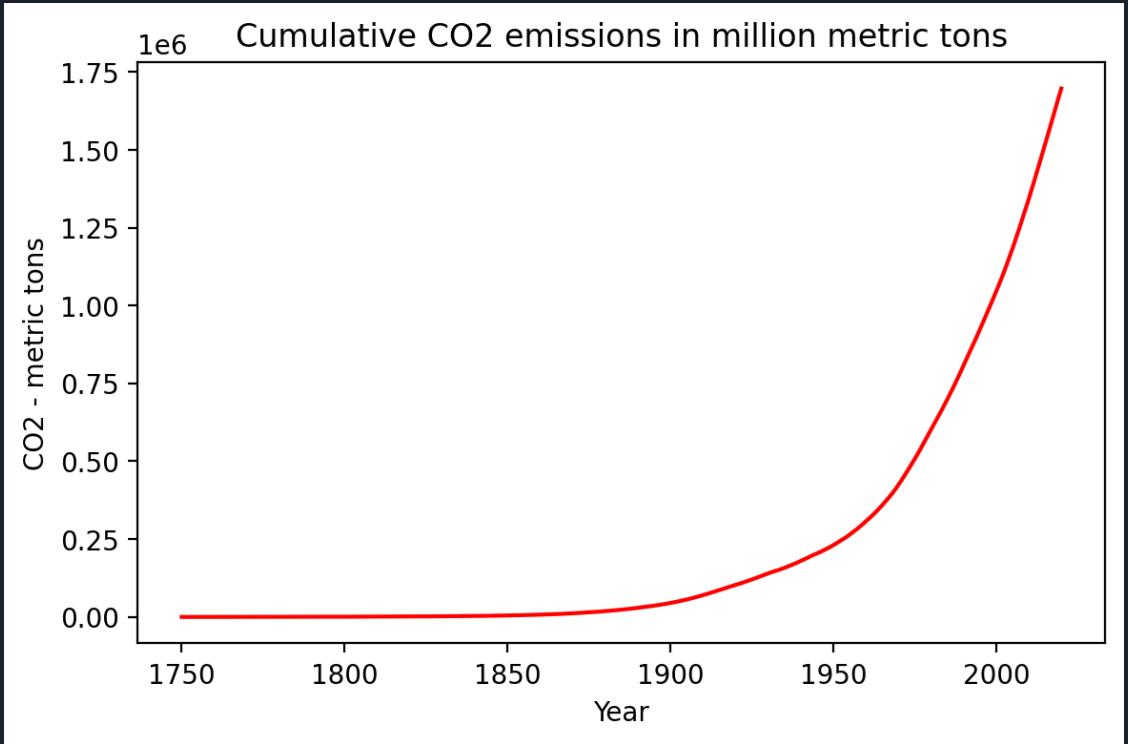
Worldwide CO^2 Emissions

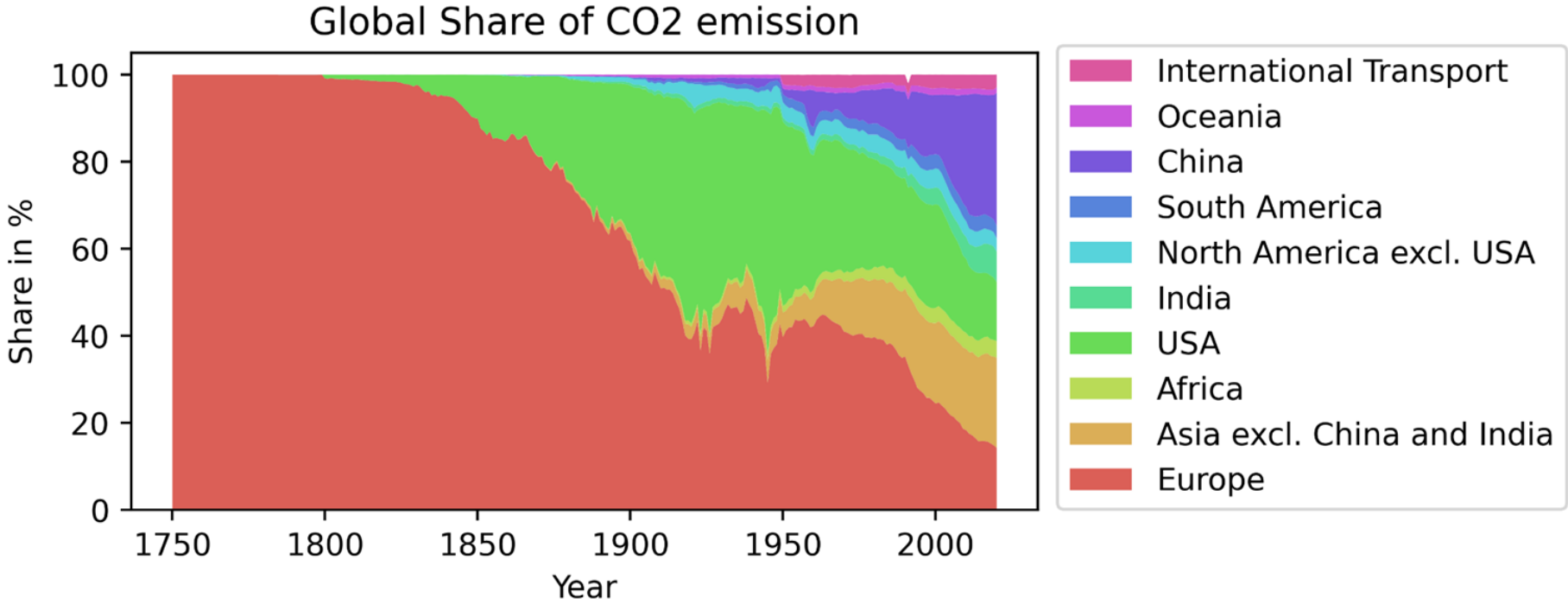
Data Overview

Cumulative CO^2 emissions - worldwide



- Exponential behaviour !
- 75% of all CO^2 emissions were produced after 1970

Global Share of CO^2 Emission by region

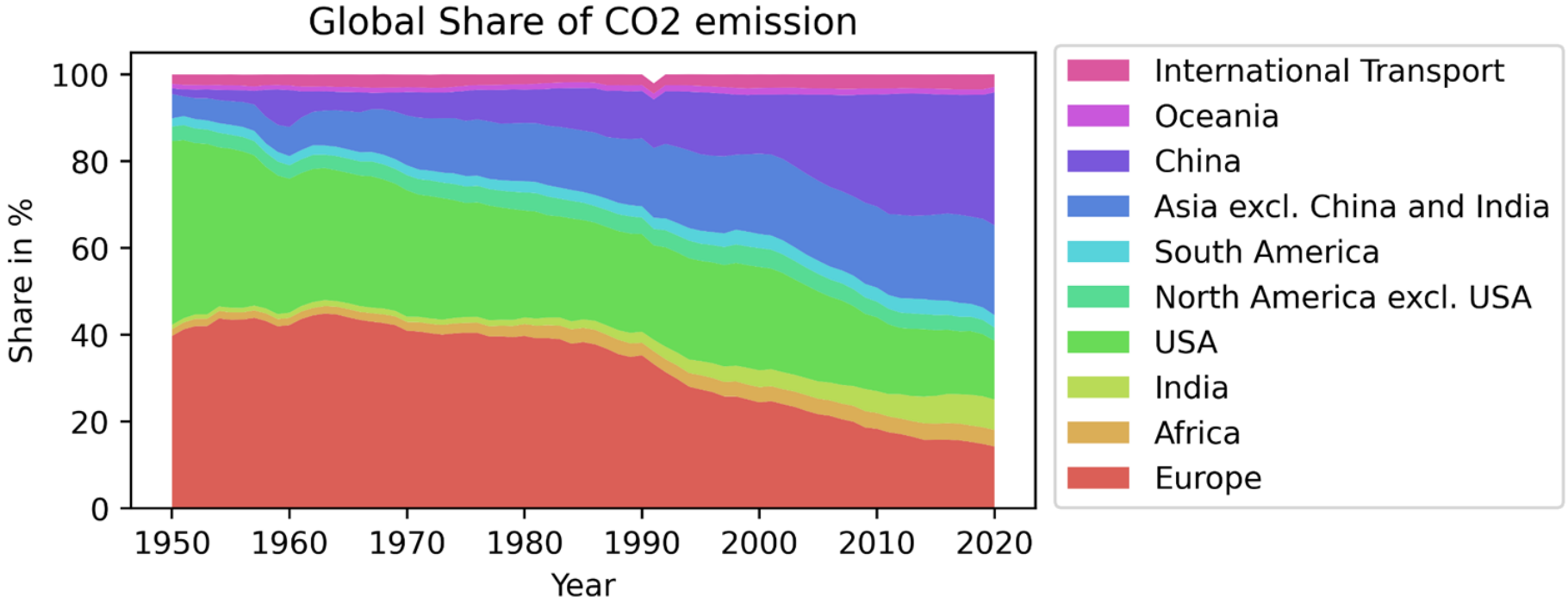


Global Share of CO^2 Emission by region

- Industrial Revolution has its origins in Europe, precisely in the UK
- During 1750-1815 more than 90% of the worldwide CO^2 emissions were in Great Britain
- From then on the revolution swept over the channel and overseas to France, Germany or the USA
- Up to the 2nd World War essentially all industrial power was located in these “north-western hemispheres”
- After the war more regions went through an industrialization period

→ CO^2 emissions ramped up

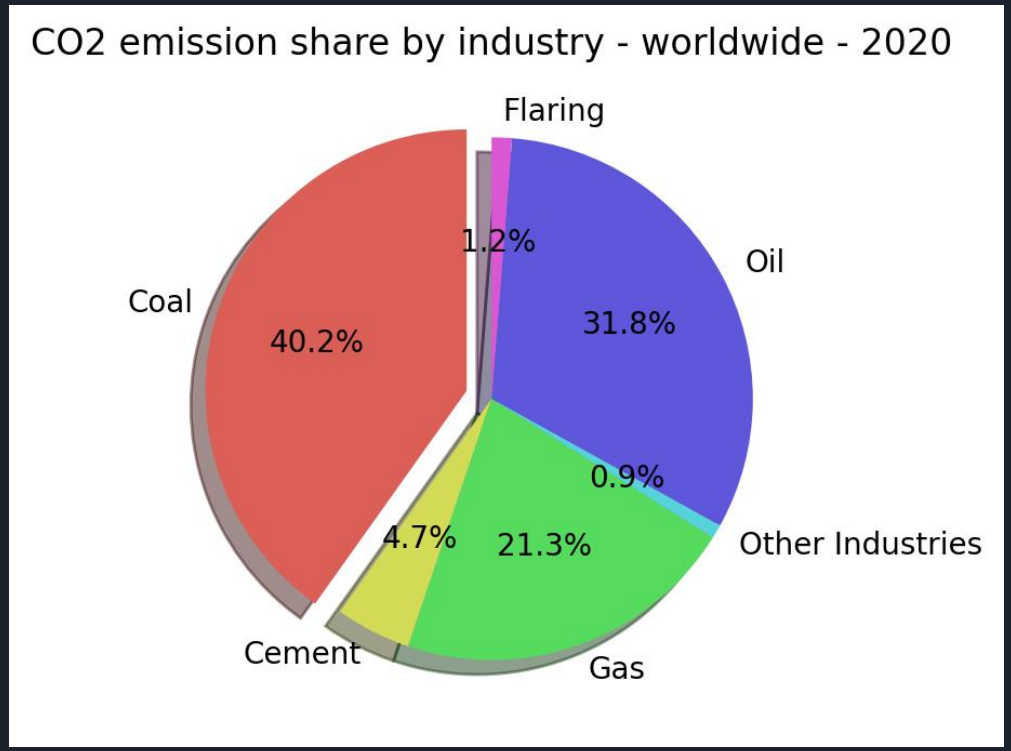
Global Share of CO^2 Emission by region



Global Share of CO^2 Emission by region

- Especially Asia/China really “caught up”: Accountable for 50% of all CO^2 emission (20%/30% respectively)
- Considering the higher population in this region the CO^2 emission per head is considerably below that of Europe or the USA

CO^2 emissions by industry



- Biggest sectors are by far **Oil**, **Coal** and **Gas**.

Outlook

- Further Analysis of different industries
- In detail look at “Big Players” like China, USA, EU
- Methane and Nitrous oxide emissions: 25 times and 298 times the global warming potential of a CO^2 molecule respectively

  → Effect Analysis of different greenhouse gases

- Analyse connection of different fields with **Population**, **GDP** or **Energy Use**

  → Which country has the greenest economy, that is the lowest CO^2 emissions per GDP?

  → Which country emits the least CO^2 per head?

- Possible trend analysis for certain regions?

The Data Set

The Data Set

- Published: Our World in Data based on the Global Carbon Project and Maddison Project Database 2020 (Bolt and van Zanden, 2020) (https://doi.org/10.18160/gcp-2021)
- Contains measured and estimated values for various fields

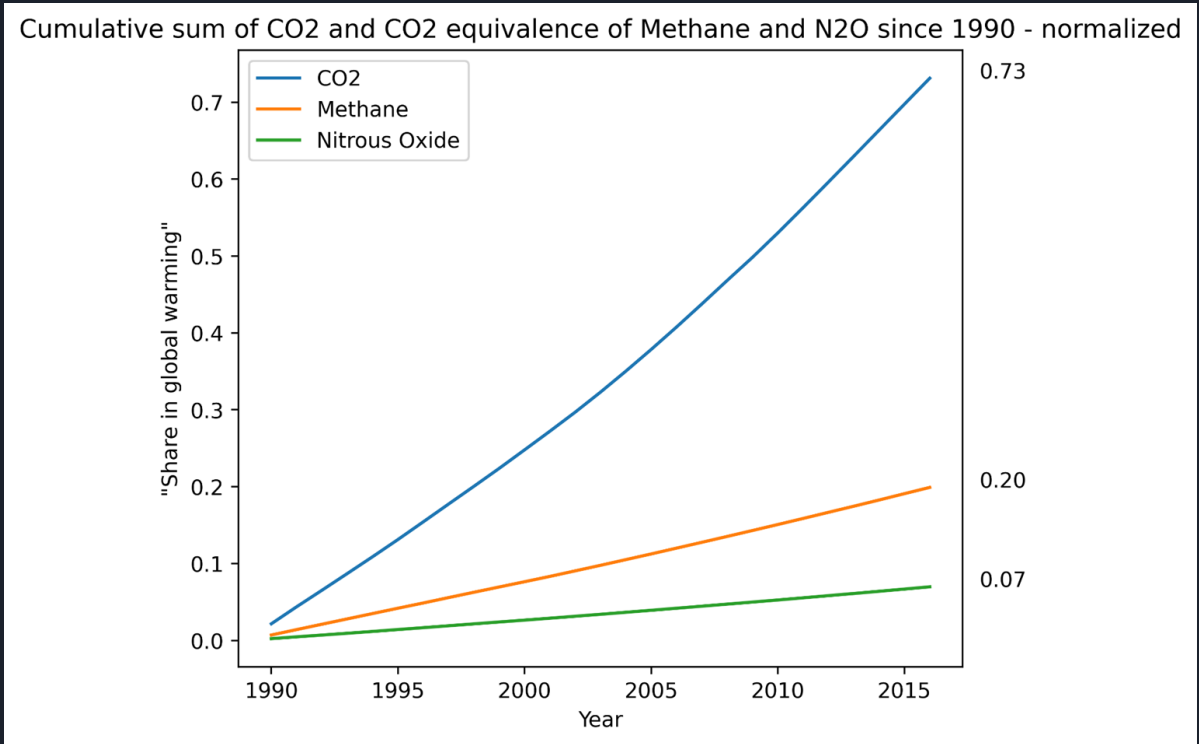
Field	CO^2 emission	CO^2 consumption	CO^2 consumption per capita	CO^2 consumption per GDP	Nitrous oxide emissions	Methane emissions
Measure	Emitted/ produced amount	**Consumed** amount: CO^2 emission adjusted for ex-/imported emissions	CO^2 consumption divided by the population	CO^2 consumption divided by gross domestic product	CO^2 equivalent of N^2O emissions (Adjusted with 'climate factor' of 298)	CO^2 equivalent of CH_4 emissions (Adjusted with 'climate factor' of 25)
Metric	Million metric tons	Million metric tons	Metric tons per person	Kilogram per $	Million metric tons	Million metric tons

The Data Set

- Goal: Analysis of recent developments of the world wide greenhouse gas emissions (1990-2020)
- Questions and Topics:
  1. Methane and Nitrous oxide
  2. Fossil Fuel distributions
  3. CO^2 emissions per capita
  4. CO^2 emissions and the economy - Who transforms their economy?
  5. Who can achieve climate neutrality in the near future

Methane and Nitrous Oxide

Methane and Nitrous Oxide and their share in global warming



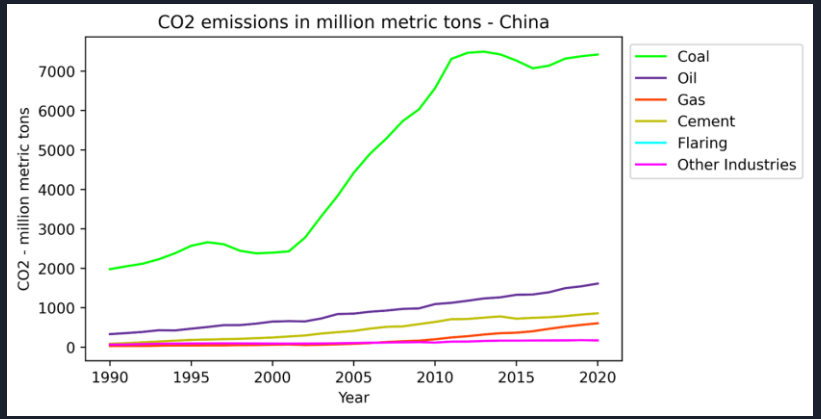
- Cumulative sum of the different greenhouse gases but normalized to the overall emissions

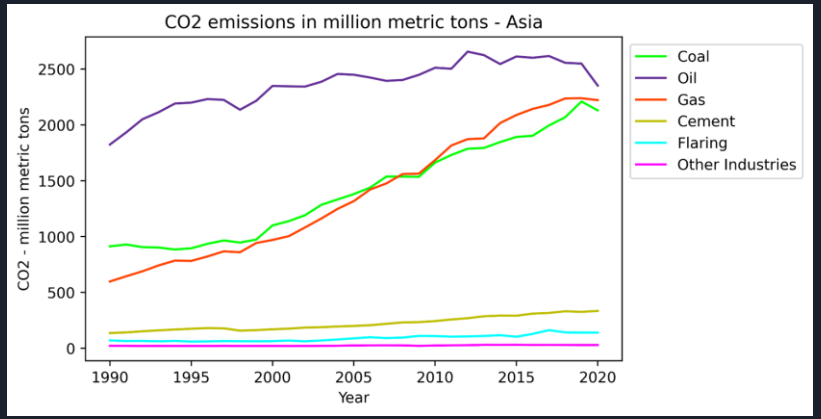
→ Result shows the ‘Percentage in Global Warming’ since 1990

- This estimate is probably not very accurate due to a lack of data
- Measurements or accurate estimates can only be provided since 1990
- Further Read Up: https://www.ccacoalition.org/en/resources/global-methane-assessment-full-report

Fossil Fuel consumption

Fossil Fuels - Consumption since 1990

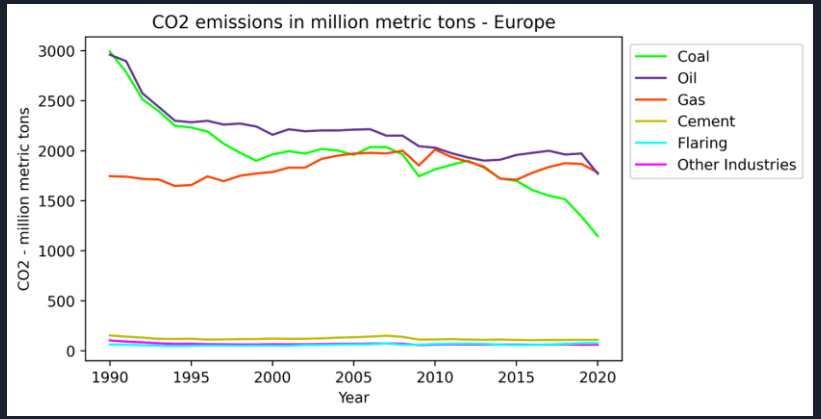


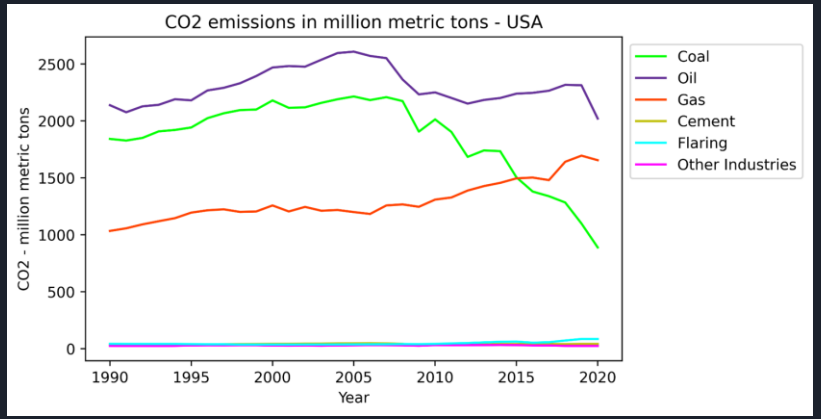


- Massive investment in Coal infrastructure throughout the last couple of decades (+250%)
- Other fuels also on slight uptrend

- Most important fuel is Oil
- Gas and Coal equally important and on a big uptrend (+270% and +140%)

Fossil Fuels - Consumption since 1990

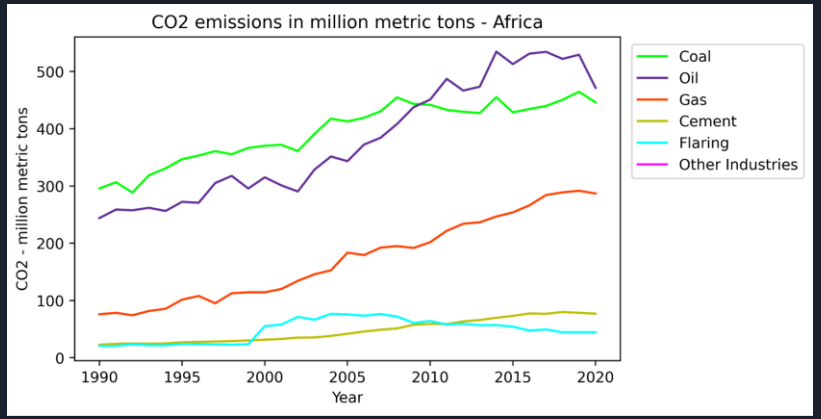


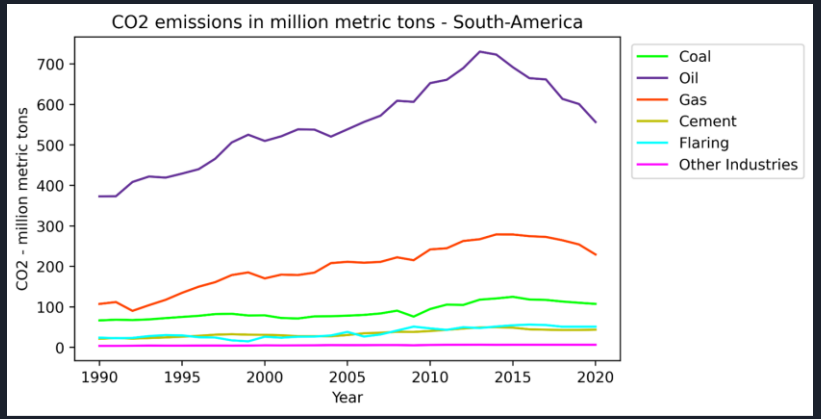


- Coal and Oil on a downtrend (~50% and ~33%)
- Stable Gas consumption

- Most important fuel is Oil
- Huge decrease (~60%) in Coal emissions
- Rising Gas consumption

Fossil Fuels - Consumption since 1990

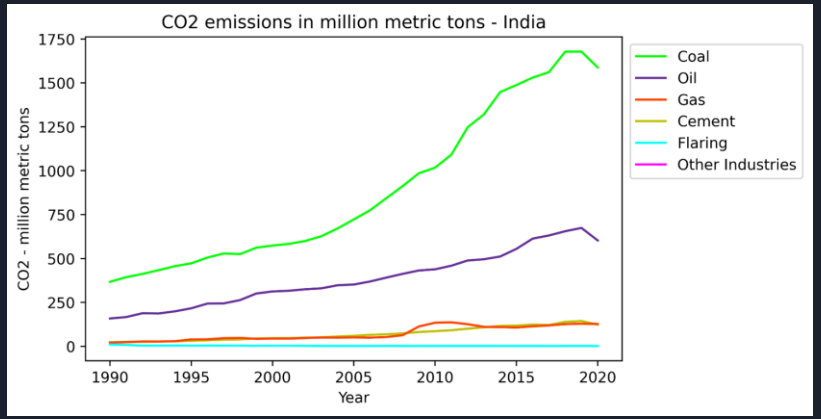


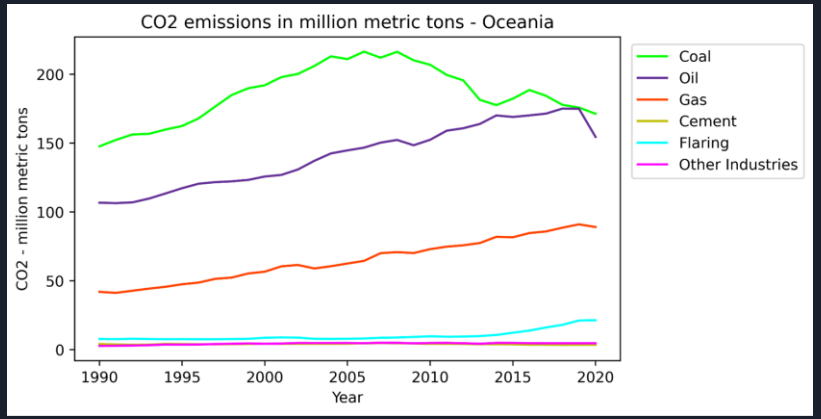


- Coal and Oil on an uptrend (~40% and ~60%)
- Rising Gas consumption (~200%)
- Reduced Flaring in recent years

- Most important fuel is Oil
- In recent years slight decrease or stable consumption for most fuels

Fossil Fuels - Consumption since 1990



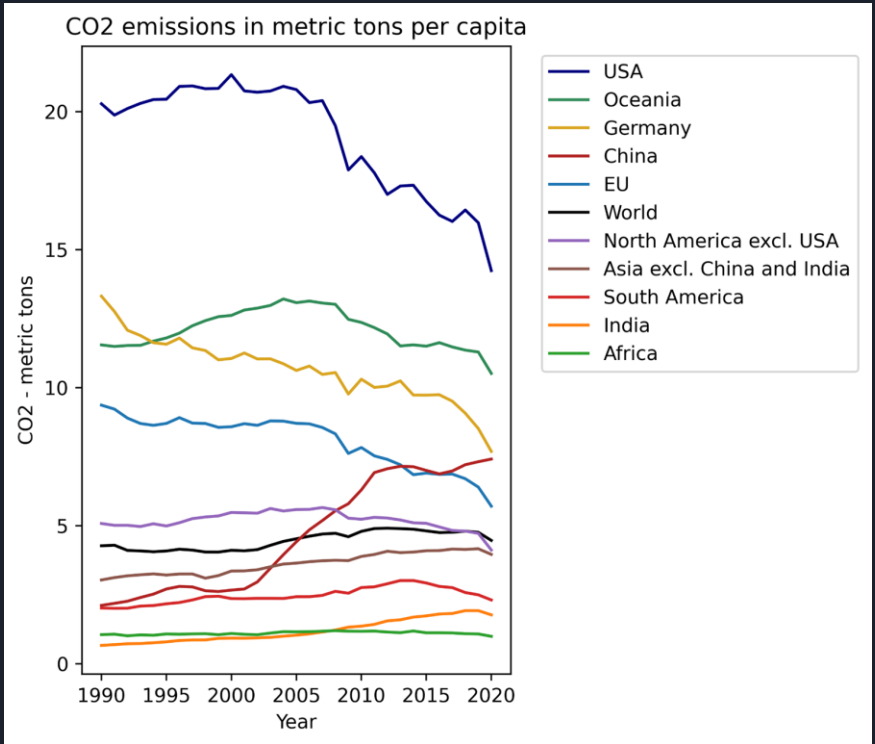


- Similar movements to China: Huge commitment to Coal
- Other fuels also on a rising trajectory

- Minor downtrend for Coal
- Uptrend for Oil and Gas

CO^2 consumption per capita

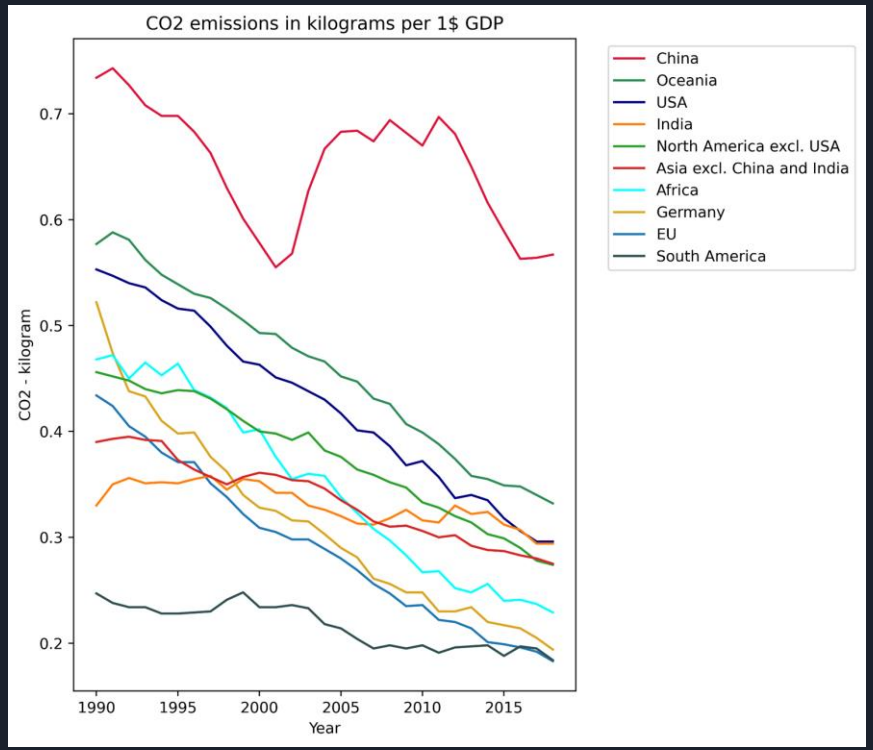
CO^2 consumption per capita



- King of the Hill: USA, but on a downtrend
- 2nd place: Oceania
- China with rising emissions per capita:
  'Overtook' most regions and notably the EU in recent years.
  But decelerating: Planned peak of CO^2 emissions before 2030
- EU, North and South America on a decreasing trend
- Other regions: Rather stable

CO^2 and the Economy

CO^2 emissions and the Economy



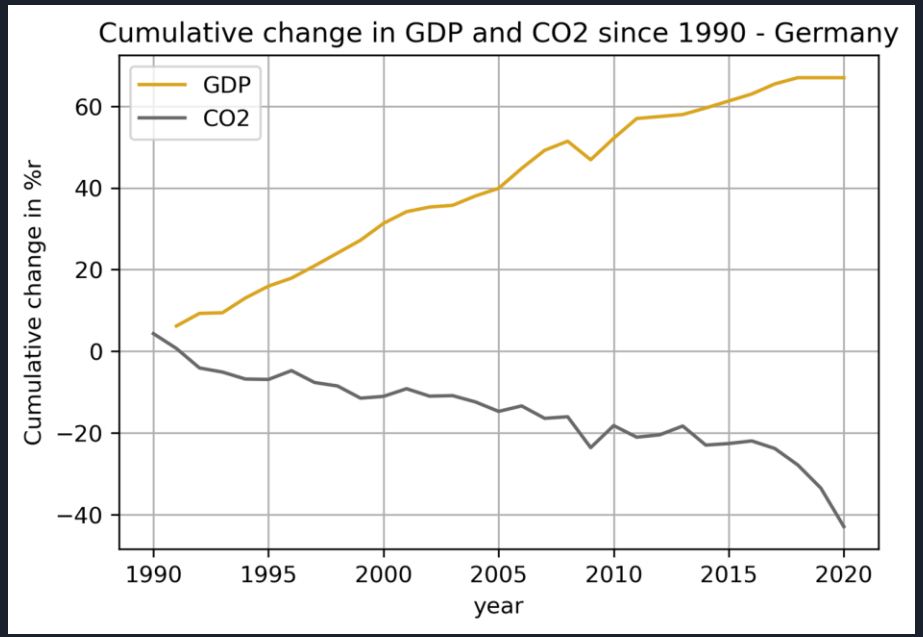
- China has the 'dirtiest' economy by far
- All other regions or countries show a very substantial decrease

Discussion: Is this statistic profound/important?

- We know that there isn't a decrease in CO^2 consumption
  → In recent years most economies were just growing faster than their emissions

Who is actually **transforming** their economy?

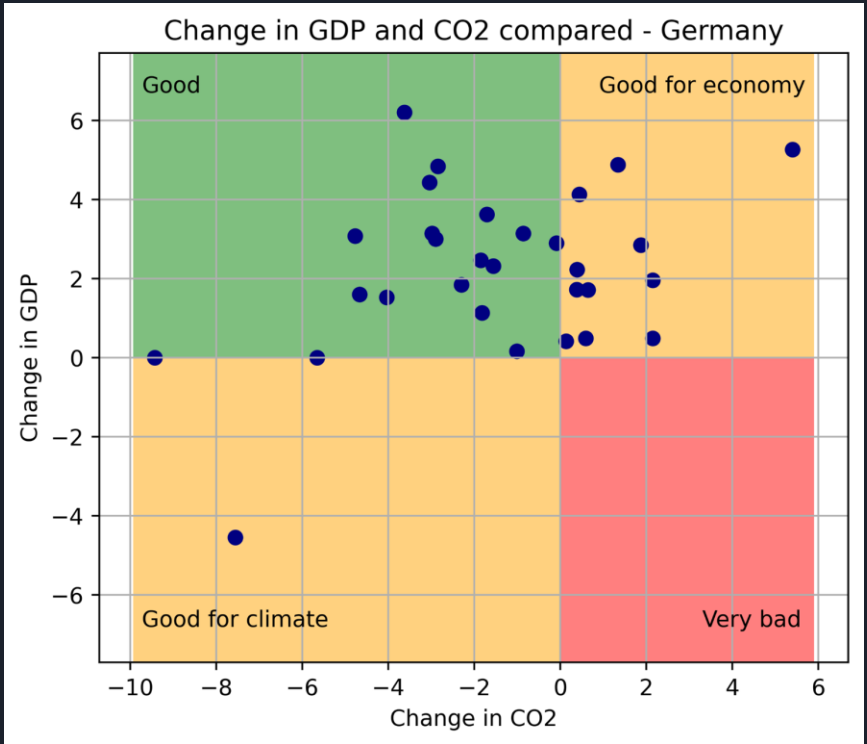
CO^2 emissions and the Economy



- What's the goal?
  Achieve an increase of the GDP and at the same time a decrease of CO^2 emissions

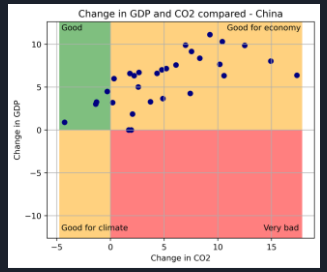
→ Black line below 0 and the Yellow curve

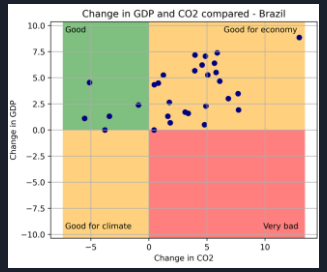
CO^2 emissions and the Economy

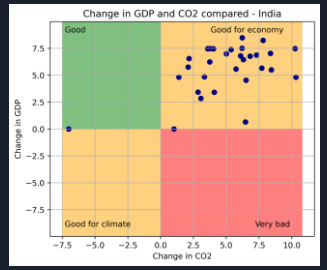


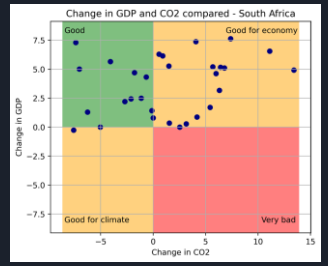
- Goal = Green Quadrant: Decrease of CO^2 emissions and economic growth
- Germany does a fairly decent job at that: 60% of all years since 1990 are in that region

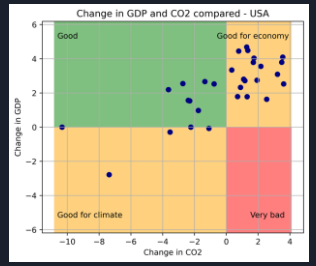
CO^2 emissions and the Economy



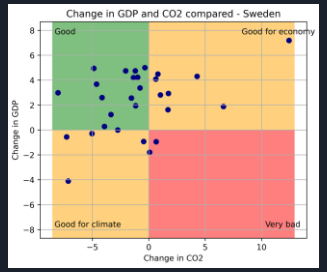


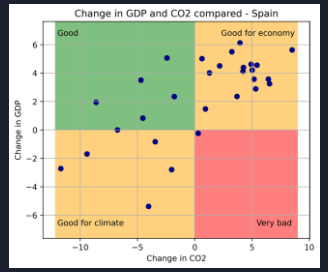


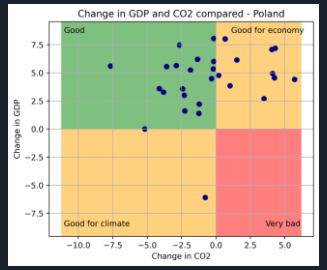


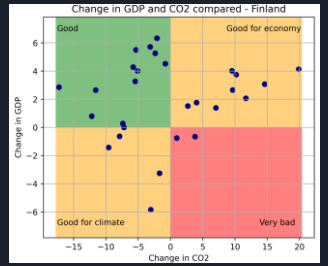


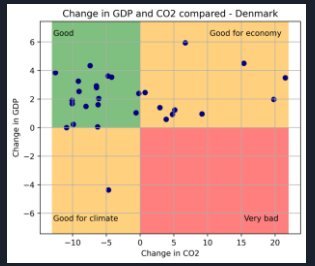
- Most of the ‘big’ countries had their focus on economic growth in recent years







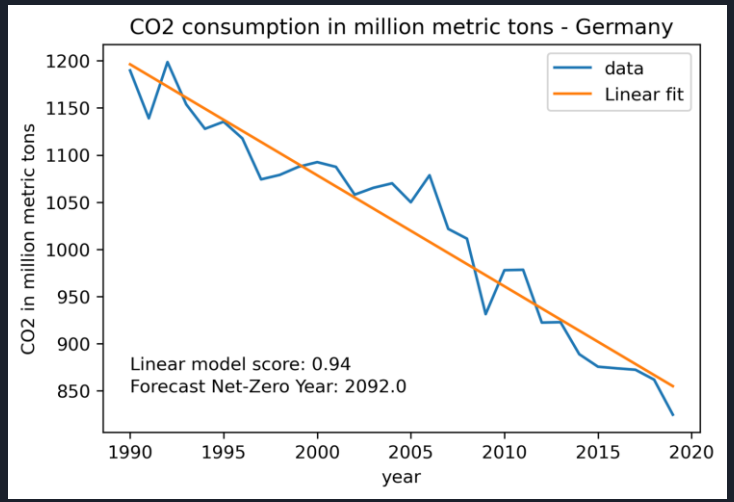




- Many countries in the European Union show signs of transforming their economy

Net Zero Year - When?

Trend Analysis - Who will reach Net Zero first?

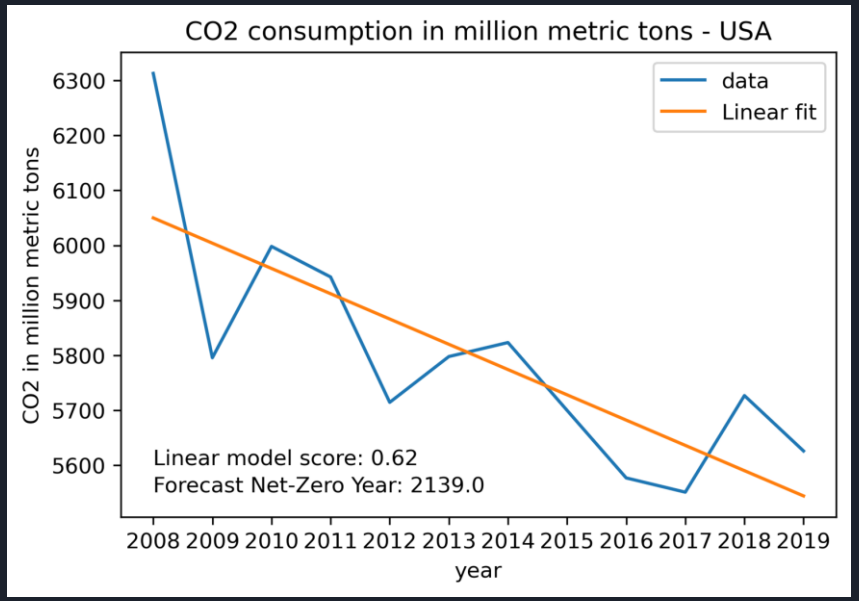


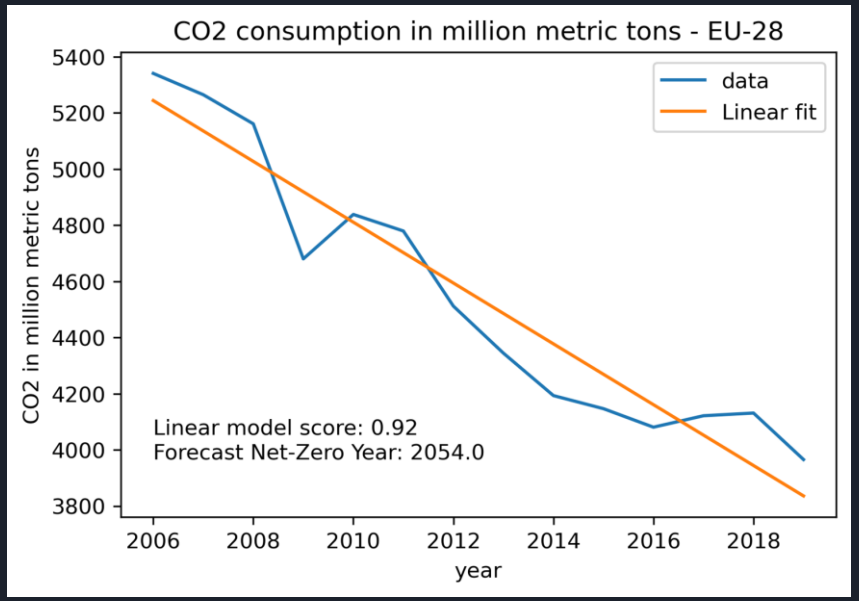
More engagement needed to reach the Paris goal

- If a negative trend in CO^2 consumption was observed in recent years I fitted a linear model through the available data points for different countries
- Linear model score: R^2 score [0,1] →{bad model, good model}
- Paris climate pledge: Carbon neutral by 2050
- Forecasted Net Zero Year should be taken with a grain of salt:

  For most countries the available data is only a couple of years

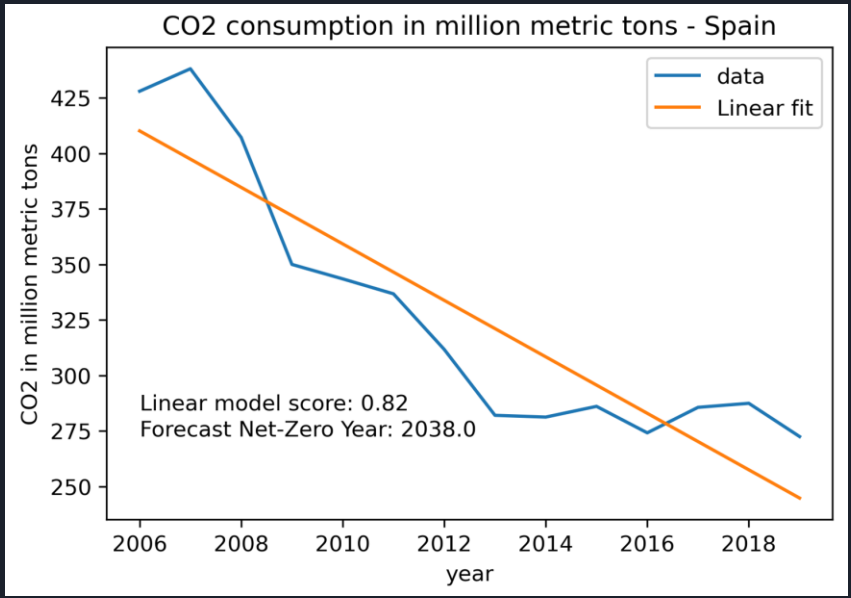
  The data doesn't explain whether the emission reduction is intended

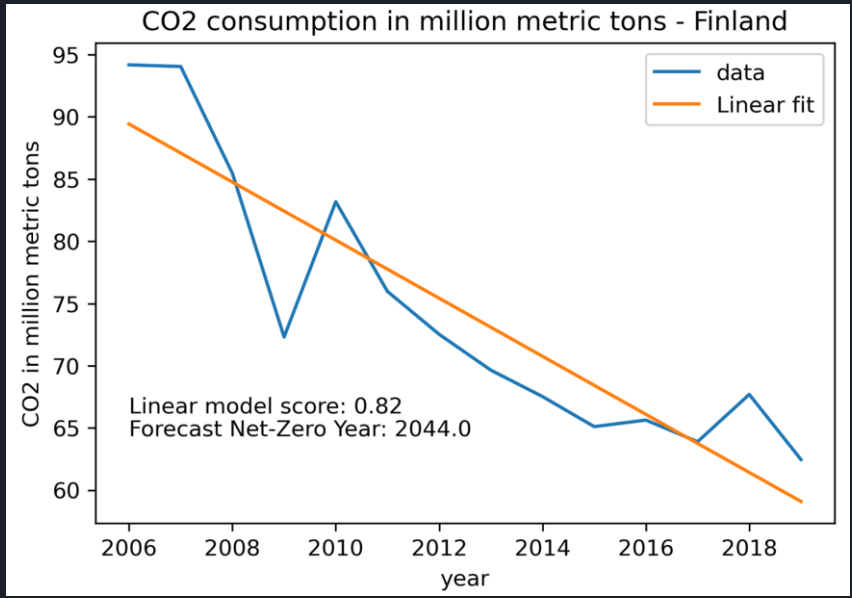




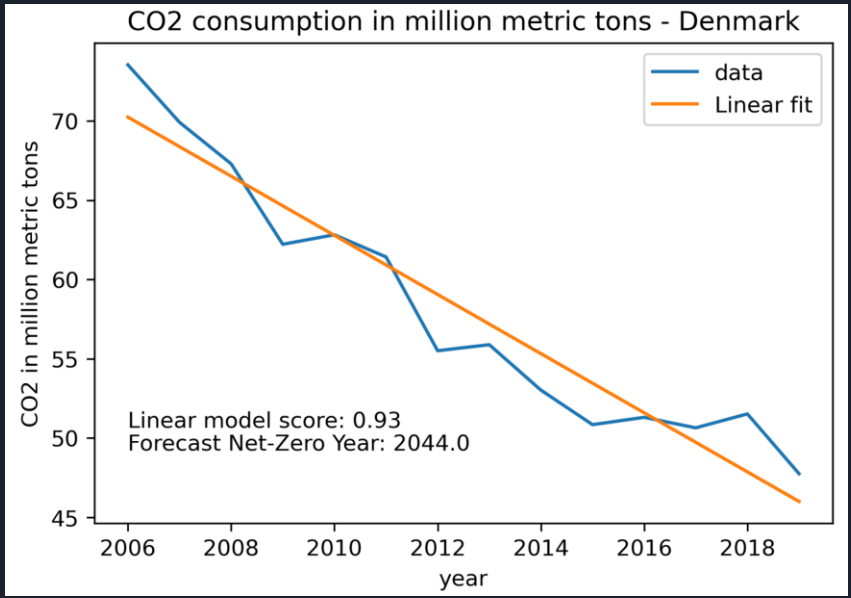
The USA is also way of the needed pace

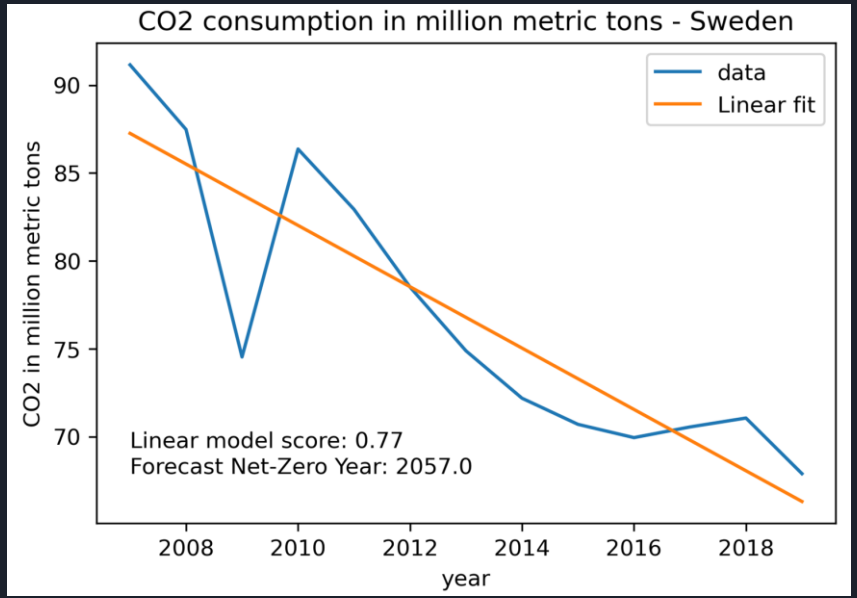
European Union surprisingly comes very close to 2050



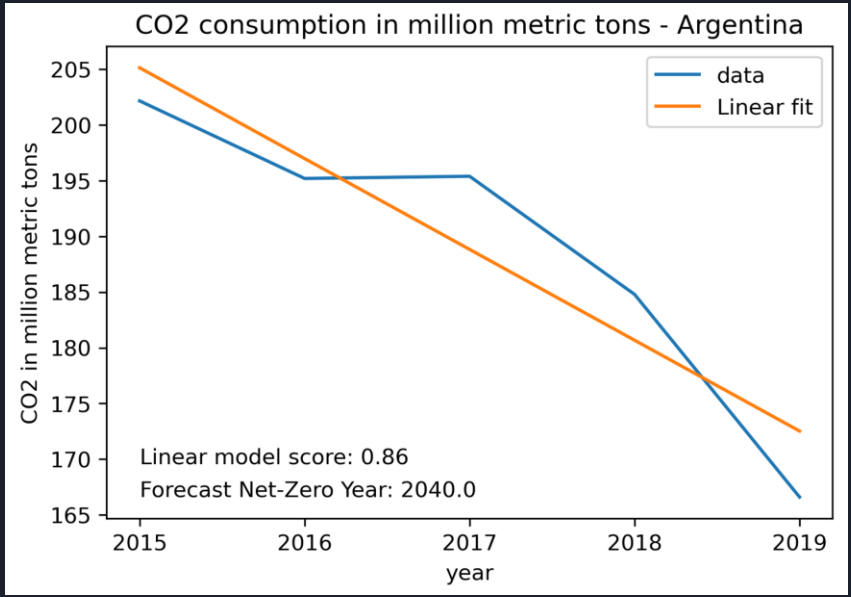


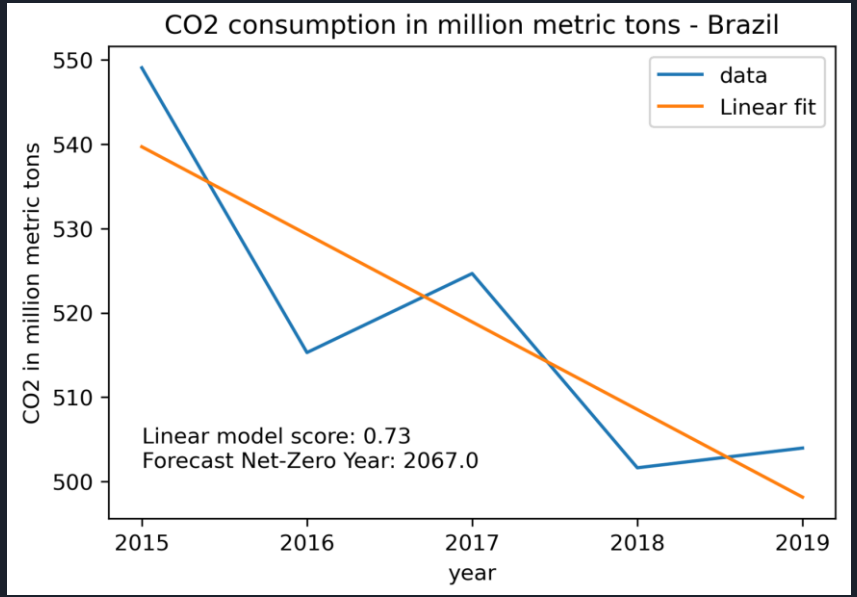
The EU is being ‘carried’ by Spain and Finland





Denmark and Sweden are also on course to reach carbon neutrality





South American countries seem to be well situated for carbon neutrality in the near future

In the last couple of years many countries actually show signs of reduced CO^2 emissions

With current efforts climate neutrality surely won’t be reached by 2050!