



Air and GHG Emissions

Data Surfers

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Agenda



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What are Greenhouse Gases?



According to the EPA they are “gases that trap heat in the atmosphere.” This trapped heat leads to increasing global temperatures which cause:

- Less stable weather patterns (more floods, droughts, or intense rain, as well as more frequent and severe heat waves.)
- Animal and Plant species extinction
- Ocean Warming and Acidification

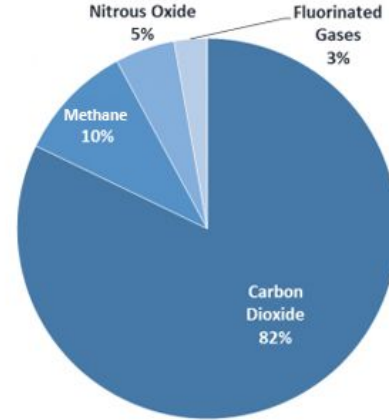
Greenhouse gases are primarily caused by burning fossil fuels, solid waste, trees, and wood, and also the result of industrial practices.

Three types of greenhouse gases we will address:

- Carbon Dioxide (CO₂)
- Nitrous Oxide (NO_x)
- Sulfur Oxides (SO_x)

With NO greenhouse gases at all in its atmosphere, scientists estimate that Earth's average atmospheric temperature would be about -18 deg C.

U.S. Greenhouse Gas Emissions in 2015

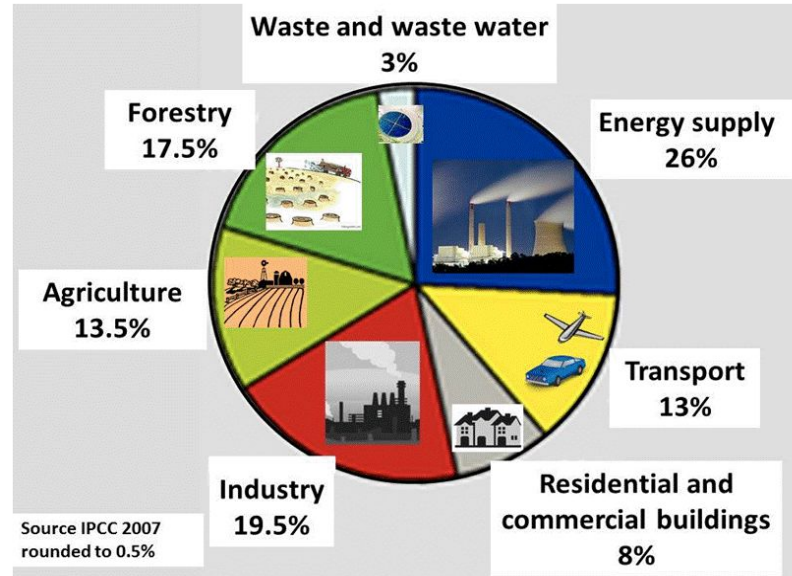


Sources of Greenhouse Gas Emissions



Global human sourced GHG emissions by sector

- Electricity Production
- Transportation
- Industry
- Commercial and Resident
- Agriculture
- Land Use and Forestry



Data Source



OECD - Organization for Economic Co-operation and Development.

The dataset consists of columns such as location, indicator, subject, measure, frequency, time, value, flag_codes.

The mission of OECD is to promote policies that will improve the economic and social well-being of people around the world.

The OECD provides a forum in which governments can work together to share experiences and seek solutions to common problems.



First Research Question:

Which countries and regions contribute the most CO₂ emissions, both on a total volume basis and from a per capita perspective? Do the top offenders have similar patterns of increasing and decreasing emissions?

To answer this question, we looked at the top five CO₂ producers by volume since 1971, at approximately 5 year increments. There were seven countries that were in these top 5 for the years analyzed.

We used population data from the World Bank and calculated a per capita consumption amount for each data point.

We then graphed total and per capita emissions for each of the top 7 countries.

Total Emissions

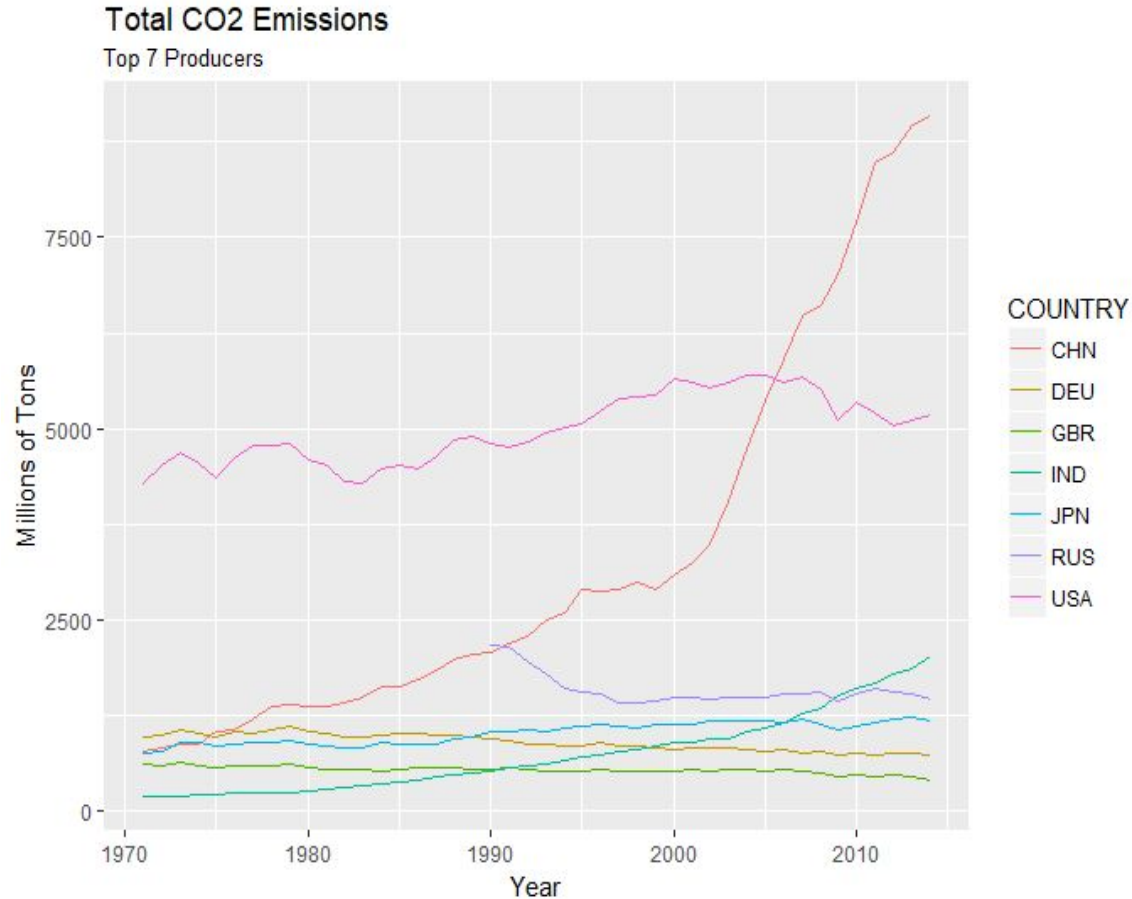
Total emissions changed slowly for most leading countries.

US was consistently highest, showing greater rate of increase through the 90's than other leaders.

China's total emissions have increased steadily and particularly steeply since 2000. But are expected to level off in the next decade.

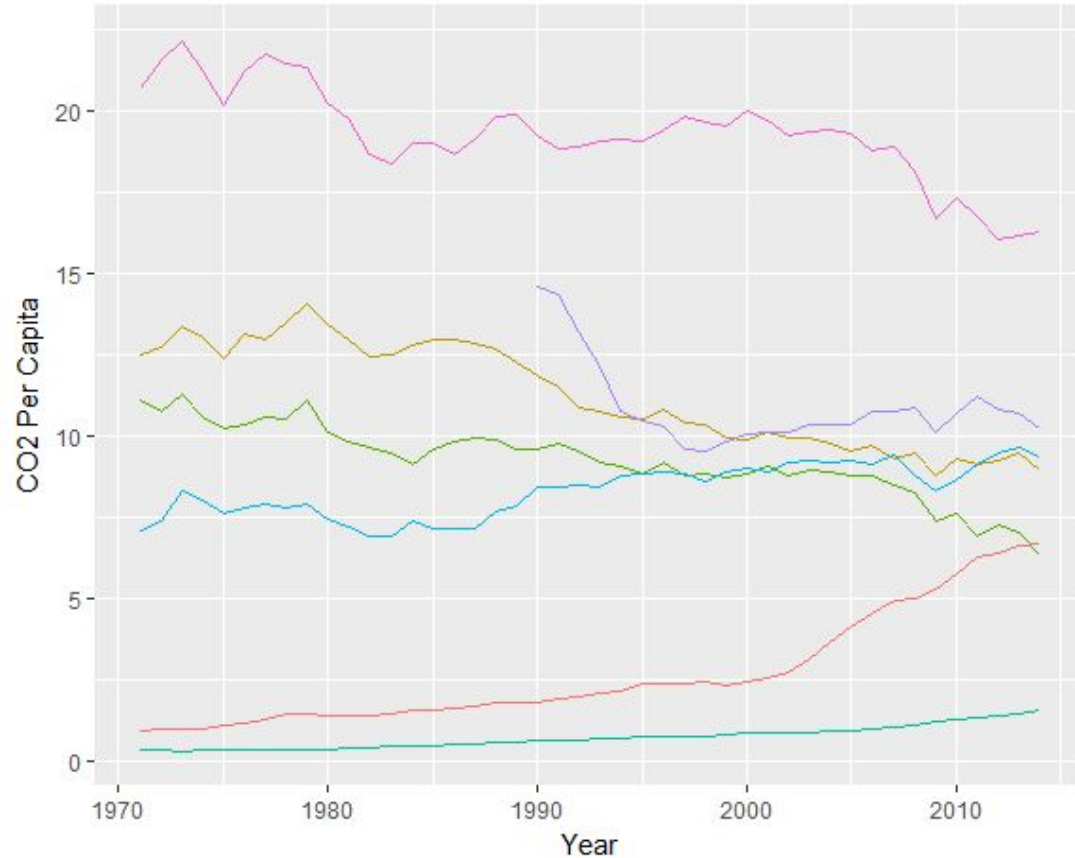
India shows consistently growing emissions.

Russian data is unavailable prior to 1990 and the disbanding of the Soviet Union.



CO2 Emissions per Capita

Top 7 Producers



Per Capita Emissions

Most countries show decreasing trend in per capita emissions over time.

China shows a steep rise in per capita emissions, although still much lower than US.

India showing a slow increase in per capita emissions, but much lower than other top producing countries..

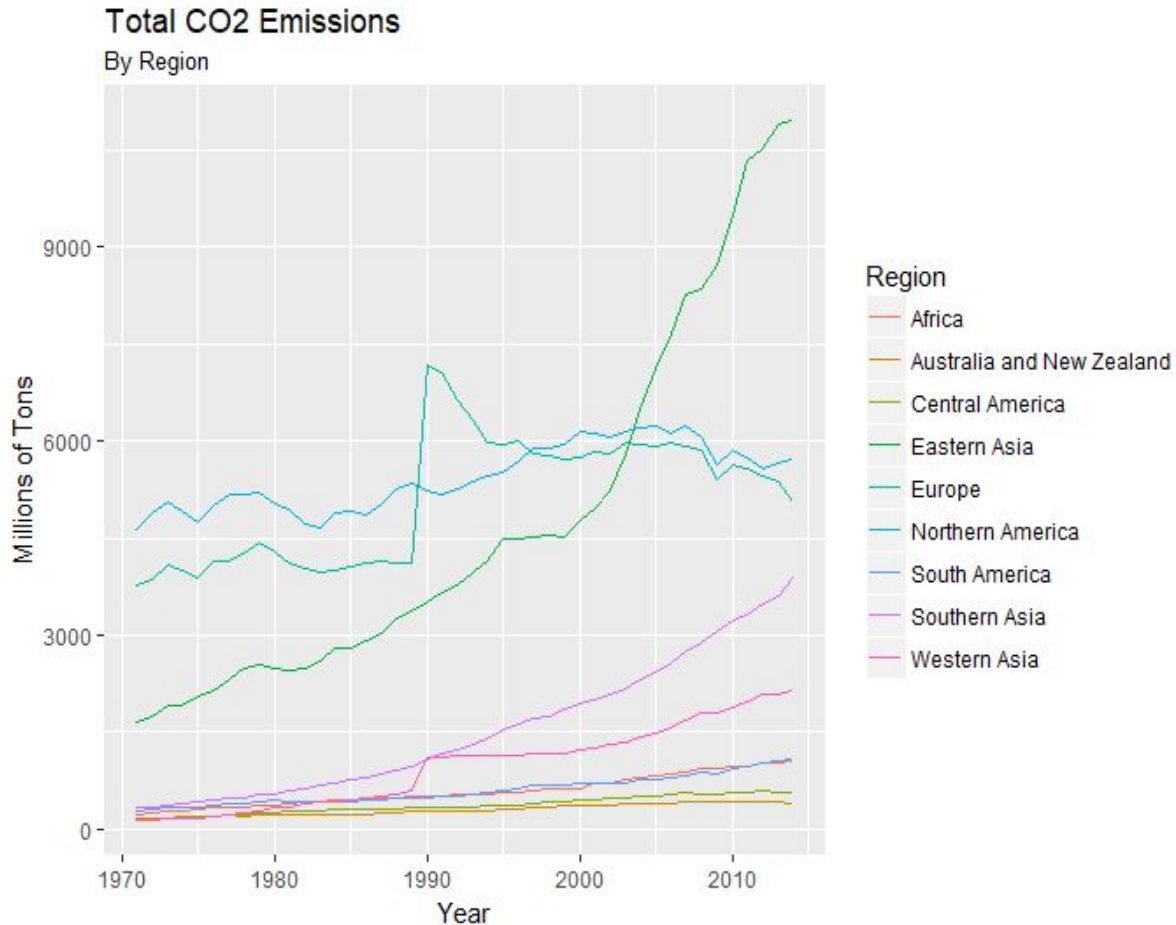
Regional Emissions

Regions Dominated by US and China much higher emissions than other regions of the world.

Europe leaps in 1990 with the addition of Russia. Western Asia adds other former Soviet states at the same time.

Europe, North America, Australia, and Central America show recent decreases or leveling of total emissions.

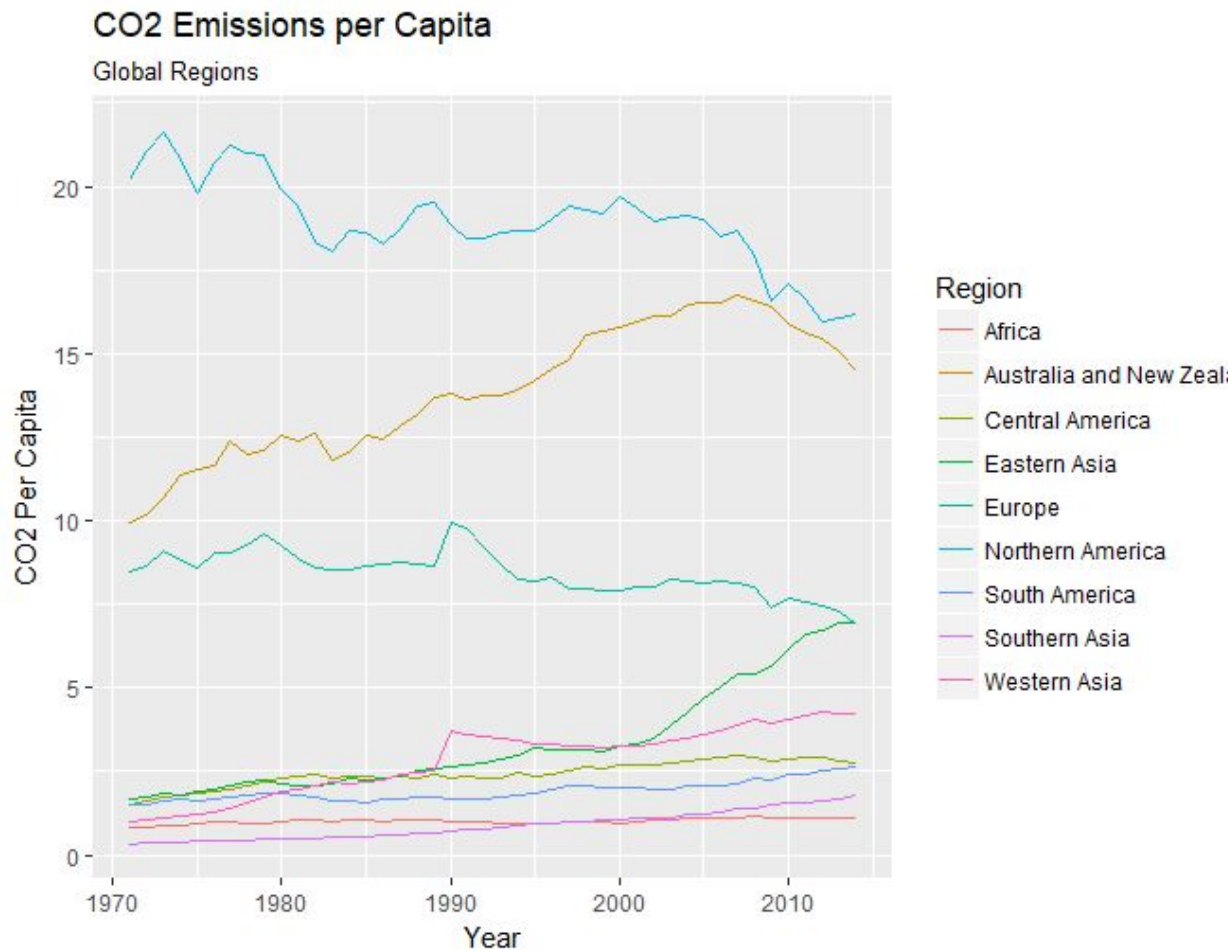
Asian regions show varying rates of increasing emissions.



Regional Emissions Per Capita

1990 Again sees a bump in European consumption from the addition of Russia.

Western Asia sees the same bump from the addition of other former Soviet States (Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Uzbekistan, Turkmenistan)



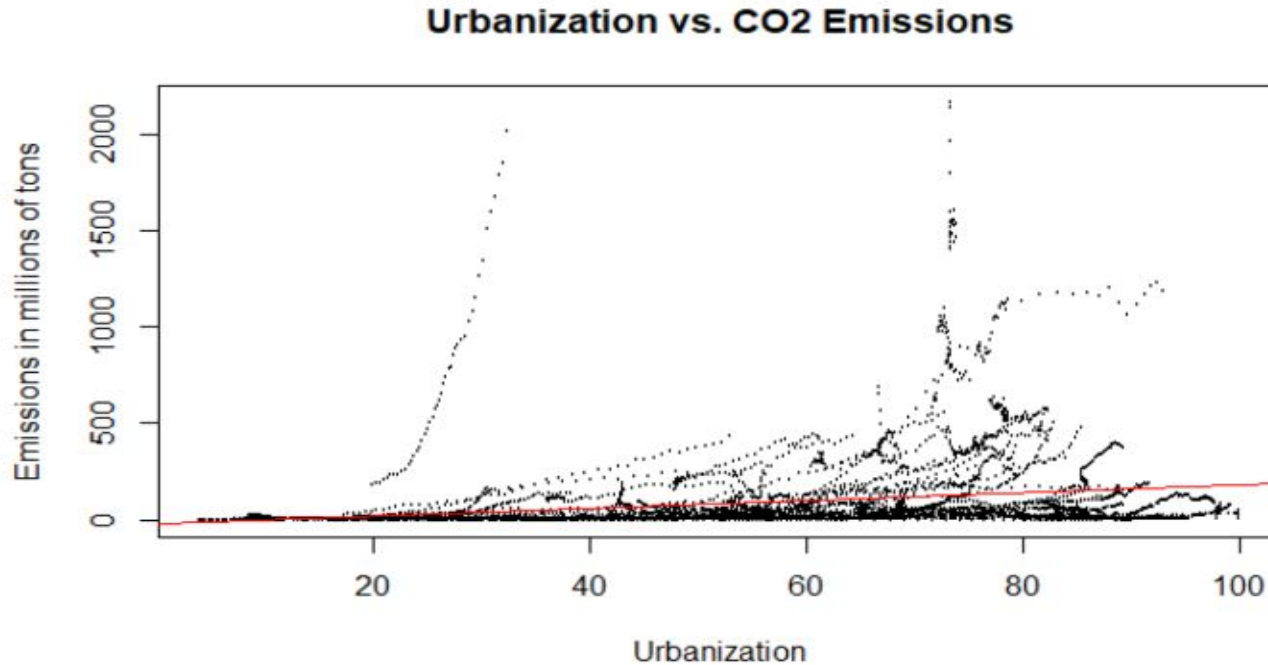
Second Research Question



According to the values in the dataset, are urbanization, population reasons for amount of CO2 emission? Are urbanization rates correlated to carbon dioxide emissions?

- We answered this question by analyzing the correlation between Urbanization and CO2 emissions.
- Positively Correlated.
- Top 5 largest CO2 emissions - China, USA, Russia, India, Japan
- Top 5 urbanized countries - Hong Kong, Singapore, kuwait, Belgium, Qatar
- Top 10 urbanized countries with population > 100 million - Japan, Brazil, USA, Mexico, Russia, China, Philippines, Pakistan, Bangladesh, India.

Correlation between Co2 Emissions and Urbanization



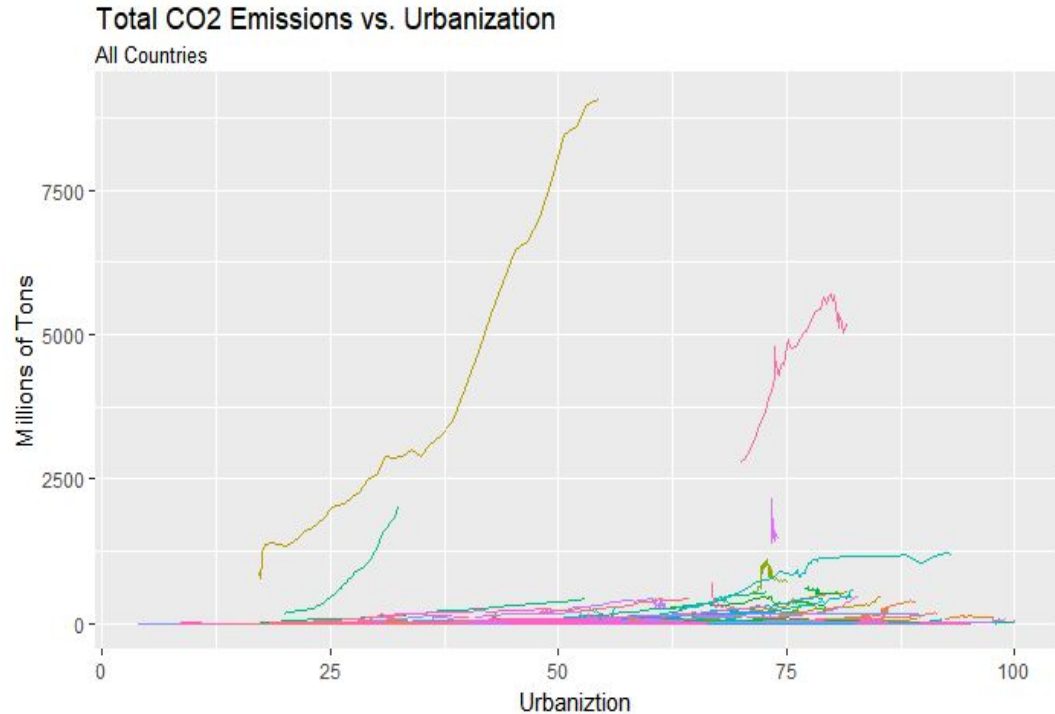
Country wise CO2 emissions vs Urbanization

Most of the countries show steady
Increase in CO2 emissions as
Urbanization rate increases.

Except China, USA all have CO2 emissions
less than 2500 million tonnes.

China has Urbanization percentage
less than 54%

We can see a positive correlation
between Urbanization and CO2 emissions



Countries with largest CO2 Emissions

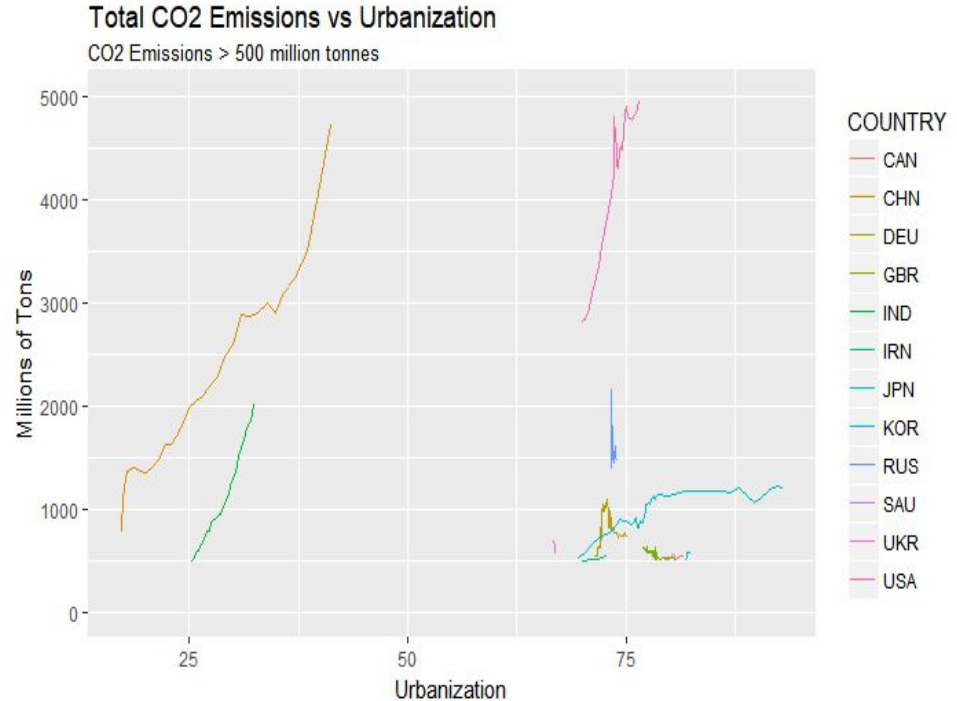


Surprisingly, countries such as Russia, DEU(Germany) show steady decrease in emissions after a point of time.

China, India, USA show steady increase.

Out of these 13 countries, 11 countries are highly urbanized(>50%).

So we can state that urbanization can also be considered as one of the factors for Increase in CO2 gas emissions.



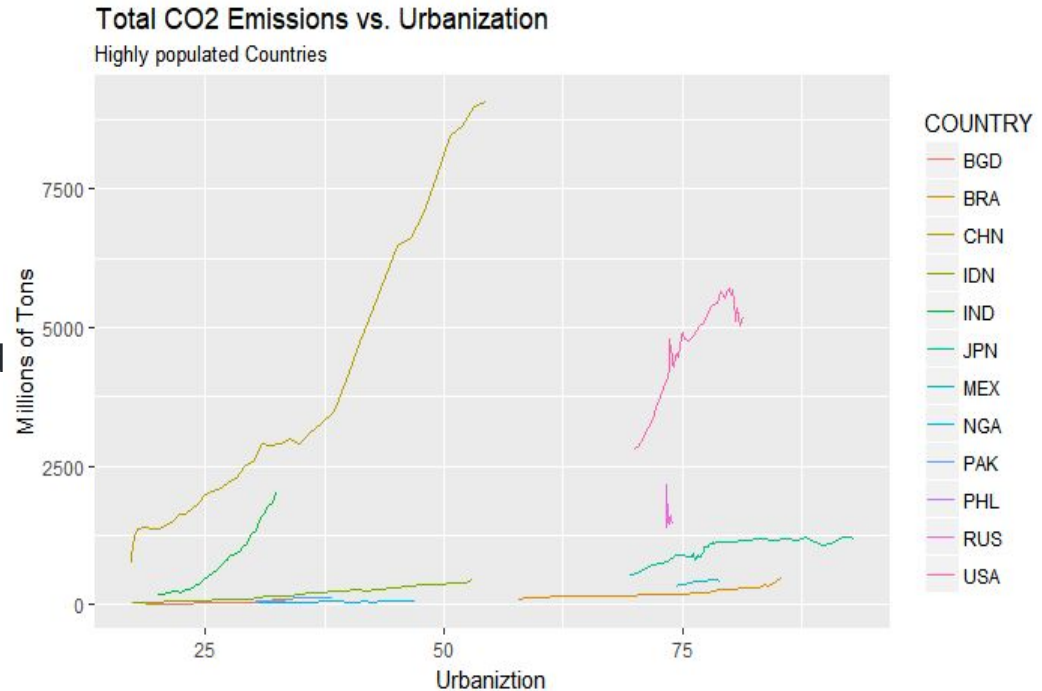
Highly populated Countries



Population greater than 100 million.

They vary differently irrespective of their urbanization level.

Highly urbanized countries (>50%) such as Korea, Russia, Germany have a steady decrease in CO2 emissions when compared less urbanized countries (<50%) such as China and India.



Less Populated Countries



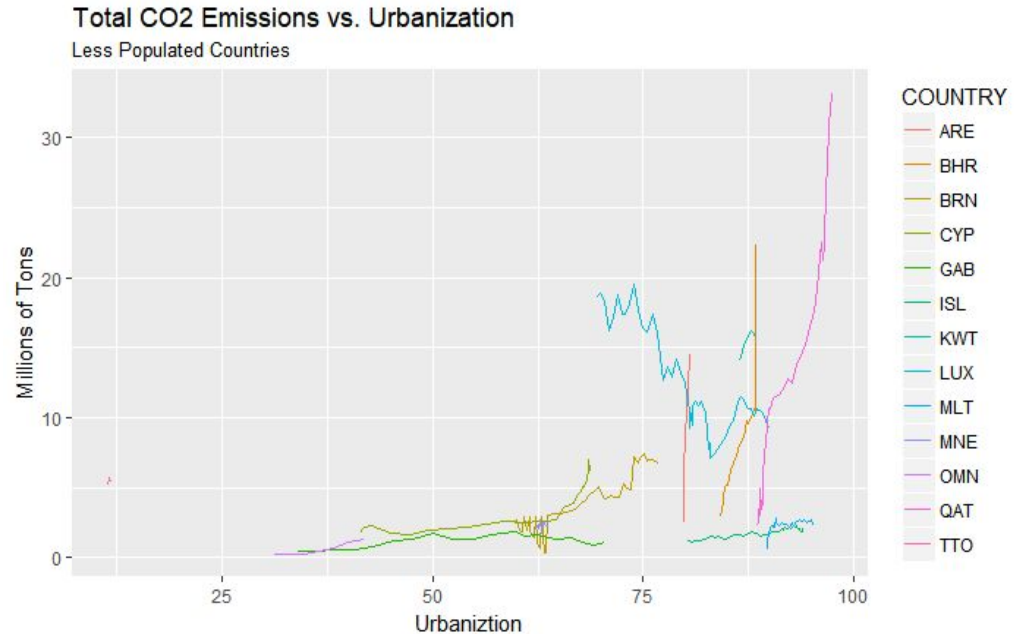
Population less than 10 million.

Mostly Urbanized.

CO2 emissions less than 40 million tonnes.

Iceland has world's first "negative Emissions plant" where CO2 is converted into stone.

"Capture-Compress-Buried "



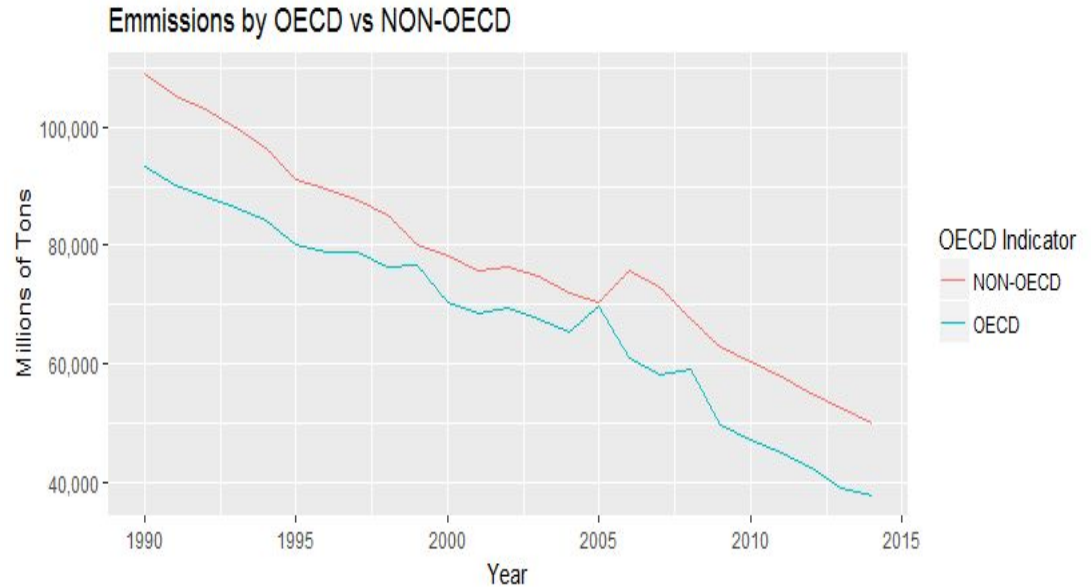
OECD vs NON-OECD countries (NOX,SOX)



Nox, Sox gas emissions started decreasing.

OECD countries produces more emissions than non-OECD countries.

China is a part of non-OECD countries.

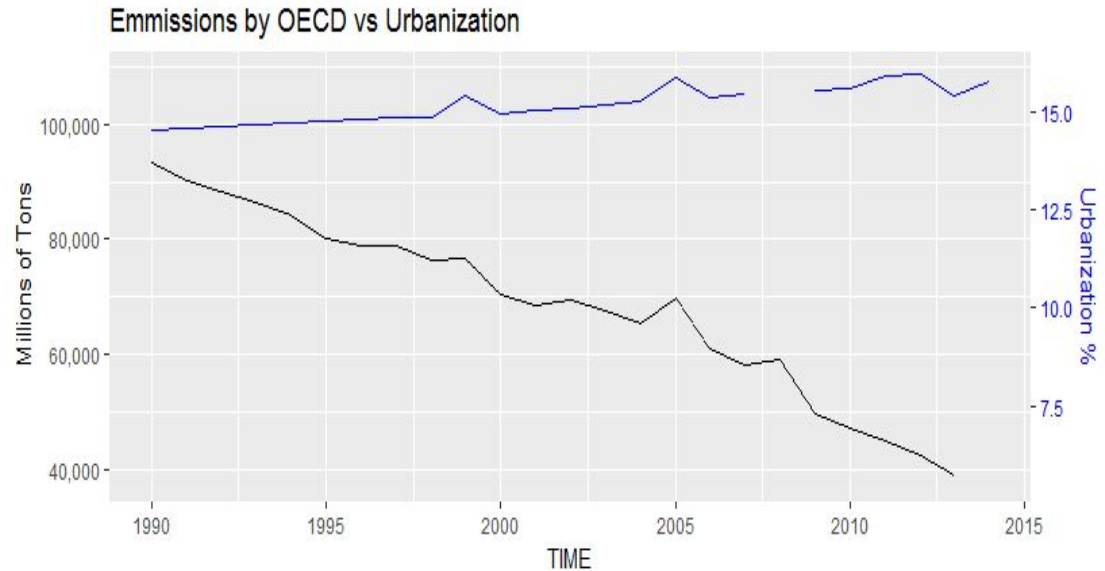


OECD VS Urbanization (NOX,SOX)



Urbanization increased but not with great velocity.

If urbanization has increased more, emissions might not have decreased with this slope.

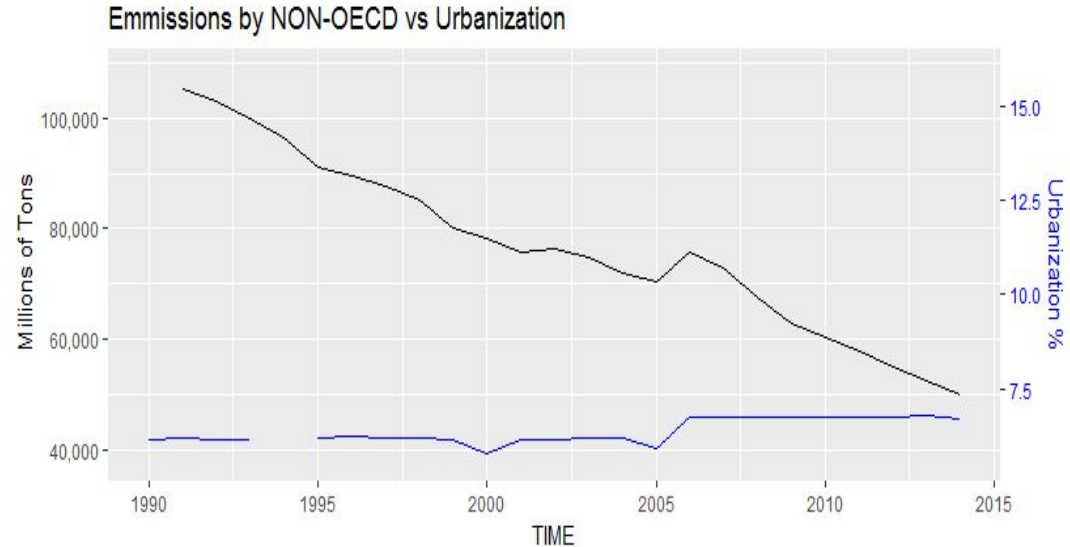


Non-OECD VS Urbanization (NOX,SOX)



Though the urbanization is low, the emissions are high because of china.

If urbanization has increased more, emissions might not have decreased with this slope.





Limitations

Our analysis was made for the time period 1961-2015.

We did not consider records which had missing values as assuming the value or replacing the values with mean did not seem to be a good option.

Our analysis based on Urbanization and population did not include Taiwan.



Conclusion:

Everyone needs to care about greenhouse gas emissions, for we are all affected by the changing climate.

Studies have shown that the greatest effects of the changing climate are occurring in the most vulnerable populations who are actually contributing the least to the problem.

It is a moral and ethical imperative for all who are in a position to affect change to support local, regional, national, and international policies that will reduce emissions, restore wetlands, and end deforestation on a global scale. Evidence exists that when global forces come together, emissions are reduced.

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Also used: <https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS>
<https://data.worldbank.org/indicator/SP.POP.TOTL?page=2>