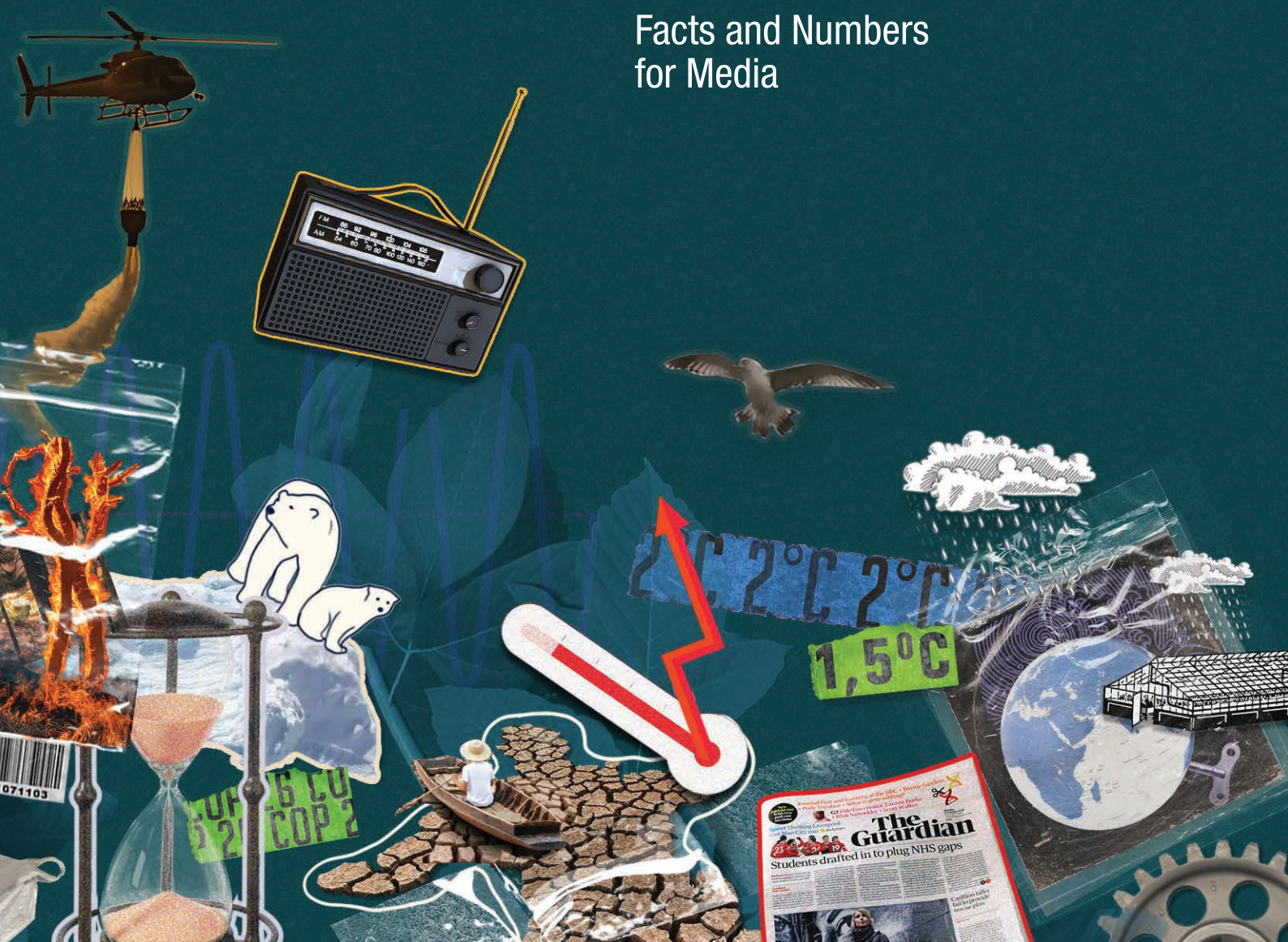
CLIMATE CHANGE:

Challenges and Responses

Facts and Numbers
for Media



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Tbilisi | 2021

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ACRONYMS:

AD	Adaptation Fund
AR 5	5th Assessment Report of IPCC
BUR	Biennial Update Report
COP	Conference of Parties
GHG	Green House Gases
IPCC	Intergovernmental Panel for Climate Change
NC	National Communication
GCF	Green Climate Fund
GtC	Gigatonnes of Carbon
GWP	Global Warming Potential
LEDS	Low-Emission Development Strategies
LULUCF	Land use, Land-use Change, and Forestry
MOP	Meeting of Parties
NAMA	Nationally Appropriate Mitigation Actions
NAPA	National Adaptation Programme of Action
NDC	Nationally Determined Contributions
ppm	Parts Per Million
SDGs	Sustainable Development Goals
UNFCCC	United Nations Framework Convention on Climate Change
UN	United Nations
UNEP	UN Environment Programme
UNDP	UN Development Program
WMO	World Meteorological Organization

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EU4Climate is the initiative of the European Union to support six EU Eastern Partnership countries — Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine — to implement the Paris Agreement on Climate Change, to contribute to climate change mitigation and adaptation, to foster development towards a low-emission and climate-resilient economy, to improve and consolidate climate policies and to ensure countries' legislative compliance.

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01 CLIMATE CHANGE: A HISTORICAL PERSPECTIVE


CO_2
CO_2 CH_4
HFC PFC
SF6
SF6

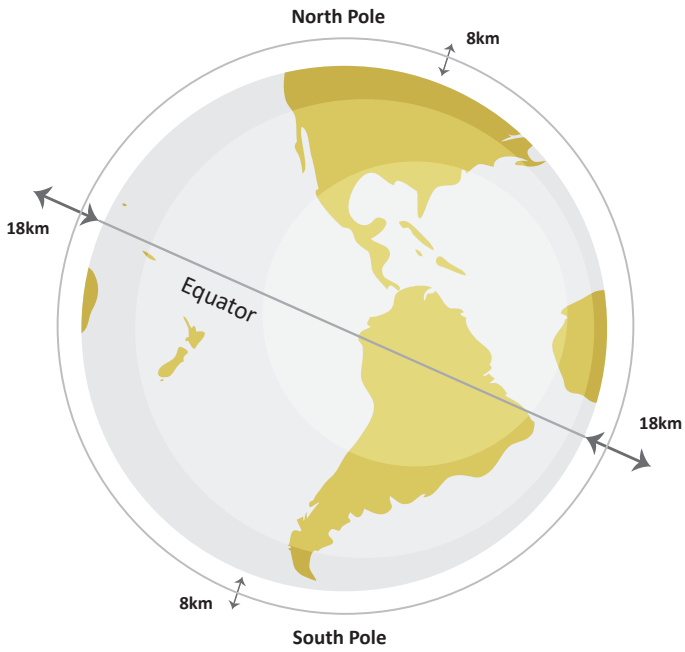
1.1 WHAT IS THE DIFFERENCE BETWEEN WEATHER AND CLIMATE?

It is necessary to thoroughly distinguish the key concepts of climate and weather.

Weather is the conditions of the atmosphere that we perceive in everyday life. It is the ever-changing state of the Earth's atmosphere, usually considered for a relatively small period of time (e.g., day, week).

The atmosphere consists of several layers of air around the Earth. The troposphere, the layer nearest to the Earth's surface, reaches a height of 8 to 9 km at the poles and 16 to 19 km at the equator. Gases in this layer play an important role in the process of absorption and accumulation of solar thermal energy. The troposphere is also the layer where complex physical events occur, when the thermal energy received from the sun is redistributed between the Earth's surface, oceans and the atmosphere. This redistribution of absorbed solar energy results in daily meteorological events (e.g. wind, precipitation, temperature change) that we call weather.

In addition, we should keep in mind that when we speak about the weather, we mean the condition of the atmosphere in a given location as described by different parameters, such as temperature, precipitation and wind speed.



Simply put, weather is the conditions of the atmosphere that we perceive in everyday life.

The troposphere (tropos is a Greek word meaning motion) is a constantly changing atmospheric layer where all the atmospheric phenomena that we call weather (rain, wind, clouds, snow, thunderstorms, etc.) occurs.

The troposphere contains almost 90 percent of the air in the atmosphere, consisting mainly of nitrogen (78 percent) and oxygen (21 percent). Water that evaporates to the troposphere returns to the Earth's surface as precipitation. This layer creates the necessary conditions for terrestrial life.

The stratosphere, above the troposphere, is where the physical and chemical composition of the atmosphere changes. The stratosphere contains less water and has a layer of ozone (O_3) that absorbs ultraviolet radiation from the sun. This layer of ozone protects living organisms on the Earth's surface from the harmful impacts of this ultraviolet radiation.

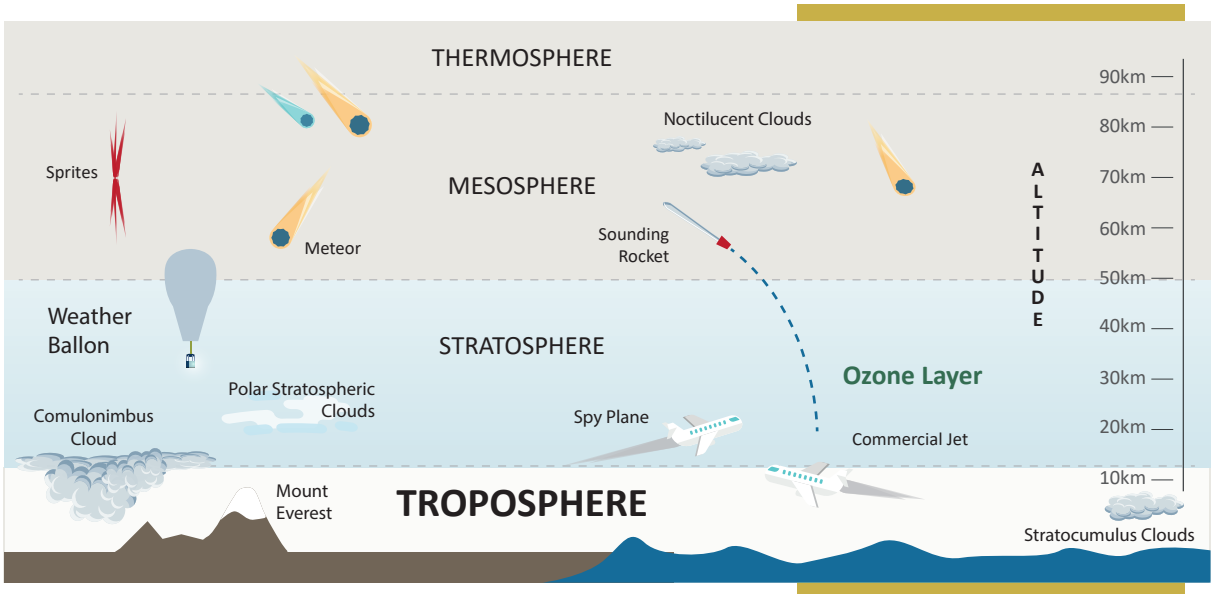


Figure 1: Tropesphere

Climate refers to an averaged condition of the lower layers of the atmosphere and the associated waters and the Earth's surface. Indicators that describe a climate include annual average temperature, average annual maximum and minimum temperature, annual precipitation, etc. The World Meteorological Organization (https://public.wmo.int/en) advises to assess climate data using at least 30 years period. More frequently data of relatively longer periods (centuries, millennia, and more) are applied for analysis. Thus, **climate describes the average weather conditions of a particular location over a long period of time.**

Climate change as a phenomenon is related to the consistent and statistically proven changes in average indicators (average annual temperature, annual and seasonal precipitation, temperature extremes, extreme weather events – flash floods, floods, hurricanes, etc.). A single, extreme event is not an indication of climate change, yet increased frequency of extreme events over a period of time may indicate climate change.

1.2 WHICH FACTORS DETERMINE THE CLIMATE?

The Earth's climate is rooted in many complex relationships, particularly among the sun (the main source of energy), the oceans, the cryosphere, land surface and the biosphere[1]. Due to the Earth's elliptical orbit and its tilted rotational axis, different parts of the atmosphere and the surface absorb different amounts of energy at different times of the year. Sunlight reflection and absorption rates also vary. For example, an ice-covered area reflects the sunlight intensely, while land surface tends to absorb solar radiation. The world's oceans and the land surface emit and retain heat differently, one of the reasons why coastal region climates differ from the continental region climates.

Uneven absorption of solar thermal energy by the Earth's surface leads to an energy imbalance in the atmosphere, which is manifested, for example, in the formation of layers of warm and cold air and areas of high and low pressure. This imbalance leads to the formation of strong currents of air, water and energy, which is the process of balancing the energy absorbed by the atmosphere. These balancing events in the Earth's atmosphere are perceived as weather which is assessed through temperature, precipitation, wind speed, air humidity, pressure changes and other meteorological variables.

The hydrological cycle consists of three consequent processes: water evaporating from oceans, seas, other reservoirs and the land surface (first stage); evaporated water condensing in the atmosphere (second stage); and then returning to the Earth as precipitation (third stage). Hydrological cycles also play a key role in redistributing energy generated in the atmosphere and in forming the climate.

The chemical composition of the atmosphere plays an essential role in the process of climate formation. Depending on their physical properties, different gases absorb solar radiation with different intensities; changes in the atmospheric concentration of these gases have a significant impact on climate.

The atmospheric air we breathe is a mixture of different gases, mostly nitrogen and oxygen. Although other gases (e.g. carbon dioxide, water vapor, methane) are present in relatively small concentrations, they still play a major role in climate formation.

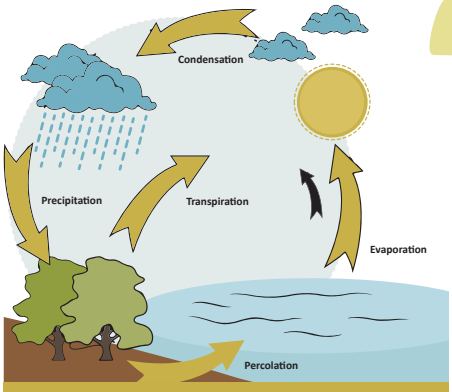


Figure 2: Hydrological cycle

1 **Cryosphere** - the part of the Earth's surface characterized by the presence of snow and ice (temporarily or permanently) and temperature is below zero. **Biosphere** - stratum of the earth's surface, where life exists and develops and is influenced by living organisms.

1.3 WHY IS THE CLIMATE CHANGING?

Climate has been constantly changing throughout the Earth's history. Both global warming and cooling periods have occurred cyclically and will occur many more times in the future **(see Figure 3)**. Various factors cause this phenomenon (e.g. change in the angle of the Earth axial tilt, volcanic eruptions, changing intensity of solar radiation, drifting tectonic plates and cosmic collisions). It is noteworthy that the Earth's axial tilt changes cyclically, which is due to the gravitational interaction of the Earth, Moon and Sun (the Milankovitch cycles).

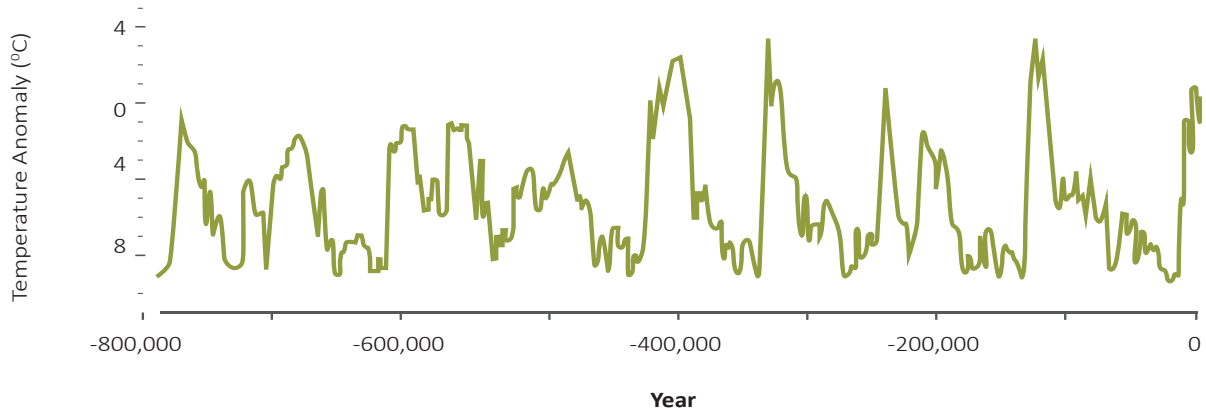


Figure 3: Average Global Temperature over Time

NASA, graph by Robert Simmon
Over the last 800,000 years, climate change has occurred in cycles, with alternating ice periods and warmer interglacials (the data are obtained by analysis of air samples in glacial layers).

These cyclical changes affect the amount of solar energy the Earth absorbs. The climate also changes cyclically, manifested by periodic cooling and warming. Such phenomena usually occur over fairly long periods of time (e.g. we know of 25,000-year and longer cycles of warming and cooling).

We also know of shorter periods observed during the last 2,000 years, e.g. the Medieval Warm Period in the 10th and 11th centuries (when the Vikings settled in Greenland) and the Little Ice Age in the 15th and 18th centuries in Europe. The annual average temperature has decreased and increased during these climate change cycles.

Along with natural processes, over the last two hundred years climate change has been greatly influenced by human economic activities. One of the key factors is the increasing concentration of "greenhouse gases" emitted into the atmosphere, largely caused by the combustion of fossil hydrocarbons (oil, coal, gas). This intensifies the greenhouse effect, which in turn has a significant impact on the climate.

1.4 WHAT IS THE GREENHOUSE EFFECT?

Greenhouse gases (GHGs) have a climate regulating role: changes in GHG concentrations are followed by warming or cooling. Key GHGs include carbon dioxide, water vapour, methane and nitrous oxide.

Atmospheric gases absorb part of the solar radiation, which causes the atmosphere to heat up. About half of the radiation gets through to the Earth's surface and warms the land and oceans. Some of the energy absorbed by the Earth returns to the atmosphere as infrared radiation (see Figure 4).

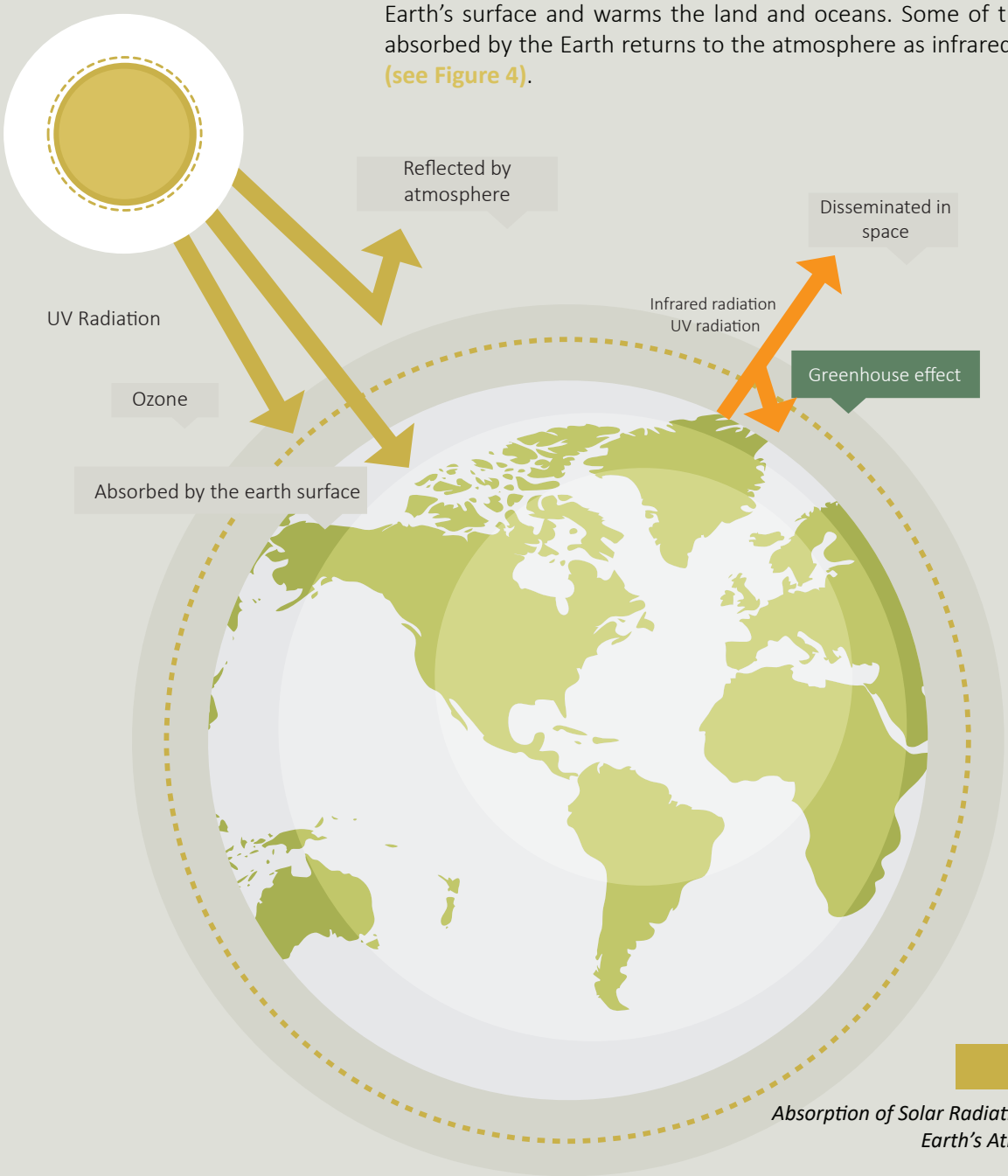


Figure 4:

Absorption of Solar Radiation by the Earth's Atmosphere

Infrared radiation is easily absorbed by atmospheric gases such as carbon dioxide, methane and nitrogen oxides. This phenomenon is called the 'greenhouse effect' because the heat is trapped following the same principle as in glass-covered greenhouses **(see Figure 5)**.

Carbon dioxide, water vapor, methane and nitrous oxide play main role in generating greenhouse effect. Consequently, the higher the GHG concentration in the atmosphere, the more solar energy is converted into heat. These assumptions are supported by geological and glaciological (glacier ice) studies that show that periods of warming and cooling in the past corelate with increased and decreased concentrations of carbon dioxide in the atmosphere (see Figure 6).

The greenhouse effect significantly changes environmental conditions on Earth, warming up the climate and increasing the current average temperature to 15^{0}C. Absent the greenhouse effect, Earth's current average temperature would be 33^{0}C lower (-18^{0}C).

According to the anthropogenic theory of climate change, human combustion of fossil hydrocarbons has increased the concentration of carbon dioxide and other GHGs in the atmosphere, reinforcing the greenhouse effect and consequently promoting climate change.

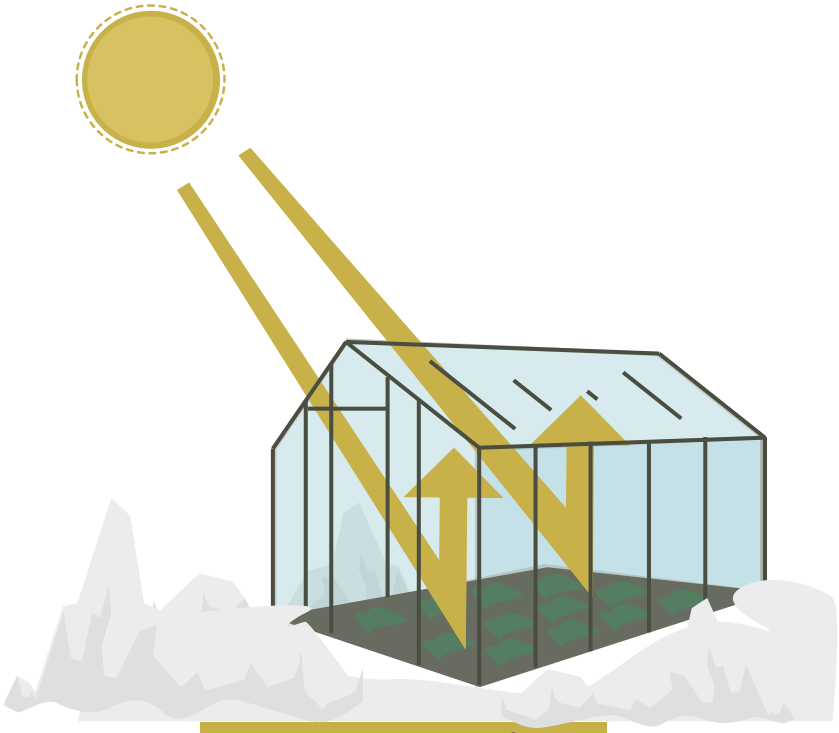
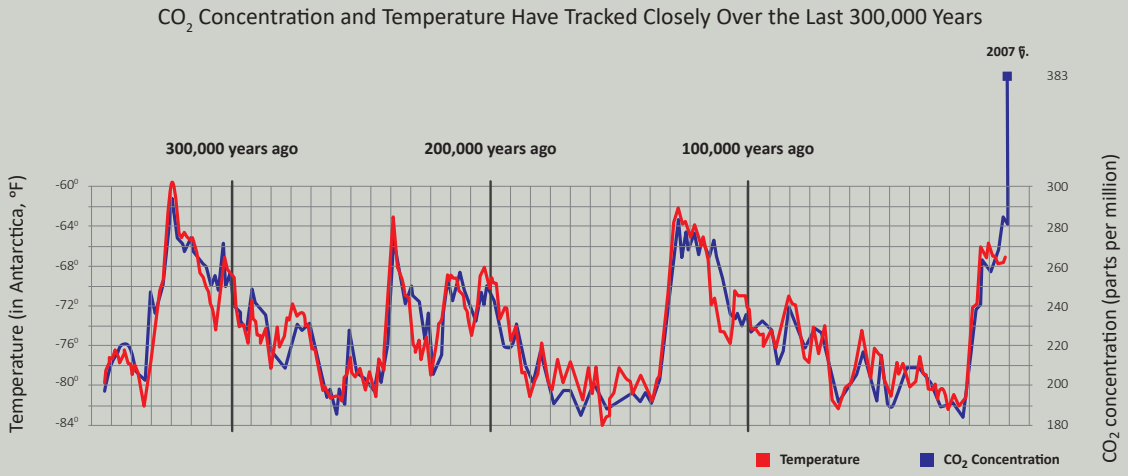


Figure 5: *Greenhouse Effect*



Relationship between CO_2 Concentrations and Changes in the Annual Average Temperature in the Atmosphere in the Recent Geological Past

Figure 6

In 1992, the United Nations adopted the UN Framework Convention on Climate Change (UNFCCC), which aimed to stabilize GHG concentrations in the atmosphere. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change.

The UNFCCC requires Parties to the Convention, including Georgia, to collect information and report on the following gases:

1. Carbon dioxide (CO_2);
2. Methane (CH_4);
3. Nitrous oxide (N_2O);
4. Hydrofluorocarbons (HFC);
5. Perfluorocarbon (PFC);
6. Sulfur hexafluoride (SF_6).

02 HUMAN IMPACT ON THE ENVIRONMENT AND CLIMATE


ENVIRONMENT AND
CLIMATE

2.1 WHAT IMPACT DOES HUMAN ACTIVITY HAVE ON THE CLIMATE?

Natural processes have caused cyclical climate change to occur throughout the Earth's geological history. Recently, human economic activities have had serious impacts on climate over the last two hundred years, one being the release of GHGs into the atmosphere resulting from the aforementioned combustion of hydrocarbons.

Data that have been published since the 1980s indicate a direct link between increased CO_2 emissions and global climate change. In 1975, the first data were published by Killing and his colleagues (based on information of the Mauna Loa Observatory and other sources) that show that CO_2 concentrations alone have increased by almost 42 percent since the pre-industrial period.

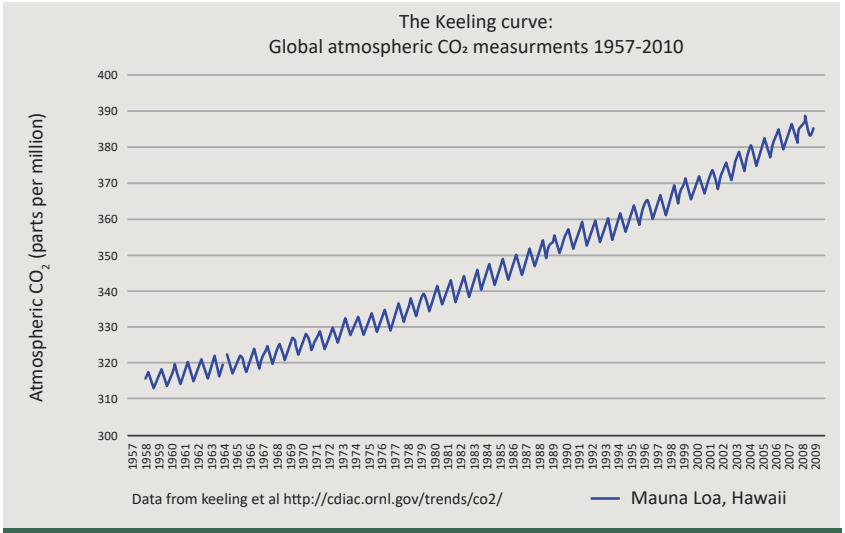


Figure 7: The Keeling Curve: Global Atmospheric CO_2 Measurements 1957 - 2010

Keeling and his colleagues obtained data on the increase in carbon dioxide over the last 50 years. In addition to showing increases in carbon dioxide concentration over time, the graph also reflects annual seasonal fluctuations.

Studies have shown that the current concentration of atmospheric carbon dioxide is approximately 412 parts per million (ppm); it was 280 ppm in the early 18th century. The increase in CO_2 concentration consequently enhances the greenhouse effect. Data published by Mann and Jones supports this theory. Their data shows that the mean annual temperature increase over the last 200 years coincides with increases in the concentration of atmospheric CO_2 **(see Figure 6)**.

Carbon dioxide is the main product of combustion of fossil fuels (petrol products, gas and coal). Its concentration in the atmosphere is constantly increasing due to human activities. In addition, CO_2 is also emitted from natural sources (volcanoes, soils, world oceans, living organisms, etc.), which increasingly alter the concentration of CO_2 in the atmosphere and affect the natural cycle.

These data underlie the global climate change theory that implies that intensive human consumption of oil, coal, gas and other raw materials over the last two centuries has resulted in higher GHG concentrations in the atmosphere and, consequently, increases in global mean temperatures.

Due to human economic activities, the current atmospheric CO_2 concentration is the highest it has been in the last 800,000 years (or maybe even more), and the mean annual temperature is the highest in the last million years.

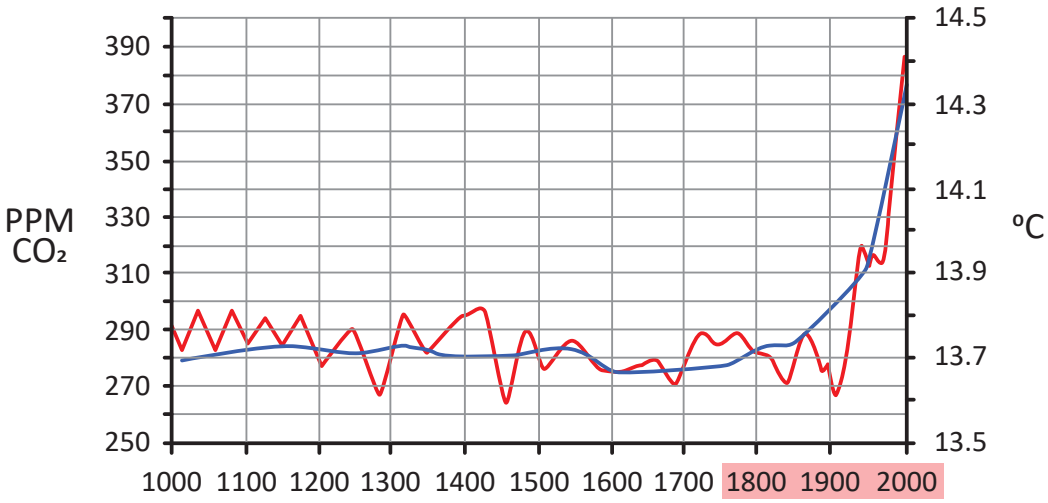


Figure 8: ***Annual average temperature increase over the last 200 years (red line)***

Data published by Mann and Jones, shows that the annual average temperature increase over the last 200 years (red line) coincides with the increase in CO_2 concentrations in the atmosphere (blue line).

Box 1

Collecting Climate Information by Analysing the Ice Cover

In glaciers, thick layers of ice form gradually. The layers result from the annual accumulation and compression of snow. Consequently, the ice is older at depth than at the surface. Amounts of snow in a year exceeding the amount of melting results in increasing glacier ice mass. Based on these glacier features, scientists cut out cylindrical samples of the ice ('ice cores') for analysis. The deeper the core is sampled from, the older the ice.

Analysing air bubbles, dust particles, radioactive substances, and other parameters found in the older layers of the ice enable scientists to obtain information about the climate of that historical period. Analysis of ice cores recovered in different parts of the Earth permits estimating the climate of different periods of time.

2.2 HOW HAVE WE GOT TO THE CLIMATE CRISIS FROM THE ONSET OF THE INDUSTRIALIZATION ERA TO THE PRESENT?

As noted, increased GHG emissions to the atmosphere resulting from human economic activities underlie the theory of global climate change. According to this theory, intensive consumption of oil, coal, gas and other raw materials by humans over the last two centuries has intensified the greenhouse effect.

According to data collected by the Intergovernmental Panel on Climate Change (IPCC)[2], a body established under the UNFCCC, anthropogenic factors have increased the average global temperature by 1.2°C compared to the pre-industrial level (see https://www.ipcc.ch/s chapter / chapter-1 /).

Since the beginning of the 21st century, temperatures have been rising in parallel with increasing CO_2 concentrations in the atmosphere. According to the IPCC, the annual average temperature increase since 2005 has been 0.87°C, which is higher than the annual average temperature growth rate in the 20th century (see Figure 9).

The amount of CO_2 emissions has steadily increased since the onset of the industrial era and is now 35-49 gigatons (Gt) per year. The total amount of CO_2 in the atmosphere by humans exceeds 400 Gt (which is a huge amount). Studies show that about 40 percent of these emissions remain in the atmosphere, while the rest accumulates in plants, soil and the ocean; Intense absorption of carbon dioxide by oceans increases their acidity, affecting phytoplankton, zooplankton and reef ecosystems. Maintenance of oxygen concentration in the atmosphere depends significantly on the process of photosynthesis in phytoplankton; reduction in the amounts of phytoplankton can cause significant adverse changes.

Carbon dioxide absorbed by plants and stored as fossilized hydrocarbons for millions of years is being now released to the atmosphere through combustion. Moreover, this has been happening in a small period of time — just 200 years. Naturally, as a result of such additional emissions, GHG concentrations in the atmosphere have increased significantly.

Information on GHGs and climate change impacts, its detailed analysis and global or regional characteristics are reflected in IPCC assessment reports. Assessment reports are published periodically and are the most credible source of information on climate change (see https://www.ipcc.ch/reports/).

2 Intergovernmental Panel on Climate Change (IPCC)) is a scientific body of the UNFCCC that brings together the world leading experts and scientists to assess the science related to climate change

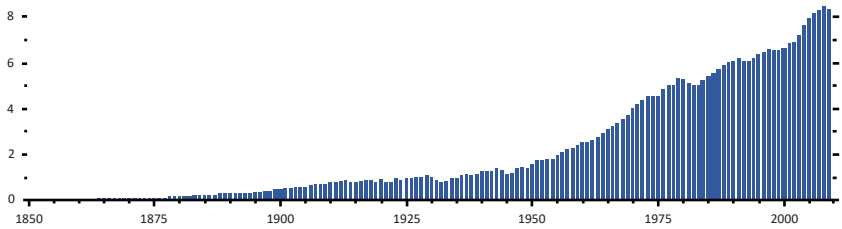


Figure 9:

Changes in Global Carbon Dioxide Emissions in 1850-2020 (in gigatons)

Emissions of carbon dioxide by humanity (primarily from the burning of fossil fuels, with a contribution from cement production) have been growing steadily since the onset of the industrial revolution. About half of these emissions are removed by the fast carbon cycle each year, the rest remain in the atmosphere. (Source: Graph by Robert Simmon, Global Carbon Project data)

2.3 WHICH SECTORS OF THE ECONOMY AFFECT THE CLIMATE THE MOST?

The sectors that affect the climate the most are those that consume oil, coal or gas as energy sources — primarily the transport and energy sectors.

In recent years, electricity generation from renewable sources (e.g. wind, solar, geothermal, water, biofuels) has increased significantly around the world. Unfortunately, the amount of electricity generation relative to electricity demand is still a drop in the bucket; coal, gas and oil remain the key sources of energy generation, followed by nuclear and hydropower (see Figure 9).

Transport is the biggest source of carbon dioxide emissions and actually totally depends on petroleum fuels. In this regard, a particularly large share of emissions comes from international freight shipments, including aircraft and motor transport.

Another significant impact on the greenhouse effect comes from changes in land-use patterns. The growing need for food that results from human population growth has led to more land being used for agricultural purposes and to deforestation, draining and use of flood ecosystems (swamps, etc.). As a result of these processes, the carbon that accumulates in plants (e.g. in woody species) is converted to carbon dioxide and released into the atmosphere. Unfortunately, a significant portion of global GHG emissions come from 'land use, land-use change and forestry' activities (LULUCF).

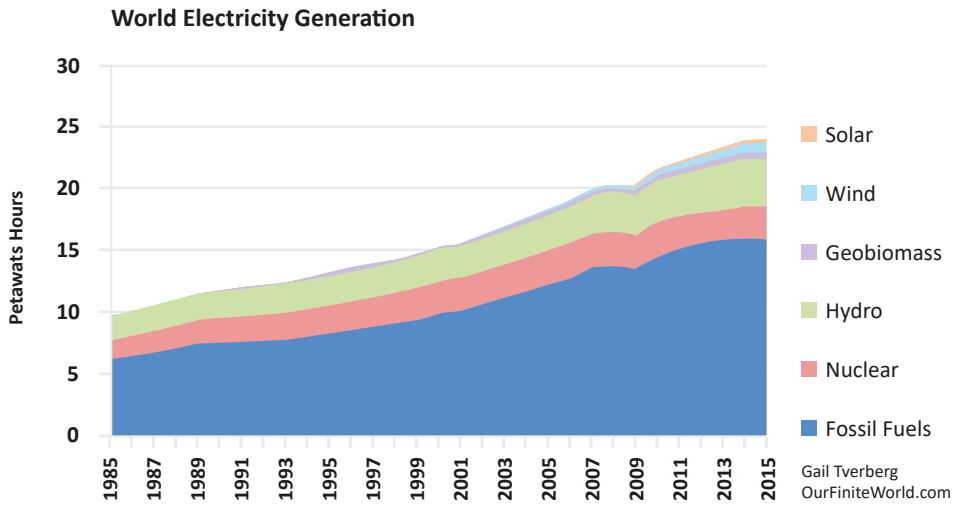


Figure 10: *World Electricity Generation by Sources*

Other GHG emissions are also important. For example, although atmospheric methane concentrations are smaller, methane absorbs infrared radiation 21 times more than carbon dioxide[3]. Because of these properties, even small amounts of methane strongly add to the greenhouse effect. See **Figure 10** for key sources of methane emissions. Unfortunately, livestock breeding is the major source of methane, as herbivores physiologically emit large amounts of methane during digestion. Furthermore, globally half of the land in agriculture is used for husbandry. This has its reasons economic development and improved life quality lead to growing demands for meat and dairy products which, in turn, increases demand for livestock. Unfortunately, this is one of the biggest challenges that is often ironically criticized by climate change sceptics, as the main way to address this issue is to change meat and dairy consumption habits in societies, where they are consumed in excessive quantities.

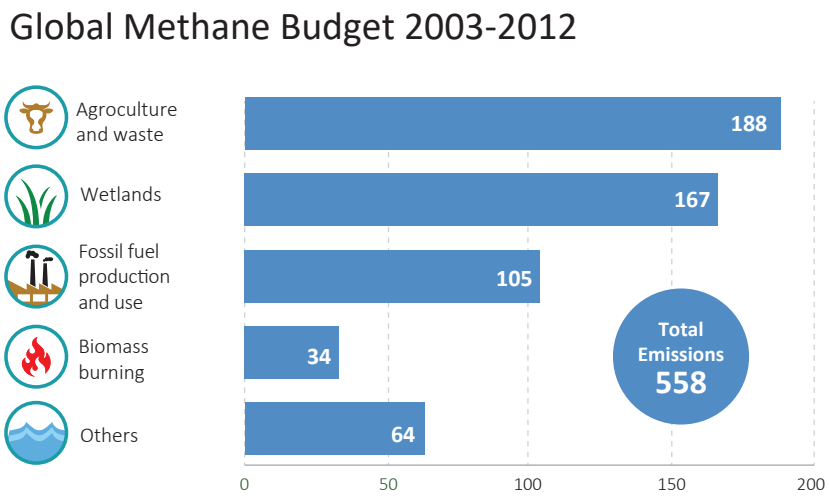


Figure 11:

Total Annual Methane Emissions
Soucre: CNN, 22 Jan 2017

3 Impact of GHG on global warming is measured by the Global Warming Potential (GWP), that is determined by physical and chemical properties of gases, as well as their break down time in the atmosphere. GWP is measured by CO_2 equivalent

Another important source of methane emissions is the melting permafrost (permanently frozen soil) in the polar zone. Permafrost contains large amounts of organic matter that starts decomposing with rising annual average temperatures (that are higher in the north than in the temperate zone where Georgia is located), releasing huge amounts of methane. This massive release will greatly accelerate the process of climate change.

Another source of methane emissions is solid waste and domestic and industrial wastewater.

According to the IPCC Common Reporting Format (CRF), the following six sectors are considered in GHG inventories:

1. CRF Sector 1 **Energy**
2. CRF Sector 2 **Industrial processes**
3. CRF Sector 3 **Solvent and other product use**
4. CRF Sector 4 **Agriculture**
5. CRF Sector 5 **Land use change and forestry**
6. CRF Sector 6 **Waste**

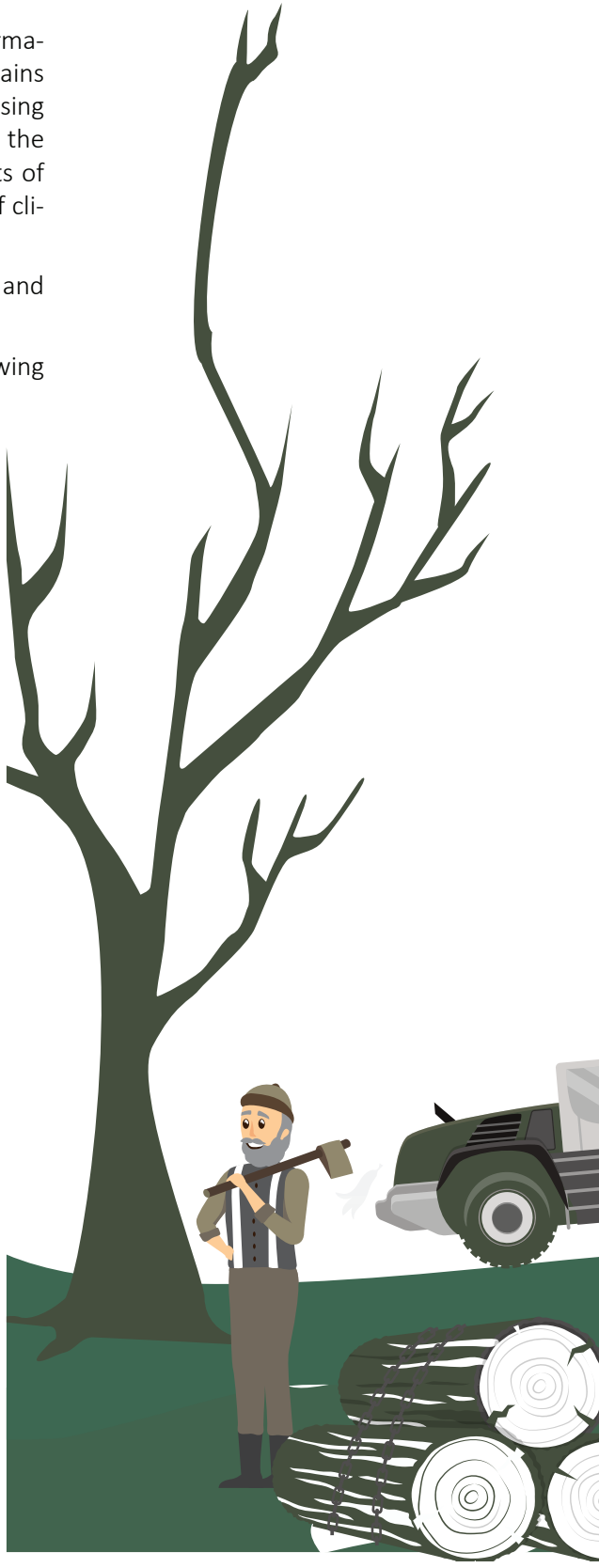


Figure 12: *Anthropogenic Sources of CO_2 Emissions*

The following human activities contribute to increasing greenhouse gas concentrations in the atmosphere of Earth:

- Fossil fuel consumption
- Deforestation
- Animal farming
- Waste disposal
- Agricultural technologies
- Aerosols and refrigeration technologies

03 FORECASTS FOR THE FUTURE


90
2000
2035

3.1 HOW COULD EVENTS DEVELOP TOWARDS THE END OF THE 21ST CENTURY, AND WHAT COULD BE THE CONSEQUENCES OF CLIMATE CHANGE?

Since the onset of the industrial era, carbon dioxide emissions have been constantly increasing. If 40-50 years ago emissions were increasing by 10 to 12 Gt per year, currently this figure is in a range of 35-38 Gt. This is largely due to global economic growth and the emergence of new economic powers (e.g., China, India, Brazil, etc.) that consequently, increases demand for resources.

Available data show that climate change is now happening faster. Unless we take action, these processes will develop intensively and the situation would be even more extreme by the end of the 21st century.

Based on current forecasts, the annual average temperature is expected to increase by 2 to 5-6°C by the end of the century, depending on whether emissions increase or decrease. If the CO_2 emissions stay the same, the worst scenario of events would be expected over the next 100 years, involving an increase of 3 to 5°C in the annual average temperature. A decrease in emissions could limit the projected annual average temperature rise to approximately 1.5°C. This scenario is enshrined in the Paris Agreement, which calls on UNFCCC Parties to reduce their GHG emissions.

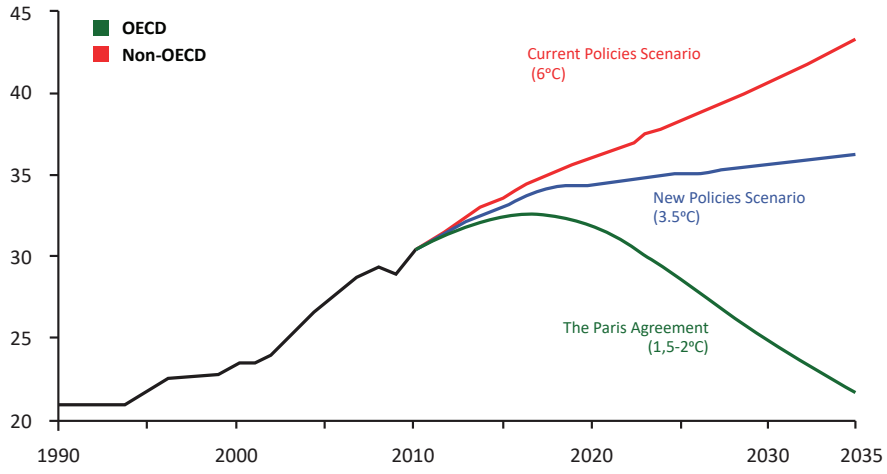


Figure 13: **Future Temperature Changes based on Projected Greenhouse Gas Emissions**

The scenarios of annual average temperature increase depend on CO_2 emission rates: the current policy scenario leads (red line) to the worst outcomes, pushing up annual average temperature by 5-6 °C. The blue and green lines reflect new policy scenarios that involve measures to reduce CO_2 emissions, limiting the annual average temperature increase to 1.5 to 2°C.
Soucre: Global Carbon Project https://www.globalcarbonproject.org/carbonbudget/

Climate change is having a strong impact on national economies; failure to take mitigation measures would significantly increase economic losses.

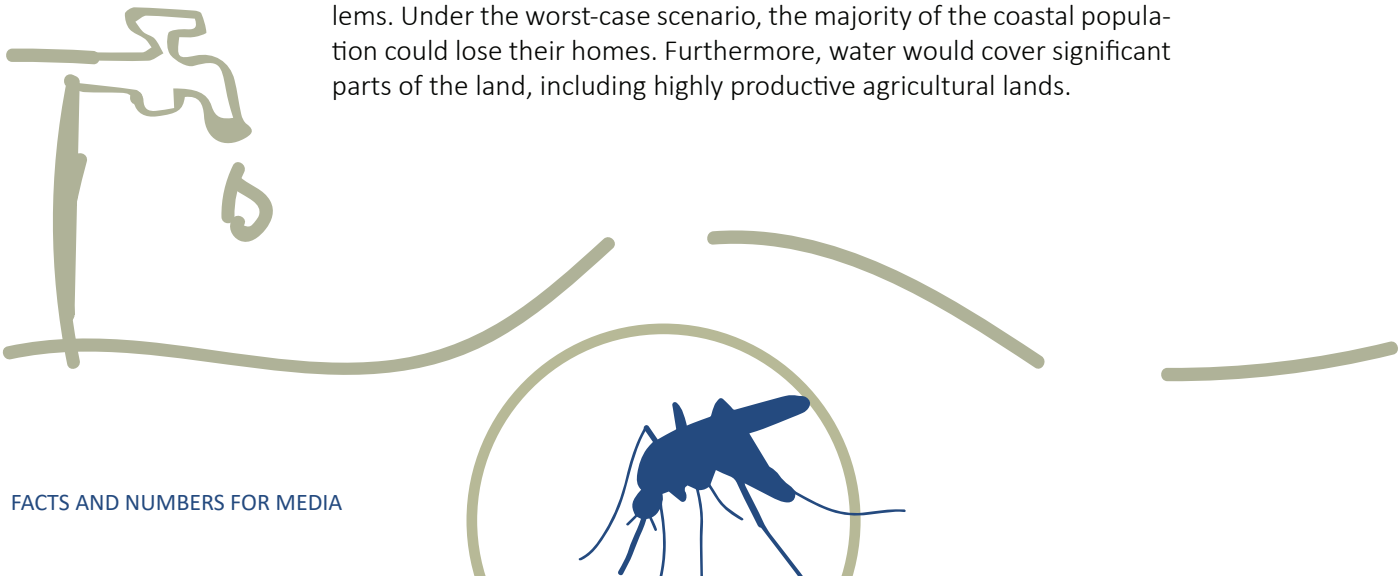
There is also a likelihood of increasing extreme weather events and disasters (e.g., storms, floods, landslides, avalanches), which would have a direct impact on human health, the economy and livelihoods.

There is also a likelihood of increasing extreme weather events and disasters (e.g., storms, floods, landslides, avalanches), which would have a direct impact on human health, the economy and livelihoods.

One of the top priorities is to prevent biodiversity loss and ecosystem degradation, followed by the shrinkage of ecosystem services. 'Ecosystem services' are the benefits that people and businesses receive from the environment (e.g., clean water, fresh air, timber, food and recreation). Therefore, prevention of biodiversity loss and combating degradation of ecosystem services is one of the priorities of international community.

The European Council adopted a policy that reflects the European Union's vision and development goals since 2010. The policy recognizes ecosystem degradation processes and the shrinking of ecosystem services as among the main risks associated with climate change. According to this document, climate change can significantly reduce biodiversity across Europe, limit ecosystem services and, more alarmingly, contribute to disrupting ecosystem functions (including those that have an impact on the climate).

It is generally accepted that increases in annual average temperatures will inevitably cause the melting of polar ice cover and glaciers, followed by rising global ocean levels. This rise in ocean levels will cause floods in many coastal areas. Given that 600 mln the world's population lives in coastal regions, this flooding would cause serious humanitarian problems. Under the worst-case scenario, the majority of the coastal population could lose their homes. Furthermore, water would cover significant parts of the land, including highly productive agricultural lands.



3.2 HOW WOULD CLIMATE CHANGE AFFECT BIODIVERSITY AND ECOSYSTEM SERVICES?

Biodiversity and climate change are widely recognized as interrelated phenomena. Climate change affects the rate of total biomass production and interactions between species. It also has a particular impact on habitats in both terrestrial and aquatic ecosystems, posing a particularly high risk to species and communities that already experience strong anthropogenic pressures.

Recent studies have shown that climate change, together with other factors (environmental degradation, over-extraction, environmental pollution and invasion of new species), is one of the lead causes of biodiversity loss.

According to the Ad Hoc Technical Expert Group of the Convention on Biodiversity, 10 percent of species could be endangered if the annual average temperature increases by 1°C.

The climatic change results in unprecedented environmental conditions for ecosystems, communities and species. Under radically new climate conditions, many species may face the threat of extinction; significant changes are expected at the level of both communities and ecosystems. In turn, this would affect ecosystem services and economic sectors such as agriculture, energy generation, water supply, transport and more, creating serious challenges that would determine the future of the civilization.

Resilient ecosystems are a key determinant of stable climate conditions, as living organisms play an essential role in regulating the carbon cycle. It is a well-studied and proven fact that biodiversity loss deepens and enhances climate change.

The higher the ecosystem resilience and biodiversity rates, the more they can accumulate carbon and thus contribute to stabilizing the climate.

It is noteworthy that significant biodiversity losses limit ecosystem services and, more alarmingly, lead to disruption of ecosystem functions, including those that have an impact on climate.

For example, climate change impacts can have different manifestations on forest ecosystems. Rising annual average temperatures, as well as decreasing precipitation and snow cover periods, affect the forest function for water retention. Climate change leads to deforestation and changes in the forest composition that, in turn, have an impact on hydropower generation and water supply and will result in billions of dollars in losses. Climate change is also expected to cause more frequent forest fires; according to the US Forest Service, the number of forest fires would increase as much as six times.

Ecosystems that are already disadvantaged are less likely to survive the serious environmental shocks that are associated with climate change.

3.3 WHAT ARE THE FORECASTS FOR GEORGIA?

Climate change effects can be seen everywhere on the Earth today. These effects are more apparent closer to the poles; they are less noticeable — yet still present — in the temperate zone.

Georgia began measuring air temperatures in 1836; regular temperature monitoring began in 1845, when the Magnetic and Meteorological Observatory was established in Tbilisi. Temperatures and other climatic parameters have been monitored throughout the country since the beginning of the 20th century. Studies based on these observations have been reflected in national communications that have been prepared for the UNFCCC.

Studies show that signs of climate change have been observed in Georgia since the 1950s and that climate change impacts are now occurring faster and are more tangible. For example, comparing two 30-year periods (1956-1985 to 1986-2015) shows that mean daily daytime temperatures increased by 0.25-0.58°C depending on the region. The average increase in the territory of Georgia is 0.47^{0}C. The most significant warming was observed in the Dedoplistskaro region, where the annual increase between the two periods reached 0.73°C. Temperatures also increased relatively intensely in Samegrelo (by 0.63°C in both Zugdidi and Poti). Identified upward temperature trends show seasonal character. For example, more intense warming was observed in eastern Georgia from June to October and from January to March, while the average temperature in Guria-Adjara has not changed.

Annual precipitation mainly increased in western Georgia, where the biggest increase (up to 15 percent) was observed in Poti and Khulo (60-75 mm in 10 years). The only exceptions are the region of Guria and the high mountainous zone of Adjara (the Goderdzi Pass), where precipitation decreased. In eastern Georgia, precipitation significantly decreased in Tianeti (by 18 percent/39 mm in 10 years). Months with the highest levels of precipitation changed from summer to spring, with May and June previously being the rainiest months, whereas now, in most eastern regions, rainfall is the highest in May.

In most parts of western Georgia, the highest precipitation is now observed in autumn: October-November or in January, instead of December as previously.

An increase in rainfall rates per 24 hours or per five days could significantly increase the risk of natural disasters. Unfortunately, these parameters have also increased in Georgia.

During the last 55 years (1961-2015), the trends of **rising average annual temperatures** were observed throughout the entire territory of Georgia

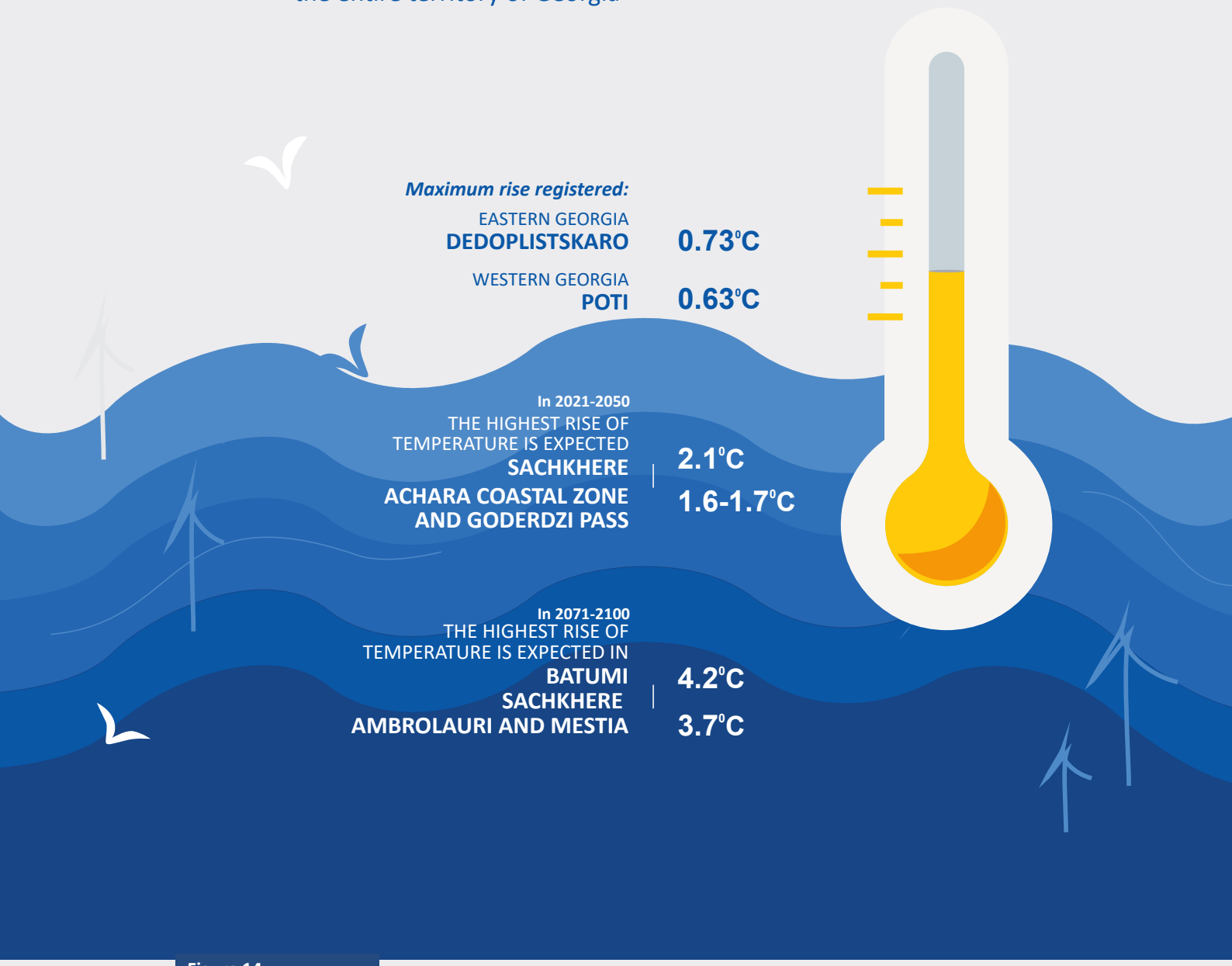


Figure 14:

Trends and Forecasts of Temperature Changes for Georgia (Source: EU4Climate Project)

National-level studies also show that climate change has increased the frequency and intensity of natural hydrometeorological events (floods, snow avalanches, strong winds and droughts). Georgian glaciers are also melting intensely.

According to forecasts, between 2041 and 2070, the annual average temperature will increase between 1.6°C to 3.0°C above average temperatures recorded between 1971 and 2000. Predicted temperature increases in eastern Georgia range from 1.8°C to 3.0°C, in western Georgia- from 1.6°C to 2.9°C.

The annual average temperature will continue to increase additionally by 0.4°C 1.7°C during the period of 2071-2100. The overall temperature rise in this period versus the 1971-2000 will amount to 2.1°C 3. 7°C. The smallest rise is expected in Lentekhi and the highest in Sagarejo.

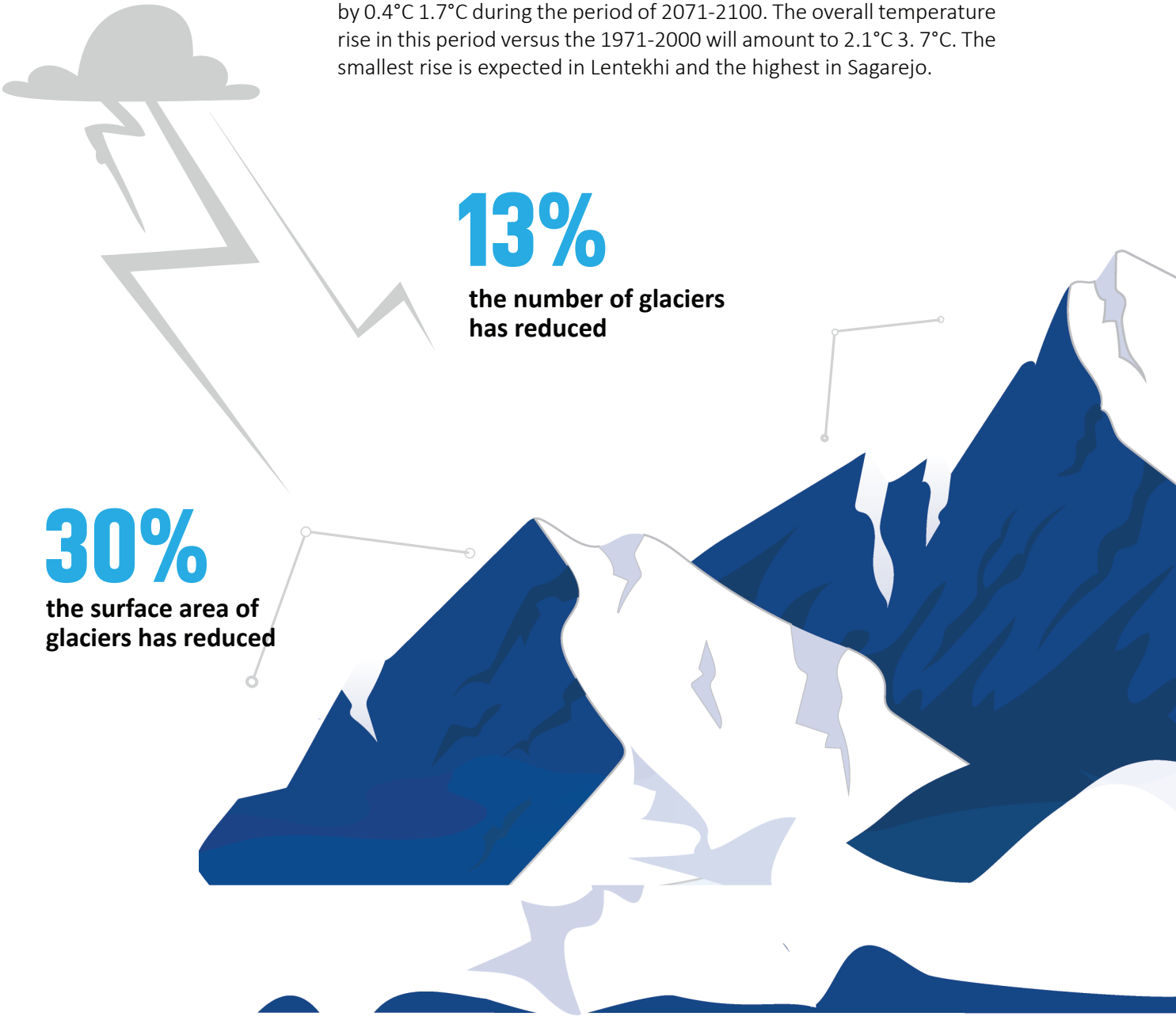
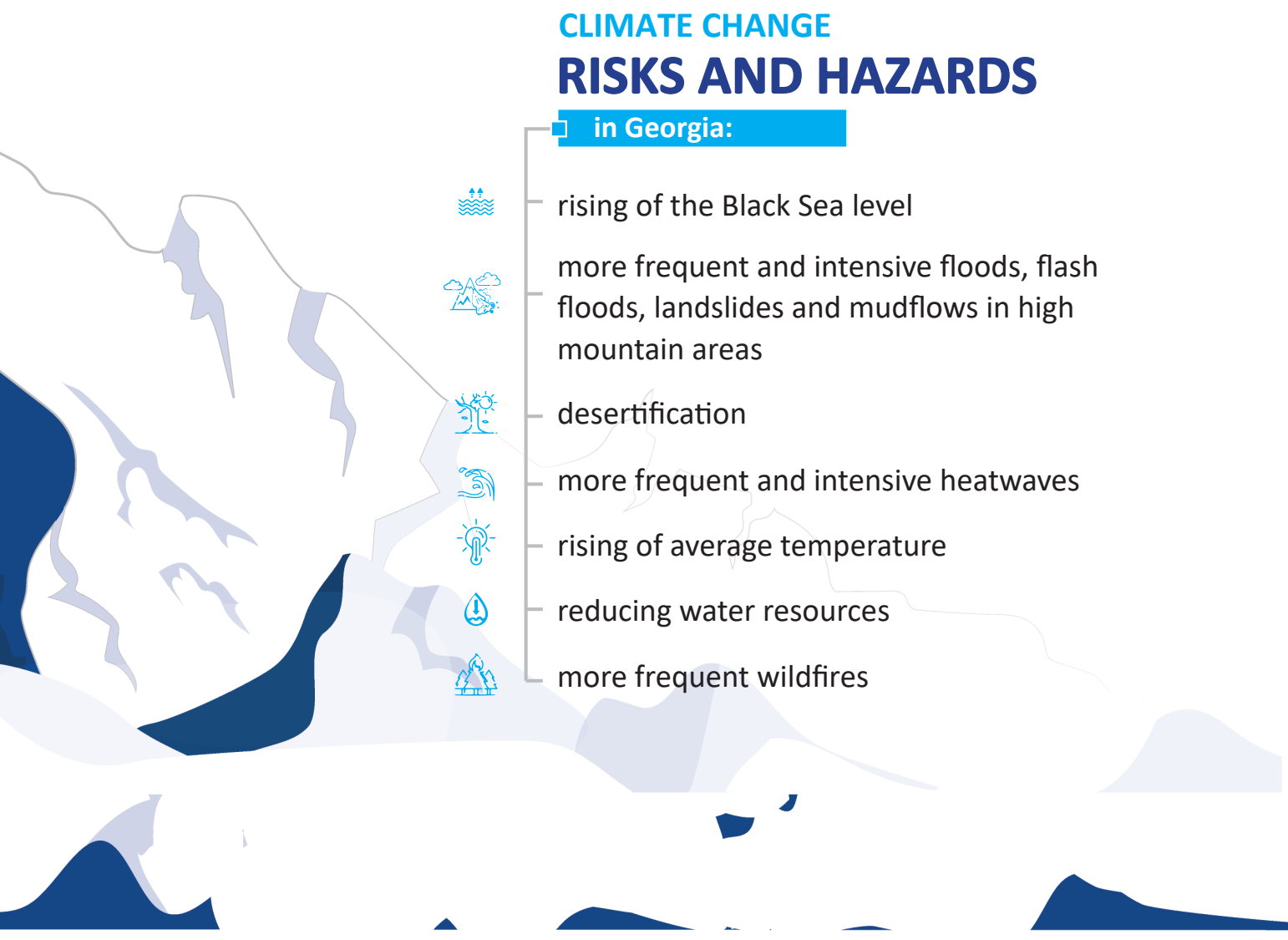


Figure 15: *Glacier Reduction Trends in Georgia (Source: EU4Climate Project)*

Significant changes are expected in precipitation. In this regard, the picture in Georgia is different depending on the region: e.g. along the Black Sea coast in western Georgia, the annual rainfall is likely to increase by 90 mm, while a decrease is to be observed in the Caucasus in general. By the end of the 21st century, precipitation is expected to decrease by 10-20 percent in all regions of Georgia; by 2100, relative humidity is also expected to decrease.

With rising temperatures, increases in extreme weather events are expected. These increases may be accompanied by changes in precipitation distribution and intensity. These processes could lead to changes in food supply and ecosystem imbalances, which would inevitably affect flora, fauna and human activities in Georgia.



Risks Caused by Climate Change in Georgia (Source: EU4Climate Project) **Figure 16:**

3.4 WHAT CAN WE DO TO REDUCE CLIMATE CHANGE IMPACTS?

Climate change can be said to be the most difficult and significant challenge facing humanity, and that human's survival as a species depends on our ability to overcome climate change consequences.

The world needs to take actions to reduce anthropogenic climate change impacts and help stabilize GHG concentrations in the atmosphere, thus allowing ecosystems to adapt to new climate conditions.

This is a global challenge that requires efforts beyond the capabilities of an individual country. A number of mechanisms have been set up to coordinate international joint actions to mitigate and adapt to climate change consequences. The United Nations Framework Convention on Climate Change (UNFCCC)) and related agreements are among these mechanisms. These agreements envisage joint planning and implementation of actions. Each Party to the Convention committed to fulfilling their obligations under the UNFCCC.

According to

THE GLOBAL RISKS ASSESSMENT REPORT

Climate change, by the significance of its impact, ***overtakes hazard like the mass destruction weapons***

The top five risks by the probability of their occurrence are environment-related, including: ***climate change, more frequent extreme weather conditions and natural disasters***

The purpose of the UNFCCC is to stabilize GHG concentration in the atmosphere (within the framework of the Convention) in order to exclude anthropogenic impacts on the climate.

According to the UNFCCC, GHG concentrations should be adjusted so that natural ecosystems can adapt to climate change, which could ensure food security and sustainable economic development.

The UNFCCC recognizes the priority of Parties' economic development but calls on countries to take measures to ensure climate stability — Parties should take preventive measures to minimize the adverse effects of climate change. Further details about the Convention are provided in chapter 6.

Figure 17: *Climate Change as a Global Crisis (Source: EU4Climate)*

3.5 HOW TO MITIGATE CLIMATE CHANGE IMPACTS?

Stabilizing and reducing GHG concentrations in the atmosphere are key tasks of the UNFCCC. This primarily involves reducing carbon dioxide emissions, which requires, among other things, the development and application of new energy-efficient technologies, a shift from fossil fuel-based energy (oil, gas, coal) to renewable energy (solar, wind, hydro, etc.), the use of sustainable agricultural methods, development of green economy sectors and electro transport, waste management optimization and the introduction of zero-waste technologies.

The second important direction of mitigation is the removal of already-emitted carbon dioxide from the atmosphere and its storage in biomass, soil or other ecosystem components. It is also important to increase ecosystem resilience and to reduce habitat degradation because healthy ecosystems can accumulate higher amounts of carbon.

Both approaches are known as climate change mitigation. Given the scale of the problem, mitigation measures need to be implemented through joint efforts of the international community, otherwise would be impossible to reduce GHG emissions globally.

In addition, without mitigation measures, the worst climate change scenarios could occur (annual average temperature increase of 3-5°C by the end of the century). According to IPCC experts, if global warming exceeded 2°C by 2100, ecosystems would not be able to adapt to the new conditions, which would have dire consequences.

Proper mitigation could limit the annual average temperature increase to 1.5oC by the end of the century. This is a cornerstone of the Paris Agreement, under which UNFCCC parties undertook the responsibility to reduce their GHG emissions.

It is very important to develop, disseminate and transfer green technologies to developing countries.

Mitigation also affects the achievement of social goals related to human health, food security, biodiversity, the quality of the local environment, access to energy and to equitable, sustainable development.

3.6 WHAT IS CLIMATE CHANGE ADAPTATION?

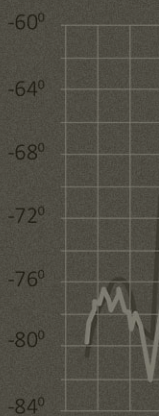
Climate change adaptation includes taking appropriate steps based on anticipated risks in order to minimize the damage caused by climate change. Well-planned actions can save lives and prevent potential losses.

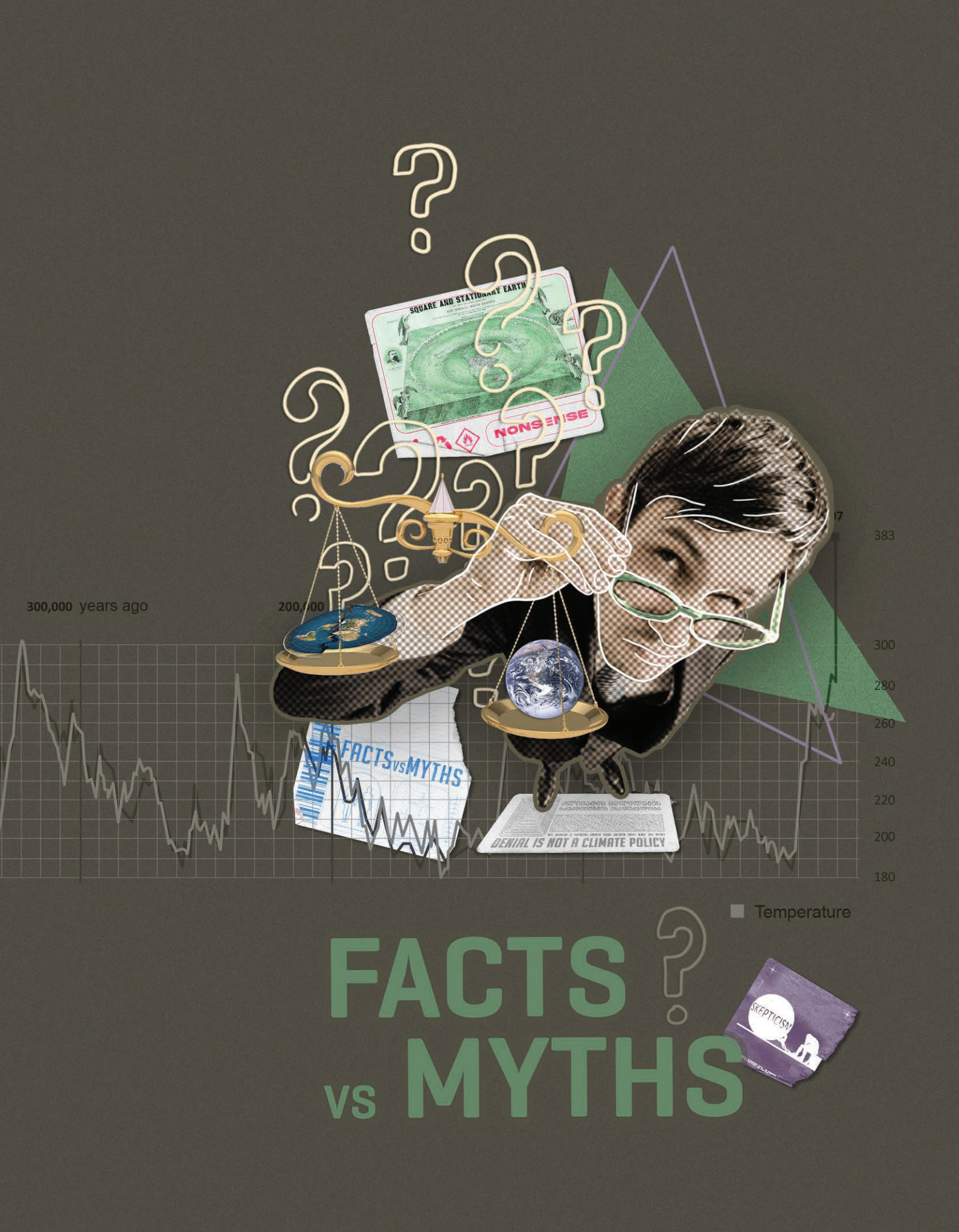
Adaptation minimizes the risks of climate change before climate change impacts are mitigated. Adaptation includes using water efficiently, planning measures to control floods or other extreme events, developing construction norms aimed to increase energy efficiency, stimulating the use of drought-resilient agricultural crops, and planting forests of species resilient to hurricanes, diseases and other adverse impacts.

To ensure wellbeing of the population, it is crucial to have in place environmental requirements of high standard in order to minimize the negative consequences caused by climate change and biodiversity loss.

In terms of adaptation, ecosystem-based approaches must be actively applied to protect biodiversity, reduce land erosion and conserve water resources. These approaches will also contribute to reducing air pollution and developing alternative energy sources. To protect habitats, it is essential to maintain their natural or near-natural state and to maintain the ecological balance that strengthens the ecosystem's ability to adapt to climate change.

04 UNGROUNDED SKEPTICISM ABOUT CLIMATE CHANGE





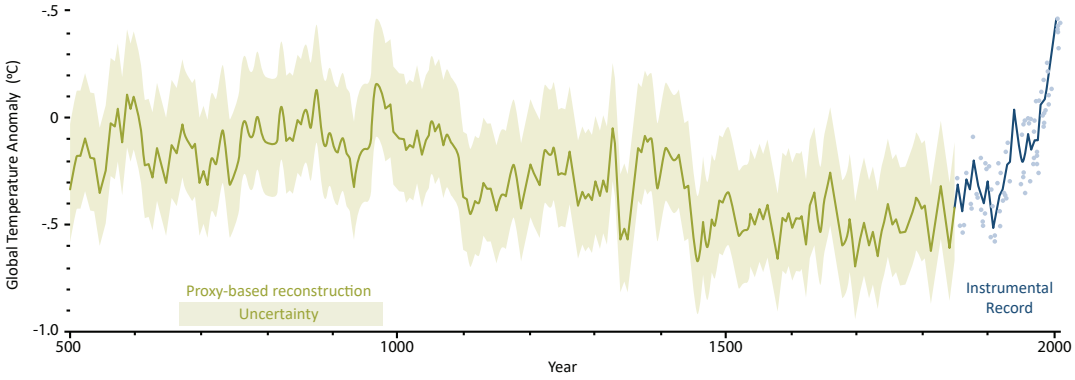
FACTS vs MYTHS

Scientists are generally sceptical of issues on which there is no scientific consensus. However, there is a general unanimity in the scientific community regarding climate change studies; there is actually no scepticism observed among climate scientists. Yet there are some people and a handful of scientists who are sceptical — or who generally deny climate change. Below are some of the arguments most sceptics use when discussing climate change and some facts to explain why their scepticism is unfounded.

4.1 SCEPTICISM ABOUT RISING ANNUAL AVERAGE TEMPERATURES

When talking about this issue, sceptics often argue that the annual average temperature has always fluctuated over the course of the Earth's history and that there is nothing alarming about the current temperature rise.

Indeed, air temperature has always fluctuated on the planet. However, **climate change reflects an upward trend in temperature changes persisting over a long period of time.** Temperatures have been regularly measured since 1880, and data from the last 150 years confirm that the annual average temperature has been increasing during this period. In addition, scientists have been able to reconstruct temperature changes by studying ice cover on the Earth; this indirect method has been used to analyse temperatures of the last few millennia. Studies show that the annual average temperature today is higher than it was 1500 years ago.



Global Temperature Trends over the Past 1500 years (Source: NASA[4])

Figure 18

4 NASA web-site: https://earthobservatory.nasa.gov/features/GlobalWarming/page3.php

4.2 SCEPTICISM ABOUT HUMAN CONTRIBUTIONS TO CLIMATE CHANGE

When discussing this issue, sceptics often bring two arguments:

- Since the climate has changed several times naturally during the Earth's history, the current change can be also attributed the natural process and it has nothing to do with human activities; and
- reducing dependence of the economy on fossil fuels to stop global warming is not an acceptable solution.

Climate change on Earth has always been linked with an increase in atmospheric GHG concentrations. The difference between past and present processes is that climate conditions in the Earth's history changed slowly (for hundreds of years), and living organisms were able to adapt to these changes. For the last 150 years, however, the concentration of atmospheric GHGs has grown unprecedentedly fast triggering relatively fast changes in climatic conditions.

A rapid increase in GHG concentrations has been observed since 1850. This period coincides with widespread and growing use of fossil fuels that accompanied industrialization.

Between the periods of glaciation and warming 800,000 years ago, CO_2 concentration in the atmosphere varied between 185 and 280 ppm, while since the 1850s, it rose from 280 ppm to 415 ppm (data from November 2020).

4.3 SCEPTICISM ABOUT CLIMATE CHANGE IMPACTS

In this context, sceptics generally have two arguments:

- One group questions some specific effects of climate change (e.g. they argue that melting of several glaciers is not evidence of climate change; that there was no sea level rise in the 20th century despite rising temperatures, etc.); and
- The second group of sceptics argues that 21st-century modern technologies will help people better cope with the challenges of climate change, and so there is no need to overstate its impacts.

Sceptics are under-informed about the fact that in a view of vast scientific data and analysis there is a broad consensus within scientific community regarding the links between certain changes and global warming.

In response to the arguments of the second group, the following should be emphasized: climate change impacts may be of the scale that modern technologies will not be able to help mitigate or mitigation of impacts would not be feasible. For example, 600 million people — 10 percent of the Earth's population — live in the coastal zones, 10 m below sea level; the potential scale of impact from the rising sea levels would be immeasurable regardless of impact mitigation technologies may offer.

4.4 IS 'CLIMATE CHANGE' THE SAME AS 'GLOBAL WARMING'?

Sceptics often argue that the term 'climate change' has replaced 'global warming' because the very existence of global warming has become questionable.

In fact, 'global warming' as a term has not disappeared and is still widely used by the scientific community together with 'climate change'. **Both terms are used to describe different aspects of the process and complement each other rather than interchange.** 'Global warming' refers to an increase in the average temperature of the Earth's surface, while 'climate change' encompasses all other impacts that accompany this process (e.g. changes in precipitation, frequent and continuous droughts, ice melting, etc).

05 CLIMATE CHANGE AS A THREAT MULTIPLIER


MELTED
ICE
WATER
SOS

5.1 CLIMATE CHANGE AS A THREAT MULTIPLIER

Not so long ago, global warming and climate change were controversial issues for many. Yet today, there is more than enough scientific evidence on climate change and science has more comprehensive understanding of climate processes than even recently, 10 years ago. Consequently, many questions regarding climate change have been removed and approaches towards climate change reshaped. For more than a decade, climate change has been viewed in the context of development and security.

Today, defence and security agencies in many countries have joined international organizations and academia in carrying out climate change risk assessments. Discussions are increasingly being held about what climate change means for global stability and security.

The UN Security Council has started discussing linkages between climate change and security back in 2007 and intensified deliberations on this subject since 2011. Climate change has been recognized as a threat multiplier in the special 2009 report of the UN Security Council on Climate Change and Its Possible Security Implications.

Global warming and growing risks

IPCC AR5 forecasts indicate that "climate-related risks to health, livelihoods, food security, water supply, human security, and economic growth are projected to increase with global warming of 1.5°C and increase further with 2°C".

Box 2

5.2 HOW DOES CLIMATE CHANGE MULTIPLY THREATS?

The increase in the number of extreme weather events is one of the most striking manifestations of climate change that leads to devastating natural disasters. Natural disasters may result in human casualties, cause damage to infrastructure and housing and change livelihoods and the environment, affecting quality of life and leading to high post-disaster rehabilitation and recovery costs. For example, Georgia has spent $1.2 billion on disaster rehabilitation since 1999. According to forecasts, unless appropriate mitigation measures are implemented, natural disasters could cost $12 billion over the next 10 years[5].

The price Georgia pays because of climate change

Climate Change Costs for Georgia (Source: UNDP / GCF / SDC project)

Box 3

5 Data from UNDP / GCF / SIDA / SDC project "Climate Change Disaster Risk Reduction in Georgia."

Climate change impacts contribute to competition for natural resources (e.g. reduced river discharge or land desertification increase the demand for water and land, stressing existing tensions).

Climate change also poses risks for agriculture, reducing yields and aggravating other factors (e.g. pests and infections, land degradation), causing food deficits that are further aggravated by rising food prices. Countries consequently become more dependent on food imports. Extreme weather events undermine the food supply and can aggravate working conditions for those involved in agriculture.

Adaptation to climate change in the way out

1 DOLLAR INVESTED IN PREVENTION SAVES 7 DOLLARS IN RECOVERY COSTS

1.7 MLN PEOPLE, 40% of Georgia's population, better protected from climate-driven disasters

62 LIVES SAVED per year

3,500 PROPERTIES protected from damage

USD 58 MLN saved economic assets in the next 20 years

Box 4

Benefits of Climate Change Adaptation Action in Georgia (Source: UNDP/GCF/SDC Project)

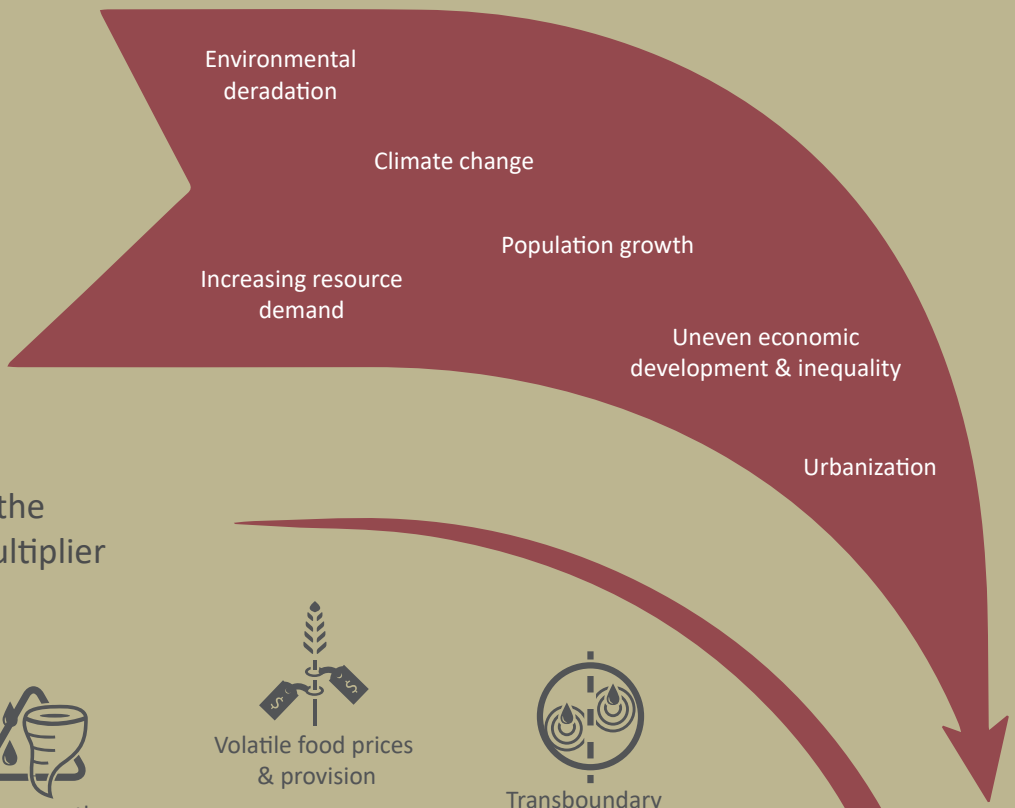
In addition to direct impacts, frequent natural disasters contribute to other adverse processes, such as mass human migration due to the loss of housing and livelihoods. Between 2008 and 2016, 20 million people worldwide migrated annually due to extreme natural disasters. According to the United Nations Office for Disaster Risk Reduction (UNDRR), climate change impacts may result in the number of eco-migrants (both within and between countries) between 25 million to 1 billion by 2050.

Despite the global character of climate change, it has a lot of specific for the region manifestations: shrinking water resources and land degradation are most intense on the African continent; tsunamis and storms mostly affect Southeast Asia; sea-level rise and and endangering with extinction small island states. An increased number and scale of natural disasters, melting of glaciers and agricultural impacts are most noted in Georgia.

If adaptation and risk reduction measures are implemented timely, the scale of climate change impact will be considerably reduced. This is why climate change calls for immediate attention and implementation of mitigation and adaptation measures.

Seven compound climate-fragility risks threaten states and societies

1. Global pressures are increasing



2. Climate change is the ultimate threat multiplier

06 INTERNATIONAL EFFORTS TO COMBAT CLIMATE CHANGE


CLIMATE IS CHANGING
COP 26
THERE
IS NO
PLAN B
1,5°C

6.1 TWO APPROACHES TO CLIMATE CHANGE

Climate change response requires a comprehensive approach that mitigates the root causes of climate change (i.e. reduction of GHG emissions) and prevents or reduces its negative impacts. These two approaches are known as climate change mitigation and adaptation.

Climate change mitigation refers to actions aimed at reducing GHG emissions and preserving and enhancing their sinks and reservoirs. In practice, this means switching from fossil fuels (e.g. oil, coal, gas) to non-carbon-based, renewable energy sources (e.g. water, sun, wind, etc.). This process is often referred to as the **decarbonization of the economy**. Increasing energy efficiency and removing CO_2 emissions by expanding forests and other "sinks" is another set of mitigation actions.

According to the 2018 **IPCC Report**, in order to limit global warming to 1.5^{0}C, global CO_2 emissions need to be reduced by approximately 45 percent by 2030 (versus 2010 levels) and reach net zero by 2050. **Net-zero CO_2 emissions means** that the amount of carbon dioxide emitted into the atmosphere is equal to the amount that is absorbed. This approach is known as **carbon-neutral development**. To date, 77 countries and more than 100 cities around the world have committed to reducing their carbon emissions to zero by 2050[6].

6 Statement of the UN Secretary General at the 2019 Climate Summit.

Adaptation to climate change refers to measures that allow to better prepare for projected climate change effects and minimize impacts of climate change on human systems. It may include measures that target large-scale infrastructure changes (e.g. flood protection walls at river banks), building early warning systems, or behavioral changes (e.g. purchasing flood or hail insurance, plating crops that are heat resistant and require less irrigation, etc.)

The effectiveness of these two approaches depends on joint efforts of all countries. GHG emissions affect global warming irrespective of their origin. Although contribution of various countries to GHG emissions vary vastly, impacts of climate change are manifesting all around globe, including in countries with relatively smaller or negligible share in GHG emissions. This is why climate change is a global challenge that concerns all. Efforts of separate countries to reduce GHG emissions will not yield any results, if others continue to emit GHG in same or growing quantities. Therefore, regulating emissions at global level by setting GHG reduction targets is a key to addressing this challenge. Success equally depends also on adaptation measures and sharing knowledge and experience between countries.

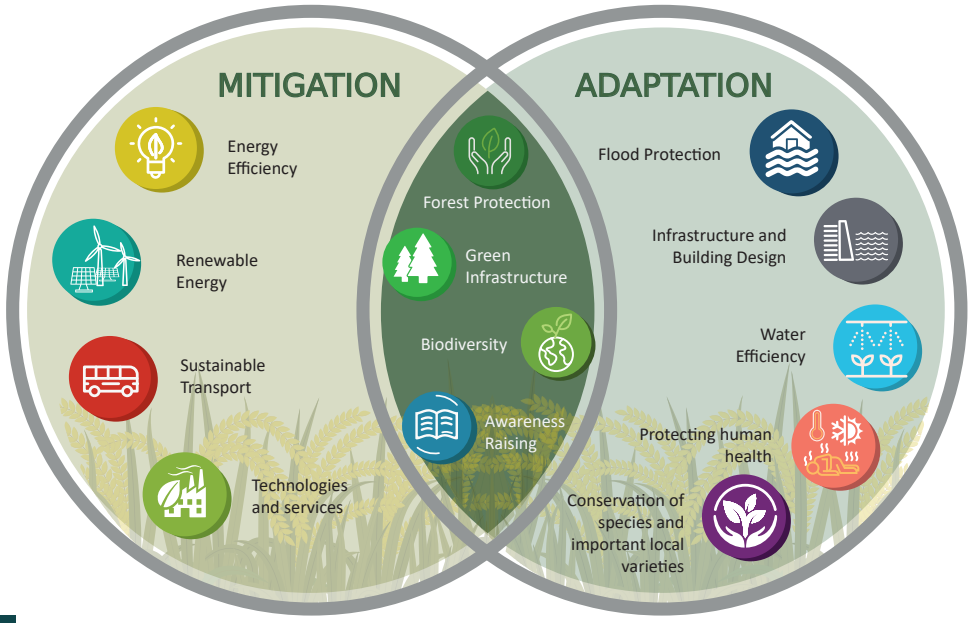


Figure 19:

Climate change

mitigation and adaptation measures

6.2 THE INTERNATIONAL LEGAL FRAMEWORK FOR CLIMATE CHANGE ACTION

Scientific evidence gathered in the late 1980s and growing concerns regarding changes in climatic conditions and its impacts put climate change on the global policy agenda. At the 1992 Earth Summit in Rio de Janeiro the United Nations (UN) member states adopted the first international treaty – the UN Framework Convention on Climate Change (UNFCCC) that sets out basic obligations to address and combat climate change. The UNFCCC has been signed and ratified by 196 countries and 1 regional organization[7]. The UNFCCC is a framework convention that creates an overall regime for addressing climate change. Specific and legally binding targets are outlined in other complementary treaties - the 1997 Kyoto Protocol (entered into force in 2005) and the 2015 Paris Agreement (entered into force in 2016).

Cutting down GHG emissions is only part of the solution. Unfortunately, our plant has already reached the point, when we need to deal with consequences of global warming. This is why all climate change treaties bring forward two parallel responses to the challenge- curbing GHG emissions, known as the climate change **mitigation strategy** and lowering risks of climate change impacts, known as the climate change **adaptation strategy**.

Countries' differing contributions to climate change have been a key obstacle on the way to finding effective, yet equitable solution to global warming that does not deprive countries of their basic right to develop. For this reason, the Convention is built on principles of **equity** and "**common but differentiated responsibility**". This means that the Convention offers different GHG emission regimes for individual countries. For example, it imposes a heavier burden on developed countries; they have to play a leading role in climate change action and reduce emissions to a greater extent than developing countries. These are referred to as '**Annex I countries**' and include all developed countries as well as the Russian Federation, Turkey, the Czech Republic, Belarus and Ukraine.

The Kyoto Protocol required 37 industrialized countries and the European Union to reduce GHG emissions on an average 5% below 1990 levels in the 2008-2012 period, whereas developing nations (including Georgia), that are part of 'Annex II countries', were given the choice to comply voluntarily and to gradually prepare for reducing their emissions.

Global Warming Trends

"Human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate (high confidence)." Source: IPCC 2018, Special report

Box 5

7 The regional organization that is party to the UNFCCC is the European Union.

6.3 WHY IS THE 2015 PARIS AGREEMENT IMPORTANT?

In 2013, the IPCC released the part of the Fifth Assessment Report (AR 5) that confirmed with high certainty (99-100% probability) that human influence is the dominant reason for warming temperatures recorded since the mid-20th century. The AR 5 also underlined those continued emissions of anthropogenic GHGs will cause further warming of climate triggering long-lasting changes in climatic conditions. In order to limit climate change, substantial and sustained reduction of GHG emissions is needed. This report once again brought to the attention of public and decision makers all around the globe the urgency of actions to limit global warming.

Climatologists warn that **countries' late 1990s-era commitments to GHG reduction as well as measures taken so far are not enough to prevent further increases in temperature**. If countries are to continue with current trends of GHG emissions by 2100, the global average temperature might rise by 4.1°C to 4.8°C[8]. This would lead to irreversible changes in weather system, intensify glacier and ice sheet melting, increase extreme weather events, accelerate other negative climate change impacts.

It was increased call to prevent climate crisis that led to years long negotiations to draft a new course of action to combat climate change. In 2015 these efforts yielded result and international community came together to hammer out an agreement known as **the Paris Agreement** with a stricter set of targets. The Paris Agreement sets **the target to limit global temperature rise to 2°C and intends to pursue efforts to limit this increase to 1.5°C**. If target is achieved, the risks and impacts of climate change will be significantly reduced. Table 1 presents the difference in outcomes between an increase in the global annual average temperature by 2°C compared to 1.5°C.

8 IPCC.

Table 1:

Comparison of Climate Change Impacts with Temperatures Increases by 1.5°C and by 2°C

Climate change impacts on some environmental characteristics	1.5°C limit	2°C limit
Sea level rise	48 sm	56 sm
Arctic ice cover	Without ice, once in 100 years	Without ice, once in 10 years
Glacier melting in the 21st century	76 mm	89 mm
Sea level rise by year 2100	0.26 - 0.77 m	0.3-0.83 m
Increased number of hot days	16%	25%
Average period of drought	2 months	4 months
Population at risk of water deficit	271 million	388 million
Population at risk in the coastal zones in case of sea-level rise	31-69 million	32- 80 million
Increase in heat wave periods	17 days	35 days
Probability of -10/+10% changes in by 2100	84%	73%
Wheat yields	-9%	-16%
Rice yields	+6%	+6%
Species to lose over 50% habitats:		
Plants	8%	16%
Invertebrates	6%	18%
Vertebrates	4%	8%
Insects	6%	18%

Source: primary source of information- IPCC Report: Global warming of 1.5°C (available at https://www.ipcc.ch/sr15/)

Reaching the target values of 2°C and 1.5°C would significantly reduce the risks and impacts of climate change compared to taking no action. As of January 2021, the Paris Agreement was signed by 197 Parties and ratified by 191 countries.

Other key commitments in the Paris Agreement include:

- Identifying Nationally Determined Contributions to combat climate change;
- Developing and implementing long-term low-emission development strategies; and
- Creating a global carbon market system to move countries to a low-emission economy.

Box 6: *National Contributions*

To achieve the goals set out in the Paris Agreement, countries draw up **Nationally Defined Contributions (NDC)**, document that sets out the country's planned reduction of GHG emissions by 2030 and its climate change adaptation priorities. The first round of NDC communications to the UNFCCC Secretariat started in 2015. Analysis showed that countries' commitments were not sufficient to limit temperature rise to 2°C. New, more ambitious GHG reduction targets were then set out in NDCs submitted in 2020 and 2021.

With its updated NDC, Georgia commits to a 35 percent reduction in GHG emissions by 2030 compared to 1990, and with international support, the potential for GHG reduction could increase to 50-57percent.

6.4 EFFORTS AT THE NATIONAL LEVEL

Georgia is actively involved in taking climate change mitigation and adaptation measures. This includes drafting sectoral policy documents, initiating legislative changes and implementing specific measures.

In its **NDC** (updated in 2021), Georgia committed to a 35 percent reduction in GHG emissions by 2030 compared to 1990. It also states that with international support, GHG reductions could increase to 50-57 percent below 1990 levels. The main goal of Georgia's NDC is to promote the country's sustainable and balanced development by equally addressing environmental and socio-economic challenges. Georgia's NDC, Climate Change Strategy 2030 and Action Plan for 2021-2023 set out specific measures for reducing GHG emissions in sectors such as energy generation, transport, construction, industry, agriculture, land use, forestry and waste management.

Georgia's updated NDC, the Climate Change Strategy 2030 and the Action Plan for 2021-2023 were approved by the Government of Georgia on April 8, 2021.

In parallel with reducing GHG emissions, equali-

ty important is to carry out adaptation measures, that encompass the most vulnerable sectors and resources, such as, mountain ecosystems, the Black Sea coast, tourism, agriculture, surface and groundwater resources, forestry and biodiversity.

The main purpose of the NDC is to facilitate sustainable and balanced development that gives same emphasis to environment as to socio-economic challenges. Implementation of the vision outlined in the NDC will considerably improve the quality of life of Georgian population.

Within the country's international commitments, a number of sectoral policy documents are being developed to support climate change adaptation and low-carbon development. These include the **Low-emission Development Strategy 2021-2050**, which defines the country's approaches to reducing GHG emissions in priority sectors/areas of economic activity, and **the Climate Change Adaptation Plan 2021-2030**, which identifies specific adaptation measures. As part of the **Covenant of Mayors** initiative, 13 self-governing municipalities have developed **Sustainable Energy Action Plans**, which outline their strategy and specific measures to reduce GHG emissions.

In 2019-2020, Georgia adopted laws on **energy labelling, energy efficiency and energy efficiency of buildings**. These laws aim to reduce GHG emissions and to facilitate the introduction and widespread use of low-emission technologies. Decisions made a few years ago to cut the excise tax on hybrid vehicles by 60 percent and to abolish import taxes on electric vehicles have encouraged the transition to low-emission vehicles. This has had a positive impact in terms of cutting travel costs and reducing GHG emissions and vehicular air pollution.

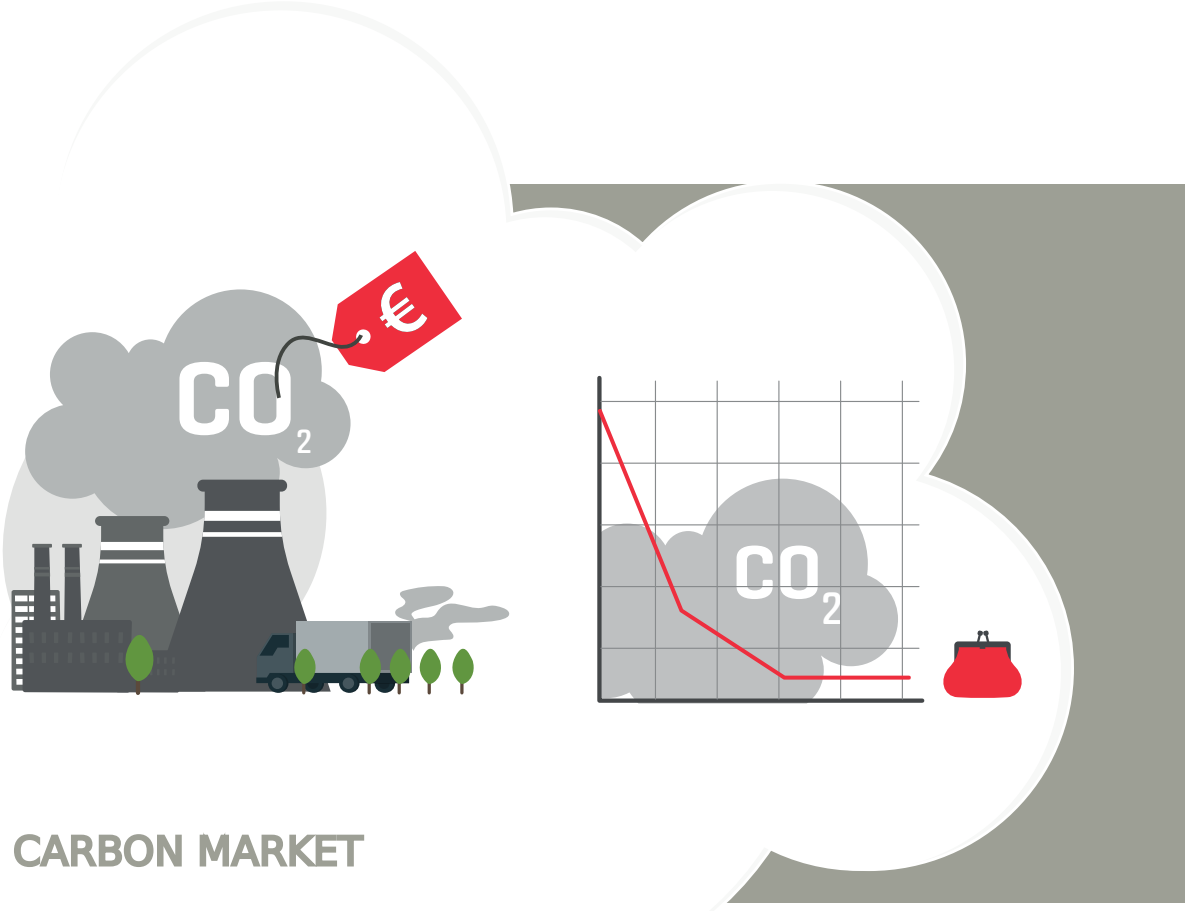
It is important to note that climate change mitigation and adaptation measures create new opportunities for economic growth, create new jobs and improve the quality of life (e. g. production and use of insulation materials for residential houses, use of renewable energy sources, water-saving irrigation methods, etc. promote economic growth and create new jobs).

Georgia is actively involved in working with the **Green Climate Change Fund** and the **Adaptation Fund**; it has received several tens of millions of dollars to implement significant adaptation measures. To support GHG emission reductions, international finance institutions are providing Georgia with technical assistance. It has also received access to grants and soft loans for energy efficiency projects in the processing industry and in the construction and household heating sector (e.g. insulation of houses). Replacing old municipal buses with buses using compressed natural gas and electric motor technologies allows to reduce GHG emissions from public transport. With international assistance and its own co-funding, Georgia has carried out works to prevent methane emissions from landfills.

6.5 WHAT IS A CARBON MARKET?

A **carbon market** is a system that uses market approaches to reduce GHG emissions. Most GHGs contain carbon molecules, hence the name. **Its main purposes include encouraging emission reductions and generating additional revenues for those who are actively reducing emissions.** Actors who reduce GHG emissions over the set limit have the opportunity to sell this surplus to those who are still emitting GHGs in excess of their allocated carbon budget.

The **EU Emission Trading System (ETS)**[9] has existed since 2005. It currently includes about 16,400 companies, which emit up to 50 percent of GHGs in the EU. The maximum amount of emissions is evaluated annually at the EU level, with maximum amounts trending downward from year to year. With these indicators in mind, companies are mandated to limit GHG emissions to a certain level or to purchase surplus emission credits.



CARBON MARKET

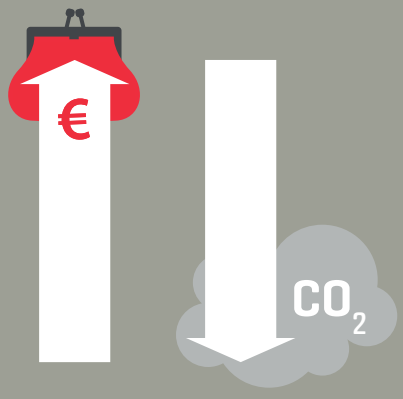
The ETS has enabled the EU to steadily reduce its overall GHG emissions. **Companies involved in the ETS cut their GHG emissions by 35 percent in 2019 compared to 2005**[10]. Similar schemes operate or are being introduced in Canada, China, Japan, New Zealand, South Korea, Switzerland, and some US states.

The Paris Agreement envisages the creation of an international/global carbon market that would enable countries to reach agreements on carbon trading, thus enabling participating nations to buy and sell carbon credits to help meet their commitments.

9 For more information see: https://ec.europa.eu/clima/sites/clima/files/docs/ets_handbook_en.pdf
10 EU Emission Trading System: https://ec.europa.eu/clima/policies/ets_en

EU countries (and Iceland) had committed to jointly achieving a 20 percent reduction in greenhouse gas emissions by 2020 (compared to 1990 levels). They have surpassed this goal, reaching a reduction of 23 percent. Even more, ambitious target indicators have been identified for the 2021–2030 period:

- Reducing greenhouse gas emissions by at least 40 percent (compared to 1990 levels);
- Achieving a share of energy from renewables that is at least 32 percent of the EU's production;
- Achieving energy efficiency improvements by at least 32.5 percent.

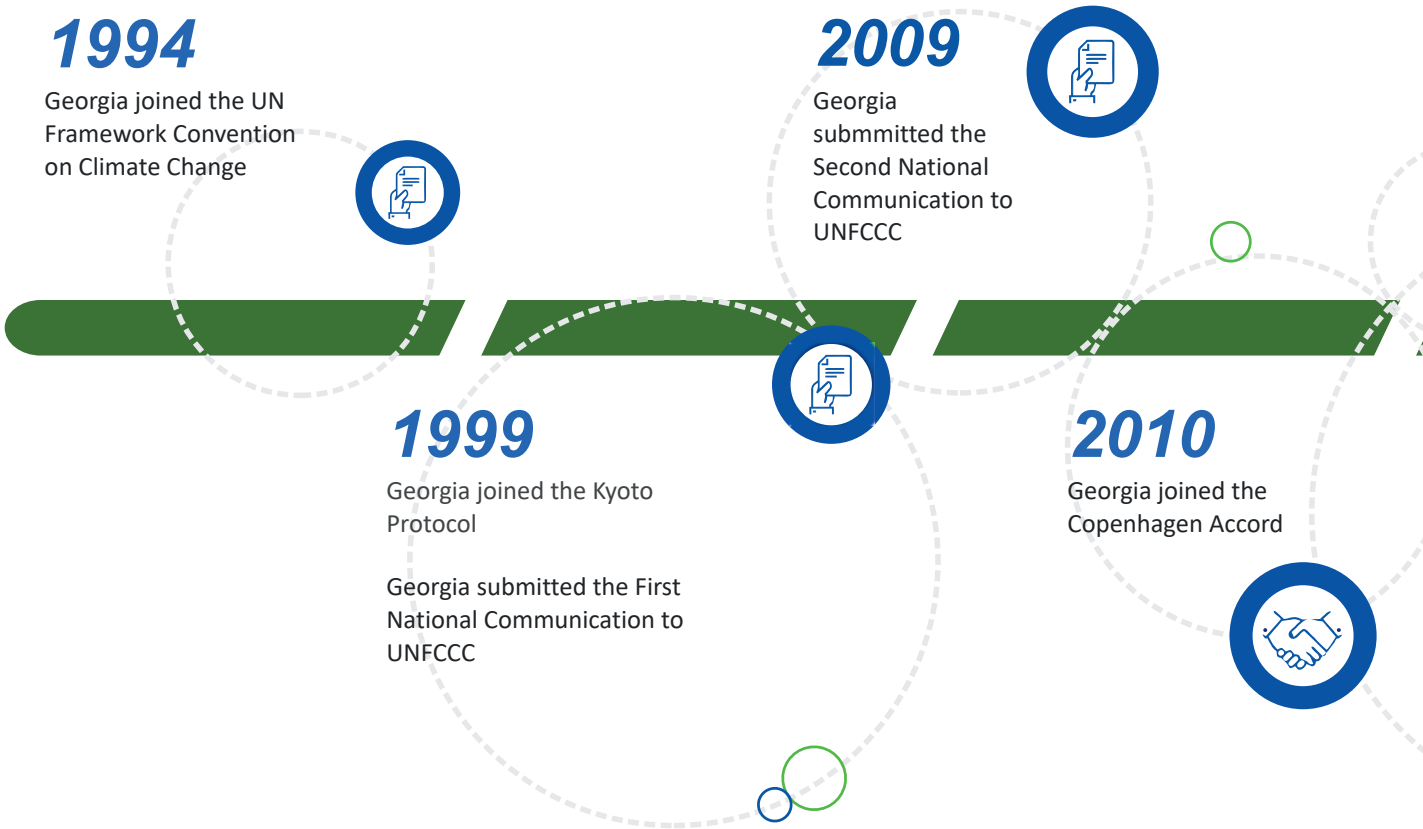


In December 2019, the EU presented a new economic growth strategy, known as the Green Deal. It aims to make the EU economy more modern, resource-efficient and competitive. The initiative developed an action plan that would boost the efficient use of resources by moving to a clean, circular economy, restoring biodiversity and cutting pollution.
The EU aims to be climate neutral by 2050. Reaching this target will require decarbonising its energy sector, increasing the energy efficiency of buildings, supporting industry innovation and rolling out cleaner, cheaper and healthier forms of private and public transportation.

For more information on the Green Deal, see: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

EU Climate Change Objectives **Box 7**

6.6 GEORGIA IN INTERNATIONAL CLIMATE PROCESS



13 CLIMATE ACTION

Figure 20: *Georgia and International Climate Change Process (Source: EU4Climate)*

2015

Georgia submitted the First NDC document

Georgia joined the Paris Agreement on Climate Change

2017

Georgia submitted the Third National Communication to UNFCCC

Georgia became a full memeber of the European Energy Community

2021

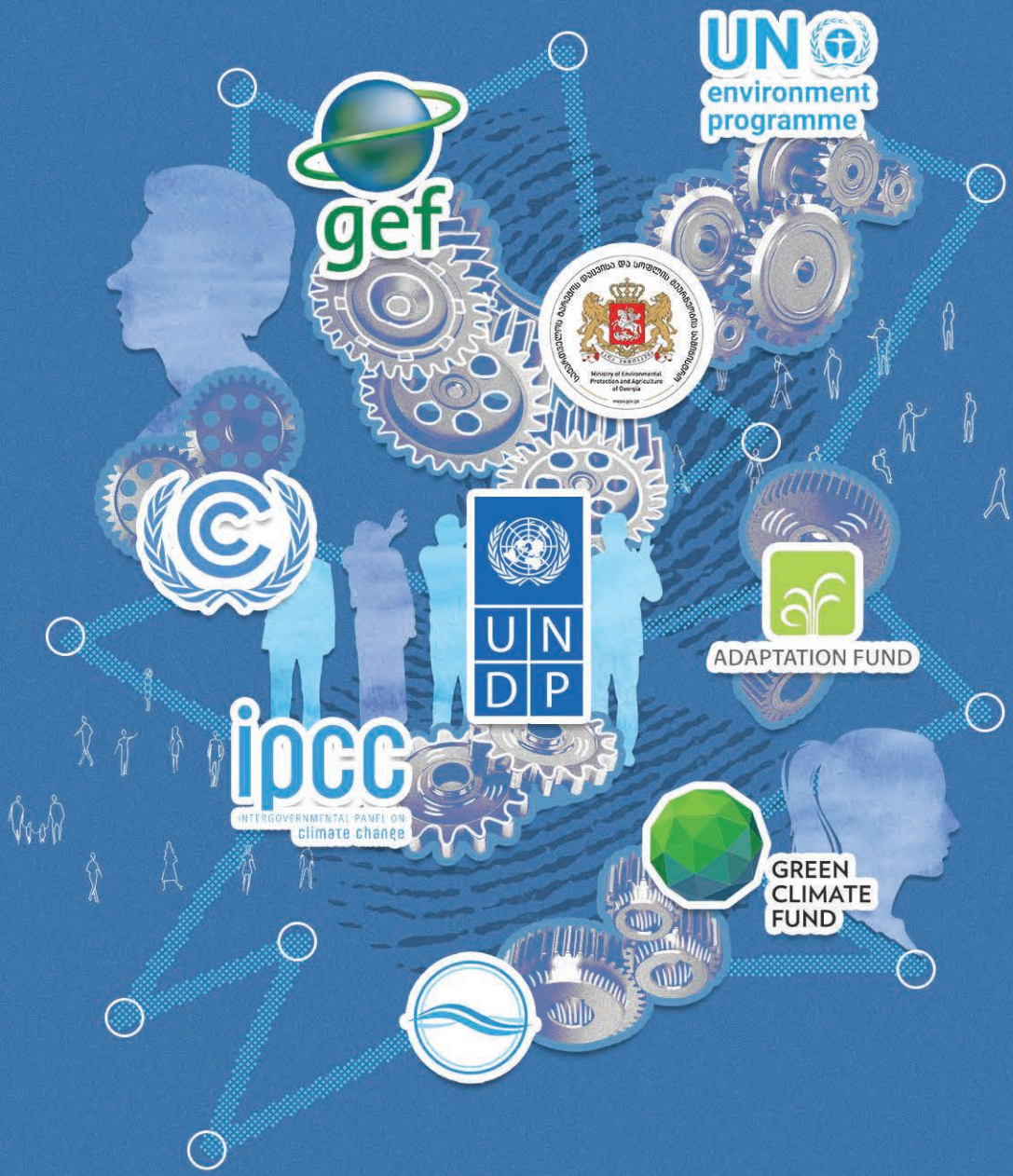
Georgia submitted to the UNFCCC updated NDC and the Fourth National Communication

The 2030 Climate Change Strategy and the 2021-2023 Action Plan were approved

Long Term Strategy for Low Emission Development is under preparation

National Plan for Energy and Climate Action Plan is under preparation

07 WHO IS WHO?


UN
environment
programme
gef
Ministry of Environmental Protection and Agriculture of Georgia
UNDP
ADAPTATION FUND
ipcc
INTERGOVERNMENTAL PANEL ON
climate change
GREEN
CLIMATE
FUND

7.1 AT THE INTERNATIONAL LEVEL

Conference of Parties (COP) – The supreme body of the UNFCCC. More information at: https://unfccc.int/process/bodies/supreme-bodies/conference-of-the-parties-cop

The Intergovernmental Panel on Climate Change (IPCC) – UN body that conducts regular scientific assessment on climate change and publishes assessment reports that are widely recognized as the most credible existing sources of information on climate change. The IPCC is independent of the Convention. More information at: https://www.ipcc.ch/

United Nations Development Program (UNDP) – implements most of its climate change projects in developing countries. It helps countries to develop projects and mobilize funds for their implementation. More information at: https://www.ge.undp.org/content/georgia/ka/home.html

UN Environment (UNEP) – focuses on assessing global, regional and national environmental conditions and tendencies and on developing international and national environmental instruments. A number of important environmental conventions were elaborated under its leadership. UNEP is also actively involved in the IPCC's activities implementing a number of climate change programmes. More information at: https://www.unep.org/

Adaptation Fund (AF) – was established to finance concrete adaptation projects and programmes in developing countries that are Parties to the Kyoto Protocol. More information at: https://www.adaptation-fund.org/

Green Climate Fund (GCF) – is an operating entity of the financial mechanism of the Convention. The GCF supports projects, programmes, policies and other activities in developing country Parties. More information at: https://www.greenclimate.fund/

Global Environment Facility (GEF) – offers grants for projects implemented in developing countries, including those related to climate change. More information at: https://www.thegef.org/

7.2 IN GEORGIA

The Georgian Climate Change Council (CCC) was established in January 2020. The Council's goal is to effectively implement the requirements of the UNFCCC, the Kyoto Protocol and the Paris Agreement in Georgia through the coordination of public agencies. CCC members include heads of the Georgian Ministry of Environmental Protection and Agriculture; Ministry of Economy and Sustainable Development; Ministry of Finance; Ministry of Regional Development and Infrastructure; Ministry of Education and Science; and the Ministry of Internally Displaced Persons from the Occupied Territories, Labour, Health and Social Affairs. The Council also involves the Chairmen of the Government of the Autonomous Republics of Adjara and Abkhazia, Chairman of the Covenant of Mayors Signatory Municipalities Coordination Group and Executive Director of the National Statistics Office of Georgia. According to the Council's statute, the function of the CCC's Secretariat is fulfilled by the Climate Change Division of the Environment and Climate Change Department at the Ministry of Environment and Natural Resources of Georgia.

Climate Change in the Georgia-EU Association Agreement

"Under this Agreement, inter alia, Georgia commits to combating climate change and working closely with the EU on climate change issues. In particular, Georgia undertakes to develop a National Climate Change Adaptation Action Plan and a low-emission development strategy to facilitate technology transfer and to implement action to decrease the use of ozone-depleting substances and fluorinated greenhouse gases. In its turn, the EU commits to helping Georgia meet these obligations, both financially and technically."

Box 8

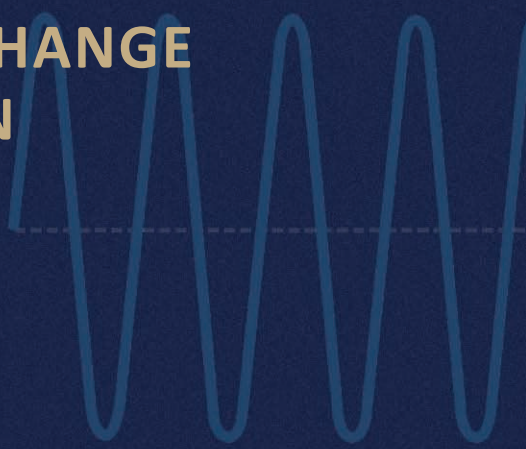
The Ministry of Environmental Protection and Agriculture of Georgia is the key state agency responsible for climate change policymaking and implementation. The Ministry represents the country at international climate change forums and provides communication and reporting to the UNFCCC. It also drafts relevant laws and prepares proposals for high-level government discussions on climate change policy. **The Ministry's Environment and Climate Change Department** and its subordinate **Climate Change Division** work on these issues.

The National Environment Agency carries out research, prepares and disseminates information, forecasts and warnings on hydrometeorological and geodynamic processes. The agency plays a key role in the operation of the early warning system to reduce disaster risks. Climate change issues mainly fall under the competence of the **Departments of Hydrometeorology and Geology**.

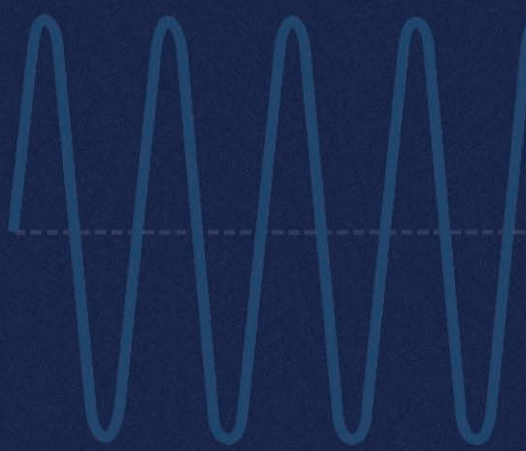
Other ministries and agencies directly involved in climate change activities include

- **Ministry of Economy and Sustainable Development**, which works on policies in the energy, construction and transport sectors, which are crucial to mitigating climate change;
- **Ministry of Regional Development and Infrastructure**, which implements infrastructure projects to mitigate and adapt to climate change; and
- **Municipalities**, including 23 municipalities that have signed the Covenant of Mayors that obliges them to reduce greenhouse gas emissions and develop climate change adaptation plans.

08 CREDIBLE SOURCES OF CLIMATE CHANGE INFORMATION




Students drafted in to plug
The New York Times
A Wider Net In an Inquiry At City Hall
A NEW PARIS PLOT BEFORE BRUSSELS SPREADS CONCERN
BBC NEWS
FM
AM



08 CREDIBLE SOURCES OF CLIMATE CHANGE INFORMATION

8.1 TYPES OF CLIMATE CHANGE REPORTING

At the international level

IPCC Assessment Reports provide objective scientific information on climate change, its economic impacts and risks and discuss ways of mitigating climate change impacts. The Summary for Policymakers is a Board of Trustees document intended for a wider audience. IPCC recently (August 2021) released its the Sixth Assessment Report with accompanying headline statements to facilitate communication.

At the national level

Documents officially submitted under the UNFCCC are countries' most credible and informative sources of information on greenhouse gas emissions and the trends and impacts of climate change.

The Parties to the Convention, including Georgia, regularly prepare and submit two types of documents:

- **National Communications** - these are important documents that inform sectoral policies in the country in terms of climate change. They provide information on the country's fulfilment of its obligations under the Convention. In particular, this document reflects information on the following issues: country context, greenhouse gas inventory, mitigation and adaptation measures, capacity building, technological needs, as well as information on climate change trends and forecasts. National Communications are available in Georgian and English.
- **Biennial Report** are prepared by Annex I countries to present data on emission reduction targets and progress by economic sectors. Non-Annex I countries, including Georgia, prepare **Biennial Update Reports**. These reports provide results of national GHG inventories and information on mitigation measures and emission reductions. These documents inform the planning of GHG reduction measures in the country and effective implementation of relevant sectoral policies; they also provide detailed information on GHG emissions by industry and year.

The main findings and key messages in the National Communications and Biennial Update Reports are set out in their Summary sections. Links to these documents are given in the References section of this document.

As of September 2021, Georgia already submitted four National Communications to the Conference of the Parties (in 1999, 2009, 2015 and 2021) and three Biennial Update Reports (2016, 2019 and 2021).

Under the Paris Agreement, a new reporting process starts in 2024. This new process requires all countries to regularly submit **Biennial Transparency Reports** to the Convention in place of Biennial Report/ Biennial Update Reports. This commitment will enter into force for Georgia in 2024.

8.2 CREDIBLE SOURCES ON CLIMATE CHANGE

Information on climate change in Georgia can be obtained from the following trusted sources:

- **Georgia's National Communications to the UNFCCC** are available on the UNFCCC website at https://unfccc.int/non-annex-I-NCs.These documents are available in Georgian on the website of the Environmental Information and Education Centre at http://eiec.gov.ge/თემები/კლიმატის-ცვლილება/Documents/Strategic-Document.aspx
- **The National Adaptation Action Plan and the National Low-Emission Development Strategy** are now underway. The documents will offer an additional reliable source of information on climate change in Georgia. These documents outline specific, planned actions to reduce greenhouse gas emissions and enhance the country's adaptation potential.
- Georgia's climate change policy and actions are also reflected in **the Third National Environmental Action Plan for 2017-2021**, available at: http://eiec.gov.ge/NavMenu/Documents/Action-Plan.aspx
- Other credible, yet unofficial, sources are documents developed within the technical assistance projects funded by donor organizations, in

  - Climate Change Adaptation RoadMap, available at: http://nala.ge/climatechange/uploads/RoadMap/RoadMap_Geo.pdf

- Climate Change and Sustainable Development, available at: http://weg.ge/sites/default/files/climate_change_and_sustainable_development.pdf
- Climate Change and Security in the South Caucasus, available at: https://www.osce.org/secretariat/355546?download=true

Global climate change information is available from the following reliable sources:

- **UN** website dedicated to climate change, also including information on planned events, available at: https://www.un.org/climatechange/
- **European Union** website provides detailed information on EU climate change policies, available at: https://ec.europa.eu/info/policies/climate-action_en
- **Covenant of Mayors** website containing a database of the Sustainable Energy (and Climate) Action Plan of the signatories (including Georgia) and information on the Covenant itself, available at: https://www.covenantofmayors.eu/en/
- **World Resource Institute (WRI)** is a global research organization uniting scientists and researchers, available at: https://www.wri.org/our-work/topics/climate
- **Climate Watch** is WRI's online platform that offers open data, visualizations and analysis to help policymakers, researchers and other stakeholders gather insights on countries' climate progress. It is available at: https://www.climatewatchdata.org/
- **The Guardian, BBC, New York Times and Deutsche Welle** (also DW in English) are leading media outlets that actively cover climate change issues. Websites are available at:
  - https://www.theguardian.com/environment/climate-change
  - https://www.bbc.com/news/topics/cmj34zmwm1zt/climate-change
  - https://www.nytimes.com/section/climate
  - https://www.dw.com/en/top-stories/climate-change/s-13967
- **World Economic Forum:** available at: https://www.weforum.org/agenda/archive/climate-change/
- **Climate Action Network** disseminates information on processes related to climate change policies, available at: https://climatenetwork.org/
- **Graphics on the NASA website:** available at: https://climate.nasa.gov/resources/graphics-and-multimedia/?page=0&per_page=25&order=pub_date+desc&search=&condition_1=1%3Ais_in_resource_list

- **Graphics on the WRI website:** available at: https://www.wri.org/blog/2017/04/climate-science-explained-10-graphics
- **Climate change in media:** available at: https://www.coveringclimatenow.org/
- **Communications on climate change:** available at: https://www.youtube.com/watch?v=zO23d8ze7pM

Terms used in IPCC report	What does it mean in terms of likelihood of the outcome
Virtually certain	99–100% probability
Very likely	90–100% probability
Likely	66–100% probability
About as likely as not	33 to 66% probability
Unlikely	0–33% probability
Very unlikely	0–10% probability
Exceptionally unlikely	0–1% probability

Additional terms:

- Extremely likely 95–100%;
- More likely than not >50–100%;
- More unlikely than likely 0–<50%;
- Extremely unlikely 0–5% are also used when appropriate.

The Language of Climate Change Impact Assessment Reports
source: IPCC

Box 9

ENGLISH-GEORGIAN DICTIONARY

OF CLIMATE CHANGE TERMS

GLOSSARY OF CLIMATE CHANGE

ACRONYMS AND TERMS

ENGLISH-GEORGIAN DICTIONARY OF CLIMATE CHANGE TERMS[11]

Adaptation - ადაპტაცია

Afforestation - ტყის გაშენება

Agriculture, Forestry, Land Use (AFLU) - სოფლის მეურნეობა, სატყეო მეურნეობა და მიწათსარგებლობის სექტორი

Anthropogenic - ანთროპოგენული/ადამიანის მოქმედებით გამოწვეული

Biennial Update Report (BUR) – ორწლიანი განახლებადი ანგარიში

Business As Usual (BAU) Scenario – საქმიანობის ტრადიციული გზით განვითარების სცენარი

Clean Development Mechanism (CDM) - სუფთა განვითარების მექანიზმი

Conference of Parties (COP) - მხარეთა შეთანხმება

Covenant of Mayors (CoM) - მერების შეთანხმება

Decayed Organic Carbon (DOC) – დაშლადი ორგანული ნახშირბადი

Emission Factor - ემისიის კოეფიციენტი

Environmental Impact Assessment - გარემოზე ზემოქმედების შეფასება

Evaporative emissions - აორთქლებადი ემისიები

Fossil Fuel - წიაღისეული საწვავი

Fugitive emissions - აქროლადი ემისიები

Global Warming - გლობალური დათბობა

Good Practice Guidance (GPG) – კარგი პრაქტიკის სახელმძღვანელო

Greenhouse gases - სათბურის აირები (CO_2, CH_4 , N_2O, HFCs, PFCs, SF6)

Greenhouse gases emission - სათბურის აირების გაფრქვევა

Heating Degree Days (HDD) index - გასათბობი გრადუს-დღეების ინდექსი

Industrial Processes and Product Use (IPPU) - სამრეწველო პროცესებისა და პროდუქტების მოხმარების სექტორი

Intended Nationally Determined Contributions (INDC) - ეროვნულ დონეზე წინასწარ განსაზღვრული წვლილი

Land Use, Land Use Change and Forestry (LULUCF) – მიწათსარგებლობა, ცვლილება მიწათსარგებლობაში და სატყეო მეურნეობა

Liquefied Petroleum Gas - თხევადი გაზი

Low Emission Development Strategy (LEDS) - დაბალემისიანი განვითარების სტრატეგია

Low Heating Value - დაბალი თბოუნარიანობა

Mitigation - შერბილება

Mitigation Action - შერბილების ღონისძიება

Monitoring/Measurement-Reporting-Verification (MRV) – მონიტორინგი/გაზომვა, ანგარიშგება და გადამოწმება

National Adaptation Programmes of Action (NAPA) – ადაპტაციის ეროვნული სამოქმედო პროგრამები

National Communication - ეროვნული შეტყობინება

Nationally Appropriate Mitigation Actions (NAMA) - ეროვნულ დონეზე მისაღები შემარბილებელი ღონისძიებები

Nationally Determined Contributions (NDC) - ეროვნულ დონეზე განსაზღვრული წვლილი

Non-annex 1 country – ქვეყანა, რომელიც არ არის I დანართში

Permafrost - მზრალობა

Reforestation - ტყის მასივების აღდგენა

11 Source: Climate change and sustainable development - study material, 2016 (in Georgian), World Experience for Georgia.

GLOSSARY OF CLIMATE CHANGE ACRONYMS AND TERMS[12]

Adaptation – Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Annex I Parties – The industrialized countries listed in Annex I to the Convention, which committed to returning their greenhouse-gas emissions to 1990 levels by the year 2000. They have also accepted emissions targets for the period 2008 – 2012 as per the Kyoto Protocol. They include the 24 original OECD members, the European Union and 14 countries with economies in transition.

Annex II Parties – The countries listed in Annex II to the Convention that have a special obligation to provide financial resources and facilitate technology transfer to developing countries. Annex II Parties include the 24 original OECD members plus the European Union.

Carbon sequestration – The process of removing carbon from the atmosphere and depositing it in a reservoir.

Clean Development Mechanism (CDM) – A mechanism under the Kyoto Protocol through which developed countries may finance greenhouse-gas emission reduction or removal projects in developing countries and receive credits for doing so, for which they may apply to meet emission reduction

EIT – Countries with Economies in Transition. Central and East European countries and former republics of the Soviet Union in transition from state-controlled to market economies.

Global warming potential (GWP) – An index representing the combined effect of the differing times greenhouse gases remain in the atmosphere and their relative effectiveness in absorbing outgoing infrared radiation.

Greenhouse gases (GHGs) – The atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N20). Less prevalent —but very powerful — greenhouse gases are hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

Joint implementation (JI) – A mechanism under the Kyoto Protocol through which a developed country can receive "emissions reduction units" when it helps to finance projects that reduces net greenhouse-gas emissions in another developed country (in practice, the recipient state is likely to be an EIT nation).

Kyoto Protocol – An international agreement standing on its own and requiring separate ratification by governments but linked to the UNFCCC. The Kyoto Protocol, among other things, sets binding targets for the reduction of greenhouse-gas emissions by industrialized countries.

Mitigation – In the context of climate change, a human intervention to reduce the sources or enhance the sinks of greenhouse gases. Examples include using fossil fuels more efficiently for industrial processes or electricity generation, switching to solar energy or wind power, improving the insulation of buildings, and expanding forests and other 'sinks' to remove greater amounts of carbon dioxide from the atmosphere.

National communication – A document submitted in accordance with the Convention (and the Protocol) by which a Party informs other Parties of activities undertaken to address climate change.

12 Source: https://unfccc.int/process-and-meetings/the-convention/glossary-of-climate-change-acronyms-and-terms.

Nationally Determined Contributions – A document that set out the country's planned reduction of GHG emissions by 2030 and its climate change adaptation priorities.

Non-Annex I Parties – Refers to countries that have ratified or acceded to the United Nations Framework Convention on Climate Change that are not included in Annex I of the Convention.

Parts per million – is a unit used to measure very low concentrations. This number tells how many parts of greenhouse gases there are in one million parts of air.

REDD - Reducing Emissions from Deforestation and Forest Degradation.

Renewable energy – is energy generated from resources that are constantly available and can replenish naturally.

Rio+20 – The United Nations Conference on Sustainable Development, held in Rio de Janeiro, Brazil, in 2012. The first UN Conference on Sustainable Development was the Earth Summit, held in 1992.

Technology transfer – A broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change among different stakeholders.

Vulnerability – The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.

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