Greenhouse Gas Emissions report by country from 1990 to 2020*

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The primary goal of this assignment is to analyze and understand the patterns, trends and implications of the historical data of the Greenhouse Gas (GHG) emissions in the world from 1990 to 2020. GHG emissions are threatening the ecosystem of the Earth and it requires collaborate efforts at national level to reduce these emissions. I have identified the nations that emit significant amount of GHG and have created a graph to show the historical trend of GHG emissions by countries. This paper aims to raise concern for the high level of GHG emissions worldwide and call for an action to reduce this.

1 Introduction

Greenhouse Gas (GHG) emissions are a fundamental factor on sustainable global environment due to its massive impact on climate change. The total GHG emissions, collected by the climatewatchdata.org include carbon dioxide (CO2), methane (CH4), nitrous oxide (N20), and fluorinated gases that come from human activities such as deforestation, burning up fossil fuels and agriculture. An excesss of these gases, if exposed to the atmosphere, trap heat within the Earth's atmosphere which lead to greenhouse effect. This seriously disrupts the planet's maintenance of the temperature, resulting in global warming.

The increase in the temperature not only warms up the Earth but also disrupts weather patterns, leading to irregular climate patterns such as flood, storms, heatwaves, tsunami and changing rainfall patterns. These will further affect the natural ecosystems. Furthermore, global warming severely leads to melting ice caps, which lead to a rise in the sea level. This poses increased risk of flooding and displacement of millions of people worldwide. The oceans

*Code and data are available at: https://www.climatewatchdata.org/ghg-emissions?calculation=ABSOLUTE_VALUE&chartType=line&end_year=2020&start_year=1990.

are increasing in the level of acidification due to higher CO2 levels in the atmosphere that will affect biodiversity and marine life.

Global leaders, organizations, and communities have been working hard to reduce the level of GHG emissions worldwide in recognition of the critical need to mitigate climate change and its impacts. In 1997, Kyoto Protocol focused on reducing emissions of six GHG in industrialized countries; in the Paris Agreement in 2015, countries promised to limit global warming below 2 degrees Celsius compared to pre-industrial levels.

This paper will introduce the dataset, its columns and variables. It will then talk about the data cleaning process and discuss the findings. It will analyze the historical trends of GHG emissions by the top 10 most GHG emitting nations from 1990 to 2020. The results show that China and the United States far outweigh other nations in GHG emissions. China, in particular, has the highest GHG emissions and the trend is sharply increasing. We have found that this increase trend needs to stop to prevent further global warming.

2 Data

The data used in this paper was gathered from "https://www.climatewatchdata.org/ghg-emissions?calculation=ABSOLUTE_VALUE&chartType=line&end_year=2020&start_year=1990", an open data source that provide insights on countries' climate progress. The dataset used in this analysis was 'Historical GHG Emissions', which gather total GHG emissions by countries from 1990 to 2020.

To perform the analysis, the data was cleaned and manipulated by using the statistical software R (R Core Team 2022) and the packages "tidyverse" (**Rtidyverse?**), "janitor" (**Rjanitor?**), "dplyr" (**Rdylyr?**), "ggplot2" (**Rggplot2?**) and "knitr" (**Rknitr?**) were used.

2.1 Variables

This dataset contains five columns in total: iso (country code), country/region, unit (MtCO2e), year (years from 1990 to 2020) and emission (the numeric values of the GHG emissions). This dataset is the most suitable dataset for this paper because it contains all the historical GHG emissions per country from 1990 to 2020.

2.2 Data cleaning process

I have firstly decided to deliberately select the year 2020 to see which countries emit the most GHG in recent years because 2020 is the most recent data collected. Therefore, I have filtered the dataset to only include the year 2020. This new dataset is saved into ghg_emissions_data.csv file. From this, I have made Table 1 below. As shown below, the

top 10 most GHG emitting nations are China, the United States, India, Russia, Indonesia, Brazil, Japan, Iran, Canada, and Saudi Arabia. These countries are typically developed countries or developing countries with high economic growth, with large population with robust economies.

This illustrates the fact that developed or developing countries with large scale of economy emit the most GHG still to this date. This raises concerns because usually developed countries are the ones who have started to worsen global warming by initial increase in GHG emissions in history as their early economic growth capitalized the heavy use of coal and resources which caused greenhouse effects.

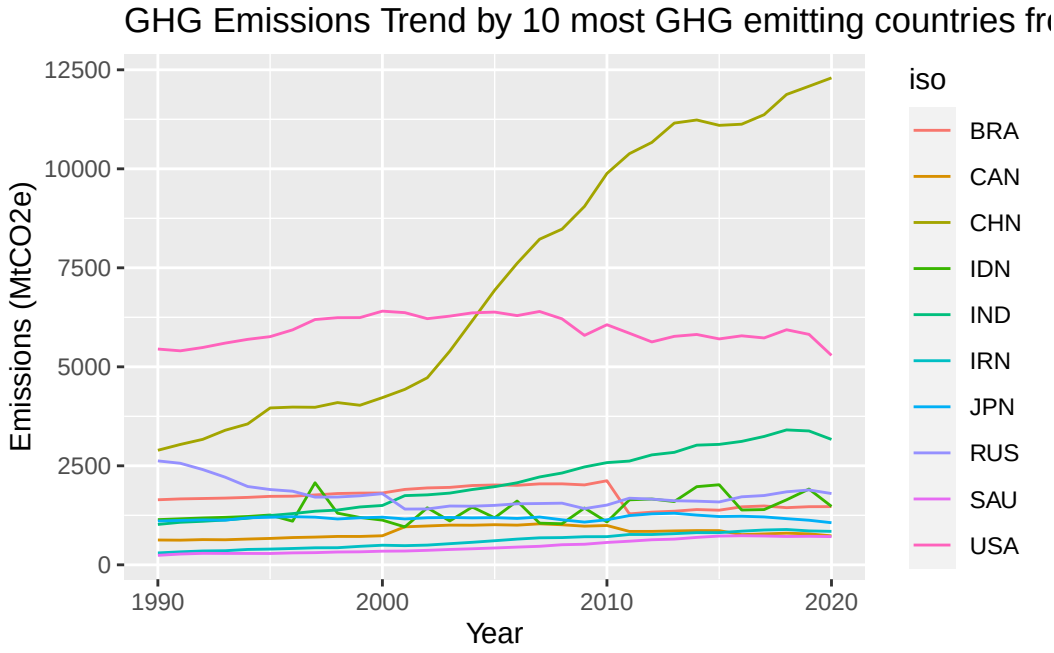
Table 1: GHG Emissions by Country/Region in 2020

iso	country/region	unit	year	emissions
CHN	China	MtCO2e	2020	12295.62
USA	United States	MtCO2e	2020	5289.13
IND	India	MtCO2e	2020	3166.95
RUS	Russia	MtCO2e	2020	1799.98
IDN	Indonesia	MtCO2e	2020	1475.83
BRA	Brazil	MtCO2e	2020	1469.64
JPN	Japan	MtCO2e	2020	1062.78
IRN	Iran	MtCO2e	2020	844.71
CAN	Canada	MtCO2e	2020	731.54
SAU	Saudi Arabia	MtCO2e	2020	712.59

2.3 Further cleaning

I will now analyze the historical trend of GHG emissions by top 10 the most GHG emitting countries from available years from 1990 to 2020. To perform this, I have used the ggplot package to make a line graph.

3 Result



This graph shows the trend of GHG emissions over the course of the past 30 years for 10 countries that emit the most GHG. Each line represents a different country, identified by their ISO country codes (e.g. USA for the United States, CAN for Canada). The x-axis represents the years from 1990 to 2020 and the y-axis is a measure of GHG emissions in the unit of MtCO2e, which is a unit for comparing emissions from various greenhouse gases.

From the graph, we can observe that China (CHN) has the highest and the sharply increasing trend in GHG emissions. In 1990 where she was the second most GHG emitting country after the United States (USA), she overcame the Unites States in 2005 with a noticeable rise, ending up emitting 12500 MtCO2e per year by 2020. This is twice the size of the second highest emitting country. The United States could be a good example of a reduction in the level of GHG emissions as the trend shows a peak then a slight yet continuous decline towards 2020. However, she is still the second most GHG emitting country and more work needs to be done. Developing countries with high economic growth like India (IND), Brazil (BRA), Indonesia (IND) show a relatively flatter trend with moderate increases in emissions over the 30 years.

This graph is valuable for understanding the historical patterns of GHG emissions by indentifying the major contributors to global emissions. Despite the fact that the differences in emission levels between countries may be affected by their size, population, economy and energy use, this can be used as evidence in discussions on the responsibility of major countries and the possible policies and agreements in reducing emissions and the need for a target and sanction in high-emission countries.

References

R Core Team. 2022. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.