project title*

project subtitle

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*Code and data supporting this analysis is available at: Link to repository.

1 Introduction

Climate change has become a critical global challenge, driven largely by rising carbon dioxide (CO_2) emissions from human activities. The Intergovernmental Panel on Climate Change (IPCC) warns that without immediate and deep emission reductions, the world is on track to exceed the Paris Agreement's 1.5°C warming threshold, underscoring an urgent need to curb CO_2 from all sectors (Intergovernmental Panel on Climate Change (IPCC) 2022). In this context, the United States – historically the single largest national source of CO_2 – plays a pivotal role. Cumulatively, the U.S. has emitted roughly 25% of all fossil-fuel CO_2 since the industrial era began (Ritchie 2019), and it remains one of the top annual emitters today. Understanding the trajectory of U.S. emissions, especially from major sectors like transportation, industry, and energy generation, is therefore of global importance for climate change mitigation.

This project focuses on analyzing the effect of U.S. transportation, industry, and energy generation on CO_2 emissions from 1750 up to 2023. Using historical emissions data from the Our World in Data's dataset (Ritchie et al. 2025), we examine how these three key sectors have contributed to national CO_2 output over time. The study not only reviews historical trends but also develops forecasts for future emissions, providing both a retrospective and forward-looking perspective on U.S. CO_2 emissions.

The motivation for this research is grounded in climate and energy policy relevance. The chosen sectors – transportation, industrial production, and power generation – are the dominant sources of U.S. greenhouse gas emissions (Keerthana et al. 2023). For example, in 2019 the transportation sector accounted for about 29% of U.S. CO_2-equivalent emissions, followed by electricity generation (25%) and industrial processes (23%) (Keerthana et al. 2023). These activities collectively drive the bulk of national emissions, meaning any meaningful climate strategy must address each of them. Analyzing historical patterns in these sectors can reveal how past economic growth, technological changes, and policies (such as vehicle efficiency standards or power plant regulations) have impacted emissions. Moreover, forecasting future emissions is crucial for gauging progress toward sustainability goals. The U.S. has set ambitious targets under the Paris Agreement – pledging a 50–52% reduction in greenhouse gases by 2030 (from 2005 levels) and net-zero emissions by 2050 (Keerthana et al. 2023) – which heightens the real-world significance of this study. By projecting emissions trajectories, we can assess whether current trends align with these climate goals or if additional policy interventions may be required.

The paper is structured as follows: Section 2 TBD, Section 3 TBD, Section 4 TBD.

2 Method

2.1 Data

The primary dataset for this project is the Our World in Data CO_2 and Greenhouse Gas Emissions database (Ritchie et al. 2025), which provides annual, country-level estimates of total, per-capita, and cumulative CO_2 emissions, as well as sectoral breakdowns (energy production, industrial processes, transportation, residential/commercial, and land-use) from 1750 through the most recent available year.

Our research mainly focus on the total CO_2 emission in the USA, we extract the following variables:
• trade_co2: Emissions embodied in international trade
• oil_co2: Emissions from oil consumption
• gas_co2: Emissions from natural gas consumption
• flaring_co2: Emissions from gas flaring
• coal_co2: Emissions from coal consumption
• cement_co2: Emissions from cement production
• consumption_co2: Emissions attributable to final consumption
• other_industry_co2: Emissions from other industrial processes
These predictors will serve in our egression model of total CO emissions; any rows with missing values on these variables are omitted.

2.2 Model

2.2.1 Model 1

2.2.2 Model 2

3 Result

4 Discussion

5 Appendix

5.1 Project Code

Table 1

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[47] "nitrous_oxide_per_capita"
[48] "oil_co2"
[49] "oil_co2_per_capita"
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References

Intergovernmental Panel on Climate Change (IPCC). 2022. "Climate Change 2022: Mitigation of Climate Change."

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