger for every kilometre

Plane, short flight	250 g
Car, driver alone	170 g
Bus	96 g
Car, 4 people	43 g
Train	35 g
Bike or walking	≈ 0 g

Train instead of plane: about 7 times less

AT HOME — g CO_2e each time we use it

Tumble dryer, 1 load	1 200 g
Washing machine, 40 °C	280 g
Kettle, 1 litre	50 g
Video streaming, 1 hour	36 g
Old 60 W bulb, 1 hour	28 g
LED bulb, 1 hour	4 g

Dry clothes on a line: about 1 kg less every load

THINGS WE BUY — kg CO_2e over the item's whole life

Smartphone	56 kg
Jeans, 1 pair	33 kg
Cotton T-shirt	3.7 kg

About 80% of a phone's footprint comes from making it — keep yours longer!

For comparison: **1 kg CO_2e** is about what a petrol car carrying one person emits over **6 km**.

Global averages, rounded. Real values vary by country, production method and electricity source (home: world-average electricity).

Sources: Poore & Nemecek (2018); UK DESNZ via Our World in Data (2023); Ember (2026); IEA (2020); Apple (2024); Levi Strauss & Co. (2015); TU Berlin (2019).

Carbon footprints include two types of emissions:

- **Direct emissions.** Greenhouse gases are released when fossil fuels are burned directly, for example in car engines, heating systems, or factories.
- **Indirect emissions.** Emissions produced when energy and resources are used to manufacture, transport, and sell the products and services we consume.

Calculating a carbon footprint is not always easy, because there are many factors that must be considered.

To measure the real footprint, you often have to look at:

- **How it was made.** Did the factory use clean power or fossil fuels?
- **How it was transported and from where.** Did it come by an airplane or a slow, clean train?
- **What it's made of.** Does it use natural materials or special plastics that take a lot of energy to create?

Because every product has a different journey, we have to look at the whole picture to understand its impact on our planet.



How can I help the planet?

Reducing your carbon footprint does not always require major lifestyle changes. It begins with awareness and responsible daily habits. The choices we make every day — how we travel, what we buy, how we use electricity and water — all these influence our greenhouse gas emissions.

Even small actions can make a difference. When many people adopt environmentally responsible habits, the positive impact on the planet becomes much greater.

Below are simple ways to reduce greenhouse emissions:

Keeping a comfortable temperature at home

We can keep our homes comfortable while using less energy:

- In extremely hot weather, open the windows at night to let fresh, cool air in and close them in the morning to keep the cool air inside. Use electric fans instead of air conditioners when possible.
- Avoid setting the heating or air conditioning systems too high or too low. Maintaining moderate indoor temperatures is usually much better for our overall health and also helps save energy.
- Improve insulation, seal window and door gaps to prevent heat escaping in winter and entering in summer. Use thick blinds or curtains to block out the strong sunlight in summer and help keep the warmth inside during winter.



- In cold weather, ventilate rooms briefly each day, then close the windows to keep the heat inside. Instead of constantly turning up the heater, dress appropriately for the winter season.
- Make sure furniture does not block radiators or airflow, so warm or cool air can circulate properly.

Transportation



- Walk or ride a bicycle for short distances.
- Use public transportation, such as buses, trains, or the metro.
- Share rides with others instead of traveling alone.
- Avoid unnecessary trips. Combine several errands into one trip to save fuel and time.

Appliances and electronics

- Choose energy-efficient electronics and appliances whenever possible.
- Turn off electrical devices completely when they are not in use.
- Unplug chargers and avoid leaving appliances on standby mode.

Lighting

- Turn off lights when they are not needed.
- Choose energy-efficient (LED) light bulbs.
- Use direct task lighting ("spotlighting") instead of strong ceiling lights.
- Choose light-colored walls and curtains to better reflect natural light.



- Clean windows and light bulbs regularly to maximize the natural brightness.
- Do not block natural daylight from windows.

Cooking

- Use flat-bottomed pans that match the exact size of the stove burner.
- Cover pots with lids to cook food faster and save energy.
- Turn off the stove a few minutes early and let residual heat finish the cooking.
- Use pressure cookers or energy-efficient appliances when possible.
- Soak grains and beans before cooking to reduce time.
- Boil only the amount of water you need.

Refrigerators

- Open the fridge only when necessary, so cold air does not escape.
- Do not put hot food directly inside; let it cool first.
- Keep the fridge reasonably full to maintain a stable temperature.
- Place it away from heat sources such as stoves or sunlight.
- Defrost regularly and store food in covered containers.
- Check that the door closes tightly.

Buying new items

- Think before you buy! Ask yourself if you truly need something, or if you could borrow it instead
- Take care of your things so they last longer.
- If you have toys, books or clothes you don't need anymore, give them to someone who could use them.
- Recycle broken items, you can check if your town has a recycling center.
- Bring your own bags when shopping
- Buy big packages of things that last a long time, it saves money and packaging



Food choices



- Choose local and seasonal food when possible.
- Avoid wasting food! Buy only what you need
- Store food properly so it does not spoil.
- Eat more plant-based foods, they usually have a lower carbon footprint than meat.
- Use reusable bottles, lunch boxes, and containers instead of disposable ones.

Laundry

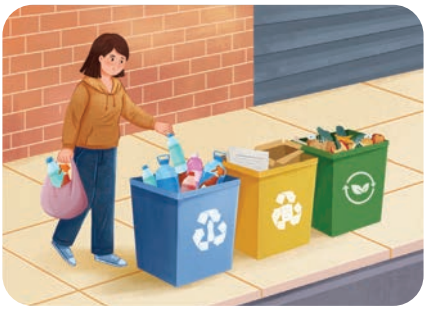
- Wash clothes in cold or warm water, not hot, since it saves lots of power.
- Wait until you have a full load before using the washing machine
- Spread clothes evenly inside so the machine works smoothly and choose the shortest suitable washing program.
- Sort clothes before ironing: start with cool temperatures and finish with hotter ones.
- Hang clothes neatly to avoid extra ironing.

Water saving

- Take short showers instead of baths.
- Don’t waste water! Turn the tap off while brushing teeth or washing food.
- Wash fruits and vegetables in a bowl instead of under running water.
- Fix leaking taps promptly.

Waste and recycling

- Reuse items whenever possible instead of throwing them away.
- Sort waste for recycling if it is available in your area
- Avoid single-use products whenever possible.
- Use both sides of paper before recycling it.
- Compost food scraps if your family has the possibility.





Now take a moment to think about your own daily habits. Which of these actions are already part of your life? Which ones could you start practicing today? Even small changes — such as turning off unused lights, avoiding food waste, or choosing to walk instead of taking a car — can help reduce greenhouse gas emissions. Choose a few actions that are realistic for you and try to make them a new habit.



3.4 Global cooperation on climate change and sustainable development

Climate change affects the entire planet, which means it is a challenge we must face together. Greenhouse gases released in one country spread through the atmosphere and influence the climate everywhere. No single country can solve the problem on its own.

Countries must cooperate to reduce emissions, develop new technologies, and protect the environment. International cooperation allows countries to share scientific knowledge, set common goals, and support each other in taking climate action.

UNFCCC





PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

Key steps in global climate cooperation

Over time, countries have created several important international agreements to address climate change.

1979

First world climate conference

Scientists from many countries met to discuss climate change. The conference showed that human activities could influence the global climate.

1988

Creation of the IPCC

The United Nations (UN) and the World Meteorological Organization created the Intergovernmental Panel on Climate Change (IPCC). The IPCC studies climate science and provides reliable information about how human activities affect the climate.

1992

UN Climate Convention

At the Earth Summit in Rio de Janeiro, countries agreed to work together to address climate change. This agreement created the United Nations Framework Convention on Climate Change (UNFCCC), which became the main international framework for climate cooperation.

1997

Kyoto Protocol

Countries adopted the Kyoto Protocol, which required developed countries to reduce greenhouse gas emissions during the period of 2008–2012.

2015

Paris Agreement

Each country prepares a national climate plan every 5 years, called a Nationally Determined Contribution (NDC).

Climate change and sustainable development

Climate action is closely linked to sustainable development, which aims to improve people's lives while protecting the environment and using natural resources responsibly. It seeks to balance economic growth, social well-being, and environmental protection.

In 2015, all UN member states adopted the 2030 Agenda for Sustainable Development, which includes 17 Sustainable Development Goals (SDGs).

One of these goals — Goal 13: Climate Action - focuses specifically on taking urgent action to combat climate change and its impacts.

Climate action is linked to other goals. For example, Goal 7 promotes access to reliable, sustainable energy. Many people worldwide still lack access to electricity or rely on traditional cooking fuels, causing health and environmental damage. This energy poverty shows how closely energy access, human well-being, and climate action are connected. Expanding clean energy improves lives while reducing greenhouse emissions.

This is just one example, but climate action is connected to many other Sustainable Development Goals. Climate change affects food production, water resources, human health, cities, and ecosystems. For this reason, progress in addressing climate change can support many other global goals, and actions taken to achieve the Sustainable Development Goals can also help protect the climate.



Sustainable Development Goals (SDGs)

Climate action: an effort by the whole society

Addressing climate change requires cooperation between many different groups.

These include:



Governments
Which create laws and international agreements.

Scientists
Who study the global climate and provide knowledge.





Businesses
Which develop new technologies and cleaner energy solutions.

Community organizations
Which support local environmental initiatives.





Young people and citizens
Who raise awareness and promote climate action

Since the Paris Agreement in 2015, thousands of climate initiatives have been launched by organizations, companies, cities, and community groups around the world. By 2023, more than 32,000 initiatives had been registered under the United Nations climate framework.

Young people, in particular, are becoming increasingly active in climate action. Around the world, youth groups organize campaigns, develop new ideas, and encourage communities to take action to protect the climate.

Climate Book

United Nations Development Programme, 2026

Climate Book was developed as part of the Climate Box Educational Programme. It is a shorter and more accessible version of the Climate Box textbook, presenting key topics of climate change in a clear, concise and engaging format.

The book brings together essential climate knowledge, real-world examples, illustrations and practical ideas in an accessible format, helping readers make sense of these complex topics and relate them to the world around them.

Climate Book is designed for children and young people, while also serving as a useful educational resource for teachers, educators, parents and anyone interested in learning more about climate change.

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Illustrations

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