Natural carbon sinks - status, policy and trends

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Abstract: According to the scientific community, human activity is the main source of climate change, and carbon dioxide (CO2) is the greenhouse gas that humanity emits in the largest quantitie. Climate change, as a component of the natural environment, has a huge impact on human society. Having more greenhouse gases in the atmosphere than the earth can naturally absorb traps excess heat and raises global temperatures. In this regard, the EU adopted the European Climate Law as a key element of the European Green Deal. The Union's ambitions are to reduce emissions by 55% compared to 1990 levels by 2030, and to achieve carbon neutrality in terms of climate by 2050, i.e., building a society and economy with zero emissions. The purpose of this report is to reveal the gobal temperature trends as an important indicator of the scale of climate change and its possible impacts on various spheres of vital importance for the planet's population such as agriculture, construction, transport, tourism, healthcare, etc. The subject of research is the model of global warming trends. The results of the research **provide an opportunity for the development of strategic solutions to increase competitive advantages and make them more sustainable in the conditions of a highly competitive environment.**

1 Introduction

Climate change, as a component of the natural environment, has a huge impact on human society [1]. Its influence is expressed through impact on various spheres of vital importance for the population of the planet, such as agriculture, construction, transport, tourism, health, etc. [2].

Global temperature trends are an important indicator of the scale of climate change and its possible impacts [3]. In recent years, we have witnessed natural disasters such as devastating floods, prolonged droughts, forest fires, strong storms, hurricanes and unbearable heat. The global average temperature has risen by more than 1°C compared to the pre-industrial period [4]. The data shows that the last 8 years (2015–2022) are the warmest in human history (Fig. 1).

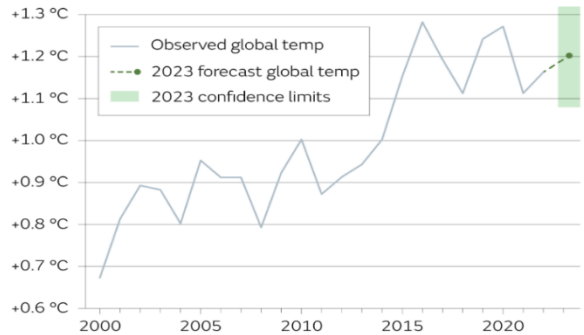

Fig.1. Average annual temperature values for the period 2000-2023 [5]. Source: **https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2022/2023-global-temperature-forecast**

Computer models predict a continued rise in global temperature by 2100 in the range of 4 -5^{0}C (Fig.2).

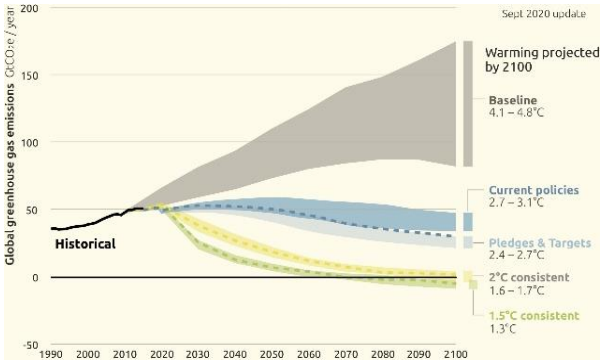

Fig. 2. Model of global warming trends. Source: **https://www.climatemedicine.net/climate-projections**

Anthropogenic activities, and especially greenhouse gas emissions, are largely responsible for this warming [6, 7].

The 2015 Paris Climate Agreement, signed by 195 countries around the world, calls for action to limit the rise in global temperatures to below 2°C above pre-industrial levels by 2050, with the possibility of limiting the increase to 1.5°C. [8]

Achieving a zero balance of carbon emissions does not mean completely getting rid of them, but finding an opportunity for their compensation and inadmissibility of possible growth.

2 Literature review

Climate change is caused by excess greenhouse gases. Having more greenhouse gases in the atmosphere than the earth can naturally absorb traps excess heat and raises global temperatures. [10] In fig. 3 presents the impact of increasing greenhouse gases with global warming.

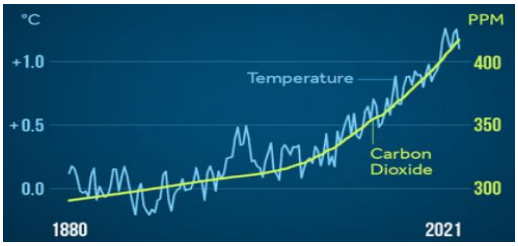

Fig.3. Impact of CO2 on global temperature. **Source:** https://cbs6albany.com/weather/weather-extra/soaring-co2-raising-global-temperatures-another-record-set-this-year-2022

According to the scientific community, human activity is the main source of climate change and carbon dioxide (CO2) is the greenhouse gas that mankind emits in the largest quantities. By 2023, CO2 represents 64% of the total amount of greenhouse gases, followed by methane (CH4) with 18%, nitrogen oxide (N2O) with 4% and fluorinated gases (HFC, PFC, SF6) – 2% (Fig.4). [11]

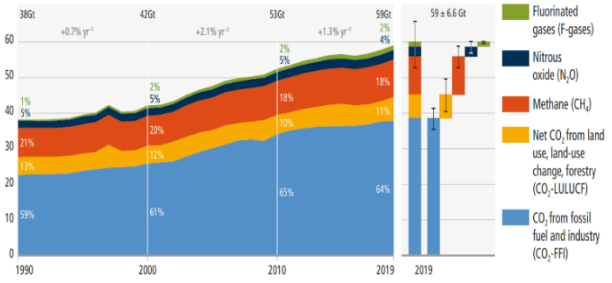

Fig.4. Distribution of types of greenhouse gases emitted by human activities, 2023. Source: https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_FullReport.pdf

According to data for 2019, global emissions amounted to 59 Gt. (fig.5) The EU generates 8% of them. [11] The largest emitter is the East Asia region with 27%, followed by the North America region with 12% and Latin America and the Caribbean with 10%.

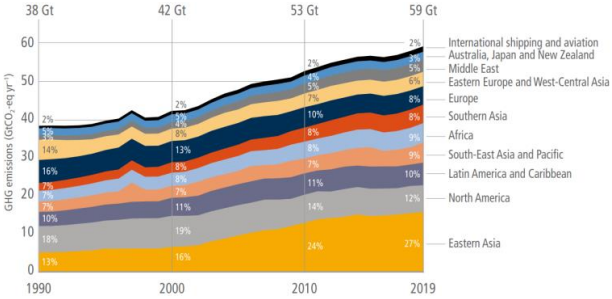

Fig.5. Global net anthropogenic GHG emissions by region (1990–2019). Source: https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_FullReport.pdf

Distribution of generated greenhouse gases by sector is presented in fig. 6.

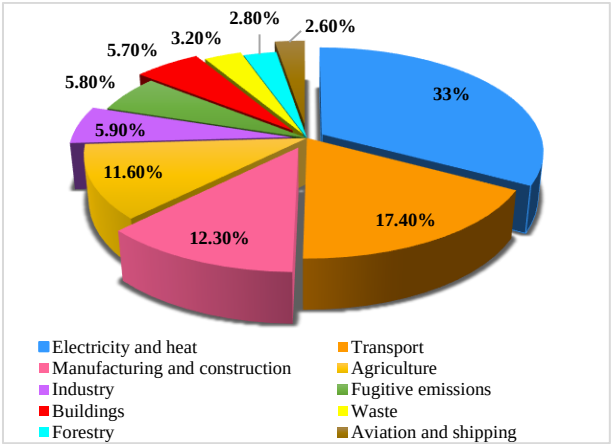

Fig. 6. Sectoral distribution of greenhouse gases, 2019. **Source:**https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_FullReport.pdf

The largest share falls on the energy sector (33%), followed by the transport sector (17.4%).

In line with the goals of the Paris Agreement, on December 12, 2019, the European Council reached an agreement on climate neutrality by 2050. A year and a half later, on June 28, 2021, it adopted the European Climate Law as a key element of the European Green Deal . The Union's ambitions are to reduce emissions by 55% compared to 1990 levels by 2030, and to achieve carbon neutrality in terms of climate by 2050, i.e. building a society and economy with zero emissions.

Carbon neutrality refers to a state in which greenhouse gas emissions caused by human activity equal the amounts that are captured and released into the atmosphere. [12]

In this regard, on 14.03.2023, the EU adopted a law on carbon sinks from the land use and forestry sector. [13] The goal is to increase carbon sinks in the EU by 15% by 2030. All member states set binding national targets, with penalties for non-compliance provided for non-compliance. For Bulgaria, the value of net greenhouse gas emissions must be reduced by 9.718 million tons of CO2 equivalent by 2030.

A ***greenhouse gas sink*** is any process, activity, or mechanism that results in the removal of a greenhouse gas, a precursor, or an aerosol from the atmosphere.

According to the current regulation (from 2018), each member state must ensure that emissions from the sector are offset by at least an equivalent amount of removals in the period 2021-2030. New rules envisage a two-stage approach to meet the new target, containing two phases (2023)

According to Phase 1 - until 2025, the current system remains in force, with each member state obliged to balance emissions and removals.

According to Phase 2 - in the period 2026 - 2030, the new target (at EU level) of net removals of 310 Mt should be approached.

In fig. 7 presents the status of the level of carbon absorption in the EU in 2019 (in the amount of 249 million tons of CO2, the current target (-225 Mt CO2) and the new target (-310 Mt CO2).

Mt = million tons of CO2 equivalent

Fig. 7. Status, current target and updated target for CO2 sinks from the land use and forestry sector.

Given that plants and especially trees are natural sinks that absorb CO2 from the atmosphere and capture it as part of the photosynthesis process, the removal of CO2 through carbon 'sinks' has become an EU policy priority.

3 Research and discussions

The land use and forestry sector absorbs more carbon than it emits into the atmosphere. This defines it as a net carbon sink. Forests in the EU absorb the equivalent of almost 10% of all greenhouse gas emissions generated by the Union [14].

The EU has an area of 4.104 million km² [15] The total area of forests in the Union by 2021 is 159 million hectares. According to Eurostat data, they occupy 39% of the territory of the countries of the Community. [16] In five of the countries, more than 50% of the territory is occupied by forests (Fig. 8).

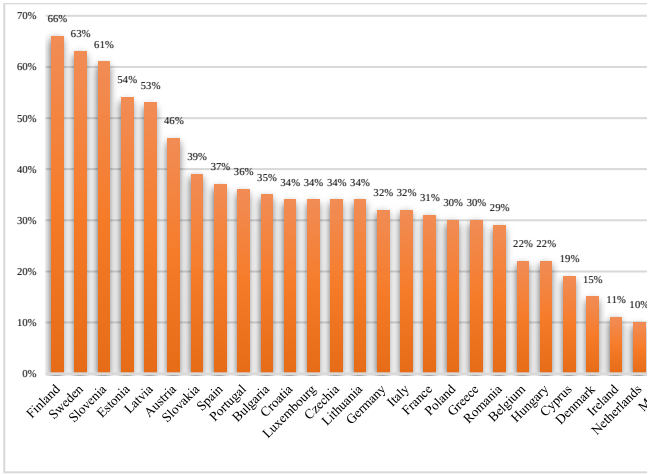

Fig. 8. Areas covered by forests in EU countries, 2020. Source: **https://ec.europa.eu/eurostat/web/products-eurostat-news/-/edn-20210321-1**

These are Finland (66%), Sweden (63%), Slovenia (61%), Estonia (54%) and Latvia (53%). Bulgaria is in 10th place with a 35% share of forest massifs. Last in the ranking is Malta with 1%.

According to the latest data from FAO, fallow land in the EU-27 in 2019 was about 6.1 million hectares, which represents 6% of arable agricultural land. The share of fallow land varies considerably between Member States (fig.9). Spain has the most of them. [17]

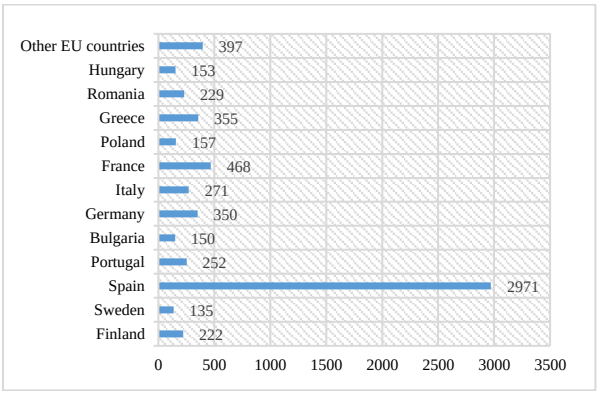

Fig. 9. Wasteland in EU countries, 1000 hectares in 2019. Source: **https://eu.boell.org/sites/default/files/2022-04/E-Paper%20Analysis%20fallow%20land.pdf**

Forests have a key role in maintaining ecosystems in nature and balancing greenhouse gas emissions as a result of human activity.

The total emissions of greenhouse gases in Bulgaria as of 2020 are 57 MtCO2 (Fig. 10). [18] Taking into account the reported removals from the sector "Land use, agriculture and forestry", for the same period the country emitted 48.7 MtCO2e. Compared to the data of 2005, the reduction by 6.7% [19].

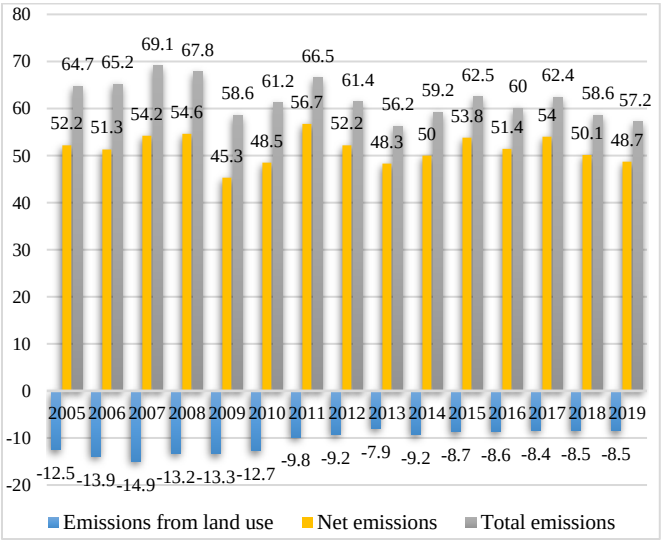

Fig. 10. Total emissions of greenhouse gases in Bulgaria, 2005-2019. Source: **https://eea.government.bg/bg/soer/2019/climate/climate1**

Distribution of sources generating greenhouse gases by sector is summarized in fig. 11.

The sector that emits the largest amount of greenhouse gases in Bulgaria is the energy sector (39%), followed by the transport sector (16%) and industry (12%).

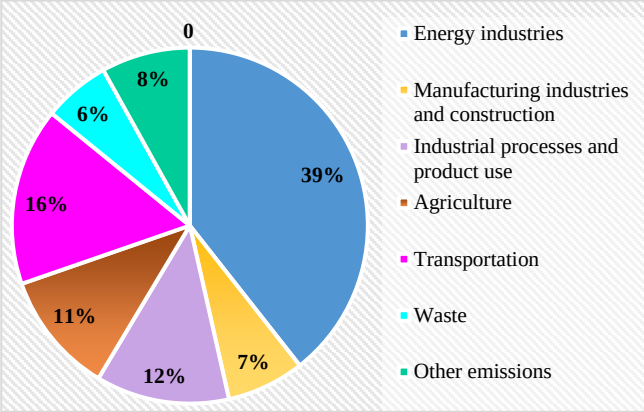

Fig. 11. Distribution of greenhouse gas emissions by sector in Bulgaria, 2019.

4 Conclusion

In nature, there are natural systems that absorb carbon dioxide – such as soils, forests and oceans. The problem is that natural systems cannot cope with the current level of emissions. They are estimated to absorb between 9.5 and 11 gigatons of carbon dioxide per year. Human-caused emissions reached 38 gigatons in 2019.

Although work is being done on the construction of installations to withdraw carbon emissions from the atmosphere, at the moment they cannot reach a scale that would make a real contribution to the fight against global warming.

An additional problem is that forests and other natural absorption systems are only effective if they are maintained. Forest fires, logging and deforestation are moving us away from carbon neutrality.

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