



# A Report on CO2 Emissions and Energy Usage

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## 1 CO2 Emissions and Energy Usage

### Introduction

We have been living in this world for such a long time now. Indeed, we cannot imagine the precious resources that are bestowed upon us by nature. However, we humans have caused grave damage and disrupted natural cycles through energy exploitation and accompanied emissions. Countries have been competing to generate energy and exploit other resources, thus boosting their economies. Alas, this comes at a cost; carbon emissions that fuel climate change. Damage from climate change is expected to go far beyond drought, melting ice sheets and crop failures.

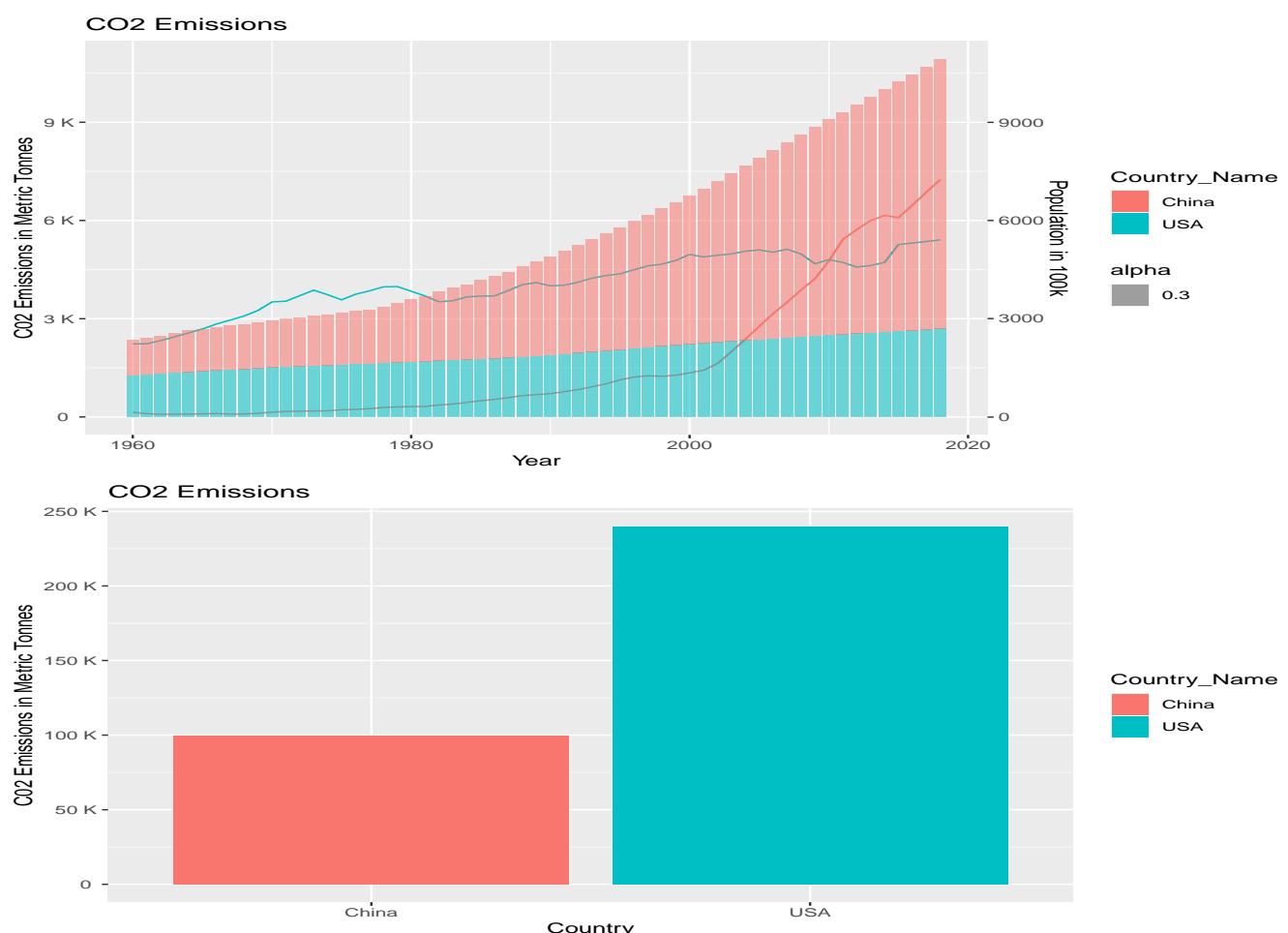
This report is an analysis on the carbon footprint(Wikipedia contributors/definition ([2021a](#))) of countries to answer the inherent questions about the trends in carbon dioxide emission and energy usage.

### 1.1 Country USA and China

In terms of economies, USA and China have dominated this millennial, striving to compete in all sectors. *Each Country's Share of CO2 Emissions (2020)* suggests that they contribute to almost half of the world's carbon footprint, 15% and 28% respectively. As such, it is only reasonable to analyze carbon footprint trend for these countries.

- 1) Which country has contributed more to the carbon footprint over the years? Compare the carbon emissions of these countries.

The figure 1 (CO2 emissions represented by line graph) shows that, from the early 2000s, China witnesses an exponential growth in CO2 emissions surpassing USA in 2010, probably owing to its economic growth(Wikipedia contributors/definition (2021b)) and the massive difference in the population of USA and China. On the contrary, USA had a dip in emissions and a steady population growth. However, cumulatively from 1960, emissions from USA far exceed than that of China.

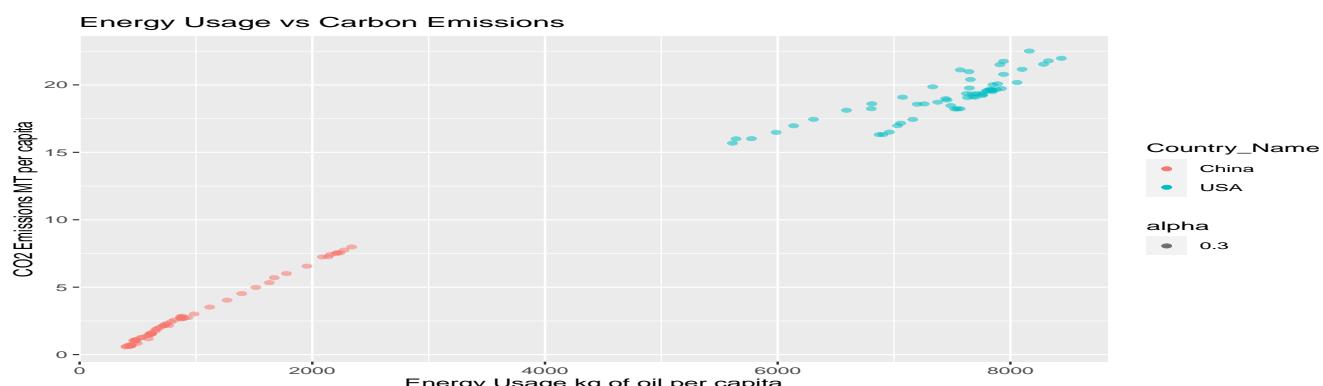


- 2) Research on the energy sources of each country and its impact and justify if per capita energy usage is an apt factor for comparison of these two countries. Which country has a better carbon footprint?

Sustainable development has been recognized as an important goal by several countries. Emissions from sustainable sources such as biomass combustion are lower than fossil fuel combustion. Clean energy reduces environmental pollution, thus, improving public health, reducing premature mortality and saving on related health costs and will play a major role in combating climate change. The figure 2 shows that CO2 emissions are proportional to the energy usage. The articles, [U.S. Energy Information Administration - EIA - Independent Statistics and Analysis \(n.d.\)](#) and [U.S. Energy Information Administration - EIA - Independent Statistics and Analysis \(n.d.\)](#), show the energy distributions in both countries. It can be noted that China, though having lower per capita energy consumption contributes more to the carbon footprint than US, presently. This is because it is heavily dependent on coal whereas US has a higher dependence on natural gas, a clean energy source. Therefore, currently, US has a better carbon footprint.

The figure 3 and the table 1 show that the per capita energy consumption and CO2 emissions have been dominated severely by the US. The boxplot 4 shows that per capita energy usage and CO2 emission is higher for US in comparison to China. However, we know from above that it is due to the population difference between the two countries and China is considerably dependent on the non-clean energy sources. Therefore, scaling the energy usage and CO2 emission to per capita is not a correct measure to compare countries that have a huge population difference.

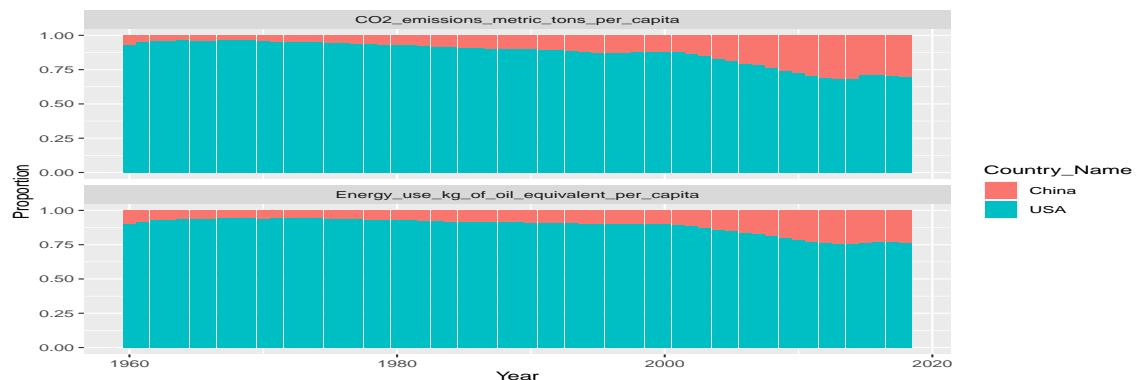
For more insights on the CO2 emissions from different countries, please refer Wikipedia contributors/[List of countries by carbon dioxide emissions \(2021\)](#).



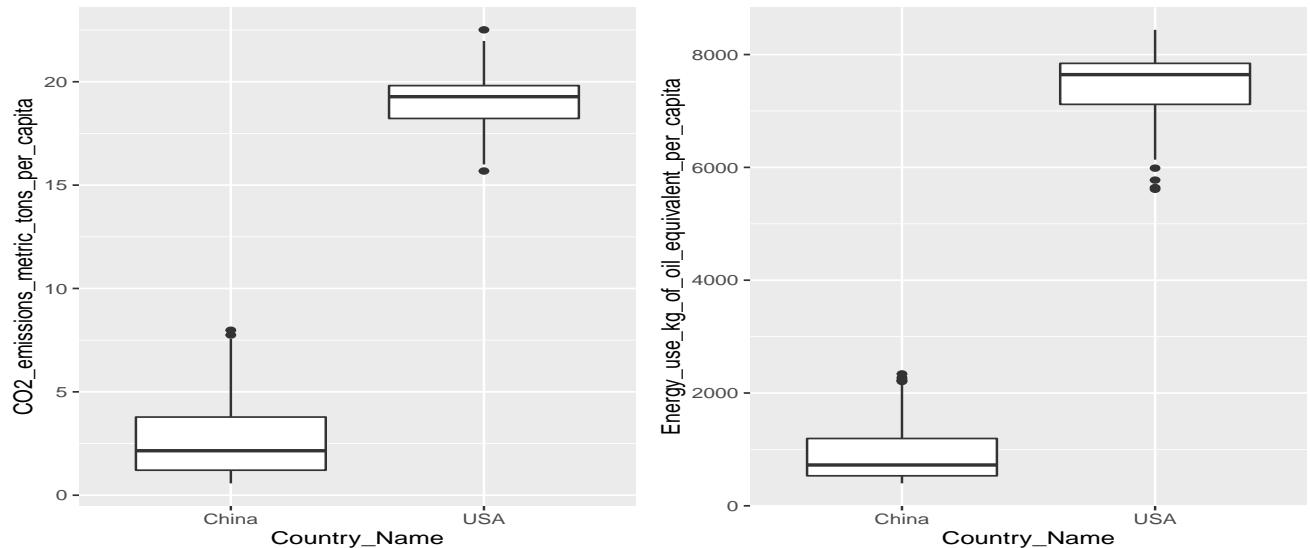
**Figure 2: Energy Usage vs Carbon Emissions**

**Table 1: Energy Consumption Comparision**

Year	USA	China
2018	7567.554	2338.658
2017	7543.050	2274.102
2016	7520.716	2204.976
2015	6803.919	2136.623
2014	6960.682	2236.730
2013	6905.647	2213.759
2012	6872.103	2155.165
2011	7030.033	2086.487
2010	7161.451	1954.723
2009	7056.784	1778.434
2008	7488.082	1672.904



**Figure 3: Proportion Share Across The Years**



**Figure 4: Distribution of CO2 Emissions and Energy Usage**

## 1.2 Country Chile and Canada

This section of the report focuses on the CO2 emissions (metric tonnes per capita) and energy usage (kg of oil equivalent per capita) for countries, Chile and Canada. The research questions addressed are the comparison of both countries on the basis of trend of CO2 emissions over the years and to determine which country has performed better with respect to CO2 emissions as well as energy usage.

Table analysis of both countries

**Table 2:** CO2 Emissions of Chile

CO2_emissions_metric_tons_per_capita
Min. :1.659
1st Qu.:2.069
Median :2.483
Mean :2.823
3rd Qu.:3.773
Max. :4.736
NA's :4

**Table 3:** CO2 Emissions of Canada

CO2_emissions_metric_tons_per_capita
Min. :10.63
1st Qu.:15.37
Median :16.31
Mean :15.78
3rd Qu.:17.02
Max. :18.27
NA's :4

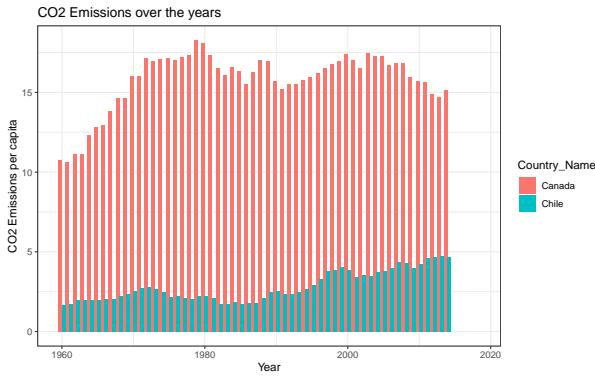
It can be seen from table 2, that the mean CO2 emissions of Chile are 2.823 metric tons per capita while table 3 shows Canada's mean CO2 emissions are 15.78 metric tons per capita. Both countries have a rising population but Chile has a better performance in terms of CO2 emissions.

Figure analysis of both countries

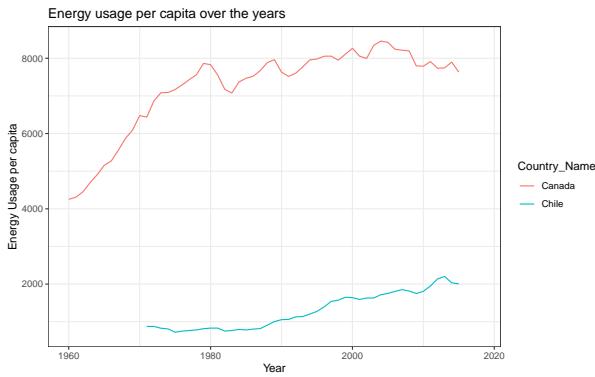
The figure 5 represents the trend of CO2 emissions per capita of countries Chile and Canada.

The figure 6 represents the trend of Energy usage per capita of countries Chile and Canada.

Figure 5 and Figure 6 represent the trend of CO2 emissions and Energy usage per capita of Canada and Chile respectively. It can be observed that Chile has a better performance as it had less emissions and energy usage. Figure 7 represents CO2 emissions and energy usage per capita of both countries.

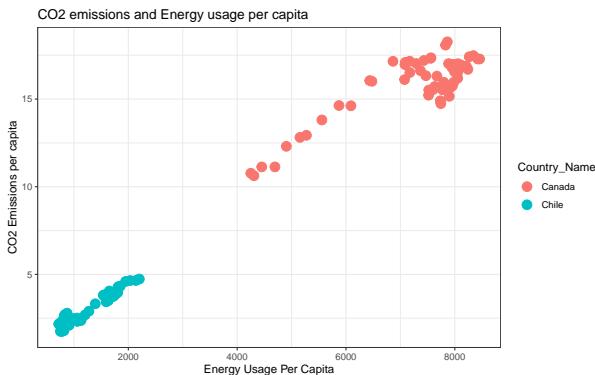


**Figure 5:** CO2 Emissions over the years



**Figure 6:** Energy usage per capita over the years

To conclude, table 2, table 3 and 5 represented the comparison of CO2 emissions in Chile and Canada, where Chile performed better. Figures 6 and 7 represented the overall measures of CO2 emissions and energy usage of both countries, where again Chile's measures were better. According to Joo, Kim, and Yoo (2015), the reason for CO2 emissions in Chile are because of its dependence on carbon energy consumption for its rising economic growth.



**Figure 7:** CO2 emissions and Energy usage per capita

### 1.3 Country United Arab Emirates and Singapore

Table analysis

Table 4 shows the mean per capita of co2 emission and energy use of United Arab Emirates is 30.6894 and 8639 respectively, and for Singapore, it is 9.6409 and 3838 as shown in Table 5. Although both countries are in high income group, Singapore has a better performance from the tables.

**Table 4:** *The summary of UAE*

CO2_emissions_metric_tons_per_capita	Energy_use_kg_of_oil_equivalent_per_capita
Min. : 0.1091	Min. : 2869
1st Qu.: 19.0517	1st Qu.: 7209
Median : 28.7833	Median : 9025
Mean : 30.6894	Mean : 8639
3rd Qu.: 35.8852	3rd Qu.: 10972
Max. : 101.0517	Max. : 12172
NA's : 4	NA's : 15

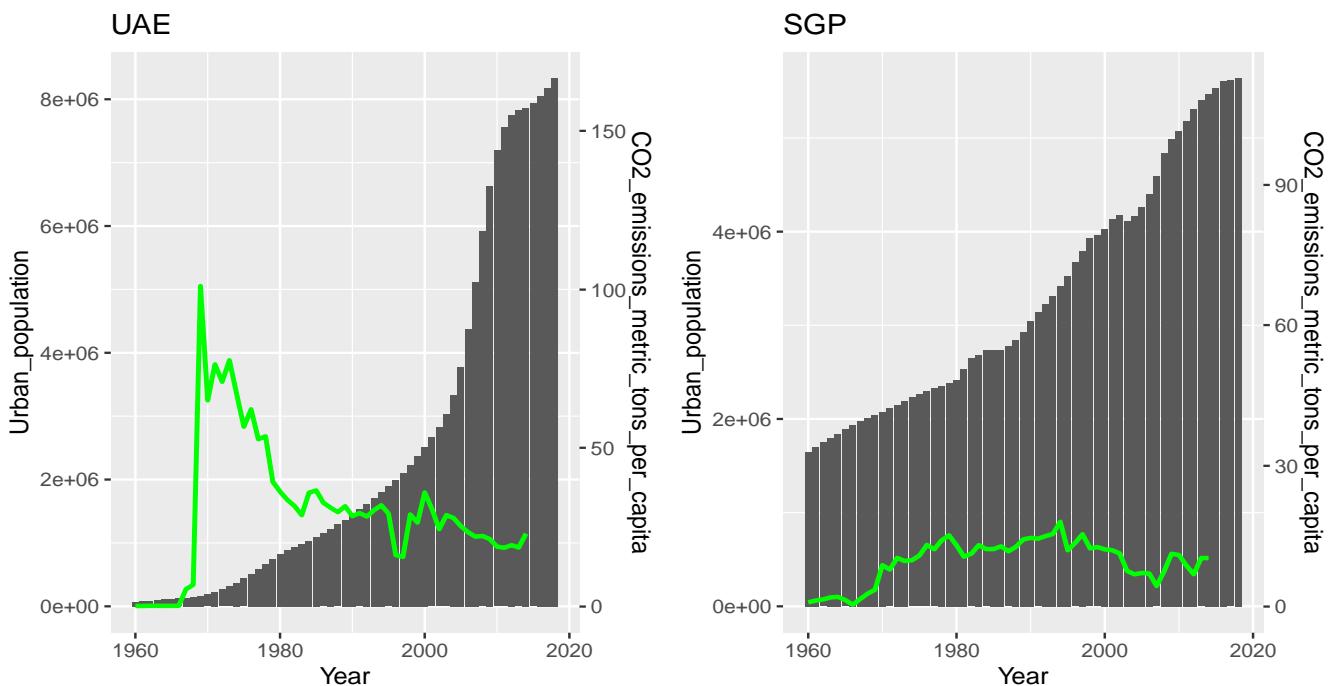
**Table 5:** *The summary of SGP*

CO2_emissions_metric_tons_per_capita	Energy_use_kg_of_oil_equivalent_per_capita
Min. : 0.3488	Min. : 1292
1st Qu.: 7.0573	1st Qu.: 2180
Median : 10.9604	Median : 4423
Mean : 9.6409	Mean : 3838
3rd Qu.: 12.7502	3rd Qu.: 5086
Max. : 18.0409	Max. : 7371
NA's : 4	NA's : 15

Figure analysis

In Figure 8, Singapore had stable C02 emissions of under 20 metric tons per capita with a growing population over years, while UAE fluctuated wildly with a higher average emissions. It was up to 101.0517 in 1969 with a low population, and fortunately kept dropping after that.

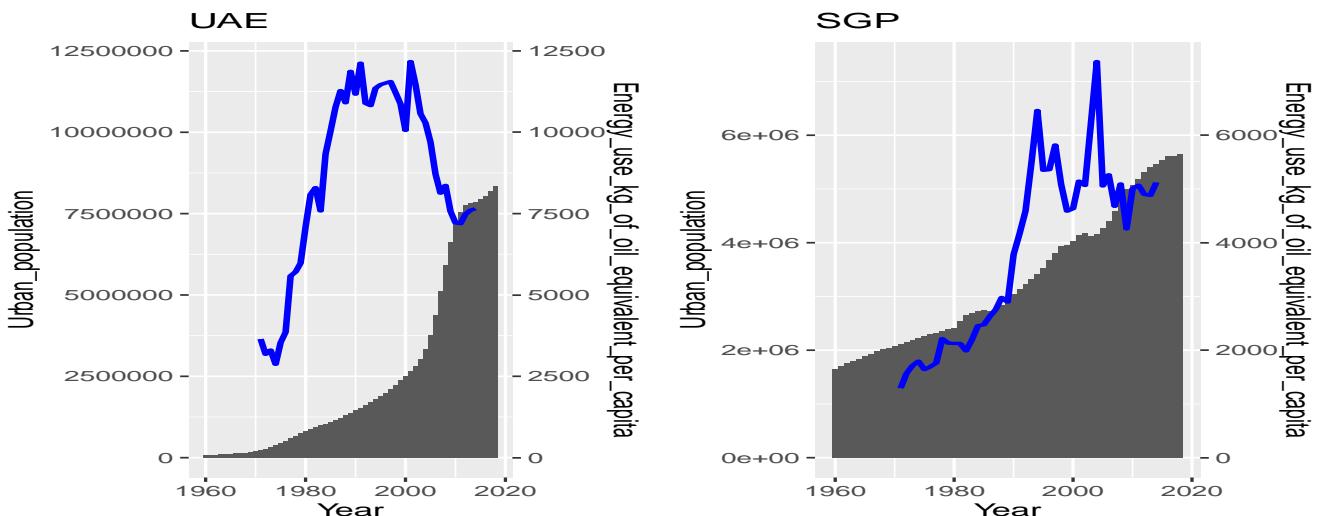
### Relationship between population(bar) and co2 emissions(line)



**Figure 8:** population and co2 emissions relationship

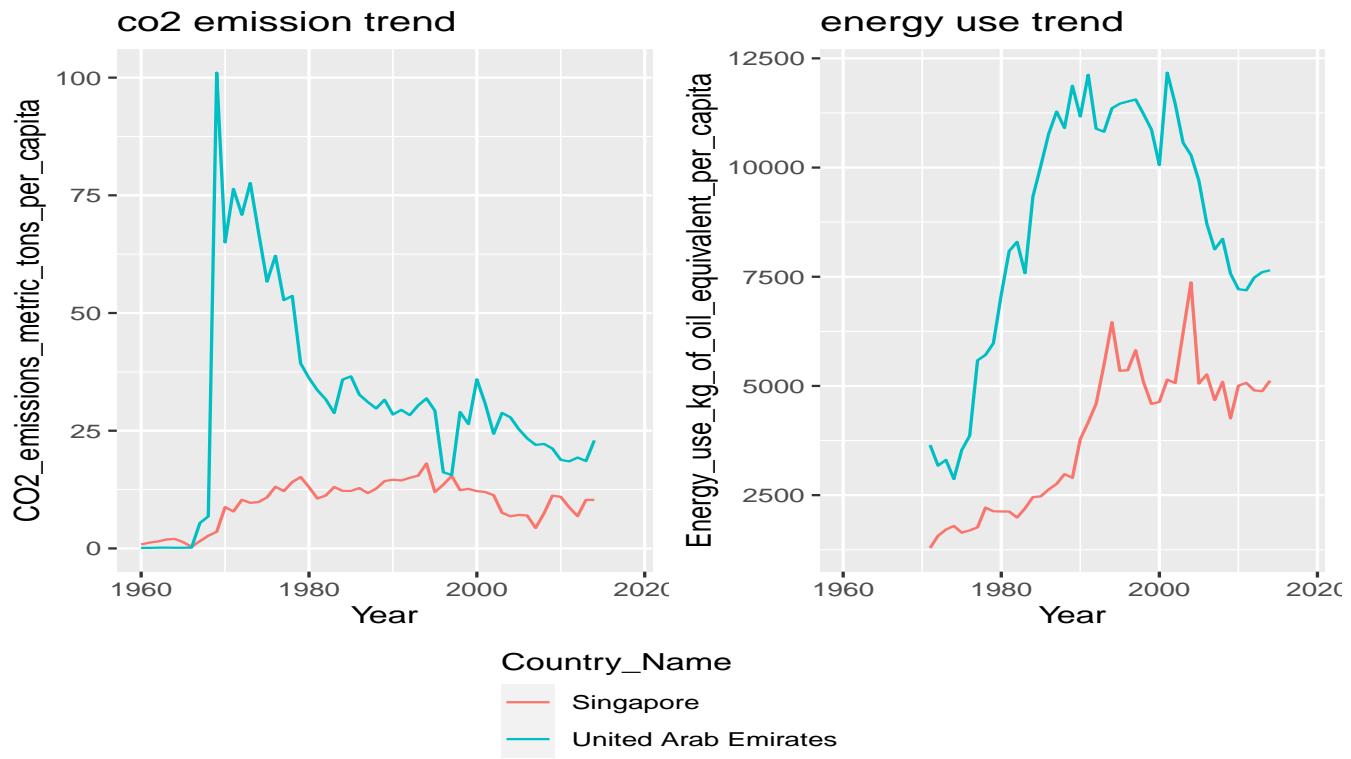
In Figure 9, UAE has a higher energy use than Singapore and a smaller size of population. Increase and decrease sharply appears in both countries but the trend of Singapore is relatively less smooth than UAE's.

### Relationship between population(bar) and energy use(line)



**Figure 9:** population and energy use relationship

Both CO2 emissions and energy use trend of two countries will be discuss with the following figure.



**Figure 10:** Trend of co2 emission and energy use

The co2 emissions was up to 101.05 metric tons per capita in 1969, this might be due to oil commencement of oil exports from 1962, and also the flight service operations in Dubai, especially for the private jets [Factbox: Why does the UAE have such a high carbon footprint? \(2010\)](#). From Figure 10, Singapore performed better than UAE in either of the trend of CO2 emissions or energy usage as Singapore's trend is much smaller.

## Conclusion

In conclusion, all countries must gear up and implement strategies for climate action to make this world a better place. We say, save green, breathe pure, eat clean and live bonjour!!!

## R Packages

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Xie (2021a) Dietrich (2020) Wickham et al. (2021),

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Zhu (2021),

Xie (2021b),

Tierney et al. (2020),

Pedersen (2020),

Henry and Wickham (2020),

Wickham and Hester (2020),

Wickham and Seidel (2020),

Wickham (2019),

Müller and Wickham (2021),

Wickham (2021b),

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Tierney (2019),

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Wickham (2016),

Xie (2015),

Xie (2014),

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