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Are We the Reason for Climate Change?

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Abstract: ***Climate change is a pressing global issue, primarily driven by human activities such as burning fossil fuels, deforestation, and industrial processes, which release greenhouse gases into the atmosphere. This study explores the evidence supporting the human role in climate change, assessing individual carbon footprint patterns and their contribution to greenhouse gas emissions. It discusses various human activities leading to carbon emissions and presents a method for calculating individual carbon footprints. Additionally, it outlines strategies to reduce carbon footprints, including using public transport, minimizing electricity usage, and promoting sustainable practices like recycling and planting trees. This study highlights the urgent need for collective action to address climate change, emphasizing the critical importance of transitioning to sustainable energy sources and adopting mitigation strategies to limit temperature rise.***
Keywords: Human Activities, Carbon Emission, Carbon Footprint, Greenhouse Gases, Global Warming, Climate Change.

I. INTRODUCTION

Climate change is the change of the temperature or weather patterns. This climate change occurs mainly because of two things, one is Natural processes and other is Human activities. It is extremely likely (> 95%) that human activities have been the main cause of climate change. Human activities, such as burning fossil fuels, deforestation, and industrial processes, result in the emission of greenhouse gases, primarily CO2. These carbon emissions will lead to the accumulation of greenhouse gases in the atmosphere. Increased concentration of greenhouse gases, resulting from human activities, leads to global warming, which in turn causes changes in climate patterns.

The Earth's temperature has been steadily increasing since 1850, with an average rise of 0.11°F (0.06°C) per decade. 2023 has the highest average temperature since 1850. Many researchers are not unfolding the facts that human daily activities lead to climate change by analysing the individual's carbon footprint patterns. One's carbon footprint is the total amount of greenhouse gases released by his actions in his whole life. This paper aims to explore the evidence supporting the human role in climate change, assess the individual's carbon footprint patterns.

II. HUMAN ACTIVITIES LEADING TO CARBON EMISSION

Human activities can increase the carbon footprint of the individual, organization, etc. Few of the human actions that lead to carbon emission are (1) Combustion of fossil fuels such as coal, oil, and natural gas for electricity generation, transportation, heating, and industrial processes (2) Vehicles powered by gasoline and diesel engines by burning fuel for propulsion (3) Many industrial activities release greenhouse gases as byproducts of manufacturing processes (4) Deforesting for agriculture, logging, urban development, and other purposes reduces the number of trees available to absorb CO_2 through photosynthesis (5) Agricultural practices such as livestock farming, rice cultivation, and the use of synthetic fertilizers release methane (CH_4) and nitrous oxide (N_2O) (6) Landfills and waste treatment processes produce methane as organic waste decomposes without oxygen.

A. Carbon Footprint

Carbon footprint is the measure of gases (which trap heat in the Earth's atmosphere) released directly or indirectly by human activities. Carbon footprint can be emitted from sources that are owned or controlled by the individual (e.g., combustion of fossil fuels in vehicles, heating, and industrial processes), from the generation of purchased electricity, heat, or steam consumed by the entity, emitted because of the activities of the individual but are not directly owned or controlled by it, including emissions from the supply chain, transportation, waste disposal, and employee commuting.

B. Calculation Of Individual Carbon Footprints

Author Alexandra Shimo-Barry has given the formula for calculating the carbon footprint of one household by using following steps:

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"A.) Multiply your monthly electricity bill by 105
B.) Multiply your monthly gas bill by 105
C.) Multiply your monthly oil bill by 113 (If you do not use either B or C, enter 0.)
D.) Multiply total yearly mileage by .79
E.) Multiply the number of flights--4 hours or less--by 1,100
F.) Multiply the number of flights--4 hours or more--by 4,400
G.) Do you recycle newspaper? If no, add 184. If yes, add 0.
H.) Do you recycle aluminium and tin? If no, add 166. If yes, add 0.

A+B+C+D+E+F+G+H = your carbon footprint (1)

A number below 6,000 (reflected in pounds per year) is excellent. Over 22,000? Not so great. Good is anywhere from 6,000 to 15,999, while 16,000 to 22,000 is average." By using the above procedure one can calculate his carbon footprint. Based on his carbon footprint if it is in less range then well and good. But if it is in more range, then he must follow the reduction procedure to reduce his carbon footprint.

C. How To Reduce One's Carbon Footprints

One can reduce his own carbon footprint by following several measures:

1) *By using public transport:* Nowadays every individual is owning a car. They often use these vehicles for small distant place. Even employees use car for their self to go to office. By using vehicles, the carbon footprint can increase rapidly. We can reduce this carbon footprint by choosing cycle or walk for short distant places, preferring public transport where several number of people can travel in same vehicle at same time.
2) *Using clothes for extended period:* If an individual keeps on purchasing new clothes for every week, then the demand for the clothes will be increased. To turn this demand into products, the manufactures consume more raw materials, electricity, transportation, etc. Which leads to increase in one's carbon footprint. To reduce this, we can use our own clothes for extended period, and we can purchase second hand clothes if they in good condition.
3) *Reducing the electricity usage:* Using electricity for crucial requirements is ok. But using above the requirement may lead to carbon footprint increase. In thermal power plants, fossil fuels such as coal, natural gas, or oil are burned in a combustion chamber to produce heat. The heat generated from burning fossil fuels is used to produce steam by heating water in a boiler. Carbon dioxide (CO_2) is primarily released during the combustion of fossil fuels.

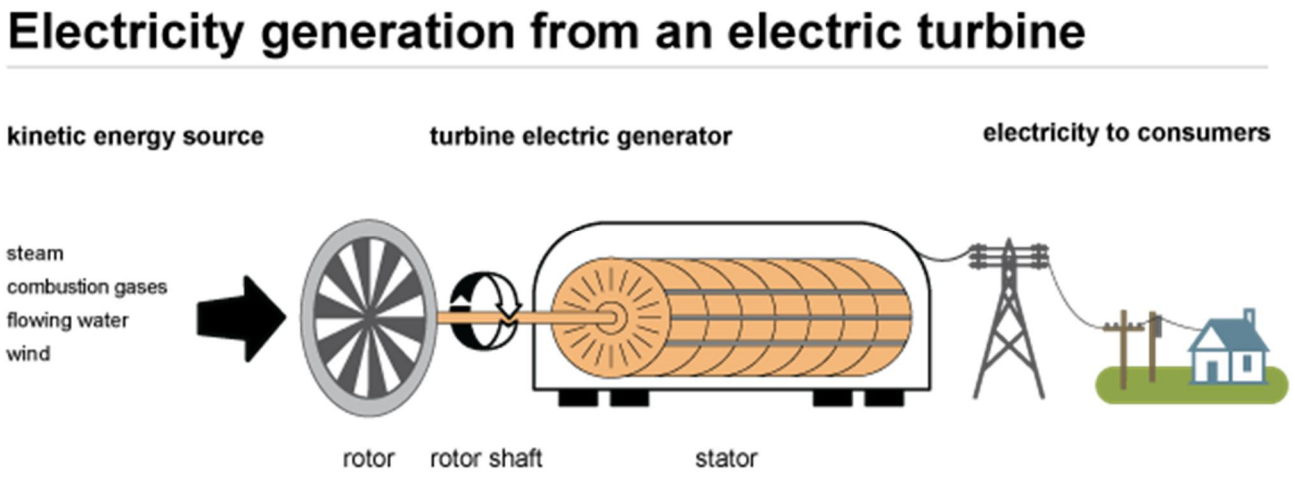


Fig. 1 Electricity generation from an electric turbine (Source: EIA.GOV)

4) *Planting Plants:* According to Our World in Data, "The world has lost one-third of its forest, which is twice the size of the United States. From 2001 to 2022, there was a 12% decrease in tree cover globally, with 459 million hectares lost". This will increase the global warming. Whenever one tree is cut then a new plant should be planted in other location. Plants take the CO_2 and release oxygen. In this way by planting at least one plant a week can reduce one's carbon footprint.

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5) *Preferring local food:* Eating local food does not need much transportation. But wanting to eat nonlocal food can increase the carbon footprint by using more transportation. Preferring local food can have a significant positive impact on reducing carbon footprint, supporting sustainable agriculture, fostering community resilience, and promoting environmental conservation. By making conscious choices to prioritize locally sourced foods, you can contribute to a more sustainable and climate-friendly food system.
6) *Offsetting:* In some cases, we cannot eliminate all greenhouse gas emissions then, carbon offsetting can be used to reduce emission by reforestation, renewable energy projects, etc.

III. GREENHOUSE GASES

The Earth receives energy from the sun in the form of sunlight, which primarily consists of visible and ultraviolet (UV) radiation. When sunlight reaches the Earth's atmosphere, some of it is absorbed by the surface of the planet, while the rest is reflected into space. The absorbed solar energy heats the Earth's surface, causing it to emit heat energy in the form of infrared (IR) radiation. This outgoing IR radiation is essential for cooling the Earth and maintaining its overall temperature balance. Greenhouse gases in the Earth's atmosphere, such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and water vapor (H_2O), have the unique property of absorbing and re-emitting IR radiation. When IR radiation is emitted from the Earth's surface, greenhouse gases absorb some of it, trapping heat in the atmosphere. Human activities, particularly the burning of fossil fuels, deforestation, industrial processes, and agriculture, have significantly increased the concentrations of greenhouse gases in the atmosphere since the Industrial Revolution. This enhanced greenhouse effect intensifies the trapping of heat, leading to a warming of the Earth's surface and lower atmosphere. The increase in greenhouse gas concentrations results in global warming, leading to changes in Earth's climate patterns. By reducing one's carbon footprint we can reduce the greenhouse gases emission.

IV. GLOBAL WARMING

Global warming means the long period increase in Earth's average surface temperature due to the emission of greenhouse gases. As greenhouse gases trap heat, they increase the average temperature of the Earth's surface. The increase in global temperatures changes weather patterns. Global warming causes polar ice caps, glaciers, and ice sheets to melt. This melting ice leads to rising sea levels.

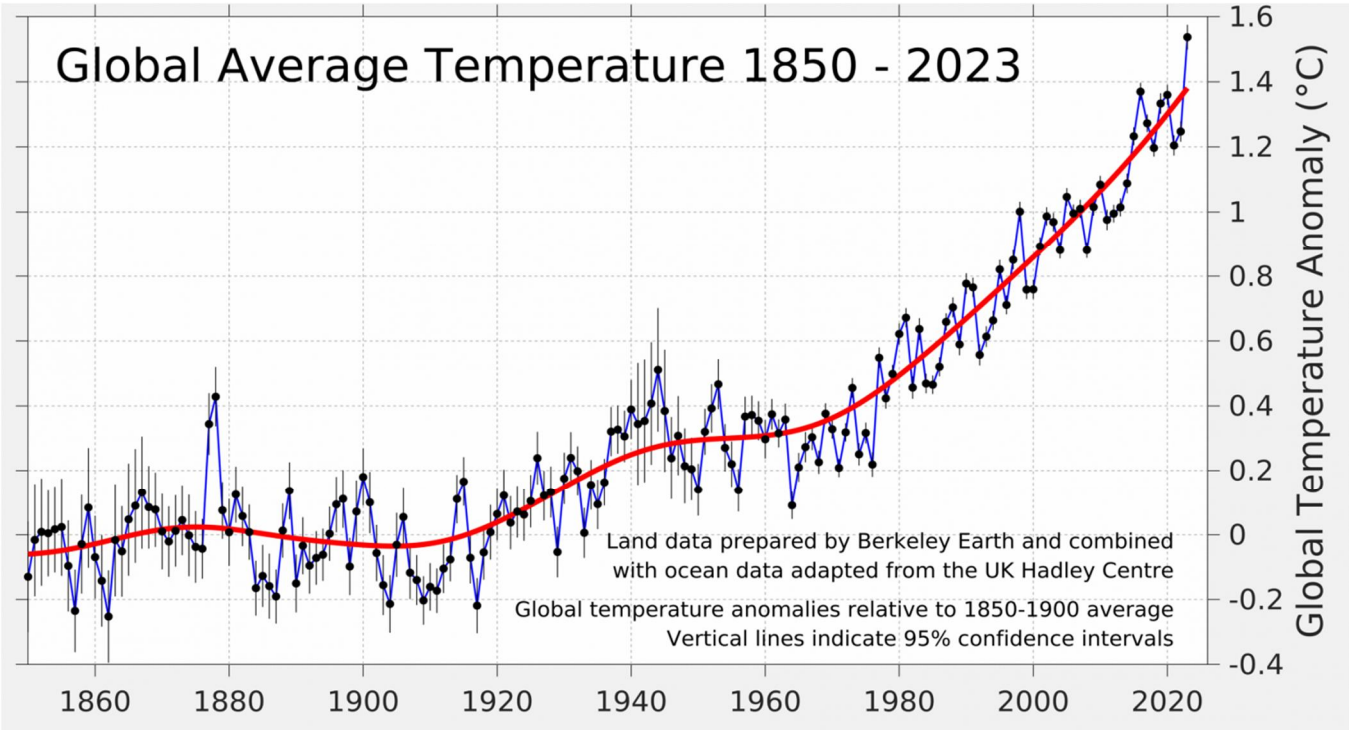


Fig. 2 Global Average Temperature (Source: BERKELEYEARTH.ORG)

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In 2023, Berkeley Earth's analysis set up that the global mean temperature was estimated to be1.54 ±0.06 °C (2.77 ±0.11 °F) above the average temperature from 1850- 1900, a period used as a pre-industrial birth for global temperature comparisons. This marks an increase of 0.17 °C (0.30 °F) compared to the previous record high observed in 2016. Accordingly, 2023 was the warmest year from the data.

V. CLIMATE CHANGE

Climate change means the change of temperature or weather patterns, primarily caused due to human activities that alter the composition of the atmosphere. Main reason for climate change includes the emission of greenhouse gases (GHGs) such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) from burning fossil fuels, deforestation, industrial processes, and agriculture. Climate change affects human health in many ways, heat-related illnesses, respiratory problems from air pollution, vector-borne diseases, food and water insecurity, and mental health issues related to climate-related disasters.

Climate scientists have provided compelling evidence that human activities are the primary cause of global warming, which in turn drives changes in the Earth's climate. Through activities such as burning fossil fuels, deforestation, industrial processes, and agriculture, humans are emitting greenhouse gases at high rates, leading to accelerated warming of the planet. The average temperature of the Earth's surface has increased by approximately 1.1°C since the late 1800s, surpassing temperatures seen in the last 100,000 years. While many people associate climate change primarily with warmer temperatures, the impacts extend beyond just heat.

VI. RESULTS AND DISCUSSION

This result discusses about the concept of carbon footprint, explaining how individual actions contribute to greenhouse gas emissions. It discusses various human activities that lead to carbon emissions, such as combustion of fossil fuels, industrial processes, deforestation, and agricultural practices. It emphasizes the importance of collective action in mitigating climate change and highlights the role of offsetting emissions through reforestation and renewable energy projects. It also discusses the role of greenhouse gases in trapping heat in the Earth's atmosphere, leading to global warming. Overall, it provides a comprehensive overview of the link between human activities, greenhouse gas emissions, and climate change, urging individuals and societies to take proactive steps towards sustainability and environmental stewardship.

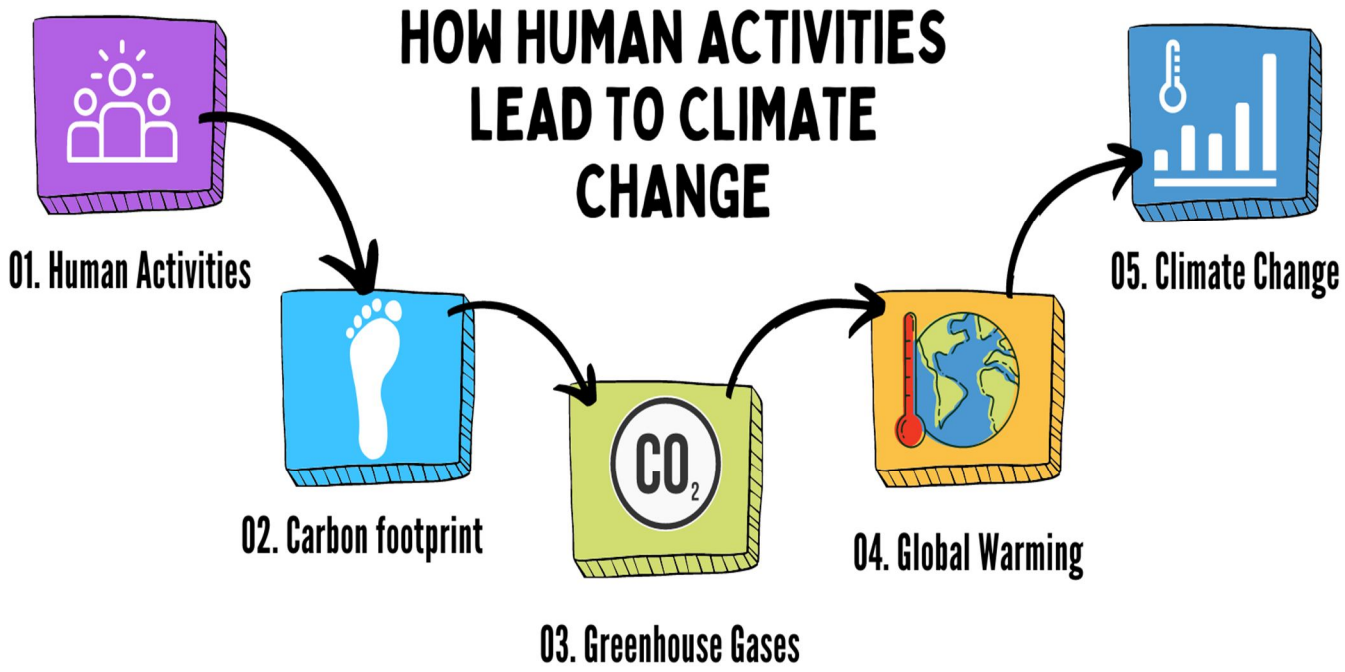


Fig. 3 How human activities are causing climate change

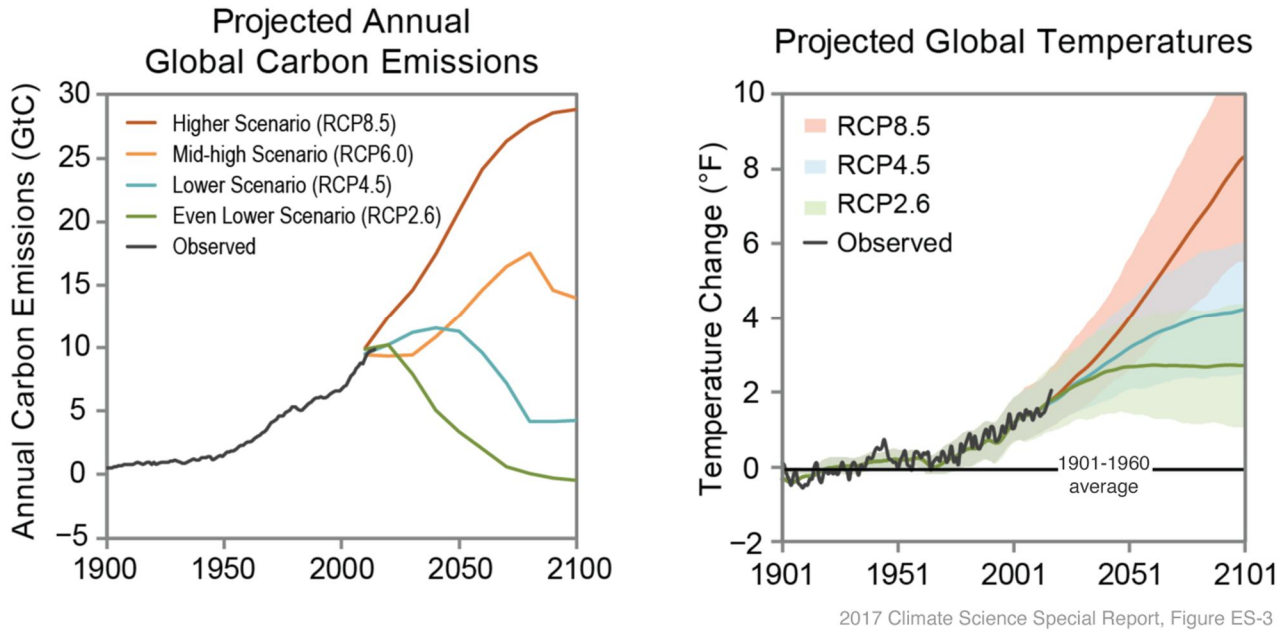


Fig. 4 Global temperature in future with same increase rate (Source: CLIMATE.GOV)

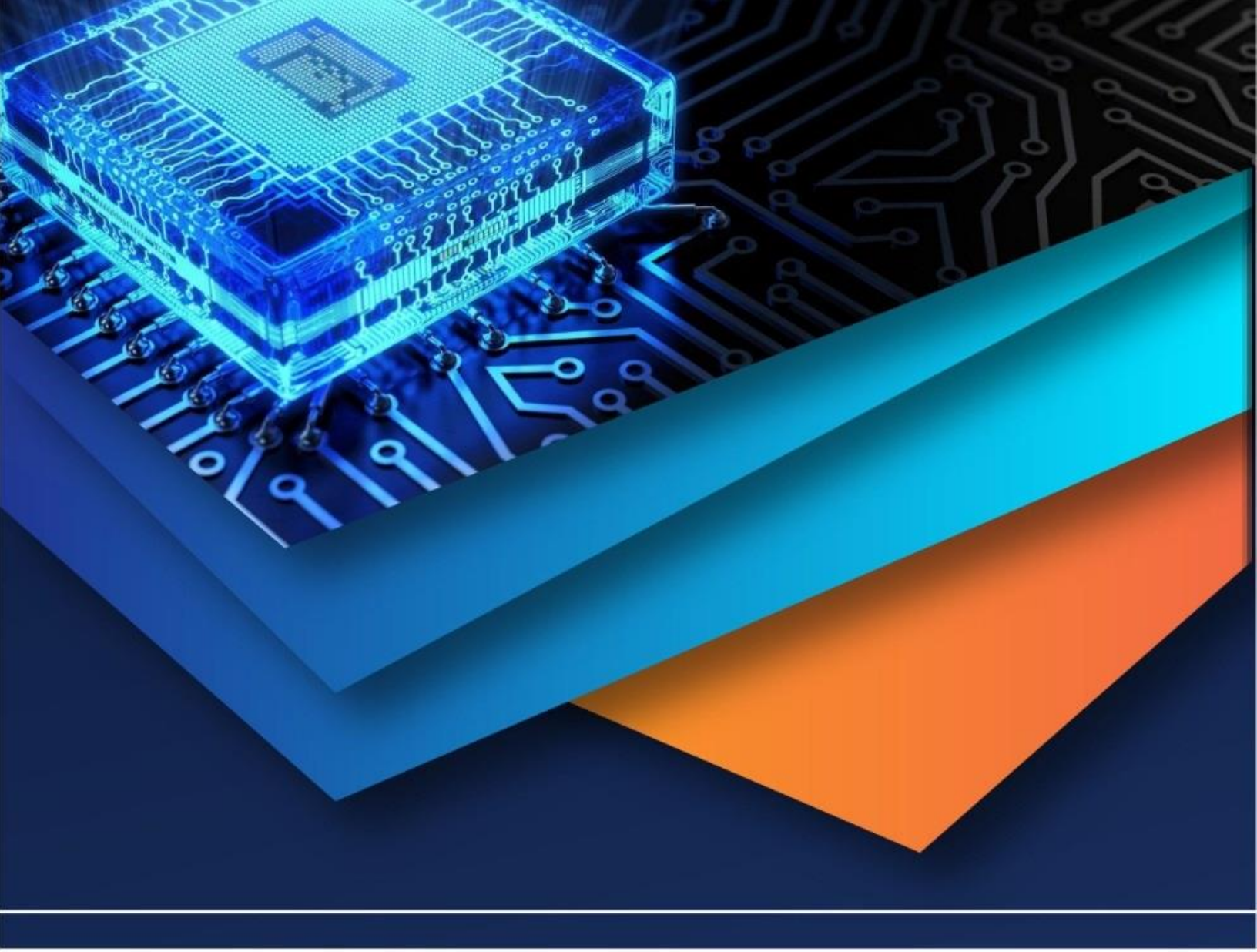
According to the 2017 U.S. Climate Science Special Report, if yearly emissions continue to increase rapidly as they have since 2000, models project significant temperature increases by the end of this century. Specifically, global temperatures are expected to rise by at least 5 degrees Fahrenheit compared to the 1901-1960 average, with the possibility of reaching up to 10.2 degrees warmer. However, if annual emissions increase more slowly and begin to decline significantly by 2050, the projected temperature rise would still be substantial. In this scenario, temperatures are expected to be at least 2.4 degrees Fahrenheit warmer than the first half of the 20th century, with the potential for an increase of up to 5.9 degrees. These projections highlight the critical importance of reducing greenhouse gas emissions to mitigate the impacts of climate change and limit temperature rise. Urgent action is needed to transition to more sustainable energy sources and adopt mitigation strategies to prevent the most severe consequences of global warming.

VII. CONCLUSION

In conclusion, it provides a thorough examination of the factors contributing to climate change, particularly focusing on the role of human activities in greenhouse gas emissions and subsequent global warming. It discusses the concept of carbon footprint and highlights various actions that individuals and societies can take to mitigate their impact on the environment. By emphasizing the importance of reducing carbon emissions through measures such as using public transport, reducing electricity usage, and supporting sustainable practices like recycling and planting trees, the paper underscores the urgent need for collective action to address climate change. Climate Science Special Report, emphasizing the critical importance of transitioning to more sustainable energy sources and adopting mitigation strategies to limit temperature rise.

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