Mathematical modeling of CO_2 emissions

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Abstract

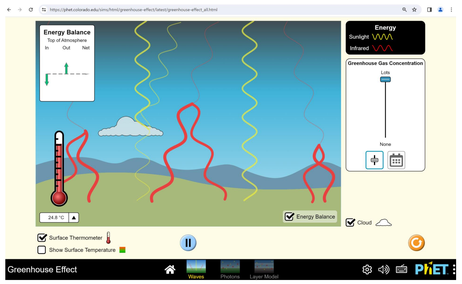
- Greenhouse gases like CO_2 are the drivers of climate change and global warming.
- We employ integral calculus and statistics-based methods to model and estimate the cumulative CO_2 emissions as a function of time.
- We study both global and country wise emissions, focusing on the largest emitters of CO_2 in the environment. We study the science of how CO_2 in the environment leads to global warming and implications for future if current emission trends are continued.
- Current advances for reducing CO_2 footprint that are being used for environmental sustainability include use of alternative sources of energy like solar and wind energy, developing mass transit to limit CO_2 emissions, use of electric vehicles, etc.
- We will also discuss current research on CO_2 trapping in olivine minerals that scientists hope will help contain CO_2 and clean our environment in future.

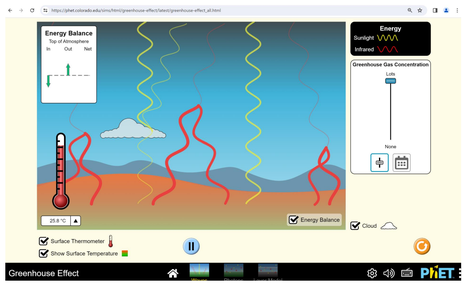
Objectives

- This project focuses on CO_2 as a driver of climate change.
- We utilize integral calculus and statistics for CO_2 emissions modeling.
- We explore advances in reducing CO_2 footprint, including alternative energy sources, green spaces, electric vehicles, and mass transit.
- We discusses research on CO_2 trapping in olivine minerals for environmental cleanup.
- We Integrate mathematical modeling and scientific research for environmental sustainability issues.

Background

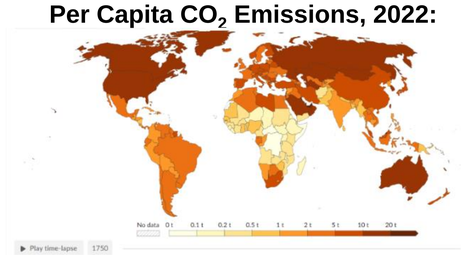
Green House Gas Effect:





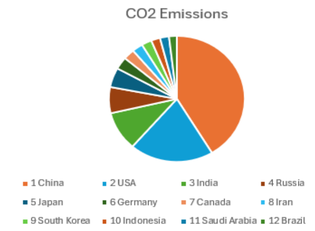
- The greenhouse effect is a natural process crucial for maintaining Earth's temperature within a habitable range.
- It involves gases like CO_2, CH_4, and water vapor trapping heat from the sun in the atmosphere.
- Greenhouse gases trap infrared radiation reflected from Earth's surface, preventing it from escaping back into space.
- The greenhouse effect is beneficial in moderation, as it keeps the planet warm enough to support life and ensures climate stability.
- However, human activities have increased greenhouse gas concentrations, leading to an enhanced greenhouse effect.
- This enhanced effect is causing global warming, with rising temperatures and associated impacts like severe weather events and melting polar ice caps.
- The current imbalance in greenhouse gases is disrupting ecosystems, biodiversity, and sea levels**.**

Per Capita CO_2 Emissions, 2022:



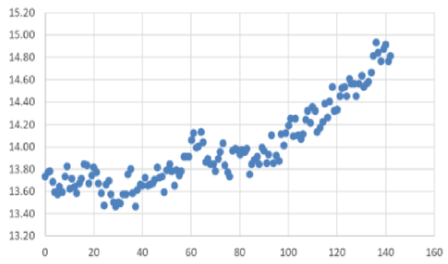
Research

Percentage of CO_2 Emissions



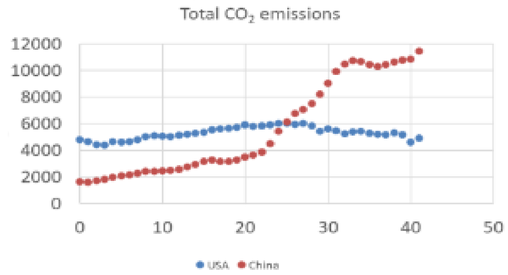
https://www.worldometers.info/co2-emissions/co2-emissions-by-country/

Average Global Temperature (C °) t years after 1880



Results

Total CO2 emissions (million metric tons) of USA and China, t years after 1950



https://sustainabilitymath.org/

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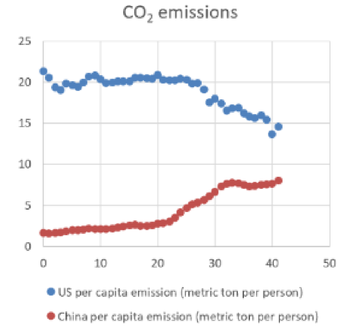

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Total CO_2 Emissions Since 1950

USA Left Riemann sum: 216407 million metric tons

USA Right Riemann sum: 216555 million metric tons

China Left Riemann sum: 219389 million metric tons

China Right Riemann sum: 229212 million metric tons

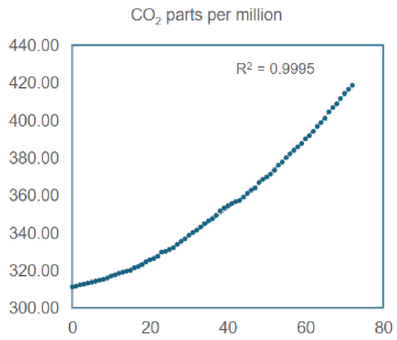
Average rate of change from 1980 to 2020 (Per capita):

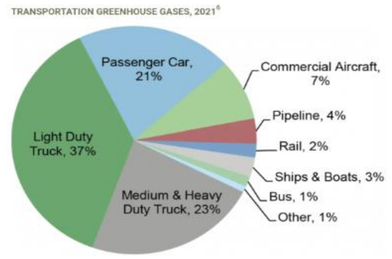
China: 0.15569 metric ton per person per year

USA: -0.16493 metric ton per person per year

Conclusion

Mauna Loa CO_2 Data





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- Industrialization has contributed to increased CO_2 in our environment that leads to climate change..
- We study the science of how CO_2 in the environment leads to global warming and implications for future if current emission trends are continued.
- Ways to reduce carbon footprint are suggested. Recent research suggests that trapping CO_2 from environments into rocks and olivine minerals look promising towards reducing CO_2 in our environment!

References

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